TENDER FOR

CONSTRUCTION OF CENTRE FOR PROPULSION TECHNOLOGY (COPT) BUILDING (GROUND PLUS 6 UPPER FLOORS) INCLUDING FINISHING WORKS, INTERNAL WATER SUPPLY, SANITARY AND ELECTRICAL INSTALLATIONS, FIRE FIGHTING, FIRE ALARM & ELV SYSTEMS, LIFTS, AIRCONDITIONING, EXTERNAL DEVELOPMENT AND FURNITURE WORKS AT IIT BOMBAY, POWAI, MUMBAI - 400076

NIT No.: IITB/DIPS/COPT/TENDER/02

Dated: 18th July 2023

DEAN, INFRASTRUCTURE PLANNING AND SUPPORT
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
POWAI, MUMBAI 400076.
## INDEX

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>PART A-1: NOTICE INVITING TENDER</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tender Details</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Brief Particulars of the Work</td>
<td>5-7</td>
</tr>
<tr>
<td>3</td>
<td>Instructions and Information to the Bidders</td>
<td>7-13</td>
</tr>
<tr>
<td>4</td>
<td>Eligibility Criteria</td>
<td>14-27</td>
</tr>
<tr>
<td>5</td>
<td>Percentage Tender and Contract Works &amp; IITB Acceptance</td>
<td>28-29</td>
</tr>
<tr>
<td>II</td>
<td><strong>PART A-2: CONDITIONS OF THE CONTRACT</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Conditions of the Contract (GCC)</td>
<td>33</td>
</tr>
<tr>
<td>6.1</td>
<td>Definitions</td>
<td>33-35</td>
</tr>
<tr>
<td>6.2</td>
<td>Clauses of the Contract</td>
<td>35-74</td>
</tr>
<tr>
<td>6.3</td>
<td>Additional Conditions of the Contract (ACC)</td>
<td>75-91</td>
</tr>
<tr>
<td>6.4</td>
<td>Special Clauses of Contract (SCC)</td>
<td>92-94</td>
</tr>
<tr>
<td>7</td>
<td>Safety Code</td>
<td>95-99</td>
</tr>
<tr>
<td>8</td>
<td>Model Rules for the Protection of Health and Sanitary Arrangements for</td>
<td>99-103</td>
</tr>
<tr>
<td></td>
<td>Workers employed by the Contractor</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Contractor’s Labour Regulation</td>
<td>104-123</td>
</tr>
<tr>
<td>10</td>
<td>Integrity Pact</td>
<td>124-129</td>
</tr>
<tr>
<td>11</td>
<td>Proforma of Schedules “A to F”</td>
<td>130-138</td>
</tr>
<tr>
<td>12</td>
<td>Standard Proformas</td>
<td>139-149</td>
</tr>
<tr>
<td>III</td>
<td><strong>PART B: MAJOR COMPONENTS (CIVIL, STRUCTURAL AND PLUMBING WORKS)</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Specifications</td>
<td>151</td>
</tr>
<tr>
<td>2</td>
<td>Special Conditions for Cement and Steel Reinforcement Bars</td>
<td>152-156</td>
</tr>
<tr>
<td>3</td>
<td>Additional / Particular Specifications for Civil Works &amp; Plumbing Works</td>
<td>157-204</td>
</tr>
<tr>
<td>4</td>
<td>List of Approved Manufacturers and Specialised Agencies</td>
<td>205-212</td>
</tr>
<tr>
<td>5</td>
<td>Tender Drawings</td>
<td>213</td>
</tr>
<tr>
<td>Sr No</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>IV</td>
<td>PART-C: MINOR COMPONENTS (ELECTRICAL AND MECHANICAL WORKS)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Additional / Particular Specifications (Electrical, Fire Fighting, HVAC and Elevator Works)</td>
<td>215-440</td>
</tr>
<tr>
<td>2</td>
<td>List of Approved Materials</td>
<td>441-447</td>
</tr>
<tr>
<td>3</td>
<td>Tender Drawings</td>
<td>448</td>
</tr>
<tr>
<td>V</td>
<td>PART-D: COMMERCIAL BID</td>
<td>449</td>
</tr>
<tr>
<td>1.</td>
<td>PART – D1: PERCENTAGE ON ESTIMATED AMOUNT</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>PART – D2: BILL OF QUANTITIES</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>Civil Works</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>Electrical Works</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>Mechanical Works</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>Firefighting Works</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>Plumbing Works</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>PART E – OTHER DOCUMENTS</td>
<td>450</td>
</tr>
<tr>
<td>1</td>
<td>NOC Copies (MCGM, Fire etc.)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Field and Topography Survey Reports</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Geotechnical Report</td>
<td></td>
</tr>
</tbody>
</table>
PART-1:
NOTICE INVITING TENDER (NIT)
1. **Tender Details**

1.1 Dean Infrastructure Planning and Support (IPS), on behalf of Director, IITB invites percentage rate composite Tender for the following work from the eligible firms / contractors in Two Part Bid System:

<table>
<thead>
<tr>
<th>NIT No.</th>
<th>NIT No.: IITB/DIPS/COPT/TENDER/02</th>
</tr>
</thead>
</table>

**Name of Work & Location**
Construction of Centre for Propulsion Technology (COPT) Building (ground plus 6 upper floors) including finishing works, internal water supply, sanitary and electrical installations, firefighting, fire alarm and ELV systems, lifts, Airconditioning, external development and furniture works at IIT Bombay, Powai, Mumbai – 400076

**Estimated cost put to tender**

| i) Major Component (Civil & Plumbing) | Rs. 44,85,28,832.00 |
| ii) Minor Component (E&M Works) | Rs. 20,33,00,774.00 |
| iii) Furniture | Rs. 2,66,96,201.00 |
| iv) Total | Rs 67,85,25,807.00 |
| v) GST @ 18% | Rs. 12,21,34,645.00 |
| vi) Grand Total | Rs 80,06,60,452.00 |

**Earnest Money Deposit**
Rs. 90,06,605.00
(Rs. Ninety lakh six thousand six hundred five only)

**Period of Completion**
21 Months

1.2 **Scheduled Dates**

i. Date of Notice to Inviting the Tender: **18.07.2023**
ii. Date for Pre Bid Meeting: **31.07.2023 at 11.00 AM**
iii. Last date for submission of Tender (including EMD): **28.08.2023 up to 15.00 Hrs**
iv. Time and date of opening of eligibility bid: **28.08.2023 at 15.30 Hrs**
v. Time and date of opening of financial bid: Shall be intimated later

Note: The Pre-Bid meeting will be held in the office of Dean (IPS), 1st Floor, Main Building, Indian Institute of Technology Bombay, Powai, Mumbai 400076. Intending bidders shall participate in person or through their authorised representatives. Any queries regarding the Tender document can be raised in the meeting. Intending bidders can also raise queries through email IDs given in Para 3.1 on or before the scheduled date of Prebid Meeting.

2. **Brief Particulars of the work for which Tenders are invited:**

Indian Institute of Technology (IIT) Bombay is situated in Powai, Mumbai. The campus is fully functional. Following is the brief detail of work under present tender. However, this scope is indicative only and not exhaustive.

2.1 **Project Description:**

The site is in Mumbai at IIT Bombay, Powai campus. The proposed building for COPT is Ground + 6 floors houses the following:

(a) Offices
Part A-1: NIT-Tender Details

(b) Laboratories
(c) Classrooms
(d) Seminar room
(e) Conference room
(f) Meeting rooms
(g) Lounges
(h) Waiting Area
(i) Pantry
(j) Utility room – Maintenance, Server, Panel & UPS rooms
(k) Restrooms

Adequate Underground & Overhead water tanks, Pump room, DG set provision, Compound walls, Gates, landscape & horticulture works have been planned.

2.2 Scope of Work

(a) Construction of the proposed CoPT building includes the comprehensive finishing for the structure, civil & interior related works along with all the required allied scope involving Public Health works for water supply, drainage & sanitation, Electrical work including supply & distribution, Low voltage components, Fire detection & firefighting, Lifts comprising of two passenger & one freight elevators, mechanical ventilation, internal furniture both built-in fixed & modular and/or loose furniture including external site development, landscape & horticulture works.

(b) The building is designed to achieve a GRIHA rating of minimum 3 Star.

(c) The earmarked site is a corner plot and is contoured with vegetation and an untrained water path. The scope the levelling to achieve the designed formation site levels to be in sync with the roads on the South & East.

(d) Accessibility to the building is proposed considering the differently abled via adequate ramps and elevators.

(e) The entire building is serviced by three Fire staircases opening out to the exterior at the Ground level and providing access to the terrace.

(f) There are two Passenger lifts and one dedicated Freight lift planned to accommodate the vertical circulation within the building. The Lifts have been planned with Lift machine rooms having adequate access from the terrace level. Dedicated restrooms have been provided as per the Statutory MCGM byelaws for Gents & Ladies. Separate restroom has also been designed for the differently abled at every floor. A common pantry area has also been planned with a separate access.

(g) The Underground water tank along with the pump room has been envisaged in the North east corner of the plot.

(h) At the Ground level, adequate plinth protection has been provided as per the proposed finished formation levels.

(i) The Main entrance & exits at Staircase have been designed with canopy in structural steel and finished in Aluminium Composite panels.
(j) Each floor has been designed in detail to house the rooms as per the Users’ requirements.

(k) Terrace floor comprises of Overhead water tanks for Fire, Flushing & Domestic water supply, Lift machine rooms with required access, Space allotment for mechanical ventilation provided for the toilets & pantry. Solar panels & outdoor HVAC equipment shall also be provided on the terrace.

(l) Internal electrification of the building is with Distribution cable, panels, Distribution Boards etc.

(m) Power Distribution system with Rising Main and DBs. Firefighting system, Lifts, Sprinkler system, Public Address system and Fire Alarm system as per Fire NoC.

(n) Certain rooms have been designed to accommodate the built-in & loose furniture.

2.3 Definitions

In this document the following words and expressions have the meaning hereby assigned to them.

(a) Employer Means the Director IITB, acting through the Dean (IPS).

(b) Bidder Means the individual proprietary firm, firm in partnership, limited company private or public or corporation.

(c) Year means “Financial Year” unless stated otherwise.

(d) Composite Work means work includes, in addition to building work, all other construction works and services such as sanitary and water supply, drainage, electrical, mechanical, development works like retaining walls, horticulture, roads and paths, furniture etc.

(e) Major Works means the construction scope of Civil, Structural, Furniture and Plumbing Works.

(f) Minor Works means the construction scope of Mechanical, Electrical, Airconditioning and Mechanical ventilation works.

(g) Composite Tender means the Tender for Composite Work which includes the construction scope of Major and Minor Works including specialised works.

3. Instructions and Information to the Bidders

3.1 For any queries, send an Email to Dean (IPS) (dean.ips@iitb.ac.in), and copy to Chief Program Management Consultant (PMC) (pmc.ips@iitb.ac.in), office of Dean (IPS) (dean.ips.office@iitb.ac.in) and Project Officer (po.ips@iitb.ac.in).

3.2 Venue for all personal interactions related to this Tender: Office of Dean (IPS), 1st Floor, Main Building, IIT Bombay, Powai, Mumbai 400 076, the bid forms and other details can be obtained from http://www.iitb.ac.in/deanpl/tender.

3.3 Entire bid document shall be submitted in total Three (3) Envelopes suitably superscribed as below:

3.4 EMD in one Envelope

3.5 Eligibility and Technical Documents in one Envelope

3.6 Financial Bid (Part D1 & D2) in one Envelope

3.7 Last Date & time for submitting EMD and other documents to Office of Dean (IPS) at 1st Floor, Main Building, IITB Campus, Powai, Mumbai 400 076 on or before the date as per Para 1.2 above.
Part A-1: NIT-Instructions to the Bidders

3.8 Tender to be opened on the mentioned date & time (refer Para 1.2 above) in the office in presence of the Bidder representatives who may be present at Dean (IPS) office, 1st floor, Main Office Building, IIT Bombay Campus, Powai, Mumbai 400 076.

3.9 General Guidelines
   a. Letter of Transmittal and forms for Prequalification are provided in Para 4.32.1.
   b. All information called for in the enclosed forms should be furnished against the relevant columns in the forms (under Para 4.32). If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in column, a “nil” or “no such case” entry should be made in that column. If any particulars / query is not applicable in case of the bidder, it should be stated as “not applicable”. The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the bidder being summarily disqualified. Bids received late will be rejected.
   c. The bid should be type written / neatly hand written. The bidder should sign each page of the bid.
   d. Over writing should be avoided. Correction, if any, should be made by neatly crossing out, initialling, dating and rewriting. Pages of the pre-qualification document are numbered. Additional sheets, if any, added by the Contractor, should also be numbered by him. These should be submitted as a package with signed letter of transmittal.
   e. References, information and certificates from the respective clients, certifying suitability, technical know-how or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent.
   f. The bidder may furnish any additional information, which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after submission of pre- qualification document unless it is called for by the Employer.

3.10 Method of Application
   a. If the bidder is an individual, the bid shall be signed by him above his full typewritten name with current address.
   b. If the bidder is a proprietary firm, the bid shall be signed by the proprietor above his full typewritten name and the full name of his firm with its current address.
   c. If the bidder is a firm in partnership, the bid shall be signed by all the partners of the firm above their full typewritten names and current addresses or alternatively by a partner holding power of attorney for the firm. In the latter case, a certified copy of the power of attorney should accompany the bid. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.
   d. If the bidder is a limited company or a corporation, the bid shall be signed by a duly authorized person holding power of attorney for signing the bid accompanied by a certified copy of the power of attorney. The bidder should also furnish a copy of this memorandum of Articles of Association duly attested by a public Notary.

3.11 Final decision-making Authority

The employer (IITB) reserves the right to accept or reject any bid and to annul the bidding process and reject all bids at any time, without assigning any reason or incurring any liability to the bidders.
3.12 Opening of Price Bid

After evaluation of applications, a list of short-listed Bidders will be prepared. Thereafter, the financial bids of only the qualified and technically accepted bidders shall be opened at the notified time, date and place in presence of qualified bidders or their representatives. The bid shall remain valid for a period of 120 days from the due date of submission / extended date of submission.

3.13 Award Criteria: The employer reserves the right, without being liable for any damages or obligation to:

a. Amend the scope and value of Contract to the bidder.
b. Reject any or all the applications without assigning any reason.
c. Any effort on the part of the bidder or his agent to exercise influence or to pressure the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

3.14 Agreement shall be drawn with the successful bidders on prescribed standard forms. Bidder shall quote his percentage and amount thus worked out shall be as per various terms and conditions of the said form which will form part of the agreement.

3.15 The time period for carrying out the work shall be as per the Para 1.2 under this Section which shall be from the date of start as defined in schedule ‘F’ or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the tender documents.

3.16 The site for the work is available. Preliminary architectural and structural drawings for the work are available; however, Good for Construction (GFC) drawings shall be issued soon after award of the work.

3.17 The Bid documents / Tender documents consisting of plans, specifications, schedule of quantities of various types of items of work to be executed, specifications and the set of terms and conditions of the Contract to be complied can be downloaded from the Central Public Procurement Portal (CPPP) website https://eprocure.gov.in/eprocure/app and https://www.iitb.ac.in/deanpl/tender.html at free of cost.

3.18 Copy of certificate of work experience and other documents as specified in this Tender document shall physically submitted in the office of Dean (IPS). Financial bid shall be opened only of those bidders meeting the Eligibility Criteria and declared qualified by IITB.

3.19 The bid submitted are liable to become invalid if:

a. The bidders are found ineligible.
b. The bidder does not submit EMD
c. The bidder does not submit all the documents (including GST registration) as stipulated in the bid document.

3.20 EMD amount as specified in Para 1.1 is to be submitted along with the Bid documents in any of the following forms:

a. Banker’s Cheque of a Commercial Bank
b. Account Payee Demand Draft (DD) of a Commercial Bank
c. Fixed Deposit Receipt (FDR) of a Commercial Bank
d. A part of earnest money is acceptable in the form of Bank Guarantee including e-Bank Guarantee also. In such cases 50% of earnest money or Rs. 20 lakh whichever is less, will have to be deposited in shape prescribed above and balance can be accepted in form of Bank Guarantee issued by a Commercial Bank.

3.21 After opening of the eligibility documents, the deficiencies found in the bid of each bidder vis-a-vis requirements as per NIT will be communicated to individual bidders by email with a request to furnish required documents within Three working days of receipt, failing which it will be presumed that the individual bidder do not have any further documents to furnish and decision on bids will be taken accordingly.
Part A-1: NIT-Instructions to the Bidders

3.22 The original EMD receiving authority releases the EMD to unsuccessful bidders after the expiry of stipulated bid validity period or immediately after acceptance of the successful bidder, whichever is earlier. EMD shall be refunded to the successful Bidder on receipt of Performance Guarantee submitted on award of the work.

3.23 BG / Bankers Cheque / Pay Order/ DD / FDR / Bonds shall be drawn in favour of Registrar Indian Institute of Technology Bombay, Payable at Mumbai.

3.24 The Bidder whose bid is accepted shall also furnish either copy of applicable licenses/registrations or proof of applying for obtaining labour licenses, registration with EPFO, ESIC and BOCW Welfare Board including Provident Fund Code No. If applicable and also ensure the compliance of aforesaid provisions by the subcontractors, if any engaged by the Contractor for the said work within the period specified in Schedule F.

3.25 The Bidder whose bid is accepted will also be required to furnish Programme Chart (Time and Progress using PRIMAVERA) within the period as specified in Schedule F.

3.26 Intending Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The bidders shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the Contract documents. Submission of a bid by a bidder implies that he has read this notice and all other Contract documents and has made himself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the IITB and local conditions and other factors having a bearing on the execution of the work.

3.27 The competent authority on behalf of Director IITB reserves to himself the right of accepting the whole or any part of the bid and the bidders shall be bound to perform the same at the rate quoted.

3.28 The Bidder shall not be permitted to bid for works in the IITB, in which his near relative is posted a Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any officer in the IITB. Any breach of this condition by the Contractor would render him liable to be removed from the approved list of contractors of this Institute/IITB.

3.29 This notice inviting Bid shall form a part of the Contract document. The successful bidders / contractor, on acceptance of his bid by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the Contract consisting of The Notice Inviting Tender, all the documents including Additional Conditions, Additional and Special Conditions, Specifications and Drawings, etc. forming part of the bid as uploaded at the time of invitation of bid and the rates quoted at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.

3.30 On acceptance of the tender, the name of the accredited representative(s) of the Contractor who would be responsible for taking instructions from the Engineer-in-Charge shall be communicated in writing to the Engineer-in-Charge.

3.31 GST or any other tax applicable in respect of inputs procured by the Contractor for this Contract shall be payable by the Contractor and IITB will not entertain any claim whatsoever in respect of the same. However, component of GST at time of supply of service (as provided in CGST Act 2017) provided by the Contract shall be varied if different from that applicable on the last date of receipt of tender including extension if any.

3.32 In this Percentage Rate Tender, the tenderer shall quote percentage below/above (in figures as well as in words) at which he will be willing to execute the work. He shall also work out the total amount of his offer and the same should be written in figures as well as
in words in such a way that no interpolation is possible. In case of figures, the word ‘Rs.’ Should be written before the figure of rupees and word ‘P’ after the decimal figures, e.g. ‘Rs. 2.15 P and in case of words, the word ‘Rupees’ should precede and the word ‘Paisa’ should be written at the end.

3.33 The Contractor whose tender is accepted, will be required to furnish performance guarantee of 5% (Five Percent) of the tendered amount within the period specified in Schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than Rs. 10,000/-) or deposit at call receipt of any scheduled bank/Banker’s cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay order of any scheduled bank (in case guarantee amount is less than Rs. 1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank.

3.34 The contractor whose tender is accepted will also be required to furnish by way of Security Deposit for the fulfilment of his Contract, an amount equal to 5% of the tendered value of the work. The Security deposit will be collected by deductions from the running bills as well as final bill of the contractor at the rates mentioned above. The Security amount will also be accepted in cash or in the shape of Government Securities. Fixed Deposit Receipt of a Scheduled Bank or will also be accepted for this purpose provided confirmatory advice is enclosed.

3.35 Performance Bank Guarantee and Security Deposit Bank Guarantee as per the Clause 1 and Clause 1A of Clauses of the Contract respectively shall be drawn in favour of Registrar, Indian Institute of Technology Bombay payable at Mumbai.

3.36 The tender submitted shall be treated as invalid if the Bidder does not quote percentage above/below on the total amount of tender or any section/sub head of the tender.

3.37 Tenders, which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort including conditional rebates, will be summarily rejected.

3.38 Forfeiture of Earnest Money

1. (i) If any tenderer withdraws his tender or makes any modification in the terms & conditions of the tender which is not acceptable IITB within 7 days after last date of submission of bids, then the IITB shall without prejudice to any other right or remedy, be at liberty to forfeit 50% of earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

(ii) If any tenderer withdraws his tender or makes any modification in the terms & conditions of the tender which is not acceptable to the department after expiry of 7 days after last date of submission of bids, then the IITB shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

2. If contractor fails to furnish the prescribed performance guarantee within the prescribed / extended period, the earnest money is absolutely forfeited to the IITB automatically without any notice.

3. In case of forfeiture of earnest money as prescribed in Para (1) and (2) above, the bidder shall not be allowed to participate in the re-tendering process of the work.

3.39 In case the lowest tendered amount (estimated cost + amount worked on the basis of percentage above/below) of two or more contractors is same, such lowest contractors will be asked to submit sealed revised offer in the form of letter mentioning percentage above/ below on estimated cost of tender including all sub sections/sub heads as the case may be, but the revised percentage quoted above/below on tendered cost or on each sub section/ sub head should not be higher than the percentage quoted at the time of submission of tender. The lowest tenderer shall be decided on the basis of revised offers. In case any of such Bidder refuses to submit revised offer, then it shall be treated as withdrawal of his tender before acceptance and 50% of earnest money shall be forfeited.

3.40 If the revised tendered amount of two more contractors received in revised offer is again found to be equal, the lowest tender, among such contractors, shall be decided by draw of lots in the presence of Director (IITB) or his Authorised Representative & the lowest contractors those have quoted equal amount of their tenders.
3.41 In case all the lowest Bidder those have quoted same tendered amount, refuse to submit revised offers, then tenders are to be recalled after forfeiting 50% of EMD of each Bidder. Bidder(s), whose earnest money is forfeited because of non-submission of revised offer, shall not be allowed to participate in the re-tendering process of the work.

3.42 For Composite Bids

a. The quoted percentage of the bidder shall be applicable for all items of major component as well as minor components of work.

b. After acceptance of the bid by competent authority, the Dean (IPS) IITB shall issue letter of award of work on behalf of Director IITB. After the work is awarded, the Contractor shall have to enter into an agreement with Dean (IPS).

c. Entire work under the scope of composite bid including major and all minor components shall be executed under one agreement.

d. The Contractor has to associate agency(s) for minor component(s). Name of the agency(s) to be associated shall be approved by Dean (IPS).

e. In case the Contractor intends to change any of the above agency/agencies during the operation of the Contract, he shall obtain prior approval of Dean (IPS).

f. The Contractor has to enter into agreement with contractor(s) associated by him for execution of minor component(s). Copy of such agreement shall be submitted to Dean (IPS). In case of change of associate contractor, the Contractor has to enter into agreement with the new contractor associated by him.

g. The Contractor shall prepare detailed execution programme of the work which forms part of his agreement with the IITB in the event of the award. He shall indicate in the programme, the time/stage of the work when the agencies of specialized components of works will be deployed by him.

h. Running payment for the works done and measured shall be made by Dean (IPS) to the Contractor on basis of Quoted Percentage Above or Below on The Estimated Cost of each item.

i. The composite work shall be treated as complete when all the components of the work are complete. The completion certificate of the composite work shall be recorded by Dean (IPS) after record of completion certificate of all other components.

j. Final bill of whole work shall be finalized and paid by the Dean (IPS).

k. The completion certificate of the work shall be recorded by Dean (IPS).

l. All requirements shall be as per the NIT provisions.

3.43 List of the documents to be submitted by the Bidders within the period of bid submission listed as below:

1. Envelope No 1: EMD amount as specified in Para 1.1 to be submitted in a separate envelope superscribed ‘EMD’ in the form elaborated in Para 3.20.

2. Envelope No 2: Shall consist of Eligibility and Technical documents and superscribed as such listed below:

   (a) Letter of transmittal.

   (b) Certificate of Registration for GST and acknowledgement of up-to-date filled return.

   (c) Certified copy of the partnership deed & current address of all the partners of the firm and certified copy of the power of attorney for signing the application/copy of memorandum of Articles of Association duly attested by a Public Notary and certified copy of the power of attorney for signing the application (If applicable).
(d) Details of the similar works carried out as per the Para 4.3 under this Section.

(e) Bidding Capacity.

(f) Balance sheet for Last three Financial Years.

(g) Certificates of Financial Turnover from Chartered Accountant (Form A).

(h) Bank Solvency Certificate (Form B).

(i) Certificates of Work Experience (Form C & D).

(j) Structure & Organisation (Form E)

(k) Affidavit for “Proforma of Affidavit for Non-Black Listing” (Form F).

(l) Any other document specified in the public notice.

(m) List of works executed for the last 7 years (Project name, date of start, scheduled and actual date of completion, Work Order value, final value of the work upon completion, name of the Client, etc.).

(n) List of work in Hand (progress) with date of start, scheduled date of completion, Value of work, status of work, name of the Client etc.) in the following form:

<table>
<thead>
<tr>
<th>Name of work</th>
<th>Client who awarded the work</th>
<th>Ordered Value of work</th>
<th>Started Date</th>
<th>Scheduled Completion Date</th>
<th>Percentage of work completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.</td>
<td>3.</td>
<td>4.</td>
<td>5.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Envelope No 3: Shall be of Commercial Bid consist of the following duly signed and stamped by the Bidder

   a. Part D1 : Percentage quote on Estimated Amount

   b. Part D2 : Bill of Quantities (BOQ)
Part A: NIT-Eligibility Criteria

4. **Eligibility Criteria**

4.1 Tenders shall be considered from eligible contractors who have satisfied eligibility criteria as specified in the tender, vide documents to be submitted in Envelope-2 of the Tender subject to producing definite proof (from the appropriate authority which shall be to the satisfaction of the competent authority) of having satisfactorily completed similar works of magnitude specified hereinafter.

4.2 Joint ventures and Special Purpose vehicles are not accepted.

4.3 Should have completed the works as mentioned below during the last Seven (7) years ending previous day of last date of submission of tenders.

a. Three similar works each costing not less than Rs 32,02,64,181.00 (including GST)

or

b. Two similar works costing not less than that Rs 48,03,96,271.00 (including GST)

or

c. One similar work each costing not less than Rs 64,05,28,362.00 (including GST)

and

d. One construction work of any nature either from the above or separately carried out of which cost is not less than Rs. 32,02,64,181.00 with any Central or State Government / Central or State Autonomous Body/ Central or State Public Sector Undertaking

and

e. Completed at least one building work involving HVAC system either from the above or separately carried out at least total to 145 Ton of Refrigeration (TR).

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to previous day of last day of submission of tenders.

Similar work shall mean ‘the building consisting of RCC Framed Structure having minimum five (5) storey above plinth including Finishing works, internal Water Supply & Sanitary installations, Internal Electrical Installation, Firefighting (Wet Riser / Down comer) system, Lifts, HVAC etc., all executed under one agreement / contract’.

Bidders are advised to submit copy of Agreement / final bill or any other relevant document in support of their proposed completed work(s) which conforms to the definition of similar work.

In case of private works, the same shall be supported by TDS certificate for the work(s) under consideration.

4.4 Turnover: Should have average annual financial turnover of Rs 24,01,98,136.00 on construction works during the immediate last 5 consecutive financial years ending 31st March 2022. The value of annual turnover figures shall be brought to the current value by enhancing the actual turnover figures at simple rate of 7% per annum.

4.5 Profit / loss: Should not have incurred any loss (profit after tax should be positive) in more than two years during available last five consecutive balance sheet (balance sheet in case of private/public limited company means its standalone financial statement and consolidated financial statement both), duly audited and certified by the Chartered Accountant.

4.6 Bidding Capacity: Should have bidding capacity equal to or more than the estimated cost of the work put to tender. The bidding capacity shall be worked out by the following formula:

\[ \text{Bidding Capacity} = \left(\frac{A \times N \times 2}{N} - B \right) \]

Where,
A = Maximum turnover in construction works executed in any one year during the last seven years taking into account the completed as well as works in progress. The value of completed works shall be brought to current costing level by enhancing at a simple rate of 7% per annum.

N = Number of years prescribed for completion of work for which bids have been invited.

B = Value of existing commitments and ongoing works to be completed during the period of completion of work for which bids have been invited.

Note: The bidder should submit bidding capacity as per Form 'C-3'.

4.7 Banker’s Certificate from a Commercial Bank or Net worth Certificate:
Should have Banker's Certificate of the amount equal to Rs 32,02,64,181.00 or
Net worth certificates of minimum Rs 8,00,66,045.00 issued by certified Chartered Accountant with UDIN.

4.8 Financial Information
Bidder shall furnish Annual financial statement for the last five years (in the Form “A”) and solvency certificate (in form “B”).

4.9 Experience in Works, highlighting the experience in Similar Works.
List of eligible similar nature of work successfully completed during the last seven years (In the Form “C”, “C1”, “C3”).

4.10 Performance report of works referred in form “C” shall be submitted in the form of Form “D” signed by officer not below the rank of Executive Engineer /Project Manager or equivalent.

4.11 Organisation information: Bidder shall submit information in respect to his organization (in the Form “E”).

4.12 Eligibility Letter of Transmittal shall be submitted in the format provided in Para 4.32.1.

4.13 The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to previous day of last date of submission of tenders.

4.14 Bids of those Bidders who meet the eligibility criteria para 4.1 to 4.7 will be evaluated for Quality / safety / schedule / performance evaluation of completed / ongoing works etc. by an Evaluation committee constituted by the Director, IIT Bombay based on the following parameters. The bidder shall get minimum 60% of the allocated marks for each category of the following parameters and also shall get over all 75% to qualify for opening of Financial Bid.

   a. Quality/safety performance based one similar completed work -20 marks.
   c. Schedule performance of the current and past works, in the last 5 works – 20 marks.
   d. Resources including manpower, equipment software etc. with the agency to be made available for deploying at site - 20 marks.
   e. Demonstration of capabilities of having undertaken similar projects under local by-laws / working environment using local resources etc.- 20 marks

The bidder shall submit documents/report detailing each of the above signed by the authorized signatory and should be part of the bid.

The Bidders shall be subject to thorough verification by the Technical Evaluation Committee constituted by IITB of their credentials, inspection of ongoing / completed
construction works or both at the discretion of IITB for quality (form D-1 for reference), safety, time schedules and execution methodologies, office establishment and facilities etc. The performance reports from the Authorities to whom the works are being executed or completed shall also become part of the technical evaluation.

Responsibility of obtaining necessary permissions from the respective Authorities to visit the Bidders ongoing / completed construction works for inspection by the IITB Technical Evaluation Committee lies with the Bidder.

4.15 The bidder shall submit documents/report detailing each of the above signed by the authorized signatory and shall be part of the bid.

4.16 To become eligible for issue of bid, the bidders shall have to furnish and affidavit as Under:

“I / We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Dean IPS, then I/We shall be debarred for tendering in IITB in future forever. Also, if such violation comes to the notice of Dean IPS before date of start of work, the Dean IPS shall be free to forfeit the entire amount of EMD / Performance guarantee.”

4.17 The intending bidder must read the terms and conditions as spelt out in this NIT document. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required.

4.18 All the taxes as applicable shall be borne by the Contractor himself. The Bidder shall quote his tendered amount considering all such taxes and hence their tendered amount should be inclusive of all the tax components. Goods and Service tax (GST) shall be indicated separately.

4.19 Information and Instruction for bidders posted on website shall form part of bid document.

4.20 The bid document consisting of plans / drawings, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the Contract to be complied with the Contractor whose bid may be accepted, and other necessary documents can be seen on [https://www.iitb.ac.in/deanpl/tender.html](https://www.iitb.ac.in/deanpl/tender.html) and on Central Public Procurement Portal (CPPP) website [https://eprocure.gov.in/eprocure/app](https://eprocure.gov.in/eprocure/app).

4.21 Tender should be submitted along with original EMD. EMD should be submitted in separate envelope super scribed ‘EARNEST MONEY DEPOSIT’.

4.22 Certificate of Financial Turn over: At the time of submission of bid, Bidder has to Submit Affidavit/Certificate from CA mentioning Financial Turnover of last 5 years and further details if required may be asked from the Bidder after opening of eligibility bids. There is no need to submit entire voluminous balance sheet.

4.23 Tenderer shall ensure to quote percentage against estimated cost put to tender.

4.24 The Eligibility bid shall be opened first on due date and time as mentioned above (Refer to Para no. 1.2 above). The time and date of opening of financial bid of tenderers qualifying the eligibility bid shall be communicated to them at a later date.

4.25 The building is targeted for minimum 3 Star GRIHA rating from TERI. The bidders shall provide all necessary support and required facilities in order to secure this rating. Nothing extra on this account shall be payable.

4.26 IITB reserves the right to reject any prospective Tender without assigning any reason and to restrict the list of qualified Tenderers to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.

4.27 EMD amount as specified in Para 1.1 in the form elaborated in Para 3.20, shall be drawn in favour of Registrar Indian Institute of Technology, Bombay, payable at Mumbai.

4.28 Information pertaining to any additions, changes, modifications including Record notes of Pre-Bid meeting etc. shall be uploaded on the official websites and no separate
communication shall be made in this regard. Bidders are advised to regularly check websites for further Information/Communication.

4.29 It will be obligatory on part of the tenderer to sign the tender documents for all the components (Schedule of Quantities, General Terms & conditions, Special Terms & Conditions and Performa Schedules including additions, changes, modifications, Record notes of Pre-Bid meeting, addendums and amendments to the Tender etc.).
4.30 FORMS / FORMATS

4.30.1 Format for Information Regarding Eligibility Letter of Transmittal

To:

Dean (IPS),
1st floor Main building,

Sub: Construction of ____________________________ at IIT Bombay.

Dear Sir,

Having examined the details given in Notice inviting tender and bid document for the above work, I/We, hereby submit the relevant information.

1. I / We, hereby certify that all the statements made, and information supplied in the enclosed form “A” to “F” accompanying statements are true and correct.

2. I/We have furnished all information and details necessary for pre-qualification and have no further pertinent information to supply.

3. I / We, submit the requisite certified solvency certificate and authorize the Dean (IPS) to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I/We, also authorize Dean (IPS) to approach individuals, employers, firms and corporation to verify our competence and general reputation.

4. I/We, submit the following certificates in support of our suitability, technical know-how and capability for having successfully completed the following eligible similar works:

<table>
<thead>
<tr>
<th>Name of work:</th>
<th>Certificate from:</th>
</tr>
</thead>
</table>

**Certificate:**

It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I / we shall be liable to be debarred, disqualified/ cancellation of enlistment in case any information furnished by me/us found to be incorrect.

**Enclosures:**

Date of Submission:________________________ Signature(s) of Bidder(s)

Seal of the Bidder
4.30.2 **FORMS ‘A’ to ‘F’**

i. **Form A – FINANCIAL INFORMATION**

Financial Analysis – Details to be furnished duly supported by figures in balance sheet / Profit and Loss account for the last five years duly certified by the Chartered Accountant as submitted by the Bidder to the Income–Tax IITB (Copies to be attached).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Annual Turnover on Construction works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit/loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signature(S) Of Bidder(s)  Signature of Chartered Accountant
with Seal  with Seal
ii. FORM “B”: FORM OF BANKER’S CERTIFICATE FROM A SCHEDULED BANK
(Not more than three months old)

This is to certify that to the best of our knowledge and information that
M/S./Sh..................................................having marginally noted address, a customer of
our bank are / is respectable and can be treated as good for any engagement up to a limit of
Rs.................................................(Rupee ...................................................only).

This certificate is issued without any guarantee or responsibility on the bank or any of the
officers.

Address and (Signature) for the Bank

NOTE:
1. Banker’s certificates should be on letter head of the Bank addressed to tendering authority.
2. In case of partnership firm, certificate should include names of all partners as recorded with
   the Bank.
### iii. FORM “C”:

DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED DURING THE LAST SEVEN YEARS ENDING PREVIOUS DAY OF LAST DATE OF SUBMISSION OF TENDERS

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of work/ project and location</th>
<th>Owner or sponsoring organization</th>
<th>Cost of work in crores of rupees</th>
<th>Date of commencement as per contract</th>
<th>Stipulated date of completion</th>
<th>Actual date of completion</th>
<th>Litigation/ arbitration cases pending/ in progress with details*</th>
<th>Name and address/ telephone number of officer to whom reference may be made</th>
<th>Whether the work was done on back to back basis</th>
<th>Yes/ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

*Indicate gross Amount Claimed and Amount Awarded by the Arbitrator.

Signature(s) of Bidder(s)

### FORM 'C'-1

PROJECTS UNDER EXECUTION

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of work/ Project and location</th>
<th>Owner or sponsoring organization</th>
<th>Cost of work in crores of rupees</th>
<th>Date of commencement as per contract</th>
<th>Stipulated date of completion</th>
<th>Up to date percentage progress of work</th>
<th>Slow progress if any and reasons thereof</th>
<th>Name and address/ telephone number of officer to whom reference may be made</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Signature(s) of Bidder(s)
**FORM 'C'-2**

- Form C2 is deleted

**FORM 'C'-3**

**Calculation of bidding capacity**

Details of existing commitments and ongoing works.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of work/project and location</th>
<th>Owner or sponsoring organization</th>
<th>Contract value in crore of rupees</th>
<th>Date of commencement as per contract</th>
<th>Stipulated date of completion</th>
<th>Up to date percentage progress of work</th>
<th>Remaining work in percentage (100 \times \text{Column 7} / 100)</th>
<th>Column 4 x Column 8 (100)</th>
<th>telephone number of officer to whom reference may be made</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total (B) = [AxNx1.5] - B

Maximum turnover in last seven years = Rs. ..........  
Updated value of turnover (A) = Rs. ..........  
No. of years (N) = .............  
Bidding Capacity = .............  

Certificate:  
I certify that all the awarded and ongoing works have been included in the above list.

Signature(s) of Bidder(s)
iv. **FORM “D”:**

**PERFORMANCE REPORT OF WORKS REFERRED IN FORM ‘C’**

1. Name of Work/Project and Location:

2. Agreement No.

3. Estimated Cost:

4. Cost of the project done:
   i. Tendered Cost:
   ii. Value of work done:

5. Date of start

6. Date of completion
   i. Stipulated date of completion:
   ii. Actual date of completion:

7. i. Whether case of levy of compensation for delay has been decided or not: Yes/No
   ii. If decided, amount of compensation levied for delayed completion if any

8. Amount of reduced rate items, if any

9. Performance Report:
   (i) Quality of Work
       Good/Poor : Outstanding/ Very Good/
   (ii) Financial Soundness
       Good/Good/Poor : Outstanding/Very
   (iii) Technical Proficiency
       Good/Poor : Outstanding/ Very Good/
   (iv) Resourcefulness
       Good/Poor : Outstanding/ Very Good/
   (v) General behaviour
       Good/Poor : Outstanding/Very Good/

Signature: (Executive Engineer or Equivalent)

Date:

**Note:** If Name of Work is not clearly defining scope of work as specified in the definition of similar work, bidders are advised to submit a copy of Agreement/ final bill or any other relevant document in support of their proposed completed work conforming to the definition of similar work.
### FORM D1 (FOR INFORMATION)

**ASSESSMENT OF QUALITY FOR COMPLETED AS WELL AS ONGOING WORKS**

Name of work: -

Date of Inspection: -

Date of submission of the report: -

<table>
<thead>
<tr>
<th>A. General Observations and Operational Aspects</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Availability of approval from local bodies in case of construction of private buildings.</td>
<td></td>
</tr>
<tr>
<td>2 Availability of approved structural drawings.</td>
<td></td>
</tr>
<tr>
<td>3 Observation on seepage/ leakage in the building</td>
<td></td>
</tr>
<tr>
<td>4 Whether line and level maintained</td>
<td></td>
</tr>
<tr>
<td>5 In case of basement, observation on seepage, if any.</td>
<td></td>
</tr>
<tr>
<td>6 Any structural defects/ distress observed. If yes give details</td>
<td></td>
</tr>
<tr>
<td>7 Whether safety measures adopted at site as per CPWD safety code and or govt. guidelines are adequate or not.</td>
<td></td>
</tr>
<tr>
<td>8 Whether the welfare facilities provided to labour as per cause 19 H of GCC for CPWD works / and or govt. guidelines are adequate or not.</td>
<td></td>
</tr>
<tr>
<td>9 Whether AHU getting automatically switched off and fire damps closed in case of fire signal</td>
<td></td>
</tr>
<tr>
<td>10 Whether thimbles used for termination of wires in DBs, EBDs and panels?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Quality of Work</th>
<th>Marks Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Quality of plaster/finishing</td>
<td></td>
</tr>
<tr>
<td>2 Quality of RCC/CC work</td>
<td></td>
</tr>
<tr>
<td>3 Quality of flooring</td>
<td></td>
</tr>
<tr>
<td>4 Quality of wood work</td>
<td></td>
</tr>
<tr>
<td>5 Quality of steel work / aluminium work</td>
<td></td>
</tr>
<tr>
<td>6 Quality of plumbing and sanitary installation</td>
<td></td>
</tr>
<tr>
<td>7 Quality of workmanship</td>
<td></td>
</tr>
<tr>
<td>8 Quality of water proofing</td>
<td></td>
</tr>
</tbody>
</table>
### A. General Observations and Operational Aspects

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>If cladding done, observation on efficiency/ quality of cladding / brick work</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Quality of internal electrification work</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Quality of DBs, EBDs and panels?</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Quality of E&amp;M equipment, panels and feeder pillar.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Quality of fire alarm system/ fire-fighting system</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Quality of Air conditioning work.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Quality of Sub-Station based on complete live diagram, capacitor panel, power factor, insulating materials, cleanliness, cable termination, earthing pits, earthing of transformer /DG sets.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Any other aspect (To be elaborated)</td>
<td></td>
</tr>
</tbody>
</table>

### FORM “E”: STRUCTURE AND ORGANISATION

1. Name and address of the bidder:

2. Telephone No./Telex No./Fax No.

3. Legal status of the bidder (Attach copies of original document defining the legal status)
   i. An individual
   ii. A proprietary Firm
   iii. Affirm in Partnership
   iv. A limited company or Corporation

4. Particulars of registration with various Government bodies (Attach Attested Photocopy)
   Organisation /Place of Registration no.
   i. 
   ii. 

5. Names and Titles of Directors and Officers with designation to be concerned with this work.

6. Designation of individuals authorized to act for the organization.

7. Has the bidder, or any constituent partner in case of partnership firm, Limited company/joint venture, ever has been convicted by the court of Law? If so, give details.

8. In which field of Civil Engineering Construction and MEP Works the bidder has specialization and interest?

9. Any other information considered necessary, but not included above.

Signature(s) of Bidder(s)
v. **FORM “F”: PROFORMA OF AFFIDAVIT FOR NOT BLACK LISTING**

I/we undertake and confirm that our firm/partnership firm has not been blacklisted by any State /Central / IITs /PSUs /Autonomous bodies during the last 7 years of its operations. Further that, if such information comes to the notice of the IITB then I/we shall be debarred for bidding in IITB in future forever. Also, if such information comes to the notice of IITB on any day before date of start of work, Dean (IPS) shall be free to cancel the agreement and to forfeit the entire amount of Performance Guarantee (Scanned copy of this notarized affidavit to be uploaded at the time of submission of bid).

NOTE: Affidavit to be furnished on a ‘non-Judicial’ stamp paper worth Rs 100/-. 

Signature of Bidder(s) 
or an authorized Officer 
of the firm with stamp 

Signature of Notary with seal
4.30.3 **Form of Earnest Money Deposit -Bank Guarantee Bond**

WHEREAS, Contractor......................(Name of Contractor) (herein after called "the Contractor") has submitted his tender dated.............(Date) for the construction of ..........................................................(name of work) (herein after called" the Tender").

KNOW ALL PEOPLE by the represents that we.................................(name of bank) having our registered office at............................(herein after called "the Bank") are bound unto Dean (IPS), Indian Institute of Technology Bombay (herein after called "the Dean (IPS" ") in the sum of Rs......................(Rs. In words……..) for which payment well and truly to be made to the said Engineer-in-Charge the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this.............day of.............20.... THE CONDITIONS of this obligation are:

1) If after Tender opening the Contractor withdraws, his tender during the period of validity of the Tender (including extended validity of Tender) specified in the Tender;

2) If the Contractor having been notified of the acceptance of his tender by the Dean (IPS):

   (a) Fails or refuses to execute the Form of Agreement in accordance with the Instructions to Contractor, if required.

   OR

   (b) Fails or refuses to furnish the Performance Guarantee, in accordance with the provisions of Tender document and Instructions to the Contractor,

   We undertake to pay at Mumbai to the Dean (IPS) either up to the above amount or part thereof upon receipt of his first written demand, without the Dean (IPS) having to substantiates his demand, provided that in his demand the Dean (IPS)will note that the amount claimed by his is due to him owing to the occurrence of one or any of the above conditions, specifying the occurred condition or conditions.

   This Guarantee will remain in force up to and including the date*............. after the deadline for submission of Tender as such deadline is stated in the Instructions to Contractor or as it may be extended by the Dean (IPS), notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

   Date.............Signature of the Bank with Seal

   Witness.................

   (Signature, Name and Address)

   *Date to be worked out on the basis of validity period of 120 days from last date of receipt of tender including extension, if any.
5. **Percentage Tender and Contract for Works:**

a. I/We have read and examined the notice inviting tender, schedule A, B, C, D, E & F Specifications applicable, Drawings & Designs, General Conditions of Contract with amendments up to the last date of submission of tenders, Technical Specifications as per CPWD, General Conditions of the Contract, Special conditions of the Contract, Schedule of Rate & other documents and Rules referred to in the Conditions of the Contract and all other contents in the Tender document for the work “Construction of COPT building (ground plus 6 upper floors) including finishing works, internal water supply, sanitary and electrical installations, firefighting, fire alarm & ELV systems, lifts, Airconditioning, internal furniture and external development works at IIT Bombay, Powai, Mumbai 400076.”

b. I/We hereby tender for the execution of the work specified for the IITB within the time specified in Schedule ‘F’ in accordance in all respect with the specifications, designs, schedule of quantities, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of Contract with amendments up to the last date of submission of tenders and with such materials as are provided for by, and in respect of accordance with, such conditions so far as applicable.

c. We agree to keep the tender open for One Twenty (120) days from the date of extended bid submission and not to make any modification in its terms and conditions.

d. A sum of Rs _______ is hereby forwarded in cash/receipt treasury challan/deposit at call receipt of a scheduled bank/fixed deposit receipt of scheduled bank/demand draft of a scheduled bank/bank guarantee issued by a scheduled bank as earnest money.

e. If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the said IITB, shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely. Further, if I/We fail to commence work as specified, I/We agree that IITB shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the General Conditions of the Contract.

f. Further, I/We agree that in case of forfeiture of Performance Guarantee or committing such breach as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.

g. I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another Contractor on back-to-back basis. Further that, if such a violation comes to the notice of IITB, then I/We shall be debarred for tendering in IITB in future forever. Also, if such a violation comes to the notice of IITB before date of start of work, Dean (IPS) shall be free to forfeit the entire amount of Performance Guarantee.

h. I/We hereby declare that I/We shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information /derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

Dated:…………………… Signature of the Bidder:……………

Address: ………………… Postal Address:………………..

Position: …………………

Witness Signature: …………..

Witness name and address: …………………

(Blanks to be filled by the Bidder)
5.1 IITB Acceptance

The above tender (as modified by you as provided in the letters mentioned here under) is accepted by me for an on behalf of Director IITB for a sum of Rs. ………………………………..(Rupee…………………………………………………………..).

The letters refer red to below shall form part of this Contract agreement:

(a)

(b)

For & on behalf of ………………………………..

Signature…………………………………………

Dated: …………

Designation……………………

(Blanks to be filled by Dean (IPS))
PART A-2: CONDITIONS OF THE CONTRACT
## GENERAL CONDITIONS OF THE CONTRACT

### INDEX

<table>
<thead>
<tr>
<th>CLAUSE</th>
<th>TITLE OF THE CLAUSE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Definitions</td>
<td>33-35</td>
</tr>
<tr>
<td>6.2</td>
<td>Clauses of the Contract</td>
<td>35-36</td>
</tr>
<tr>
<td>Clause 1</td>
<td>Performance Guarantee</td>
<td>36</td>
</tr>
<tr>
<td>Clause 1A</td>
<td>Recovery of Security Deposit</td>
<td>36-37</td>
</tr>
<tr>
<td>Clause 2</td>
<td>Compensation for Delay</td>
<td>37-38</td>
</tr>
<tr>
<td>Clause 3</td>
<td>When Contract can be Determined</td>
<td>38-40</td>
</tr>
<tr>
<td>Clause 4</td>
<td>Contractor liable to pay compensation even if action not taken under Clause 3</td>
<td>40-41</td>
</tr>
<tr>
<td>Clause 5</td>
<td>Time and Extension for Delay</td>
<td>41-42</td>
</tr>
<tr>
<td>Clause 6</td>
<td>Computerized Measurement Book</td>
<td>42-44</td>
</tr>
<tr>
<td>Clause 7</td>
<td>Payment on intermediate certificate to be regarded as Advances</td>
<td>44-45</td>
</tr>
<tr>
<td>Clause 8</td>
<td>Completion Certificate and Completion Plans</td>
<td>45-46</td>
</tr>
<tr>
<td>Clause 8 A</td>
<td>Completion Plans to be Submitted by the Contractor</td>
<td>46</td>
</tr>
<tr>
<td>Clause 9</td>
<td>Payment of Final Bill</td>
<td>46</td>
</tr>
<tr>
<td>Clause 9A</td>
<td>Payment of Contractor’s Bills to Banks</td>
<td>46</td>
</tr>
<tr>
<td>Clause 10A</td>
<td>Materials to be provided by the Contractor</td>
<td>46-47</td>
</tr>
<tr>
<td>Clause 10B</td>
<td>Secured Advance on Materials</td>
<td>47-48</td>
</tr>
<tr>
<td>Clause 10C</td>
<td>Payment on Account of Increase in Prices/ Wages due to Statutory Order(s)</td>
<td>48-49</td>
</tr>
<tr>
<td>Clause 10CA</td>
<td>Deleted</td>
<td>49</td>
</tr>
<tr>
<td>Clause 10CC</td>
<td>Price Adjustment for Works</td>
<td>49-52</td>
</tr>
<tr>
<td>Clause 10 D</td>
<td>Dismantled Material IITB Property</td>
<td>52</td>
</tr>
<tr>
<td>Clause 11</td>
<td>Work to be Executed in Accordance with Specifications, Drawings, Orders etc</td>
<td>52-53</td>
</tr>
<tr>
<td>Clause 12</td>
<td>Deviations/ Variations Extent and Pricing</td>
<td>53-54</td>
</tr>
<tr>
<td>Clause 13</td>
<td>Foreclosure of Contract due to Abandonment or Reduction in Scope of Work</td>
<td>54-55</td>
</tr>
<tr>
<td>Clause 14</td>
<td>Carrying out part work at risk &amp; cost of Contractor</td>
<td>55-56</td>
</tr>
<tr>
<td>Clause 15</td>
<td>Suspension of Work</td>
<td>56-57</td>
</tr>
<tr>
<td>Clause 16</td>
<td>Action in case of Work not done as per Specifications</td>
<td>57-58</td>
</tr>
<tr>
<td>Clause 17</td>
<td>Contractor Liable for Damages, defects during Maintenance period</td>
<td>58</td>
</tr>
<tr>
<td>Clause 18</td>
<td>Contractor to Supply Tools &amp; Plants etc.</td>
<td>58</td>
</tr>
<tr>
<td>Clause 18-A</td>
<td>Recovery of Compensation paid to Workmen</td>
<td>58-59</td>
</tr>
<tr>
<td>Clause 18-B</td>
<td>Ensuring Payment &amp; Amenities to Workers if Contractor fails</td>
<td>59</td>
</tr>
<tr>
<td>Clause 19</td>
<td>Labour Laws to be Complied by the Contractor</td>
<td>59</td>
</tr>
<tr>
<td>Clause 19-A</td>
<td>No Labour below 18 years.</td>
<td>59</td>
</tr>
<tr>
<td>Clause 19-B</td>
<td>Payment of Wages</td>
<td>59-60</td>
</tr>
<tr>
<td>Clause 19-C</td>
<td>Safety Provisions for Labour &amp; Penalty on Default</td>
<td>60-61</td>
</tr>
<tr>
<td>Clause 19-D</td>
<td>Submission of Fortnightly Labour Chart by every fortnight</td>
<td>61</td>
</tr>
<tr>
<td>Clause 19-E</td>
<td>Contractor to Comply Govt. Rules on Health &amp; Sanitary Arrangements for Workers</td>
<td>61</td>
</tr>
<tr>
<td>Clause 19-F</td>
<td>Maternity Benefit Rules (Leave and Pay)</td>
<td>61</td>
</tr>
<tr>
<td>Clause 19-G</td>
<td>Penalty for Non-Compliance of Labour Regulations</td>
<td>62</td>
</tr>
<tr>
<td>Clause 19-I</td>
<td>Removal of Incompetent Workers</td>
<td>63</td>
</tr>
<tr>
<td>Clause 19-J</td>
<td>No Part of Building to be Occupied - Action on Breach thereof</td>
<td>64</td>
</tr>
<tr>
<td>Clause 19-K</td>
<td>Employment of Skilled / Semi skilled Workers</td>
<td>64</td>
</tr>
<tr>
<td>Clause 19-L</td>
<td>Contribution of EPF and ESI</td>
<td>64-65</td>
</tr>
<tr>
<td>Clause 20</td>
<td>Minimum Wages Act to be Complied with</td>
<td>65</td>
</tr>
<tr>
<td>Clause 21</td>
<td>Work Not to be Sub-let / Action in Case of insolvency</td>
<td>65</td>
</tr>
<tr>
<td>Clause 22</td>
<td>Sums Payable by Way of Compensation</td>
<td>65</td>
</tr>
<tr>
<td>Clause 23</td>
<td>Changes in Firm's Constitution to be Intimated</td>
<td>65</td>
</tr>
<tr>
<td>Clause 24</td>
<td>Life Cycle Cost</td>
<td>65</td>
</tr>
<tr>
<td>Clause</td>
<td>Title of the Clause</td>
<td>Page</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Clause 25</td>
<td>Settlement of Disputes &amp; Arbitration</td>
<td>65-67</td>
</tr>
<tr>
<td>Clause 26</td>
<td>Contractor to Indemnify IITB against Patent Rights</td>
<td>67</td>
</tr>
<tr>
<td>Clause 27</td>
<td>Lumpsum Provisions in Tender.</td>
<td>68</td>
</tr>
<tr>
<td>Clause 28</td>
<td>Action where no Specifications are Specified</td>
<td>67-68</td>
</tr>
<tr>
<td>Clause 29</td>
<td>Withholding and lien in respect of sum due from Contractor</td>
<td>68</td>
</tr>
<tr>
<td>Clause 29A</td>
<td>Lien in respect of claims in other Contracts</td>
<td>68-69</td>
</tr>
<tr>
<td>Clause 29B</td>
<td>Employment of coal mining or controlled area labour not Permissible</td>
<td>69</td>
</tr>
<tr>
<td>Clause 30</td>
<td>Water for Works</td>
<td>69</td>
</tr>
<tr>
<td>Clause 30A</td>
<td>Alternate water Arrangements</td>
<td>69-70</td>
</tr>
<tr>
<td>Clause 31</td>
<td>Hire of Plant &amp; Machinery</td>
<td>70</td>
</tr>
<tr>
<td>Clause 32</td>
<td>Employment of Technical Staff and employees</td>
<td>70-71</td>
</tr>
<tr>
<td>Clause 33</td>
<td>Levy/Taxes payable by Contractor</td>
<td>71</td>
</tr>
<tr>
<td>Clause 34</td>
<td>Conditions for reimbursement of levy/taxes if levied after receipt of Tenders</td>
<td>71-72</td>
</tr>
<tr>
<td>Clause 35</td>
<td>Termination of Contract on death of the Contractor</td>
<td>72</td>
</tr>
<tr>
<td>Clause 36</td>
<td>If relative working in IITB then the Contractor not allowed to tender</td>
<td>72</td>
</tr>
<tr>
<td>Clause 37</td>
<td>No Gazetted Engineer to work as Contractor within one year of retirement</td>
<td>72</td>
</tr>
<tr>
<td>Clause 38</td>
<td>Theoretical consumption of Material</td>
<td>72-73</td>
</tr>
<tr>
<td>Clause 39</td>
<td>Compensation during warlike situations</td>
<td>73-74</td>
</tr>
<tr>
<td>Clause 40</td>
<td>Apprentices Act provisions to be complied with</td>
<td>74</td>
</tr>
<tr>
<td>Clause 41</td>
<td>Release of Security deposit after labour clearance</td>
<td>74</td>
</tr>
</tbody>
</table>
6. GENERAL CONDITIONS OF THE CONTRACT:

6.1 Definitions

The Contract means the documents forming the tender and acceptance thereof and the formal agreement executed between the competent authority on behalf of the Director of Indian Institute of Technology Bombay and the Contractor, together with the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-in-Charge and all these documents taken together, shall be deemed to form one Contract and shall be complementary to one another.

1. In the Contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them:

   a. The expression works or work shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the Contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.

   b. The Site shall mean the land, places on, into or where work is to be executed under the Contract or any adjacent land, path or street or where work is to be executed under the Contract or any adjacent land, path or street which may be temporarily allotted or used for the purpose of carrying out the Contract.

   c. The Contractor shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, for the successors of such firm or company and the permitted assignees of such individual, firm or company.

   d. The Institute/IITB means Indian Institute of Technology Bombay an Autonomous institute of Government of India

   e. The Director means Director of Indian Institute of Technology Bombay and his successors.

   f. The Engineer-in-charge means the Dean, Infrastructure Planning and Support (IPS) herein after called Dean (IPS) who shall supervise and be in charge of the work and who shall sign the Contract on behalf of Director IITB as mentioned in Schedule ‘F’ hereunder.

   g. The Dean Infrastructure planning and support (IPS) or his successors means the professor in charge of infrastructure construction works of IITB, appointed by Director IITB and he shall also exercise the powers and duties of Engineer in Charge

   h. The Architect/ Architectural consultant means the consulting agency appointed by Dean (IPS) for comprehensive architectural design of the building.

   i. Program Management Consultancy (PMC) means the Agency appointed by IITB to assist him in Pre and Post Award of the Contracts, project Management and day-to-day quality assurance/quality control and supervision of the construction works.

   j. Accepting Authority shall mean the authority mentioned in Schedule ‘F’ for acceptance of the Tender.

   k. Excepted Risk are risks due to riots (other than those on account of Contractor’s employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the Contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by IITB of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to IITB faulty design of works.
1. **Market Rate** shall be the rate as decided by the Engineer-in-Charge on the basis of the cost of materials and labour at the site where the work is to be executed plus the percentage mentioned in Schedule “F” to cover, all overheads and profits, provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the Contractor as per terms of the Contract.

m. **Schedule(s)** referred to in these conditions shall mean the relevant schedule(s) annexed to the tender documents or the standard Schedule of Rates of the government mentioned in Schedule “F” hereunder, with the amendments thereto issued up to the date of receipt of the tender.

n. **Institute** means IITB which invites tenders on behalf of Director of Indian Institute of Technology Bombay as specified in schedule “F”.

o. **Tendered value** means the value of the entire work as stipulated in the letter of award.

p. **Date of commencement of work**: The date of commencement of work shall be the date of start as specified in schedule “F” or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document.

q. **GST** shall mean Goods and Service Tax Central, State and Inter State

2. **Scope and Performance**

a. Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.

b. Headings and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

c. The Contractor shall be furnished, free of cost one certified copy of the Contract documents except standard specifications, Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the tender documents. None of these documents shall be used for any purpose other than that of this Contract.

3. **Works to be carried out**

The work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all labourers, materials, tools, plants, equipment and transport which may be required in preparation of and for and in the full and entire execution and completion of the works. The descriptions given in the Schedule of Quantities (Schedule-A) shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labours necessary in and for the full and entire execution and completion of the work asforesaid in accordance with good practice and recognized principles.

4. **Sufficiency of Tender**

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the rates and prices quoted in the Schedule of Quantities, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the works.

5. **Discrepancies and Adjustment of Errors**

The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.
i. In the case of discrepancy between the schedule of Quantities, the Specifications and/or the Drawings, the following order of preference shall be observed: -

a. Description of Schedule of Quantities.

b. Particular Specifications and Special Conditions, if any.

c. Drawings.

d. Specifications of Contracts / CPWD specifications

e. Indian Standard Specifications of B.I.S.

ii. If there are varying or conflicting provisions made in any one document forming part of the Contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the Contractor.

iii. Any error in description, quantity or rate in Schedule of Quantities or any omission therefrom shall not vitiate the Contract or release the Contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from any of his obligations under the Contract.

6. Signing of the Contract

The successful tenderer, on acceptance of his tender by the Accepting Authority, shall, within 15 days from the stipulated date of start of the work, sign the Contract consisting of:

i. the notice inviting tender, all the documents including drawings, if any, forming the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto.

ii. Standard Form as mentioned in Schedule ‘F’ consisting of:

a. Various standard clauses with corrections up to the date stipulated in Schedule ‘F’ along with annexures thereto.


c. Model Rules for the protection of health, sanitary arrangements for workers employed by CPWD or its contractors.

d. CPWD Contractor’s Labour Regulations.

e. List of Acts and omissions for which fines can be imposed.

Note: The above formats and documents, even though form part of the IITB Contract, they have been derived as standard formats from CPWD.

iii. No payment for the work done will be made unless the Contract is signed by the Contractor.

6.2 **CLAUSES OF THE CONTRACT:**

**Clause 1: Performance Guarantee:**

i. The Contractor shall submit an irrevocable Performance Guarantee of 5% (Five percent) of the tendered amount in addition to other deposits mentioned elsewhere in the Contract for his proper performance of the Contract Agreement, (not withstanding and/or without prejudice to any other provisions in the Contract) within period specified in Schedule ‘F’ from the date of issue of letter of acceptance. This period can be further extended by the Engineer-in-Charge up to a maximum period as specified in schedule ‘F’ on written request of the Contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This guarantee shall be in the form of Cash (in case guarantee amount is less than Rs. 10,000/-) or Deposit at Call receipt of any scheduled bank/Bank’s Cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay Order of any scheduled bank (in case guarantee amount is less than Rs. 1,00,000/-) or
Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the form annexed hereto. In case a fixed deposit receipt of any Bank is furnished by the Contractor to the IITB as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the Contractor and the Contractor shall forthwith on demand furnish additional security to the IITB to make good the deficit.

ii. The Performance Guarantee shall be initially valid up to the stipulated date of completion plus minimum 60 days beyond that, if the same is submitted by the agency on scheduled format-I as per GCC. If the same is submitted on the format-II as per GCC, then the Performance Guarantee shall be valid up to the stipulated date of completion plus minimum 6 months beyond that. In case the time for completion of work gets enlarged, the Contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the Contractor, without any interest. However, in case of contracts involving maintenance of building and services/any other work after construction of same building and services/other work, then 50% of Performance Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

iii. The Engineer-in-Charge shall make a claim under the performance guarantee except for amounts to which the Director of Indian Institute of Technology, Bombay (IITB) is entitled under the Contract (not withstanding and/or without prejudice to any other provisions in the Contract agreement) in the event of:

a. Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.

b. Failure by the Contractor to pay Director of IIT B any amount due, either as agreed by the Contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer-in-Charge.

iv. In the event of the Contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Director, IITB.

v. On substantial completion of any work which has been completed to such an extent that the intended purpose of the work is met and ready to use, then a provisional completion certificate shall be recorded by the Engineer-in-Charge. This provisional certificate shall have appended with a list of outstanding balance item of work that need to be completed in accordance with the provisions of the Contract.

This provisional completion certificate shall be recorded by the concerned Engineer-in-Charge. After recording of the provisional completion certificate for the work by the competent authority, the 80% of performance guarantee shall be returned to the Contractor, without any interest.

However, in case of contracts involving Maintenance of building and services /any other work after construction of same building and services/ other work, then 40% of performance guarantee shall be returned to the Contractor, without any interest after recording the provisional Completion certificate.

Clause 1 A: Recovery of Security Deposit

The person/persons whose tender(s) may be accepted (hereinafter called the Contractor) shall permit IITB at the time of making any payment to him for work done under the Contract to deduct a
sum at the rate of 5% of the gross amount of each running and final bill till the sum deducted will amount to 5% of the tendered value of the work. Such deductions will be made and held by IITB by way of Security Deposit unless he/they has/have deposited the amount of Security at the rate mentioned above in cash or in the form of Government Securities or fixed deposit receipts. In case a fixed deposit receipt of any Bank is furnished by the Contractor to the IITB as part of the security deposit and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the Contractor and the Contractor shall forthwith on demand furnish additional security to the IITB to make good the deficit.

All compensations or the other sums of money payable by the Contractor under the terms of this Contract may be deducted from, or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the Contractor by IITB on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid, the Contractor shall within 10 days make good in cash or fixed deposit receipt tendered by the State Bank of India or by Scheduled Banks or Government Securities (if deposited for more than 12 months) endorsed in favour of the Engineer-in-Charge, any sum or sums which may have been deducted from, or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills and the final bill of the Contractor at the rates mentioned above.

The security deposit as deducted above can be released against bank guarantee issued by a scheduled bank, on its accumulations to a minimum of Rs. 5 lac subject to the condition that amount of such bank guarantee, except last one, shall not be less than Rs. 5 lac. Provided further that the validity of bank guarantee including the one given against the earnest money shall be in conformity with provisions contained in clause 17 which shall be extended from time to time depending upon extension of Contract granted under provisions of clause 2 and clause 5.

In case of contracts involving maintenance of building and services/any other work after construction of same building and services/other work, then 50% of Performance Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

**Note-1:** Government papers tendered as security will be taken at 5% (five per cent) below its market price or at its face value, whichever is less. The market price of Government paper would be ascertained by the Engineer-In-Charge at the time of collection of interest and the amount of interest to the extent of deficiency in value of the Government paper will be withheld if necessary.

**Note-2:** Government Securities will include all forms of Securities mentioned in Rule No. 274 of the G.F. Rules except fidelity bond. This will be subject to the observance of the condition mentioned under the rule against each form of security.

**Note-3:** Note 1 & 2 above shall be applicable for both clause 1 and 1A

**Clause 2: Compensation for Delay**

If the Contractor fails to maintain the required progress in terms of clause 5 or to complete the work and clear the site on or before the Contract or justified extended date of completion as per clause 5 (excluding any extension under Clause 5.5) as well as any extension granted under clauses 12 and 15, he shall, without prejudice to any other right or remedy available under the law to the IITB on account of such breach, pay as compensation the amount calculated at the rates stipulated below as the authority specified in schedule ‘F’ may decide on the amount of accepted tendered Value of the work for every completed day/month (as determined) that the progress remains below that specified in Clause 5 or that the work remains incomplete.

a. Compensation for delay of work: with maximum rate @ 1% (one percent) per month of delay to be computed on per day basis based on quantum of damage suffered due to stated delay on the part of Contractor.

Provided always that the total amount of compensation for delay to be paid under this condition
shall not exceed 10% (ten percent) of the accepted Tendered Value of work or of the accepted Tendered Value of the Sectional part of work as mentioned in Schedule ‘F’ for which a separate period of completion is originally given.

In case no compensation has been decided by the authority in Schedule ‘F’ during the progress of work, this shall be no waiver of right to levy compensation by the said authority if the work remains incomplete on final justified extended date of completion. If the Engineer in Charge decides to give further extension of time allowing performance of work beyond the justified extended date, the Contractor shall be liable to pay compensation for such extended period. If any variation in amount of Contract takes place during such extended period beyond justified extended date and the Contractor becomes entitled to additional time under clause 12, the net period for such variation shall be accounted for while deciding the period for levy of compensation. However, during such further extended period beyond the justified extended period, if any delay occurs by events under sub clause 5.2, the Contractor shall be liable to pay compensation for such delay.

Provided that compensation during the progress of work before the justified extended date of completion for delay under this clause shall be for non-achievement of sectional completion or part handing over of work on stipulated/justified extended date for such part work or if delay affects any other works/services. This is without prejudice to right of action by the Engineer-in-Charge under clause 3 for delay in performance and claim of compensation under that clause.

In case action under clause 2 has not been finalized and the work has been determined under clause 3, the right of action under this clause shall remain post determination of Contract but levy of compensation shall be for days the progress is behind the schedule on date of determination, as assessed by the authority in Schedule F, after due consideration of justified extension. The compensation for delay, if not decided before the determination of Contract, shall be decided after of determination of Contract.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other Contract with the IITB. In case, the Contractor does not achieve a particular milestone mentioned in Schedule F (Clause 5), or the re-scheduled milestone(s) in terms of Clause 5.4, the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied as above. With-holding of this amount on failure to achieve a milestone, shall be automatic without any notice to the Contractor. However, if the Contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the Contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. However, no interest, whatsoever, shall be payable on such withheld amount.

Clause 3: When Contract can be Determined:

Subject to other provisions contained in this clause, the Engineer-in-Charge may, without prejudice to any other rights or remedy against the Contractor in respect of any delay, not following safety norms, inferior workmanship, any claims for damages and/or any other provisions of this Contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the Contract in any of the following cases:

i. If the Contractor having been given by the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or un-workman like manner shall omit to comply with the requirement of such notice for a period of seven days thereafter.

ii. If the Contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.

iii. If the Contractor fails to complete the work or section of work with individual date of
completion on or before the stipulated or justified extended date, and the Engineer-in-Charge without any prejudice to any other right or remedy under any other provision in the Contract has given further reasonable time in a notice given in writing in that behalf as either mutually agreed or in absence of such mutual agreement by his own assessment making such time essence of Contract and in the opinion of Engineer-in-Charge the Contractor will be unable to complete the same or does not complete the same within the period specified.

iv. If the Contractor persistently neglects to carry out his obligations under the Contract and/ or commits default in complying with any of the terms and conditions of the Contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge.

v. If the Contractor shall offer or give or agree to give to any person in IITB service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other Contract for IITB.

vi. If the Contractor shall enter into a Contract with IITB in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge.

vii. If the Contractor had secured the Contract with IITB as a result of wrong tendering or other non-bona fide methods of competitive tendering or commits breach of Integrity Agreement.

viii. If the Contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.

ix. If the Contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to appoint a receiver or a manager or which entitle the court to make a winding up order.

x. If the Contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.

xi. If the Contractor assigns (excluding part(s) of work assigned to other agency(s) by the Contractor as per terms of Contract), transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer-in-Charge. When the Contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of Dean IPS shall have powers:

a. To determine the Contract as aforesaid so far as performance of work by the Contractor is concerned (of which determination notice in writing to the Contractor under the hand of the Engineer-in-Charge shall be conclusive evidence). Upon such determination, Security Deposit already recovered, Security deposit payable and Performance
Guarantee under the Contract shall be liable to be forfeited and shall be absolutely at the disposal of the IITB.

b. After giving notice to the Contractor to measure up the work of the Contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another Contractor to complete the work. The Contractor, whose Contract is determined as above, shall not be allowed to participate in the tendering process for the balance work including any new items needed to complete the work. In the event of above courses being adopted by the Engineer-in-Charge, the Contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the Contract. And in case action is taken under any of the provision aforesaid, the Contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this Contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

Clause 3 A

In case, the work cannot be started due to reasons not within the control of the Contractor within 1/8th of the stipulated time for completion of work or one month whichever is higher, either party may close the Contract by giving notice to the other party stating the reasons. In such eventuality, the Performance Guarantee of the Contractor shall be refunded within following time limits:

If the Tendered value of work is up to Rs. 1 Crore: 15 days.

If the Tendered value of work is more than Rs. 1 Crore and up to 21 days Rs.10 Crore: 21 days

If the Tendered value of work exceeds Rs. 10 Crore: 30 days

Neither party shall claim any compensation for such eventuality. This clause is not applicable for any breach of the Contract by either party.

Clause 4:

Contractor liable to pay compensation even if action not taken under Clause 3

In any case in which any of the powers conferred upon the Engineer-in-Charge by Clause 3 thereof, have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the Contractor and the liability of the Contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the Contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the Contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or any tools, plant, materials and stores, in or upon the works, or the site thereof belonging to the Contractor, or procured by the Contractor and intended to be used for the execution of the work/or any part thereof, paying or allowing for the same in account at the Contract rates, or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose certificate thereof shall be final, and binding on the Contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) in the event of the Contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the Contractor’s expense or sell them by auction or private sale on account of the Contractor and his risk in all respects and the certificate of the Engineer-in-Charge as to the expenses of any such removal and
the amount of the proceeds and expenses of any such sale shall be final and conclusive against the Contractor.

**Clause 5: Time and Extension for Delay**

The time allowed for execution of the Works as specified in the Schedule 'F' or the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the work shall commence from such time period as mentioned in schedule 'F' or from the date of handing over of the site, notified by the Engineer-in-Charge, whichever is later. If the Contractor commits default in commencing the execution of the work as aforesaid, the performance guarantee shall be forfeited by the Engineer in Charge and shall be absolutely at the disposal of the IITB without prejudice to any other right or remedy available in law.

5.1 As soon as possible but within 7 (seven) working days of award of work and in consideration of:

a. Schedule of handing over of site as specified in the Schedule 'F'.

b. Schedule of issue of designs as specified in the Schedule 'F'.

(i) The Contractor shall submit a Time and Progress Chart for each milestone. The Engineer-in-Charge may within 7 (seven) working days thereof, if required modify, and communicate the program approved to the Contractor failing which the program submitted by the Contractor shall be deemed to be approved by the Engineer-in-Charge. The work programme shall include all details of balance drawings and decisions required to complete the Contract with specific dates by which these details are required by Contractor without causing any delay in execution of the work. The Chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents.

(ii) In case of non-submission of construction programme by the Contractor, the program approved by the Engineer-in-Charge shall be deemed to be final.

(iii) The approval by the Engineer-in-Charge of such programme shall not relieve the Contractor of any of the obligations under the Contract.

(iv) The Contractor shall submit the Time and Progress Chart and progress report using the mutually agreed software or in other format decided by Engineer-in-Charge for the work done during previous month to the Engineer-in-charge on or before 5th day of each month failing which a recovery as per Schedule F (Clause 5) to be decided by the NIT approving authority shall be made on per week or part basis in case of delay in submission of the monthly progress report.

5.2 If the work(s) be delayed by:-

(i) force majeure, or

(ii) abnormally bad weather, or

(iii) serious loss or damage by fire, or

(iv) civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or

(v) delay on the part of other contractors or tradesmen engaged by Engineer-in-Charge in executing work not forming part of the Contract, or
(vi) Any other cause like above which, in the reasoned opinion of the Engineer-in-Charge is beyond the Contractor's control.

then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer-in-Charge but shall nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Charge to proceed with the works.

The Contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s for events listed in sub clause 5.2.

5.3 In case the work is hindered by the Institute or for any reason / event, for which the Institute is responsible, the authority as indicated in Schedule 'F' shall, if justified, give a fair and reasonable extension of time and reschedule the mile stones for completion of work, such extension of time or rescheduling of milestone/s shall be without prejudice to any other right or remedy of the parties in Contract or in law; provided further that for concurrent delays under this sub clause and sub clause 5.2 to the extent the delay is covered under sub clause 5.2 the Contractor shall be entitled to only extension of time and no damages.

5.4 Request for rescheduling of Mile stones or extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay on the prescribed forms i.e. Form of application by the Contractor for seeking rescheduling of milestones or Form of application by the Contractor for seeking extension of time (Appendix -XVI) respectively to the authority as indicated in Schedule 'F'. The Contractor shall indicate in such a request the period by which rescheduling of milestone/s or extension of time is desired. With every request for rescheduling of milestones, or if at any time the actual progress of work falls behind the approved programme by more than 10% of the stipulated period of completion of the Contract, the Contractor shall produce a revised programme which shall include all details of pending drawings and decisions required to complete the Contract and also the target dates by which these details should be available without causing any delay in execution of the work. A recovery as specified in Schedule 'F' shall be made on per day basis in case of delay in submission of the revised programme.

5.4.1 In any such case the authority as indicated in Schedule 'F' may give a fair and reasonable extension of time for completion of work or reschedule the mile stones. Engineer -in- Charge shall finalize/ reschedule a particular mile stone before taking an action against subsequent mile stone. Such extension or rescheduling of the milestones shall be communicated to the Contractor by the authority as indicated in Schedule 'F' in writing, within 21 days of the date of receipt of such request from the Contractor in prescribed form. In event of non-application by the Contractor for extension of time E-in-C after affording opportunity to the Contractor, may give, supported with a programme (as specified under 5.4 above), a fair and reasonable extension within a reasonable period of occurrence of the event.

5.5 In case the work is delayed by any reasons, in the opinion of the Engineer-in-Charge, by the Contractor for reasons beyond the events mentioned in clause 5.2 or clause 5.3 or clause 5.4 and beyond the justified extended date; without prejudice to right to take action under Clause 3, the Engineer-in-Charge may grant extension of time required for completion of work without rescheduling of milestones. The Contractor shall be liable for levy of compensation for delay for such extension of time.

Clause 6: Computerized Measurement Book

6.1 Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the Contract.
6.2 All measurements of all items having financial value shall be entered by the Contractor and compiled in the shape of the Computerized Measurement Book having pages of A-4 size as per the format of the IITB so that a complete record is obtained of all the items of works performed under the Contract.

6.3 All such measurements and levels recorded by the Contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the Contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections made by the Engineer-in-Charge, the measurement sheets shall be returned to the Contractor for incorporating the corrections and for resubmission to the Engineer-in-Charge for the dated signatures by the Engineer-in-Charge and the Contractor or their representatives in token of their acceptance.

6.4 Whenever bill is due for payment, the Contractor would initially submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The Contractor will, thereafter, incorporate such changes as may be done during these checks/test checks in his draft computerized measurements, and submit to the department a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in-Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

6.5 The final, fair, computerized measurement book given by the Contractor, duly bound, with its pages machine numbered, should be 100% correct, and no cutting or overwriting in the measurements would thereafter be allowed. If at all any error is noticed, the Contractor shall have to submit a fresh computerized MB with its pages duly machine numbered and bound, after getting the earlier MB cancelled by the Institute. Thereafter, the MB shall be taken in the Dean IPS Office records, and allotted a number as per the Register of Computerized MBs. This should be done before the corresponding bill is submitted to the Dean IPS Office for payment. The Contractor shall submit two spare copies of such computerized ‘B’s for the purpose of reference and record by the various officers of the department.

6.6 The Contractor shall also submit to the department separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the bill. Thereafter, this bill will be processed by the Dean IPS Office and allotted a number as per the computerized record in the same way as done for the measurement book meant for measurements.

6.7 The Contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements/levels by the Engineer-in-Charge or his representative.

6.8 Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

6.9 The Contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or otherwise
placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

6.10 Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded by Contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

6.11 It is also a term of this Contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the Contractor from liabilities from any over measurement or defects noticed till completion of the defect's liability period.

**Clause 7: Payment on intermediate certificate to be regarded as Advances**

7.1 No payment shall be made for work, estimated to cost Rs. Twenty lakhs or less till after the whole of the work shall have been completed and certificate of completion given. For works estimated to cost over Rs. Twenty lakhs the interim or running account bills shall be submitted by the Contractor for the work executed on the basis of such recorded measurements on the format of the Department in triplicate on or before the date of every month fixed for the same by the Engineer-in-Charge. The Contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment/adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Schedule 'F', in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified by taking or causing to be taken, where necessary, the requisite measurements of the work. In the event of the failure of the Contractor to submit the bills, no claims whatsoever due to delays on payment including that of interest shall be payable to the Contractor. Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the Contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge. An amount of ad-hoc payment not less than 75% of the net amount of the bill under check, shall be made within 10 working days of submission of the bill by the Contractor to the Engineer-in-Charge together with the account of the material issued by IITB, or dismantled materials, if any. The remaining payment is also to be made after final checking of the bill within 28 working days of submission of bill by the Contractor.

7.2 All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-Charge relating to the work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the Contract and
specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-in-Charge under the Contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the Contract.

7.3 Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the department to take action under the terms of this Contract for delay in the completion of work, if the extension of date of completion is not granted by the competent authority.

Payments in composite Contracts

In case of composite tenders, running payment for the major and minor components shall be made by Dean IPS to the Contractor.

In case main Contractor fails to make the payment to contractor associated by him within 15 days of receipt of each running account payment, then on the written complaint of contractor associated for such minor component, Dean (IPS) shall serve the show cause to the Contractor and if reply of the Contractor either not received or found unsatisfactory, he may make the payment directly to contractor associated for minor component as per the terms and conditions of the agreement drawn between the Contractor and associate contractor fixed by him. Such payment made to the associate contractor shall be recovered by Engineer-in-charge from the next Running Account Bill / final bill due to the Contractor as the case may be.

Clause 7A:

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the Contractor to the Engineer-in-Charge.

Clause 7B: Payment to third party

If the exigencies of the work so demand, the Engineer-in-Charge may allow payment to a third party, who is creditor to the contractor, after fulfilling the following conditions:

(a) The Contractor gives an authority letter addressed to the Engineer-in-Charge on a non-judicial stamp paper of Rs.100 in the format given below:

I / We authorize the Dean (IPS) to pay directly on my / our behalf to (name of the third party) an amount of Rs........................(Rupees in words) for the work done or supplies made by ......................... (name of the third party). I / We shall be responsible for the quality and quantity of the same under the provisions of agreement number ............

Signature of the Contractor

(b) The total payment to third party (or parties) shall not exceed 10% of the agreement cost of the work.

Clause 8: Completion Certificate and Completion Plans:

Within ten days of the completion of the work, the Contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice, the Engineer-in-Charge shall inspect the work and if there is no defect in the work, shall furnish the Contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the Contractor and/or (b) for which payment will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the Contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the
works as shall have been erected or constructed by the Contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the Contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the Contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the Contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

**Clause 8 A: Completion Plans to be Submitted by the Contractor:**

The Contractor shall submit completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work, provided that the service plans having been issued for execution by the Engineer-in-Charge, unless the Contractor, by virtue of any other provision in the Contract, is required to prepare such plans.

In case, the Contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum of 0.1 % (zero-point one percent) of accepted Tendered Value or limit prescribed in Schedule F whichever is more as may be fixed by the authority as mentioned in Schedule F and in this respect the decision of the that authority shall be final and binding on the Contractor.

**Clause 9: Payment of Final Bill**

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier. No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payment of those items of the bill in respect of which there is no dispute, and for those items which are in dispute on account of quantity and/or rates shall be paid at approved quantity and/or rates by the Engineer-in-Charge, within three months period reckoned from the date of receipt of the bill by the Engineer-in-Charge or his authorized Assistant Engineer, complete with account of materials issued by the Department and dismantled materials.

**Clause 9A: Payment of Contractor’s Bills to Banks**

Payments due to the Contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the Contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank; registered financial, co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by IITB or his signature on the bill or other claim preferred against IITB before settlement by the Engineer-in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions. While the receipt given by such banks; registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the Contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank; registered financial, co-operative or thrift societies or recognized financial institutions any rights or equities vis-a-vis the Director, IITB.

**Clause 10A: Materials to be provided by the Contractor.**
The Contractor shall, at his own expense, provide all materials, required for the works other than those which are stipulated to be supplied by the IITB as per Appendix F.

The Contractor shall, at his own expense and without delay; supply to the Engineer-in-Charge samples of materials to be used on the work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the Contract. The Contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Engineer-in-Charge shall within thirty days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer-in-Charge for his approval, fresh samples complying with the specifications laid down in the Contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shall be issued after the test results are received.

The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in-Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The Contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in-Charge and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the Contract or specifications. The Engineer-in-Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the Contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the Contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

The Contractor shall at his own expense, provide a material testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified in schedule F.

Clause 10 B: Secured Advance on Materials

(i) The Contractor, on signing an indenture in the form to be specified by the Engineer-in-Charge, shall be entitled to be paid during the progress of the execution of the work up to 75% of the assessed value of any materials or an amount not exceeding 75% of the material element cost in the tendered rate of the finished item of the work, whichever is lower, which are in the opinion of the Engineer-in-Charge non-perishable, non-fragile and non-fragile and are in accordance with the Contract and which have been brought on the site in connection therewith and are adequately stored and/or protected against damage by weather or other causes but which have not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be
recovered/deducted from the next payment made under any of the clause or clauses of this Contract.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the Contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-Charge shall be final and binding on the Contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel etc.

**Mobilization advance**

(ii) Mobilization advance not exceeding 10% of the tendered value may be given, if requested by the Contractor in writing within six months of the order to commence the work. Such advance shall be released in two or more instalments to be determined by the Engineer-in-Charge at his sole discretion. The first instalment of such advance shall be released by the Engineer-in-charge to the Contractor on a request made by the Contractor to the Engineer-in-Charge in this behalf. The second and subsequent instalments shall be released by the Engineer-in-Charge only after the Contractor furnishes a proof of the satisfactory utilization of the earlier instalment to the entire satisfaction of the Engineer-in-Charge.

Before any instalment of advance is released, the Contractor shall execute a Bank Guarantee Bonds not more than 6 in number from commercial Bank for the amount equal to 110% of the amount of advance and valid for the period till recovery of advance. This (Bank Guarantee from commercial Bank on prescribed format for the amount equal to 110% of the balance amount of advance) shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery.

**Interest & Recovery**

(iii) The mobilization advances in (ii) above bear simple interest at the rate of 8 percent per annum and shall be calculated from the date of payment to the date of recovery, both days inclusive, on the outstanding amount of advance. Recovery of such sums advanced shall be made by the deduction from the contractors bills commencing after first ten percent of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time eighty percent of the gross value of the Contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the instalment.

(iv) If the circumstances are considered reasonable by the Engineer-in-Charge, the period mentioned in (ii) and (iii) for request by the Contractor in writing for grant of mobilization advance may be extended at the discretion of the Engineer-in-Charge.

**Clause 10 C**

**Payment on Account of Increase in Prices/ Wages due to Statutory Order(s)**

If after submission of tender, if the price of any material incorporated in the work (excluding the material covered under clause 10 CA and/or wages of labour increases as a direct result of the coming into force of any fresh law or statutory rule or order (but not due to any variation of rate in GST applicable on such material(s) being considered under this clause) beyond the prices/wages prevailing at the time of the last stipulated date of receipt of tenders including extensions, if any, for the work during Contract period including the justified period extended under the provisions of clause 5 of the Contract without any action under clause 2, then the amount of the Contract shall accordingly be varied.

If after submission of the tender, the price of any material incorporated in the works (excluding the materials covered under Clause 10CA and/or wages of labour as prevailing at the time of last stipulated date of receipt of tender including extensions, if any, is decreased as a direct result of the coming into force of any fresh law or statutory rules or order (but not due to any variation of rate in GST applicable on such material(s) being considered under this clause), IITB shall in respect of materials incorporated in the works (excluding the materials covered under Clause
10CA and/or labour engaged on the execution of the work after the date of coming into force of such law, statutory rule or order be entitled to deduct from the dues of the Contractor, such amount as shall be equivalent to the difference between the prices of the materials and/or wages as prevailed at the time of the last stipulated date for receipt of tenders including extensions if any for the work and the prices of materials and/or wages of labour on the coming into force of such law, statutory rule or order. This will be applicable for the Contract period including the justified period extended under the provisions of clause 5 of the Contract without any action under clause 2.

Engineer-in-Charge shall call books of account and other relevant documents from the Contractor to satisfy himself about reasonability of increase in prices of materials and wages.

The Contractor shall, within a reasonable time of his becoming aware of any alteration in the price of any such materials and/or wages of labour, give notice thereof to the Engineer-in-Charge stating that the same is given pursuant to this condition together with all information relating thereto which he may be in position to supply.

For this purpose, the labour component of 85% of the value of the work executed during period under consideration shall not exceed the percentage as specified in Schedule F, and the increase/decrease in labour shall be considered on the minimum daily wages in rupees of any unskilled Mazdoor, fixed under any law statutory role and order. The cost of work for which escalation is applicable (W) is same as cost of work done worked out as indicated in sub-para (ii) of clause 10 CC except the amount of full assessed value of secured Advance.

Provided always that:

(a) Where provisions of clause 10CC are applicable, provisions of clause 10C will not be applicable.

(b) Where provisions of clause 10CC are not applicable, provisions of clause 10C will become applicable.

Clause 10CC

Price adjustment for Works

If the prices of materials and/or wages of labour required for execution of the work increase, the Contractor shall be compensated for such increase as per provisions detailed below and the amount of the Contract shall accordingly be varied, subject to the condition that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the Contract including the justified period extended under the provisions of clause 5 of the Contract without any action under clause 2. Such compensation for escalation in the prices of materials and labour, when due, shall be worked out based on the following provisions:

(i) The base date for working out such escalation shall be the last stipulated date of receipt of tenders including extension, if any.

(ii) The cost of work on which escalation will be payable shall be reckoned as below:

(a) Gross value of work done up to this quarter: (A)
(b) Gross value of work done up to the last quarter: (B)
(c) Gross value of work done since previous quarter (C) = (A - B):
(d) Full assessed value of Secured Advance fresh paid in this quarter: (D)
(e) Full assessed value of Secured Advance recovered in this quarter: (E)
(f) Full assessed value of Secured Advance for which escalation Payable in this
quarter \( F = (D - E) \)

(g) Advance payment made during this quarter: \( G \).

(h) Advance payment recovered during this quarter: \( H \).

(i) Advance payment for which escalation is payable in this Quarter \( (J) = (G - H) \)

(j) Amount paid based on prevailing market rates due to deviations / variations as per Clause 12 during this quarter: \( J \)

Then, \( M = C + F + I - J \)

Cost of work for which escalation is applicable: \( W = 0.85 M \)

Components for material, labour, etc., shall be pre-determined for every work and incorporated in the Conditions of the Contract attached to the tender documents included in Schedule F. The decision of the Engineer-in-Charge in working out such percentage shall be binding on the Contractors.

(iii) The following principles shall be followed while working out the payment / recovery on account of variation of prices of materials and /or wages of labour.

a) The compensation for escalation shall be worked out at quarterly intervals, and shall be with respect to the cost of work done as per bills paid during three calendar months of the said quarter. The date of submission of bill by the contractor to the IITB shall be guiding factor to decide the bills relevant to the quarterly interval. The first such payment shall be made at the end of three months after the month (excluding the month in which the letter of commencement for the work is issued by the Engineer-in-Charge) and thereafter at three months interval. At the time completion of the work, the last period for payment might become less than 3 months, depending on the actual date of completion.

b) The indices as defined below (excluding LI) relevant to any quarter / period for which compensation is to be paid shall be the arithmetical average of the indices relevant to the three calendar months. If the period up to the date of completion after the quarter covered by the last such instalment of payment, is less than three months, the indices shall be the average of the indices for the months falling within that period.

c) The minimum wage of an unskilled Mazdoor shall be the higher of the wage notified by Government of India, Ministry of Labour and that notified by the local administration both relevant to the place of work and the period of reckoning.

d) The escalation for labour also shall be paid at the same quarterly intervals when escalation due to increase in cost of materials is paid under this clause. If such revision of minimum wages takes place during any such quarterly intervals, the escalation compensation shall be payable at revised rates only for work done in subsequent quarters.

e) Irrespective of variations in minimum wages of any category of labour, for the purpose of this clause, the variation in the rate for an unskilled Mazdoor alone shall form the basis for working out the escalation compensation payable on the labour component.

(iv) In the event the price of materials and/or wages of labour required for execution of the work decreases, there shall be a downward adjustment of the cost of work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this Contract and in this regard the formula herein stated below under this Clause 10CC shall mutatis mutandis apply.

(v) The Contract price shall be adjusted for increase or decrease in rates and prices of labour, cement, steel reinforcement bar, fuel and lubricants and other input materials as per percentage of materials/labour specified in Schedule F and in accordance with the principles, procedures and formulae specified below:
(a) Price adjustment for change in cost shall be paid in accordance with the following formulae:

(i) For Construction period of this work:

\[ V_w = W \times \left( \frac{1}{100} \right) \times \left[ \frac{C_p \times (C_I - C_O)}{C_O} + \frac{L_P \times (L_I - L_O)}{L_O} + \frac{C_M \times (C_M_I - C_M_O)}{C_M_O} + \frac{E_M \times (E_M_I - E_M_O)}{E_M_O} + \frac{F_P \times (F_I - F_O)}{F_O} + \frac{S_P \times (S_I - S_O)}{S_O} + \frac{B_P \times (B_I - B_O)}{B_O} \right] \]

(ii) For Maintenance period of this work:

\[ V_w = \frac{L_P \times (L_I - L_O)}{L_O} + \frac{C_M \times (C_M_I - C_M_O)}{C_M_O} + \frac{E_M \times (E_M_I - E_M_O)}{E_M_O} + \frac{B_P \times (B_I - B_O)}{B_O} \]

Where, \( W \) = cost of work done as per para (ii) above.

\( V_w \) (variation of cost of work) = Increase or decrease in the cost of works during the period under consideration due to change in the rates for relevant components.

Percentage components of materials \& labour as specified in the schedule F are defined as under:

- **CP**: Cement Component,
- **LP**: Labour component,
- **CMP**: Civil component of other construction materials,
- **EMP**: E \& M component of construction materials,
- **FP**: POL (Diesel) component
- **SP**: Reinforcement steel bars / TMT bars / structural steel (including strands and cables) component
- **BP**: Bitumen component

Indices for various components of materials \& labour to be used for the purpose of this Clause are defined as under:

- **CO**: Wholesale Price Index for Pozzolana Cement published by office of the Economic Adviser, Ministry of Industry \& Commerce valid for the month of last date of receipt of tender including extension, if any.
- **CI**: Wholesale Price Index for Pozzolana Cement published by office of the Economic Adviser, Ministry of Industry \& Commerce valid for the period under consideration.
- **LO**: Minimum daily wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as on the last date of receipt of tender including extension, if any.
- **LI**: Minimum wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration.
- **CMO**: Price Index for civil components of other construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Civil) or successor of CPWD. In case of such issuance stopped / discontinued by CPWD, same shall get replaced for the subsequent quarters with the indices for Wholesale Price Index for All Commodities published by office of the Economic Adviser, Ministry of Industry \& Commerce valid for the month of the last date of receipt of tender including extension, if any.
- **CMI**: Price Index for civil components of other construction materials for the period under consideration and as issued by the office of CE CSQ (Civil) or successor of CPWD. In case of such issuance stopped / discontinued by CPWD, same shall get replaced for the subsequent quarters.
quarters with the indices for Wholesale Price Index for All Commodities published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the period under consideration.

EMO = Price Index for E & M components construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Electrical) or successor of CPWD. In case of such issuance stopped / discontinued by CPWD, same shall get replaced for the subsequent quarters with the indices for Wholesale Price Index for All Commodities published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt including extension, if any.

EMI = Price Index for E & M components construction materials for the period under consideration and as issued by the office of CE CSQ (Electrical) or successor of CPWD. In case of such issuance stopped / discontinued by CPWD, same shall get replaced for the subsequent quarters with the indices for Wholesale Price Index for All Commodities published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the period under consideration.

FO = Wholesale Price Index of HSD (High Speed Diesel) published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any.

FI = Wholesale Price Index of HSD (High Speed Diesel) published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

SO = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any.

SI = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

BO = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any.

BI = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

(vi) Provided always that:

(a) Where provisions of Clause 10CC are applicable, provisions of Clause 10C will not be applicable.

(b) Where provisions of Clause 10CC are not applicable, provisions of Clause 10C will become applicable.

Clause 10 D: Dismantled Material IITB Property:

The Contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as IITB’s property and such materials shall be disposed of to the best advantage of IITB according to the instructions in writing issued by the Engineer-in-Charge.

Clause 11: Work to be Executed in Accordance with Specifications, Drawings, Orders etc.

The Contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The Contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work signed by the Engineer-in-Charge and the Contractor shall be furnished free of charge one copy of the Contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications of Central Public Works Department specified in Schedule ‘F’ or in any
Bureau of Indian Standard or any other, published standard or code or, Schedule of Rates or any other printed publication referred to elsewhere in the Contract.

The Contractor shall comply with the provisions of the Contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the Contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

**Clause 12: Deviations/ Variations Extent and Pricing**

The Engineer-in-Charge shall have power (i) to make alteration in, omissions from, additions to, or substitutions for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and (ii) to omit a part of the works in case of non-availability of a portion of the site or for any other reasons and the Contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall form part of the Contract as if originally provided therein and any altered, additional or substituted work which the Contractor may be directed to do in the manner specified above as part of the works, shall be carried out by the Contractor on the same conditions in all respects including price on which he agreed to do the main work except as hereafter provided.

12.1 The time for completion of the works shall, in the event of any deviations resulting in additional cost over the tendered value sum being ordered be extended, if requested by the Contractor, as follows:

(i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original tendered value plus.

(ii) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

12.2 **Deviation, Extra Items and Pricing**

In the case of extra item(s) (items which are not available in the Contract), the Contractor may within fifteen days of the receipt of order or occurrence of the item(s), submit claim for market rate(s), supported with proper analysis of rate and manufacturer's specification for the work, invoices, vouchers, etc. (as applicable), failing which the rate(s) approved later by the Engineer-in-Charge shall be final and binding. Where the Contractor submits claim for market rate(s) in the manner prescribed above, the Engineer-in-Charge shall, within 45 days of the receipt of the claims, after giving consideration to the analysis of rates and other documents submitted by the Contractor, determine the rates on the basis of the market rates and the Contractor shall be paid in accordance with the rates so determined.

The rates(s) of extra items so determined by the Engineer-In-Charge shall be final and binding on the Contractor, and shall not be arbitrable.

**Deviation, deviated Quantities, Pricing**

In the case of Contract items which exceed the limit laid down in Schedule F, the Contractor may within fifteen days of the receipt of order or occurrence of the excess, claim revision of the rates, supported with proper analysis of rate and invoices, vouchers, etc. (as applicable), for the quantity in excess of the above-mentioned limit. The Engineer-in-charge shall within 45 days of receipt of the claims, after giving consideration to the analysis of rates and other documents submitted by the Contractor, determine the rates on the basis of the market rates and the Contractor shall be paid in accordance with the rates so determined.
The rates(s) of extra items so determined by the Engineer-In-Charge shall be final and binding on the Contractor, and shall not be arbitrable.

12.3 In the case of the Contract items which exceed the limit laid down in Schedule F, the Engineer-in-Charge shall after giving notice to the contractor within 30 days of submission of that bill by the Contractor which contains such item(s), and after taking into consideration any reply received from the Contractor within 15 days of the issue of such notice, reduce the rate for quantity in excess of the above mentioned limit on the basis of market rates, within 30 days of the expiry of the said period of 15 days, and the Contractor shall be paid in accordance with the rates so determined.

The rate(s) so determined by the Engineer-in-Charge shall be final and binding on the contractor, and shall not be arbitrable.

12.4 Deleted

12.5 The cost of any operation necessarily in contemplation of tendered while quoting tender or necessary or incidental to proper execution of an item of work included in the Schedule of Quantities or in the Schedule of Rates mentioned in Schedule F, whether or not specifically indicated in the description of the item and the relevant specifications, shall be deemed to be included in the rates quoted by the tenderer or the rate given in the said Schedule of Rates, as the case may be. Nothing extra shall be admissible for such operations.

Clause 13: Foreclosure of Contract due to Abandonment or Reduction in Scope of Work

If at any time after acceptance of the tender or during the progress of work, the purpose or object for which the work is being done changes due to any supervening cause and as a result of which the work has to be abandoned or reduced in scope the Engineer-in-Charge shall give notice in writing to that effect to the Contractor stating the decision as well as the cause for such decision and the Contractor shall act accordingly in the matter. The Contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the foreclosure of the whole or part of the works.

The Contractor shall be paid at Contract rates, full amount for works executed at site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the work to the full extent in view of the foreclosure;

(i) Any expenditure incurred on preliminary site work, e.g., temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.

(ii) IITB shall have the option to take over the Contractor’s materials or any part thereof either brought to site or of which the Contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work) provided, however IITB shall be bound to take over the materials or such portions thereof as the Contractor does not desire to retain. For materials taken over or to be taken over by IITB, cost of such materials as detailed by Engineer-in-Charge shall be paid. The cost shall, however, take into account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the Contractor.

(iii) Reasonable compensation for transfer of T & P from site to Contractor’s permanent stores or to his other works, whichever is less. If T & P are not transported to either of the said places, no cost of transportation shall be payable.

(iv) Reasonable compensation for repatriation of Contractor’s site staff and imported labour to the extent necessary.
The Contractor shall, if required by the Engineer-in-Charge, furnish to him, books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i), (iii) and (iv) above shall not be in excess of 2% of the cost of the work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted tender less the cost of work actually executed under the Contract and less the cost of Contractor’s materials at site taken over by the IITB as per item (ii) above. Provided always that against any payments due to the Contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due’ from the Contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the IITB from the Contractor under the terms of the Contract.

In the event of action being taken under Clause 13 to reduce the scope of work, the Contractor may furnish fresh Performance Guarantee on the same conditions, in the same manner and at the same rate for the balance tendered amount and initially valid up to the extended date of completion or stipulated date of completion if no extension has been granted plus minimum 60 days beyond that. Wherever such a fresh Performance Guarantee is furnished by the Contractor the Engineer-in-Charge may return the previous Performance Guarantee.

**Clause 14: Carrying out part work at risk & cost of Contractor**

If the Contractor:

(i) At any time makes default during currency of work or does not execute any part of the work with due diligence and continues to do so even after a notice in writing of 7 working days in this respect from the Engineer-in-Charge; or

(ii) Commits default in complying with any of the terms and conditions of the Contract and does not remedy it or takes effective steps to remedy it within 7 working days even after a notice in writing is given in that behalf by the Engineer-in-Charge; or

Fails to complete the work(s) or items of work with individual dates of completion, on or before the date(s) so determined, and does not complete them within the period specified in the notice given in writing in that behalf by the Engineer-in-Charge.

(iii) The Engineer-in-Charge without invoking action under clause 3 may, without prejudice to any other right or remedy against the Contractor which have either accrued or accrue thereafter to IITB, by a notice in writing to take the part work / part incomplete work of any item(s) out of his hands and shall have powers to:

   a. Take possession of the site and any materials, constructional plant, implements, stores, etc., thereon; and/or

   b. Carry out the part work / part incomplete work of any item(s) by any means at the risk and cost of the Contractor.

The Engineer-in-Charge shall determine the amount, if any, is recoverable from the Contractor for completion of the part work/ part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the Contractor, the liability of Contractor on account of loss or damage suffered by IITB because of action under this clause shall not exceed 10% of the tendered value of the work.

In determining the amount, credit shall be given to the Contractor with the value of work done in all respect in the same manner and at the same rate as if it had been carried out by the original Contractor under the terms of his Contract, the value of Contractor’s materials taken over and incorporated in the work and use of plant and machinery belonging to the Contractor.
The certificate of the Engineer-in-Charge as to the value of work done shall be final and conclusive against the Contractor provided always that action under this clause shall only be taken after giving notice in writing to the Contractor. Provided also that if the expenses incurred by the department are less than the amount payable to the Contractor at his agreement rates, the difference shall not be payable to the Contractor.

Any excess expenditure incurred or to be incurred by IITB in completing the partwork/ part incomplete work of any item(s) or the excess loss of damages suffered or may be suffered by IITB as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to Government in law or per as agreement be recovered from any money due to the Contractor on any account, and if such money is insufficient, the Contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

If the Contractor fails to pay the required sum within the aforesaid period of 30 days, the Engineer-in-Charge shall have the right to sell any or all of the contractor’s unused materials, constructional plant, implements, temporary building at site etc. and adjust the proceeds of sale thereof towards the dues recoverable from the Contractor under the Contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the Contract.

In the event of above course being adopted by the Engineer-in-Charge, the Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the work or the performance of the Contract.

Clause 15: Suspension of Work

(i) The Contractor shall, on receipt of the order in writing of the Engineer-in-Charge, (whose decision shall be final and binding on the Contractor) suspend the progress of the works or any part thereof for such time and in such manner as the Engineer-in-Charge may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of the following reasons:

   a. on account of any default on the part of the Contractor or;

   b. for proper execution of the works or part thereof for reasons other than the default of the Contractor; or

   c. for safety of the works or part thereof.

The Contractor shall, during such suspension, properly protect and secure the works to the extent necessary and carry out the instructions given in that behalf by the Engineer-in-Charge.

(ii) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:

   a. the Contractor shall be entitled to an extension of time equal to the period of every such suspension PLUS 25%, for completion of the item or group of items of work for which a separate period of completion is specified in the Contract and of which the suspended work forms a part, and;

   b. If the total period of all such suspensions in respect of an item or group of items or work for which a separate period of completion is specified in the Contract exceeds thirty days, the Contractor shall, in addition, be entitled to such compensation as the Engineer-in-Charge may consider reasonable in respect of salaries and/or wages paid by the Contractor to his employees and labour at site, remaining idle during the period of suspension, adding thereto 2% to cover indirect expenses of the Contractor provided the Contractor submits his claim supported by details to the Engineer-in-Charge within fifteen days of the expiry of the period of 30 days.
(iii) If the works or part thereof is suspended on the orders of the Engineer-in-Charge for more than three months at a time, except when suspension is ordered for reason (a) in sub para (i) above, the Contractor may after receipt of such order serve a written notice on the Engineer-in-Charge requiring permission within fifteen days from receipt by the Engineer in-Charge of the said notice, to proceed with the work or part thereof in regard to which progress has been suspended and if such permission is not granted within that time, the Contractor, if he intends to treat the suspension, where it affects only a part of the works as an omission of such part by IITB or where it affects whole of the works, as an abandonment of the works by IITB, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to the Engineer-in-Charge.

In the event of the Contractor treating the suspension as an abandonment of the Contract by IITB, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the work in full but which he could not derive in consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer-in-Charge may consider reasonable, in respect of salaries and/or wages paid by him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the Contractor provided the Contractor provides the Contractor submits his claim supported by details to the Engineer-in-Charge within 30 days of the expiry of the period of 3 months.

Clause 16: Action in case Work not done as per Specifications.

All works under or in course of execution or executed in pursuance of the Contract, shall at all times be open and accessible to the inspection and supervision of the Engineer-in-Charge, his authorized subordinates in charge of the work and all the superior officers, officer of the Quality Assurance Unit of the Department or any organization engaged by the Department for Quality Assurance and of the Chief Technical Examiner’s Office, and the Contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the Contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor’s agent shall be considered to have the same force as if they had been given to the Contractor himself.

If it shall appear to the Engineer-in-charge or his authorized subordinates in charge of the work or to the Chief Engineer in charge of Quality Assurance or his subordinate officers or the officers of the organization engaged by the Department for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any work has been executed with unsound, imperfect, or unskilful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the Contract, the Contractor shall, on demand in writing which shall be made within twelve months (six months in the case of work costing Rs. 10 Lac and below except road work) of the completion of the work from the Engineer-in-Charge specifying the work, materials or articles complained of notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer-in-Charge in his demand aforesaid, then the Contractor shall be liable to pay compensation at the same rate as under clause 2 of the Contract (for non-completion of the work in time) for this default.

In such case the Engineer-in-Charge may not accept the item of work at the rates applicable under the Contract but may accept such items at reduced rates as the authority specified in schedule ‘F’ may consider reasonable during the preparation of on account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he
may reject the work outright without any payment and/or get it and other connected and incidental items rectified, or removed and re-executed at the risk and cost of the Contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same will be final and binding on the Contractor.

Clause 17: Contractor Liable for Damages, defects during defect liability Period

If the Contractor or his working people or servants shall break, deface, injure or destroy any part of building in which they may be working, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass or grassland, or cultivated ground contiguous to the premises on which the work or any part is being executed, or if any damage shall happen to the work while in progress, from any cause whatever or if any defect, shrinkage or other faults appear in the work within twelve months (six months in the case of work costing Rs. Ten lacs and below except road work) after a certificate final or otherwise of its completion shall have been given by the Engineer-in-Charge as aforesaid arising out of defect or improper materials or workmanship the Contractor shall upon receipt of a notice in writing on that behalf make the same good at his own expense or in default the Engineer-in-Charge cause the same to be made good by other workmen and deduct the expense from any sums that may be due or at any time thereafter may become due to the Contractor, or from his security deposit or the proceeds of sale thereof or of sufficient portion thereof. The security deposit of the Contractor shall not be refunded before the expiry of twelve months (six months in the case of work costing Rs. Ten lakhs and below except road work) after the issue of the certificate final or otherwise, of completion of work, or till the final bill has been prepared and passed whichever is later. Provided that in the case of road work, if in the opinion of the Engineer-in-Charge, half of the security deposit is sufficient, to meet all liabilities of the Contractor under this Contract, half of the security deposit will be refundable after six months and the remaining half after twelve months of the issue of the said certificate of completion or till the final bill has been prepared and passed whichever is later.

In case of Maintenance and Operation works of E&M services, the security deposit deducted from contractors shall be refunded within one month from the date of final payment or within one month from the date of completion of the maintenance Contract whichever is earlier.

Clause 18: Contractor to Supply Tools & Plants etc.

The Contractor shall provide at his own cost all materials machinery, tools & plants as specified in schedule F. In addition to this, appliances, implements, other plants, ladders, cordage, tackle, scaffolding and temporary works required for the proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the Contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore to and from the work. The Contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the purpose of setting out works, and counting, weighing and assisting the measurement for examination at any time and from time to time of the work or materials. Failing his so doing, the same may be provided by the Engineer-in-Charge at the expense of the Contractor and the expenses may be deducted, from any money due to the Contractor, under this Contract or otherwise and/or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof.

Clause 18 A: Recovery of Compensation paid to Workmen.

In every case in which by virtue of the provisions sub-section (1) of section 12 of the Workman's Compensation Act, 1923, IITB is obliged to pay compensation to a workman employed by the Contractor, in execution of the works, IITB will recover from the Contractor, the amount of the compensation so paid: and without prejudice to the rights of the IITB under sub-section(2) of
section 12, of the said Act, IITB shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by IITB to the Contractor whether under this Contract or otherwise. IITB shall not be bound to contest any claim made against it under sub-section (1) of section 12, of the said Act, except on the written request of the Contractor and upon his giving to IITB full security for all costs for which IITB might become liable in consequence of contesting such claim.

**Clause 18B: Ensuring Payment and Amenities to Workers if Contractor fails**

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, IITB is obliged to pay any amounts of wages to a workman employed by the Contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules under Clause 19H or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by IITB. Contractors, IITB will recover from the Contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the IITB under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, IITB shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by IITB to the Contractor whether under this Contract or otherwise IITB shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the Contractor and upon his giving to the IITB full security for all costs for which IITB might become liable in contesting such claim.

**Clause 19: Labour Laws to be complied by the Contractor.**

The Contractor shall obtain a valid license under the Contract Labour (R&A) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, before the commencement of the work, and continue to have a valid license until the completion of the work.

The Contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.

The Contractor shall also abide by the provisions of the Child and Adolescent Labour (Prohibition and Regulation) Act, 1986.

The Contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfill these requirements shall attract the penal provisions of this Contract arising out of the resultant non-execution of the work.

**Clause 19A**

No labour below the age of 18 (Eighteen) years shall be employed on the work.

**Clause 19B: Payment of wages:**

(i) The Contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as defined in the C.P.W.D. Contractor’s Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

(ii) The Contractor shall, notwithstanding the provisions of any Contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.
(iii) In respect of all labour directly or indirectly employed in the works for performance of the Contractor's part of this Contract, the Contractor shall comply with or cause to be complied with the Central Public Works Department Contractor's Labour Regulations made by Government from time to time in regard to payment of wages, wage period, deductions from wages, recovery of wages not paid and deductions unauthorizedly made, maintenance of wage books or wage slips, publication of scale of wage and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

(iv) (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the Contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the Contract or non-observance of the Regulations.

(b) Under the provisions of Minimum Wages (Central) Rules, 1950, the Contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the Contractor by the Engineer-in-Charge concerned.


(vi) The Contractor shall indemnify and keep indemnified IITB against payments to be made under and for the observance of the laws aforesaid and the CPWD. Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.

(vii) The laws aforesaid shall be deemed to be a part of this Contract and any breach thereof shall be deemed to be a breach of this Contract.

(viii) Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the Contractor to the workmen directly without the intervention of Jamadar and that Jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.

(ix) The Contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen.

Clause 19C

In respect of all labour directly or indirectly employed in the works for performance of the Contractor's part of this Contract, the Contractor shall at his own expense arrange for the safety provisions as per Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the Contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty as decided by the authority mentioned in Schedule F for each default and in addition, the Engineer-in-Charge
shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the Contractor.

Clause 19D

The Contractor shall submit by the 4th and 19th of every month, to the Engineer-in-Charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively:

(a) the number of labourers employed by him on the work,
(b) their working hours,
(c) the wages paid to them,
(d) the accidents that occurred during the said for night showing the circumstances under which they happened, and the extent of damage and injury caused by them, and
(e) the number of female workers who have been allowed maternity benefit according to Clause 19 F and the amount paid to them.

Failing which the Contractor shall be liable to pay to IITB, a sum as decided by the authority mentioned in Schedule F for each default or materially incorrect statement. The decision of the Engineer-In-Charge shall be final in deducting from any bill due to the Contractor, the amount levied as fine and be binding on the Contractor.

Clause 19E

In respect of all labour directly or indirectly employed in the works for the performance of the Contractor's part of this Contract, the Contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the Central Public Works Department and its contractors.

Clause 19F

Leave and pay during leave shall be regulated as follows:

1. Leave:
   (a) in the case of deliver-- maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,
   (b) in the case of miscarriage - up to 3 weeks from the date of miscarriage.

2. Pay:
   (a) in the case of deliver-- leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined or at the rate of Rupee one only a day whichever is greater.
   (b) in the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.

3. Conditions for the grant of Maternity Leave:

   No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The Contractor shall maintain a register of Maternity (Benefit) in the Prescribed Form as shown in Appendix -I and II, and the same shall be kept at the place of work.
Clause 19G

In the event of the Contractor(s) committing a default or breach of any of the provisions of the Central Public Works Department, Contractor’s Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the IITB a sum as decided by the authority mentioned in Schedule F for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of 'he Contractor(s) defaulting continuously in this respect, the penalty may be enhanced to as decided by the authority mentioned in Schedule F per day for each day of default subject to a maximum of 5 percent of the estimated cost of the work put to tender. The decision of the Engineer-in-Charge shall be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the Contractor(s) is/are not properly observing and complying with the provisions of the C.P.W.D. Contractor’s Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the Contractor(s) (hereinafter referred to as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the Contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the Contractor(s) shall fail within the period specified in the notice to comply with and observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the Contractor(s). The Contractor(s) shall erect, make and maintain at his/their own expense and as per approved standards all necessary huts and sanitary arrangements required for his/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the Contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the Contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the Contractor(s).

Clause 19H

The Contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

(a) The minimum height of each hut at the eaves level shall be 2.10 m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sq.m. (30 sq.ft.) for each member of the worker’s family staying with the labourer.

(b) The Contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80 m x 1.50 m (6'x5') adjacent to the hut for each family.

(c) The Contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.

(d) The Contractor(s) shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.
(e) All the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the Contractor shall ensure that throughout the period of their occupation, the roofs remain water-tight.

(f) The Contractor(s) shall provide each hut with proper ventilation.

(g) All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.

(h) There shall be kept an open space of at least 7.2 m (8 yards) between the rows of huts which may be reduced to 6 m (20 ft.) according to the availability of site with the approval of the Engineer-in-Charge. Back-to-back construction will be allowed.

(i) Water Supply – The Contractor(s) shall provide adequate supply of water for the use of labourers. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which may be of metal or masonry, shall be provided. The Contractor(s) shall also at his/ their own cost make arrangements for laying pipe lines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore.

(j) The site selected for the camp shall be high ground, removed from jungle.

(k) Disposal of Excreta – The Contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration which shall be according to the requirements laid down by the Local Health Authorities. If trenching or incineration is not allowed, the Contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee/authority for the removal of the excreta. All charges on this account shall be borne by the Contractor and paid direct by him to the Municipality/authority. The Contractor shall provide one sweeper for every eight seats in case of dry system.

(l) Drainage – The Contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy.

(m) The Contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.

(n) Sanitation – The Contractor(s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

Clause 19I

The Engineer-in-Charge may require the Contractor to dismiss or remove from the site of the work any person or persons in the contractor’s employ upon the work who may be incompetent or misconduct himself and the Contractor shall forthwith comply with such requirements. In respect of maintenance/repair or renovation works etc. where the labour have an easy access to the individual houses, the Contractor shall issue identity cards to the labourers, whether temporary or permanent and he shall be responsible for any untoward action on the part of such labour.
Clause 19J

It shall be the responsibility of the contractor to see that the building under construction is not occupied by anybody unauthorized during construction, and is handed over to the Engineer-in-Charge with vacant possession of complete building. If such building though completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy up to 5% of tendered value of work may be imposed by the Engineer-In-Charge whose decision shall be final both with regard to the justification and quantum and be binding on the Contractor.

However, the Engineer-In-Charge through a notice, may require the contractor to remove the illegal occupation any time on or before construction and delivery.

Clause 19K: Employment of skilled/semi-skilled workers

The Contractor shall, at all stages of work, deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training Institute / National Institute of Construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi-skilled.

Workers required in each trade at any stage of work. The Contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the Contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of Contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by Contractor at the rate specified in schedule ‘F’ per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

Provided always, that the provisions of this clause, shall not be applicable for works with estimated cost put to tender being less than Rs. 5 crores.

For work costing more than Rs. 10 Crores, and up to Rs. 50 Crores, the Contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 20% of the unskilled workers engaged in the project in co-ordination with the CPWD Regional Training Institute & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi-skilled tradesmen.

For works costing more than Rs. 50 Crores, the Contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 30% of the unskilled worker engaged in the project in co-ordination with the CPWD Regional Training Institute & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi-skilled tradesmen. The cost of such training as stated above shall be borne by the Contractor. The necessary space and workers shall be provided by the Contractor and no claim what so ever shall be entertained.

Clause 19L: Contribution of EPF and ESI

The ESI and EPF contributions on the part of employer in respect of this Contract shall be paid by the Contractor. These contributions on the part of the employer paid by the Contractor shall be reimbursed by the Engineer-in-charge to the Contractor on actual basis. The verification of deployment of labour will be done through biometric attendance system or any other suitable method by the Engineer in Charge. The applicable and eligible amount of EPF & ESI shall be
reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment provided same are in order.

Clause 20: Minimum Wages Act to be Complied With
The Contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time and rules framed there under and other labour laws affecting Contract labour that may be brought into force from time to time.

Clause 21: Work not to be sublet. Action in case of in solvency
The Contract shall not be assigned or sublet without the written approval of the Engineer-in-Charge. And if the Contractor shall assign or sublet his Contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given, promised or offered by the Contractor, or any of his servants or agent to any public officer or person in the employ of IITB in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the Contract, the Engineer-in-Charge on behalf of the Director, IITB shall have power to adopt the course specified in Clause 3 hereof in the interest of IITB and in the event of such course being adopted, the consequences specified in the said Clause 3 shall ensue.

Clause 22
All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of IITB without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

Clause 23: Changes in firm’s Constitution to be Intimated.
Where the Contractor is a partnership firm, the previous approval in writing of the Engineer-in-Charge shall be obtained before any change is made in the constitution of the firm. Where the Contractor is an individual or a Hindu undivided family business concern, such approval as aforesaid shall likewise be obtained before the Contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the works hereby undertaken by the Contractor. If previous approval as aforesaid is not obtained, the Contract shall be deemed to have been assigned in contravention of Clause 21 hereof and the same action may be taken, and the same consequences shall ensue as provided in the said Clause 21.

Clause 24: Life Cycle Cost
The Contractor shall be responsible for safety, quality and soundness of the buildings including structural elements beyond maintenance period. The Contractor shall have obligation to rectify such defects minimum up to 1 (One) year from the date of completion of work. The defects have to be rectified within a reasonable time not exceeding forty-five days after issue of notice by Engineer-in-Charge. If Contractor does not take corrective action within 3 days, then action for debarring of the agency shall be taken by the appropriate authority.

Clause 25: Settlement of Disputes & Arbitration
Except where otherwise provided in the Contract, all questions and disputes relating to the meaning of the specifications, design, drawings and instructions here-in before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the Contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising
during the progress of the work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter:

(i) If the contractor considers any work demanded of him to be outside the requirements of the Contract, or disputes any drawings, record or decision given in writing by the Engineer-in-Charge or if the Engineer in Charge considers any act or decision of the Contractor on any matter in connection with or arising out of the Contract or carrying out of the work, to be unacceptable and is disputed, such Contractor shall within 15 days of the arising of the disputes first refer to Dean IPS, IITB who acts as Engineer-In-Charge (EIC). If the decision of EIC is not acceptable to the Contractor, either party shall promptly within 15 days request to Deputy Director (FEA) IITB (DD(FEA)). In case of the decision of DD(FEA) is not acceptable, the matter shall be taken up with the Director IITB, who shall refer the disputes to Dispute Redressal Committee (DRC) within 15 days along with a list of disputes with amounts claimed if any in respect of each such dispute. The Dispute Redressal Committee (DRC) give its decision within a period of 60 days extendable by 30 days by consent of both the parties. The constitution of Dispute Redressal Committee (DRC) shall be as indicated in Schedule 'F'. Provided that no party shall be represented before the Dispute Redressal Committee by an advocate / legal counsel etc.

The DRC will submit its decision to the Director IITB for acceptance. Director IITB will in a time limit of 30 days from receipt of DRC decision will convey acceptance or otherwise on the said decision. If the Dispute Redressal Committee (DRC) fails to give its decision within the aforesaid period or the Director IITB fails to give his decision in the aforesaid time limit or any party is dissatisfied with the decision of Dispute Redressal Committee (DRC)/ Director IITB then either party may within a period of 30 days from the receipt of the decision of Dispute Redressal Committee (DRC) / Director IITB or on expiry of aforesaid the time limits available to DRC) / Director IITB ,may give notice to the Chairman, Board of Governors, IITB (BOG) for appointment of arbitrator on prescribed proforma as per Appendix XVII under intimation to the other party.

It is a term of Contract that each party invoking arbitration must exhaust the aforesaid mechanism of settlement of claims / disputes prior to invoking arbitration.

The Chairman (BOG) shall in such case appoint the sole arbitrator or one of the three arbitrators as the case may be within 30 days of receipt of such a request and refer such disputes to arbitration. Wherever the Arbitral Tribunal consists of three Arbitrators, the Contractor shall appoint one arbitrator within 30 days of making request for arbitration or of receipt of request by Engineer-in-charge to DD(FEA) for appointment of arbitrator, as the case may be, and two appointed arbitrators shall appoint the third arbitrator who shall act as the Presiding Arbitrator. In the event of

(a) A party fails to appoint the second Arbitrator, or

(b) The two appointed Arbitrators fail to appoint the Presiding Arbitrator, then the Chairman (BOG) shall appoint the second or Presiding Arbitrator as the case may be.

(ii) Dispute or difference shall be referred for adjudication through arbitration by a Tribunal having sole arbitrator where claimed amount is Rs 100 Crore or less. Where claimed Value is more than Rs. 100 Crore, Tribunal shall consist of three Arbitrators as above. The requirements of the Arbitration and Conciliation Act, 1996 (26 of 1996) and any further statutory modification or re-enactment thereof and the rules made there under and for the time being in force shall be applicable.

It is a term of this Contract that the party invoking arbitration shall give a list of disputes with amounts claimed, if any, in respect of each such dispute along with the notice for
appointment of arbitrator and giving reference to the decision of the DD(FEA) on the finding / recommendation of DRC.

It is also a term of this Contract that member of the Arbitration Tribunal shall be a Graduate Engineer with experience in handling public works engineering contracts, and further he shall have earlier worked at a level not lower than Chief Engineer/ equivalent (i.e. Joint Secretary level of Government of India). This shall be treated as a mandatory qualification to be appointed as arbitrator.

Parties, before or at the time of appointment of Arbitral Tribunal may agree in writing for fast-track arbitration as per the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015.

Subject to provision in the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015 whereby the counter claims if any can be directly filed before the arbitrator without any requirement of reference by the appointing authority. The arbitrator shall adjudicate on only such disputes as are referred to him by the appointing authority and give separate award against each dispute and claim referred to him and, in all cases, where the total amount of the claims by any party exceeds Rs. 1,00,000/-, the arbitrator shall give reasons for the award.

It is also a term of the Contract that fees payable to arbitral tribunal shall be as approved by IITB, this fee shall be shared equally by parties.

The place of arbitration shall be as mentioned in Schedule F. In case there is no mention of place of arbitration, the arbitral tribunal shall determine the place of arbitration.

The venue of the arbitration shall be such place as may be fixed by the Arbitral Tribunal in consultation with both the parties. Failing any such agreement, then the Arbitral Tribunal shall decide the venue.

**Clause 26: Contractor to Indemnify IITB against Patent Rights**

The Contractor shall fully indemnify and keep indemnified the Director IITB against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the Contract. In the event of any claims made under or action brought against IITB in respect of any such matters as aforesaid, the Contractor shall be immediately notified thereof and the Contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise there from, provided that the Contractor shall not be liable to indemnify the Director IITB if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

**Clause 27: Lumpsum Provisions in Tender.**

When the estimate on which a tender is made includes lump sum in respect of parts of the work, the Contractor shall be entitled to payment in respect of the items of work involved or the part of the work in question at the same rates as are payable under this Contract for such items, or if the part of the work in question is not, in the opinion of the Engineer-in-Charge payable of measurement, the Engineer-in-Charge may at his discretion pay the lump-sum amount entered in the estimate, and the certificate in writing of the Engineer-in-Charge shall be final and conclusive against the Contractor with regard to any sum or sums payable to him under the provisions of the clause.

**Clause 28: Action where no Specifications are Specified.**

In the case of any class of work for which there is no such specifications as referred to in Clause 11, such work shall be carried out in accordance with the Bureau of Indian Standards.
Specifications. In case there are no such specifications in Bureau of Indian Standards, the work shall be carried out as per manufacturer’s specifications, if not available then as per state/ District Specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge.

Clause 29: Withholding and lien in respect of sum due from Contractor:

(a) Whenever any claim or claims for payment of a sum of money arises out of or under the Contract or against the Contractor, the Engineer-in-Charge or the IITB shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the Contractor and for the purpose aforesaid, the Engineer-in-Charge or the IITB shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the Contractor, the Engineer-in-Charge or the IITB shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the Contractor under the same Contract or any other Contract with the Engineer-in-Charge of the IITB or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the Contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or IITB will be kept withheld or retained as such by the Engineer-in-Charge or IITB till the claim arising out of or under the Contract is determined by the arbitrator (if the Contract is governed by the arbitration clause) by the competent court, as the case may be and that the Contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the Contractor. For the purpose of this clause, where the Contractor is a partnership firm or a limited company, the Engineer-in-Charge or the IITB shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

(b) IITB shall have the right to cause an audit and technical examination of the works and the final bills of the Contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the Contractor under the Contract or any work claimed to have been done by him under the Contract and found not to have been executed, the Contractor shall be liable to refund the amount of overpayment and it shall be lawful for IITB to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the Contractor was paid less than what was due to him under the Contract in respect of any work executed by him under it, the amount of such underpayment shall be duly paid by IITB to the Contractor, without any interest thereon whatsoever.

Provided that the IITB shall not be entitled to recover any sum overpaid, nor the Contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Engineer-in-charge on the one hand and the Contractor on the other under any term of the Contract permitting payment for work after assessment by the Engineer-in-charge.
Clause 29A: Lien in respect of claims in other Contracts:

Any sum of money due and payable to the Contractor (including the security deposit returnable to him) under the Contract may be withheld or retained by way of lien by the Engineer-in-Charge or the IITB or any other contracting person or persons through Engineer-in-Charge against any claim of the Engineer-in-Charge or IITB or such other person or persons in respect of payment of a sum of money arising out of or under any other Contract made by the Contractor with the Engineer-in-Charge or the IITB or with such other person or persons. It is an agreed term of the Contract that the sum of money so withheld or retained under this clause by the Engineer-in-Charge or the IITB will be kept withheld or retained as such by the Engineer-in-Charge or the IITB or till his claim arising out of the same Contract or any other Contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the Contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the Contractor.

Clause 29B: Employment of coal mining or controlled area labour not Permissible

The Contractor shall not employ coal mining or controlled area labour falling under any category whatsoever on or in connection with the work or recruit labour from area within a radius of 32 km (20 miles) of the controlled area. Subject as above the Contractor shall employ imported labour only i.e., deposit imported labour or labour imported by contractors from area, from which import is permitted. Where ceiling price for imported labour has been fixed by State or Regional Labour Committees not more than that ceiling price shall be paid to the labour by the Contractor.

The Contractor shall immediately remove any labourer who may be pointed out by the Engineer-in-Charge as being a coal mining or controlled area labourer. Failure to do so shall render the Contractor liable to pay to IITB a sum calculated at the rate of Rs.10/- per day per labourer. The certificate of the Engineer-in-Charge about the number of coal mining or controlled area labourer and the number of days for which they worked shall be final and binding upon all parties to this Contract.

It is declared and agreed between the parties that the aforesaid stipulation in this clause is one in which the public are interested within the meaning of the exception in Section 74 of Indian Contract Act, 1872.

Explanation: - Controlled Area means the following areas:

Districts of Dhanbad, Hazaribagh, Jamtara – a Sub-Division under Santhal Pargana Commissionery, Districts of Bankura, Birbhum, Burdwan, District of Bilaspur.

Any other area which may be declared a Controlled Area by or with the approval of the Central Government.

Clause 30: Water for Works

The Contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

(a) That the water used by the Contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

(b) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of Contractor(s) if the arrangements made by the Contractor(s) for procurement of water are in the opinion of the Engineer-in-Charge, unsatisfactory.

Clause 30A: Alternate water Arrangements:

The Contractor shall be allowed to construct temporary wells in IITB land for taking water for construction purposes only after he has got permission of the Engineer-in-Charge in writing. No charges shall be recovered from the Contractor on this account, but the Contractor shall be
required to provide necessary safety arrangements to avoid any accidents or damage to adjacent buildings, roads and service lines. He shall be responsible for any accidents or damage caused due to construction and subsequent maintenance of the wells and shall restore the ground to its original condition after the wells are dismantled on completion of the work. If any approvals are required for temporary wells, the same has to be obtained by the agency from statutory authorities.

**Clause 31: Hire of Plant & Machinery**

The Contractor shall arrange at his own expense all tools, plant, machinery and equipment (hereinafter referred to as T&P) required for execution of the work.

**Clause 32: Employment of Technical Staff and employees**

Contractors Superintendence, Supervision, Technical Staff & Employees

(i) The Contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the Contract.

The Contractor shall immediately after receiving letter of acceptance of the tender and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in Schedule ‘F’. Even of the Contractor (or partner(s) in case of firm/company) is himself/herself an Engineer, it is necessary on the part of the Contractor to Employ principal technical representative/technical representative(s) as per stipulation in Schedule ‘F’.

The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative(s) to the Contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the Contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the Contractor in this respect. Such a principal technical representative and other technical representative(s) shall be appointed by the Contractor soon after receipt of the approval from Engineer-in-charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s) The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/herself, as required, to the Engineer-in-Charge and/or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the Contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in-Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/her signature in token of noting the instructions and in token of acceptance of measurements/checked measurements/test checked measurements. The representative(s) shall not look after any other work. Substitutes, duly approved by Engineer-in-Charge of the work in similar
manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the Contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the Contractor as specified in Schedule ‘F’ and the decision of the Engineer-In-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the Contractor. Further if the Contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the Contractor shall be held responsible for the delay so caused to the work. The Contractor shall submit a certificate of employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every on-account bill/ final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

(ii) The Contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The Contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the Contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in-Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

Clause 33: Levy/Taxes payable by Contractor:

(i) GST, Building and other Construction Workers Welfare Cess or any other tax, levy or Cess in respect of input for or output by this Contract shall be payable by the Contractor and IITB shall not entertain any claim whatsoever in this respect except as provided under Clause 34.

(ii) The Contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, etc. from local authorities.

If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the IITB and does not any time become payable by the Contractor to the State Government, Local authorities in respect of any material used by the Contractor in the works, then in such a case, it shall be lawful to the IITB and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the Contractor.

Clause 34: Conditions for reimbursement of levy/taxes if levied after receipt of Tenders:

(i) All tendered rates shall be inclusive of any tax, levy or cess applicable on last stipulated date of receipt of tender including extension if any. No adjustment i.e. increases or decrease shall be made for any variation in the rate of GST, Building and Other
Construction Workers Welfare Cess or any tax, levy or cess applicable on inputs.

However, effect of variation in rates of GST or Building and Other Construction Workers Welfare Cess or imposition or repeal of any other tax, levy or cess applicable on output of the works Contract shall be adjusted on either side, increase or decrease.

Provided further that for Building and Other Construction Workers Welfare Cess or any tax (other than GST), levy or cess varied or imposed after the last date of receipt of tender including extension if any, any increase shall be reimbursed to the Contractor only if the Contractor necessarily and properly pays such increased amount of taxes/levies/cess.

Provided further that such increase including GST shall not be made in the extended period of Contract for which the Contractor alone is responsible for delay as determined by authority for extension of time under Clause 5 in Schedule F.

(ii) The Contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the IITB and/or the Engineer in-Charge and shall also furnish such other information/document as the Engineer-in-Charge may require from time to time.

(iii) The Contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, or variation or repeal of such tax or levy or cess give a written notice thereof to the Engineer-in-Charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

Clause 35: Termination of Contract on death of the Contractor:

Without prejudice to any of the rights or remedies under this Contract, if the Contractor dies, the Engineer-in-Charge on behalf of the Director IITB shall have the option of terminating the Contract without levy of compensation to the Contractor.

Clause 36: If relative working in IITB then the Contractor not allowed to tender

The Contractor shall not be permitted to tender for works in the IITB responsible for award and execution of contracts in which his near relative is posted as IITB officer. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Officer in the IITB or in the Ministry of Housing and Urban Affairs. Any breach of this condition by the Contractor would render him liable to be removed from the approved list of contractors of this Department. If however the Contractor is registered in any other department, he shall be debarred from tendering in IITB for any breach of this condition.

NOTE: By the term “near relatives” is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

Clause 37: No Gazetted Engineer to work as Contractor within one year of retirement:

No engineer of gazetted rank or other gazetted officer employed in engineering or administrative duties in an engineering department of the Government of India shall work as a Contractor or employee of a Contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This Contract is liable to be cancelled if either the Contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government of India as aforesaid, before submission of the tender or engagement in the Contractor’s service, as the case may be.
Clause 38: Theoretical consumption of Material

(i) After completion of the work and also at any intermediate stage in the event of Non reconciliation of materials issued theoretical quantity of materials used in the work shall be calculated on the basis and method given hereunder:

(c) Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of work as shown in the Schedule of Rates mentioned in Schedule 'F'. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above-mentioned schedule/statement or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.

(d) Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in-Charge, including authorized lappages, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual, each diameter wise, section wise and category wise separately.

(e) Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 5% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 10%), such determination & comparison being made diameter wise & category wise.

(f) For any other material as per actual requirements.

Over the theoretical quantities of materials so computed a variation shall be allowed as specified in Schedule 'F'. For non-scheduled items, the decision of Engineer-In-Charge regarding theoretical quantities of materials which should have been actually used, shall be final and binding on the Contractor.

(ii) The said action under this clause is without prejudice to the right of the IITB to take action against the Contractor under any other Conditions of the Contract for not doing the work according to the prescribed specifications.

Clause 39: Compensation during warlike situations:

The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the Contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the Contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the Contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge. The Contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the Contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this Contract.

Provided always that no compensation shall be payable for any loss in consequence of
hostilities or warlike operations (a) unless the Contractor had taken all such precautions against air raid as are deemed necessary by the A.R.P. (Air Raid precaution) Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work. In the event of the Contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Engineer-in-charge.

Clause 40: Apprentices Act provisions to be complied with

The Contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the Contract and the Engineer-in-charge may, in his discretion, cancel the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

Clause 41: Release of Security deposit after labour clearance

The Security Deposit of the work shall be refunded if no labour complaint has been received from the labour officer till the due date of its payment. If a labour complaint is received during this period, the Engineer-in-Charge shall, after issue of notice in this regard to the Contractor, deduct the amount required to settle the complaint from his security deposit and refund the balance amount.
6.3 ADDITIONAL CONDITIONS OF THE CONTRACT:

(i) The Contractors are advised to inspect and examine the site and its surroundings and satisfy themselves with the nature of site, the means of access to the site, constraints put by local regulations, if any, weather conditions at site, general ground / subsoil conditions etc. or any other circumstances which may affect or influence their tenders. The Contractor shall carry out survey of the work area at his own cost, setting out the layout and fixing of alignment of the building as per architectural and Structural drawings in consultation with the Dean (IPS). Any discrepancy between the architectural drawings and actual layout at site shall be brought to the notice of the Dean (IPS). It shall be responsibility of the Contractor to ensure correct setting out of alignment. Nothing extra shall be payable on this account. No claims, whatsoever, shall be entertained at a later date for any errors found, on plea that the information supplied by the IITB in the tender is insufficient or is at variance with the actual site conditions.

(ii) The Contractor shall, if required by him, before submission of the tender, inspect the drawings in the Office of the Dean (IPS). The IITB shall not bear any responsibility for the lack of knowledge and also the consequences, thereof to the Contractor. The information and data shown in the drawings and mentioned in the tender documents have been furnished, in good faith, for general information and guidance only. Dean (IPS), in no case, shall be held responsible for the accuracy thereof and/or interpretations or conclusions drawn there from by the Contractor and all consequences shall be borne by the Contractor. No claim, whatsoever, shall be entertained from the Contractor, if the data or information furnished in tender document is different or in-correct otherwise or actual working drawings are at variance with the drawings available for inspection or attached to the tender documents. It is presumed that the Contractor shall satisfy himself for all possible contingencies, incidental charges, wastages, bottlenecks etc. likely during execution of work and acts of coordination, which may be required between different agencies. Nothing extra shall be payable on this account.

(iii) Sub-soil investigation report of work site is available in the office of the Dean IPS). Interested bidders can go through the report if required for their guidance. However, the Bidder is advised to obtain requisite details directly as may be considered necessary by him before quoting rates in the tender. No claim whatsoever on account of any discrepancy between the sub-surface strata conditions that may be actually encountered at the time of execution of the work and those available in the report shall be entertained under any circumstances. The ground water table is a variable condition and the information given in the report is only indicative and it may vary from time to time.

(iv) The nomenclature of the item given in the schedule of quantities gives in general the work content but is not exhaustive i.e., does not mention all the incidental works required to be carried out for complete execution of the item of work. The work shall be carried out, all in accordance with true intent and meaning of the specifications and the drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings and/or described in the specifications, provided that the same can be reasonably inferred. There may be several incidental works, which are not mentioned in the nomenclature of each item but will be necessary to complete the item in all respects. All these incidental works / costs which are not mentioned in item nomenclature but are necessary to complete the item shall be deemed to have been included in the rates quoted by the Contractor for various items in the schedule of quantities. No adjustment of rates shall be made for any variation in quantum of incidental works due to variation / change in actual working drawings. Also, no adjustment of rates shall be made due to any change in incidental works or any other deviation in such element of work (which is incidental to the items of work and are necessary to complete such items in all respects) on account of the directions of Dean (IPS). Nothing extra shall be payable on this account.
(v) The Contractor(s) shall give to the local body, police and other authorities all necessary notices etc. that may be required by law and obtain all requisite licenses for temporary obstructions, enclosures etc. and pay all fee, taxes and charges which may be leviable on account of these operations in executing the Contract. He shall make good any damage to the adjoining property whether public or private and shall supply and maintain lights either for illumination or for cautioning the public at night.

(vi) The Contractor(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night. In case of any accident of labours/contractual staff the entire responsibility will rest on the part of the Contractor and any compensation under such circumstances, if becomes payable, shall be entirely borne by the Contractor.

(vii) The work shall generally be carried out in accordance with the latest “CPWD Specifications” with up-to-date correction slips, additional/Particular Specifications, architectural/Structural drawings and as per instructions of Dean (IPS). Any additional item of the work, if taken up subsequently, shall also confirm to the CPWD / other relevant specifications as mentioned above.

(viii) Several documents forming the tender are to be taken as mutually complementary to one another. Detailed drawings shall be followed in preference to small scale drawings and figured dimensions in preference to scale dimensions.

(ix) There be any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work (including special conditions) and I.S. Codes etc., the following order of preference shall be observed.

   a. Description of items as given in Schedule of quantities
   b. Particular specifications
   c. Special conditions
   d. Additional Conditions
   e. CPWD Technical Specifications including correction slips issued up to the last updated date of uploading/ till submission of the tender.
   f. General Conditions of the Contract.
   g. Indian Standards Specifications of B.I.S.
   h. Decision of Dean (IPS).

(x) The works to be governed by this Contract shall cover delivery and transportation up to destination, safe custody at site, insurance, erection, testing and commissioning of the entire works.

(xi) The works to be undertaken by the Contractor shall inter-alia include the following:

   a. Preparation of detailed SHOP drawings and AS BUILT drawings wherever applicable.
   b. Obtaining of Statutory permission is in the scope of Architectural consultant appointed by IITB. The agency has to assist in providing AS-BUILT drawing etc.
   c. Pre-commissioning tests as per relevant standard specifications, code of practice, Acts and Rules wherever required.
   d. Warranty obligation for the equipment's and / or fittings/fixtures supplied by the Contractor. Contractor shall provide all the shop drawings or layout drawings for all the coordinated services before starting any work or placing any order of any
of the services etc. These shop drawings/layout drawings shall be got approved from Dean (IPS) / Architect before implementation and this shall be binding on
the Contractor. The Contractor shall submit material submittals along with
material sample for approval of Dean (IPS) / Architect prior to delivery of material
at site.

(xii) The work shall be carried out in accordance with the approved architectural drawings,
structural drawings, services drawings to be issued from time to time, by the Engineer-in-
Charge. Before commencement of any item of work the Contractor shall correlate all the
relevant architectural and structural drawings, nomenclature of items and specifications
etc. issued for the work and satisfy himself that the information available from there is
complete and unambiguous. The figure and written dimension of the drawings shall be
superseding the measurement by scale. The discrepancy, if any, shall be brought to the
notice of the Dean (IPS) before execution of the work. The Contractor alone shall be
responsible for any loss or damage occurring by the commencement of work on the basis
of any erroneous and or incomplete information and no claim whatsoever shall be
entertained by the IITB on this account.

(xiii) Unless otherwise provided in the Schedule of quantities vide Part-D2 and the percentage
tendered by the Contractor shall be all inclusive and shall apply to all heights, lifts, leads
and depths of the building and nothing extra shall be payable to him on this account.

(xiv) The Contractor(s) shall take instructions from the Dean (IPS) regarding collection and
stacking of materials at any place. No excavated earth or building rubbish shall be
stacked on areas where other buildings, roads, services and compound walls are to be
constructed. The stacking shall take place as per stacking plan however, if any change is
required, the same shall be done with the approval of Dean (IPS).

(xv) The Contractor shall bear all incidental charges for cartage, storage and safe custody of
materials, if any, issued by IITB as well as to those materials also arranged by the
Contractor.

(xvi) Any cement slurry added over base surface (or) for continuation of concreting for better
bond is deemed to have been built in the items and nothing extra shall be payable or
extra cement considered in consumption on this account.

(xvii) The Contractor shall give performance test of the entire installation(s) as per the
specifications in the presence of the Dean (IPS) or his authorized representative before
the work is finally accepted and nothing extra what-so-ever shall be payable to the
Contractor for such test.

(xviii) Prevention of Nuisance and Pollution Control
The Contractor shall take all necessary precautions to prevent any nuisance or
inconvenience to the owners, tenants or occupiers of adjacent properties and to the
public in general and to prevent any damage to such properties from pollutants like
smoke, dust, noise. The Contractor shall use such methodology and equipment so as to
cause minimum environmental pollution of any kind and minimum hindrance to road
users and to occupants of the adjacent properties or other services running adjacent/near
vicinity. The Contractor shall make good at his cost and to the satisfaction of the Dean
(IPS), any damage to roads, paths, cross drainage works or public or private property
whatsoever caused due to the execution of the work or by traffic brought thereon by the
Contractor. All waste or superfluous materials shall be carried away by the Contractor,
without any reservation, entirely to the satisfaction of the Dean (IPS).

(xix) Security and Traffic Arrangements

(xx) In the event of any restrictions being imposed by the Security agency, Traffic or any other
authority having jurisdiction in the area on the working or movement of labour / material,
the Contractor shall strictly follow such restrictions and nothing extra shall be payable to the Contractor on such accounts. The loss of time on these accounts, if any, shall have to be made up by augmenting additional resources whatever required.

(xxi) No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The Contractor shall be fully responsible for any damage to the govt. property and the work for which payment has been advanced to him under the Contract and he shall make good the same at his risk and cost. The Contractor shall be fully responsible for safety and security of his material, T&P/Machinery brought to the site by him.

(xxii) The Contractor shall construct suitable godowns, yard at the site of work for storing all other materials so as to be safe against damage by sun, rain, damages, fire, theft etc. at his own cost and also employ necessary watch and ward establishment for the purpose at his cost.

(xxiii) All materials obtained from Contractor shall be got checked by the representative of Engineer-in-Charge on receipt of the same at site before use.

(xxiv) The Contractor shall be responsible for the watch and ward/guard of the buildings, safety of all fittings and fixtures including all equipment’s, services provided by him against pilferage and breakage during the period of Installations and thereafter till the building is physically handed over to the IITB, the Client IITB. No extra payment shall be made on this account and no claim shall be admissible on this account.

(xxv) The Contractor shall keep himself fully informed of all acts and laws of the Central & State Governments, all orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All the rules & regulations and bye-laws laid down by Collector / MCGM and any other statutory bodies shall be adhered to, by the Contractor, during the execution of work. The Contractor shall also adhere to all traffic restrictions notified by the local authorities. The water charges (for municipal water connection as well as tanker water) shall be borne by the Contractor. Also, if the Contractor obtains water connection for the drinking purposes from the municipal authorities or any other statutory body, the consequent charges shall be borne by the Contractor. All statutory taxes, levies, charges (including water and sewerage charges, charges for temporary service connections and / or any other charges) payable to such authorities for carrying out the work, shall be borne by the Contractor. The Contractor shall arrange to give all notices as required by any statutory / regulatory authority and shall pay to such authority all the fees that is required to be paid for the execution of work. He shall protect and indemnify the IITB and its officials & employees against any claim and / or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts. The fee payable to statutory authorities for obtaining the various permanent service connections and Occupancy Certificate for the building shall be borne by the IITB.

(xxvi) For works below ground level the Contractor shall keep that area free from water. If de-watering or bailing out of water is required, the Contractor shall do the same at his own cost and nothing extra shall be paid.

(xxvii) The Contractor shall make all necessary arrangements for protecting from rains, fog or likewise extreme weather conditions, the work already executed and for carrying out further work, during monsoon including providing and fixing temporary shelters, protections etc. Nothing extra shall be payable on this account and also no claims for hindrance shall be entertained on this account.

(xxviii) In case of flooding of site on account of rain or any other cause and any consequent damage, whatsoever, no claim financially or otherwise shall be entertained
notwithstanding any other provisions elsewhere in the Contract agreement. Also, the Contractor shall make good, at his own cost, the damages caused, if any. Further, no claims for hindrance shall be entertained on this account.

(xxix) The Contractor will take reasonable precautions to prevent his workman and employees from removing and damaging any flora (tree/plant/vegetation) from the project area.

6.3.1 Setting out Works:

(i) The Contractor shall carry out survey of the work area, at his own cost, setting out the layout of buildings/ roads/ services in consultation with the Engineer - in-Charge & proceed further. Any discrepancy between architectural drawings and actual layout at site shall be brought to the notice of the Engineer -in-charge. It shall be responsibility of the Contractor to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and centre lines, etc., Nothing extra shall be payable on this account.

(ii) The Contractor shall establish, maintain and assume responsibility for grades, lines, levels and benchmarks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions etc. to the Engineer -in-Charge before commencing work. Commencement of work shall be regarded as the Contractor's acceptance of such grades, lines, levels, and dimensions and no claim shall be entertained at a later date for any errors found.

(iii) If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the Contractor shall, at his own expense rectify such error, if so required, to the satisfaction of the Engineer -in-Charge. Nothing extra shall be payable on this account.

(iv) The Contractor shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the Dean (IPS) or his authorized representatives. The work at different stages shall be checked with reference to bench marks maintained for the said purpose. Nothing extra shall be payable on this account.

(v) The approval by the Dean (IPS) of the setting out by the Contractor, shall not relieve the Contractor of any of his responsibilities and obligation to rectify the errors/ defects, if any, which may be found at any stage during the progress of the work or after the completion of the work.

(vi) The Contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the Contractor at his own cost to the entire satisfaction of the Engineer- in-Charge.

(vii) The Tendered Amount by the Contractor is deemed to be inclusive of site clearance, setting out work (including marking of reference points, Centre lines of buildings), construction and maintenance of reference bench mark(s), taking spot levels, construction of all safety and protection devices, barriers, barricading, signage, labour safety, labour welfare and labour training measures, preparatory works, working during monsoon, working at all depths, height and location etc. and any other incidental works required to complete this work. Nothing extra shall be payable on this account.

6.3.2 Site Testing Laboratory

A site laboratory with the minimum equipment’s as specified in CPWD specifications/in this agreement shall be established, made functional and maintained within one month from the award of work as per clause 10A of schedule A to F without any extra cost to the IITB. In case of non-compliance / delay in compliance in this, a recovery @ Rs. 500/- per day will be imposed which will be recovered from the immediate next R/A Bill of the
6.3.3 **Tools and Plants:**
The bidder should have own constructions equipment required for the proper and timely execution of the work. Nothing extra shall be paid on this account. No tools and plants including any special T&P etc. shall be supplied by the IITB and the Contractor shall have to make his own arrangements at his own cost. No claim of hindrance (or any other claim) shall be entertained on this account.

6.3.4 **Scaffolding:**
Wherever required for the execution of work, all the scaffolding shall be provided and suitably fixed, by the Contractor. It shall be provided strictly with steel double scaffolding system, suitably braced for stability, with all the accessories, gangways, etc. with adjustable suitable working platforms to access the areas with ease for working and inspection. It shall be designed to take all incidental loads. It should cater to the safety features for workmen. Nothing extra shall be payable on this account. It shall be ensured that no damage is caused to any structure due to the scaffolding.

6.3.5 **Schedule and Deployments (Personnel and Equipment)**
The Contractor shall do proper sequencing of the various activities by suitably staggering the activities within various pockets in the plot so as to achieve early completion. The agency to deploy adequate equipment, machinery and labour as required for the completion of the entire work within the stipulated period specified. Also, ancillary facilities shall be provided by Contractor commensurate with requirement to complete the entire work within the stipulated period. Nothing extra shall be payable on this account. Adequate number/sets of equipment in working condition, along with adequate stand-by arrangements, shall be deployed during entire construction period. It shall be ensured by the Contractor that all the equipment, Tools & Plants, machineries etc. provided by him are maintained in proper working conditions at all times during the progress of the work and till the completion of the work. Further, all the constructional tools, plants, equipment and machineries provided by the Contractor, on site of work or his workshop for this work, shall be exclusively used in the construction of this work and they shall not be shifted/ removed from site without the permission of the Engineer-in-Charge.

6.3.6 The Contractor shall maintain all the work in good condition till the completion of entire work. The Contractor shall be responsible for and shall make good, all damages and repairs, rendered necessary due to fire, rain, traffic, floods or any other causes. The Engineer-in-Charge shall not be responsible for any claims for injuries to person/workmen or for structural damage to property happening from any neglect, default, want of proper care or misconduct on the part of the Contractor or of any other of his representatives, in his employment during the execution of the work. The compensation, if any, shall be paid directly to the IITB/ authority / persons concerned, by the Contractor at his own cost.

6.3.7 **Royalty:**
Royalty at the prevalent rates shall be paid by the Contractor or the RMC supplier as per the terms of supply between them, on all materials such as boulders, metals, all sizes stone aggregates, brick aggregates, coarse and fine sand, murum, earth, river sand, gravels and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned. Further, the Contractor needs to submit proof of submission of full royalty to the state government or local authority. Nothing extra shall be payable on this account.

6.3.8 **Preservation and Conservation measures**
(i) Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar
services, if any, encountered in the course of the execution of work shall be protected against the damage by the Contractor at his own expense. In case the same are to be removed and diverted, expenditure incurred in doing so shall be payable to the Contractor. The Contractor shall work out the cost, get the same approved by Dean (IPS) before taking up actual execution. The Contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services.

(ii) All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on project location during excavation/construction shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation. The Contractor will take reasonable precaution to prevent his work men or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer-in-charge of such discovery and carry out the official instructions of Engineer-in-charge for dealing with the same, till then all work shall be carried out in a way so as not to disturb/damage such article or thing.

6.3.9 Responsibility:

(i) He shall protect and indemnify IITB and its officials & employees against any claim and/or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts.

(ii) The Contractor shall assume all liability, financial or otherwise in connection with this Contract and shall protect and indemnify the IITB from any and all damages and claims that may arise on any account. The Contractor shall indemnify the IITB against all claims in respect of patent rights, royalties, design, trademarks- of name or other protected rights, damages to adjacent buildings, roads or members of public, in course of execution of work or any other reasons whatsoever and shall himself defend all actions arising from such claims and shall indemnify the IITB in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

(iii) The entire work up to the plinth level, as required for obtaining approval of the plinth from the local authority, shall be completed by the Contractor at the same time. Work above plinth shall be allowed to be carried out only after obtaining plinth approval from the local body. No delay shall be allowed on this ground and also no claim whatsoever on account of any delay in approval at plinth level by the local body shall be entertained from the Contractor. Nothing extra shall be payable on this account.

(iv) On completion of work, the Contractor shall submit required sets of “as built” drawings to the Dean (IPS) furnishing requisite information for obtaining various service connections.

6.3.10 Co-operation with other contractors / Specialized agencies / Associated contractors:

(i) The Contractor shall take all precautions to abide by the environmental related restrictions imposed by any statutory body having jurisdiction in the area as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Contractor, entirely to the satisfaction of the Engineer-in-Charge and disposed at designated places only. No claim what so ever on account of site constraints mentioned above or any other site constraints, lack of public transport, inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of construction machinery spare parts and any other constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Tenderers are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. Nothing extra shall be payable on this account.
The Contractor shall cooperate with and provide the facilities to the associate contractors and other agencies working at site for smooth execution of the work. The Contractor shall indemnify IITB against any claim(s) arising out of such disputes. The Contractor shall:

a) Allow use of scaffolding, toilets, sheds etc.

b) Properly co-ordinate their work with the work of other contractors.

c) Provide control lines and benchmarks to his associate contractors and the other contractors.

d) Provide electricity and water at mutually agreed rates.

e) Provide hoist and crane facilities for lifting material at mutually agreed rates.

f) Co-ordinate with other contractors for leaving inserts, making chases, alignment of services etc. at site.

g) Adjust work schedule and site activities in consultation with the Engineer-in-Charge and other contractors to suit the overall schedule completion.

h) Resolve the disputes with other contractors/associate contractors amicably and the Dean (IPS) shall not be made intermediary or arbitrator.

(iii) The work should be planned in a systematic manner so as to ensure proper co-ordination of various disciplines viz. sanitary & water supply, drainage, rain water harvesting, electrical, firefighting & fire alarm system, information technology, communication & electronics and any other services.

6.3.11 Supervision of Works:

The Contractor shall depute Site Engineer & skilled workers as required for the work. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured that all decision-making powers shall be available to the representatives of the Contractor at Mumbai itself to avoid any likely delays on this account. The Contractor shall also furnish list of persons for specialized works to be executed for various items of work. The Contractor shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the Dean (IPS) is of the opinion that the deployed staff is not sufficient or not well experienced, the Contractor shall deploy more staff or better-experienced staff at site to complete the work with quality and in stipulated time limit. Principle Technical representative of the Contractor having minimum experience in similar nature of work as mentioned in the clause 36 of the General Conditions of the Contract, shall always be available at the site during the actual execution of the work.

6.3.12 Eligible Criteria for specialized sub heads of the Contract Works

The successful bidder shall have to associate the specialized agencies / firms for carrying out each specialized sub heads separately. Eligibility Criteria for each of specialized Sub Head are as below. However, if the Contractor himself satisfies the eligibility criteria for any sub head, then the firm may carry out that work after getting the approval from the Engineer-in-Charge. The tenderer whose tender is accepted shall indicate the name(s) of his associated specialized agencies those fulfilling the eligibility criteria laid down below after award of work and at least 90 days before commencement of such items for the approval of the Engineer-in-Charge, whose decision shall be final and binding. If the tenderer, having valid electrical license applicable for E.I. works,
himself fulfils the eligibility criteria laid down below for associated specialized agencies, then the tenderer shall not require associating with himself the associated specialized agency.

Only reputed, technically qualified /OEM authorized Integrators or companies with sound financial state having past experience are to be engaged for carrying out sub head works. The Contractor shall provide necessary Documents, Evidence, Financial soundness and authorized dealer certificate to support their selection and seek approval of IITB prior to award of the Work. No traders or fair-weather suppliers should be engaged in Installation, Supply & Commissioning activity. Joint ventures are not accepted.

Eligibility Criteria for each sub head:

A. Specialized agency with experience of having successfully completed similar work during last seven years, ending last day of the month previous to the one in which tenders are invited.
   i. One similar work of value not less than 80% of the estimated cost of corresponding Sub head put to tender including applicable GST
   OR
   ii. Two similar works each of value not less than 60% of the estimated cost of corresponding Sub Head put to tender including applicable GST
   OR
   iii. Three similar works each of value not less than 40% of the estimated cost of corresponding Sub Head put to tender including applicable GST

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Specialized SubHead</th>
<th>Estimated cost of Sub Head (in Rs.) including 18% GST</th>
<th>Definition of Similar work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electrical Installation</td>
<td>1316.39 Lakhs</td>
<td>The agency shall have valid Electrical License.</td>
</tr>
<tr>
<td>2</td>
<td>Firefighting system</td>
<td>195.18 Lakhs</td>
<td>Similar work shall mean “Supply, Installation, Testing and Commissioning (SITC) of Fire Fighting System” and shall have valid license.</td>
</tr>
<tr>
<td>3</td>
<td>Electrical Low Voltage (ELV) System</td>
<td>271.92 Lakhs</td>
<td>Similar work shall mean “SITC of Addressable FireAlarm System, PA system, Telecom &amp; LAN, CC TV and Access Control system”</td>
</tr>
<tr>
<td>4</td>
<td>Lifts</td>
<td>130.67 Lakhs</td>
<td>Similar work shall mean “SITC of Lifts”</td>
</tr>
<tr>
<td>8</td>
<td>VRV / VRF TypeAir-Conditioning Systems</td>
<td>484.78 Lakhs</td>
<td>Similar work shall mean “SITC of VRV/ VRF type Air-Conditioning Systems”</td>
</tr>
<tr>
<td>10</td>
<td>Water proofing works</td>
<td>86.88 Lakhs</td>
<td>Similar work shall mean “Waterproofing Work /treatment”</td>
</tr>
</tbody>
</table>
ty of the Contractor to sort out any dispute / litigation with the Specialized Agencies without any time & cost overrun to IITB. The Contractor shall be solely responsible for settling any dispute / litigation arising out of his agreement with the Specialized Agencies. The Contractor shall ensure that the work shall not suffer on account of litigation/ dispute between him and the specialized agencies. No claim of hinderance in the work shall be entertained from the Contractor on this account. No extension of time shall be granted and no claim whatso ever, of any kind, shall be entertained from the Contractor on account of delay attributable to the selection/rejection of the Specialized Agencies or any dispute amongst them.

6.3.13 Quality Assurance and Testing of Materials:

(i) All material to be used in the work shall bear ISI certification mark unless otherwise the make is specified in the SOQ, list of approved makes and other conditions / specifications, appended with this tender document. In case ISI mark materials or the materials mentioned in the tender documents are not available, the material to be used shall conform to CPWD specifications applicable to this tender and / or national / international codes as approved by Dean (IPS). In such cases, the Engineer-in-charge shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified, as first quality by the manufacturers / suppliers shall be used in the work, unless otherwise specified. All materials not having ISI mark, if allowed to be used in the work by Dean (IPS), shall be tested as per relevant specifications, as approved by the Dean (IPS). In all cases of use of ISI marked materials, proper proof of procurement of materials from authentic manufacturers shall be provided by the Contractor to the entire satisfaction of Engineer in charge. The mass procurement of material should be done only after approval of IITB in writing.

(ii) The Contractor shall make available, on request from IITB, the copies of challan, cash memos, receipts and other certificates, if any, vouchers towards the quantity and quality of various materials procured for the work and the same shall be kept in record. The Contractor shall also provide information and necessary documentation on the name of the manufacturer, manufacturer’s product identification, manufacturer’s instructions, warning, date of manufacturing and test certificates (from manufacturers for the product

(iii) Inspection of Electrical items at Manufacturers works by consultant and client’s representative will have to be arranged by contractors if it is intended by Engineer in charge.

(iv) The Contractor has to establish field laboratory at site including all necessary equipment for field tests as given in Schedule ‘F’. All the relevant and applicable standards and specifications shall be made available by the Contractor at his cost in the field laboratory. The Contractor shall designate one of his technical representatives as Quality Assurance Engineer, who shall be responsible for carrying out all mandatory field/ laboratory tests. The Contractor shall also provide adequate supporting staff at his cost for carrying out field tests, packaging & forwarding of samples for outside laboratory tests and for maintaining test records. All the registers of tests carried out at site or in outside laboratories shall be maintained by the Contractor. All the entries in the test register will be made by the designated engineer of the Contractor and same shall be regularly reviewed by the Dean (IPS) or his authorized representatives at site.

(v) The Contractor shall submit, immediately after the award of work, a detailed and complete ‘Method Statement’ for the execution, testing and Quality Assurance, of such items of works, as directed by the Dean (IPS). All the materials to be used in the work shall comply with the requirements of the specifications and shall pass all the tests required as per specifications as applicable or such specifications / standards as directed by the Dean (IPS).
(vi) The Contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents, as per the item description and particular specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, only when the specified make is not available. This is, however, subject to documentary evidence produced by the contractor regarding non availability of the specified brand and also subject to independent verification by the Dean (IPS). In exceptional cases, where such approval is required, the decision of Dean (IPS) as regards equivalent make of the material shall be final and binding on the Contractor. No claim, whatsoever, of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account. Also, the material shall be procured only after written approval of the Dean (IPS).

(vii) All materials for construction / incorporation shall be got checked by the Engineer-In-Charge or his authorized personnel on receipt of the same at site before use.

(viii) The Contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor. The Contractor or his authorized representative shall remain in contact with the Engineer-in-Charge or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Contractor.

(ix) All expenditure to be incurred for testing of samples like packaging, sealing, transportation, loading, unloading, necessary personnel assistance in the process etc. including testing charges shall be borne by the Contractor.

(x) All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions before covering.

(xi) Water tanks, taps, sanitary, water supply and drainage pipes, fittings and accessories should conform to byelaws and municipal body / corporation where CPWD Specifications are not available. The Contractor should engage licensed plumbers for the work and get the materials (fixtures/fittings) tested by the Municipal Body/Corporation authorities wherever required at his own cost.

6.3.14 Program Chart:

(i) The Contractor shall prepare an integrated program chart within fifteen days of issue of award letter including civil as well as E & M activities for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfillment of the program within the stipulated period and submit the same for approval of the Dean (IPS). These shall be submitted by the Contractor through electronic media besides forwarding hard copies of the same. The integrated program chart so submitted should not have any discrepancy with the physical milestones attached in the Contract agreement. The program chart should include the following:

(ii) Descriptive note explaining sequence of various activities.

(iii) Construction Program prepared on PRIMAVERA Software, which will indicate resources in financial terms, manpower and specialized equipment for every important stage.

(iv) Program for procurement of materials by the Contractor.

(v) Program for arranging and deployment of manpower both skilled and unskilled so as to achieve targeted progress.

(vi) Program of procurement of machinery/equipment having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the
Part A-2, Conditions of the Contract – Additional Conditions of the Contract

Contractor.

(vii) In case of noncompliance/delay in compliance in this, a penalty @ Rs. 500/- per day will be imposed which will be recovered from the immediate next R/A Bill of the Contractor.

(viii) If at any time, it appears to the Dean (IPS) that the actual progress of work does not conform to the approved program referred above, the Contractor shall produce a revised program showing the modifications to the approved program by additional inputs to ensure completion of the work within the stipulated time.

(ix) The submission for approval by the Dean (IPS) of such program or the furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the Contract. This is without prejudice to the right of Engineer- In-Charge to take action against the Contractor as per terms and conditions of the agreement.

(x) Apart from the above integrated program chart, the Contractor shall be required to submit fortnightly progress report of the work in a computerized form on 1st and 16th of every month. The progress report shall contain the following, apart from whatever else may be required as specified above:

a. Construction schedule of the various components of the work through a bar chart for the next two fortnights (or as may be specified), showing the micro- milestone/milestones, targeted tasks (including material and labour requirement) and up to date progress. At least 10 digital photographs showing all the parts of construction site along with at least 5 minutes video of executions of different items in soft copy has to be submitted in every fortnightly progress report.

b. Progress chart of the various components of the work that are planned and achieved, for the fortnight as well as cumulative up to the fortnight under reckoning, with reason for deviations, if any in a tabular format.

c. Plant and machinery statement, indicating those deployed in the work.

(xi) In case of non-compliance / delay in compliance in submission of fortnightly, a penalty @ Rs. 1000/- per fortnightly report will be imposed which will be recovered from the immediate next R/A Bill of the Contractor.

(xii) IITB shall in no way be responsible for either any delay in getting electric and/or water and/or telephone connections for carrying out the work or not getting connections at all. No claim of delay or any other kind, whatsoever, on this account shall be entertained from the Contractor. Also, contingency arrangement of stand-by water & electric supply shall be made by the Contractor for commencement and smooth progress of the work so that work does not suffer on account of power failure or disconnection or not getting connection at all. No claim of any kind whatsoever shall be entertained on this account from the Contractor. Nothing extra shall be payable on this account.

6.3.15 Cleanliness of the Site:

(i) The Contractor shall not stack building material / malba/muck on the land or road of the institute or on the land owned by the others, as the case may be. So the muck, rubbish etc. shall be removed periodically as directed by the Dean (IPS), from the site of work to the approved dumping grounds as per the local bye laws and regulations of the concerned authorities and all necessary permissions in this regard from the local bodies shall be obtained by the Contractor. Nothing extra shall be payable on this account. In case, the Contractor is found stacking the building material / malba as stated above, the Contractor shall be liable to pay the stacking charges/penalty as may be levied by the local body or any other authority and also to face penal action as per the rules, regulations and bye-laws of such body or authority. The Engineer –in-Charge shall be at liberty to recover, such sums due but not paid to the concerned authorities on the above accounts, from any sums due to the Contractor including amount of the Security Deposit.
and performance guarantee in respect of this Contract agreement.

(ii) The Contractor shall take instructions from the Dean (IPS) regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, services and compound walls are to be constructed.

(iii) The Contractor shall take all care to prevent any water logging at site. The waste water, slush etc. shall not be allowed to be collected at site. For discharge into public drainage system, necessary permission shall be obtained from relevant authorities after paying the necessary charges, if any, directly to the authorities. The work shall be carried out in such a way that the area is kept clean and tidy. All the fees/charges in this regard shall be borne by the Contractor. Nothing extra shall be payable on this account.

6.3.16 Inspection of Work:

Officers of IIT Bombay or authorized personnel of IITB shall be inspecting the on-going work at site at any time with or without prior intimation. The Contractor shall, therefore, keep updated the following requirements and detailing.

(i) Display Board showing detail of work, weekly progress achieved with respect to targets, reason of shortfall, status of manpower, wages being paid for different categories of workers.

(ii) Entrance and area surrounding to be kept cleaned.

(iii) Display layout plan key plan, building drawings including plans, elevations and sections.

(iv) Up to date displays of Bar chart, CPM and PERT etc.

(v) Keep details of quantities executed, balance quantities, deviations, possible Extra item, substituted Item etc.

(vi) Keep plastic / cloth mounted one sets of building drawings.

(vii) Set of Helmets and safety shoes for exclusive use for officers/dignitaries visiting at site.

6.3.17 Final Testing of the Installation:

The Contractor shall demonstrate trouble free functioning of all the Civil, Mechanical, Electrical, Plumbing (MEP) installations and services. The Dean (IPS) or his authorized representatives shall carry out final inspection of the various Civil and MEP services and installations. Any defect(s) noticed during demonstration shall be rectified by the Contractor at his own cost to the entire satisfaction of the Dean (IPS). Nothing extra shall be payable on this account.

6.3.18 Defect Liability Period (Refund of Security Deposit):

The clause 17 of the General Conditions of the Contract shall be applied. The defect liability / maintenance period shall start after the date of issue of completion certificate. Besides observing other formalities prescribed in the General Conditions of the Contract, for release of security deposit, the Contractor shall have to produce a certificate stating that no defects are pending for rectification from the Dean (IPS), IIT Bombay or any other authorized representative of the IIT Bombay.

6.3.19 Unit Rates:

(i) Wherever any reference to any Indian Standards occurs in the documents relating to this Contract, the same shall be inclusive of all amendments issued thereto or revisions thereof, if any, up to the date of receipt of tenders.

(ii) Unless otherwise specified in the schedule of quantities, the rates for all items of work shall be considered, as inclusive of pumping out or bailing out water, if required throughout the construction period for which no extra payment shall be made. This shall
also include water encountered from any sources such as rains, floods, sub soil water table being high and/or due to any other cause whatsoever.

(iii) The rates for all items of work, shall unless clearly specified otherwise, include cost of all operations and all inputs of labour, material, T & P, wastages, transportation, scaffolding at all locations, levels and heights, wastages, watch and ward, other inputs, all incidental charges, all taxes, cess, VAT, duties, levies etc. required for execution of the work.

(iv) Unless otherwise provided in the Schedule of Quantities, the unit rates for the various items are inclusive of carrying out the works at and / or up to all heights, lifts, leads and depths.

(v) Unless otherwise specified in the Schedule of Quantities, the unit rates for the various items shall be inclusive of carrying out the work in curvilinear portions of the building in plan and elevation as per the architectural drawings. Nothing extra shall be payable on this account.

(vi) Waterproofing and Anti-termite Treatment items of work shall be carried out by specialized Agencies and shall carry 10 years warranty which shall commence from Project completion date.

(vii) All warranty obligations as per the Contract are deemed included in the unit rates. Warranty shall be provided in the standard formats incorporated in the Tender and mutually agreed format if not incorporated in the Tender.

6.3.20 Insurance Policies:

(i) Before commencing the execution of work, the Contractor shall, without in any way limiting his obligations and liabilities, insure at his own cost and expense against any damage or loss or injury, which may be caused to any person or property, at site of work. The Contractor shall obtain and submit to the Dean (IPS) proper Contractor All Risk Insurance Policy for an amount 1.25 times the Contract amount for this work, with Dean (IPS) as the first beneficiary. The insurance shall be obtained in joint names of Dean (IPS) and the Contractor (who shall be second beneficiary). Also, he shall indemnify the IITB from any liability during the execution of the work. Further, he shall obtain and submit to the Dean (IPS), a third-party insurance policy for maximum Rs.10 lakh for each accident, with the Dean (IPS) as the first beneficiary. The insurance shall be obtained in joint names of Dean (IPS) and the Contractor (who shall be second beneficiary).

(ii) The Contractor shall, from time to time, provide documentary evidence as regards payment of premium for all the Insurance Policies for keeping them valid till the completion of the work. The Contractor shall ensure that Insurance Policies are also taken for the workers of his Sub-Contractors / specialized agencies also. Without prejudice to any of its obligations and responsibilities specified above, the Contractor shall within 10 days from the date of letter of acceptance of the tender and thereafter at the end of each quarter submit a report to the IITB giving details of the Insurance Policies along with Certificate of these insurance policies being valid, along with documentary evidences as required by the Dean (IPS). No work shall be commenced by the Contractor unless he obtains the Insurance Policies as mentioned above. Also, no payment shall be made to the Contractor on expiry of insurance policies unless renewed by the Contractor. Nothing extra shall be payable on this account. No claim of hindrance (or any other claim) shall be entertained from the Contractor on these accounts.

6.3.21 Facilities for IITB:

(i) The Contractor shall provide, construct and maintain at all times during execution and till completion of the work, a temporary site office with adequate electrical light fittings, A.C., fans, electric/ power points, switches etc. at his cost for exclusive use of the Dean (IPS) and his authorized representatives, Program Management Consultants and Architects.
Area of such office shall be approximately 160 sqm and shall have required partitions, doors, windows, locking arrangement etc. with a conference hall for 20 persons with conference table, chairs etc. all as per direction of Dean (IPS). Adequate toilet facilities connected to a temporary septic tank /soak pit, drinking water with water purifier & cooler etc. shall also be provided in the site office. All the water and electricity charges for the site office shall be borne by the Contractor. The Contractor shall provide one licenced software PRIMAVERA to IITB.

(ii) The Contractor shall at all reasonable times provide access to the Dean (IPS) or his authorized representative to the workshops, factories or other places where materials are stored, for inspection and/or collection of samples. Nothing extra shall be payable on this account.

6.3.22 Preparation of Mockups and Sample Units:

The Contractor shall prepare & display mock-ups in actual position of each and every item and obtain approval of Dean (IPS) before execution in masse. The mock up shall be preserved for the purpose of reference till completion of the item represented by the mock up. Similarly, the Contractor shall prepare two sample toilet blocks comprising of all finishes and fittings included in the scope of this Contract. Approval of Dean (IPS) shall be obtained before taking up finishing works en masse. The work executed in approved mock ups / sample units in actual position forming part of the main work shall be measured and paid to the Contractor under the respective items of the Contract. However, any mock-up/sample not approved shall not be measured and paid. Also, the Contractor shall have to dismantle and remove the same from the site of work at his cost. However, those mock-up/ samples not prepared in actual position and not forming the part of main work shall not be paid.

6.3.23 Standard operating procedure for GRIHA during construction:

It is envisaged to obtain minimum 3-star GRIHA rating from TERI for building to be constructed under this Contract. The Contractor shall strictly adhere to the following conditions as part of his contractual obligation. Tendered Amount deemed to be inclusive of expenditure on this account and nothing extra shall be paid for these compliances.

(i) The Contractor shall give priority to sourcing materials which are manufactured within a 400 km radius of the Project site.

(ii) Barricading of existing retained trees shall be provided with brick foundation single layer, bamboo/bar supports & covered with transparent green cloth.

(iii) Sedimentation & erosion control system shall be provided by construction of temporary sedimentation tank at the lowest level of site. (Dimensions- 2 m X 2 m X 0.6 m) along with wire mesh filter at the outlet. Once the sediments in Water settle down, the water can be pumped into the city storm-water drains. Nothing extra shall be paid on this account.

(iv) TOP SOIL PROTECTION: Top soil to be tested by accredited laboratory of ICAR – Indian Council of Agricultural Research. Parameters to be checked in test are for primary plant nutrients {Organic Carbon (%), Alkaline KMnO4 Nitrogen (%), Olsen Phosphorus (Kg/ha), Ammonia Acetate Potassium (mg/g)} and pH. Top soil up to 20 cm in depth to be removed from the areas proposed for the buildings, roads, paved areas and external services. The top soil should be stockpiled to a height of 40 cm and reapplied during plantation of the proposed vegetation. Nothing extra shall be paid on this account

(v) Provide minimum level of sanitation/safety facilities for construction workers: The agency shall ensure compliance with the NBC (latest revision) safety norms for providing the necessary safety equipment and measures for construction workers. Provisions for drinking water, healthy and clean-living conditions and sanitation facilities shall be provided for the workers. Nothing extra shall be paid on this account.
(vi) Barricading of complete site along with suitable gates for vehicular and personnel movement shall be carried out and removed after completion of the Project including intermittent removal and reconstruction as and when needed to facilitate the construction or ease of movement of the vehicles / machinery / personnel. Payment towards this activity is made as per the item provision in the Bill of Quantities (BOQ) under Part D2 of the Tender.

(vii) Spraying of water on loose soil at site shall be done by the agency at regular interval. Nothing extra shall be paid on this account.

(viii) Wheel washing facility for outgoing vehicles- Gravel bed where truck types will be washed before exit from site. Nothing extra shall be paid on this account.

(ix) Efficient water use during construction: Use waste jute bags to cover columns and beams during curing. Nothing extra shall be paid on this account.

(x) Percolation test: A percolation test needs to be carried out to ascertain the recharging rate of water and to know the ground water table at site. Nothing extra shall be paid on this account.

(xi) Storage & segregation of recyclable waste generated at site: A separate storage area (weather proof shed) to be maintained at site for the following materials: Steel/Aluminium/Metals- Should be sent to recyclers.

a. RMC- should be used for back filing
b. Concrete debris-should be used for back filing
c. Blocks-should be used for back filing
d. Glass-Should be sent to recyclers
e. Wood-Should be sent to recyclers
f. Cement bags/Plastics-Should be sent to recyclers

(xii) Water Meters shall be provided for the following:

a. Municipal Inlet
b. Bore Well inlet
c. STP Outlets
d. Treated water Flushing
e. Treated water Landscaping

(xiii) Firefighting system: It shall be CFC free and Halon free.

(xiv) Energy meter for the following:

a. Main Source (from electricity supply company)
b. Alternate source DG
c. Internal lighting,
d. External lighting,
e. Air Conditioning,
f. Solar PV system
g. Major loads, if any.
(xv) Automatic controls for 100% of outdoor lightings: Automatic switches (Timer) for 100% of outdoor lights.

(xvi) Luminous efficacy of 100% of lamps used in outdoor lighting to meet the lamp luminous efficacy table shown.

(xvii) Lighting levels in tabular format for all indoor spaces along vis-à-vis the lighting levels required by NBC 2005 (BIS 2005).

(xviii) HVAC System
   a. The efficiencies of the air conditioning system should be as (mandatory): o Split ACs- IS 1391 – part 2(table 5.3)
   b. Refrigeration system should be CFC free. (mandatory).
   c. Insulation proposed in the building is CFC & HCFC free. (mandatory)
   d. Fresh air calculations for all spaces (conditioned & non-conditioned areas) as per NBC Part 8, section-3 or as per ASHARE 62-4 ventilation std. (mandatory).

(xix) No Smoking
   No smoking signages to be installed in the project building at various places/common areas. Penalty clause to be included in the signages.
6.4 SPECIAL CONDITIONS OF THE CONTRACT:

(PERTAINING TO SITE FACILITIES /RESTRICTIONS)

a. IIT Bombay is fully residential and fully operational campus. The bidders are advised to take utmost care while executing the works that minimum/ no disturbances happen to the users. The bidder shall also protect site of work from the unauthorized entry of any persons by erecting necessary barricading as specified for which payments shall be done under relevant item.

b. IIT Bombay campus is situated in densely populated locality of Mumbai with huge flow of traffic in the roads leading to IIT Bombay. The bidders shall fully understand restrictions before participating in the tender. Nothing extra shall be paid on this account. No delay or claims of any kind shall be entertained from the Contractor on this account.

c. Since the campus is fully residential, no concrete plant/ batch mix plant/ ready mix plant shall be allowed inside the IIT campus. Nothing extra shall be paid on this account.

d. Water only for drinking purposes on chargeable basis shall be made available by IIT Bombay at one point near the site. The agency shall be required to lay the grid as per their requirement for which nothing extra shall be paid on this account. Charges @ Rs.7/- per kilo litre or as per prevailing rate from time to time and 70% of sewerage charges (i.e Rs 11.90 per kilo litres) plus GST shall be payable to IITB. The Contractor shall be required to pay water charges at regular interval as desired by IITB. RA bill/Final bill shall be paid only after proof of up-to-date payment of water charges and sewerage charges submitted to the Dean (IPS).

e. Water for construction purposes shall be responsibility of Contractor. Bore well will be allowed only after permission from IITB (subjected the quality of water conforms to CPWD specification /applicable BIS Code and after obtaining all approval from local body/administration/ competent authority. The contractors shall hand over the bore well in working condition to IIT after completion of work for which nothing extra shall be paid. In case approval for drilling bore well not granted by IITB/ local body/ competent authority, the Contractor shall make own arrangement for tanker water for which nothing extra shall be paid.

f. Electricity connection shall be provided by IIT at one point near the site. The Contractor shall make is own arrangement for tapping at multiple locations and distribution network for which nothing extra shall be paid. Consumption charges as per MSEDCyll TII Commercial tariffs. The current rates are at Rs 14.11 per unit and Rs.640.00 fixed monthly charges or as per prevailing rate from time to time shall be payable to IITB by the Contractor. Before tendering, he shall visit the site and assess the manner in which he is able to arrange the above facilities. The Dean (IPS) shall in no way be responsible for any delay on this account and no claim, whatsoever, on this account shall be entertained. The Contractor shall be required to pay electricity charges at regular interval as desired by IITB. RA bill/ Final bill shall be paid only after proof of up-to-date payment of electricity charges submitted to the Engineer-in-Charge.

g. The Contractor shall abide by the rules /bye laws applicable in respect of water z/electricity connection and he shall be solely responsible for any penalty on account of violation of any of the rules / bye laws in this regard. The Contractor shall indemnify the IITB against any claim arising out of pilferage, theft, damage, penalty, non-settlement of bills etc. whatsoever on this account.

h. Space for site office, site storage yard and worker restrooms (including toilets) shall be provided in the vicinity of site free of ground rent. The agency shall be required to establish all such facilities and for which nothing extra shall be paid. It shall be responsibility of agency to transport the material from material stacking yard to site and for which nothing extra shall be paid. In case any building or infrastructure work is required to be executed on the land occupied by the site office/site store/workers rest room/ labour camp, agency shall relocate these shelters for which nothing extra shall be paid.
i. Site office facilities for IITB and / or the representatives appointed by IITB (PMC and Architect Consultants) shall be provided by the Contractor at free of cost on the free issued land / plot by IITB in the vicinity of the Site / Work as elaborated in the Special Conditions of the Contract.

j. Contractor shall make temporary access / approach roads to the work site / storage areas etc. to suite with the movement and loads of the transport vehicles including smooth movements during monsoon period at free of cost and deemed included in the Tendered price.

k. The Contractor has to provide creche facility for the children of labour deployed in the work. The Contractor also has the option of sending children of labour to the creche facility run by IITB. To avail the facility of IIT run creche facility, the Contractor shall be required to pay @Rs.18,000/- per month to IITB for contribution towards running of the creche facility for the full or part month during which such facility was availed. The Contractor shall be required to pay contribution at regular interval, as desired by IITB. However, IITB has no liability to run the creche facility in case of any unforeseen circumstances.

l. Public Health Officer of IITB shall be authorized to check the cleanliness and hygienic of the site & labour accommodation units and suggestion given by him will be binding on the Contractor for which nothing extra shall be paid.

m. The Contractor shall be required to strictly follow security norms and procedure in terms of entry/exit passes to all the vehicles/ persons/ materials, issue/ reissue/ surrender of labour passes and other rules and regulations that will be brought in force from time to time by IITB. Any penalty imposed by IIT Bombay for violating security norms will be immediately paid by the Contractor for which nothing extra shall be paid.

n. All pre-fabrication works wherever possible shall be carried outside the IITB premises and only assembling and finishing portion of the work shall be at the site of work.

o. Trees existing in the vicinity of construction area need to be preserved throughout the construction period and till final handing over of the Building to IITB. The Contractor shall take every measure for protection of such trees and nothing extra shall be paid on this account.

p. Space of about 500 Sq. M designated place for labour accommodation shall be provided within the campus. Whole area of labour accommodation shall be cordoned off by erecting GI Sheet of height 3.5 metre for which nothing extra shall be paid. The Bidder Shall be required to construct labour accommodation neatly with proper sanitation including soak pit etc. The bidder shall follow security regulations issued by IITB from Time to time. Nothing extra shall be paid on this account. Bidder shall be required to pay at Rs.40 / month (Including applicable GST) per Sq.M or part thereof to IITB toward licence fee for the area being used for labour hutment. After completion of work area shall be handed over in original condition.

q. Contractor shall be responsible to establish the Closed-Circuit Television (CCTV) Surveillance system for the entire construction Site throughout the Construction activity right from the taking over the Site and till handed over the Building and Facility to IITB.

r. CCTV Surveillance system of HD quality shall be included with the necessary hardware, software, networking cables, switches, signal boosters etc. for construction site shall cater minimum requirements but not limited to the following:

- Real time viewing, watching progress as it unfolds
- Record of constant traffic all day long and during the night
- Keeping track of all the construction and other activities that occur at the site on day-to-day basis
- Archiving, all major project milestones saved and logged
- Embeddable video (java script), to view any of the site related feeds on the website.
• CCTV camera shall act as deterrent against crime and vandalism at site
• CCTV cameras shall be able to provide a virtual experience of going around the entire site to determine the progress of work and current worker's activities at site.
• Timelapse video of the construction progress from commencement to till date of the request

The cost towards CCTV Surveillance system establishment and removal after completing the project is deemed included in the tendered amount and shall not be paid separately.
7. **SAFETY CODE**

1. Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder issued, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and handhold shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (¼ horizontal and 1 vertical).

2. Scaffolding of staging more than 3.6 m (12 ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3 ft.) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6m(12ft.) above ground level or floor level they should be closely boarded, should have adequate width and should be suitably fastened as described in (2) above.

4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm,(3ft.)

5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladders shall be over 9 m. (30 ft.) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (11½") for ladder up to and including 3 m. (10 ft.) in length. For longer ladders, this width should be increased at least ¼" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit; action or proceedings to any such person or which may, with the consent of the Contractor, be paid to compensate any claim by any such person.

6. Excavation and Trenching - All trenches 1.2 m. (4 ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100 ft.) in length or fraction thereof, Ladder shall extend from bottom of the trench to at least 90 cm. (3 ft.) above the surface of the ground. The side of the trenches which are 1.5 m. (5 ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5 ft.) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done.

7. Safety Measures for digging bore holes: -

   a. If the bore well is successful, it should be safely capped to avoid caving and collapse of the borewell. The failed and the abandoned ones should be completely refilled to avoid caving and collapse;

   b. During drilling, Sign boards should be erected near the site with the address of the drilling contractor and the Engineer in-charge of the work;

   c. Suitable fencing should be erected around the well during the drilling and after the installation of the rig on the point of drilling, flags shall be put 50 m around the point
8. **Part A-2, Conditions of the Contract – Health and Sanitary Arrangements**

of drilling to avoid entry of people;

d. After drilling the borewell, a cement platform (0.50 m x 0.50 m x 1.20 m) 0.60 m above ground level and 0.60 m below ground level should be constructed around the well casing;

e. After the completion of the borewell, the Contractor should cap the bore well properly by welding steel plate, cover the bore well with the drilled wet soil and fix thorny shrubs over the soil. This should be done even while repairing the pump;

f. After the borewell is drilled the entire site should be brought to the ground level.

8. All necessary personal safety equipment as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractors should take adequate steps to ensure proper use of equipment by those concerned. The following safety equipment shall invariably be provided.

a. Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles

b. Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes, shall be provided with protective goggles.

c. Those engaged in welding works shall be provided with welder’s protective eye shields.

d. Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

e. When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public. In addition, the Contractor shall ensure that the following safety measure are adhered to:-

   i. Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.

   ii. At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.

   iii. Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.

   iv. Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.

   v. Safety belt with rope should be provided to the workers. While working inside the manholes, such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

   vi. The area should be barricaded or cordoned of by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

   vii. No smoking or open flames shall be allowed near the blocked manhole being cleaned.

   viii. The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of
slippery nature of the malba.

ix. Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-in-Charge shall decide the time up to which a worker may be allowed to work continuously inside the manhole.

x. Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

xi. Air-blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

xii. The workers engaged for cleaning the manholes/sewers should be properly trained before allowing to work in the manhole.

xiii. The workers shall be provided with Gumboots or non-sparking shoes bump helmets and gloves non sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

xiv. Workmen descending a manhole shall try each ladder stop or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

xv. If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

xvi. The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

9. The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:

a. No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

b. Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

c. Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

10. Workmen executing work on scaffolds or other structures above specified height shall be provided with full body harness and fall arresters.

11. An additional clause (viii)(i) of Central Public Works Department Safety Code (iv) the Contractor shall not employ women and men below the age of 18 on the work of painting with product containing lead in any form, wherever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use:

(a) White lead, sulphate of lead or product containing this pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.

(b) Measures shall be taken, wherever required in order to prevent danger arising from the application of a paint in the form of spray.

(c) Measures shall be taken, wherever practicable, to prevent danger arising out of from
(d) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

(e) Overall, shall be worn by working painters during the whole of working period.

(f) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.

(g) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man appointed by competent authority of IITB

(h) IITB may require, when necessary medical examination of workers.

(i) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

12. When the work is done near any place where there is risk of drowning, all necessary equipment's should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision, should be made for prompt first aid treatment of all injuries likely to be obtained during the course of the work.

13. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

(a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and in good working order.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

(c) Every crane driver or hoisting appliance operator, shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

(d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(e) In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in-Charge. As regards Contractor’s machines the contractors shall notify the safe working load of the machine to the Engineer-in-Charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.

14. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

15. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

16. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the Contractor.
17. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the Contractor shall be open to inspection by the Labour Officer or Engineer-in-Charge of the department or their representatives.

18. Notwithstanding the above clauses from (1) to (15), there is nothing in these to exempt the Contractor from the operations of any other Act or Rule in force in the Republic of India.

8. **MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY CONTRACTORS.**

   **A. APPLICATION**
   These rules shall apply to all buildings and construction works in charge of Central Public Works Department/PWD (DA) in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the Contract work is in progress.

   **B. DEFINITION**
   Workplace means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the Contract work is in progress.

   **C. FIRST-AID FACILITIES**
   (a) At every workplace, there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed.

   (b) The first-aid box shall be distinctly marked with a red cross on white background and shall contain the following equipment:

   (c) For workplaces in which the number of contract labour employed does not exceed 50: Each first-aid box shall contain the following equipment:

   (i) 6 small sterilised dressings.

   (ii) Medium size sterilised dressings.

   (iii) Large size sterilised dressings.

   (iv) Large sterilised burn dressings.

   (v) 1 (30ml.) bottle containing two percent alcoholic solution of iodine.

   (d) 1 (30 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.

   (i) 1 snakebite lancet.

   (ii) 1 (30 gms.) bottle of potassium permanganate crystals.

   (iii) 1 pair scissors.

   (e) 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.

   (i) 1 bottle containing 100 tablets (each of 5 gms.) of aspirin.

   (ii) Ointment for burns.

   (iii) A bottle of suitable surgical antiseptic solution.

   (f) For workplaces in which the number of contract labour exceed 50. Each first-aid box shall contain the following equipment:

   (i) 12 small, sterilised dressings.

   (ii) 6 medium size sterilised dressings.

   (iii) 6 large size sterilised dressings.
(iv) 6 large size sterilized burn dressings.
(v) 6 (15 gms.) packets sterilized cotton wool.
(vi) 1 (60 ml.) bottle containing a two per cent alcoholic solution iodine.
(vii) 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
(viii) 1 roll of adhesive plaster.
(ix) 1 snake bite lancet.
(x) 1 (30 gms.) bottle of potassium permanganate crystals.
(xi) 1 pair scissors.
(xii) 1 copy of the first-aid leaflet issued by the Director General Factory Advice Service and Labour Institutes /Government of India.
(xiii) A bottle containing 100 tablets (each of 5 gms.) of aspirin.
(xiv) Ointment for burns.
(xv) A bottle of suitable surgical antiseptic solution.
(g) Adequate arrangements shall be made for immediate recoupment of the equipment when necessary.
(h) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.
(i) A person in charge of the First-aid box shall be a person trained in First-aid treatment in the work places where the number of contract labour employed is 150 or more.
(j) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.
(k) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

D. **DRINKING WATER**

(a) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.
(b) Where drinking water is obtained from an Intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.
(c) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and waterproof.
(d) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

E. **WASHING FACILITIES**

(a) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.
(b) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.
(c) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.
F. **LATRINES AND URINALS**

(a) Latrines shall be provided in every work place on the following scale namely:

(b) Where female are employed, there shall be at least one latrine for every 25 females.

(c) Where males are employed, there shall be at least one latrine for every 25 males.

(d) Provided that, where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be up to the first 100, and one for every 50 thereafter.

(e) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

(f) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting non-absorbent materials and shall be cement washed inside and outside at least once a year. Latrines shall not be of a standard lower than borehole system.

(g) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers “For Men only” or “For Women Only” as the case may be.

(h) The notice shall also bear the figure of a man or of a woman, as the case may be.

(i) There shall be at least one urinal for male workers up to 50 and one for female workers up to fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeding 500, it shall be sufficient if there is one urinal for every 50 males or females up to the first 500 and one for every 100 or part thereafter.

   (i) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.

   (ii) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

(j) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

(k) Disposal of excreta: - Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure).

(l) The Contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the Contractor’s workmen or employees on the site. The Contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

G. **PROVISION OF SHELTER DURING REST**

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10 ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sq.m. per head.

Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.
H. CRECHES

(a) At every work place, at which 20 or more women workers are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H (ii) a,b& c.

(b) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

(c) The Contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bedroom.

(d) The Contractor shall provide one ayaa to look after the children in the creche when the number of women workers does not exceed 50 and two when the number of women workers exceed 50.

(e) The use of the rooms earmarked as creches shall be restricted to children, their attendants and mothers of the children.

I. CANTEENS

(a) In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the Contractor for the use of such contract labour.

(b) The canteen shall be maintained by the Contractor in an efficient manner.

(c) The canteen shall consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils.

(d) The canteen shall be sufficiently lighted at all times when any person has access to it.

(e) The floor shall be made of smooth and impervious materials and inside walls shall be lime-washed or colour washed at least once in each year.

(f) Provided that the inside walls of the kitchen shall be lime-washed every four months.

(g) The premises of the canteen shall be maintained in a clean and sanitary condition.

(h) Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.

(i) Suitable arrangements shall be made for the collection and disposal of garbage.

(j) The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time.

(k) The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square metre per diner to be accommodated as prescribed in sub-Rule 9.

(i) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.

(ii) Washing places for women shall be separate and screened to secure privacy.

(a) Sufficient tables stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9.

(b) There shall be provided and maintained sufficient utensils crockery, furniture and any other equipment necessary for the efficient running of the canteen.

(c) The furniture utensils and other equipment shall be maintained in a clean and hygienic condition.

(d) Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.
(e) A service counter, if provided, shall have top of smooth and impervious material.

(f) Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment’s.

(g) The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.

(h) The charges for food stuffs, beverages and any other items served in the canteen shall be based on ‘No profit, No loss’ and shall be conspicuously displayed in the canteen.

(i) In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be taken into consideration as expenditure namely:-

   (i) The rent of land and building.

   (ii) The depreciation and maintenance charges for the building and equipment provided for the canteen.

   (iii) The cost of purchase, repairs and replacement of equipment including furniture, crockery, cutlery and utensils.

   (iv) The water charges and other charges incurred for lighting and ventilation.

   (v) The interest and amounts spent on the provision and maintenance of equipment provided for the canteen.

(j) The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

J. ANT MALARIAL PRECAUTIONS:

(a) The Contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrow pits which may have been dug by him.

(b) The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

K. AMENDMENTS

Government may, from time to time, add to or amend these rules and issue direction-- it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.
9. CONTRACTOR’S LABOUR REGULATIONS

A. SHORT TITLE

These regulations may be called the CPWD / PWD (DA) Contractors Labour Regulations.

B. DEFINITIONS

(a) Workman means any person employed by IITB or its Contractor directly or indirectly through a subcontractor with or without the knowledge of the IITB to do any skilled, semiskilled or unskilled manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment are expressed or implied but does not include any person:

(i) Who is employed mainly in a managerial or administrative capacity: or

(ii) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of powers vested in him, functions mainly of managerial nature: or

(iii) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the principal employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the principal employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer.

(b) No person below the age of 14 years shall be employed to act as a workman.

(c) Fair Wages means wages whether for time or piece work fixed and notified under the provisions of the Minimum Wages Act from time to time.

(d) Contractors shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor.

(e) Wages shall have the same meaning as defined in the Payment of Wages Act.

(f) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

(g) When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week, he shall be paid over time for the extra hours put in by him at double the ordinary rate of wages.

(h) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time irrespective of whether such worker is governed by the Minimum Wages Act or not.

(i) Where the minimum wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages at the rate applicable to the next preceding day, provided he has worked under the same Contractor for a continuous period of not less than 6 days.

(j) Where a Contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day on one of the five days immediately before or after the normal weekly holiday and pay wages to such worker for the work performed on the normal weekly holiday at overtime rate.

C. DISPLAY OF NOTICE REGARDING WAGES ETC.

The Contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clear and legible condition in
conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers giving the minimum rates of wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix 'III'.

D. **PAYMENT OF WAGES**

(a) The Contractor shall fix wage periods in respect of which wages shall be payable.

(b) No wage period shall exceed one month.

(c) The wages of every person employed as contract labour in an establishment or by a Contractor where less than one thousand such persons are employed shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.

(d) Where the employment of any worker is terminated by or on behalf of the Contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.

(e) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.

(f) Wages due to every worker shall be paid to him direct by Contractor through Bank or ECS or online transfer to his bank account.

(g) All wages shall be paid through Bank or ECS or online transfer.

(h) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.

(i) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the Contractor to the Engineer-in-Charge under acknowledgment.

(j) It shall be the duty of the Contractor to ensure the disbursement of wages through bank account of labour.

(k) The Contractor shall obtain from the Junior Engineer or any other authorised representative of the Engineer-in-Charge as the case may be, a certificate under his signature at the end of the entries in the “Register of Wages” or the “Wage-cum-Muster Roll” as the case may be in the following form:

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified that the amount shown in column No ................................ has been paid to the workman concerned through bank account of labour on ................................ at...........</td>
</tr>
</tbody>
</table>

E. **FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES**

(a) The wages of a worker shall be paid to him without any deduction of any kind except the following:

(b) Fines

(c) Deductions for absence from duty i.e., from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

(d) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody or for loss of money or any other deduction which he is required to account, where such damage or l

(e) Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register.
(f) Any other deduction which the Central Government may from time to time allow.

(g) No fines should be imposed on any worker save in respect of such acts and
omissions on his part as have been approved of by the Chief Labour Commissioner.

Note: - An approved list of Acts and Omissions for which fines can be imposed is enclosed at
Appendix-X

(h) No fine shall be imposed on a worker and no deduction for damage or loss shall be
made from his wages until the worker has been given an opportunity of showing
cause against such fines or deductions.

(i) The total amount of fine which may be imposed in any one wage period on a worker
shall not exceed an amount equal to three paise in a rupee of the total wages,
payable to him in respect of that wage period.

(j) No fine imposed on any worker shall be recovered from him by instalment, or after
the expiry of sixty days from the date on which it was imposed.

(k) Every fine shall be deemed to have been imposed on the day of the act or omission
in respect of which it was imposed.

F. LABOUR RECORDS

(a) The Contractor shall maintain a Register of persons employed on work on contract in
Form XIII of the CL(R&A) Central Rules 1971 (Appendix IV)

(b) The Contractor shall maintain a Muster Roll register in respect of all workmen
employed by him on the work under Contract in Form XVI of the CL (R&A) Rules
1971 (Appendix V).

(c) The Contractor shall maintain a Wage Register in respect of all workmen employed
by him on the work under contract in Form XVII of the CL (R&A) Rules 1971
(Appendix VI).

(d) Register of accidents - The Contractor shall maintain a register of accidents in such
form as may be convenient at the work place but the same shall include the following
particulars:

(e) Full particulars of the labourers who met with accident.

(f) Rate of Wages.

(g) Sex

(h) Age

(i) Nature of accident and cause of accident.

(j) Time and date of accident.

(k) Date and time when admitted in Hospital,

(l) Date of discharge from the Hospital.

(m) Period of treatment and result of treatment.

(n) Percentage of loss of earning capacity and disability as assessed by Medical Officer.

(o) Claim required to be paid under Workmen’s Compensation Act.

(p) Date of payment of compensation.

(q) Amount paid with details of the person to whom the same was paid.

(r) Authority by whom the compensation was assessed.

(s) Remarks

(t) The Contractor shall maintain a Register of Fines in the Form XII of the CL (R&A)
Rules 1971 (Appendix-XI)
(u) The Contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omissions for which fines can be imposed (Appendix-X).

(i) The Contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix-XII).

(ii) The Contractor shall maintain a Register of Advances in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIII).

(iii) The Contractor shall maintain a Register of Overtime in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV).

G. ATTENDANCE CARD-CUM-WAGE SLIP

(a) The Contractor shall issue an Attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-VII).

(b) The card shall be valid for each wage period.

(c) The Contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.

(d) The card shall remain in possession of the worker during the wage period under reference.

(e) The Contractor shall complete the wage slip portion on the reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.

(f) The Contractor shall obtain the signature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

H. EMPLOYMENT CARD

The Contractor shall issue an Employment Card in Form XIV of the CL (R&A) Central Rules 1971 to each worker within three-days of the employment of the worker (Appendix-VIII).

I. SERVICE CERTIFICATE

On termination of employment for any reason whatsoever the Contractor shall issue to the workman whose services have been terminated, a Service certificate in Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX).

J. PRESERVATION OF LABOUR RECORDS

All records required to be maintained under Regulations Nos. 6 & 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorised by the Ministry of Urban Development in this behalf.

K. POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY

The Labour Officer or any person authorised by Central Government on their behalf shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and the Provisions of these Regulations. He shall investigate into any complaint regarding the default made by the Contractor or sub-contractor in regard to such provision.

L. REPORT OF LABOUR OFFICER

The Labour Officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Executive Engineer concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the Contractor’s bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the Contractor under Clause 13 of these regulations, actual payment to labourers will be made by the
Executive Engineer after the Superintending Engineer has given his decision on such appeal.

(a) The Executive Engineer shall arrange payments to the labour concerned within 45 days from the receipt of the report from the Labour Officer or the Superintending Engineer as the case may be.

M. APPEAL AGAINST THE DECISION OF LABOUR OFFICER

Any person aggrieved by the decision and recommendations of the Labour Officer or other person so authorised may appeal against such decision to the Superintending Engineer concerned within 30 days from the date of decision, forwarding simultaneously a copy of his appeal to the Executive Engineer concerned but subject to such appeal, the decision of the officer shall be final and binding upon the Contractor.

N. PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER

(a) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by:-

(i) An officer of a registered trade union of which he is a member.

(ii) An officer of a federation of trade unions to which the trade union referred to in clause (a) is affiliated.

(iii) Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed.

(b) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by:

(i) An officer of an association of employers of which he is a member.

(ii) An officer of a federation of associations of employers to which association referred to in clause (a) is affiliated.

(iii) Where the employer is not a member of any association of employers, by an officer of association of employer connected with the industry in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged.

(iv) No party shall be entitled to be represented by a legal practitioner in any investigation or enquiry under these regulations.

O. INSPECTION OF BOOKS AND SLIPS

The Contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorised by the Central Government on his behalf.

P. SUBMISSIONS OF RETURNS

The Contractor shall submit periodical returns as may be specified from time to time.

Q. AMENDMENTS

The Central Government may from time to time add to or amend the regulations and on any question as to the application/Interpretation or effect of those regulations the decision of the Engineer-In-Charge shall be final.
## REGISTER OF MATERNITY BENEFITS (Clause 19 F)

<table>
<thead>
<tr>
<th>Name of the employee</th>
<th>Father’s/husband’s name</th>
<th>Nature of employment</th>
<th>Period of actual employment</th>
<th>Date on which notice of confinement given</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Date on which maternity leave commenced and ended

<table>
<thead>
<tr>
<th>Date of delivery/ miscarriage</th>
<th>In case of delivery</th>
<th>In case of miscarriage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                              |                     |                         |
| 6                              | 7                   | 8                        |
| 9                              | 10                  |                          |

### Leave pay to the employee

<table>
<thead>
<tr>
<th>Rate of leave pay</th>
<th>Amount paid</th>
<th>Rate of leave pay</th>
<th>Amount paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>
Part A-2. Conditions of the Contract – Contractor’s Labour Regulations

SPECIMEN FORM OF THE REGISTER, REGARDING MATERNITY BENEFIT ADMISSIBLE TO THE CONTRACTOR’S LABOUR IN CENTRAL PUBLIC WORKS DEPARTMENT WORKS.

1. Name and address of the contractor

2. Name and location of the work

3. Name of the woman and her husband’s name

4. Designation

5. Date of appointment

6. Date of discharge/dismissal, if any.

7. Date of production of certificates in respect of pregnancy

8. Date on which the woman informs about the expected delivery

9. Date of delivery/miscarriage/death

10. Date of production of certificate in respect of delivery/miscarriage

11. Date with the amount of maternity/death benefit paid in advance of expected delivery.

12. Date with amount of subsequent payment of maternity benefit

13. Name of the person nominated by the woman to receive the payment of the maternity benefit after her death.

14. Signature of the contractor authenticating entries in the register

15. Remarks column for the use of Inspecting Officer.
# Labour Board

**Name of work**

**Name of Contractor**

**Address of Contractor**

**Name and address of C.P.W.D. Division**

**Name of C.P.W.D. Labour Officer**

**Address of C.P.W.D. Labour Officer**

**Name of Labour Enforcement Officer**

**Address of Labour Enforcement Officer**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Minimum wage fixed</th>
<th>Actual wage paid</th>
<th>Number present</th>
<th>Remarks</th>
</tr>
</thead>
</table>

**Weekly holiday**

**Wage period**

**Date of payment of wages**

**Working hours**

**Rest interval**
Part A-2, Conditions of the Contract – Contractor’s Labour Regulations

Appendix IV

<table>
<thead>
<tr>
<th>क्रम</th>
<th>Name of workman</th>
<th>Father/Husband's name</th>
<th>Date of birth</th>
<th>Permanent home address (Village and Tehsil)</th>
<th>Local address</th>
<th>Date of commencement of employment</th>
<th>Date of termination of employment</th>
<th>Reasons for terminations</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>क्र. संख्या</td>
<td>नाम व लिखित नाम</td>
<td>श्रेणी</td>
<td>जीता/पति का नाम</td>
<td>तिथियाँ</td>
<td>नोट्स</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------</td>
<td>-------</td>
<td>-----------------</td>
<td>-------</td>
<td>-------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name and address of principal employer: For the Month of fortnight
Part A - 2, Conditions of the Contract - Contractor's Labour Regulations

Register of wages

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of workman</th>
<th>Basic wages</th>
<th>Dearness allowances</th>
<th>Overtime</th>
<th>Total</th>
<th>Other cash payments (indicate nature)</th>
<th>Deductions if any (indicate nature)</th>
<th>Net amount paid</th>
<th>Signature or thumb impression of the workman</th>
<th>Initial of contractor or his representative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NIT No: IITB/DIPS/COPT/TENDER/02; Construction of COPT Building

Page: 114 of 450
<table>
<thead>
<tr>
<th>Date</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

Received from

The Wage Card is valid for one month from the date of issue
Form 19/Record-XIX

Name and address of contractor:

Name and Father's/Husband's name of workman:

Nature and location of work:

For the Week/Fortnight/Month ending:

1. No. of days worked:

2. No. of units worked in case of piece rate workers:

3. Rate of daily wages/piece rate:

4. Amount of overtime wages:

5. Gross wages payable:

6. Deduction, if any:

7. Net amount of wages paid:

Initials of the contractor or his representative:
Appendix VIII

कार्य 14 / Form-XIV
(कृपया नियम 76 देख)
[See rule 76]

रोजगार कार्ड
Employment Card

Name and address of contractor-

Name and address of establishment under which contract is carried on-

Name of work and location of work-

Name and address of Principal Employer-

1. मजदूर का नाम
   Name of the workman-

2. लगाये गए मजदूरों के रजिस्ट्रर में क्रम संख्या
   Sl. No. in the register of workman employed-

3. रोजगार/पद का नाम
   Nature of employment/designation-

4. मजदूरी की दर
   (पीस वर्क के बारे में एकक के ब्यौरा सहित)
   Wage rate (with particulars of unit in case of piece work)-

5. मजदूरी की अवधि
   Wage period-

6. रोजगार की अवधि
   Tenure of employment-

7. टिप्पणी
   Remarks-

ARGIN
Signature of contractor
### Service Certificate

<table>
<thead>
<tr>
<th>क्र. नं.</th>
<th>रोजगार की कृति अवधि</th>
<th>किए गए कार्य का स्वरूप</th>
<th>मजदूरी दर (पीस वर्क के मामले में एकक के ब्योरो सहित)</th>
<th>टिप्पणी</th>
<th>अंकिताकर / Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix X

LIST OF ACTS AND OMISSIONS FOR WHICH FINES CAN BE IMPOSED

In accordance with rule 7(v) of the CPWD Contractor’s Labour Regulations to be displayed prominently at the site of work both in English and local Language.

1. Willful insubordination or disobedience, whether alone or in combination with other.
2. Theft or dishonesty in connection with the contractors beside a business or property of CPWD.
3. Taking or giving bribes or any illegal gratifications
4. Habitual late attendance.
5. Drunkenness lighting, riotous or disorderly or indifferent behaviour
6. Habitual negligence.
7. Smoking near or around the area where combustible or other materials are locked
8. Habitual indiscipline.
9. Causing damage to work in the progress or to property of the CPWD or of the contractor.
10. Sleeping on duty.
11. Malingerer or slowing down work.
12. Giving of false information regarding name, age father’s name, etc.
13. Habitual loss of wage cards supplied by the employers.
14. Unauthorised use of employer’s property of manufacturing or making of unauthorised particles at the work place.
15. Bad workmanship in construction and maintenance by skilled workers which is not approved by the Department and for which the contractors are compelled to undertake rectifications.
16. Making false complaints and/or misleading statements.
17. Engaging on trade within the premises of the establishments.
18. Any unauthorised divulgence of business affairs of the employees.
19. Collection or canvassing for the collection of any money within the premises of an establishment unless authorised by the employer.

20. Holding meeting inside the premises without previous sanction of the employers.
21. Threatening or intimidating any workman or employer during the working hours within the premises.
<table>
<thead>
<tr>
<th>No.</th>
<th>Date on which fine imposed</th>
<th>Date on which fine realized</th>
<th>Description of Offence</th>
<th>Name of person or firm of whose presence at the time of occurrence of such incident the employer has no knowledge</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>T2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>T1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>T0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Register of Fines** (See Rule 78(2) (d))

- Name and address of contractor
- Name and address of establishment in which contract is carried on
- Nature and address of Principal Employer
### Table: Contractor’s Labour Regulations

<table>
<thead>
<tr>
<th>No.</th>
<th>Name and address of Principal Employer</th>
<th>Name and address of establishment in which contract is carried on.</th>
<th>Name and address of contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

1. **Date of Recovery**
2. **Amount of Deduction**
3. **Date of Damage/loss**
4. **Details of Damage/loss**
5. **Identification of damage/loss**
6. **Person in whose presence employee was employed at time of damage/loss**
7. **Date of First Instalment**
8. **Amount of Installment**
9. **Remaining Amount**
10. **Date of Next Instalment**
11. **Amount of Next Instalment**
12. **Remaining Amount**
13. **Date of Last Instalment**
14. **Amount of Last Instalment**
15. **Remaining Amount**

**Source:**

(See Rule 76(2)(d))
### अधिकार का रजिस्टर Register of Advances

#### तेजवेर का नाम व पता
Name and address of contractor

#### कार्यालय का नाम व पता जिससे अधिकार तेजवा चल रहा है
Name and address of establishment in under which contract is carried on

#### कार्य का स्थान व स्थान
Nature and location of work

#### मुख्य नियोजक का नाम व पता
Name and address of Principal Employer

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of workman</th>
<th>Father’s/Husband name</th>
<th>Designation/ nature of employment</th>
<th>Wages or period and wages payable</th>
<th>Date and amount of advance given</th>
<th>Purpose(s) for which advance made</th>
<th>विषय मात्रक</th>
<th>किशोर की संख्या</th>
<th>नीताई नहीं पूरी हुई किशोर की संख्या</th>
<th>Date and which lump sum was repaid</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### समयोपरि रजिस्टर Register of Overtime

| नं. | नाममात्रा का नाम | फात /पिता का नाम | बाल उद्धेश्य | दिवस /वक्ता का दिना | बाल का तारिख | कुल समयोपरि की कार्य के अवधारित | कार्य की लंबाई | समयोपरि संबंधित | समयोपरि की रुपरेट | रुपरेट की दर | निपटान
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>टेनेक्ट का नाम व पता</td>
<td>Name and address of contractor</td>
<td>कार्यालय का नाम व पता</td>
<td>जिसका अभीन ढेका बना है</td>
<td>Name and address of establishment in under which contract is carried on</td>
<td>कार्य का स्थान व स्थान</td>
<td>Nature and location of work</td>
<td>Name and address of Principal Employer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. INTEGRITY PACT

(DECLARATION BY IITB)

To,

...........................................

...........................................

...........................................

Sub: NIT No. ______________________

Name of the work:

Dear Sir,

It is here by declared that IITB is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender / bid documents, failing which the tenderer / bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the IITB.

Yours faithfully

Dean (IPS), IITB
INTEGRITY PACT

(UNDEARTAKING BY THE BIDDER)

To,

Dean (IPS) IITB,

……………………………………
……………………………………

Sub: Submission of the Tender for the work of _________________

Dear Sir,

I/We acknowledge that IITB is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE AND ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the Contract, which will come into existence when tender/bid is finally accepted by IITB. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in line with Para 6 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, IITB shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid in accordance with the terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder)
INTEGRITY AGREEMENT

This Integrity Agreement is made at ............... on this ........... day of ........... 20 ..... 

BETWEEN

Director IITB represented through Dean IPS

Dean IPS, IIT, Bombay..........................................................(Herein referred as the
(Address of Division)

‘Principal/Owner’, which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

(Name and Address of the Individual/firm/Company)

through ...........................................................(Hereinafter referred as the (Details of duly authorized signatory)

“Bidder/Contractor” and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender (NIT No______) (hereinafter Referred to as “Tender/Bid”) and intends to award, under laid down organizational procedure, Contract for Construction of __________________________________________________________(Name of work).

hereinafter referred to as the “Contract”.

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as “Integrity Pact” or “Pact”), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows cv and this Pact witnesses as under:

..........................................................
Article 1: Commitment of the Principal/Owner

(1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

a. No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

b. The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

c. The Principal/Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.

(2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

(1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the IITB / Department all suspected acts of fraud or corruption or Coercion or Collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.

(2) The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

a. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner’s employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

b. The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.

c. The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/ Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d. The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/ representatives in India, if any. Similarly, Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participates in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

e. The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any
other intermediaries in connection with the award of the Contract.

3. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a wilful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.

5. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/Contractor accepts and undertakes to respect and uphold the Principal/Owner’s absolute right:

1. If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days’ notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. Such exclusion may be forever or for a limited period as decided by the Principal/Owner.

2. Forfeiture of EMD/Performance Guarantee/Security Deposit: If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

3. Criminal Liability: If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of IPC Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

1. The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.

2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/Owner.

3. If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

1. The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Subcontractors/sub-
vendors.

(2). The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.

(3). The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

**Article 6 - Duration of the Pact**

This Pact begins when both the parties have legally signed it. It expires for the Contractor, 12 months after the completion of work under the Contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, IITB.

**Article 7 - Other Provisions**

(1). This Pact is subject to Indian Law, place of performance and jurisdiction is the Headquarters of the Division of the Principal/Owner, who has floated the Tender.

(2). Changes and supplements need to be made in writing. Side agreements have not been made.

(3). If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.

(4). Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

(5). It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.

**Article 8 - Legal and Prior Rights**

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

| 1 | ........................................... |
|-----------------------------------------------|
| (Signature, name and address) |

| 2 | ........................................... |
|-----------------------------------------------|
| (Signature, name and address) |

Place:
Dated:
11. PROFORMA OF SCHEDULES  
(COMBINED FOR MAJOR AND MINOR COMPONENTS)  
SCHEDULE “A” to “F”

SCHEDULE “A”

Percentage bid is as per Part D1 and Schedule of Quantities as per Part D2

SCHEDULE “B”

Schedule of materials to be issued to the Contractor: NIL

SCHEDULE “C”

Tools and Plants to be hired to the Contractor: NIL

SCHEDULE “D”

Extra Schedule for specific requirements/documents for the work, if any: NIL

SCHEDULE “E”

Reference to General Conditions of Contract:  
Referred to PART-A2- Conditions of the Contract  
Name of Work:  
Construction of Centre for Propulsion Technology (COPT) Building (ground plus 6 upper floors) including finishing works, internal water supply, sanitary and electrical installations, firefighting, fire alarm & ELV systems, lifts, Airconditioning, external development and furniture works at IIT Bombay, Powai, Mumbai – 400076

Estimated Amount:  
Referred to Article 1.1 of Part A

Earnest Money:  
Referred to Article 1.1 of Part A

Performance Guarantee:  
5% of tendered value

Security Deposit:  
5% of tendered value

SCHEDULE “F”

Reference to General Conditions of Contract:  
Referred to PART-A2- Conditions of the Contract  
Office inviting Tender:  
Dean (IPS)

Definitions:
2(v) Dean (IPS):  
Dean (IPS), IITB

2(viii) Accepting Authority:  
Dean (IPS)

2(x) Percentage on cost of materials and labour to cover all overheads and profits:  
15%

2(xi) Standard Schedule of Rates:  
Delhi Schedule Rates (DSR) 2021, updated Dec 2021 for Civil and PHE Works.

Delhi Schedule Rates, Analysis of Rates and specification (Horticulture & Landscape) 2020.
2(xii) Institute: INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

9(ii) Standard Contract Form: Generally, as per PART-A2- Conditions of the Contract

**CLAUSE 1:**

i. Time allowed for submission of Performance Guarantee, Programme Chart (Time and Progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance by IITB: 15 days

ii. Maximum allowable extension beyond the period provided in (i) above: 7 days with late fee @0.1% per day of the Performance Guarantee amount.

**CLAUSE 2:**

Authority for fixing compensation under Clause 2: Deputy Director (FEA), IITB

**CLAUSE 2A:**

Incentive for early completion: Not Applicable

**CLAUSE 5:**

Schedule of handing over of site reckoned from date of issue of work order: 15 Days

Schedule of issue of designs: 7 days after W.O

Submission of Programme Chart (Time and Progress using PRIMAVERA) within a period from the date of start: 07 days

Number of days from the date of issue of letter of acceptance / Work Order for reckoning date of start of the work: 15 days or date of handing over whichever is later
Milestones as per the Table below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of Milestone (Physical progress)</th>
<th>Time allowed in months (from date of start)</th>
<th>Amount to be withheld in case of non-achievement of milestone (% of the tendered amount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Completion of excavation work</td>
<td>2 months</td>
<td>0.50%</td>
</tr>
<tr>
<td>2.</td>
<td>Completion of work up to plinth level (including RCC slab at plinth level)</td>
<td>5 months</td>
<td>0.50%</td>
</tr>
<tr>
<td>3.</td>
<td>Completion of RCC work up to 1st floor slab and placed the order for Lifts</td>
<td>7 months</td>
<td>0.50%</td>
</tr>
</tbody>
</table>
| 4.      | • Completion of RCC work up to 5th floor slab  
• Completion of masonry work up to 3rd floor  
• Completion of sample toilet at 1st floor  
• Completion of sample room at 1st floor  
• Electrical and MEP Shop Drawings, Lift GA Drawings | 12 Months                                   | 0.50%                                                                                  |
| 5.      | • Completion of all RCC work including UGT and OHT  
• Completion of internal plumbing work up to 6th floor  
• Completion of masonry, plaster & flooring work up to 6th floor  
• Completion of Internal Electrical work up to 6th floor  
• Completion of firefighting work up to 6th floor  
• Delivery of Lift at site | 15 months                                   | 1.00%                                                                                  |
| 6.      | • Completion of entire masonry, plaster & flooring work  
• Completion of electrical work up to 9th floor  
• Completion of entire internal & external plumbing work  
• Lift installation & testing  
• Completion of entire Fire Fighting work | 18 months                                   | 0.50%                                                                                  |
<table>
<thead>
<tr>
<th>7.</th>
<th>Completion of entire internal painting work of building</th>
<th>21 months</th>
<th>0.50%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completion of entire electrical work</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Completion of HVAC work</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply &amp; installation of furniture items including built-in furniture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External development works including electricals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exterior finishing &amp; painting works of building</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ancillary balance works under Civil, E&amp;M &amp; Furniture works</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AUTHORITY TO DECIDE:**

- Extension of time: Dean (IPS)
- Rescheduling of Milestones: Dean (IPS)
- Shifting of date of start in case of delay in handing over of site: Dean (IPS)

**CLAUSE 6, 6A:**

Clause applicable (6 or 6A) 6A (only computerized MB)

**CLAUSE 7:**

Gross work to be done together with net payment/ adjustment of advances for material collected, if any, since the last such payment for being eligible to Interim payment (As per discretion of Engineer-In-Charge) Rs. 100 lakhs

**CLAUSE 7A**

Applicable licenses/ registrations or proof of applying for obtaining labour licenses, registration with EPFO, ESIC and BOCW Welfare Board including Provident Fund Code No. If applicable shall be submitted within a period of 15 days from issue of work order.

**CLAUSE 8A**

Authority to decide compensation on account if Contractor fails to: Dean IPS submit completion plans

Compensation for failure in submission of completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work is limited to 0.1% of the Tendered Price.
CLAUSE 10A

a. List of minimum testing equipment to be provided by the Contractor at site lab for Civil Works

1. Cube testing machine (with Calibration)
2. Silt testing Jar
3. Sieve analysis – full set
4. Proctor density apparatus
5. Levelling instrument.
6. Oven 01 Number.
7. Cube mould-30 Nos.
8. Balance – 7 to 10 kg-1 No. and 500 gm capacity-1 No.
9. Vernier Calliper,
10. Measuring cylinder-2Nos,
11. Measuring tape 3-meter, 5-meter, 10-meter, 30 meter – 2 each.
12. Earth Merger,
14. Phase sequence Metre
15. R-L-C Metre
16. Clip-on-metre for different rangers.

b. List of testing equipment to be provided by the Contractor at site lab for E&M Works:

1. Megger
2. Earth Tester
3. Lux meter
4. Wire Gauge
5. Micro meter
6. Vernier Calipers

This list is only indicative and not exhaustive. The bidders shall be required to provide any such testing equipment as required as per CPWD specifications item nomenclature as and when required on the site.

CLAUSE 10B (ii): (Mobilization advance)

Whether clause 10B (ii) shall be applicable: Yes

CLAUSE 10C:

Component of labour expressed as percent of value of work: Not applicable
CLAUSE 10CA:

Whether clause 10CA shall be applicable: Clause 10CA shall not be applicable and stands deleted

CLAUSE 10CC:

Clause 10CC to be applicable in the Contract with stipulated period of completion exceeding the period shown in next Column: 12 (Twelve) Months

Schedule of component of other materials, Labour, POL etc. for price escalation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement component *</td>
<td>14.5%</td>
</tr>
<tr>
<td>Labour component</td>
<td>25%</td>
</tr>
<tr>
<td>Civil component of other construction materials</td>
<td>30%</td>
</tr>
<tr>
<td>E&amp;M (Electrical and Mechanical) component</td>
<td>11%</td>
</tr>
<tr>
<td>POL (Diesel) component</td>
<td>NIL</td>
</tr>
<tr>
<td>Reinforcement steel bars / TMT bars / Structural steel**</td>
<td>19.5%</td>
</tr>
<tr>
<td>Bitumen component</td>
<td>Nil</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Includes Cement component used in RMC brought at site from outside approved RMC plants, if any
** Structural steel doesn't include stainless steel.

CLAUSE 11:

Specifications to be followed for execution of work: As per CPWD Specifications for Civil and MEP works with up-to-date correction slips (Hereinafter termed as CPWD specifications).

(i) For Civil, Plumbing Works Horticulture & Landscaping:

CPWD Specifications- 2019_VOL 01 (July 2019) and updates if any till submission of the Bid and

CPWD Specifications- 2019_VOL 02 (July 2019) and updates if any till submission of the Bid.

Manufacturer specifications and IS Standards for non-scheduled items of CPWD.

(ii) Electrical works (Part – 1); internal – 2013 & External (Part-II)-1994,
iii. Lift & Escalators (Part – III) - 2003,
v. Substation (Part IV) - 2013,
vi. DG Sets (Part VII) - 2013,
viii. And relevant IS codes

CLAUSE 12:

12.2, Deviation Limit beyond which clauses 12.2, 12.3 & 12.4 of GCC shall apply
12.3 & 12.4 for E&M Works
12.5 i) Deviation Limit beyond which clauses 12.2, 12.3 & 12.4 of GCC shall apply for substructure up to plinth level
100 % (One Hundred percent)
ii) Deviation Limit beyond which clauses 12.2, 12.3 & 12.4 of GCC shall apply for super structure.
100 % (One Hundred percent)

CLAUSE 16:
Competent Authority for deciding reduced rates. Dean (IPS)

CLAUSE 17:
Defect liability period: 12 months (From the date of certificate or otherwise of completion of work).

CLAUSE 18:
As minimum, list of mandatory machinery, tools & plants to be deployed by the Contractor at site:

1. Tower Crane 1 no.
2. Truck 2 nos,
3. Shuttering and props – Quantity as required as per the approved programme.
4. Building hoist 3 nos.
5. Excavator 2 nos.
6. Vibrator 5 nos.
7. Vibration compactor 2 nos.
8. Dewatering pump 4 nos.
9. Cutting & Bending machine 2 Set
10. Total Station – 1 No.
11. Auto Level – 1 nos.
12. DG set – 1 No
This list is indicative only and not exhaustive. The bidders shall be required to deploy any such T & P as required as per as per work requirement and contract conditions.

**CLAUSE 19:**

Authority for applying Penalty for default under this Clause: Dean (IPS)

Clause 19C - Engineer-In-Charge

Clause 19D - Shall be as decided by Engineer-In-Charge for each default

Clause 19G - Shall be as decided by Engineer-In-Charge for each default

Clause 19K - Shall be as decided by Engineer-In-Charge for each failure of such Tradesman deployment

**CLAUSE 25:**

Constitution of Dispute Redressal Committee (DRC) Building Works Committee (BWC) of IITB shall act as Dispute Resolution Committee (DRC) with co-opted additional members with legal and contract expertise in the committee by the Director IITB.

Place of Arbitration Mumbai

**CLAUSE 32 (ii):**

Requirement of Technical Representative(s) and recovery Rate: -

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Minimum Qualification of Technical Representative</th>
<th>Discipline</th>
<th>Designation (Principal Technical / Technical Representative)</th>
<th>Minimum Experience</th>
<th>Number</th>
<th>Rate at which recovery shall be made from the Contractor in the event of not fulfilling provision of clause 32 (ii)</th>
<th>Rate at which recovery shall be made from the Contractor in the event of not fulfilling provision of clause 32 (ii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project Manager with degree in Civil Engineering</td>
<td>Civil</td>
<td>Principle Technical Representative</td>
<td>15 Years</td>
<td>1 no.</td>
<td>1,00,000/- (Rupees One Lakh only) per Month</td>
<td>(Rupees One Lakh only) per Month</td>
</tr>
<tr>
<td>2</td>
<td>Graduate Engineer</td>
<td>Civil/Electrical</td>
<td>Senior Technical Representative</td>
<td>12 Years</td>
<td>2 No.</td>
<td>55,000/- (Rupees Fifty-five Thousand only) Per Month</td>
<td>(Rupees Fifty-five Thousand only) Per Month</td>
</tr>
<tr>
<td>3</td>
<td>Graduate Engineer Or Diploma Engineer</td>
<td>Civil</td>
<td>Technical Representative</td>
<td>2 Years 5 Years</td>
<td>1 Nos</td>
<td>30,000/- (Rupees Thirty Thousand only) Per Month</td>
<td>(Rupees Thirty Thousand only) Per Month</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Minimum Qualification of Technical Representative</td>
<td>Discipline</td>
<td>Designation (Principal Technical / Technical Representative)</td>
<td>Minimum Experience</td>
<td>Number</td>
<td>Rate at which recovery shall be made from the Contractor in the event of not fulfilling provision of clause 32 (ii)</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
<td>------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------</td>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Figures (in Rs.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Words</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Graduate Engineer Or Diploma Engineer</td>
<td>Electrical</td>
<td>MEP</td>
<td>5 Years 10 Years</td>
<td>1 no.</td>
<td>30,000/- (Rupees Thirty Thousand only) per month</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Graduate Engineer</td>
<td>Civil</td>
<td>Project Planning/Billing Engineer</td>
<td>6 Years</td>
<td>1 No.</td>
<td>25,000/- (Rupees Twenty-five Thousand only) Per Month</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Diploma Engineer</td>
<td>QA/QC</td>
<td>Quality Engineer/Inspector</td>
<td>2 Years</td>
<td>1 No.</td>
<td>30,000/- (Rupees Thirty Thousand only) per month</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Degree in any discipline with Certificate in Safety</td>
<td>Safety</td>
<td>Safety Cum Labour Officer</td>
<td>NA</td>
<td>1 no.</td>
<td>25,000/- (Rupees Twenty five Thousand only) per month</td>
<td></td>
</tr>
</tbody>
</table>

Note:
Assistant Engineers retired from Government services who are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10-year relevant experience with a reputed company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.
## 12. STANDARD PROFORMAS

### 12.1 APPENDIX - XVI

(Refer Clause 5)

**FORM OF APPLICATION BY THE CONTRACTOR FOR SEEKING EXTENSION OF TIME**

1. Name of Contractor
2. Name of work as given in the agreement
3. Agreement no.
4. Estimated amount put tender CON 297 Page 27
5. Date of commencement of work as per agreement
6. Period allowed for completion of work as per agreement.
7. Date of completion stipulated in agreement.
8. Period for which extension of time if has been given by authority in Schedule’ F’ previously.

<table>
<thead>
<tr>
<th>Letter no.and date</th>
<th>Extension granted</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 1st extension</td>
<td></td>
</tr>
<tr>
<td>(b) 2nd extension</td>
<td></td>
</tr>
<tr>
<td>(c) 3rd extension</td>
<td></td>
</tr>
<tr>
<td>(d) 4th extension</td>
<td></td>
</tr>
<tr>
<td>(e) Total extension previously given</td>
<td></td>
</tr>
</tbody>
</table>

9. Reasons for which extension have been previously given (copies of the previous applications should be attached)
10. Period for which extension if applied for
11. Hindrances on account of which extension is applied for with dates on which hindrances occurred and the period for which these are likely to last (for causes under clause 5.2 and 5.3).

Submitted to the Authority indicated in Schedule F With copy to the Engineer-in-charge.

Signature of the Contractor

Dated

...............
12.2 APPENDIX - XVII
Notice for appointment of Arbitrator.

[Refer Clause 25]

To

Director IITB

..........................................

...........................................

Dear Sir,

In terms of clause 25 of the agreement, particulars of which are given below, I/we hereby give
notice to you to appoint an arbitrator for settlement of disputes mentioned below:

1. Name of applicant
2. Whether applicant is Individual/Prop. Firm/Partnership Firm/Ltd. Co.
3. Full address of the applicant
4. Name of the work and contract number in which arbitration sought
5. Name of the Division which entered into contract
6. Contract amount in the work
7. Date of contract
8. Date of initiation of work
9. Stipulated date of completion of work
10. Actual date of completion of work (if completed)
11. Total number of claims made
12. Total amount claimed
13. Date of intimation of final bill (if work is completed)
14. Date of payment of final bill (if work is completed)
15. Amount of final bill (if work is completed)
16. Date of appeal to you
17. Date of receipt of your decision.

Specimen signatures of the
Applicant (only the
person/authority who signed
the contract should sign)

I/We certify that the information given above is true to the best of my/ our knowledge. I/We enclose
following documents.

1. We have exhausted provision of DRC as per clause 25 of this agreement.
2. Statement of claims with amount of claims.

Yours faithfully,

(Signatures)

Copy in duplicate to:

1. Dean IPS IITB/ DD FE
12.3. FORMATS OF GUARANTEE BONDS:
FORM OF PERFORMANCE SECURITY (GUARANTEE)

BANK GUARANTEE BOND - FORMAT - I

In consideration of the Director, Indian Institute of Technology Bombay (hereinafter called "the IITB") having offered to accept the terms and conditions of the proposed agreement between………………………………………………….(herein after called "the said Contractor(s)") for the work………………………………………………….(herein after called "the said agreement") having agreed to production of an irrevocable Bank Guarantee for Rs…………………..(Rupees…………………..only) as a security /guarantee from the Contractor(s) for compliance of this obligations in accordance with the terms and conditions in the said agreement.

1. We, …………………………………………..(herein after referred to as "the Bank") hereby undertake to pay to the IITB an amount not exceeding Rs. ……………………..(Rupees…………………..Only) on demand by the IITB.

2. We, …………………………………………….. (indicate the name of the Bank) do hereby undertake to pay the amounts due and payable at Mumbai under this guarantee without any demure, merely on a demand from the IITB stating that the amount claimed as required to meet the recoveries due or likely to be due from the said Contractor(s). Any such demand made on the bank shall be conclusive as regards the amount due and payable at Mumbai by the bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs.……..(Rupees…………………..only).

3. We, the said bank further undertakes to pay the IITB any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payments made by us under this bond shall be a valid discharge of our liability for payment there under and the Contractor(s)shall have no claim against us for making such payment.

4. We, (indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the IITB under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in-Charge on behalf of the IITB certified that the terms and conditions of the said agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

5. We, ………………………………………………..(indicate the name of the Bank) further agree with the IITB that the IITB shall have the fullest liberty without our consent and without affecting in any manner our obligation here under to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the IITB against the said Contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act of omission on the part of the IITB or any indulgence by the IITB to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

7. We, ………………………………………………..(indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of the IITB in writing.

8. This guarantee all be valid up to …………………………………unless extended on demand by the IITB.

Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs………………………..(Rupees………………….. ) and unless acclaim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged. Dated the…………………..day of…………………..for…… (Indicate the name of the Bank).
FORM OF PERFORMANCE SECURITY (GUARANTEE)

BANK GUARANTEE BOND- FORMAT -II

In consideration of the Director, Indian Institute of Technology Bombay (herein after called "the IITB") having offered to accept the terms and conditions of the proposed agreement between………………………………….(here in after called "the said Contractor(s)") for the work…………………………. (here in after called "the said agreement") having agreed to production of an irrevocable Bank Guarantee for Rs.………………………………………………….. (Rupees only) as a security / guarantee from the Contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement.

1. We, ……………………………….. (hereinafter referred to as "the Bank") hereby undertake to pay to the IITB an amount not exceeding Rs. …………………….. (Rupees…………Only) on demand by the IITB.

2. We, ……………………………….. (indicate the name of the Bank) do hereby undertake to pay the amounts due and payable at Mumbai under this guarantee without any demure, merely on a demand from the IITB stating that the amount claimed as required to meet the recoveries due or likely to be due from the said Contractor(s). Any such demand made on the bank shall be conclusive as regards the amount due and payable at Mumbai by the bank under this Guarantee. However, our liability under this guarantees hall be restricted to an amount not exceeding Rs.…………………..(Rupees…………………..only)

3. We, the said bank further undertakes to pay the IITB any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suitor proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payments o made by us under this bond shall be a valid discharge of our liability for payment there under and the Contractor(s)shall have no claim against us for making such payment.

4. We, ………………………………..(indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to been force able till all the dues of the IITB under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineering Charge on behalf of the IITB certified that the terms and conditions of these aid agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

5. We, ………………………………..(indicate the name of the Bank) further agree with the IITB that the IITB shall have the fullest liberty without our consent and without t affecting in any manner our obligation here under ovary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the IITB against the said Contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act of omission on the part of the IITB or any indulgence by the IITB to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sure ties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

7. We, (indicate the name of the Bank) lastly undertaken ot to revoke this guarantee except with the previous consent of the IITB in writing.

8. This guarantee shall be valid up to unless extended on demand by the IITB. Not with standing anything mentioned above, our liability against this guarantee is restricted to Rs.…………………………………….(Rupees…………………………………).
12.4 INDENTURE FOR SECURED ADVANCES

THIS INDENTURE made the ..................... day of .....................20....... BETWEEN
............................................(Hereinafter called the Contractor which expression shall where the
context so admits or implies be deemed to include his executors administrators and assigns)
of the one part and the Dean IPS/ Director IITB (hereinafter called the President which
expression shall where the context so admits or implies be deemed to include his successors
in office and assigns) of the other part.

WHEREAS by an agreement dated (hereinafter called the said agreement) the
Contractor has agreed AND WHEREAS the Contractor has applied to the Director, IITB that
he may be allowed advances on the security of materials absolutely belonging to him and
brought by him to the site of the works the subject of the said agreement for use in the
construction of such of the works as he has undertaken to execute at rates fixed for the
finished work (inclusive of the cost of materials and labour and other charges) AND
WHEREAS the Director IITB has agreed to advance to the Contractor the sum of Rupees
_________ on the security of materials the quantities and other particulars of which are
detailed in Accounts of Secured Advances attached to the Running Account Bill for the said
works signed by the Contractor on and the Director IITB has reserved to himself the option of
making any further advance or advances on the security of other materials brought by the
Contractor to the site of the said works. Now THIS INDENTURE WITNESSETH that in
pursuance of the said agreement and in consideration of the sum of Rupees on or before the
execution of these presents paid to the Contractor by the Director IITB (the receipt whereof
the Contractor doth hereby acknowledge) and of such further advances (if any) as may be
made to him as aforesaid the Contractor doth hereby covenant and agree with the Director
IITB and declare as follows: -

(1) That the said sum of Rupees so advanced by the Director IITB to the Contractor
as aforesaid and all or any further sum or sums advanced as aforesaid shall be
employed by the Contractor in or towards expediting the execution of the said works
and for no other purpose whatsoever.

(2) That the materials detailed in the said Account of Secured Advances which have been
offered to and accepted by the Director as security are absolutely the Contractor’s own
property and free from encumbrances of any kind and the Contractor will not make any
application for or receive a further advance on the security of materials which are not
absolutely his own property and free from encumbrances of any kind and the
Contractor indemnifies the Director IITB against all claims to any materials in respect of
which an advance has been made to him as aforesaid.

(3) That the materials detailed in the said Account of Secured Advances and all other
materials on the security of which any further advance or advances may hereafter be
made as aforesaid (hereinafter called the said materials) shall be used by the
Contractor solely in the execution of the said works in accordance with the directions of
the Engineer in charge and in the term of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate
arrangements for the proper watch, safe custody and protection against all risks of the
said materials and that until used in construction as aforesaid the said materials shall
remain at the site of the said works in the Contractor’s custody and on his own
responsibility and shall at all times be open to inspection by the Engineer in charge
authorised by him. In the event of the said materials or any part thereof being stolen,
destroyed or damaged or becoming deteriorated in a greater degree than is due to
reasonable use and wear thereof the Contractor will forthwith replace the same with
other materials of like quality or repair and make good the same as required by the Engineer-in-Charge.

(5) That the said materials shall not on any account be removed from the site of the said works except with the written permission of the Engineer in charge or an officer authorised by him on that behalf.

(6) That the advances shall be repayable in full when or before the Contractor receives payment from the Director IITB of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the Director IITB will be at liberty to make a recovery from the Contractor’s bill for such payment by deducting there from the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously, the value for this purpose being determined in respect of each description of materials at the rates at which the amounts of the advances made under these presents were calculated.

(7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the Director IITB shall immediately on the happening of such default be repayable by the Contractor to the Director IITB together with interest thereon at 12% (twelve per cent) per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs, charges, damages and expenses incurred by the Director IITB in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the Director IITB to repay and pay the same respectively to him accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the Director IITB of the said sum of Rupees _________ and any further sum or sums advanced as aforesaid and all costs charges, damages and expenses payable under these presents PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and whenever the covenant for payment and repayment herein before contained shall become enforceable and the money owing shall not be paid in accordance therewith the Director IITB may at any time thereafter adopt all or any of the following courses as he may deem best:-

a. Size and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion and the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor, he is to pay same to the Director IITB on demand.

b. Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the Director IITB under these presents and pay over the surplus (if any) to the Contractor.

c. Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except in the event of such default on the part of the Contractor as aforesaid interest on the said advance shall not be payable.
(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been herein before expressly provided for the same shall be finally resolved as per provisions of clause 25 of the contract.

In witness whereof the said …………………and …………………… by the order and under the direction of the Director IITB have hereunto set their respective hands the day and year first above written.

Signed, sealed and delivered by…………………………the said Contractor in the presence of ………………………………………………………………………………………………………

Signature ……………………………
Witness Name …………………………………………………
Address ……………………………
Signed by…………………………

by the order and direction of the Director IITB in the presence of ……………………………

Signature ……………………………
Witness Name …………………………………………………
Address ……………………………
12.5 FORMS FOR GUARANTEE BONDS

i. GUARANTEE BOND FOR REMOVAL OF DEFECTS OF WATER PROOFING WORKS.

This Agreement made this ………day of two thousand and……………..

Between (Name of the Contractor, hereinafter called the Guarantor on the one part) and Director, Indian Institute of Bombay (hereinafter called the IITB on the other part).

WHEREAS this agreement is supplementary to a contract (hereinafter called the contract) dated and made between the GUARANTOR on the one part and the IITB on the other part for construction (Name of the work) where by the GUARANTOR, interalia, undertook to render the buildings and structures in the said contract recited completely water and leak proof.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said structures will remain water and leak proof for ten years from the date of completion of the work.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be ten years to be reckoned from the date of completion of the work as a whole.

Provided that the GUARANTOR will not be responsible for leakage caused by earthquake or structural defects or misuse of roof or alteration and for such purpose.

(a) Misuse of roof shall mean any operation which will damage water proofing treatment, like chopping of firewood and things of the same nature which might cause damage to the roof;

(b) Alteration shall mean construction of an additional storey or a part of the roof or construction adjoining to existing roof whereby water proofing treatment is removed in parts;

(c) The decision of the Engineer – in - Charge with regard to cause of leakage shall be final

During this period of guarantee, the GUARANTOR shall make good all defects and in case of any defects being found, render the building water-proof at his cost to the satisfaction of the Engineer – in- Charge / authorized representative of IITB, and shall commence the work for such rectification within seven days from the date of issue of the notice from Engineer – in – Charge / authorized representative of IITB calling upon him to rectify the defects, failing which the work shall be got done by IITB / IITB through some other Contractor at the GUARANTOR’S cost and risk. The decision of the Engineer – in – Charge / authorized representative of IITB as to the cost, payable by the Guarantor shall be final and binding.

That if the GUARANTOR fails to execute the necessary rectification of water proofing or commits breach there under, then the Guarantor will indemnify IITB and his successors against all loss, damage, cost expense or otherwise which may be incurred by him by reasons of any default on the part of GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and / or damage and / or cost incurred by the IITB, the decision of the Engineer – in – Charge / IITB will be final and binding on the parties.

IN WITNESS WHEREOF these presents has been executed by the Obligator 1. Director. IITB and by and for and on behalf of the Director, IITB on the day, month and year first above written.

Signed, sealed and delivered by OBLIGATOR in the presence of:

1. ______________________ 2. ______________________

SIGNED FOR AND ON BEHALF OF DIRECTOR IITB by in the presence of:

1. ______________________ 2. ______________________
Clause 25

ii. GUARANTEE BOND FOR REMOVAL OF DEFECTS IN CURTAIN GLAZING & OTHER RELATED WORKS.

This Agreement made this ______ day of two thousand and __________

between __________________ (Name of the Contractor, hereinafter called the Guarantor on the one part) and the Director, Indian Institute of Technology Bombay (hereinafter called the IITB on the other part).

WHEREAS this agreement is supplementary to a contract (hereinafter called the contract) dated _____ and made between the GUARANTOR on the one part and the IITB on the other part for construction ______________ (Name of the work) where by the GUARANTOR, interalia, undertook to carry out structural analysis and design, preparation of shop drawings, setting out, design, supply, fabrication, installation, aligning, fixing, protection and testing of the curtain glazing and other related works, all as specified and set out in the contract and as per the correct international / national standards.

AND WHEREAS THE GUARANTOR agreed to give a guarantee (for all works as stated above) for the following:

1. System
   a. Structural design has been carried out for design loads, as specified, thermal stresses, building movements and the consequent deflections without compromising the performance characteristics.
   b. That deflections in the framing members shall be within permissible limits as specified.
   c. Structural stability, safety, integrity and required performances of the work for all design works and building movements as specified.

2. Material
   a. Glass (single, laminated or DGUs) – Substrate, coatings, lamination of laminated glass, insulation of DGUs
   b. Sealant – Material used, performance of sealant used, usage as per the requirement of structural design and functional requirement, compatibility with different substance and sealants, bite size, quality assurance during sealing of DGUs and fixing glass to glass and glass to the aluminium frame, etc.
   c. EPDM / Silicone gaskets – for ozone resistance and other properties as specified etc.
   d. Aluminium – material quality, tempering requirement, suitability of aluminium grade and anodizing etc.
   e. Anchor fasteners – suitability and strength requirements as per manufacturers’ specifications etc.

3. Performance
   a. Water tightness, wherever specified in the Contract.
   b. Workmanship
   c. Integrity of system during movements within and relative to the building structure.
   d. Indemnify the IITB against all claims of whatsoever nature due to defective designing by the Contractor, material & workmanship etc. and/or non-performance of the work during the guarantee period.
NOW THE GUARANTOR hereby guarantees that the work executed by him shall perform to the specified standards of quality and workmanship during the guarantee period of ten years to be reckoned from the date of completion of work.

During this period of guarantee, the guarantor shall make good all defects and if any defect is noticed during the guarantee period, it shall be rectified by the Contractor within seven days of issue of notice to the Contractor, at least temporarily, to the satisfaction of the Dean (IPS), till the permanent rectification of the defects / replacement of defective materials is carried out by the Contractor, in maximum four months period, retaining same aesthetic and other functional parameters of the original work. If not attended to, the same shall be got done by the IITB / IITB through other agency at the risk and cost of the Contractor which shall be final and binding on the Contractor.

That if the Guarantor fails to execute the necessary rectification or commits breach there under, then the Guarantor will indemnify IITB and his successors against all loss, damage, cost expense or otherwise which may be incurred by him by reasons of any default on the part of GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and / or damage and / or cost incurred by IITB, the decision of the Dean (IPS) will be final and binding on the parties.

IN WITNESS WHEREOF these presents has been executed by the OBLIGATOR

and

by

and for and on behalf of Director. IITB. on the day month and year first above written.

SIGNED, SEALED AND DELIVERED by OBLIGATOR in the presence of:

1. 

2. 

SIGNED FOR AND ON BEHALF OF DIRECTOR. IITB. BY

in the presence of:

1. 

2.
ARTICLES OF AGREEMENT made this …. Day of …..  

BETWEEN  
Dean, IPS, for and on behalf of Director, Indian Institute of Technology Bombay, Powai, Mumbai-400 076 (hereinafter referred to as “the Employer” which expression shall include its successors and designs where the context so admits) of the one point.  

AND  
M/s………………..(herein after referred to as “the Contractor” which expression shall include their heirs, executors, administrators and designs where the context so admits) of the other part.  

WHEREAS  
The employer is desirous that certain works should be executed, viz “Construction of…………………………. At IIT Bombay, Powai, Mumbai-400 076” and has accepted Tender by the Contractor for the execution completion and maintenance of such works Now THIS AGREEMENT WITNESSTH as follows:-  

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.  

2. The following documents shall be deemed to form and be read and constructed as part of this Agreement, viz:-  
   a) Work order No. IITB / Dean.(IPS)/CACI/…….. dated……. Along with the correspondence.  
   b) Conditions of the Contract.  
   c) Technical Specifications of Civil works.  
   d) Technical Specifications of Services.  
   e) Financial Bid-Bill of Quantities  
   f) Drawings  
   g) Prebid queries and responses  

3. In consideration of the payments to be made by the Employer to the Contractor as herein after mentioned the Contractor hereby covenants with the Employer to execute, complete and maintain the works in conformity in all respects with the provisions of Contract.  

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and maintenance of the works at the Contract price at the time and in the manner prescribed by the Contract.  

5. The particulars referred to in the various clauses of the Conditions of the Contract are as given in Schedules A to F.  

IN WITNESS whereof the parties hereto have caused of their respective Common Seals to be here into affixed (or have hereinto set their respective hands and seals) the day and year first above written.  

For and on behalf Director, IIT Bombay  
Dean (I.P.S.):  

In the Presence of:- 1. _____________ 2. _____________  

For and on behalf Contractor, ………….  

In the Presence of:- 1. _____________ 2. _____________
PART B:

MAJOR COMPONENTS (CIVIL & PLUMBING WORKS)
1 SPECIFICATIONS

Referred to Clause 11 of the ‘Clauses of the Contract’ under GCC and to the Proforma of Schedules A to F.
2 SPECIAL CONDITIONS FOR CEMENT AND STEEL REINFORCEMENT BARS

2.1 SPECIAL CONDITIONS FOR STEEL REINFORCEMENT BARS

a) The Contractor shall procure TMT bars of Fe 550D, at the discretion of Engineer-In-Charge, from SAIL, Tata Steel Ltd., RINL, Jindal Steel & Power Ltd. and JSW Steel Ltd. The Contractor may also procure IS marked TMT bars of various grades from the steel manufactures or their authorized dealers (as per following selection criteria) have valid BIS license for IS: 1786-2008 (Amendment -1 November 2012) from the producers fulfilling the following criteria.

b) The procured steel should have following qualities:
   i) Excellent ductility, bend ability and elongation of finished product due to possible refining technology.
   ii) Consumption of steel should be accurate as per design.
   iii) Steel should have no brittleness problem in finished product.
   iv) Steel should carry the quality of corrosion and earthquake resistance.
   v) Quality steel with achievement of proper level of sulphur and phosphorus as per IS: 1786-2008.

c) Selection criteria of steel manufacturers: shall have the following selection criteria of steel manufactures:
   i) Steel producers of any capacity using iron ore/processed iron ore as the basis raw material adopting advance refining technologies as given hereunder:
      (1) DRI-EAF = Direct Reduced Iron – Electric arc furnace.
      (2) BF-BOF = Blast furnace – Basic oxygen furnace
      (3) CORES-BOF = COREX - Basic oxygen furnace

For production of liquid steel to finish product at single/multiple locations with NABL or any other similarly placed accrediting Government body which operates in accordance with ISO/IEC 17011 and accredits labs as per ISO/IEC 17025 conforming to IS: 1786-2008 (Amendment -1 November 2012). Following is the check lists for incorporation any quality steel producer for technical assessment.

<table>
<thead>
<tr>
<th>Sl.</th>
<th>item</th>
<th>Checkpoint</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steel producer having manufacturing facilities at Plant</td>
<td>a. Factory address and Registration no.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Certificate of manufacturing process</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Refining process of steel producer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c.1 BF-BOF route</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c.2 Corex-BOF route</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c.3 DRI-EAF route</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. With documentary evidence either for BOF or EAF</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e. Steel plant having infrastructure for producing Sponge iron, billet and TMT Rebars</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>f. Production and Quality Flow Chart</td>
<td></td>
</tr>
<tr>
<td>Sl.</td>
<td>Item</td>
<td>Checkpoint</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>2</td>
<td>Established</td>
<td>g. Plant Evaluation and Process Verification</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>h. List of Plant &amp; Machinery</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Document verification for:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Govt./PSU Approvals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Supply orders of TMT Re–bars in Govt. Projects (Minimum–5 years)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Verification of direct supply orders to any State/Central Govt. Department</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. User Certificate issued by any Govt. Department</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e. directly</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Indigenous</td>
<td><strong>Documents evidence like:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Certificate of Incorporation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Memorandum of Articles of Association</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Credit rating of the company from CARE/CRISIL/ICRA should not be C/D grade (minimum last 3 years)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Reliable</td>
<td>a. Test Results from Govt./NABL accredited laboratories</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. In–house testing facility for physical/chemical tests (NABL accredited)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Calibration certificates</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. List of lab Equipment:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e.1 Spectrometer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>e.2 Computerized UTM</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Use of Iron – Ore/Processes Iron are as basic raw materials</td>
<td><strong>Verification of Iron–Ore / Process iron ore invoices</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>In house rolling facility</td>
<td><strong>Plant verification to identify in house rolling facilities, production of liquid steel and crude</strong></td>
<td></td>
</tr>
</tbody>
</table>
### 7. Licenses and Certificates

- a. ISO 9001:2008 Certification
- b. ISO 14001:2004 Certification
- c. OHSAS 18001:2007 Certification
- d. IS 1786:2008 (TMT Re-bars)
- e. IS 2830:1992 (Billets)

### 8. Product Range

- TMT Re-bars FE 415/415D/500/500D
- CRS (Corrosion Resistant) & EQR (Earthquake Resistant) TMT Re-Bar Size 8 to 36 mm dia.

**Note:**

DRI-EAF -> Direct Reduce Iron-Electric ARC Furnace  
BF-BOF -> Blast Furnace-Basic Oxygen Furnace  
COREX BOF -> COREX Furnace-Basic Oxygen Furnace.

b) Dean IITB shall approve the steel manufacturers prior to procurement and it shall be the responsibility of the Contractor to obtain the proposed manufacturer, much in advance so as not to hamper progress of the site work.

c) The Contractor shall have to obtain and furnish test certificates to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work.

d) Samples shall also be taken and got tested by the Engineer-in-charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the Contractor does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the Contractor at his cost within a week time on written orders from the Engineer-in-charge to do so.

e) The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, as decided by the Engineer-in-charge.

f) The steel reinforcement bars shall be stored by the Contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

g) For checking nominal mass, tensile strength, bend test, re-bend test etc. specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

<table>
<thead>
<tr>
<th>Size of bar</th>
<th>For consignment below 100 ton</th>
<th>For consignment above 100 ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 10 mm dia bars</td>
<td>One sample for each 25 ton or part thereof</td>
<td>One sample for each 40 ton or part thereof</td>
</tr>
<tr>
<td>10 mm to 16 mm dia bars</td>
<td>One sample for each 35</td>
<td>One sample for each 45</td>
</tr>
<tr>
<td>Size of bar</td>
<td>For consignment below 100 ton</td>
<td>For consignment above 100 ton</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td>Ton or part thereof</td>
<td>Ton or part thereof</td>
</tr>
<tr>
<td>Over 16 mm dia bars</td>
<td>One sample for each 45</td>
<td>One sample for each 60</td>
</tr>
<tr>
<td></td>
<td>Ton or part thereof</td>
<td>Ton or part thereof</td>
</tr>
</tbody>
</table>

h) The Contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the Contractor.

i) The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in Clause 10 A of the General Conditions of the Contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 38 of the General Conditions of the Contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations, recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment needs to be made.

j) The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.

k) For the purpose of payment, the actual weight of reinforcement steel shall be worked out as below:

To arrive at unit weight for the purpose of payment three random samples each of 1 meter length shall be collected for each diameter of re-bar from every consignment received at site. Actual weight of three specimens for each diameter shall be taken and average weight calculated and recorded. The average weight so arrived at shall be compared with the theoretical weight of that particular diameter of rebar. Actual or theoretical weight whichever is less shall be considered for making payment for that consignment. However final payment shall be made on the basis of weighted average of all the consignment. The decision of the Engineer-in-charge as regards the random samples and average weight shall be final and binding on the Contractor and no claim of any kind shall be entertained in this regard.

2.2 CONDITIONS WHERE CEMENT IS TO BE PROCURED BY THE CONTRACTOR:

a) The Contractor shall procure 43/53 grade ordinary Portland cement conforming to IS 8112/Portland Pozzolana Cement conforming to IS: 1489 (Part-I) as required in the work, from reputed manufacturers of cement such as ACC, Ultratech, Vikram, Shree Cement, Ambuja, Jaypee Cement, Century Cement & J.K. Cement or from any other reputed cement Manufacturer having a production capacity not less than one million tonnes per annum as approved by ADG for that sub region.

b) The tenderers may also submit a list of names of cement manufacturers which they propose to use in the work. The tender accepting authority reserves right to accept or reject name(s) of cement manufacturer(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer, fully or partially. The supply of cement shall be taken in 50 kg. bags bearing manufacturer’s name and ISI marking.

c) Samples of cement arranged by the Contractor shall be taken by the Engineer-in-charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the Contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the Contractor at his own cost within a week's time of written order from the Engineer-in-charge to do so.

d) The cement shall be brought at site in bulk supply of approximately 50 tonnes or as decided by the Engineer-in-charge.

e) The cement godown of the capacity to store a minimum of 2000 bags of cement or as decided by the Engineer-in-charge shall be constructed by the Contractor at site of work for which no extra payment shall be made.
f) Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the keys of the other lock shall remain with the Contractor. The Contractor shall be responsible for the watch and ward and safety of the cement godown. The Contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time.

g) The cement shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received. The Contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the Contractor / IITB in the manner indicated below:

i) By the Contractor, if the results show that the cement does not conform to relevant BIS codes.

ii) By the IITB, if the results show that the cement conforms to relevant BIS codes.

h) The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the Contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 38 of the Contract and shall be governed by conditions laid therein. In case the cement consumption is less than the theoretical requirement including permissible variation, recovery at the rate prescribed in Schedule F shall be made. In case of excess consumption, no adjustment shall be made.

i) Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer-in-Charge.

j) Damaged cement, noticed if any shall be removed from the site immediately by the Contractor on receipt of a notice from the Engineer-in-Charge. In the absence of compliance within 3 days of receipt of such notice, the Engineer-in-Charge shall be at liberty to get the same removed from the site at the cost of the Contractor.
3 ADDITIONAL / PARTICULAR SPECIFICATIONS:

3.1 Particular Specifications for Earthwork
a. Earthwork in excavation, in general, shall be carried out as per the CPWD Specifications.

b. The earthwork in excavation, wherever required, shall be carried out in slushy position. Rates for earthwork shall include cost of the element for working in or under water / liquid mud including pumping of water / liquid mud. Nothing extra shall be payable on this account. Therefore, the Contractor shall quote his rates after studying the site conditions.

3.2 Particular Specifications for De-watering
a. De-watering shall be carried out by suitable means with adequate stand-by arrangements of pumps etc. and it shall be ensured that its disposal is carried out as per the regulations of the local bodies. The agencies are, therefore, advised to inspect and acquaint themselves of the site and location of disposal point(s) of water / slush and satisfy themselves as regards method of pumping and disposal required to be adopted. Any default or failure on the part of the Contractor to acquaint himself with the aforesaid aspect of work shall not absolve him from his responsibility for the execution / performance of this Contract. Also, all permissions in this regard, to be taken from local authorities, shall be obtained by the Contractor. Nothing extra shall be payable on these accounts.

b. In trenches where surface water is likely to get into cut / trench during monsoons, a ring bund of puddle clay or by any other means shall be formed outside, to the required height, and maintained by the Contractor. Also, suitable steps shall be taken by the Contractor to prevent back flow of pumped water into the trench. Nothing extra shall be payable on this account.

c. The cost of de-watering or working under water and / or liquid mud for execution of all the items for the work is deemed to be included in quoted rates of the respective items and shall not be measured separately for payment. Nothing extra shall be payable for de-watering in this work, irrespective of whether specified or not, in the item descriptions or in the specifications / conditions in this Contract Agreement.

d. This shall also include water encountered from any sources such as rains, floods, sub soil water table being high and/or due to any other cause whatsoever.

3.3 Particular Specifications for Block Work
A. AAC block masonry
a. The work in general shall be carried out as per the CPWD specifications. The AAC blocks shall conform to Grade I of IS: 2185 (Part 3)–1984 and shall be procured from the approved manufactures only.

b. The material received at site shall be fully cured and shall have attained the required strength before delivery to the site. The material shall be free of cracks.

c. The AAC blocks shall be supplied in the required sizes as approved by the Dean (IPS).

d. The samples of AAC blocks (each sample consisting of 6 specimen) shall be collected randomly from the lot procured and tested for various parameters specified below. One sample shall be tested for every 100 cum or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 100 cum. If required, Dean (IPS) or his authorized representative shall inspect the factory during production of the material for this work and also collect samples (of materials used for making AAC blocks) from the factory...
Part B: Major Component (Civil) - Additional / Particular Specifications - Civil Works

itself. The Contractor shall consider this contingency also while placing the order with one of the approved manufacturers. Nothing extra shall be paid on this account.

e. AAC blocks shall be got tested for following parameters from any accredited laboratory approved by the Dean (IPS) for:
   i. Compressive strength
   ii. Oven Dry Density
   iii. Thermal conductivity
   iv. Drying shrinkage
   v. Dimensional Tolerances

f. The AAC blocks shall meet following parameters:
   vi. Compressive strength shall not be less than 4 N/sq. mm.
   vii. Oven Dry Density shall not be more than 650 kg/cum.
   viii. Thermal conductivity shall not be more than 0.24 W / m.k
   ix. Drying shrinkage shall not be more than 0.05%
   x. Dimensional Tolerances in the size shall not be more than ± 5mm for length and
   xi. ± 3mm for height and width.

g. AAC masonry work shall be executed as per the specifications and instructions of the Engineer-in-Charge.

h. The scope of work also includes chasing the AAC block masonry work for embedding pipes, laying conduits etc. and also making good the same by filling cement mortar 1:4 (1 cement : 4 coarse sand) for which nothing extra shall be payable. The chasing shall, however, be carried out using machine cutters in a workman like manner, so as not to disturb the joints in the masonry and without any cracks being developed in the AAC blocks and the masonry. Such defective work shall be replaced free of cost by the Contractor.

i. Mode of measurement shall be same as of brick masonry work as per the Specifications in the Contract.

3.4 Particular Specifications for Concrete and RCC Works

a. The work in general shall be carried out as per the CPWD specifications.

b. Before taking up the RCC, the Contractor shall submit a method statement for carrying out shuttering and RCC work, for approval of Dean (IPS). The work for this portion shall be executed only after approval of method statement and after taking into consideration the observations of Dean (IPS), if any.

c. In case, expansion strip is required to be provided as per the structural requirement in any of the buildings, the Contractor shall follow the scheme provided by Dean (IPS) including keeping the shuttering in position for extended period. Nothing extra shall be paid on this account.

d. Construction joints in RCC shall be provided only at places as per approved structural drawings. It shall not in any manner structurally or functionally affect the structure. If, any additional construction joint is required to be provided, it shall be done with approval of the Dean (IPS).

e. The centring, shuttering, strutting etc., required for the construction joint in RCC shall be provided as per the CPWD Specifications.
3.5 Particular specifications for wood work, factory made doors and wooden fire-resistant door (FRD) frames and shutters

a. General
b. The work in general shall be carried out as per the CPWD specifications.
c. The glue / wooden adhesive to be used for this sub-head shall be PVAc based adhesive, of approved make (Fevicol of Pidilite Industries Ltd. or Korlok of National).

B. Wood work

a. The work in general shall be carried out as per the CPWD specifications.
b. The wood shall be selected best quality teak wood of class as per the BOQ.
c. The work shall be carried out in accordance with the architectural drawings issued by the IITB. The architectural drawings shall at all times be properly correlated and architectural requirements have to be fully satisfied.
d. All the wood used for the manufacturing of the door shutters including the door frames, internal & external lipping, beading for fixing glazing etc. shall be seasoned as per the requirements of the CPWD Specifications.
e. All the screws used for woodwork shall be fully threaded, counter sunk stainless steel screws, grade 304 and they shall be suitably concealed or plugged.

C. Factory made doors

The work shall be carried out as per the CPWD specifications.

a. Decorative high pressure laminate
b. The Contractor shall procure and submit to the Dean (IPS), samples of laminate for approval. After approval of the samples, the Contractor shall prepare a mock up for approval. The material shall be procured and the mass work taken up only after the approval of the mock up by the Dean (IPS).
c. Each type of laminate shall be obtained from only one of the approved manufacturers as specified and in one lot. Adequate spare quantity shall be ordered to cover for any damaged sheet and for replacement by the Contractor till the completion of the work.
d. The Contractor shall ensure that the edges of the laminates do not come out or chip / peel off during cutting and fixing of the laminates. Defective work on this account shall not be accepted and shall be redone by the Contractor at his own cost.

D. Wooden Fire-Resistant Door (FRD) frames and shutters

a. The fire-resistant flush doors along with the frames shall be procured as a set from one of the approved manufacturers and shall be as per the specifications, as per description of the item and the approval of the Dean (IPS). The door shutters shall be entirely symmetrical on both faces. The complete door assembly shall have the required stability and shall satisfy performance required for integrity & insulation as per BS 476: Part 20 & 22 applicable for 2 hours fire rating. Besides, it shall conform to all the requirements for Flush door shutters as per the relevant IS codes and CPWD Specifications.
b. The gap between the shutter and frame, between shutters in case of double leaf shutter should not be more than 2mm. Similar care shall be taken for making rebates for fixing hinges and other hard wares. The workmanship required is of superior class for achieving the desired results.
c. Graphite based Intumescent strip seal of required size as per manufacturer's specifications shall be provided and fixed in the grooves on the door shutters all around the periphery exception the bottom to prevent penetration of smoke and fire. The shutters shall not be worked upon at site to prevent damage to the intumescent
strip. In case of double leaf shutters, intumescent strips, of required size as per manufacturer’s specifications shall be fixed in the rebate portion of meeting styles of each leaf of the shutter.

d. All the FRD shutters shall be provided with 2nd class teak wood external lipping all around the shutter as per manufacturer’s specifications. The grooves of required size and shape shall be made in the external wooden lipping for fixing intumescent seal. All the external visible surfaces of lipping will be finished with 3 coats of melamine polish.

e. The hinges to be used for fixing the door shutters shall be fire rated stainless steel ball bearing hinges of grade 304 fixed with stain steel screws of grade 304. While testing for fire resistance, the whole assembly shall be tested along with the door shutter, door frame, beadings, hinges, etc.

f. All the shutters shall be treated for anti-termite treatment, against woodborer, fungus, pests etc. Therefore, it shall be provided with the preservative treatment based on Boron & Fluoride and as per CPWD Specifications. Nothing extra shall be payable on this account.

g. The calcium silicate boards to be used for manufacturing fire rated door shutters shall be from one of the approved brands. It shall be non-combustible and shall conform to BS 476 part 4 and to class 1 of BS476 part 7 for surface spread of flame.

h. The Contractor shall submit manufacturer’s test certificate for specified fire rating for integrity and insulation criteria, required as per the item nomenclature and the specifications. The Contractor shall also co-ordinate and facilitate with the office of the Fire Officer for obtaining clearance for the FRD shutters along with frames including getting the required site visits conducted by such authorities with a view to obtain Fire NOC. The Contractor shall also be responsible for liaising work required, if any, in this regard. Statutory charges / fees etc. required to be paid to the concerned authorities in this connection shall only be paid by the IITB or shall be reimbursable to the Contractor on production of proof of actual payment by him.

i. Destructive Testing for fire resistance of the door shutter along with door frame shall be done in a laboratory approved by Dean (IPS). The complete door assembly should be able to resist thermal stresses and should not fail on account of shrinkage, cracking or distortion or any other reason, during testing for the duration for which it is fire rated. The cost of sample of door shutter along with the frame (including cost of laminates, beadings, intumescent strips, hinges, screws etc. but excluding painting, polishing etc.), packaging, sealing and transportation of sample to the approved laboratory etc., shall be borne by the Contractor. At least one finished sample (door shutter fixed to the door frame with hinges etc.) for two-hour fire rating shall be tested.

j. The sample shall be randomly chosen by the Dean (IPS), from the lot (of shutter along with frame) procured and brought to the site of work for fixing. If the shutter fails to satisfy the test requirements, the entire lot shall be rejected and replaced by the Contractor at his own cost. Nothing extra shall be payable on this account and no delay shall be accepted on this account.

k. Necessary Testing charges including packaging, sealing, transportation, loading, unloading, necessary personnel for logistic arrangements etc. shall be borne by the Contractor.

l. Measurement - For the purpose of payment, the area shall be measured shutter in Sq.M and Doofr frames in Running Meters (Rmt). The embedded portion of the door frames inside the floors shall not be measured separately for payment. No deduction shall be made for making vision panel, if any.

**E. Metal Fire Resistant Door (FRD) frames and shutters**
a. The fire-resistant metal flush doors along with the frames shall be procured as a set from one of the approved manufacturers and shall be as per the specifications, as per description of the item and the approval of the Dean (IPS).

b. The metal door shutters shall be entirely symmetrical on both faces. The complete door assembly shall have the required stability and shall satisfy performance required for both stability & integrity as per BS 476: Part 20 & 22 and IS 3614Part -2 applicable for 2 hours fire rating. Besides, it shall conform to all the requirements of fire rated flush door shutters as per the relevant IS codes and CPWD Specifications.

c. The gap between the shutter and frame, between shutters in case of double leaf shutter should not be more than 3mm. Similar care shall be taken for making rebates for fixing hinges and other hardwares. The workmanship required is of superior class for achieving the desired results.

d. The hinges to be used for fixing the door shutters shall be fire rated stainless steel ball bearing hinges of grade 304 fixed with stainless steel screws. While testing for fire resistance, the whole assembly shall be tested along with the door shutter, door frame, beadings, hinges, vision panels etc.

e. Honey comb paper or fire metal ceramic wood of 96 kg/M3 should be used for manufacturing the metal fire doors. The wool or honey comb paper shall be snugly fit in the internal frame work of the door shutter.

f. The Contractor shall submit through the proposed manufacturer prior test certificates for the specified 2 hours fire rating for stability and integrity criteria for both single leaf and double leaf doors required as per the item nomenclature and the specifications. The test certificates shall clearly show that doors have been tested with vision panels and approved hardware to establish the technical credentials of the proposed manufacturer. The Contractor shall also co-ordinate and facilitate with the office of the Fire Officer for obtaining clearance for the FRD shutters along with frames including getting the required site visits conducted by such authorities with a view to obtain Fire NOC. The Contractor shall also be responsible for liaising work required, if any, in this regard. Statutory charges / fees etc. required to be paid to the concerned authorities in this connection shall only be paid by the IITB or shall be reimbursable to the Contractor on production of proof of actual payment by him.

g. Destructive Testing for fire resistance of the door shutter along with door frame shall be done in a laboratory approved by Dean (IPS). The complete door assembly should be able to resist thermal stresses and should not fail on account of shrinkage, cracking or distortion or any other reason, during testing for the duration for which it is fire rated. The cost of sample of door shutter along with the frame (including cost of intumescent strips, hinges, screws etc. but excluding painting, polishing etc.), packaging, sealing and transportation of sample to the approved laboratory etc., shall be borne by the Contractor. At least one finished sample (door shutter fixed to the door frame with hinges etc.) for two-hour fire rating shall be tested.

h. The sample shall be randomly chosen by the Dean (IPS), from the lot (of shutter along with frame, vision panels and the proposed hardware) procured and brought to the site of work for fixing. If the shutter fails to satisfy the test requirements, the entire lot shall be rejected and replaced by the Contractor at his own cost. Nothing extra shall be payable on this account and no delay shall be accepted on this account.

i. Necessary Testing charges including packaging, sealing, transportation, loading, unloading, necessary personnel for logistic arrangements etc. shall be borne by the Contractor.

j. Measurement - For the purpose of payment, the area shall be measured from outer frame to outer frame above the finished floor level excluding the portion embedded.
inside floors, wall cladding. The door frame shall not be measured separately for payment. No deduction shall be made for making vision panel, if any.

k. All door frames and shutters shall be finished with polyurethane aliphatic grade paint of approval colour. The door leaf and frame shall have passed minimum 250 hours of Salt Spray Test.

F. Medium Density Fibre Board (MDF)

1. SCOPE
   a. This standard covers the requirements of medium density fibre boards for general purposes having density in the range of 600-900 kg/m³.
   b. This standard does not cover veneered or laminated or prelaminated or other specially treated boards, moulded boards, etc.

2. REFERENCE
The standards listed in Annex A contain provisions, which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3. TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply and for definitions other than those given below, reference may be made to IS 707.

3.2 Additive - Any material introduced prior to the final consolidation of a board to increase bulking or improve some property of the final board. Fillers and preservatives are included under this term.

3.3 Defibration - Under the influence of steam and heat, lignin is softened and the fibres can be separated from each other by a low energy output. Normally in medium density fibre board plant, the fibre separation takes place in defibrators where steamed chips are pushed through screws and ground between big grinding disc, one stationary and the other rotating.

3.4 Fibre - Wood fibre produced by fibreising steamed wood under pressure in a refiner and defibrator. Medium density fibre boards.

3.5 Formation (Forming) -
The laying of the blended mass of glued fibers to form a mat for medium density fibre board.

3.6 MDF - MDF is the short term for medium density fibre board.

3.7 Particles - Distinct particles or fractions of wood or other lignocellulose material produced mechanically lignocellulose as a first step towards defibration. The chips may be in the form of off-lakes, granules, shavings, splinter and sliver as stated below:

a) Flakes - Specially made thin flat particles, with the grain of the wood essentially parallel to the surface of the flake, prepared with the cutting action of the knife in a plane parallel to the grain but at an angle to the axis of the fibre.

b) Granule - A particle in which the length, width and thickness are approximately equal, such as particle of saw-dust.

c) Shaving - A thin slice or strip of wood pared off with a knife, planer or other cutting instrument, the knife action being approximately along the axis of the
fibre, such as the shavings produced in planing the surface of wood.

d) Splinter and Silver - Particle of nearly square or rectangular cross-section with a length parallel to the grain of the wood of at least four times the thickness.

3.8 Sizing Material - Alum, wax, resin or other additive introduced to the agglomerate for MDF prior to forming, primarily to increase water resistance.

4. TYPES

Medium density fibre boards for general purpose shall be of one type only, that is, flat pressed single layer. It may, however, be of two Grades, Grade I and Grade II and may be designated as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid board Grade I</td>
<td>SBG I</td>
</tr>
<tr>
<td>Solid board Grade II</td>
<td>SBG II</td>
</tr>
</tbody>
</table>

5. MATERIAL

Wood Any species of wood or any other lignocellulosic material may be used for the manufacture of medium density fibre boards. However, the purchaser may at his own discretion, specify a particular species of wood or any particular lignocellulosic material for the manufacture of medium density fibre boards. For ECO-Mark, only species of wood other than natural forests, such as wood from rubber, coconut, cashew, industrial and social forestry plantations, etc and shade trees from tea and coffee estates, wood residues or agricultural wastes shall be used for the manufacture of MDF board.

Adhesive: Any suitable type of synthetic resin adhesive may be used for the purpose of bonding to comply with physical and mechanical requirements given in Table.

Sizing Material: Paraffin wax dissolved in mineral spirit or alternatively emulsified with water, or melted shall be used as sizing material.

Preservative Treatment: A suitable preservative may be added to the fibre mix at the mixing stage of adhesive. The following preservatives are regarded as suitable and their percentage is given on the basis of oven dry weight of fibres:

a) Sodium pentachlorophenate to the extent of 2 percent, and
b) Trichlorophenol to the extent of 5 percent.

6. MANUFACTURE

Wood Any species:

Wood or any other lignocellulosic material shall be cut into small chips/particles on suitable chipping machine. These chips shall be steam ed and defibrated in suitable defibrating machine. These fibre thus produced shall be dried in flash dryers and blended with resin and wax. The blended fibres shall then be formed into mats by air felting and pressed into panels by passing into press under controlled heat, pressure and time conditions.

7. FINISH

Medium density fibre board shall be of uniform thickness and density throughout the length and width of the boards. All medium density fibre boards shall be flat. Both surfaces of the boards shall be sanded to a smooth finish. The boards shall be rectangular and shall have square edges. Edge straightness and squareness shall be measured according to the method given in Annex B.
8. DIMENSIONS AND TOLERANCES:

8.1 The dimensions of plywood shall be as follows:
Length: The length of plywood shall be 5.49, 4.89, 3.66, 3.05, 2.44, 1.83 and 1.22 m.
Width: The width of plywood shall be 1.22 m.
Thickness: The thickness of plywood shall be 6, 9, 12, 15, 18, 22, 25, 30, 35 & 40mm.
NOTE- Any other dimension as agreed to between the purchaser and the manufacturer may be used.

8.2 Tolerances
Tolerances on the nominal dimensions of finished boards shall be as follows:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>± 3 mm/m</td>
</tr>
<tr>
<td>Width</td>
<td>± 3 mm/m</td>
</tr>
<tr>
<td>Thickness</td>
<td>± 0.3 mm/m</td>
</tr>
<tr>
<td>Squareness</td>
<td>2 mm/m</td>
</tr>
<tr>
<td>Edge straightness</td>
<td>2 mm/m</td>
</tr>
</tbody>
</table>

9. PHYSICAL AND REQUIREMENTS:-
Density, moisture content, water absorption, linear expansion, modulus of elasticity, modulus of rupture, internal bonding and screw withdrawal strength of MDF boards when tested in accordance with 10 and 11, shall meet the requirements specified.

10. TESTING OF SAMPLES
10.1 Scale of Sampling
10.1.1 Lot :-
In any consignment, all the MDF boards of same grade, type and N dimensions and manufactured under similar conditions of production shall be grouped together to constitute a lot.
10.1.2 The conformity of a lot, to the requirements of this specification, shall be ascertained on the basis of tests on MDF boards selected from it.
10.1.3 The number of MDF boards to be selected from a lot shall be in accordance with the following:

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>Number of Medium Density Fibre Boards to be Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>n</td>
</tr>
<tr>
<td>Up to 50</td>
<td>2</td>
</tr>
<tr>
<td>51-100</td>
<td>3</td>
</tr>
<tr>
<td>101-200</td>
<td>4</td>
</tr>
<tr>
<td>201-300</td>
<td>5</td>
</tr>
<tr>
<td>301-500</td>
<td>7</td>
</tr>
<tr>
<td>50 I and above</td>
<td>10</td>
</tr>
</tbody>
</table>

10.1.4 These MDF boards shall be selected at random (see IS 4905). In order ensure randomness of selection, all the MDF boards in the lot may be
arranged in a serial order and every \( r \)th MDF board may be selected till the required number is obtained, \( r \) being the integral part of \( N/n \), where \( N \) is the lot size and \( n \) is the sample size.

10.2 Test Specimens and Number of Tests

The length, width, thickness and the diagonals of the MDF boards selected as in 10.1.3 shall be measured before cutting the MDF boards for taking test specimens. The straightness of edge shall also be measured.

10.2.1 From each of the MDF boards selected, following test specimens shall be cut out for portions 150 mm away from the edges for tests as specified under 11. The method of preparation and conditioning of specimens for tests listed in (c), (d), (e), (f) and (g) below shall be as specified in IS 2380 (Part 1).

a) For determination of density - Three test specimens from each sample, each of size 150 mm x 75 mm x full thickness of board. Other sizes of sample specimens may be used when deemed necessary.

b) For determination of moisture content - Three test specimens from each sample, each of size 150 mm x 75 mm x full thickness of board. Smaller specimens may be used when deemed necessary.

c) For water absorption test - Three test specimens from each sample, each of size 300 mm x 300 mm x full thickness of board.

d) For determination of linear expansion:

1. Due to general absorption - Three test specimens from each sample, each of size 200 mm x 100 mm x full thickness of board.

2. Due to surface absorption - Three test specimens from each sample, each of size 200 mm x 100 mm x full thickness of board.

e) For determination of modulus of elasticity and modulus of rupture - Three test specimens each for modulus of elasticity and modulus of rupture, from each sample to conform to dimensions as specified in 2 of IS 2380 (Part 4).

f) For screw withdrawal test - Three test specimens from each sample confining to the dimensions specified in 2 of IS 2380 (Part 14)

g) Internal bond - Six specimens from each sample conforming to the dimensions specified in 3 of IS 2380 (Part 5). Out of these, three specimens shall be subjected to the test for internal bond as given in 11.9. The remaining three specimens shall be subjected to either cyclic or accelerated water resistance test as given in 11.9.1.

10.3. Criteria for Conformity

A lot shall be considered as conforming to the requirements of this specification, if all the samples and test specimens pass the conditions as prescribed in 11.10.4. If any sample fails to conform to the requirements, further samples shall be taken from the lot, double in number, and the lot shall be considered to have passed, if these samples conform to the requirements prescribed.

11. TESTING OF SAMPLES

11.1 The samples drawn and the test specimens made therefrom in accordance with 10 shall be subjected to the tests as given in 11.3 to 11.10. The
specimens shall meet the requirements specified in Table I (see also 9 and 10.3).

11.2 Preparation and Conditioning of Test Specimens: All the test specimens shall be prepared and conditioned before testing in accordance with the procedure given in IS 2380 (Part 1).

11.3 Accuracy of Dimensions of Boards

All the samples selected in accordance with 10.2.1 shall be measured for straightness of edges, squareness of boards, lengths, widths and thickness as given in IS 2380 (Part 2). The dimensions shall comply with the requirements specified in 8.

11.4 Test for Density:

The average value of density as prescribed in 10.2.1(a), when tested in accordance with IS 2380 (Part 3) shall meet the requirements specified in Table I (see 9).

11.5 Test for Moisture Content

The average value of moisture content as prescribed in 10.2.1(b), when tested in accordance with IS 2380 (Part 3), shall meet the requirements specified in Table I.

11.6 Test for Water Absorption

The average value of water absorption as prescribed in 10.2.1(c), when tested in accordance with IS 2380 (Part 16) shall not exceed the limits specified in Table I (see 9).

11.7 Test for Linear Expansion (Swelling in Water)

11.7.1 Due to General Absorption

The average value of linear expansion as prescribed in 10.2.1(d), when tested in accordance with IS 2380 (Part 17) shall not exceed the limit specified in Table I.

11.7.2 Due to Surface Absorption

The average value of surface absorption as prescribed in 10.2.1(d), when tested in accordance with IS 2380 (Part 17) shall not exceed the limit specified in Table I.

11.8 Test for Modulus of Elasticity and Modulus Rupture

The average and minimum individual value of modulus of elasticity and modulus of rupture as prescribed in 10.2.1(e), when tested in accordance with IS 2380 (Part 4) shall not be less than the value specified in Table I (see 9).

11.9 Test for Internal Bond

The average and minimum individual value of internal bond as prescribed in 10.2.1(f), when tested in accordance with IS 2380 (Part 5) shall not be less than the value specified in Table I (see 9).

11.9.1 The average and minimum individual value of internal bond as prescribed in 10.2.1(f), when subjected to (a) cyclic test or (b) accelerated water resistance test as given in Table I shall be not less than the values specified in Table I (see 9).
11.10 Test for Screw Withdrawal Strength

The average value of screw withdrawal strength as prescribed in 10.2.1 (g), when tested in accordance with IS 2380 (Part 14) shall not be less than the value specified in Table I.

12 OPTIONAL REQUIREMENT FOR ECO-MARK

12.1 General Requirement

12.1.1 MDF shall conform to the requirement of quality and performance as specified in this standard. The manufacturer shall produce to BIS environmental consent clearance from State Pollution Control Board as per the provisions of the Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution) Act, I 991 and Water (Prevention and air Pollution) Cess Act, 1977 along with the authorization, if required under the Environment (Protection) Act, 1986, while applying for ECO-Mark appropriate with enforced rules and regulations of Forest Department.

12.2 MDF shall conform to the specific requirements given for ECO-Mark under relevant clauses of the standard.

NOTE - The manufacturer shall provide documentary evidence by way of certificate or declaration to Bureau of Indian Standards, while applying for ECO-Mark of quality and performance as specified in this standard.

13 MARKING.

13.1 Each fibre board shall be legibly marked near any of its corners with the following:

Name of the manufacturer;

a) Grade of fibre board (see 4 and Table I);

b) Nominal dimensions (length, width and thickness);

c) Date of manufacture, and

d) The criteria for which the MDF has been labelled as ECO-Mark.

13.2 BIS Certification Marking

13.2.1 Each fibre board may also be marked with Standard Mark.

13.2.2 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. Details of conditions under which a license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table I: Physical and Mechanical Requirements or Medium Density Fibre Boards

(Clauses 5.2,9,11.1,11.4,11.5,11.6,11.7.1,11.7.2,11.8,11.9,11.9.1 and 11.10)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Properties</th>
<th>Grade II (SBG I)</th>
<th>Grade I (SBG I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Density (Kg/m³)</td>
<td>600-900</td>
<td>600-900</td>
</tr>
<tr>
<td>1)</td>
<td>Variation from mean density, percent</td>
<td>±10</td>
<td>±10</td>
</tr>
</tbody>
</table>
### Part B: Major Component (Civil) - Additional / Particular Specifications - Civil Works

#### 111) Moisture content, percent

|      | 5-10 | 5-10 |

#### 111) Variation from mean moisture content percent (absolute)

|      | ±3   | ±3   |

#### 11) Water absorption percent, Max

- **a)** After 2h soaking: 9%
- **b)** After 24h soaking:
  - Up to and including 6 mm thick: 45%
  - 7 to 12 mm thick: 30%
  - 13 to 19 mm thick: 20%
  - 20 mm thick and above: 18%

#### 111) Linear expansion (swelling in water) percent, Max

- **a)** Due to general absorption after 24h soaking:
  - Thickness: 7 mm
  - Length: 0.4 mm
  - Width: 0.4 mm
- **b)** Due to surface absorption (in thickness) after 2h soaking: 5%

#### 1111) Modulus of rupture, N/mm²

- **a)** Upto 20 mm thickness
  - Average: 28
  - Minimum individual: 22
- **b)** Above 20 mm thickness
  - Average: 25
  - Minimum individual: 22

#### 11111) Modulus of elasticity, N/mm²

- **a)** Upto 20 mm thickness
  - Average: 2800
  - Minimum individual: 2500
- **b)** Above 20 mm thickness
  - Average: 2500
  - Minimum individual: 2300

#### 1,i) Internal bond, N/mm²

- **a)** Upto 20 mm thickness
  - Average: 0.8
  - Minimum individual: 0.7
- **b)** Above 20 mm thickness
  - Average: 0.7
  - Minimum individual: 0.6

#### 1,x) Internal bond, N/mm²

- **a)** After cycle test
  - Average: 0.45
  - Minimum individual: 0.4
- **b)** After accelerated water resistance test
  - Average: 0.30
  - Minimum individual: 0.25

#### 1,i:1) Screw with draw all, strength (Min), N

- **a)** Face: 1500
- **b)** Edge (for thickness > 12 mm): 1250
Cycle test - Specimens are immersed in water at $27\pm 2^\circ C$ for a period of 72h, followed by drying in air at $27\pm 2^\circ C$ for 24h. And then heating in dry air at $70^\circ C$ for 72h. Three such cycles are to be followed and then the specimens are tested for internal bond strength.

Accelerated water resistance test - Specimens are immersed in water at $27 \pm 2^\circ C$ and water is brought to boiling and kept at boiling temperature for 2 hours. Specimens are then cooled in water to $27 \pm 2^\circ C$ and then tested for internal bond strength.

G. BAKELITE SHEET

**Technical Description:** These are Paper Based Laminated Bakelite sheets confirming to specification, as per IS: 2036, Bakelite Sheets of Grade P1 have Excellent mechanical and adequate electrical properties. Suitable for low tension non humid applications.

**Applications:** Battery eliminator (transformer, switch gears and choke bobbins), Tube light ends and chokes, Control panels, Condenser mountings, Drill back up and Drill entry.

**Thickness:** Thickness of sheets ranges from 0.5 MM – 50.0 MM.

**Size:** Standard size of Bakelite sheets: 1220 x 1220mm (4 ft x 4 ft) or 2440mm x 1220mm (8 ft x 4 ft).

**Tolerance:** Bakelite Sheets are supplied as per tolerance specified in IS: 2036. More closer tolerance can be met as per customers’ specific requirement.

**Colours:** Available Bakelite sheet colours are natural brown, dark brown, black and gray.
Technical Data for Grade P1

<table>
<thead>
<tr>
<th>Properties</th>
<th>Units</th>
<th>Average Test Results</th>
<th>Value As Per IS : 2036- 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance after immersion in water for 24 hrs at 20°C</td>
<td>Meg Ohms</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Electrical Strength in Oil at 90°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat wise (3.0mm Thickness )</td>
<td>Kv/mm</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Edge wise (5.0mm Thickness )</td>
<td>Kv</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>kgcm²</td>
<td>1050</td>
<td>-</td>
</tr>
<tr>
<td>Flexural Strength/ Cross Breaking strength</td>
<td>Kg/cm²</td>
<td>1450</td>
<td>1300Min.</td>
</tr>
<tr>
<td>Shear Strength</td>
<td>Kg/cm²</td>
<td>900</td>
<td>750 Min.</td>
</tr>
<tr>
<td>Impact Strength( Edgewise Charpy method)</td>
<td>KJ/m²</td>
<td>6.2</td>
<td>-</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td></td>
<td>1.38</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Absorption</th>
<th>(Specimensize-50+1mm square)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>mm</td>
<td>0.8</td>
<td>3.2</td>
</tr>
<tr>
<td>Maximum Value</td>
<td>mg</td>
<td>435</td>
<td>550</td>
</tr>
<tr>
<td>Typical Value Results</td>
<td>mg</td>
<td>245</td>
<td>270</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S.N O.</th>
<th>PROPERTIES</th>
<th>UNIT</th>
<th>SPECIFIED VALUE AS PER IS 2046:1995</th>
<th>GREENLAM TYPICAL VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thickness</td>
<td>m</td>
<td>12.0 ± 0.60</td>
<td>Complies</td>
</tr>
<tr>
<td>2</td>
<td>Length &amp; Width of Panel</td>
<td>m</td>
<td>+10/00mm</td>
<td>Complies</td>
</tr>
<tr>
<td>3</td>
<td>Resistance to Dry Heat at 180° C</td>
<td>Grade</td>
<td>Not worse than 4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Resistance to Surface Wear</td>
<td>Revolution</td>
<td>350 (min.)</td>
<td>&gt;350</td>
</tr>
<tr>
<td>5</td>
<td>Resistance to Immersion in Boiling Water</td>
<td>%</td>
<td>2.0 (max.)</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>a) Mass Increase</td>
<td>%</td>
<td>2.0 (max.)</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>b) Thickness</td>
<td>%</td>
<td>2.0 (max.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Appearance</td>
<td>Grade</td>
<td>Not worse than 4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Dimensional Stability at Deviated Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
H. **TOILET CUBICAL**  
**SOLAR GLASS FOR GENERAL PURPOSE – SPECIFICATION**  
Back painted Glass for vertical and horizontal surfaces

**PART 1  GENERAL**

1.1 **SECTION INCLUDES**
A. Back painted Colored glass, referred to as back painted or back coated glass

B. ASTM International
   1. ASTM C1036 Specification for Flat Glass
   2. ASTM C1048 Specification for Heat-Treated Flat Glass

C. American National Standards Institute (ANSI)
   1. ANSI Z97.1-2004 Glazing Materials Used in Building-Safety Performance Specifications and Methods of Test

D. American Society of Civil Engineers (ASCE)
1. ASCE7-98 Minimum Design Loads for Buildings and Other Structures

E. Consumer Product Safety Standard (CPSC)
   1.16 CFR1201: Safety Standards for Architectural Glazing Materials

F. Glass Association of American (GANA)
   1. GANA Glazing Manual
   2. Bulletin 01-0300–Proper Procedures for Cleaning Architectural Glass Products

SUBMITTALS

G. Submit under provisions of Section 013300 for general submitter requirements

H. Manufacturer’s data sheets on product being used.
   1. Technical Manual
   2. Samples: Manufacture supplied samples of 4”x4” or 12”x12” of back painted glass

1.2 QUALITY ASSURANCE

A. Employees should be fully trained on the procedure for handling glass products and the technique to back paint glass to meet and exceed industry standards

B. Installer Qualifications: Glazing Professional

1.3 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer’s unopened packaging until ready for installation.

B. Store in dry, protected, well ventilated area and protect from damage.

1.4 PROJECT CONDITIONS

A. Maintain environmental conditional (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimal results. Do not install products under environmental condition’s side manufacturer’s absolute limits.

1.5 WARRANTY

A. Provide manufacturer’s one year warranty on back painted glass products.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. As per approved make

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 Back painted Glass

A. Approved Product should be water based back painted glass

   Specified notes of back painted glass:
   - Element Designs back painted glass utilizes the highest quality industrially available water-based paint designed for the specific application of coating glass panels.
   - All glass is optically clear low iron from Element Designs to achieve optical clarity (no jade color), consistency and performance.
• All glass is tempered for strength, durability and safety.
• Each back painted color glass will have an additional light grey backer color for total opacity and increased durability. Matching primary color over backer color is available upon request.
• Maximum back painted glass panel size is 120”x48” for 6mm, 10mm and 12mm thickness. 4mm maximum back painted glass panel size is 96” x 48”.

A. Back painted tempered glass by Element Design son low iron PPG Starphire in various thickness and finishes:
   a. 4mm (5/32”) gloss (smooth surfaces both sides)
   b. 4mm (5/32”) matte (top surfaces acid etched)
   c. 6mm (1/4”) gloss (smooth surfaces both sides)
   d. 6mm (1/4”) matte (top surface acid etched) 10mm (3/8”) gloss (smooth surfaces both sides)
   e. 12mm (1/2”) gloss (smooth surfaces both sides)
   f. 12mm (1/2”) matte (top surfaces acid etched)

Note: Other low iron thicknesses and surface finishes may be available upon request

B. Edge work options on Element Designs back painted glass:
   a. Flat edge polish (available in 4mm, 6mm, 10mm and 12mm thicknesses) – EXPOSED edge applications
   b. Seamed edge (available in 4mm, 6mm, 10mm and 12mm thicknesses) – CONSEALLED edge applications.

C. Color options on Element Designs back painted glass:
   a. Standard Colors: selection of nine standard colors – see manufacturer’s website or catalog
   b. Non-Standard Colors: selection of 277 pre-formulated RAL colors – see manufacturer’s website or catalog
   c. Custom Colors: Element Designs can match any paint supplier’s SOLID color code or by a physical colors watch. Color samples on specified glass type, thickness and finish will be produced and approved prior to production.

PART 3 EXECUTIONS

3.1 EXAMINATION
   A. Do not begin installation until all products are properly prepared by a glazing professional.

3.2 INSTALLATION
   A. Installing accordance to manufacturer’s instructions/recommendations.

3.3 PROTECTION
   A. Protect installed product until completion of project.

3.4 Particular specifications for door hardware and fittings
   i. General
      a. The work in general shall be carried out as per CPWD specifications.
      b. The Contractor shall procure and submit samples of various hardware’s and fittings for approval, of the Dean (IPS). The material shall be procured and the
mass work shall be taken up only after the approval of the samples by the Dean (IPS).

c. All the hardware and fittings shall be supplied with the required spindles, pivots, stud, connecting bolts, screws, grub screws, nuts, bolts, connecting pin / bolt (including stainless steel washers / shims, PVC washers, PVC buffers etc.) and of the material as per the manufacturer’s specifications. Their cost is deemed to be included in the cost of the hardware and fittings to be supplied and these accessories shall not be measured separately for payment. If any of the accessories get damaged during fixing of the hardware and fittings, additional numbers as required shall be supplied by the Contractor at his own cost.

d. The size for the hardware and fittings shall be as specified in the item description in the schedule of quantities and the particular specifications. Wherever the size is not mentioned in the item nomenclature and particular specifications, it shall be as per the manufacturer’s specifications or as directed by the Dean (IPS). The shape has been specified as per the model number mentioned in the manufacturer’s product catalogue / information.

e. If the model number for an item is changed or modified or the item itself is changed /modified, during execution and / or during the defect liability period / guarantee period, the decision of the Dean (IPS) as to the equivalence of the item provided in the schedule of quantities shall be final and binding on the Contractor and no claim of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account.

f. The Contractor shall be permitted to supply items superior than the item in the schedule of quantities, but only with specific written approval of the Dean (IPS), provided they are aesthetically similar and nothing extra shall be payable on this account. That the product proposed to be supplied by the Contractor is superior than that provided in the schedule of quantities / product supplied, shall be the sole discretion of the Dean (IPS) and his decision shall be final and binding on the Contractor and no claim of any kind shall be entertained from the Contractor on this account.

g. The entire supply for each type of hardware and fittings shall be made, preferably, in one lot to keep variations in finishes to the minimum.

h. Three samples from each lot of each hardware shall be tested for conformity to the required grade. Samples shall be supplied by the agency free of cost. Necessary arrangements for testing and testing charges shall be borne by the Contractor.

ii. Handles

a. All the Door handles shall be of the same type (model and finish) and make unless specifically permitted in writing by the Dean (IPS).

b. The handles shall be of stainless-steel grade as specified under item description.

c. The handles shall be supplied in required finish as directed by Dean (IPS) for which nothing extra shall be paid.

iii. Mortise latch, mortise dead bolt, mortise latch cum lock, lock with keys, escutcheon.

a. The mortise latch, mortise dead bolt, mortise latch cum lock, lock with keys and escutcheon shall be of approved same make.

b. The locks and accessories shall be supplied as per item description.
c. The strike plate and for end plate shall be brush finish stainless steel of grade SS 304. Nothing extra shall be payable for supplying stainless steel grade SS 316 instead of SS 304 specified.
d. The cylinder escutcheons (key hole covers) shall be of stainless-steel grade SS
e. These shall be supplied along with the key cylinder lock and shall not be measured separately for payment. Nothing extra shall be payable for supplying stainless steel grade SS 316 instead of SS 304 specified.
f. The lock shall be supplied with a set of three keys.
iv. Concealed / flush tower bolts
   The concealed / flush tower bolts shall be made out of SS grade, size and shape as specified, as per the item description and as per the approved samples.
v. Door stopper
   a. The fittings shall be made out of stainless steel of Grade as specified.
b. The required screws, bolts, spindles etc. of stainless-steel grade SS 304 as per the manufacturer's specifications, shall be supplied along with the fittings and their cost is deemed to be included in the cost of the fitting itself.
c. The fittings shall be of size, shape and finish as specified in the item description in the schedule of quantities and as per the approved samples.
vi. Floor spring: The floor spring of approved make shall conform to the following parameters:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Attributes</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Mechanism</td>
<td>As per manufacturer’s specifications</td>
</tr>
<tr>
<td>6.2</td>
<td>Maximum door width</td>
<td>≤1100 mm</td>
</tr>
<tr>
<td>6.3</td>
<td>Maximum door weight</td>
<td>Minimum 120 kg</td>
</tr>
<tr>
<td>6.4</td>
<td>Spring strength (EN)</td>
<td>1 - 4</td>
</tr>
<tr>
<td>6.5</td>
<td>back check</td>
<td>Mechanical</td>
</tr>
<tr>
<td>6.6</td>
<td>Closing speed</td>
<td>Two Independent Speed Adjustment Valves - (175° – 15°) and (15°- 0°)</td>
</tr>
<tr>
<td>6.7</td>
<td>Hold open Function feature</td>
<td>At 90°</td>
</tr>
<tr>
<td>6.8</td>
<td>Internal components of floor Spring</td>
<td>Stainless steel precision manufactured</td>
</tr>
<tr>
<td>6.9</td>
<td>Cover plate</td>
<td>Stainless steel SS grade 304, secured to the floor spring body using stainless steel screws of SS 304 grade.</td>
</tr>
<tr>
<td>6.10</td>
<td>Non handed</td>
<td>Should be suitable for single and double action doors</td>
</tr>
</tbody>
</table>
vii. Surface door closer: The surface door closer of approved make shall conform to the following parameters:

a. Surface door closer –

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Attributes</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.1</td>
<td>Mechanism</td>
<td>As per manufacturer’s specifications</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Maximum door width</td>
<td>1100mm</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Closing force as per EN</td>
<td>2–4</td>
</tr>
<tr>
<td>7.1.4</td>
<td>Non-handed</td>
<td>Feature needed</td>
</tr>
<tr>
<td>7.1.5</td>
<td>Two Independent Speed Adjustment for variable closing and latching speed</td>
<td>Two Independent Speed Adjustments, (180°–15°) and speed (15°- 0°).</td>
</tr>
</tbody>
</table>

b. Surface door closer -

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Attributes</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2.1</td>
<td>Mechanism</td>
<td>As per manufacturer’s specifications</td>
</tr>
<tr>
<td>7.2.2</td>
<td>Maximum door width</td>
<td>1100mm</td>
</tr>
<tr>
<td>7.2.3</td>
<td>Closing force as per EN</td>
<td>3–4</td>
</tr>
<tr>
<td>7.2.4</td>
<td>Non-handed</td>
<td>Feature needed</td>
</tr>
<tr>
<td>7.2.5</td>
<td>Two Independent Speed Adjustment for variable closing and latching speed</td>
<td>Two Independent Speed Adjustments, (180°–15°) and speed (15°- 0°).</td>
</tr>
<tr>
<td>7.2.6</td>
<td>Suitability for fire door</td>
<td>Feature needed</td>
</tr>
</tbody>
</table>

3.5 Particular Specifications for pressed galvanized steel door frame

a. The work in general shall be carried out as per the Specifications (as per Schedule F) for pressed steel doorframe and relevant IS code.

3.6 SLIDING DOOR

Features and advantages at a glance

- Modular, flexible system
- For door units up to 2 x 85 kg
- Problem-free adaptation to individual requirements
- Low number of system components Industrially prefabricated and tested mini drive unit
- Easy assembly of drive systems
- Multi-functional control, commissioning without programming equipment
- Easy fixing and commissioning
- Can be combined with all customary door profiles
- Reliable function and high safety standards
- Smooth movement
- Complete program at program switches
- Numerous standard connections
- Reliable investment due to compliance with all relevant European standards

Door parameters
- Panel sliding door-
  - Transit width LW: 700 – 3000 mm
  - Door panel weight, max.: 1 x 100 kg.
- Panel sliding door-
  - Transit width LW: 800 – 3000 mm
  - Door panel weight, max.: 1 x 100 kg.

Technical data

<table>
<thead>
<tr>
<th>Control Unit</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>100 und 150 mm</td>
</tr>
<tr>
<td>Depth</td>
<td>180 mm</td>
</tr>
<tr>
<td>Opening and closing force max.</td>
<td>150 N</td>
</tr>
<tr>
<td>Microprocessor controller</td>
<td>Standard</td>
</tr>
<tr>
<td>Opening speed (incremental setting)</td>
<td>10 – 50 cm/s</td>
</tr>
<tr>
<td>Closing speed (incremental setting)</td>
<td>10 – 40 cm/s</td>
</tr>
<tr>
<td>Hold-open time</td>
<td>0,5 – 30 sec.</td>
</tr>
<tr>
<td>Mains voltage, frequency</td>
<td>230 V, 50/60 Hz</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Standard</td>
</tr>
<tr>
<td>International protection</td>
<td>IP 20</td>
</tr>
<tr>
<td>Tested according to low-voltage guidelines</td>
<td>Standard</td>
</tr>
<tr>
<td>Manufacture according to ISO 9001:2000</td>
<td>Standard</td>
</tr>
<tr>
<td>Emergency off</td>
<td>Standard</td>
</tr>
<tr>
<td>Self-learning</td>
<td>Standard</td>
</tr>
<tr>
<td>Automatic reversing</td>
<td>Standard</td>
</tr>
<tr>
<td>Connection for bistable electro-mechanical locking</td>
<td>Standard</td>
</tr>
<tr>
<td>Connection for light barriers (max. 2 pairs)</td>
<td>Standard</td>
</tr>
<tr>
<td>Setting of basic parameters via integrated display and push-buttons</td>
<td>Standard</td>
</tr>
<tr>
<td>Emergency opening or closing (with use of battery pack)</td>
<td>Standard</td>
</tr>
<tr>
<td>24 V output for external consumption</td>
<td>Standard</td>
</tr>
<tr>
<td>Read-out error store with error codes</td>
<td>Standard</td>
</tr>
</tbody>
</table>

Specification text

Automatic sliding door operator for

1. Panel
2. Panel sliding door
3. 150 mm height
4. 100 mm height
Dimensions (H x T): 150/100 x 180 mm.

Microprocessor control, self-learning, reversing when obstruction is encountered.

Transit width:
1- Panel 700 – 3000 mm
2- Panel 800 – 3000 mm

Door weight:
1- Panel max. 1 x 100 kg
2- Panel max. 2 x 85 kg

Function programs:
Off, Automatic, Permanent open, Exit only, Partial open, Night-bank switch, Emergency off.
Basic parameter of door adjustable via integrated display and push-buttons. Choice between emergency opening and emergency closing in the event of a power cut (with optional battery pack).

Produced according to the guidelines for power-operated windows, doors and gates BGR 232, the UVV and the VDE regulations. TÜV design tested, tested according to the low-voltage guidelines, production according to ISO 9001:2000 certification. Fulfils the DIN V18650 (prEN 12650).

Connection:
230 V, 50/60 Hz
- Switch, push-button:
- Program switch:
  - external concealed/flush-mounted
  - external surface-mounted
  - internal
  - lockable
- Emergency off push-button installation:
  - external concealed/flush-mounted
  - external surface-mounted
  - internal
  - double socket external
  - under glass

Additional equipment:
Battery pack, fitted in transom, for emergency opening or emergency closing
Pulse sender:
- Radar system
- directional sensitive………….pcs.
- non-directional sensitive…..pcs.
- other…………………………….pcs.
- Light barriers, comprising receiver and transmitter
- (only 3-wire technology)…………….pcs.

Locking:
- electro-mechanical locking, bistable
- door status detector, locking detector
- manual unlocking
- Colour light alloy parts:
  - silver, anodized E6/C0
  - RAL .................
- Drive unit dimensions:
- Total length B......................... mm
- Transit width LW......................... mm

3.7 Particular Specifications for hot dipping galvanizing work

a. Work shall be carried out as per item nomenclature and relevant IS code.
b. Rates quoted by the bidder also includes cutting of required sections, transporting to factory, compete procedure for galvanization, transporting to site and installation.
c. Three random sample of each section shall be tested for required coating and samples shall be supplied free of cost by the agency. Testing shall be done as per relevant IS code in the lab approved by Dean (IPS).

3.8 Particular Specifications for Stainless Steel Works

a. Stainless steel work: The work under this sub-head in general shall be carried out as per the CPWD Specifications.
b. Stainless steel cladding:
   
   The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless-steel work till completion and handing over of the work.

   Based on the samples approved by the Dean (IPS), the Contractor shall prepare mock up (one no.) at site of work, for approval of quality of workmanship. If the quality of the workmanship and the material is as per the required standards and approved by the Dean (IPS), the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the Contractor and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.

   One test (three specimens) for each lot shall be conducted for the stainless-steel sheet in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer. If the test fails, the entire lot of material shall be rejected and shall be replaced by the Contractor at his own cost. The cost of the sample shall be borne by the Contractor.

   The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform finish as directed by Dean (IPS).

   Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

3.9 Particular Specifications for Flooring & Dado / Cladding
a. General (applicable for all kinds of flooring and dado / cladding works under this sub-head):

b. The work under this sub-head in general shall be carried out as per the CPWD Specifications, as per the architectural drawings and as per the direction of Dean (IPS).

c. The Dean (IPS) or his representative may, if required, visit the source of supply of the various stones to assess the quality as well as availability of the material in the required quantities. The IITB shall bear the cost of such visits of the officers of the IITB.

d. Based on the samples approved by the Dean (IPS) for various flooring and dado / cladding items, for approval of quality of workmanship and material specified. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in-Charge, the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the Contractor as directed by the Dean (IPS) and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.

e. The stones / tiles shall be transported to site well packed in boxes or otherwise. These shall be handled carefully to prevent any damage. The various types of stones and tiles, procured shall be free of any surface defect or any edge damage. The damaged stones and tiles shall not be allowed to be used in the work. So, the contractor shall procure additional quantity of the stone and tiles to cover such contingencies. However, nothing extra shall be payable on this account.

f. For the enclosures with circular or curved profile, only the actual area of the flooring shall be measured for payment and nothing extra shall be payable for labour, material, wastage’s and any other incidental charges.

g. For the skirting in the enclosures with curvilinear profiles, the tiles / stones shall be cut to the required size and the shape to match the profile and/or the joints as per the architectural drawings. Similarly, the skirting shall be fixed in a manner as to flush or project from the finished face of the wall as per the architectural drawings and as directed by the Engineer-in-Charge. Any chasing of the C.C masonry blocks required for such fixing is deemed to be included in the cost of masonry. Nothing extra shall be payable on this account.

h. For flooring work, the joints between the different types of flooring shall be located as per the architectural drawings and the measurement shall be done as per item description. Also, the Contractor shall maintain the uniform level of the finished flooring of the different types unless specifically mentioned on the architectural drawings. Nothing extra shall be payable on these accounts.

i. All the flooring works specified under this sub-head shall be adequately protected by a layer of plaster of Paris which shall be laid over a 400-micron PVC film. The protective layer shall be maintained throughout the execution of works and removed just before handing over of the site for which nothing extra shall be payable.

j. At the time of handing over, flooring & dado / cladding shall be free of any scratches, stains etc. The flooring & dado / cladding shall be properly cleaned.
before handing over. However, abrasive cleaners shall not be used to clean the marks and other scratches.

3.10 Kota stone work

a. The Contractor shall procure and submit the samples of the kota stone for flooring as well as risers and treads in the staircase, for the approval of the Dean (IPS) prior to the execution of the item.

b. Mock up (one no.) shall be prepared for staircase (tread as well as riser).

c. All the Kota stones shall have uniform colour and shade. So, the entire quantity shall be obtained, preferably, in one lot from one location (in one quarry) to keep variation to the minimum. The Contractor shall also sort, segregate and use the stone slabs, according to colour, shade, etc. at any one location to keep variation in the colour, shade etc. in stones used to the minimum. Any stone slab with a variation, not acceptable to the Engineer-in-Charge, shall not be used in the work and shall be removed and replaced by the Contractor at his own cost. Nothing extra shall be payable on these accounts. Also, no claim of any kind shall be entertained from the Contractor on this account.

d. The exposed cut edges of the Kota Stone slab in risers and treads along its width (sides of the risers and treads of the steps i.e. along the shorter dimensions of the kota stone slab for the risers and treads) shall be polished in a workmanlike manner. The top exposed edge of the kota stone skirting shall also be polished in a workmanlike manner. Nothing extra shall be payable on this account.

e. Nosing / edge moulding shall be provided to the front edge of the Kota stone slab treads along its length i.e. along the longer dimensions of the kota stone slab, as per the architectural drawings. The payment of the same shall be made separately under relevant item.

3.11 Granite stone work

a. The Contractor shall procure and submit the samples of different types of granite stones, for the approval of the Dean (IPS) prior to the execution of the item.

b. The mock up (one each) shall be prepared in staircase, amphitheatre, stilt of academic block, dining area, etc.

c. The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one location to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Dean (IPS), shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also, no claim of any kind shall be entertained from the Contractor on this account.

d. Granite stone slabs shall be pre polished (mirror polished) or given any other surface treatment as specified in the item nomenclature, as per the Architectural drawings and as directed by the Dean (IPS).

e. Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the Dean (IPS) may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of
tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

f. The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

g. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost of such items. For the purpose of payment, the actual area of granite stone shall be measured separately as specified under the relevant items.

h. The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Dean (IPS) . Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Dean (IPS) . In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Dean (IPS) .

i. The specifications for dressing, laying, curing, finishing, measurements, rate etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the CPWD Specifications. The wall lining / veneer work with granite stone shall be as per the CPWD Specifications for Marble work Sub Head.

3.12 Vitrified and ceramic tiles work

a. The Contractor shall procure and submit the samples of approved make, shade and thickness of different types of vitrified and ceramic tiles, for the approval of the Dean (IPS) prior to the execution of the item.

b. The mock up (one each) shall be prepared for flooring and dado, for vitrified tiles etc.

c. The entire supply for each type of tiles shall be procured from one manufacturer/ authorized dealer, preferably, in one lot to keep variations to the minimum.

d. The tiling work may be required to be carried out in patterns, design and / or in combination with tiles of different colour and shade and in combination of different stone slabs / tiles for which nothing extra shall be payable. The tiles shall be provided as per the architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

e. For the flooring portions curved in plan, the tiles (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastages and incidental charges on such accounts shall be deemed to be included in the cost of such items.
f. The Contractor shall obtain and submit to the IITB the manufacturer’s test certificate for compliance of various parameters for the material as per the manufacturer’s specifications, with each lot of material received at site.

g. The flooring and dado / cladding should be set out such that the perimeter/ corner tiles are in excess of half a tile so that the edge panels on both the sides are of equal sizes, as far as possible. The tiles shall be cut to required size and shape in a workman like manner but with all precautions, as per the manufacturer’s specifications.

h. For dado / cladding / skirting work, the tiles shall be chamfered at the meeting edges on the corners in a manner that butt edges are not visible. It shall be ensured that the edges shall be ground / filed to chamfer the edges so that the glazing layer at the edges of the tiles is not chipped off otherwise the work shall be rejected and redone by the Contractor at his own cost.

3.13 PVC sports flooring

a. The Contractor shall procure and submit the samples of approved make, shade and thickness of PVC sports flooring material along with accessories and adhesives proposed to be used as per the manufacturer's recommendations, for the approval of the Dean (IPS) prior to execution of the item.

b. Once the material is approved, the entire material for PVC sports flooring shall be procured from one of the approved manufacturers / authorized dealers preferably, in one lot to keep variations to the minimum. The Contractor shall also procure various accessories and adhesive required for satisfactory installation of PVC sports flooring.

c. The work shall be carried out as per the architectural drawings, as per site conditions and as per the directions of the Engineer-in-Charge. The work shall be carried out in design and pattern including in combination with PVC sheets/ tiles of different colours and shade in linear as well as curvilinear portions of the building, as per the architectural drawings. The joints shall be kept as minimum as possible.

d. The work shall be carried out as per the manufacturer's specifications. The work shall be got executed through an experienced agency executing similar works.

e. Before fixing the PVC sports flooring, it shall be ensured that the sub floor on which the PVC sports flooring is being laid is smooth, flat, hard & free from moisture, grease, etc. In case of uneven sub floor, the same shall be levelled by self-levelling compound at no extra cost to the IITB. The PVC sports flooring shall have perfect level after laying and no undulations from the sub-base shall be visible (reflected) on the surface. Also, there shall not be any air bubbles or delamination of the flooring, otherwise the work shall be rejected and redone by the Contractor at his own cost.

f. Care shall also be taken to ensure that sub floor is dry at the time of installation.

g. The composite thickness of the PVC flooring sheet shall be as per item description.

h. All the joints shall be sealed by hot welding as recommended by the manufacturer to make the floor seamless and safe.

i. The Contractor shall obtain and submit to the IITB the manufacturer’s test certificate for compliance of various parameters for the material as per relevant EN standards, with each lot of material received at site.
j. For the purpose of measurement, the actual area of PVC sports flooring including skirting provided and fixed in position shall be considered.

3.14 Vinyl flooring

1. Summary
   A. Section Includes: Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.
   B. Related Documents: Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

2. SYSTEM DESCRIPTION
   A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.
   B. Administrative Requirements
      A. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
      B. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e. moisture tests, bond test, pH test, etc)]
      C. Test Installations/ Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner’s and Consultant’s acceptance of finish color, texture and pattern, and workmanship standards.
         A. Mock-Up Size: 4’x4’.
         B. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
         C. Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.
      D. Sequencing and Scheduling
         A. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
         B. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

3. SUBMITTALS
   B. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.
   C. Submit Safety Data Sheets (SDS) available for flooring products, adhesives, weld rod, patching/leveling compounds, floor finishes (polishes) and cleaning agents.
   D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
E. Closeout Submittals: Submit the following:
   A. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
   B. Warranty: Warranty documents specified herein
4. QUALITY ASSURANCE
   A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
   B. Select an installer who is competent in the installation of Armstrong resilient sheet flooring using Armstrong Flooring S-761 Seam Adhesive method.
   A. Engage installers certified as Armstrong Commercial Flooring Certified Installers
   B. Confirm installer's certification by requesting their credentials
   C. Fire Performance Characteristics: Provide resilient vinyl sheet flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
      A. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
      B. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
      C. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.
5. DELIVERY, STORAGE, AND HANDLING
   A. Comply with Division 1 Product Requirements Sections
   B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
   C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
   D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
6. PROJECT CONDITIONS
   A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of [100°F (38°C)][85°F (29°C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the
7. LIMITED WARRANTY
   A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
   B. Limited Warranty Period: 10 years
   C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
   D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

8. MAINTENANCE
   A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
   B. Quantity: Furnish quantity of flooring units equal to 10% of amount installed.
   C. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

9. VINYL SHEET FLOORING MATERIALS
   A. Provide Homogeneous Sheet Vinyl Flooring: ColorArt™ Medintech® with Diamond 10™ Coating manufactured.
      • Description: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a diamond-infused UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
      • Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing
      • Pattern and Color: color selected from the range currently available from Armstrong Flooring Inc.
      • Width: 6 ft. 7 in. (2.0 m).
      • Length: up to 65.6 lineal feet (20 meters)
      • Thickness: 0.080 in. (2.0 mm)
   B. Vinyl Weld Rod:
      • Provide solid color vinyl weld rod as by manufacture, and intended for heat welding of seams. Color shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring.
   C. Seam Adhesive:
• Provide Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

10. ADHESIVES
   A. Provide Vinyl Sheet Flooring Adhesive Premium Commercial for field areas Flash Cove Adhesive at flash coving as recommended by the flooring manufacturer.
   B. For High-Moisture Installation Warranty, Full Spread: Provide Commercial Sheet Flooring and LVT Adhesive for field areas Flash Cove Adhesive at flash coving as recommended by the flooring manufacturer.
   C. For non-heat welded seams: Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

11. INSTALLATION OF FLOORING
   A. Install flooring in strict accordance with the latest edition of manufacturer Flooring Guaranteed Installation Systems manual, F-5061. Failure to comply may result in voiding the manufacturer’s warranty listed in Section 1.08.
   B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
   C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the sub floor around covers and to covers.
   D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
   E. Adhere flooring to the sub floor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
   F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer’s recommendations.
   G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer’s written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
   H. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.
   I. Provide integral flash cove wall base where shown on the drawings, including cove fillet support strip and top edge cap trim. Construct flash cove base in accordance with the flooring manufacturer’s instructions. Heat-weld seams as specified for those on the floor.

3.15 CARPET TILE

1. SUMMARY
1.1 Furnish and install carpet tile, cove base, and all accessories as shown on Construction Drawings or as otherwise requested.

1.2 This standard does not cover veneered or laminated or prelaminated or other specially treated boards, moulded boards, etc.

2. SUBMITTALS

A. The following shall be submitted in accordance with Section 01330, “Submittal Procedures.”

B. Product Data: Submit manufacturer's product literature and installation instructions for each type of carpeting material and installation accessory required.

C. Samples

1. Submit manufacturer's standard size samples showing full range of colors, textures, and patterns available for each type of carpet tile required.

2. Submit a minimum of four 24-inch square samples for each type of carpet tile required. Submit samples that are large enough to show pattern repeat if beyond an 18-inch sample dimension.

3. Submit samples of each type exposed edge stripping, vinyl base, and accessory item.

D. Certification

1. Submit certificate stating that the manufacturer and installer comply with Quality Assurance requirements. Include a minimum of five (5) references, complete with addresses, telephone numbers, and contact persons for installations within the time period indicated.

2. Submit manufacturer's certificate stating that materials furnished comply with specified requirements. Include supporting independent certified laboratory testing data indicating that material meets specified test requirements.

3. Submit Material Safety Data Sheet (MSDS) for adhesives, leveling compounds, and primers required.

4. Submit written warranty information stating compliance with requirements.

E. Sustainability Data

1. Submit product data or manufacturer’s certification letter indicating percentages by weight of pre-consumer and post-consumer recycled content for each carpet product.

2. Submit product data, MSDS, or manufacturer’s certification letter indicating volatile organic compound (VOC) content for each adhesive used for installation of carpet, cove base, and carpet edge guard products.

3. Submit manufacturer’s documentation that cove base and carpet edge guard products are compliant with one of the following:
   a. Floor Score IAQ Certification Program
   b. GREENGUARD Children & Schools Certification Program
   c. Emission Criteria of California Section 01350 Program

4. Submit manufacturer's documentation that carpet systems meet the following CRI IAQ program requirements:
   a. Carpet: Green Label Plus Program
   b. Carpet Cushion: Green Label Program
F. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated traffic and use conditions. Include precautions against materials and methods that may be detrimental to finishes and performance.

The standards listed in Annex A contain provisions, which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3. TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply and for definitions other than those given below, reference may be made to IS 707.

3.2 Additive - Any material introduced prior to the final consolidation of a board to increase bulking or improve some property of the final board. Fillers and preservatives are included under this term.

4.1 Crazy ceramic (china mosaic) tile flooring

a. The materials to be used shall be broken glazed ceramic tile pieces. These shall be obtained from broken glazed tiles of uniform thickness and of approved shade and manufacture and conforming to I.S. 13753. The tile pieces shall be hard, sound, dense and glossy in texture. These shall be of required colour and shade and free from stains, cracks, decay and weathering.

b. The work shall be carried out as per the architectural drawings in design (geometric, abstract etc.) and in linear and / or curvilinear pattern and in combination with tile pieces of different colour and shade.

c. Before laying tile flooring on RCC slabs / PCC base, the laitance shall be removed and the surface shall be roughened. A coat of cement slurry @ 2.2 kg of cement per sqm shall be applied over the base surface for bonding between RCC slab / PCC and mortar bedding of tile flooring. Nothing extra shall be payable on this account.

d. Pieces of ceramic glazed shall be brought to required size & shape to achieve the required design/ pattern. The shade of the tiles shall also be selected depending upon the pattern/ design. Tiles shall be thoroughly cleaned and soaked in water before fixing. Cement grout of desired consistency admixed with approved water-proofing compound and synthetic polyester fibre shall be spread over the mortar bedding when the mortar is still plastic. Pieces of glazed tile shall be pressed piece by piece in the required pattern in the cement float. The fixing shall be done by keeping the joints between the pieces as thin as possible but not exceeding 5mm. The work shall be carried out to correct level and slopes and compacted by striking the surface with hand thappies and straight screed tamper. The grout shall cream up to the surface. The junctions of the flooring and the parapet wall shall be rounded and the flooring shall be extended up to the wall for 15cm or as specified. After the flooring has been laid or the day’s fixing work is completed, surplus cement grout that may have come out of the joints on compacting shall be cleaned off. The flooring laid shall be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

e. Once the floor has set, it shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after the construction work is completed.
f. The Contractor shall ensure that the China Mosaic work provides waterproofing treatment and shall not allow penetration of water. The guarantee for the water proofing work at the terrace shall also include restoration of the China Mosaic work after rectification, if any to the integral cement based waterproofing treatment to the terrace. Nothing extra shall be payable on this account.

g. For the purpose of payment, actual area of the China Mosaic tile work shall be measured in sqm correct to two decimal places. No deduction shall be made for joint width between the adjacent tile pieces.

4.2 Particular Specifications – Roofing (False ceiling)

a. General (applicable for all kinds of roofing works under this sub-head):

b. The work in general shall be carried out as per the CPWD specifications, as per the manufacturer’s specifications, as per architectural drawings and as per directions of Engineer-in-Charge.

c. Various false ceiling shall be done in different levels in linear and curvilinear pattern in plan and elevation and in combination with other types of false ceiling as specified in schedule of quantities, as per the architectural drawings. However, payment shall be made under respective items.

d. The tiles and the suspension system shall be as specified in the item nomenclature. The Contractor shall procure and submit the samples of tiles and grid system of approved make, for the approval of the Dean (IPS) prior to execution of the item.

e. The Contractor shall prepare the mock-up at site for approval of material and quality of workmanship by the Dean (IPS). Only after the approval of Mock-up, the Contractor shall start the mass work. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in-Charge, the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the Contractor as directed by the Dean (IPS) and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.

f. Once the material and mock up are approved, the entire material (tiles as well as grid system) shall be procured from the approved manufacturer or its authorized dealer.

g. The installation shall be got done through an experienced installer, executing similar works.

h. The material shall be transported to site well packed. The ceiling material procured shall be free of any surface defect, edge damage and any other such defects. The Contractor shall ensure careful handling and storage and prevent any rough handling, rolling of cartons or dropping cartons to prevent any edge damage or breakage. The defective / damaged material shall not be allowed to be used in the work. So, the contractor shall procure additional quantity of material to cover such contingencies. However, nothing extra shall be payable on this account.

i. Adequate care shall be taken before installation as well as afterwards till completion of the work. It shall be protected from rains, excessive humidity, chemical fumes, vibrations, dust etc. Any tile with edge damaged or crack etc. shall not be allowed to be used in the work and shall be replaced by the Contractor at his own cost. Similarly, adequate care shall be taken by the Contractor while placing or removing and handling the tiles so as not to cause
any damage. The ceiling shall be cleaned as per manufacturer's specifications. Abrasive cleaners shall not be used to clean the marks.

d. The Contractor shall obtain and submit to the IITB the manufacturer's test certificate/report for compliance of the material to the relevant standards along with each lot of material supplied for the work.

e. The suspension system for various types of false ceiling shall be as per manufacturer's specifications. The false ceiling tiles shall be fixed on to coordinated suspension ceiling system with supporting grids system that fully integrates with the ceiling tiles as per manufacturer's specifications. It shall be ensured that the suspension system shall be suitable to take all designed dead, imposed and all incidental loads efficiently and shall not sag. The true line and levels for false ceiling work shall be maintained.

f. The luminaries, air grills / diffusers, signages etc. shall be as far as possible independently supported to avoid any over loading of the ceiling system which may result in excessive deflection or twisting of grids. Any strengthening of grid system by providing additional hangers, fasteners, runners, cross tees etc. or providing additional bracing may be carried out as required for any specific locations or for specific purpose for which nothing extra shall be payable.

g. The rate for the item of various false ceiling system shall include cost of all inputs of labour, materials, wastage if any, T&P, scaffolding, staging or any other temporary enabling structure/services etc. and all other incidental charges including making necessary cut outs for A.C diffusers, Light fittings, grills, Fire detection, alarm, sprinklers devices and fittings etc. No deduction in the area shall be made for openings nor anything.

4.3 Gypsum board false ceiling

a. The work in general shall be carried out as per CPWD specifications extra shall be payable for making the openings. Also, nothing extra shall be payable on account of any wastage in materials. Also, nothing extra shall be payable on account of any strengthening of the supporting suspension system for the false ceiling, around the openings in the false ceiling by using additional hangers, fasteners, runners, cross tees, cross channels, etc. However, for the purpose of payment only the actual area of the false ceiling shall be measured in sqm., as per the manufacturer's specifications, as per architectural drawings and as per directions of Dean (IPS).

4.4 Particular Specifications – Finishing Works

A. General (applicable for all items under this sub-head)

a. The work shall in general be carried out as per the CPWD specifications and the manufacturer's specifications (where CPWD specifications are not available).

b. The theoretical consumptions of the various materials like plaster, primer, paint, etc. shall be as per the CPWD specifications and the various coefficients specified herein. Wherever coefficients are not mentioned in CPWD specifications, the same shall be as specified under relevant items. Nothing extra shall be payable on account of actual consumption exceeding the theoretical consumption. However, in exceptional cases, if the actual consumption is lesser than the theoretical consumption, cost adjustment shall be made for lesser consumption of material at the prevailing market rate.

B. Ready Mixed Cement Plaster

c. The quantity of plaster required as per the theoretical consumption including wastages, if any, shall be procured from one of the approved manufacturers or his authorized dealers.
d. The plaster shall be obtained in packing (40 Kg or 50 Kg, as per manufacturer) as far as possible.

e. The name of the manufacturer, manufacturer’s product identification, and manufacturer’s mixing instructions, warnings and instructions for handling and application, date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of each bag. These details shall be kept in record. The material shall be consumed in the order of material brought to site, first come first consume basis. The Contractor shall obtain and submit to the IITB the manufacturer’s test certificate for compliance of various parameters for the material as per the manufacturer’s specifications, with each lot of material received at site.

f. The method of storage of material shall be same as applicable for cement specifications. The material older than 6 months from the date of manufacturing shall not be allowed to be used in the work.

g. Surface preparation - The base surface shall be cured properly prior to the application of plaster. It shall be cleaned thoroughly, with no loose particles or dust. The surface shall be structurally sound, clean and free from dirt, oil, grease, efflorescence or any other contaminant that could impair the natural bond. Surface defects such as cracks, holes or voids shall be repaired prior to application. The base surface shall also be in-line & levelled before the application of plaster.

h. Pre-wetting of the substrate - The surface shall be wet properly before application of plaster.

C. Mixing:

a. Plaster shall be thoroughly mixed with water before use in a mechanical stirrer for uniform and through mixing to ensure proper workability.

b. Mixing ratio of clean potable water to the weight of the powder shall be as per manufacturers’ specifications, depending upon the thickness of the plaster to be applied.

c. The entire plaster proposed to be used in specific work shall be mixed thoroughly and uniformly with water. No plaster shall be left unmixed in the container.

d. In exceptional cases, manual mixing shall be allowed with prior approval of Engineer –in- Charge. However, it shall be ensured that the plaster is mixed uniformly during manual mixing.

e. All arrangements for measuring, dosing etc. at site shall be made by the Contractor.

D. Application:

a. Plaster shall be applied on the surface manually with a trowel.

b. The first coat of mixed plaster will be applied on the moistened wall surface uniformly, going upward from the bottom.

c. The thickness of the coating to be applied shall be as per the manufacturer’s specifications.

d. The first coat of the plastered surface shall be allowed to dry as per manufacturer’s specifications before applying second coat. The surface after second coat shall be allowed to dry completely and same process shall be followed for subsequent coats.

e. The curing shall be done as per manufacturer’s specifications.

f. The entire quantity of plaster shall be used within 2 to 3 hours or as per manufacturer’s specifications, after mixing with water. No extra water shall be added in the mixture made.
Part B: Major Component (Civil) - Additional / Particular Specifications - Civil Works

- For application in exterior surfaces, necessary measures like covering the surface with net and water curing as per manufacturer’s specification shall be undertaken.

- Coverage:
  1. The coverage for 12 mm thick plaster shall be 23 Kg per sqm. (approx.).
  2. The coverage for 18 mm thick plaster shall be 35 Kg per sqm. (approx.).

- The Contractor shall maintain proper records for receipt and consumption of the plaster for verification of Engineer-in-Charge.

- Measurement - The mode of measurement shall be as per cement plaster items of respective thicknesses as per CPWD Specifications (referred to Schedule F).

E. PAINTING AND COATING FOR GENERAL PURPOSE – SPECIFICATION

General

Type of Paint or Coating

Type of paint and coating shall be as shown on drawing and schedules.

Identification

1. Materials shall be delivered in sealed containers clearly labeled.
2. No paint shall be used more than 18 months after manufacture and more than 6 months after delivery to site whichever is earlier.
3. Coating materials other than spray paints, bituminous paints and fine textured masonry paints shall be in containers not exceeding 5 litres capacity.

Manufacturer

The Contractor shall obtain the Engineer’s approval to the product and name of manufacturer for each product.

The same approved product preferably from the same batch, shall be used throughout the works.

Samples

Sample panels of minimum three-square meters shall be prepared for each type and colour of coating material to be used in the Works for the approval of the Engineer.

Storage and Use

1. Paint shall be safety stored in an approved location away from sunlight.
2. Paint shall be delivered and kept in sealed tins.
3. Residue from one tin shall not be added to another tin.

Standards

IS 75 Specification for raw and refined linseed oil
IS 345 Specification for transparent liquid wood filler
IS 348 Specification for French polish
IS 427 Specification for distemper – dry colour
IS 428 Specification for distemper – oil emulsion colour
IS 533 Specification for gum spirit of turpentine
IS 1477 Code of Practice for painting of ferrous metals in buildings – Parts I and II (Pre-treatment and Painting)
**IS 2338** Code of Practice for finishing of wood and wood-based materials – Parts I and II (Operation and workmanship and Schedule)

**IS 2395** Code of Practice for painting concrete, masonry and plaster surfaces

**IS 2932** Specification for enamel synthetic exterior undercoating and finishing

**IS 2933** Specification for enamel exterior undercoating and finishing

**IS 3537** Specification for ready-mixed paint, finishing, interior, for general purposes to IS colours

**IS 3631** Specification for ready-mixed paint for finishing interior, alkyd and non-alkyd for general purposes to IS colours

**IS 4597** Code of Practice for finishing of wood and wood-based products with nitro-cellulose and cold-catalysed materials

**IS 5410** Specification for coloured cement paints

**IS 6005** Code of Practice for phosphating iron and steel

**IS 6278** Code of Practice for whitewashing and colour washing

**Workmanship**

**General**

1. Before painting commences all floors shall be washed over and every possible precaution taken to keep down dust.

2. Workmanship generally shall be carried out in accordance with IS codes unless otherwise specified.

3. No primed or undercoated woodwork and metal work shall be left in an exposed or unsuitable situation for long before completion of painting. No exterior or exposed painting shall be carried out under adverse weather conditions.

4. Ironmongery not required to be painted shall first be fitted, then removed before any painting preparation commences, and refixed in position when painting is completed.

5. Brushes and containers used in carrying out the work shall be clean and free from foreign matter. They shall be thoroughly cleaned before being used for different types or classes of paint or coating.

6. All materials shall be used strictly in accordance with the manufacturer’s printed instructions.

7. The Contractor shall check with the manufacturers that all materials for each type of paint / coating are compatible with one another and with the surface exposure conditions, and with any fire retardant or preservatives applied to the painted / coated item.

8. No dilution of painting material shall be allowed except strictly as recommended by the manufacturers and as approved by the Engineer.

9. Concrete, blockwork, plaster and timber surfaces which are to be painted or coated shall be wiped clean prior to painting and shall be completely dry and free of efflorescence before commencement of painting / coating.

**Preparation of Plastered and Rendered Surfaces for Painting**

1. The surface shall first be scraped to remove mortar splatter etc., and then made good, cutting out all defective work and repairing with plaster or render of the same type as previously used.
2. The surface shall then be rubbed down with fine glass paper to remove loose particles and to smooth irregularities. The filler coat shall then be spread evenly with a scraper over all surfaces and allowed to dry.

3. The first application of filler coat shall be rubbed down and a second filler coat shall be applied and dried.

4. The surface shall then be sanded using progressively finer grades of glass paper until perfectly smooth and approved by the Engineer.

5. New concrete shall be allowed to age a minimum of 28 days prior to coating application. The surface must then be chemically treated or sweep blasted to remove the laitance layer. The pH of the concrete surface should be within the 6.8 – 8.0 range for safe coating application. If the surface pH is outside this range, a fresh water rinse should be given and repeated until pH is within the required range.

   The first priming paint coat shall be thinned and applied with a brush to obtain maximum penetration.

6. All rendered surfaces shall receive one full coat of alkali resistant primer before the application of oil based paints

Preparation of Wood Surfaces for Painting

1. Large, loose or resinous knots shall be cut out and the holes plugged with sound wood. Nails shall be punched well below surfaces, especially externally.

2. Surfaces shall be rubbed down with fine glass paper in the direction of the grain to give a smooth even finish with arises pencil rounded or eased.

3. After dusting off all oily woods such as teak shall be washed with white spirit.

4. Two thin coats of knotting shall be applied to all knots and any other resinous parts of softwood.

5. Before priming preservative treated timber, all cut surfaces shall be re-treated.

6. A full coat of primer shall be vigorously brushed in, particular care being taken to fill end grain.

7. Backs of members shall receive two coats of primer.

8. After priming, all nail and screw holes and depressions shall be filled with stopping, pressed well and finished off flush with surface. Screw heads shall be countersunk sufficiently to hold the stopping.

9. After priming and stopping is completed, pores and grain irregularities shall be treated with a coat of brush or knife applied filler, and the surface rubbed down smooth and even.

10. Joinery to be painted shall have primer and an undercoat applied to rebates before glazing. For joinery to be stained or varnished two coats of staining or varnish shall be applied to glazing beads and rebates before glazing.

11. Edges of exterior plywood and blockboard, shall be sealed with two coats of primer and the backs treated with a suitable approved primer.

12. All woodwork scheduled to receive a clear finish shall be well sanded (with the grain) removing all dirt, etc., to give as smooth a surface as possible. Resinous timber shall be swabbed down with white spirit and dried thoroughly. Split or end grain shall be filled with suitable filler recommended by the clear lacquer manufacture, in accordance with their instructions, and of the appropriate shade.

13. Etched, sand blasted and ground glass shall be protected by treating edges before coating.
14. All woodwork surfaces delivered to site without priming shall be prepared and primed immediately on delivery to site.

Preparation of Metal Surface for Painting

1. Metal surfaces shall be thoroughly cleaned of all dirt, grease, rust and scale by means of chipping, scraping and wire brushing. Particular attention shall be given to the cleaning of welded, brazed and soldered joints. The surface shall be washed with white spirit and wiped dry with clean rags. One coat of metal primer shall be applied immediately the cleaned surfaces have been approved by the Engineer. Iron and steel surfaces shall receive two coats of primer of 50 microns thickness.

2. Galvanised metalwork to be painted shall be thoroughly cleaned of dirt, grease and dust and washed down with white spirit and wiped dry with clean rags. Any minor areas of rust shall be removed by wire brushing and spot primed with a zinc rich primer. At least one coat of a two pack high build epoxy undercoat, pigmented with zinc phosphate shall be applied to all surfaces to be painted.

3. If the priming coat of pre-primed metalwork has suffered damage in transit, or during erection on site, the affected areas shall be cleaned off by wire brushing, abrading and dusting off, the bared patches touched up with a primer of a similar type to that already applied.

4. Priming shall follow manual preparation as quickly as possible and not later than on the same day. With blast cleaned surfaces priming shall follow within 1 hour.

Paint Application

1. Painting shall comply with IS codes and these specifications.

2. Coating shall be applied in accordance with the manufacturer's printed instructions to clean, dry surfaces, in dust free and dry atmospheric conditions and after any previous coats have hardened.

3. Priming coats shall be applied by brush unless other methods are approved taking care to work the primer into the surface, joints, angles and end grain.

4. Any primed surfaces which have deteriorated shall be touched up.

5. Undercoats shall be applied as an even film over all exposed surfaces avoiding an uneven thickness at edges and angles.

6. Undercoats shall be rubbed down to a smooth surface with fine abrasive paper and cleaned of all dust before the application of the next coat.

7. Finishing coats shall be applied as an even film over exposed surfaces, avoiding brush marks, sags, runs and other defects. Where two gloss finishing coats are specified the second coat shall be applied within 48 hours of the first.

8. Unless otherwise indicated in the Specification or Drawings the minimum number of coats for drying-oil/resin based paint systems shall be as per the manufacturer's recommendations.

9. The permission of the Engineer must be obtained if it is necessary to proceed with painting generally if relative humidity in the building is greater than 80% or when such humidity may be expected. Polyurethane wood finishes shall not be applied when the temperature is less than 10oC.

10. In the event that the Engineer is not satisfied that the quality of finish complies with the required standards and / or the sample panel the contractor will be required to repaint at his own expense such work to the satisfaction of the Engineer. If in the opinion of the Engineer it is necessary to remove the unsatisfactory paintwork completely this shall be done under the direction of the Engineer at the expense of the Contractor.
11. If, while the work is in progress, the paint appears to be faulty, such as inconsistency of colour, drying time, or quality of finish, the work shall be stopped at once and the manufacturer consulted.

12. The manufacturers of the material shall be given every facility for inspecting the work during the progress in order to ascertain that the materials are being used in accordance with their directions, and to take samples of their products from the site if they so desire for testing.

13. The finishing coats of the various paints or surface finishing shall be free from sags, brush marks, runs, wrinkles dust, bare patches, variation in colour and texture and other blemishes.

14. When the work has been completed, the finished surfaces shall not be inferior in quality, colour and finishes to the samples approved by the Engineer, and imperfections in manufacture shall not be apparent through these finished surfaces.

F. **Acrylic texture plaster**

a. The Contractor shall procure and submit the samples of approved make and shade along with catalogue, for the approval of the Dean (IPS) prior to execution of the item.

b. Based on the samples approved by the Dean (IPS), the Contractor shall prepare the mock-up at site for approval of material and quality of workmanship by the Engineer-in-Charge. Only after the approval of mock-up, the Contractor shall start the mass work. The mock-up shall not form part of the work. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.

c. Once the material and mock up are approved, the entire quantity of various materials shall be procured from the approved manufacturer or its authorized dealer, preferably, in one lot to keep variations to the minimum.

d. The work shall be carried out as per the manufacturer’s specifications.

e. The Contractor shall obtain and submit to the IITB the manufacturer’s test certificate/report for compliance of the material to the relevant standards along with each lot of material supplied for the work.

f. The material shall consist of two parts: Scratch-plaster and Terra-coat.

g. Scratch-plaster - It shall have two components which comes in liquid & powder form. These shall be mixed at site before application in the ratio 25kg. Powder in 1.0 litre of liquid. Powder shall be made-up of Acrylic powder polymer, inert filler material in powder form, finally graded silica (450 micron to 1.00mm graded) particles, Antifungal agents, Emulsifying agent (Extender) to prevent lumping of powder during mixing, Titanium di-oxide pigments for making it water-proof from exterior while allowing trapped water vapour breathability & Thixotropic agent for maintaining consistency of mix. & to prevent flowing of mix during application. The surface to be covered shall be pre-cured & shall be applied with surface stabilization primer before application of Scratch-plaster.

h. Terra-coat - It shall be made-up of Acrylic Co-polymer emulsion, crushed & precisely graded silica particles (500 micron & down size), high quality rutile (Purest form) grade Titanium di-oxide, fungicide, plasticizers & anti-corrosive agent This shall be applied over scratch-plaster in two or more coats to get approved shade & pattern.

4.5 **Melamine polish**

a. The wood/veneer surface before polishing shall be well sanded to obtain smooth and even surface. A coat of appropriate wood sealer of the same manufacturer approved for melamine polish shall be applied over the surface before polishing. The surface shall be sand papered again to remove the excess filler material to obtain smooth
even surface. Melamine polish of approved brand and manufacture in matt or glossy finish stained to required shade shall be machine sprayed in required coats over the prepared surface. Final polished surface shall be even, smooth and free from waviness. The natural grains of the wood /veneers shall be clearly visible from the final polished surface. Consumption of the melamine polish shall not be less than 0.25 lits/sqm.

b. The material for melamine polish shall be of the approved make as specified.

4.6 Particular Specifications – Road work

A. General (applicable for all items under this sub-head)
   a. The work under this sub-head in general shall be carried out as per the CPWD specifications, as per architectural drawings and as per directions of Dean (IPS).

B. Tiles and paver block
   a. The work under this sub-head in general shall be carried out as per the CPWD specifications, as per the manufacturer’s specifications, as per architectural drawings and as per directions of Dean (IPS).
   b. The Contractor shall procure and submit the samples of approved make, shade and thickness of various materials (tiles and paver blocks etc.) along with catalogue, for the approval of the Dean (IPS) prior to execution of the item.
   c. Based on the samples approved by the Dean (IPS) for various tiles and paver blocks etc. the Contractor shall prepare the mock-up at site for approval of material and quality of workmanship by the Dean (IPS). Only after the approval of mock-up, the Contractor shall start the mass work. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in-Charge, the mock up shall be allowed as part of the work and measured for payment. Otherwise, it shall be dismantled by the Contractor as directed by the Dean (IPS) and taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference. Nothing extra shall be payable on this account.
   d. Once the material and mock-up are approved, the entire quantity of various materials shall be procured from the approved manufacturer or its authorized dealer, preferably, in one lot to keep variations to the minimum.
   e. The material (tile and paver blocks etc.) shall be supplied at site only after attainment of required strength at the factory itself.
   f. The Dean (IPS) or his representative may, if required, shall inspect the factory during production of various tiles to assess the quality of the material and also collect samples from the factory itself. The IITB shall bear the cost of such visits of the officers of the IITB.
   g. The material shall be transported to site well packed. These shall be handled carefully to prevent any damages. The material procured shall be free of any surface defect, edge damage and any other such defects. The defective / damaged material shall not be allowed to be used in the work. So, the contractor shall procure additional quantity of material to cover such contingencies. However, nothing extra shall be payable on this account.
   h. Adequate care for various materials shall be taken before fixing as well as afterwards till completion of the work. It shall be protected from rains, excessive humidity, chemical fumes, vibrations, dust etc. The Contractor shall ensure careful handling and storage and prevent any rough handling, to prevent any edge damage or breakage. Any material (tiles and paver blocks etc.) with edge damaged or crack etc. shall not be allowed to be used in the work and shall be replaced by the Contractor at his own cost. Similarly, adequate care shall be taken by the Contractor while placing...
or removing and handling the material so as not to cause any damage. The finished work shall be cleaned as per manufacturer’s specifications. Abrasive cleaners shall not be used to clean the marks

i. The work shall be carried out as per the manufacturer’s specifications.

j. The tiles and paver blocks shall be fixed in required pattern and design in combination with tiles / paver blocks of different colours and shades in linear or curvilinear pattern as per the architectural drawings and the site conditions.

k. The Contractor shall obtain and submit to the IITB the manufacturer’s test certificate / report for compliance of the material to the relevant standards along with each lot of material supplied for the work.

l. For the enclosures with circular or curved profile, only the actual area of the respective works shall be measured under relevant sub-heads for payment and nothing extra shall be payable for labour, material, wastages and any other incidental charges.

m. For tiling and paver work, the joints between the different types of tiles and pavers shall be located as per the architectural drawings and the measurement shall be done as per item description.

n. The Contractor shall maintain the uniform level of the finished flooring of the different types unless specifically mentioned on the architectural drawings.

o. At the time of handing over, the finished areas (tiles and paver blocks etc) shall be free of any scratches, stains etc. These areas shall be properly cleaned before handing over. However, abrasive cleaners shall not be used to clean the marks and other scratches.

4.7 Particular specifications for sanitary installations, water supply & drainage

A. General (applicable for items under this sub-head):

a. The work under this sub-head in general shall be carried out as per the CPWD specifications, as per architectural drawings and as per directions of Dean (IPS).

b. Before taking up the work, the Contractor shall prepare integrated shop drawings showing details of various pipe lines running horizontally and vertically and obtain approval of Dean (IPS). Integrated services drawings shall conform to local byelaws. The work shall be carried out as per approved integrated shop drawings for sanitary installations, water supply, rain water and drainage pipes.

c. Samples of all the pipes, fittings, fixtures etc., of make as per the list of approved materials shall be brought to site, well in advance, prior to start of any of the works and got approved by the Dean (IPS).

d. Two sample toilets with all the pipelines, fittings and fixtures shall be prepared and tested for proper functioning of the system and got approved from the Dean (IPS) before taking up mass work. The sample toilet(s) shall form part of the main work if the performance is found satisfactory; otherwise, the same shall be dismantled and redone by the Contractor at this cost.

e. The chasing, cutting and making holes in the masonry and / or cement concrete and / or RCC works shall be done carefully without causing any damage to the structure. As far as possible, mechanical cutters & core cutting machines shall be used in a workman like manner, for concealing the pipelines and fittings. The chases / holes, so made, shall be made good with the cement mortar of mix 1: 4 (1cement: 4 coarse sand) after testing of the pipe lines for leakage. The cost of cutting cores in RCC, cutting holes in masonry & making good the same shall be inclusive in the respective item of drainage/water supply lines.
f. All vertical sanitary & GI pipes shall be fixed to hot dipped galvanized M.S supporting frame with “U” shaped G.I bolts, threaded at both ends, as specified, with GI nuts, GI washers, GI cleats etc. as approved by the Dean (IPS). Supporting frame shall be fixed with approved anchor fasteners as directed by the Dean (IPS). In all cases, pipelines shall be fixed, minimum 50 mm away from the finished wall face and shall not be fixed directly to the walls. The cost of providing and fixing GI supporting frame shall be paid for separately under relevant items.

g. All horizontal pipes shall be fixed to the soffit of beams / slabs etc. with G.I. hanger rods & G.I. frame work as per the approved shop drawings and as directed by the Dean (IPS). The pipelines shall be clamped to the structural steel frame work with “U” bolts and nuts, washers, cleats etc., of length and diameter as required and as specified. The G.I. frame work shall be paid for separately under relevant items.

h. The Contractor shall sequence the activities for external drainage and other pipeline work in such a way that no hindrance is caused to other activities like laying of external electrical cable, development, landscape and road work etc.

4.8 Particular specifications – Aluminium work

a. The material for the work shall be procured from the approved manufacturer as per the list attached with the tender documents. The Contractor shall procure and submit samples of various materials to be used in the work for the approval of Dean (IPS) and no work shall commence before such samples are approved. Samples of un-anodized as well as anodized aluminium sections, neoprene gaskets, glass, stainless steel screws, anchor fasteners, hardware and any other material or components requiring approval of samples, in opinion of Dean (IPS), shall be submitted for the approval as mentioned above. The above samples shall be retained as standards of materials and workmanship.

b. The Contractor shall prepare the shop drawings for the aluminium windows giving details of the various aluminium sections, neoprene gaskets, cleats, anchor fasteners, hardware, sealants, glass etc. and submit the same for the approval of Dean (IPS).

c. Only after the approval of the samples and the shop drawings by the Dean (IPS), the Contractor shall procure the material for the work. All materials brought to the site by the Contractor, for use in the work, as well as fabricated components shall be subject to inspection and approval by Dean (IPS). The Contractor shall produce manufacturer's test certificates for any material or particular batch of materials supplied by him.

d. The Contractor shall prepare a finished sample of the aluminium window along with glazing panel and fittings etc. for approval of workmanship and material. Nothing extra shall be payable on this account.

e. Aluminium sections to be used for various works shall be appropriate to meet technical, structural, functional and aesthetic considerations. The anodizing shall be carried out in an approved factory / workshop as specified in the tender documents.

A. Fabrication

a. All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects.

b. All hardware used shall conform to the relevant specifications and as per samples approved by the Dean (IPS). Design, quality, type, number and fixing of hardware shall be generally in accordance with architectural drawings and as approved by the Engineer-in-Charge before use.

c. All doors, windows, ventilators and glazing etc. shall be made water tight with neoprene gaskets and weather silicone sealants to the satisfaction of the Dean (IPS), for which nothing extra shall be payable.
d. The frames shall be strictly as per Architectural drawings, the corners of the frame being fabricated to the true right angles. Both the fixed frames and openable shutter frames shall be fabricated out of sections cut to required length, metered and mechanically jointed for satisfactory performance. All members shall be accurately machine milled and fitted to form hairline joints. The jointing accessories such as aluminium cleats, stainless steel screws etc. shall not to cause any bi-metallic reaction by providing separators, wherever required.

e. Vertical members of the aluminium frame work shall be embedded in the floors, wherever required, by cutting and making good of the floor.

B. Fixing of Aluminium Frame Work

a. The screws used for fixing fixed aluminium frames of the aluminium windows to masonry walls/ RCC members and aluminium members to other aluminium members shall be of stainless steel of approved make and quality and of stainless-steel grade 304. Threads of machines crews used shall conform to requirement of I.S. 4218.

b. For the aluminium windows, the gap between the aluminium frames and the R.C.C / Masonry and also any gaps in the various sections shall be filled with weather silicone sealant DC 795 of Dow Corning or equivalent in the required bite size, to ensure water tightness including providing and fixing backer rod, wherever required. The weather silicone sealant shall be of such approved colour and composition that it would not stain or streak the masonry / R.C.C. work. It should not sag or flow and shall not set hard or dry out under any conditions of weather and shall be tooled properly. The weather silicone sealant shall be used as per the manufacturer's specifications and shall be of approved colour and shade. Any excess sealant shall be removed / cleared. Nothing extra shall be payable for the above.

c. Fixing of glass panes shall be designed in such a way that replacing damaged / broken glass panes is easily possible without having to remove or damage any members or interior finishing materials.

C. ANODIZING

a. Aluminium sections shall be anodized as per I.S. 7088 – 1973. Anodizing to be as per grade AC 20 and not less than 20 microns thick when measured as per I.S. 6012, in colour and shade as approved by the Dean (IPS) The anodic coating shall be properly sealed by steam or dipping in de-ionized water as per I.S. 1868-1982 and / or I.S. 6057. Sealing quality shall be tested in accordance with the relevant standards. Nothing extra shall be payable on this account.

b. The Contractor shall satisfy himself by checking in the factory that the thickness of the anodic coating is found to be minimum 20 microns and sealing quality is appropriate everywhere. The testing shall be done in an approved laboratory by EDDY CURRENT METHOD as per I.S. 6012for thickness. For testing the thickness of anodic coating of the anodized aluminium sections, the calibration shall be done on bare ( un-anodized ) aluminium sections of same type. If any material is found sub-standard, it shall be rejected.


d. The exposed surface of the aluminium sections shall be protected against surface damage, dents, scratches etc. It shall, therefore, be provided with protective tape. After fixing and assuring of proper functioning of doors, windows, frame work for partitions / false ceiling etc. such protective tape shall be cleaned out / removed as per the directions of Engineer-in-Charge. Nothing extra shall be payable for above.
D. Glazing
   a. All glass panes shall be retained within aluminium framing by use of exterior grade neoprene gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:
   b. All glazing rebates shall be square, to plumb, true to plane, dry and free from dust.
   c. Glass edge shall be clean and cut to exact size and grounded
   d. Annealed float glass in doors, windows, ventilators and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications.
   e. 4 mm thick glass panes shall be provided for openings not exceeding 0.5 sqm. For openings exceeding 0.5 sqm in area, 5.0 mm thick glass panes shall be provided unless specified otherwise.

E. Protections and Cleaning:
   f. All glass panes shall be retained within aluminium framing by use of exterior grade neoprene gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:
   g. All glazing rebates shall be square, to plumb, true to plane, dry and free from dust.
   h. Glass edge shall be clean and cut to exact size and grounded
   i. Annealed float glass in doors, windows, ventilators and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications.
   j. 4 mm thick glass panes shall be provided for openings not exceeding 0.5 sqm. For openings exceeding 0.5 sqm in area, 5.0 mm thick glass panes shall be provided unless specified otherwise.

F. MEASUREMENT AND RATES:
   a. Aluminium frame work shall be measured as per CPWD specifications.
   b. For glazing, the actual area of the glass panels excluding the portion in the beading shall be measured in sqm up to two decimal places, for payment.
   c. Stainless steel adjustable friction hinges and the aluminium handles for the openable side-hung windows shall be of “Earl Bihari”, make or equivalent as approved by the Engineer-in-Charge. 2 nos. friction hinges shall be provided per shutter.
   d. The cost of designing and preparation of shop drawings, all the samples, mock-up of window etc. is deemed to be included in the cost of the relevant items. Nothing extra shall be payable on this account.
   e. The item for aluminium for fixed portions for aluminium windows and frame work for partitions shall include cost of all inputs of labour, material (anodized aluminium sections, including cleats, other fixtures, weather silicone sealants, stainless steel screws, nuts, bolts, rawl plugs, backer rods, polyethylene tapes etc. which shall be required for fabrication and erection of aluminium work) T & P, all incidental charges, wastages etc. involved in the work. However, for the purpose of payment, the weight of aluminium sections for the fixed window frame and frame work for partitions, shall be measured in Kg. The aluminium cleats, stainless steel screws, nuts, bolts, separators etc. shall not be measured separately for payment and their cost is deemed to be included in the cost of this item. The item for aluminium for frame work for fixed partitions shall also include cost of providing and fixing stainless steel anchor fasteners as required.
f. The item of aluminium for the openable aluminium shutters for windows and doors etc., shall include cost of all inputs of labour, material (anodized aluminium sections, including such as cleats / angles, other fixtures, stainless steel screws nuts, bolts, stainless steel hinges, weather silicone sealant etc. which shall be required for fabrication of aluminium work) T & P, all incidental charges, wastages etc. involved in the work. However, for the purpose of payment, the weight of aluminium sections for the window shutter (sash frame) shall be measured in Kg. The aluminium cleats, stainless steel anchor fasteners, screws, nuts, bolts, separators, stainless steel hinges, etc. shall not be measured separately for payment and their cost is deemed to be included in the cost of this item. The anodized aluminium snap beading for fixing glass panels in the open able shutters of the windows shall be measured separately (on weight basis) and paid under this item of aluminium frame work for window shutters.

g. The glass shall be paid for separately under relevant item. The cost providing and fixing neoprene gasket, felt etc. is included in the cost of this item and shall not be measured separately for payment.

h. The item for the aluminium frame work includes cost of making provision for fixing fittings, wherever required, as per the item description (The cost for providing fitting (handle, lock and buffer) shall be paid for separately).

4.9 Particular specifications for waterproofing treatment

a. All the water proofing treatment shall be got executed through one of the specialized agencies as per the list of approved agencies attached with the tender. The water proofing agency shall carry out water proofing work with one of the approved water proofing compound mentioned in the tender. If so specifically requested by the Contractor, he will be allowed to use other waterproofing compound meeting various technical parameters, subject to prior approval of Dean (IPS).

b. The work under this sub-head in general shall be carried out as per the CPWD specifications, as per the manufacturer’s specifications, as per architectural drawings and as per directions of Dean (IPS)

Ten years guarantee in prescribed proforma attached shall be given by the Contractor for the water proofing treatment. In addition, 10% (ten percent) of the cost of these items of water proofing under this sub head shall be retained as guarantee amount to watch the performance of the work executed. However, half of this amount (withheld) would be released after five years from the date of completion of the work, if the performance of the waterproofing works is satisfactory. The remaining withheld amount shall be released after completion of ten years from the date of completion of work, if the performance of the waterproofing work is satisfactory. If any defect is noticed during the guarantee period, it should be rectified by the Contractor within seven days of issuing of notice by the Dean (IPS) / IITB and, if not attended to, the same shall be got done by Dean (IPS) / IITB through other agency at the risk and cost of the Contractor and recovery shall be affected from the amount retained towards guarantee. The guarantee amount can be released in full, if bank guarantee of equivalent amount, valid for the duration of guarantee period, is produced and deposited with the IITB.
LIST OF APPROVED MATERIALS:

Note:

1. The Contractor shall obtain prior approval from the Dean (IPS) before placing order for any specific material or engaging any of the specialized agencies. The Contractor shall make a detailed submittal with catalogues and highlighted proposed specifications, as well as full details of the works proposed to be executed by the specialized agency, as specified.

2. Wherever applicable, the Dean (IPS) may approve any material equivalent to that specified in the tender subject to proof being offered by the Contractor for equivalence to his satisfaction.

3. Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of approved materials attached in the tender, shall be used in the work.

4. Reinforcement steel shall be procured from any vendors who have the license for at least 5 years for manufacture of BIS subject to prior written approval of Dean (IPS). Steel sample of all the lots procured shall be subjected to testing through recognized laboratories and shall be at Contractors’ cost. Sampling shall be as per the Specifications (referred to Schedule F).

A. CIVIL AND PLUMBING WORKS

<table>
<thead>
<tr>
<th>S. NO</th>
<th>DESCRIPTION OF WORK</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STRUCTURAL &amp; ARCHITECTURAL</td>
<td>ACC, ULTRA TECH, J. P. REWA, VIKRAM, SHREE CEMENT, BIRLA JUTE, CEMENT CORPORATION OF INDIA, AMBUJA CEMENT</td>
</tr>
<tr>
<td>2</td>
<td>CEMENT</td>
<td>J.K., BIRLA</td>
</tr>
<tr>
<td>3</td>
<td>WHITE CEMENT/ PUTTY</td>
<td>A.C.C., ULTRA TECH, RMC, GODREJ, SKYWAY,</td>
</tr>
<tr>
<td>4</td>
<td>READY MIX CONCRETE</td>
<td>PIDILITE, BASF, CICO, FOSROC, ROFF, SUNANDA, SIKA</td>
</tr>
<tr>
<td>5</td>
<td>WATERPROOFING COMPOUND</td>
<td>SAIL, TATA STEEL, RINL, JINDAL STEEL &amp; POWER LTD., JSW STEEL LTD., MAKES CONFORMING TO CRITERIA MENTIONED IN TENDER DOCUMENT</td>
</tr>
<tr>
<td>6</td>
<td>REINFORCEMENT STEEL</td>
<td>SPICETEK INDIA PVT. LTD. DEXTRA INDIA PVT. LTD. ISHITA ENTERPRISES</td>
</tr>
<tr>
<td>7</td>
<td>MECHANICAL SPLICING SYSTEM WITHCOUPLER</td>
<td>TATA STEEL, SAIL, RINL, VIZAG, JINDAL, APL APOLLO</td>
</tr>
<tr>
<td>S. NO</td>
<td>DESCRIPTION OF WORK</td>
<td>MANUFACTURERS</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>CONCRETE BLOCKS</td>
<td>CONWOOD, GURJARI, HINDUSTAN, LOKGROUP, SAI BLOCK, VED PMC LTD.</td>
</tr>
<tr>
<td>9</td>
<td>AAC BLOCKS</td>
<td>AEROCON, SIPOREX, ULTRA TECH, ECOLITE, GODREJ</td>
</tr>
<tr>
<td>10</td>
<td>FLY ASH BRICKS</td>
<td>JINDAL MECHNO BRICKS, ANJANEYA, ADITI GROUP</td>
</tr>
<tr>
<td>11</td>
<td>SAND</td>
<td>GUJARAT RIVER</td>
</tr>
<tr>
<td>12</td>
<td>PRECAST CONCRETE PRODUCTS</td>
<td>SIPOREX IND, B.G. SHIRKE&amp; Co; SUPREME CONCRETE MINATO BLOCKS - KOLHAPUR</td>
</tr>
<tr>
<td>13</td>
<td>ANTI-TERMITE TREATMENT</td>
<td>PCI, PECOPP, GODREJ HI-CARE</td>
</tr>
<tr>
<td>14</td>
<td>FACTORY MADE CONCRETE BLOCKS</td>
<td>ASTRA CONCRETE, RAJ COVER BLOCKS</td>
</tr>
<tr>
<td>15</td>
<td>READY MIXED CEMENT PLASTER</td>
<td>WALPLAST, ULTRA TECH, MADRAS CEMENT LTD, SOUND BUILD CARE LTD., FERROUSCRETE, PRECISE CONCHEM PVT LTD.</td>
</tr>
<tr>
<td>16</td>
<td>PAVER BLOCKS/GRASS PAVERS/KERBSTONE</td>
<td>VYARA, BASANT BETONS, SUPER, HINDUSTAN</td>
</tr>
<tr>
<td>17</td>
<td>EXTERNAL PAVER TILES</td>
<td>H.R.JOHNSON-ENDURA, VYARA, SUPER, PAVIT, KAJARIA</td>
</tr>
<tr>
<td>18</td>
<td>EXTERNAL CERAMIC MOSAIC TILES</td>
<td>SHON, MRIDUL, KENT</td>
</tr>
<tr>
<td>19</td>
<td>EXTERNAL TEXTURE PAINT</td>
<td>RENOVO, RUFF&amp;TUFF, ROUGHTEX, SHERWIN WILLIAMS</td>
</tr>
<tr>
<td>20</td>
<td>ACRYLIC ROUGH PLASTER</td>
<td>ASIAN PAINTS, SPECTRUM, HERITAGE</td>
</tr>
<tr>
<td>21</td>
<td>WATERPROOFING CEMENT PAINT</td>
<td>SNOWCEM, BERGER, NEROLAC, ASIAN</td>
</tr>
<tr>
<td>22</td>
<td>PAINTS</td>
<td>ICI, ASIAN, BERGER, NEROLAC</td>
</tr>
<tr>
<td>23</td>
<td>GYPSUM LIGHT WEIGHT PLASTER</td>
<td>GYPROC, FERROUSCRETE, ULTRATECH, SAINT GOBAIN</td>
</tr>
<tr>
<td>24</td>
<td>POLYMER MODIFIED CEMENTITIOUS GROUT/CEMENT ADHESIVE/EPoxy GROUT</td>
<td>PIDILITE, BASF, CICO, FOSROC, ROFF, BAL, LATICRETE</td>
</tr>
<tr>
<td>S. NO</td>
<td>DESCRIPTION OF WORK</td>
<td>MANUFACTURERS</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>POLYMER MODIFIED ADHESIVE MORTAR FOR FLY ASH BLOCKS</td>
<td>WALPLAST, ULTRA TECH, MADRAS CEMENT LTD, SOUND BUILD CARE LTD., FERROUSCRETE, PRECISE CONCHEM PVT LTD.</td>
</tr>
<tr>
<td>26</td>
<td>POLISHED CONCRETE</td>
<td>ASHFORD FORMULA</td>
</tr>
<tr>
<td>27</td>
<td>INTEGRAL WATER PROOFING COMPOUND</td>
<td>PIDILITE, ROFF, FOSROC, SUNANDA, CICO, ACCOProof, MC BAUCHEMIE, SIIKA</td>
</tr>
<tr>
<td>28</td>
<td>CEMENT BONDED FIBRE PARTICLE BOARD</td>
<td>NCL INDUSTRIES, VISAKA, EVEREST, BISON, SHERA, RAMCO</td>
</tr>
<tr>
<td>29</td>
<td>MOISTURE RESISTANT BOARD</td>
<td>SAINT GOBAIN GYPROC INDIA, USG BORAL</td>
</tr>
<tr>
<td>30</td>
<td>CALCIUM SILICATE BOARDS</td>
<td>HILUX, PROMAT, VISAKA, STARPA, AEROLITE</td>
</tr>
<tr>
<td>31</td>
<td>ALUMINIUM COMPOSITE PANELS</td>
<td>ALUDECOR, EUROBOND, ALSTRONG, ALUCOBOND</td>
</tr>
<tr>
<td>32</td>
<td>FRICTION HINGES &amp; LOCKS</td>
<td>COTSWOLD, GISSSE, ALUALPHA</td>
</tr>
<tr>
<td>33</td>
<td>SPACERTAPE, BACKER ROD</td>
<td>NORTON, BOW</td>
</tr>
<tr>
<td>34</td>
<td>ALL TYPES OF SILICON</td>
<td>DOW CORNING, GE, Wacker INDIA</td>
</tr>
<tr>
<td>35</td>
<td>EPDM</td>
<td>AMEE RUBBER INDUSTRIES</td>
</tr>
<tr>
<td>36</td>
<td>NUTS, BOLTS, SCREWS</td>
<td>KUNDAN, PUJA, ATUL</td>
</tr>
<tr>
<td>37</td>
<td>WELDING ROD</td>
<td>ADOR, COSMOS, ESAB, SUPER BOND (S)</td>
</tr>
<tr>
<td>38</td>
<td>STAINLESS STEEL ANCHOR FASTENERS</td>
<td>HILTI, FISCHER</td>
</tr>
<tr>
<td>39</td>
<td>ALUMINIUM EXTRUSION SECTIONS</td>
<td>JINDAL, HINDALCO, NALCO, INDIAN ALUMINIUM CO, VEDANTA</td>
</tr>
<tr>
<td>40</td>
<td>ALUMINIUM FAÇADE SUN LOUVERS</td>
<td>HUNTER DOUGLAS, CONSTRUCTION SPECIALTIES</td>
</tr>
<tr>
<td>41</td>
<td>XPS/EPS INSULATION BOARD</td>
<td>BASF, OWENS CORNING, CARLISLE</td>
</tr>
<tr>
<td>42</td>
<td>INTUMESCENT STRIPS</td>
<td>PROMAT, PEMKO, INTUMEX, ASTROFLAME</td>
</tr>
<tr>
<td>43</td>
<td>FLOAT GLASS CLEAR</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>COATED GLASS</td>
<td></td>
</tr>
</tbody>
</table>
## Part B: Major Component (Civil) - List of Approved Materials –Civil & Plumbing Works

<table>
<thead>
<tr>
<th>S. NO</th>
<th>DESCRIPTION OF WORK</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>FLOAT GLASS MIRROR</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>DGU, SGU, FIRE RATED GLASS</td>
<td>PILKINGTON, SAINT GOBAIN, ASAHI, MODIGUARD, GUARDIAN,</td>
</tr>
<tr>
<td>47</td>
<td>LAMINATED GLASS</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>BACKPAINTED GLASS</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>SELF CLEANING GLASS</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>FIRE RESISTANT WOODEN DOOR FRAME &amp; SHUTTERS</td>
<td>SUKRITI, PROMAT, KUTTY, SIGNUM, KENWOOD, SHREEJI, TUFWOOD, NAVAIR</td>
</tr>
<tr>
<td>51</td>
<td>FIRE RESISTANT METAL DOOR FRAME &amp; SHUTTERS</td>
<td>SUKRITI, PROMAT, KUTTY, SIGNUM, KENWOOD, SHREEJI, TUFWOOD, NAVAIR, SHAKTIMATE HORMAN</td>
</tr>
<tr>
<td>52</td>
<td>FIRE RATED GLASS</td>
<td>PILKINGTON, SCHOTT, SAINT GOBAIN, ASAHI, GUARDIAN, MODI</td>
</tr>
<tr>
<td>53</td>
<td>HARDWARE FOR FIRE RATED DOORS</td>
<td>DORMA, GEZE, HAFELE, HETTICH</td>
</tr>
<tr>
<td>54</td>
<td>SS DOOR HARDWARE</td>
<td>DORMA, GEZE, HAFELE, HETTICH, KICH, PALLADIUM</td>
</tr>
<tr>
<td>55</td>
<td>FLOOR SPRINGS, DOOR CLOSURES, PANIC BAR, PATCH FITTINGS</td>
<td>DORMA, GEZE, HAFELE, HETTICH, HORMAN, SEVAX, CASMA</td>
</tr>
<tr>
<td>56</td>
<td>FRP DOOR SHUTTERS</td>
<td>MERINO, GREENLAM</td>
</tr>
<tr>
<td>57</td>
<td>BAKELITE SHEETS</td>
<td>BAKELITE HYLAM INDIA</td>
</tr>
<tr>
<td>58</td>
<td>WOODEN FLUSH DOORS</td>
<td>KENWOOD, ANCHOR, CENTURY, GREENPLY, SHREEJI, KUTTY</td>
</tr>
<tr>
<td>59</td>
<td>HIDDEN WOODWORK</td>
<td>SEASONED OLD BURMA</td>
</tr>
<tr>
<td>60</td>
<td>EXPOSED WOODWORK</td>
<td>1ST BTC</td>
</tr>
<tr>
<td>61</td>
<td>MARINE PLYWOOD</td>
<td>KENWOOD, ANCHOR, CENTURY, GREENPLY, SHREEJI, KUTTY</td>
</tr>
<tr>
<td>62</td>
<td>COMMERCIAL PLYWOOD</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>BLOCKBOARD</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>HIGH PRESSURE LAMINATES</td>
<td>GREENLAM, MERINO, FORMICA, CENTURY, ROYAL TOUCH</td>
</tr>
<tr>
<td>65</td>
<td>VENEERS</td>
<td>GREEN, EURO, ARCHID, CENTURY,</td>
</tr>
<tr>
<td>S. NO</td>
<td>DESCRIPTION OF WORK</td>
<td>MANUFACTURERS</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>66</td>
<td>HIGH PRESSURE COMPACT LAMINATE CUBICLES</td>
<td>TIMEX, MERINO, GREENLAM</td>
</tr>
<tr>
<td>67</td>
<td>STAINLESS STEEL</td>
<td>JINDAL, SAIL, TATA STEEL, JSW</td>
</tr>
<tr>
<td>68</td>
<td>SS RAILING</td>
<td>VIVA, KICH</td>
</tr>
<tr>
<td>69</td>
<td>AUTOMATIC SLIDING DOOR</td>
<td>DORMA, HAFELE, SHAKTI MATE HORMAN</td>
</tr>
<tr>
<td>70</td>
<td>ROLLING SHUTTER</td>
<td>GANDHI AUTOMATIONS, AVIANS, SWASTIK</td>
</tr>
<tr>
<td>71</td>
<td>LOGO</td>
<td>ALPHA PLUS, EIGMA ENTERPRISES, MOTIF GRAPHICS</td>
</tr>
<tr>
<td>72</td>
<td>POLYCARBONATE SHEETS</td>
<td>PALARAM, DANPALON, LEXON, ALCOX</td>
</tr>
<tr>
<td>73</td>
<td>ARCHITECTURAL FABRIC</td>
<td>FERRARI, NEHLEK, HIRAOKA</td>
</tr>
<tr>
<td>74</td>
<td>ENGINEERED COMPOSITE MARBLE</td>
<td>H.R.JOHNSON, CMC, AGL, ASIAN</td>
</tr>
<tr>
<td>75</td>
<td>ITALIAN MARBLE</td>
<td>CMC, ELEGANT, ASIA PACIFIC, STONE SOURCE</td>
</tr>
<tr>
<td>76</td>
<td>QUARTZ</td>
<td>H.R.JOHNSON, CMC, AGL, ASIAN</td>
</tr>
<tr>
<td>77</td>
<td>VITRIFIED TILES - GLAZED, SOLUBLE SALT, DOUBLE CHARGE</td>
<td>H.R.JOHNSON, CMC, AGL, ASIAN</td>
</tr>
<tr>
<td>78</td>
<td>CERAMIC TILES</td>
<td>H.R.JOHNSON, CMC, AGL, ASIAN</td>
</tr>
<tr>
<td>79</td>
<td>GLASS MOSAIC TILES</td>
<td>BISAZZA, PALLADIO</td>
</tr>
<tr>
<td>80</td>
<td>HEAVY DUTY INDUSTRIAL TILES</td>
<td>H.R.JOHNSON, PAVIT, ORIENTBELL, KAJARIA</td>
</tr>
<tr>
<td>81</td>
<td>NON SHRINK CEMENTITIOUS GROUT</td>
<td>SIKA, FOSROC, BASF</td>
</tr>
<tr>
<td>82</td>
<td>HYDROPHILIC SWELLABLE WATER BAR PROFILE SEALANTS</td>
<td>SIKA, BASF, ADEKA INDIA</td>
</tr>
<tr>
<td>83</td>
<td>POLYMER MODIFIED CEMENTITIOUS GROUT / CEMENT ADHESIVE / EPOXY GROUT</td>
<td>PIDILITE, KERACOL, ARDEX ENDURA, LATICRETE, BAL ENDURA, FERROUSCRETE</td>
</tr>
<tr>
<td>84</td>
<td>POLYMER MODIFIED ADHESIVE MORTAR FOR FLY ASH BLOCKS</td>
<td>WALPLAST, ULTRA TECH, SOUND BUILD CARE LTD., ECOLITE, FERROUSCRETE, KERACOL, PIDILITE</td>
</tr>
<tr>
<td>S. NO</td>
<td>DESCRIPTION OF WORK</td>
<td>MANUFACTURERS</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>85</td>
<td>ADHESIVE FOR GRANITE, MARBLE, STONE</td>
<td>ARALDITE, HUNSTMAN</td>
</tr>
<tr>
<td>86</td>
<td>POLYSTER PU COATING ON VENNER, WOOD</td>
<td>MRF CORP, ICA, ASIAN PAINTS</td>
</tr>
<tr>
<td>87</td>
<td>ADHESIVE FOR WOOD, LAMINATE, VENEER</td>
<td>FEVICOL-PIDILITE, EURO-JYOTI RESINS &amp; ADHESIVES</td>
</tr>
<tr>
<td>88</td>
<td>PLASTER OF PARIS</td>
<td>MK, SAINT GOBAIN</td>
</tr>
<tr>
<td>89</td>
<td>MODULAR FALSE CEILING GI FRAMES</td>
<td>HUNTER DOUGLAS, ARMSTRONG, SAINT GOBAIN</td>
</tr>
<tr>
<td>90</td>
<td>GYPSUM CEILING</td>
<td>SAINT GOBAIN - GYP SERRA</td>
</tr>
<tr>
<td>91</td>
<td>MODULAR MINERAL FIBRE CEILING TILES</td>
<td>ARMSTRONG, SAINT GOBAIN, HUNTER DOUGLAS</td>
</tr>
<tr>
<td>92</td>
<td>BAFFLE CEILING</td>
<td>ECOPHON-SAINT GOBAIN, ARMSTRONG, USG BORAL INDIA</td>
</tr>
<tr>
<td>93</td>
<td>FIBRE GLASS</td>
<td>UP TWIGA, OWENS CORNING</td>
</tr>
<tr>
<td>94</td>
<td>ACOUSTICAL SEAL</td>
<td>FALCON</td>
</tr>
<tr>
<td>95</td>
<td>ACOUSTICAL PANELS</td>
<td>SAINT GOBAIN, ANUTONE</td>
</tr>
<tr>
<td>96</td>
<td>FABRIC</td>
<td>RESPONSE, INDIA WEAVES, PRIDE</td>
</tr>
<tr>
<td>97</td>
<td>ACCESS FLOOR</td>
<td>UNITILE</td>
</tr>
<tr>
<td>98</td>
<td>CARPET TILES</td>
<td>SHAW, VOXFLOOR, INTERFACE</td>
</tr>
<tr>
<td>99</td>
<td>COMPACTORS</td>
<td>KOMPACT, GODREJ</td>
</tr>
<tr>
<td>100</td>
<td>MODULAR FURNITURE</td>
<td>GODREJ, SPACEWOOD, FEATHERLITE</td>
</tr>
<tr>
<td>101</td>
<td>MODULAR FURNITURE- SS WIRE BASKETS</td>
<td>HETTICH, HAFELE, DORMA</td>
</tr>
<tr>
<td>102</td>
<td>PVC EDGE BANDING TAPE</td>
<td>REHAU, DOLKIN, PEGASUS, FIBRO</td>
</tr>
<tr>
<td>103</td>
<td>HOT MELT GLUE FOR EDGE BANDING TAPE</td>
<td>EVA (Ethylene Vinyl Acetate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HENKEL, KLEIBERIT 773.3</td>
</tr>
<tr>
<td>104</td>
<td>WALL PAPER</td>
<td>MARSHALLS, BHARAT FURNISHINGS, PVR FLOORING</td>
</tr>
<tr>
<td>105</td>
<td>FROSTED GLASS FILM</td>
<td>3M, LLUMAR, GARWARE</td>
</tr>
</tbody>
</table>
### B. SPECIALISED AGENCIES:

<table>
<thead>
<tr>
<th>SR NO</th>
<th>DESCRIPTION FOR WORK</th>
<th>MANUFACTURERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WATERPROOFING WORKS</td>
<td>SIKA, FOSROC, SUNANDA, PIDILITE, NAYAK CONSTRUCTIONS LTD, BASF, KERACOL, LIKPROOF INDIA PVT. LTD., MODERN WATERPROOFING CO, INDIA WATERPROOFING CO., OVERSEAS WATERPROOFING CORP. KERACOL, NINA WATERPROOFING, NATIONAL</td>
</tr>
</tbody>
</table>
### List of Approved Materials – Civil & Plumbing Works

<table>
<thead>
<tr>
<th></th>
<th>WATER PROOFING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>CURTAIN GLAZING</td>
</tr>
<tr>
<td>3</td>
<td>GLASS PROCESSER</td>
</tr>
<tr>
<td>4</td>
<td>PVDF COATING</td>
</tr>
</tbody>
</table>
1. **TENDER DRAWINGS:**

   - Enclosed as an Attachment to Part B-5.
PARTC:
MINOR COMPONENTS- ELECTRICAL, MECHANICAL AND FIRE FIGHTING (E&M) WORKS
ADDITIONAL / PARTICULAR SPECIFICATIONS FOR MECHANICAL AND ELECTRICAL WORKS

1) ELECTRICAL WORKS

1.1 SPECIAL CONDITIONS

1.1.1 GENERAL

These special conditions are intended to amplify the General Conditions of Contract and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

1.2 PREAMBLE

a. This is an item rate contract. Some of the items may not be operated. The Vendor cannot raise any objection for non-operation/deletion of any items, also the rate will be remains same for any quantities variations

b. BOQ to be read in conjunction with the Drawings.

c. All material delivered on-site shall be inspected properly and Manufacturing Test Certificate (MTC) shall be submitted to PMC / Client for verification of the material.

d. The rate quoted by the Contractor shall be inclusive of the following:

e. All labour, materials, wastage, transportation, handling, use of tools, equipment, scaffolding, cheer picker etc and other items incidental to the satisfactory completion of item work at all depths, heights and at any levels.

f. Internal / external scaffolding as required for single or double heights. Contractor to erect scaffolding which will be stable, strong and safe. Contractor to take all precautionary measures to protect the workers/labours while working on scaffolding.

g. Inspection of fabricated material for FAT to be arranged by contractor wherever required.

h. Samples of any material, Mock-up (Preferably a working mock up) at place as desired by the Design Architect, Consultants or PMC

i. Making shop drawings as & when required & asked by the PMC/Design Architect with 4 sets.

j. The scope is also inclusive of name plate & tagging of switch boards/DBs/ Cables etc, pasting of warnings, ferruling, O&M trainings, handing over documents with O&M manuals, As-built layouts, in proper readable format in 4 set & Soft Copies

k. All necessary miscellaneous items to complete the item to the satisfaction of PMC, Design Consultant & Client

l. In Case of discrepancy in item description / specification in BOQ, technical Bid & Drawings, most stringent specs to be followed.

m. This project is IGBC compliance & vendor should comply the same wherever applicable for procurement & installations

A SCOPE OF WORK:

a) The work to be carried out under this contract comprises of the Electrical / ELV Installation work for the proposed project called for in the documents. The work covered under this contract comprises of supply (wherever called for), installation, connection, testing and commissioning the Electrical & ELV installation commencing from point of electric power supply within the project site as per specifications, relevant Indian standards, Code of practice.

The contractor shall carry out and complete the said work under this contract in every respect in conformity with the current rules and regulations of the local Electricity Authority, the Indian Standards and with the directions of and to the satisfaction of the Consultant/PMC and owner. The Contractor shall furnish all labor and install all materials, appliances, equipment (except those items which will be supplied by the Owner to the
contractor at site), necessary for complete provision and testing of the whole electrical installation as specified herein and shown on the drawings. This also includes any material, appliances, equipment not specifically mentioned herein or noted on the drawing as being furnished or installed but which are necessary and customary to make complete installation with all outlets for power, light, telephone conduits, all other conduits and other electrical systems shown in the schedule or described herein, properly connected and in working order.

The work shall include all incidental jobs connected with electrical installation such as cutting/drilling holes through walls/floors and grouting for fixing of fixtures, equipment etc. Chiseling in the wall or principal structure is not permitted. In general, the work to be performed under this contract shall comprise of the following, but not limited to:

i. L.T rooms including sub panels.

ii. LT Cables/

iii. Distribution boards (DB)

iv. Internal wiring and modular accessories

v. Earthing, Bonding and lightning protection system installation

vi. Maintenance Free earth station

vii. Earth continuity conductor

viii. Internal and external lighting with fixtures

ix. UPS

x. Fire Alarm System

xi. CCTV system

xii. Public Address system

xiii. Cable TV system

xiv. Access control system

B ABBREVIATIONS:

The following abbreviations have been used in the accompanying specifications, drawings and Bill of quantity:

BIS : Bureau of Indian Standard.

HRC : High Rupturing Capacity.

GI : Galvanized Iron.

MS : Mild Steel.

MV : Medium Voltage.

LV : Low Voltage.

PVC : Polyvinyl Chloride.

AMP : Amperes.

V : Volts.

KV : Kilo Volts.
**Part C: Minor Component (E&M Works)- Additional / Particular Specifications**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV</td>
<td>High Voltage</td>
</tr>
<tr>
<td>KW</td>
<td>Kilo Watt</td>
</tr>
<tr>
<td>KVA</td>
<td>Kilo Volt Ampere</td>
</tr>
<tr>
<td>PF</td>
<td>Power Factor</td>
</tr>
<tr>
<td>Hz</td>
<td>Frequency</td>
</tr>
<tr>
<td>KWH</td>
<td>Kilo Watt Hour</td>
</tr>
<tr>
<td>XLPE</td>
<td>Cross Linked Polyethylene</td>
</tr>
<tr>
<td>ACB</td>
<td>Air Circuit Breaker</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting diode</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterrupted Power Supply</td>
</tr>
<tr>
<td>DP</td>
<td>Double Phase</td>
</tr>
<tr>
<td>IEE</td>
<td>Institute of Electrical Engineers, London</td>
</tr>
<tr>
<td>MCB</td>
<td>Miniature Circuit Breaker</td>
</tr>
<tr>
<td>TPN</td>
<td>Triple pole and Neutral</td>
</tr>
<tr>
<td>SP</td>
<td>Single Pole</td>
</tr>
<tr>
<td>MCCB</td>
<td>Moulded case Circuit breaker</td>
</tr>
<tr>
<td>VCB</td>
<td>Vacuum circuit breaker</td>
</tr>
<tr>
<td>CT</td>
<td>Current transformer</td>
</tr>
<tr>
<td>DB</td>
<td>Distribution board</td>
</tr>
<tr>
<td>DG</td>
<td>Diesel generator</td>
</tr>
<tr>
<td>BOQ</td>
<td>Bill of quantity</td>
</tr>
<tr>
<td>SITC</td>
<td>Supply, installation, testing and commissioning</td>
</tr>
<tr>
<td>L.O.I.</td>
<td>Letter of intent/Acceptance letter</td>
</tr>
</tbody>
</table>

**PPI:** Per Phase Isolation

**C REGULATIONS AND STANDARDS:**

The installation shall conform in all respects to Indian standard code of Practice for Electrical Wiring installation NBC SP7 2016 , IS 732 ( 1989) (Silver Nitrate Pure and analytical reagent). It shall also be in conformity with the current Indian Electricity Rules, Indian Electricity Act, National Electrical Code and Regulations of the Local electrical supply Authority in so far as these become applicable to the installation. Wherever this specification calls for a higher standard of material and/or workmanship than those required by any of the above regulations then this specification shall take precedence over the said regulations and standard. In general, the materials equipment and workmanship not covered by the above shall conform to the relevant Indian Standards.

The electrical installation work shall follow Codes, Indian standard specifications, and rules (Within the best meaning of the same) under this contract.

The following list is given for general guidance only in addition to list given in each individual section, however all other latest editions of Codes, Indian standard specifications and Rules shall also be followed when it is required.

<table>
<thead>
<tr>
<th>IS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.S. : 1180</td>
<td>Distribution Transformer</td>
</tr>
</tbody>
</table>
I.S. : 8623  Low voltage switchgear & control gear assemblies.
I.S. : 4237  General requirement for switch gear and control gear for voltage not exceeding 1000 Volt a.c. or 1200 volts d.c.
I.S. : 13947  Low voltage switchgear and control gear.
I.S. : 9224  Low voltage fuses.
I.S. : 8828  Circuit breakers for out protection for household and similar installations.
I.S. : 12640  Earth leakage circuit breaker.
I.S. : 1248  Direct acting indicating analog electrical measuring instruments
I.S. : 2705  Current transformers.
I.S. : 4201  Application guide for voltage transformers.
I.S. : 6875  Control switches for voltage upto and indicating 1000V a.c. 1200 V d.c.
I.S. : 8197  Terminal markings for electrical measuring instruments and their accessories.
I.S. : 694  Specifications for PVC insulated cables for working voltages up to and including 1100 volts.
I.S. : 2551  Danger notice plates.
I.S. : 5216  Guide for safety procedures and practices in electrical work.

Indian Electricity Act as amended up to date.

Rules and Regulations of Regional Council of Fire Insurance & Association of India for Electrical wiring or local equivalent.

D  FEES, PERMITS AND TESTS:

The Contractor shall pay for all fees and obtain permits required for the installation work. On completion of the work the contractor shall obtain and deliver to the OWNER, certificates of final inspection and approval by the local electric supply authority and the electrical inspector.

E  UTILITY SUPPLY:

The location of receipt of incoming utilities supply (Hook up Points) like HT/LT power supply, It is the responsibility of the contractor to co-ordinate with various utility agencies, the exact location of such Hook up Point and mode of connection. Further the contractor shall co-ordinate with such utility agencies to provide necessary drawings, documents, get their approval, make the necessary arrangement for the payments and arrange the utilities supply
at no extra cost.

F MATERIAL AND EQUIPMENT:

All material and equipment shall conform to the relevant standards and shall be of the approved make and design. The materials and equipment shall conform to relevant Indian Standards. The Contractor shall be responsible for the safe custody of all the materials and shall insure them against theft, damage by fire, earthquake etc. A list of items of materials and equipment, together with sample of each shall be submitted to the OWNER within 10 days of the award of the contract. Any item which is proposed as a substitute, shall be accompanied by all technical detail giving sizes, particulars of materials and the manufacturer’s name and shall be submitted along with the tender or bid offer. At the time of the submission of proposed substitute the Contractor shall state the credit, if any due to the owner. In the event the substitution is approved, all changes and substitutions shall be requested in writing and approvals obtained in writing from OWNER. OWNER’s decision in the matter shall be final.

All materials of the same kind of service shall be identical and made by the same manufacturers. Any deviation to this rule shall be approved by the Consultant. Top priority shall be given to the products that have a permanent agent providing spare parts and maintenance facilities in the same city where the project is situated.

The make of electrical equipment, components, accessories, etc. has been mentioned in order of priorities. The tenderer has to quote for the first priority as mentioned above after ascertaining that the first preference materials are available. If at a later stage during executing the work, material of the first preference make are not available, the contractor has to get approval from the OWNER to use other make of material prior to procurement. Any rate difference for the first preference makes and the one approved will be passed on to the owner.

G MANUFACTURERS:

Where manufacturers have furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.

Where manufacturer’s names and/or catalogue numbers are given, this is an indication of the quality, standards and performance required.

When interfacing occurs, equipment shall be mutually compatible in all respects.

H RATING:

Rating of all items shall be appropriate for the conditions on the particular site on which the items will be used. All the equipment shall be fit for continuous work under the worst conditions of site and shall be rated for the following ambient condition.

- Outdoor temperature 45 deg. cel.
- Temperature under shed 40 deg. cel.
- Salty, dusty and humid

I INSPECTION AND TESTING:

OWNER’S representative reserves the right to request inspection and testing at manufacturer’s works at all reasonable times during manufacture of items for this contract. Tests on site of completed works shall demonstrate, among other things:

a. That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.
b. That all items operate efficiently and quietly to meet the specified requirements.

c. That all the features performed at its best and loading/unloading of the system.

d. That all the accessories used in low side work are of specified make only. And any deviation in the same needs written approval from our technical consultant.

e. The Owner may carry out inspection and testing at manufacturer’s works for this contract. No equipment shall be delivered without prior written confirmation from the Owner’s site Engineer. In case factory inspection is carried out then all travelling and lodging expenses for two persons one from owner and one from consultants shall be borne by the Contractor, also all expenses related to testing shall be to Contractor account.

f. The contractor shall provide all necessary instruments and labor for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the OWNER and shall provide test certificates signed by a properly authorized person. Such test certificates shall cover all works.

If tests fail to demonstrate the satisfactory nature of the installation or any part thereof then no claims for the extra cost of modifications, replacements or retesting will be considered. OWNER’s decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any requirements specified elsewhere.

J  **PRICE DETAILS:**

At any time and at the request of OWNER, the contract shall provide details or breakdown of costs and prices of any part or parts of the works.

K  **TEST CERTIFICATES:**

The contractor shall submit test certificates from Govt approved- NABL Labs for all the electrical material/system installed. These shall be issued by a government recognized inspection office certifying that all equipment, materials, construction and functions are in agreement with the requirements of these specifications, ISI and when ISI is not applicable other approved certifying agencies.

L  **INSTRUCTION MANUAL:**

The contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and maintenance of the supplied equipment and installations, and submit 4 sets to OWNER, at the time of handing over

M  **SAMPLES AND CATALOGUES:**

Before ordering the material necessary for these installations, the contractor shall submit to OWNER for approval, minimum three sample of every kind of material such as cables, conductors, conduits, switches, socket outlets, circuit breakers, lighting fixtures, boxes etc., along with the catalogues.

For big items such as Transformers, DG set, switchboards etc., the submission of catalogues shall be enough. Prior to ordering any electrical equipment/material/system, the contractor shall submit to OWNER, the catalogues, along with the samples, at least from three different manufacturers. After the selection of manufacturer by OWNER, the contractor shall arrange inspection and testing at the manufacturer’s factory or assembly shop for final approval. No material shall be procured prior to the approval of the OWNER.

N  **VENDOR AND SHOP DRAWINGS:**
The contractor shall prepare and submit to PMC/Consultant/OWNER, for his approval, two sets of vendor detailed drawings of all distribution boards, switch boards, outlet boxes, special pull boxes, and other likewise material, equipment to be fabricated by the contractor, or other vendor within 15 days of signing of the contract.

Before starting the work, the contractor shall submit to PMC/Consultant/OWNER for his approval in the prescribed manner, the shop/execution drawings for the entire installation, especially the main connections and junctions, the route of conduits and cables, no. and size of wires drawn through the conduits, location of all the outlet points, and switch boards and distribution boards and any other information required by OWNER. OWNER reserves the right to alter or modify these drawings if they are found to be insufficient or not complying with the established technical standards or if they do not offer the most satisfactory performance or accessibility for maintenance.

O AS BUILT DRAWINGS:

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit to OWNER Four sets of layout drawing drawn at appropriate scale indicating the complete wiring system “as installed” duly approved by Consultant/PMC. These drawings must provide (in plan, folded elevation and section)

a. Location and details of HT Panel, Transformer, LT Panels, distribution boards, main switches, switchgear and other particulars
b. Location of all earthing stations, route and size of all earthing conductors, manholes etc.
c. Route and particulars of all cables.
d. Lighting layout plan for all the floors along with circuit distribution details
e. External Area Lighting Plan

P GUARANTEE CUM MAINTENANCE PERIOD

At the close of the work and before issuance of final certificate of virtual completion by OWNER, the contractor shall furnish written guarantee indemnifying OWNER against defective materials and workmanship for a period of one year after completion. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to OWNER, the following:

a. Any defective work or material supplied by the contractor.
b. Any material or equipment supplied by OWNER which is damaged or destroyed as a result of defective workmanship by the contractor.
c. Any material or equipment damaged or destroyed as a result of defective workmanship by the contractor
d. Contractor shall give 24 free services (Monthly) for easy and smooth operation of the Electrical System during the defect liability period of 24 months.
e. Contractor shall operate the system for 6 months (24 x 7 – All 3 Shifts) from the date of commissioning and train the client's staff for operation and routine inhouse maintenance.
f. The Guarantee cum Maintenance period shall be 12 months from the date of completion of satisfactory commissioning of all equipment of E & M works at given locations & towards satisfactory performance of each components and same shall be in force from the date of final acceptance. The contractor shall be responsible for any defect that may be develop due to faulty material, designs, and workmanship in the work and shall at his
own cost, remedy such defects when called upon to do so by the Engineer-in-charge of the work.

g. The contractor has to carry out quarterly servicing of the HVAC system equipment’s, Fire Fighting/Plumbing, LIFT and DG supplied during warrantee period. In case the contractor fails to carry out the requisite work during maintenance period, the part of bank guarantee shall be encashed to meet the liabilities.

R SAFETY OF MATERIALS:

The contractor shall provide proper and adequate, storage facilities to protect all the materials and equipment including those issued by OWNER against damage from any cause whatsoever.

S COMPLETION CERTIFICATE:

On completion of the electrical installation (or an extension to an installation) a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local supply authority. The contractor shall be responsible for getting the electrical installation inspected and approved by the local concerned authorities.

T DEFECTS LIABILITY:

Defects liability period shall mean 12 calendar months after OWNER have issued certificate of completion of the whole work. The certificate of completion shall be issued after the necessary tests have been carried out to the satisfaction of OWNER and the required drawings are submitted.

The contractor shall make good at his own cost and to the satisfaction of OWNER, all defects or other faults arising in the opinion of OWNER out of bad workmanship or faulty materials not in accordance with the drawings, ASHRAE Standard under which it may appear within twelve months after completion of the work.

U SITE ENGINEER AND TRAINING:

The contractor shall employ a competent fully licensed qualified, full time Electrical engineer to direct the work of Electrical installation in accordance with the drawings and specifications. The engineer shall be available all times at site to receive instructions from OWNER, in the day-to-day activities throughout the duration of contract. The engineer shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The engineer coordinates with other services contractor and PMC for any coordination site issues.

Contractor shall give training to technical staff of client for Operating, Control and Basic maintenance for easy operation.

V RESTATING & FINISHING OF CIVIL DAMAGES:

For erection of equipment / Piping / Ducting etc., if any civil structure is required to be broken, the same shall be done, restated and finished as original by the tenderer without any extra cost.

V Executive Summary

The proposed project is COPT Building at IIT Bombay.

The purpose of this document is to establish the parameters for design basis and philosophy for the Electrical systems for the proposed.
This document is prepared for the Electrical engineering design of the various building only with defined battery limit with site infrastructure.
1.0 MEDIUM VOLTAGE PANEL

1.1 SCOPE OF WORK

This scope shall cover design, manufacture, check test, and SITC of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.

1.2 CODES & STANDARDS

The Panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Item</th>
<th>Relevant IS</th>
<th>Relevant IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC</td>
<td>IS: 4237</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.</td>
<td>IS: 375</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Degree of protection provided by enclosures for Low voltage switch gear and control gear.</td>
<td>IS: 2147</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Terminal marking for electrical measuring instrument and their accessories.</td>
<td>IS: 8197</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Danger notice plates</td>
<td>IS: 2551</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Code of Practice for selection, installation and maintenance of switchgear and control gear.</td>
<td>IS: 10118</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Specification for factory-built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.</td>
<td>IS: 8623</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Miniature circuit breakers.</td>
<td>IS: 8828</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Current transformers</td>
<td>IS: 2705</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Voltage transformer</td>
<td>IS: 3155</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Electrical relay for protection</td>
<td>IS: 3231</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Indicating instruments</td>
<td>IS: 1248</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Integrating instruments</td>
<td>IS: 722</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Control switches and push buttons</td>
<td>IS: 6875</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>AC motor starters of voltage not exceeding 1000 V</td>
<td>IS: 1822</td>
<td></td>
</tr>
</tbody>
</table>

The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.

1.3 DESIGN BASIS & SITE CONDITIONS

All the equipment and components provided in the panel and accessories shall be suitably designed for installation and satisfactory operation as per site condition & as per relevant standard.

1.4 TECHNICAL REQUIREMENTS

All the Panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings.

All the outdoor panel shall be double door type with IP54 protection class construction.

All the indoor panel shall have IP54 protection class construction unless otherwise specified.

The painting of all the metal part shall be as per the painting specification defined in the
datasheet.

The Panels shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45°C, 90% humidity and salty, dusty weather.

CUBICAL TYPE PANELS:

1.4.1 STRUCTURE

The Panels shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.

All CRCA sheet steel used in the construction of 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 steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP:54. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable.

All panels and covers shall be properly fitted and secured with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self-threading screws shall not be used in the construction of Panels.

A base channel of 100 mm. x 50 mm. shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most units shall be provided.

Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does not attain temperature more than 45°C. The entire electrical component shall be derated for 50°C. The ratings indicated in the drawing are derated for 50°C.

Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables.

Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site.

The Panels shall be designed to facilitate easy inspection, maintenance and repair.

The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.

1.4.2 PROTECTION CLASS:

All the indoor Panels shall have protection class of IP 54 for indoor installation and IP 54 for outdoor installation.

1.4.3 PAINTING:

Generally painting shall be 7 tank powder coating process, Matt finish with 2 coats of epoxy primer unless otherwise specified. Paint shade generally shall be RAL 7032 / Siemens Gray unless otherwise specified. Prior to fabrication the paint shade shall be confirmed with the client.
For installation in corrosive atmosphere, the painting shall be with 2 coats of epoxy primer along with two coats of PU paint [Anti-corrosive paint] of reputed brand.

1.4.4 CIRCUIT COMPARTMENTS:

Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/switch fuse unit in `ON' and `OFF' position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in `ON' position.

The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

1.4.5 INSTRUMENT COMPARTMENTS:

Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, busbar and connections.

1.4.6 BUS-BARS:

The busbar shall be air insulated and made of high quality, high conductivity, high strength Copper.

The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of high conductivity Copper. The busbar shall be of rectangular cross-section designed to withstand full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length.

The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be colour coded in red, yellow, blue and black to identify the 3 phases and neutral of the system if specified in datasheet. The busbar shall be supported on unbreakable, non-hydroscopic SMC/DMC insulated supports at sufficiently close intervals to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 15 KA RMS symmetrical for 1 sec. and a peak short circuit withstand of 31.5 KA Copper.

The bus bar shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm. thick Bakelite sheet to avoid any accidental contact. The bus bar shall be arranged such that minimum clearance between the bus bars to be maintained as below:

<table>
<thead>
<tr>
<th>Case</th>
<th>Minimum Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between phases</td>
<td>25 mm. minimum</td>
</tr>
<tr>
<td>Between phases and neutral</td>
<td>25 mm.</td>
</tr>
<tr>
<td>Between phases and earth</td>
<td>25 mm.</td>
</tr>
<tr>
<td>Between neutral and earth</td>
<td>20 mm. minimum</td>
</tr>
</tbody>
</table>

All bus bar connections shall be done by drilling holes in bus bars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional cross-section of bus bar shall be provided in all Panels to cover up the holes drilled in the bus bar. Spring and flat washers shall be used for tightening the bolts.

All connections between bus bars and circuit breakers switches and cable terminals shall be through aluminum strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.
1.4.7 ELECTRICAL POWER AND CONTROL WIRING CONNECTION:

Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder-less sockets for the cable size as indicated on the appended drawings for the Panels.

Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) armoured cables.

Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.

Both control and power terminals shall be properly shrouded.

10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal.

Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.

Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/1100 V grade, PVC insulated copper conductor cables conforming to IS: 694 and IS: 8130. Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm. Cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.

Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.

Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking and testing.

Spring type washers shall be used for all copper and aluminium connections.

Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted alongwith the Panels as one of the documents against the contract.

1.4.8 TERMINALS:

The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.

1.4.9 WIRE-WAYS:

A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

1.4.10 CABLE COMPARTMENTS:
Cable compartments of adequate size shall be provided in the Panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.

1.4.11 EARTHING:

GI earth bus of 75 X 10 mm shall be provided in the Panels for the entire length of the panel unless other wise specified. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar on both sides of the panels to the main earthing bar coming from the earth pit. Door earthing shall be provided for all the compartments.

The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be made for connection from this earth pit on both sides of the Panels.

The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.

1.4.12 LABELS:

Engraved metal labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

1.4.13 NAME PLATE:

A name plate with the Panel’s designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.

Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.

Engraved name plates shall preferably be of 3 ply,(Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.

Name plate shall be fastened by counter sunk screws and not by adhesives.

1.4.14 DANGER NOTICE PLATES:

The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.

The danger notice plate shall indicate danger notice both in Hindi and English and with a Fluorescent sticker of Skull/Bones (With Radium paint/Illumination)

The danger notice plates, in general, meet the requirements of local inspecting authorities. Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.

The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.
The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.

The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.

The danger notice plate, if possible, be of ISI certification mark. Suitable Voltage rated rubber mates to be provided.

1.4.15 INTERNAL COMPONENTS:

The Panels shall be equipped complete with all types of required number of auto transformer starters, ACB, MCCB switch fuse units, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels.

All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.

All units of the same rating and specifications shall be fully interchangeable.

COMPONENTS

1.4.16 GENERAL:

The type, size and rating of the components shall be as indicated on the relevant drawings.

While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for. The thermal and magnetic trip rating shall be compensated for the ambient temperature.

The ratings indicated on the drawing are ratings anticipated at prevailing site conditions.

1.4.17 MINIATURE CIRCUIT BREAKERS:

Miniature Circuit breakers shall be current limiting type conformed with British standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.

The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

1.4.18 FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not less than 35 MVA at 415 V. The back-up fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on
starting of motors/equipment. HRC fuses shall be of the make as specified in Make of Material.

1.4.19 AIR CIRCUIT BREAKER:

**Construction:**
The ACBs shall have following features:
- Motorized with 230 V A.C. motor.
- 230 V A.C closing and shunt trip coil
- Draw out type with "service", "test", "isolated" and "maintenance" position.
- Safety shutter of Fibre glass/polycarbonate sheet of 2mm thickness shall be provided
- Mechanically trip free plus anti-pumping feature is to be provided.
- Electrical trip free plus anti-pumping shall be provided with relay ONLY and not by contactors.
- Electrical/Mechanical operation counter shall be provided.
- Door interlock with defeat features to be provided.
- ACB shall be lockable in isolation position.

**Release:**
- Microprocessor release
- Short circuit, overload and earth fault protection shall be provided.
- Vendor to suggest release type for feeders of supply range characteristic and accuracy.

**ACB Performance:**
- ACB performance inside panels at ambient 50 Degree.
- Ith Symmetrical breaking, 65KA
- Making capacity peak 113.75 KA
- Short time rating, 1sec. 65KA

1.4.20 CONTACTORS:

The contractors shall meet with the requirements of IS: 2959 and BS: 775.
The contractors shall have minimum making and breaking capacity in accordance with utilisation category AC3 and shall be suitable for minimum Class II intermittent duty.
If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contractor shall be such that it is not possible to make an accidental contact with live parts.

1.4.21 CURRENT TRANSFORMER:

Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended upto date.

1.4.22 PUSH BUTTONS:
The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and colour as per its usage for ON, OFF, and TRIP.

1.4.23 INDICATING LAMPS:

Indicating lamps shall be transformer operated low voltage rated and shall be supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self coloured:

- ON indicating lamp: Red
- OFF indicating lamp: Green
- TRIP indicating lamp: Amber
- PHASE indicating lamp: Red, Yellow, and Blue

1.4.24 DIGITAL MULTI FUNCTION METER

The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc.

Vendor to fill up datasheet.

1.5 DRAWING & INFORMATION

Prior to fabrication of the Panels the supplier/contractor shall submit for consultant’s approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, colour, mounting details etc. The contractor shall submit manufacturer’s catalogues of the electrical components installed in the Panels.

1.6 INSPECTION & TESTING

At all reasonable times during production and prior to transport of the Panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.

Testing of Panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.

1.7 HANDING OVER DOCUMENTS

Vendor to submit 3 copy of all test report, data sheet, Guarantee-warranty certificate to Consultant, client & PMC.

1.8 SHOP DRAWING

Vendor to submit shop drawing with require all details of Panel dimension, its location, etc.

1.9 AS BUILT DRAWING

Vendor to submit As built drawing as per final work.

1.10 METHOD OF MEASUREMENT
All the items will be measured as mentioned in Bill of quantity.

1.11 TRANSPORT, DELIVERY & STORAGE

The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipment’s at site should form part of offer.

1.13 O & M

NA

1.14 ATTACHMENTS

- Data Sheet

**TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE DISTRIBUTION PANEL**

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>PARTICULARS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>SITE CONDITION</td>
<td>Indoor</td>
</tr>
<tr>
<td>1.1</td>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Mounting</td>
<td>Floor, Indoor</td>
</tr>
<tr>
<td>1.3</td>
<td>Ambient Temperature</td>
<td>50° C.</td>
</tr>
<tr>
<td>1.4</td>
<td>Atmosphere</td>
<td>Warm, Humid &amp; Dusty</td>
</tr>
<tr>
<td>2.0</td>
<td>OPERATIVE CONDITION</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Voltage</td>
<td>415 V ± 10 %</td>
</tr>
<tr>
<td>2.2</td>
<td>No. Of Phase</td>
<td>3</td>
</tr>
<tr>
<td>2.3</td>
<td>System</td>
<td>3 Ø , 4 WIRE</td>
</tr>
<tr>
<td>2.4</td>
<td>Frequency</td>
<td>50 HZ, + 3 % / - 6 %</td>
</tr>
<tr>
<td>2.5</td>
<td>Fault Level</td>
<td>30 MVA</td>
</tr>
<tr>
<td>2.6</td>
<td>Fault Current</td>
<td>As per SLD</td>
</tr>
<tr>
<td>3.0</td>
<td>CONTROL SYSTEM</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Voltage</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Control Supply Through Control Transformer</td>
<td>230 V A.C. only</td>
</tr>
<tr>
<td>3.3</td>
<td>Control Wiring</td>
<td>2.5 MM² FRLS Cu. Wire</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.0 MM² FRLS cu. Wire for CT ckt.</td>
</tr>
<tr>
<td>4.0</td>
<td>BUSBAR</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Phase Bus bar</td>
<td></td>
</tr>
<tr>
<td>A.</td>
<td>Material</td>
<td>Copper</td>
</tr>
<tr>
<td>B.</td>
<td>Support</td>
<td>SMC/DMC</td>
</tr>
<tr>
<td>C.</td>
<td>Insulation</td>
<td>Epoxy Moulded (Resin)</td>
</tr>
<tr>
<td>D.</td>
<td>Insulating Barriers</td>
<td>Fibre Glass / Poly Carbonate Of Minimum 1.5 Mm Thick And To Be Of Fr4 Class</td>
</tr>
<tr>
<td>E.</td>
<td>Current Density</td>
<td>0.8 Amp. / mm²</td>
</tr>
<tr>
<td>4.2</td>
<td>Neutral Bus bar Material</td>
<td>Copper</td>
</tr>
<tr>
<td>4.3</td>
<td>Earth Bus bar Material</td>
<td>GI</td>
</tr>
<tr>
<td>5.0</td>
<td>Source changeover System</td>
<td>As per SLD.</td>
</tr>
<tr>
<td>6.0</td>
<td>PAINTING</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Sheet Should Be 7 Tank Processed, Oven Baked At 310°C. With Powder coating.</td>
<td>EPOXY PRIMER</td>
</tr>
<tr>
<td>6.2</td>
<td>Type Of Primer</td>
<td>Powder Coating</td>
</tr>
<tr>
<td>6.4</td>
<td>Type Of Paint</td>
<td>Shall be confirmed with client</td>
</tr>
</tbody>
</table>
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>PARTICULARS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>Shade</td>
<td>Shall be confirmed with client</td>
</tr>
<tr>
<td>6.6</td>
<td>Exterior Interior Degree Of Protection Max. Temperature Rise Inside The Panel (°C.)</td>
<td>IP 54 35 ° C. above ambient</td>
</tr>
<tr>
<td>7.0</td>
<td>CONTROL WIRING</td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>Wire Size</td>
<td>3 C × 4.0 mm² as specified 3 C × 2.5 mm² / 3 C × 1.5 mm²/4 C × 1.5 mm²</td>
</tr>
<tr>
<td>8.0</td>
<td>HARDWARE (ZINC PLATED)</td>
<td>YES</td>
</tr>
<tr>
<td>9.0</td>
<td>SPACE HEATER</td>
<td>230 V A.C. With thermostat control for MLTP only.</td>
</tr>
<tr>
<td>10.0</td>
<td>POCKET FOR DRAWINGS AT DOOR</td>
<td>YES</td>
</tr>
<tr>
<td>11.0</td>
<td>Illumination and switched power plug</td>
<td>YES</td>
</tr>
</tbody>
</table>

2.0 INSTALLATION OF LT PANEL

2.1 Power Control Center / Motor Control Center, Distribution Boards

i. Erection

Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and leveled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the draw out circuit breaker shall be checked for proper alignment and interchangeability.

After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.

Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements. The bus duct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the bus duct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the bus duct shall be properly connected.

ii. Testing

Before electrical panel is energized, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
Before switchgear is energized, the insulation resistance of all control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection.

- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer’s instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/manufacturer.
- The dielectric strength of insulating oil wherever applicable shall be checked.
- Before switchgear is energized, the following tests shall be performed one each circuit breaker in its test position.
  - Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energized to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
  - Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
  - Test proper operation of circuit breakers latch, check carriage limit switch if provided.
  - Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energized, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer’s instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

iii. Performs For PCC, MCC, DB, Control Panel Test

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)
  a) between each phase of bus: Mega ohm
  b) between each phase and earth: Mega ohm
  c) DC and AC control and auxiliary circuits: Mega ohm
  d) between each phase of CT / PT and between CT & PT circuit if any: Mega ohm
- CT checks
  a) CT ratio
  b) CT secondary resistance
  c) CT polarity check
- Check for contact alignment and wipe.
• Check / test all releases / relays.
• Check mechanical interlocks.
• Check electrical interlocks.
• Check switchgear / control panel wiring.
• Check breaker / contactor circuit for:
  a) Closing - local & remote (wherever applicable)
  b) Tripping - local & remote (wherever applicable)
• Opening time of breaker / contactor.
• Closing time of breaker / contactor.
  [This preformed shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

3.0 TYPE TESTED LT PANELS:

3.1 Main Low Voltage panels

3.1.1 Enclosure

This section covers the detailed requirements of Main Low Voltage panels for 415 volts, 3 phase, 50 Hz, 4 wire system.

3.1.2 STANDARDS AND CODES

The equipment proposed in this offer to be designed, manufactured, and tested according to the relevant IEC recommendations:

• IEC 61439-1/2 Low voltage switchgear & control gear assemblies – Part 2 Power switchgear and control gear assemblies
• IEC60529 Degrees of protection provided by enclosures
• IEC60947-2 Low voltage switchgear & control gear – part 2 Circuit breakers
• IEC60947-3 Low voltage switchgear & control gear – Part 3 Switches, disconnectors, switch-disconnectors & fuse combination units
• IEC60 947-4-1 Contactors and motor starters
• IEC60044-1 Current transformers
• IEC60186 Voltage transformers
• IEEE693 Environmental testing/ Seismic Withstand Level
• IEC61140 Protection against electric shock – Common aspects for installation and equipment – Basic safety publication
• IEC61641 TR Internal Arc Test report

3.1.3 General

• LV panels shall be certified by 3rd party Certification body as per IEC 61439-1 & 2. Test reports without certificate shall not be considered admissible proof of compliance. The Certifying Authority shall be qualified under ISO/IEC 17065 as per IEC 61439-1.
• IEC 61439-1&2 compliance certificate to be submitted for all ratings of LV Switchboards as mentioned in Schedule of Quantities or Single Line Diagram for this project along with the tender.
• The LV panels and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone certification as per IEC61439-1 & 2.
• Certified design of panels shall be proven design from OEM (Original Equipment/ Switchgear Manufacturer). OEM name should be mentioned on top of each column of panels. Also, OEM Partnership Certificate shall be furnished by Panel builder.
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

- To ensure installation consistency during panel life cycle, installation system, switchgears, motor starter components and metering devices must be supplied by the same Manufacturer (OEM).

- Panels shall have a short circuit level withstand as per Schedule of Quantities and drawings. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions.

- Panels shall have Rated Impulse withstand voltage (Uimp) of 12kV for withstanding against transient Overvoltage, for which the values of clearances are referred applicable for ACB, horizontal & vertical busbars.

- All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42/55 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42/55 is retained.

- Panels shall be tested for Internal arc. The test should be performed for arc starting place - at Horizontal busbar, Vertical busbar and in outgoing cable compartments.

- As Copper busbar are recommended for panel - Internal arc test to be performed on panels having Copper busbar. Reports with Cu busbar design shall not be accepted as proof of compliance.

- To ensure right performance on Seismic risk, Panels shall be validated design for Seismic withstand for Ground Acceleration level of 2g. Test shall be performed in accordance with standard IEEE 693: 2018.

- Panels must have mechanical impact IK10 tested.

- To facilitate access within the switchboard for maintenance, its covering panels must be dismountable on all surfaces for all IP degrees

- To ensure maximum protection of people around the electrical installation, front plates must be installed in front of all control and protection equipment in order to avoid direct access without a tool to the devices and consequently to the live parts.

- For safety reasons and especially when the door is open during switchboard operation, all busbars must be covered by Metallic barriers over whole perimeter of the busbar zone. IP2X (touch proof) protection shall be available.

- As specified in the BOM the switchboard shall be form 3b. For forms of separation to be achieved, only metallic covers shall be used. Hylem/ PVC sheets shall not be allowed.

- To enhance Sustainability, LV Switchboards shall have Green Premium Certification, with eco production, with product design in accordance with RoHS & Reach directives and with End-of-Life Instructions.

- The panel shall be supplied with a smartphone/web-based maintenance tracking system. A unique identifier (like QR code) shall be employed for each switchboard to enable quick access to switchboard details including but not limited to switchboard drawings, wiring diagrams, list of spares, Switchboard BOM etc. A maintenance schedule shall be provided by the manufacturer for switchboard and major components inside. There should be a provision to enable alerts for upcoming maintenance activities for the switchboard and components. The alerts shall be automated and provided to the maintenance staff appointed by the End-user in the form of smartphone notifications.

3.1.4 Panel Configuration
The Panel shall be configured with Air Circuit Breakers, MCCB's, MCB's, Motor Starter components, Metering devices and other equipment as called for in the schedule of quantities.
The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier or Two-Tier formation to facilitate operation and maintenance.
The Panels shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

3.1.5 Constructional Features

The Panels shall be metal clad totally enclosed, floor mounted free-standing type of modular extensible design suitable for indoor installations. Switchboards, panels, and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 & 2. Sheet thickness for Load bearing frame structures shall not be less than 3.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. Also, the doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 1.6 mm.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Panel shall be supplied with a double door arrangement. IP level & Mechanical impact performance of the panel shall not be compromised in any scenario and shall remain at IP42/54 and IK10 level respectively, in all conditions.

Global door shall be provided with Ergonomic handles with locking (key RONIS n° 405).

Panels construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not accommodate any outgoing feeder. The incomer panel shall be suitable for receiving bus trunking or LV cable of size specified.

Panels shall be made up of requisite vertical sections, which when coupled together, shall form continuous switchboards.

Panel shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The Panels shall be designed for use in high ambient temperature up to 55 degree centigrade and humid tropical conditions suitable for pollution degree 3.

Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Special care to be taken to ensure effective earthing of the frame and doors of the Panels.

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contract with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some panels may be required to be installed against the wall, for such applications, documented designs shall be available.

The painting of the sheet metal shall be done by electrostatic spraying of epoxy resin powder to give smooth finish to the equipment. Color used shall be RAL 7047 for the enclosure and RAL 9022 for the functional unit.
Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 & 2. All the devices must be installed onto dedicated mounting plate designed for one or several switchgears of the same type. The objective of this point is to group protection equipment of the same type, as well as distinguish inside the switchboard the function of each device or group of devices and avoid identification mistakes.

Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

3.1.6 Panel Dimensional Limitations

The overall height of the switchboard shall be limited to 2000 mm for all the Busbar ratings and type of Panels. Panel should have integral base frame of 75/100mm, the height of the operating handle push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

Other dimensional limits if any are specified separately.

3.1.7 Panel Compartmentalization

Panel design shall be completely compartmentalized with separate compartments for horizontal busbars, vertical busbars, Cable alleys and functional units consisting of ACBs, MCCBs, & MCB’s.

Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars, and connections.

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating, and duty. All operating devices shall be in front of switchgear only. Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

3.1.8 Panel Bus Bars

Busbars shall be made of high conductivity, and high strength Copper of ETP grade.

Busbars shall be of rectangular cross sections better suitable for full load current for phase bus bars and half/ full rated current for neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

The maximum temperature of the busbars shall not exceed 90 degrees Centigrade.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar Chamber on either side of Switchgear chamber, so that busbars could be accessed with front access itself.
Design of LV Switchboard shall be such that, Phase and Neutral busbars should be together in same compartment. Also, the Neutral busbar shall always be in front to ensure safety, even when covers are open.

For ratings up to 1600A, design of LV Switchboards shall be such that Main Horizontal Busbar can be assembled at Top or at Bottom of Panel, to achieve less footprint, depending on site conditions viz. Cable Entry from Top/ Cable Entry from bottom etc.

The bus bars carrying full current of panel shall be supported on non-breakable, non-hygrosopic epoxy resin or glass fiber reinforced polymer insulated supports that are Thermoset in nature, to able to withstand high operating temperature of 135 deg C and mechanical forces, arising from a severe fault level as stipulated in schedule of quantities.

To ensure ability to resist ignition & to self-extinguish when ignited, Insulated supports shall be supplied from OEM only & confirm to Glow Wire Test the Busbar Support and the spacing should be same as per the type tested assembly.

Clearances & Creepage distances between phases should be in line with IEC.

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to site earth at two ends of Switchboard.

### 3.1.9 Panel Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 160 Amps, PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of 200 Amps & above.

All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints.

All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for Assembly of panels & also busbar connections.

### 3.1.10 Draw out Features for ACB

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test, and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

### 3.1.11 Instrument Accommodation/Meters

All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS 1248 for accuracy. All voltmeters shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided, and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the internal compartment doors.
The current transformers for metering and for protection shall be mounted on the solid copper busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

3.1.12 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall be used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

3.1.13 Space Heaters

Anti-condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 50°C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a rule, the heaters shall be placed at the bottom of the cubicle.

3.1.14 Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness of sheet approved by Engineer-in-Charge shall then be provided.

3.1.15 Testing at Works

Copies of Routine test carried out at the Panel Builder’s Workshop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at Panel Builder’s works prior to dispatch to site to witness the followings.

1. Physical variation and dimensional check
2. Verification of bill of material
3. Functional check
4. HV test
5. IR test

4.0 DISTRIBUTION BOARDS

4.1 Scope of Work

This section relates to specifications for supply of lighting distribution board (LDB) & Power distribution board (PDB) TPN/FP/DP/SP MCB isolator & ELMCB, earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item supply. Common banking of neutral and earth conductor is not allowed.

4.2 Code & Standards
The Distribution Board shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Item</th>
<th>Relevant IS</th>
<th>Relevant IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC</td>
<td>IS: 4237</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.</td>
<td>IS: 375</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Terminal marking for electrical measuring instrument and their accessories.</td>
<td>IS: 8197</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Miniature circuit breakers.</td>
<td>IS: 8828</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Design Basis & Site Conditions

All the equipment and components provided in the DB and accessories shall be suitably designed for installation and satisfactory operation as per conditions of GIR.

4.4 Technical Requirements

4.1.1 System

The lighting distribution boards shall be suitable for operation on 415/240-volt, 50 cycle per second, A.C supply system. The lighting & power distribution boards MCB shall be capable of withstanding short circuit current of 10 KA.

4.1.2 Construction

Distribution Boards (hereafter will be referred as DBs) shall be selected from the same range, based on installation requirement. Irrespective of the installation method (flush or surface mounted), they shall designed and manufactured as per Indian Standard IS 8623-1 and 3.

The DB’s shall be factory made. General arrangement lay out of the DB’s shall be approved by the consultants in charge before starting the manufacture.

The DB shall metal clad duly fabricated from 2mm. thick high quality CRCA sheet metal. It shall be powder coated with dust/dirt repellent white colour (Powder coating thickness shall be minimum 50 to 100 micron on all the plane surfaces) after seven tank process.

The DB shall be wall mounted and dead front operated.

The DB shall totally be enclosed and made dust, vermin and weatherproof such that it meets to IP43 protection classification for installation.

A detachable cover plate of 2 mm thick CRCA sheet to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate.

1. The cover plate shall be fixed to the board with adequate size zinc passivated machine screws.
2. Above the detachable cover plate, one additional hinged door of 2 mm thick CRCA sheet shall be provided with a suitable locking arrangement.
The hinged door shall be provided with a suitable gasket capable of withstanding corrosive & humid atmosphere and to maintain degree of enclosure protection to IP 43 as per IS: 13947 for installation.

The Impact Protection for entire range of DBsIK08 for DBs with Single Door, IK09 for DBs with Double Door
DBs shall be provided with Side mounted shrouded & isolated 63A rated Brass Neutral Bars. Neutral Bar shall be fastened on the U-box.

The DIN rail shall be Zinc plated and must not have any injurious sharp corners. DIN rail shall be provided with MCB stopper arrangement to achieve the comfort in center plate assembly. All the TPN/PPI DBs shall be provided with removable DIN rail chassis.

DBs shall be provided with rotary knob and shall have flexibility to change to field fittable Key lock.

The DBs shall have two nos. of external Earth Stud to ensure better Earth continuity and shall have embossed earthing symbol for easy identification.

DB shall be able to accommodate all types of Modular devices viz. Protection Devices (MCBs, RCDs, SPDs, Auxiliaries), Controlling Devices (Isolators, Changeover switches, Contactors, Impulse Relays, Push Buttons) and Indication Devices (Indicators, Meters etc.).

DB shall be provided with 5 holes (1 keyhole for DB positioning and 4 no’s capsule holes for DB fixing) for ease mounting on wall.

DBs shall be provided with removable Gland plates on top and bottom with adequate numbers of knock-out holes of appropriate size and mounted on DB with minimal possible screws to save installation time.

Neutral Terminator shall be provided to terminate the Incoming Neutral in case of 3P MCCB incomer DB’s.

DB shall be provided with door earthing.

Centre plate of double door DB shall be provided with user friendly knob for safe and ease of removal from U-box.

The DB shall have top/Bottom entry arrangement for incoming and outgoing cables/conduits. All hardware to e used in manufacture of the DB shall be S.S 304 to prevent corrosion due to humid atmosphere prevailing at the project site.

All internal electrical connections shall be carried out using 660/1100-volt grade, FRLS insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch Fuse rating at operating conditions prevailing at the project site.

The DB internals shall be earthed with use of copper wires/strips running throughout the length. Size of the earthing strip/wire shall be as shown in the respective drawing.

All non-current carrying metal surface of the DB’s shall adequately be treated and painted.

The surface imperfection shall then be rectified with applications of putty.

The DB’s shall be provided with electric components and accessories as per the details shown in the drawing for the respective electric distribution board. The circuit connection from all the circuit MCB shall be brought to connector provided on top or bottom of the DB with suitable lugs. The connector shall be suitable to receive phase, neutral and earth wire/cable coming from each individual circuit. The connector’s shall have circuit identification tag.
Use of paper/fabric base laminates is not acceptable.

4.1.3 Protection Devices

MCB

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898, IEC/EN 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 230V/415V, 50Hz supply. The MCB ratings shall be available from 1–125A in 1P/2P/3P/4P versions. The rated short circuit capacity acc to IS/IEC 60898 shall be of 10,000A. MCBs shall be offered with B, C or D tripping characteristics as per the BOQ requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) must submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. (to be mentioned on the MCB as per standards)

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation
- rated insulation voltage: 500 V
- pollution degree: 3
- rated impulse-withstand voltage: 6 kV
- Discrimination for power continuity
- Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit-breakers shall be capable of operation under ambient temperature up to 50 °C, without derating of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must comply to RoHS and REACH standards.

4.1.4 Painting

The painting shall be as per "PAINTING" specification only.

4.5 Drawing & Information
The following drawings shall be submitted along with the bid:

General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.

Terminal chamber, showing bus-bar arrangement with all dimensions.

Power wiring diagram.

4.6 Method of Measurement

Supply of the Lighting DB including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

4.7 Transport, Delivery & Storage

The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of Lighting DB on site store. The Lighting DB should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipment's at site should form part of offer.

4.8 Guarantee & Warranty

The quotes values of parameters shall be within given tolerance for given period of service life.

4A.0 INSTALLATION OF DBs:

4A.1 Scope

This section relates to specifications for installation, connection, testing and commissioning of distribution board (DB) using TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item installation. Common banking of neutral and earth conductor is not allowed.

4A.2 Installation of System

The DB’s shall be assembled and aligned together and be installed at site as per installation manual/instruction of the DB manufacturer.

The DB shall be installed in surface manner at the various location.

All minor electrical and mechanical work required to be attended to on the DB shall be completed in an approved manner after installation but before energizing the DB’s.

The M.S. angle/channel iron frame used for installation of D.B. shall be hot dip galvanized (816 g/m²).

4A.3 Power Control Center / Motor Control Center, Distribution Boards

i. Erection

Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and leveled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous.
throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchangeability.

After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.

Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements.

The bus duct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the bus duct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the bus duct shall be properly connected.

ii. Testing

Before electrical panel is energized, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.

Before switchgear is energized, the insulation resistance of all control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection.

- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer’s instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable shall be checked.
- Before switchgear is energized, the following tests shall be performed one each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energized to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energized, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer’s instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
• All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

iii. Performs For PCC, MCC, DB, Control Panel Test

• Circuit breaker or contactor module designation / bus no.
• Insulation resistance test (contacts open, breaker racked in position)
  a) between each phase of bus : Mega ohm
  b) between each phase and earth : Mega ohm
  c) DC and AC control and auxiliary circuits : Mega ohm
  d) between each phase of CT / PT and between
  CT & PT circuit if any : Mega ohm
• CT checks
  a) CT ratio
  b) CT secondary resistance
  c) CT polarity check
• Check for contact alignment and wipe.
• Check / test all releases / relays.
• Check mechanical interlocks.
• Check electrical interlocks.
• Check switchgear / control panel wiring.
• Check breaker / contactor circuit for :
  a) Closing - local & remote (wherever applicable)
  b) Tripping - local & remote (wherever applicable)
• Opening time of breaker / contactor.
• Closing time of breaker / contactor.

[This performed shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

4A.4 Inspection & Testing

Prior to commissioning of the DB’s following tests shall be carried out.

Mechanical endurance test shall be carried out by closing and opening of all the MCB’s, switches etc.

Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in open position. Similar test shall be carried out keeping the isolating switch in closed position.

All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

5.0 LT XLPE FRLS CABLE:

5.1 Scope of Work

This section shall cover supply, laying, testing and commissioning of medium voltage XLPE FRLS cables.

This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client’s approval before the placement of orders to the main supplier / manufacturer.

5.2 Codes & Standards

The following standards and rules shall be applicable:
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Item No</th>
<th>Item</th>
<th>Relevant IS</th>
<th>Relevant IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>XLPE insulated electric cables (heavy duty).</td>
<td>IS : 7098 Part I</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Recommended current ratings for cables.</td>
<td>IS : 3961</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Aluminium conductors for insulated cables</td>
<td>IS : 8130</td>
<td>Indian Electricity Act and Rules.</td>
</tr>
</tbody>
</table>

Relevant standards for FRLS cables:

- ASTM –D 2843/77,
- IEC 332-1-79,
- IEEE-383/4,
- SS-424-1475-F3,
- IEC –540-1976,
- IEC 754-1-1982,
- ASTM –D 2863 /771,
- HEMA –WC-S,IS 5831

5.3 Design Basis & Site Conditions

All equipment and materials will be selected and rated for use as per site conditions.

5.4 Technical Requirements

5.4.1 General Constructional Features

The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer’s instructions. The cables shall be delivered at site in original drums with manufacturer’s name, size, and type, clearly written on the drums.

5.5 Material

Medium voltage cable shall be XLPE insulated Flame Retardant low smoke (FRLS) PVC sheathed, aluminum or copper conductor, armoured conforming to IS: 7098 Part I.

- **a) Type**

  The cables shall be circular, multi core, annealed copper or aluminum conductor, XLPE insulated and FRLS PVC-ST2 inner sheathed, FRLS PVC-ST2 outer sheathed power cables armoured or unarmored.

- **b) Conductor**

  Uncoated, annealed copper / aluminum, of high conductivity up to 4mm.² size, the conductor shall be solid and above 4mm.², conductors shall be concentrically stranded as per IEC: 228.

- **c) Insulation**

  XLPE rated 90° c. extruded insulation
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Properties</th>
<th>Values</th>
<th>Applicable Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oxygen Index</td>
<td>29 (minimum at room temperature)</td>
<td>ASTM-D-2863</td>
</tr>
<tr>
<td>2</td>
<td>Temperature Index</td>
<td>250°C minimum at oxygen index of 21</td>
<td>ASTM-D-2863</td>
</tr>
<tr>
<td>3</td>
<td>Smoke Density Index</td>
<td>60% minimum</td>
<td>ASTM-D-2843</td>
</tr>
<tr>
<td>4</td>
<td>Acid Gas Generation</td>
<td>20% Maximum by weight</td>
<td>IEC-754-PART 1</td>
</tr>
<tr>
<td>5</td>
<td>Flammability Test</td>
<td>Passes</td>
<td>SS424, 1475 class F3, IEEE - 383 and IEC332 part-1</td>
</tr>
<tr>
<td>6</td>
<td>Fire Resistance Test</td>
<td>Passes</td>
<td>IEC- 5831</td>
</tr>
</tbody>
</table>

d) Core Identification

- Two core: Red and Black
- Three core: Red, Yellow and Blue
- Four core: Red, Yellow, Blue and Black
- Single core: Green, Yellow for earthing

Black shall always be used for neutral.

e) Assembly

Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

f) Armour

Galvanized steel flat strip / round wires applied helically in single layers complete with covering the assembly of cores.

- For cable size up to 25 Sq. mm.: Armour of 1.4 mm dia G.I. round wire
- For cable size above 25 Sq. mm.: Armour of 4 mm wide 0.8 mm thick G.I strip

g) Sheath

XLPE 90 deg.c. rated extruded.

Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables consisting of FRLS type ST2 PVC compound as per IS: 5831 with minimum oxygen index as per ASTMD -2860.

Outer sheath shall be of an extruded type layer consisting of FRLS type ST2 PVC compound as per IS : 5831 with minimum of oxygen index as per ASTMD -2860, shall be applied over armour by extrusion suitable for 90 deg.cent. Specially formulated flame-retardant low smoke PVC compound shall be provided for outer sheath. Suitable PVC material compatible with the specified ambient temp. 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.

Sequential length marking required at every 1.0 mtr. interval on outer sheath Vendor has to furnish resistance / reactance / capacitances of the cable.

a) Rating: Up to and including 1100 Volts.

5.6 Drawings & Information
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

Contractor shall submit the as built drawing of the cable laying drawing.

Handing over Documents

The supplier shall submit following:
1. Data sheet indicating results of tests
2. Test reports

5.7 Inspection and Testing

5.7.1 All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.

The cable shall be supplied in single length i.e. Without any intermediate joint or cut unless specifically approved by the client.

The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

5.7.2 Finished Cable Tests at Manufacturer’s Works

The finished cables shall be tested at manufacturer’s works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client’s representative.

a) Voltage Test
   Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

b) Conductor Resistance Test
   The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

5.7.3 Cable Test Before and After Laying of Cables at Site

a) Insulation Resistance test between phases and phase to Neutral and phase to earth.

b) Continuity test of all the phases, neutral and earth continuity conductor.

c) Sheathing continuity test.

d) Earth resistance test of all the phases and neutral.

5.8 Method of Measurement

The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in meters shall be measured lug to lug basis.

5.9 Transport, Delivery and Storage

5.9.1 The cable shall be supplied in the actual length as per detailed purchase order.

5.9.2 The cable shall be dispatched at client’s stores or at site as per detailed instructions given by client at later stage.

5.9.3 The cable shall be loaded from the main vendor’s store and properly stacked as per instruction of client’s local representative. All such labour and transportation charges shall be clearly mentioned in the offer.
5.10 Guarantee of Performance.

6.0 AUXILIARY ITEMS FOR ELECTRICAL INSTALLATIONS:

6.1 Local Push Button Stations

6.1.1 Construction Features

The construction features of the local push button stations shall be as follows:

Metal enclosed, weatherproof, suitable for mounting on wall or steel structures. The enclosure shall be die cast aluminum or sheet metal of 2 mm thickness.

Outdoor type push buttons shall be completely, weather, dust and vermin proof and shall be provided with canopy. Degree of protection shall be IP:55.

Metal parts shall be given tropicalizing treatment as per standards and painted with one coat of epoxy primer and two coats of light gray epoxy paint.

Provided with inscription plates of rear engraved Perspex with white letters on black background. The letter size shall be 6 mm.

Provided with two earthing terminals suitable for 14 SWG G.I wire.

Provided with removable undrilled gland plate and cable glands for appropriate sizes of cable. The cable entry shall be forming the bottom.

Push button contact shall be designed for extra robust both mechanical and electrical operation. High quality material shall be used in their construction to ensure mechanical life exceeding 10 million switching operations. The contact shall be of silver alloy of 10 A continuous current rating.

6.1.2 Push Buttons

All push buttons shall be:
- Fitted with one (1) normally open and one (1) normally closed contact rated to carry and breaks 6 Amps at 415 Volts (10 A at 240 V AC)
- Provide integral escutcheon plates marked with its function.

The open/close/start push buttons shall be of the momentary contact push to actuate type and shall be green in color.

6.1.3 Type of Push Button Stations

The following types of push button stations shall be supplied:

Push button station, suitable for indoor/outdoor installation and shall comprise two push buttons viz ‘START’ and ‘STOP’ for control of non-reversible motors with on indicating lamp. Both the P.B. shall be of lockable type with key.

6.1.4 Inspection & Testing

The local push button stations shall be offered for inspection after assembly. Routine and acceptance tests shall be carried out during inspection.

6.1.5 Test Equipment's

Vender shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.
6.1.6 Drawings

On award of the contract, the contractor shall submit the fully dimensioned general arrangement drawings complete with plan, elevation, and sectional views.

6.2 Conduit

The scope covers design and manufacture, inspection, testing and delivery of cable trays, necessary hardware, fittings & accessories.

6.2.1 General Requirements

The cable trays shall be prefabricated hot dip galvanized ladder type. The ladder type trays shall consist of side runners and horizontal rungs.

The ladder type trays and its accessories shall have rigid welded construction and shall be fabricated out of 2mm thick Hot rolled sheet steel. The rungs shall be welded to the side runners.

Side runners shall be 75 x 15mm channel with the flange facing inside. Rungs shall be 35 x 15mm slotted channel type construction and shall be spaced 250mm apart. All perforated channel type tray shall be 30mm high one-piece channel made out of 2 mm thick sheet steel and hot dip galvanized.

Cable trays shall be suitable for a cable weight of 100kg/mtr. running length of tray and it shall be supported @ 2m intervals.

The side runner channel and all accessories will have two holes on each end for fixing splice plates. Two splice plated (one on inside face and one on outside face) will be provided for each side runner. The side runner will also have suitable holes at every meter for clearing earthing strip. Suitable tapped holes shall be provided on the runner top and bottom for supporting and fixing tray covers at every meter.

Hot dip galvanizing shall be done after fabrication as per relevant Indian Standards Specification. The amount of galvanizing shall be minimum 65 microns.

The type of construction shall be such as to facilitate easy handling, assembly, and installation at site. The straight length of cable tray shall be min. 2.5 meters (without splice plate).

The workmanship shall be such as to ensure easy laying of cables without causing damage to cables. All surfaces shall be free from defects such as burrs, sharp edges etc.

The hardware shall conform to relevant Indian Standard specifications and shall be able to withstand the maximum loading conditions as required. All hardware fittings shall be hard chrome cadmium plated/zinc passivity. All hardware’s shall include bolts, nuts and washers etc.

The bends, tees, reducers and droppers shall have bending radius of 750mm for L.T. & 1250mm for HT cables respectively.

6.3 Junction Box

The junction box shall be made out of 2 mm mild steel sheet.

The total depth of junction box shall be 65 mm while the width and length shall be 300 mm.

The lower compartment shall accommodate the cables running through the junction box.
The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.

The upper compartment shall be provided with knock out for conduit entry on two opposite sides perpendicular to main run of the floor trunking.

The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.

The top cover of the junction box shall be hinged type and shall be made from brass / SS. To give decorative look to the exposed cover top.

6.4 ELBOW / TEE Joint

It shall be made from 2 mm mild steel sheet.

The total depth shall be 65 mm while the width and length shall be 300 mm.

The lower compartment shall accommodate the cables running through the junction box.

The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.

The upper compartment shall be provided with knock out for conduit entry on free side opposite to the direction of turn of ELBOW and free side of TEE JOINT.

The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.

The top cover of the junction box shall be hinged type and shall be made from brass / SS. To give decorative look to the exposed cover top.

6.4.1 Painting

The painting process shall be of seven tank process.

The primer shall be bromite based red oxide. Two coats of red oxide shall be applied.

The outer surface shall be coated using two coat of black coal tar compound.

7.0 INTERNAL WIRING

7.1 Scope of work

This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc.

7.2 Codes & Standards

The following standards and rules shall be applicable:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Relevant IS</th>
<th>Relevant IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Code of practice for electrical wiring installation (System voltage not exceeding 650 V)</td>
<td>IS: 732</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Code of practice for fire safety of buildings (General) Electrical installation.</td>
<td>IS: 1646</td>
<td></td>
</tr>
<tr>
<td>Item No.</td>
<td>Item</td>
<td>Relevant IS</td>
<td>Relevant IEC</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
<td>------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>3</td>
<td>Rigid steel conduits for electrical wiring.</td>
<td>IS: 9537 (Part - 2)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fittings for rigid steel conduits for electrical wiring.</td>
<td>IS: 2667</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Flexible steel conduits for Electrical wiring.</td>
<td>IS: 3480</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Accessories for rigid steel conduit for electrical wiring.</td>
<td>IS: 3837</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PVC insulated cables.</td>
<td>IS: 694</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Rigid non-metallic conduits for electrical wiring.</td>
<td>IS: 9537 (Part - 3)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Flexible (Pliable) non-metallic conduits for electrical installation.</td>
<td>IS: 6946</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3 pin plugs and sockets.</td>
<td>IS: 1293</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Specifications of conduits for electrical installation.</td>
<td>IS: 8130</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Switches for domestic purpose.</td>
<td>IS: 3854</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Fittings for rigid non-metallic conduits.</td>
<td>IS: 3419</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Guide for electrical layout in residential buildings Indian electricity act and rules.</td>
<td>IS: 4648</td>
<td></td>
</tr>
</tbody>
</table>

### 7.3 Design Basis & Site Conditions

All equipment and materials will be selected and rated for use as per site conditions.

### 7.4 Technical Requirements

#### 7.4.1 Point Wiring

A point shall consist of the branch wiring from the distribution board together with a switch as required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points.

Supply, installation, fixing of conduits with necessary accessories, junction/ pull / inspection /switch boxes and outlet boxes.
Supplying and drawing of wires of required size including earth continuity wire

Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator etc.

The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button/swan holder, connector etc.

#### 7.4.2 Point Rate

The rate per point shall include supply, installation, connection, testing and commissioning of point as described under “point wiring”. The measurements of the points will be enumerated.

#### 7.4.3 System of Wiring

Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows.
The system of wiring shall consist of single core, FRLS insulated 1100-volt grade, copper conductor wires/cables laid through conduits as directed & wherever required, conduits shall be concealed in walls and slabs

7.4.4 General

Prior to laying of conduits, the contractor shall submit for approval, the shop drawing for conduit layout indicating the route of the conduits, number and size of the conduits, location of junction/inspection/pull/outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details. Only after the drawings are approved, the contractor shall proceed with the work of laying of conduits.

7.4.5 Material

1. PVC /GI Conduit

MMS/HMS PVC conduit confirming to relevant IS code shall be used.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of manufacturers

The conduit accessories such bends, coupling etc. shall be conforming to the relevant Indian Standard specification

2. Boxes

1. Separate screwed earth terminal shall be provided in the box for earthing purpose

2. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry

3. Switch boxes to receive switches, socket outlets, power outlets, telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding.

4. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod.

5. Hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.

6. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers as required. Boxes for use in masonry block or tiled walls shall be square cornered tile type, or standard boxes having square cornered tile type covers. These boxes shall be installed in the centre of the masonry block or tiles

7. Cast metal boxes installed in wet locations and boxes installed flush with the outside of exterior surface shall be gasketed.

3. Cover Plate

The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches

4. House wire

1. The concealed wires shall conform to IS: 17048. For all internal wiring FRLS insulated copper cables of 1100 volts grade, single core shall be used.

2. The conductors shall be plain annealed copper conductors complying with IS: 8130/IEC 60228.
3. The conductors shall be circular copper conductor.

4. The insulation shall be Type HFI-TP 70 (thermoplastic) complying with the requirements of IS: 17048. It shall be applied by an extrusion process and shall form a compact homogenous body.

5. The thickness of FRLS insulation shall be as set out in the relevant standards.

6. Flame Property and other Tests
   - Oxygen index ≥ 31% in accordance to IS 10810 (Part 58)
   - Temperature index ≥ minimum 250°C in accordance to IS 10810 (Part 64)
   - Light transmission ≥ 70 % as per IS 10810 (Part 63)
   - Acid gas generation HCL content ≥ maximum 0.5% as per IEC 60754-1
   - Flammability in acc. with IS 10810-53 / IEC 60332-1x
   - Conductivity ≤ 10 μS/mm

7. Special Properties
   - RoHS
   - REACH

8. The cores of all cables shall be identified by colours in accordance with the following sequence.

<table>
<thead>
<tr>
<th>Single phase</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three phase</td>
<td>Red, Yellow, Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>Black</td>
</tr>
<tr>
<td>Earth</td>
<td>Green or Green/Yellow</td>
</tr>
</tbody>
</table>

9. Means of identifying the manufacturer shall be provided throughout the length of cable.

10. Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:
   - In case of circuit wiring for lights, exhaust fans, ceiling fans, bell, convenience socket outlet points (P+N+E):
     - 2.5sq.mm. From D.B. to switch boards.
     - 1.5sq.mm. From switch boards to outlet points
   - In case of power socket outlet circuit having not more than two 15 A power outlet (P+N+E):
     - 2.5sq.mm. From D.B. to power outlet
   - In case of power socket outlet circuit having single 16 A power outlet (like water heater) (P+N+E):
     - 4.0sq.mm. From D.B. to power outlet.
   - In case of 16 A. power outlet for window Air conditioner or other likewise appliances (P+N+E):
     - 4.0sq.mm. From D.B. to power outlet.
11. The earth continuity conductor shall be similar to circuit cables and shall be drawn through conduit along with other circuit cables. The size of the earth continuity conductor shall be as follows:

MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATE CIRCUIT CONDUCTOR

<table>
<thead>
<tr>
<th>Nominal cross-section area of largest associated copper circuit conductor in sq.mm.</th>
<th>Nominal cross-sectional area of earth continuity conductor in sq.mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

5. Switches

1. Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole, single or two way as shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5/15 A capacity. They shall be provided with insulated dollies and covers.

2. The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber.

3. The switches shall have pure silver and silver cadmium contacts.

4. The switches shall be flush modular type.

5. The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client.

6. The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weatherproof enclosures, complete with weatherproof gasketed covers.

6. Socket

1. The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.

2. Sockets shall be of three pin type, the third in being connected to earth continuity conductor.

3. The socket shall be flush modular type.

4. The sockets installed in machine room, plant room or wet/damp area shall be metal clad weatherproof type.

5. The finishing and make of all the sockets shall be same as light switch.

6. The socket shall have fully sprung contacts and solid brass shrouded.

7. Terminals to ensure positive electrical connections.

8. The sockets shall be provided with automatic shutters, which open only when earth pin of the plug inserts in the socket.

9. The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.
7.5 **Inspection and Testing**

### 7.5.1 Insulation Resistance Test

The insulation resistance shall be measured by applying 500-volt megger with all fuses in places, circuit breaker and all switches closed.

The insulation resistance in megohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit.

The insulation resistance shall be measured between:

1. **EARTH TO PHASE**
2. **EARTH TO NEUTRAL**
3. **PHASE TO NEUTRAL**
4. **PHASE TO PHASE**

### 7.5.2 Earth Continuity path

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

### 7.5.3 Polarity of Single pole switches

A test shall be made to verify that every no-linked, single pole switch is connected to one of the phases of the supply system.

### 7.5.4 Completion Certificates

All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be retested. The completed test result from shall be submitted to the client for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

### 7.6 FIRE SURVIVAL CABLES

Conforming to Fire Resistance tests of BS 6387 Cat. C/W/Z | BS 7846-2009. These cables designed as per BS 7846: 2009 | EN50228-7 (Pairs & Triads), Thermosetting insulated, armoured, fire-resistant cables of rated voltage 600/1000 V | 500 V (Pairs and Triads) having low emission of smoke and corrosive gases when affected by fire.

#### 7.6.1 Construction & Technical Data:

<table>
<thead>
<tr>
<th>Type of Cable</th>
<th>LV Fire Survival Type Power / Control / Instrumentation Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Grade</strong></td>
<td>Power &amp; Control Cable: 600 / 1000 Volts</td>
</tr>
<tr>
<td></td>
<td>Instrumentation Cable: 500 Volts</td>
</tr>
<tr>
<td><strong>Reference Standard</strong></td>
<td>Power &amp; Control Cable: BS 7846</td>
</tr>
<tr>
<td></td>
<td>Instrumentation Cable: BS EN 50288-7 &amp; BS 6387 / BS 7846</td>
</tr>
<tr>
<td><strong>Conductor</strong></td>
<td>Annealed Bare Copper Conductor (IEC 60228 / IS 8130)</td>
</tr>
<tr>
<td>Specification</td>
<td>Details</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
</tr>
<tr>
<td>Copper Conductor ONLY, No Aluminium conductor is acceptable as per BS 7846</td>
<td></td>
</tr>
<tr>
<td>Conductor Flexibility</td>
<td>Stranded</td>
</tr>
<tr>
<td>Conductor Class &amp; Shape</td>
<td>Class 2 / Circular / Shaped</td>
</tr>
<tr>
<td>Flame Barrier Tape</td>
<td>2 Layers of MICA Tape of 100 Micron Thickness with 100% Coverage</td>
</tr>
<tr>
<td>Insulation</td>
<td>XLPE (IEC 60502-1 / IS 7098-1)</td>
</tr>
<tr>
<td>Inner Sheath</td>
<td>Extruded Flame Retardant Low Smoke Zero Halogen (ST8, IEC 60502-1)</td>
</tr>
<tr>
<td>Armour</td>
<td>Single Layer of GI Round Wire (IS 3975) with Approx. 90% Coverage</td>
</tr>
<tr>
<td>Outer Sheath</td>
<td>Extruded Flame Retardant Low Smoke Zero Halogen (ST8, IEC 60502-1)</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-50° C to + 90° C in Continuous Operation (Conductor Temperature)</td>
</tr>
<tr>
<td>Short Circuit temperature of Conductor for 1 Sec. @ 250° C</td>
<td></td>
</tr>
<tr>
<td>HV Test Voltage</td>
<td>3.5 KV AC for 5 Min for Power &amp; Control range of Cables</td>
</tr>
<tr>
<td>2 KV AC for 1 Min for Instrumentation of Cables</td>
<td></td>
</tr>
<tr>
<td>Fire Survival Properties</td>
<td>Resistance to Fire alone (Cat. C): 950° C for 3 Hrs.</td>
</tr>
<tr>
<td>Resistance to Fire &amp; Water (Cat. W): 650° C for 15 Min.</td>
<td></td>
</tr>
<tr>
<td>Resistance to Fire with Mechanical Shock (Cat.Z): 950° C for 15 Min</td>
<td></td>
</tr>
<tr>
<td>Flammability</td>
<td>IEC 60332-1 &amp; IEC 60332-3 (CAT C)</td>
</tr>
<tr>
<td>Min Oxygen Index (ASTM D 2863)</td>
<td>30%</td>
</tr>
<tr>
<td>Min Temperature Index (ASTM D 2863)</td>
<td>250° C</td>
</tr>
<tr>
<td>Max. HCLGasm Emission (IEC 60754-1)</td>
<td>0.5% by Weight</td>
</tr>
<tr>
<td>Smoke Density (ASTM D 2843)</td>
<td>Min 80% Visibility</td>
</tr>
</tbody>
</table>

### 7A.0 INSTALLATION OF INTERNAL WIRING:

#### 7A.1 Scope of Work

This section covers, definition of point wiring, system of wiring and installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc.

#### 7A.2 Codes & Standards

The following standards and rules shall be applicable:

- **IS : 732** Code of practice for electrical wiring installation (System voltage not exceeding 650 V)
- **IS : 1646** Code of practice for fire safety of buildings (General) Electrical installation.
- **IS : 9537 (Part - 2)** Rigid steel conduits for electrical wiring.
- **IS : 2667** Fittings for rigid steel conduits for electrical wiring.
- **IS : 3480** Flexible steel conduits for Electrical wiring.
- **IS : 3837** Accessories for rigid steel conduit for electrical wiring.
- **IS : 694** PVC insulated cables.
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

IS : 9537 (Part - 3) Rigid non-metallic conduits for electrical wiring.
IS : 6946 Flexible (Pliable) non-metallic conduits for electrical installation.
IS : 1293 3 pin plugs and sockets.
IS : 8130 Specifications of conduits for electrical installation.
IS : 3854 Switches for domestic purpose.
IS : 3419 Fittings for rigid non-metallic conduits.
IS : 4648 Guide for electrical layout in residential buildings Indian electricity act and rules

All standard and codes mean the latest.

7A.3 Installation of the system

7A.3.1 Concealed Installation with RIGID PVC Conduit

All the rigid PVC conduit used for concealed installation shall be as per IS: 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).

Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed

Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible

All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation

Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant

7A.3.2 Concealed Wiring system with RIGID PVC Conduit

The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc

FIXING OF CONDUIT

1. Conduits embedded in concrete shall be installed in the framework before pouring concrete. The conduits shall be installed above the bottom reinforcing bars and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or outlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase. The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.

2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement.

3. All conduits shall be installed so as to avoid steam and hot water pipes.

4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client.

5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building.
6. No run of conduit shall exceed ten metre, between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line.
7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50-degree cel. or above. Use of PVC conduits in places where ambient temperature is more than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made.
8. All jointing method shall be subject to the approval of the client.
9. Separate conduits shall be provided for the following system:
   - 15A power outlets.
   - 5A outlets and lighting system.
   - Low voltage system.
   - Telephone/intercom system.
   - C.C.T.V. system
   - Sound system
   - Computer data cabling system
   - Equipment wiring

7A.3.3 Conduit Joint
1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals, as approved by the client.
2. The conduits shall be thoroughly cleaned before making the joints.
3. In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in colour) or any material as recommended by the manufacturer shall be used.

7A.3.4 Bends in Conduit
Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit.
Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit.

OUTLETS
All the outlets for fittings, switches etc. shall be boxes of substantial construction.
To minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, etc.
Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.
Joints between conduit and any type of boxes shall be affected by means of conduit couplers into each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully watertight.

BUNCHING OF CABLES
Cables of AC supply of different phase shall be bunched in separate conduits.
The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.

**MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.**

<table>
<thead>
<tr>
<th>CABLE SIZE IN MM SQ.</th>
<th>SIZE OF CONDUITS (MM)</th>
<th>MAXIMUM NO. OF CABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>4.0</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

7A.3.5 Wiring with RIGID Steel Conduit

All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used

7A.3.6 Fixing of Conduit

Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an internal of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.

Draw boxes shall be located at convenient location for easy drawing of wires

Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit

The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter

Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct

The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board

If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed

Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained

7A.3.7 Conduit Joints
Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667. The threads shall be free from grease or oil.

In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes.

Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box.

Conduit shall be secured in each outlet box switch box, electrical panel or any other ox by means of one brass hexagonal lock nut and bush, outside and inside the box.

At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union.

Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment.

The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment.

7A.3.8 Bends in Conduit

All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted.

7A.3.9 Protection Against Dampness

To minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible.

7A.3.10 Protection of Conduit Against Rust

The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound.

7A.3.11 Bunching of Cables

Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.
Wires carrying current shall be so bunched in the conduit that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.

MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

<table>
<thead>
<tr>
<th>CABLE SIZE IN MM SQ.</th>
<th>MAXIMUM NO. OF CABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>1.5</td>
<td>10</td>
</tr>
<tr>
<td>2.5</td>
<td>8</td>
</tr>
<tr>
<td>4.0</td>
<td>6</td>
</tr>
</tbody>
</table>

7A.3.12 Bunching of Cables

Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.

The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators 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 side for accommodating wires.

The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws. Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets, and regulators.

The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit.

The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

7A.3.13 Drawing of Conductors

The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends.

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

FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals,
brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections.

Only certified wire men and cable jointers shall be employed to do joining work.

For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn into any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits.

7A.3.14 Joints

The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.

Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

LOAD BALANCING

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

8.0 SUPPLY OF EARTHING SYSTEM:

8.1 Scope of work

Design, assembling, testing, painting, supply, delivery at site with all related accessories as per the specifications as specified below. Compliance with the provisions of this specification shall not relieve the Bidder of the responsibility of furnishing apparatus and accessories of proper design, electrically and mechanically suited to meet the operating requirements under the specified service conditions and be suitable for the purpose of which they are intended.

8.2 Code & Standards

The design, material, assembling, inspection and testing shall comply with all currently applicable statutes, regulations and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable standards and codes of practice as mentioned below.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Item</th>
<th>Relevant IS / IEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Code of Practice for Earthing</td>
<td>IS 3043</td>
</tr>
<tr>
<td>2</td>
<td>Insulation Co-ordination Application Guide</td>
<td>IS 3716</td>
</tr>
<tr>
<td>3</td>
<td>Code of Practice for Protection of Buildings and Allied Structures against Lightning</td>
<td>IS 2309</td>
</tr>
<tr>
<td>4</td>
<td>Indian Electricity Rules, 1956</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Indian Electricity Act, 1910</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>National Electrical Code</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Low Voltage Electrical Installations-Part 5-54: Selection &amp; Erection of Electrical equipment- Earthing arrangement &amp; protective conductors.</td>
<td>IEC 60364</td>
</tr>
<tr>
<td>8</td>
<td>Protection Against Lightning –Part 3: Protection of structures &amp; life Hazards</td>
<td>IEC 62305</td>
</tr>
</tbody>
</table>
8.3 Design Basis & Site Conditions

All the equipment and components provided in the system and accessories shall be suitably designed for installation and satisfactory operation as per site condition. Maintenance free earthing system is proposed for the project.

8.4 Technical Requirements

8.4.1 The earth grid shall consist of main grounding grid conductors forming a closed ring network with required number of maintenance free earthing pits connected to it to provide a common earth for electrical equipment and metallic structures. Two distinct connections shall be made from each earthing station to the main grounding/earthing mat through GI/Cu. flat.

8.4.2 Earthing system should offer a resistance of as per NBC 2016 and IS 3043. Earthing loop resistance during fault condition shall be less than 1ohm throughout the year. In places where Soil resistivity is more, total length of the earthing rod has to be increased by adding 1m length rods (one over the other) to achieve low and stable resistance value. In that case, necessary excavation is part of tender work. In rocky places, multiple earth rods have to be installed and inter-connected to get the required value. Earth Enhancing compound need to be used for the vertical rods as well as horizontal conductors, wherever specified.

8.4.3 Earthing shall be of TNS / TT category with separate neutral & safety conductors laid throughout the installation. A combination of earth conductors and earth electrodes / earth mats shall be laid out for efficient earthing. The same shall be interconnected to the main earth grid of the base building as well as to the steel reinforcement of the building if special provisions are provided. Equipotential earth grid to be maintained such that during the event of fault, no voltage difference or potential gradient shall exist. Step and touch voltage to be mitigated by proper placing of ground conductors or by providing low resistance path to ground.

8.4.4 The earth conductors shall be laid at a depth of not less than 600mm from finished ground level. The entire earthing shall be interconnected to the base building earth grid.

8.4.5 Due to high safety and reliability, earthing shall be carried out using copper strips unless otherwise specified. Size of the earth strip shall be indicated in the drawing. All joints should be made of exothermic welding. Neutral earthing shall be carried out using copper earth electrodes and copper earth mats. All joints in the run of the copper earth conductor shall be exothermically welded. Earth conductors of the power and lightning protection systems shall be interconnected in ground to equalize the potential as well as bonded to a common equipotential bonding bar. The minimum cross-sectional area of the earth strips shall be 75 Sq.mm. (Eg 25*3 strip)

8.4.6 All riveted joints / joints with bolt and nut as well as spot welded areas should be protected against corrosion with black bituminous paint and corrosion protection tape. Corrosion protection is not necessary for exothermically welded joints

8.4.7 Earth electrode and installation: High-grade solid steel rods molecularly bonded with 99.9% pure electrolytic copper with minimum coating thickness of 250 microns should be used as earth electrode. The rods must be UL listed as well as tested according to IEC62561-2 and comply to the requirements of IEC 60364-5-54. The rods also should withstand short circuit currents as per the chart above. All fasteners used should confirm to the requirements of the above standards. Earth enhancing compound (Soil conductivity improver) used should be tested according to IEC62561 – 7 from an NABL accredited laboratory. Exothermic welding material used shall be tested as per IEEE 837

8.4.8 The earth bus in required numbers shall be installed in various plant open areas and rooms. Each earth bus shall be provided two distinct connections by GI/Cu flats / Cu. Flexible cable from the main grounding grid conductors available nearby. The plant/building equipment,
metallic structures, tanks, etc. shall be brought to earth by providing two distinct connections between earth bus installed nearby and that equipment, tank, apparatus, etc.

8.4.9 General Construction Details

Construction of Earth Pit

1. A hole of 100 to 125 mm dia. (or as specified) shall be augured / dug to a depth of about 2.8 meters.
2. Earth electrode of minimum 3 meters length shall be placed into this hole.
3. It will be penetrated into the soil by gently driving on the top of the rod. Here natural soil is assumed to be available at the bottom of the electrode so that min 150 mm of the electrode shall be inserted in the natural soil.
4. Earth Enhancing material (min 24 KG) shall be filled in to the augured /dug hole in slurry form and allowed to set. After the material gets set, the diameter of the composite structure (earth electrode + Earth Enhancing material) shall be of minimum 100 mm dia. covering entire length of the hole.
5. Remaining portion of the hole is filled with backfill soil which is taken out during auguring / digging
6. Connectors in the earth chamber made of Aluminum Bronze / Silicon Bronze material need to be used to connect this rod with the round / flat conductors from outside
7. In places where short-circuit level is more than 15 KA, (eg all panel boards, body) a copper strip of 25 mm * 6 mm with a minimum length of 150 mm exothermically welded to the solid rod ne dot be used for bonding earth electrode with the round / flat conductors from outside. All further connections need to be done to this copper flat.

Inspection Chamber:

8. Should have an inner dimension of 250 mmX 250 mm X 250 mm made of FRP material.
9. Normal soil in Marsh land: Electrodes can be hand driven or hammered into earth for the required length.
10. For interconnection of earth pits, SOLID copper conductors with a size of 30* 3 mm flat to be used for Lightning Protection/ General purpose. In places where high short circuit currents of more than 10 KA are expected, copper flats of 25 *6mm or 50 * 6 mm need to be used depending upon the expected short circuit level. In places where short circuit current requirements are more than 10 KA, Exothermic / Aluminothermic welding are only allowed for jointing earth electrode with round / Flat conductor. Connections with nut and bolt need to be completely avoided in applications under ground level, instead exothermic / aluminothermic welding need to be performed.
11. Vendor should submit test certificates of components for approval before execution of the job. Vendor should offer a guarantee of 1 year.
12. Earth Enhancement material:

This is a conductive mineral compound to provide low resistance to the earth termination system. Earth enhancing compound should contain minerals which in normal use is reliable and without creating any hazards to persons and the surroundings.

The material shall be chemically inert to sub soil and shall not pollute the environment. It shall provide a stable environment in terms of physical and chemical properties and exhibit low resistivity. It shall not be corrosive to the earth electrode itself. The material should have low resistivity less than 50 Ohm meter.

8.4.10 Earthing Conductors

All earthing conductors of Transformers / DG neutral shall be of high conductivity copper and shall be protected against mechanical damage and corrosion. The connection of earth electrodes shall be strong secure and sound and shall be easily accessible. The earth
conductors shall be rigidly fixed to the walls, cable trenches, cable tunnel, conduits and cables by using suitable clamps.

Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage network.

Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub main or main earthing bus. All switch boards, distribution boards and isolators disconnect switches shall be connected to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits cable armouring etc. shall be connected to the earth all along their run by earthing conductors of suitable cross-sectional area. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse/protective device or a circuit breaker and shall not exceed 1Ω.

8.4.11 Location of Earth Electrode

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

- An earth electrode shall not be situated less than 3 meters from any building. The excavations for electrode shall not affect the column footings or foundations of the buildings. Entrances, pavements and roadways shall not be used for locating the earth electrode. In such cases electrode may be further away from the building.

- Earth mat locations – Earth mats shall be constructed at a suitable place in the station area as near to substation as possible.

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

8.4.12 Equipment Earthing

All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper/G.I. Earth strips/wires shall be used unless otherwise indicated.

8.4.13 Electrical and Performance Requirements

A. Power Transmission Apparatus

1. Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated continuity conductor of size 100% of the phase conductor subject to the minimum shall be provided.

2. Nonmetallic conduit shall have an insulated earth continuity conductor of the same size for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conductor shall be distinctly coloured (Green or Green / Yellow) for easy identification

3. Armoured cable shall be earthed by two distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.

4. In the case of unarmoured cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable.

5. Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB’s a single earth connection is adequate.
8.5 Drawings & Information

As per tender drawing

8.6 Inspection and Testing

The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3043

The following earth resistance values shall be measured with an approved earth megger and recorded.

1. Each earthing station
2. Earthing system as a whole
3. Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the consultant / client.

8.7 Method of Measurement

Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, chamber with cover etc. shall be treated as one unit of measurement.

The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labour etc.

1. Main equipment earthing grid and connection to the earthing station.
2. Connection to the switch board, power panels, DB etc.

The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

1. Motors - earthing forming part of the cabling / wiring for the motors.
2. Isolating switches and starters should form part of mounting frame, switch starter etc.
3. Light fittings - form part of installation of the light fittings.
4. Conduit wiring, cabling - should form part of the wiring or cabling.
5. Street lighting - should form part of the street light poles

8.8 Transport, Delivery and storage

The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of earthing system or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipment's at site should form part of offer.

8.9 Materials Required

All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated /cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.

All other items required for installation shall be as approved by site in-charge.
8.10 Installation of System

The maintenance free electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.

Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.

The earth conductors (Strips / Wires, Hot dip G.I. / copper) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long and bitumen coated.

The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

Minimum distance of 2 mtr. shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system. Earthing and lightning protection system conductors shall be bonded to each other to prevent side flashover in case of non-availability of adequate clearance.

The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall. Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

8.11 Inspection and Testing

The following earth resistance values shall be measured with an approved earth megger and recorded.

Each earthing station
Earthing system as a whole
Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case. In case of more earth resistance, the Contractor shall have to carry out necessary modification in the system without any cost implication to the Client.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the consultant / client and report should be submitted in two sets.

8A.0 INSTALLATION OF EARTHING SYSTEM:

8A.1 Scope of Work

This specification intended to cover assembly, installation and testing of earthing system complete in all respect with all equipment’s, fittings and accessories for efficient and trouble-
free operation. The material to be supplied by the Contractor and work to be carried out by the Contractor shall be in general, but not limited to, conforming to the specification laid down for each item.

8A.2 Codes & Standards

The design, material, assembling, inspection and testing shall comply with all currently applicable statutes, regulations and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable standards and codes of practice as mentioned below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Item</th>
<th>Relevant IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Code of Practice for Earthing</td>
<td>IS 3043</td>
</tr>
<tr>
<td>2</td>
<td>Insulation Co-ordination Application Guide</td>
<td>IS 3716</td>
</tr>
<tr>
<td>3</td>
<td>Code of Practice for Protection of Buildings and Allied Structures against Lightning</td>
<td>IS 2309</td>
</tr>
<tr>
<td>4</td>
<td>Indian Electricity Rules, 1956</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Indian Electricity Act, 1910</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>National Electrical Code</td>
<td></td>
</tr>
</tbody>
</table>

8A.3 Materials Required

All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated /cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.

All other items required for installation shall be as approved by site in-charge.

8A.4 Installation of System

The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level.

The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.

The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.

20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber.

Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.

The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.

The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.
The earth conductors (Strips / Wires, Hot dip G.I. / copper) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long and bitumen coated.

The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

Minimum distance of 2 mtr shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system. Earthing and lightning protection system conductors shall be bonded to each other to prevent side flashover in case of non-availability of adequate clearance.

The earthing met conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall. Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

8A.5 Inspecti on and Testing

The following earth resistance values shall be measured with an approved earth megger and recorded.

- Each earthing station
- Earthing system as a whole
- Earth continuity conductors

Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case. In case of more earth resistance, the Contractor shall have to carry out necessary modification in the system without any cost implication to the Client.

Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

All tests shall be carried out in presence of the consultant / client and report should be submitted in two sets.

9.0 LIGHTNING PROTECTION SYSTEM:

PART - 1 GENERAL

Installation of System

Lightning Protection System shall be in accordance with IEC 62305-3, NBC-2016

The lightning protection installation shall consist of air termination network, down conductors, earthing and bonding to prevent side flashing.

Definitions

LPI: Lightning Protection Institute.
NRTL: National recognized testing laboratory.
Submittals

Product Data: For air terminals and mounting accessories.

Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required for bonding of grounded and isolated metal bodies.

Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience.

Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.

Field inspection reports indicating compliance with specified requirements.

Quality Assurance

Installer Qualifications: Engage an experienced installer who is certified by.

- Listing and Labeling: NBC 2016, IEC 62035

All installation details shall be agreed with the Consultant/Owner/Architect prior to commencement of work. The Specialist Lightning Protection Installer shall obtain an inspection certificate from the manufacturer or its authorized representative towards the satisfactory installation of the system and that proper material in accordance to the above standard has been used.

The Lightning Protection Contractor shall submit the Risk Evaluation and the achieved Lightning Protection Level (LPL) calculation based on IS/IEC 62305 – Part 2and 3. In the absence of such an evaluation employment of LPL - I will be deemed mandatory. The Lightning Protection Contractor shall then submit the shop drawings based on the achieved LPL and shall employ the air termination then submit the shop drawings based on the achieved LPL and shall employ the air termination network consisting of mesh of either 5m x 5m or less, in co-ordination with rolling sphere (size as per the protection level). All the service entries to the structure i.e. power line, telecom line, gas line, water line etc. shall be protected by installing current surge protectors depending on the Lightning Protection Level (LPL) to be used to bring down the risk (R) below the tolerable risk level (RT).

Coordination

Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

Lightning Protection Installer shall ensure proper co-ordination between the Structural, Civil, Electrical and the Cladding Specialist.

Zone of Protection

The zone of protection of a lightning conductor defines the space within which Air Terminal provides protection against a direct lightning strike with probability of protection as per LPL.

LPL (Lightning Protection Level)
LPL is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum & maximum values do not exceed the normally occurring lightning. LPL can be determined by Risk analysis as explained in IEC 62305-2.

LPL levels and probability of protection:

<table>
<thead>
<tr>
<th>Class</th>
<th>Lightning current peak value MINIMUM</th>
<th>Lightning current peak value MAXIMUM</th>
<th>Interception probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPL 1</td>
<td>3 kA</td>
<td>200 kA</td>
<td>98%</td>
</tr>
<tr>
<td>LPL 2</td>
<td>5 kA</td>
<td>150 kA</td>
<td>95%</td>
</tr>
<tr>
<td>LPL 3</td>
<td>10 kA</td>
<td>100 kA</td>
<td>88%</td>
</tr>
<tr>
<td>LPL 4</td>
<td>16 kA</td>
<td>100 kA</td>
<td>78%</td>
</tr>
</tbody>
</table>

Manufacturers

Available Manufacturers: Subject to compliance with requirements as per list of approved manufacturers.

The advanced lightning protection system shall include components as follows:

Air terminal (as per rolling sphere or mesh or protective angle method or any combination thereof.)

Mechanical supports
Down-conductors
A low impedance Grounding system
Lightning Protection System Components

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.

No drilling or welding is allowed in the terrace for fixing the air terminal.

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

Values of Rolling sphere radius, Mesh size and protection angle as per Class of LPL/LPS.

<table>
<thead>
<tr>
<th>Class of LPL/LPS</th>
<th>Rolling sphere radius(m)</th>
<th>Mesh size (m)</th>
<th>Protection angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>5*5</td>
<td>Refer figure 1</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>10*10</td>
<td>Refer figure 1</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>15*15</td>
<td>Refer figure 1</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>20*20</td>
<td>Refer figure 1</td>
</tr>
</tbody>
</table>
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.

Material and Dimensions

<table>
<thead>
<tr>
<th>Material</th>
<th>May be destroyed by galvanic coupling with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper (Solid)</td>
<td>GI and Aluminum</td>
</tr>
<tr>
<td>Hot galvanized steel (Solid)</td>
<td>Copper</td>
</tr>
<tr>
<td>Stainless steel (Solid)</td>
<td>........</td>
</tr>
<tr>
<td>Aluminum (Solid)</td>
<td>Copper</td>
</tr>
</tbody>
</table>

Dissimilar metals (For eg. copper with Aluminum) must be connected only by using bimetal connectors.

Min Thickness of metal in air termination system for LPL / LPS -3

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (a) in mm</th>
<th>Thickness (b) in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvanized steel</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Copper</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Aluminum</td>
<td>7</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Prevents puncture, hot spot or ignition
Allowed only if it is not important to prevent puncture, hotspot or ignition
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

Material configuration and Min cross sectional area of air terminal and down conductors

<table>
<thead>
<tr>
<th>Material</th>
<th>Type</th>
<th>Min cross section area</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Solid tape</td>
<td>50 sq. mm</td>
<td>2mm min thickness</td>
</tr>
<tr>
<td>Copper</td>
<td>Solid round</td>
<td>50 sq. mm</td>
<td>8mm dia</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Solid tape</td>
<td>70 sq. mm</td>
<td>3mm min thickness</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Solid round</td>
<td>50 sq. mm</td>
<td>8mm dia</td>
</tr>
<tr>
<td>GI</td>
<td>Solid tape</td>
<td>50 sq. mm</td>
<td>2.5mm min thickness</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Solid tape</td>
<td>50 sq. mm</td>
<td>2mm min thickness</td>
</tr>
</tbody>
</table>

Down Conductor

In order to reduce the probability of damage to electronic/electrical equipment, the down conductors shall be arranged in such a way that from the point of strike to earth, several parallel current paths should exist & length of the current path should be minimum . Down conductors can be installed separately or more wisely it can be part of natural components of the building. Examples are steel reinforcement in RCC columns, metal facades, profile rails, metal doors & windows. Down conductors should be installed at each exposed corner of the structure.

Test joints:

At the connection of the earth terminal, a test joint should be fitted on each down conductor, except in the case of natural down conductors combined with foundation earth electrode. The purpose of test joint is to measure the earth resistance value.

Earth Terminations

Earth mat is most preferable. Where earth mat is not possible, ring earthing is the next best method. Ring earthing must be 1 meter away from the building and 0.5m below the ground level. The resistance of earthing system shall not exceed 10 ohm as per IEC 62305. Lower earth resistance is still better.

For earth termination system, 2 basic types of earth electrode arrangements are applicable. Type A & Type B arrangement.

Type A arrangement: comprises of horizontal or vertical earth electrode installed outside the structure to be protected connected to each down conductor. In type A arrangement, the total number of earth electrodes shall not be less than two.

Type B arrangement: This type of arrangement comprises either a ring conductor external to the structure to be protected, in contact with the soil for atleast 80% of its total length or a foundation earth electrode. Such earth electrodes can also be meshed. For structures with extensive electronic systems or with high risk of fire, type B earthing is most preferable method. Corrosion proofing band has to be used wherever down conductor is connected to earth termination system. Bitumen has to be applied at the point of inter-connection.

In potentially corrosive areas, Stainless steel must always be used.

Air terminal holder

Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by adhesive of good quality taking care of varying weather conditions. Air conductor holder is an insulator & should be of minimum 50 mm height so that even small amount of water logging on terrace is below the level of conductor holder. Air terminal holder shall not be more than 0.5 m apart for a flat conductor & 1m for round conductor of atleast 8mm diameter & 1.0 meter apart for vertical run.
Recommended distance between air terminal holders.

<table>
<thead>
<tr>
<th>Arrangement</th>
<th>Recommended distance for SOLID TAPE</th>
<th>Recommended distance for ROUND conductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal conductor on horizontal surface.</td>
<td>500 mm</td>
<td>1000 mm</td>
</tr>
<tr>
<td>Horizontal conductor on vertical surface</td>
<td>500 mm</td>
<td>1000 mm</td>
</tr>
<tr>
<td>Vertical conductor from Ground to 20m height</td>
<td>1000 mm</td>
<td>1000 mm</td>
</tr>
<tr>
<td>Vertical conductor above 20m height</td>
<td>500 mm</td>
<td>1000 mm</td>
</tr>
</tbody>
</table>

If antenna, air cooler or any other electrical equipment is present above terrace level, the same have to be protected by using vertical air terminal after calculating the safety or separation distance. The vertical air terminal has to have suitable supports to hold it. Vertical air terminal must be connected to horizontal air terminal by using suitable connectors.

At the crossings of the horizontal air terminals, suitable T or Cross connector has to be used for secure connection.

Safety or Separation distance.

It is must to calculate safety or separation distance in order to avoid flash over to the electrical equipment when the lightning current is passing through the vertical air terminal.

Safety/Separation distance \( (S) \) in m = \( (ki \times kc \times L) / km \)

Coefficient \( ki \) depends on class of LPL/LPS.
\( ki = 0.08 \) for LPL1,
\( ki = 0.06 \) for LPL 2,
\( ki = 0.04 \) for LPL3 and 4.

Coefficient \( kc \) depends on no of down conductors:
\( kc = 0.66 \) for 2 down conductors
\( kc = 0.44 \) for 3 or more down conductors
Value of coefficient \( km = 1 \)

Value of \( L \) is the total distance between the equipment to be protected (for e.g. Antenna) to the equi-potential bonding bar situated just above the ground.

Need for Expansion piece

In order to take care the expansion of the metal in summer and contraction of the metal in winter, expansion piece with suitable connectors have to be used at every 20m distance of horizontal air terminal.

**Joints and Bonds**

The lightning protective system shall have as few joints. As far as possible, air terminal & down conductor have to be straight. Where it is not possible, it should NOT be bent at 90 degree (right angles) & should have a curved path of 45 degree.

**Isolating spark Gap (ISC)**

ISC should be utilized to prevent unsafe potential gradients from establishing between adjacent structures or surface during lightning discharges.

ISC operates by an internal switching component which operates to establish equi-potential equalization when its predetermined spark-over voltage is reached.
PART - 2 EXECUTION

Installation

Install lightning protection components and systems according to IS/IEC 62035

Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.

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

Alternatively, steel reinforcement can be used as down conductor in line with IEC IS62305, NBC 2016

Steelwork within reinforced concrete structures is considered to be electrically continuous, provided that major part of interconnections of vertical & horizontal bars are welded, clamped or overlapped a minimum of 20 times their diameter and bound or otherwise securely connected.

While using structural reinforcement as down conductor,

Preferably outer columns which are straight from terrace up to the ground floor shall be used as down conductor. Steel bars in this column shall be welded \ bolted with proper overlapping at every floor to ensure, proper continuity throughout.

At ground level steel bars shall be taken out & welded \ bolted to the GI tape, and the tape will be carried out till the earthing pit at ground. Also at terrace level steel bars will be taken out & to the connected to the Air terminal

This method is allowed by IS \ IEC , however requires close coordination with structural agency & monitoring during construction work to ensure proper bonding of steel bars at every level.

In this case responsibility matrix, may be worked out as under –

<table>
<thead>
<tr>
<th>Sr</th>
<th>Description</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System proposal with details like, identification of column, recommended overlapping to ensure continuity, typical details for taking out reinforcement at various levels, bonding details etc,</td>
<td>MEP consultant</td>
</tr>
<tr>
<td>2</td>
<td>Integration of all above details in the arch &amp; GFC structural design to be followed for construction.</td>
<td>Arch &amp; structural consultant</td>
</tr>
<tr>
<td>3</td>
<td>Direct Supervision on site to ensure proper overlapping, workman ship to ensure continuity. Proper log of continuity at every floor level before &amp; after pouring of concrete</td>
<td>Project manager / Electrical Contractor</td>
</tr>
<tr>
<td>4</td>
<td>Ensure proper method to take out reinforcement at various levels for connection with AT &amp; EP network &amp; bonding with structure of curtain wall.</td>
<td>Project manager / Electrical Contractor</td>
</tr>
</tbody>
</table>
For buildings utilizing steel reinforcement as down conductor, the electrical continuity if reinforcing bars shall be determined by electrical testing between uppermost part & ground level. The overall electrical resistance shall not be greater than 0.2 ohms measured using test equipment suitable for this purpose.

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.

Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

Bond extremities of vertical metal bodies exceeding 18 m in length to lightning protection components.

A counterpoise installation based on requirements in Section 26 0526 Grounding and Bonding for Electrical Systems may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.

Bond ground terminals to counterpoise conductor.

Bond grounded metal bodies on building within 12 feet (3.6 m) of ground to counterpoise conductor.

Bond grounded metal bodies on building within 12 feet (3.6 m) of roof to counterpoise conductor.

Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 18-m intervals.

**GROUNDING SYSTEM**

The Lightning arrester grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning pro.

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.

All the bonding bars at different levels shall be connected to each other, which in-turn is earthed at 1 ohm.

**Corrosion Protection**

Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

**Testing**
The most critical long-term effect on the structure can be due to improper installation and testing of the LPS. Therefore special care is advised to strictly adhere to the section of testing to ensure trouble free functioning of the system in years to come.

On completion of the installation or of any modification to it, the following isolated and combined measurement and/or checks has to be made and the results recorded in a lightning protection system logbook.

The resistance to earth of each local earth electrode and in addition the resistance to earth of the complete earth termination system.

Each local earth electrode has been measured in isolation and the test point between the down conductor and the earth electrode in the disconnected position (isolated measurement)

A further measurement has to be taken with the test point in the connected position (combined measurement)

The results of visual check of all conductors, bonds and joints and their measured electrical continuity.

If the resistance to earth of a lightning protection system exceeds 10 ohms, the value must be reduced. Necessary remedial action needs to be taken to reduce the value below or equal to 10 ohms.

The shop drawings must be approved by the manufacturer or the manufacturer's authorized representative, which has to be used for installation afterwards to ensure total adherence to the standards and requirements. Also, the manufacturer or the manufacturer-authorized representative will have to survey and certify the installation to ensure the standards.

The manufacturer or the manufacturer's authorized representative will certify the bill of materials, provided by the Lightning Protection Contractor for the project.

The Lightning Protection Contractor must submit the Test Certificates of the materials used as per IS/IEC, which shall be attested in original by the manufacturer or the manufacturer's authorized representative.

References:
IS/IEC62305 – PROTECTION AGAINST LIGHTNING:
Part 1: General Principles
Part 2: Risk Management
Part 3: Protection of structures
Part 4: Protection of Electrical & Electronic equipment’s within structure

10.0 UNINTERRUPTED POWER SUPPLY:

PART 1 - GENERAL

10.1 SUMMARY

This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, battery cabinet(s), and accessories as described in this specification.

10.2 UPS DESCRIPTION

A. UPS Components: The UPS shall consist of the following main components:
1. UPS module containing Rectifier(s), Inverter(s), Battery Charger(s), Static Bypass, and associated Control and Monitor Panel.
2. Battery string(s), either internal or in external cabinets.
3. Non-matching wall mounted or floor standing maintenance bypass cabinets or multi-module parallel tie cabinets.

B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:

1. Normal: Utilising commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.
5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the UPS will utilise a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of 99% or greater, over the range of 60% to 100% load. The Energy Saver System shall be enabled by the user, and shall be adjustable. It shall incorporate a “High Alert Mode” to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed pre-set, adjustable limits. When Energy Saver System is utilised, the UPS must attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption.
6. Manual Bypass: The UPS shall include an internal manual maintenance bypass switch that shall enable safe access to internal major assemblies whilst the load is supplied by mains power.

10.3 REFERENCES

A. IEC 62040-2 C3
B. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
C. IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
D. CISPR 22 and 24
E. MIL-HDBK-217E (Military Handbook) – Reliability prediction of electronics equipment

10.4 SUBMITTALS

A. The UPS shall be supplied with sufficient documentation, including the following manuals:
1. Installation and Operation Manual: Three copies of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:

   a) UPS description
   b) UPS site planning and unpacking
   c) UPS installation
   d) Optional accessory installation
   e) UPS theory of operation
   f) Operating procedures
   g) System events
   h) UPS maintenance
   i) Performance and technical specifications
   j) Wiring requirements and recommendations
   k) Physical features and requirements
   l) Cabinet dimensions

10.5 QUALIFICATIONS

A. The UPS manufacturer shall have a minimum of twenty years' experience in the design, manufacture and testing of solid-state UPS systems. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for this application shall be supplied upon request.

B. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and service organization.

C. The UPS manufacturer shall maintain a staffed 7x24x365 call center for technical and emergency support.

D. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to start-up, maintenance, and repair of UPS equipment. The organisation shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.

E. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.

F. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.

10.6 ENVIRONMENTAL REQUIREMENTS

A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

1. Operating Temperature: 5 degrees C to +40 degrees C continuous without de-rating (excluding batteries).

2. Storage Temperature: -25 degrees C to +55 degrees C. Prolonged storage above +40 degrees C will cause rapid battery self-discharge.

3. Relative Humidity (operating and storage): 5-95% non-condensing.
4. Elevation:
   a. Operational: 1000m maximum without de-rating. De-rate by 1% for every 100m above 1000m, to a maximum of 2000m.
   b. Transportation: Capable of air transport, up to 15,000m.

**PART 2 - PRODUCTS**

10.7 **MANUFACTURERS**

A. Approved Manufacturers: As per Make list

10.8 **UPS MODULE STANDARD FEATURES**

The UPS module shall consist of the following standard components

A. Uninterruptible Power Module (UPM), which includes:

   a. Rectifier/Charger: The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bipolar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:

   1. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
   2. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

   b. Inverter: The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high-speed switching. The inverter shall also have the following features:

   1. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
   2. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

The modular design of the UPS shall permit safe and fast removal and replacement of the UPM, while in bypass. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.

B. Static Bypass: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. An integrated bypass back-feed protection contactor, in series with the static switch, shall prevent system voltages from bleeding backwards through the static switch and rectifier snubber components to the utility source in the event of a utility failure and shall also open upon detection of a short circuit static bypass SCR. The bypass shall feature the following transfer and operational characteristics:

   a. Transfers to bypass shall be automatically initiated for the following conditions:

   1. Output overload period expired.
   2. Critical bus voltage out of limits.
   3. Internal over temperature period expired.
   4. Total battery discharge.
   5. UPS failure.
b. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load.

c. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
   1. When transfer to bypass is activated manually or remotely.
   2. In the event of multiple transfers/re-transfer operations the control circuitry shall limit “cycling” to three (3) operations in any ten-minute period. The third transfer shall lock the critical load on the bypass source, for 60 minutes.
   3. UPS failure.

d. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.

e. All transfers to bypass shall be inhibited for the following conditions:
   1. Bypass voltage out of limits (+10%, to -15% of nominal)
   2. Bypass frequency out of limits (+/- 4 Hz, adjustable, factory set)
   3. Bypass out of synchronisation
   4. Bypass phase rotation / installation error

f. Static transfer time: No break, complete in less than 4ms.

g. The bypass shall be manually energised using the control panel or remotely through a building alarm input.

C. Monitoring and control components: The following components shall provide monitor and control capability:
   1. Control panel: colour LCD, touch sensitive, with LED status indicators.
   2. Alarm and metering display.
   4. Communication ports: RS-232 and USB.

D. Battery management system: The UPS shall contain a battery management system which has the following features:
   1. The battery management system shall charge the batteries using an intermittent charging cycle. The active battery charger states are constant-current (charge mode), constant-voltage (float mode) and no-charge (rest mode). The charge mode shall equalise and charge the batteries to near full capacity before entering into float mode. In float mode a constant voltage float charge shall charge the batteries for a minimum of 48 hours or until the batteries are fully charged. The batteries are then put into rest mode. The battery shall be monitored whilst in rest mode and the charge cycle shall automatically re-start should the battery voltage drop below pre-determined levels. The charging control system shall activate an alarm should the battery capacity drop below the pre-determined levels. The charge cycle will automatically restart after a utility disturbance. The batteries shall not be physically disconnected from the UPS DC bus during the charge cycle and shall be available at all times to supply the inverter.

   2. The battery management system shall automatically test the battery string(s) to ensure that the battery is capable of providing greater than 80% of its rated capacity. Testing the batteries shall not jeopardise the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:
      a) Open battery string
      b) Shorted battery string
      c) Battery capacity (runtime) less than 80% of “new” battery capacity

E. Wiring Terminals: The UPS module shall contain terminals (adequately sized to accommodate 90°C wiring) for securing user wiring to the following locations:
   1. Rectifier/charger input connections (4-wire plus ground)
   2. Bypass input connections (4-wire plus ground, 400Vac)
   3. DC link connections for battery cabinets (positive and negative plus ground).
4. AC output connections (4 wire plus ground)

10.9 PARALLEL UPS SYSTEMS

It shall be possible to parallel up to eight (8) UPS modules in a distributed parallel arrangement to increase capacity and/or add redundancy. Paralleling of UPS systems of unlike rating shall be possible, provided that each UPS cabinet is configured with a similar static bypass rating. Single UPS modules shall be capable of parallel operation and shall not require any hardware modifications in order to be paralleled with other modules in future.

10.10 UPS MODULE OPTIONS AND ACCESSORIES

The UPS system shall consist of the following options and accessories as required:

A. Network Adapter and UPS Power Monitoring Software: Optional PX Gateway card adapter shall provide a communications interface between the UPS module and the following network management systems:

1. SNMP v.1, v.3
2. Modbus TCP
3. BACnet/WS or /IP
4. IPv6

This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.

UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.

B. Relay Card: Serial dry contact card providing 4 isolated dry output contacts, 1 isolated input.

C. Battery Cabinet: The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:

1. The battery cabinet shall be the same depth and height as the UPS module.
2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature wheels. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinet shall provide bottom or side cable entry.
3. Power wiring internal to each battery cabinet shall be factory provided. Each battery cabinet shall feature up to 6 battery trays. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
4. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string within that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.
5. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
6. The circuit breaker in each battery cabinet shall feature a 24VDC or 48VDC shunt trip device. The shunt trip shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
7. Power and Control wiring between the co-located battery cabinet and the UPS shall be factory provided with compression type connectors between cabinets.

8. Expected battery life: 10-year standby design life at 25oC or 200 complete full load discharge cycles, whichever occurs first, when operated and maintained within specifications.

10.11 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A. UPS Continuous Ratings.
1. The UPS shall be rated full capacity (As per BOQ) with additional Power Module of minimum rating of an independent Power Module provided extra, for N+1 redundancy.

2. UPS Rating (max) is the maximum output possible from the UPS (for a load power factor range of 0.8 lagging to 0.8 leading). The UPS shall not require de-rating when supporting a leading power factor load of 0.8 or greater.

B. Rectifier/charger input:
1. Nominal three phase input voltage: 400 Vac:
2. 4-wire plus ground
3. Operating input voltage range: +20%, -15% of average nominal input voltage at full load and +20%, -40% of average nominal input voltage at half load without battery discharge.
4. For 50Hz systems, operating input frequency range shall be 45 to 65Hz.
5. Input power factor 0.99 lagging.
6. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:
   a. Rectifier/charger input current limit shall be adjustable from 100 to 115% of full-load input current.
   b. Battery input current limit shall be adjustable from 5% to 7% of the UPS full load input current regardless of the actual load on the UPS.
7. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:
   a. Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.
   b. Battery recharge input current limit shall be adjustable from 5% to 7% of the UPS full load input current regardless of the actual load on the UPS.

8. Input current total harmonic distortion (THD) shall be less than 3% at nominal line voltage and 5% nominal source impedance.

9. Power walk-in: Ramp-up to full utility load adjustable from 10 amps per second to 1 amp per second.

C. Bypass input:
1. Synchronising bypass voltage range shall be +10, -15% of average nominal input voltage.
2. Synchronising bypass frequency range is +/- 0.5hz to +/-4hz, user adjustable, and is centred on the nominal frequency. Default setting is +/- 4hz.
4. Bypass and rectifier inputs can be supplied from out of phase sources if required.

D. Rectifier/charger output:
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

1. Nominal DC voltage shall be either 486VDC (432 VDC open circuit battery voltage) or 540VDC (480 VDC open circuit battery voltage).
2. Steady state voltage regulation shall be +/- 0.5%.
3. Voltage ripple shall be less that 0.5% (peak-to-peak).
4. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
5. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the On Battery indicator shall enunciate operation in this mode.
6. DC sensing: Redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.
7. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:
   a. The charger shall be capable of being configured for several charge modes including:
      I. A charging mode that increases battery life by allowing the battery to rest, reducing positive plate corrosion
      II. A charging mode floating the battery at a set level, which can be adjusted via software, used for flooded cell applications
         - Nominal Float Voltage: 2.25 V per cell.
         - Equalising Voltage: 2.38 V maximum per cell (adjustable).
   b. UPS module will automatically adjust battery shutdown based upon loading and battery capacity.
      I. The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.
      II. The absolute minimum operational voltage is 1.67 V per cell (adjustable).
E. UPS output in normal mode
1. Nominal output voltage 400V, 3-phase, 4-wire plus ground at the UPS output terminals.
2. Steady-state voltage regulation (in inverter) shall be within +/- <1% average from nominal output voltage.
3. Transient voltage response shall be per EN62040-3, Class 1, ( < +/- 5% from nominal voltage for 100% load step, full load re-transfers and full load drop on battery).
4. Transient voltage recovery shall be compliant to CBEMA/ITIC Class 1.
5. Linear load harmonic distortion capability: Output voltage THD of less than 1% for 100% linear load.
6. Non-linear load harmonic distortion capability: Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
7. Line synchronization range shall be +/- 4Hz, adjustable to +/- 0.5 Hz.
8. Frequency regulation shall be +/- 0.1Hz free running.
9. Frequency slew rate shall be 1 Hz/second maximum (adjustable).
10. Phase angle control:
    I. Balanced linear load shall be <1 degree from nominal 120 degrees
11. Phase voltage control:
    II. Balanced linear loads shall be +/- 1% from average phase voltage
    III. Unbalanced linear loads shall be less than <2% from average phase voltage for 100% load unbalanced
12. Overload current capability (with nominal line and fully charged battery):
I. Double Conversion mode: The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and 126% to 150% for 10 seconds, >151% for 300ms.

II. Stored energy mode (typically on battery): The unit shall maintain voltage regulation for 102% to <110% of resistive/inductive load for 10 minutes, 111% to <125% for 60 seconds, and >126% for 300ms.

III. Energy Saver System operation: Continuous = 110%. Transient = 1000% peak current for 10ms.

IV. On bypass: Continuous = 125%. Transient = 1000% peak current for 10ms.

14. Static transfer time, inverter to bypass: No break, completed in less than 4ms.
15. Static transfer time, Energy Saver to inverter: No break, completed in less than 4ms maximum, typically <2ms.
16. Common mode noise attenuation:
   I. -65dB up to 20kHz, -40db up to 100kHz
17. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dBA at one metre from any operator surface, measured at 25 degrees C and full load, per ISO 7779 standard.
19. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
20. Efficiency: The UPS incorporates 3-level power converter design for highest possible efficiency. Efficiency shall be >96% at full load, ≥96.6% at 75% load, >96% at 50% load and >95% at 25% load.

F. Battery
1. Each UPS module shall have a single battery bank (common battery, not individual battery per UPM).
2. Battery run time shall be 15 minutes at 150kW load at 25oC at beginning of life/end of life.

G. UPS Output with High Efficiency / Eco Mode option
1. The High Efficiency / Eco Mode acts to optimize the internal components of the UPS power train to maximize system efficiency when the bypass source is within the following (adjustable) limits: Voltage: +/-10%, and Frequency: +/-3Hz.
2. Nominal output voltage 400V, 3-phase, 4-wire plus ground at UPS output.
3. Steady-state voltage regulation shall be within +/- 10% from nominal output voltage.
4. Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
5. Frequency regulation shall be +/-3Hz when bypass source is within the limits in (1) above, and +/- 0.1Hz free running.
6. Overload current capability (with bypass source within the limits of (1) above) Continuous: 110%, Transient: 1000% for 10msec.
7. Static transfer time: No break, typically completed in less than 2ms, including detection time.
8. Acoustical noise: Noise generated by the UPS in Energy Saver System mode operation shall not exceed 47dBA at 100% load at one metre from any operator surface, measured at 25 degrees C.
10. Electrostatic discharge (ESD): The UPS shall meet IEC61000-4-2 level 3; 4kV contact/8kV air discharge.
11. Efficiency: The UPS efficiency shall greater than 99%, over the range of 60% to 100% load; ≥98.5% over the range of 20 to 49% load.

10.12 MECHANICAL DESIGN

A. Enclosures: The UPS shall be housed in a free-standing double front enclosure (safety shields behind door) equipped with wheels and levelling feet. The enclosure
shall be designed for computer room applications. The front door shall have a lock to prevent unauthorized entry.

B. Modular construction: The UPS shall be comprised of:
1. Power Modules (PM)s, each including the rectifier, inverter, and battery converter power and control circuitry. The PM shall be in a draw-out assembly that can be quickly exchanged or replaced as necessary.
2. 30 KVA Static Bypass Switch assembly that can be removed and replaced as a single module.

C. Ventilation: The UPS and shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlet configuration for the UPS shall be exhaust at the rear of the cabinet. 200mm of clearance shall be required for proper air circulation at the rear of the UPS. A washable air filter shall be mounted in the front door of the UPS module. An optional rear chimney attachment shall enable front to top ventilation if required.

D. No back or side clearance or access shall be required for servicing the system. The side enclosure covers shall be capable of being located directly adjacent to a wall.

E. Cable entry: Standard cable entry for the UPS cabinet shall be through the enclosure top or bottom.

F. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.

G. Service area requirements: The system shall require no more than 900mm of front service access room and shall not require side or rear access for service or installation.

10.13 CONTROLS AND INDICATORS

A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:
1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. DSP shall eliminate variances from component tolerance or drift and provide consistent operational responses.
2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. The logic shall include system test capability to facilitate maintenance and troubleshooting. Periodic maintenance reminders shall be communicated to the User via the front panel display. Printed circuit board replacement shall be possible without requiring calibration.
3. Start-up and transfers shall be automatic functions.

B. Digital Front Panel Display: The UPS control panel shall be a 7” touch sensitive, backlit LCD front panel display that includes LED indicators for basic UPS status. Large, luminous, colour coded LED pillars (vertical bars) shall show the UPS status (green, amber, red), and be clearly visible up to 30m from the UPS. The LCD shall display:
1. UPS status (home screen): the LCD screen shall have a colour coded border (header) that turns red on alarm and shows basic UPS status in the header of the display, visible at all times. The header shall alternately show UPS status output voltage and battery time remaining and be visible constantly in all display screens. The home screen shall show load level, average efficiency, and power consumption in kWh. The home screen shall show a system mimic diagram with a colour-highlighted power path, operating mode, and active events.
2. Controls tab: Single button controls for turning the UPS on and off, transfer to/from bypass, and enabling or disabling the battery charger, initiating a battery test, and enabling or disabling Energy Saver System (ESS).
3. Metering tab: The metering screen shall show voltages currents, temperatures, kW, kVA, and power factor (as applicable) for the UPS input,
output, bypass source, and battery. Colour coded (green, amber, red) bar graph indicators will accompany power and temperature measurements

4. Logs tab: alarm/event queue, active alarms and alarm history, events, status changes and commands, all timed to the 1/1000th second for tracking and analysis.

5. Statistics tab: Numerically and graphically displays the savings afforded by ESS operation over time.

6. Settings tab: shall provide button access to user adjustable settings such as, but not limited to: date/time, building alarm designations, communications parameter setup, UPS name, user passwords, and display language.

C. Control Panel Lamp Indicators: The UPS control panel shall provide the following monitoring functions with indicator (icon) LED’s:

1. NORMAL: This green LED shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load.

2. BYPASS: This amber LED shall indicate that the UPS has transferred the load to the bypass circuit.

3. BATTERY: This amber LED shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting the load.

4. ALARM: This red LED and the accompanying audible alarm horn, shall indicate that the UPS detects an alarm condition, outlined in detail in the Logs tab from the home screen and in the operator’s manual.

D. Interface panel: The UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:

1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form “C” capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.

2. RS232 (EIA / TIA-232) and USB communications interfaces: Circuitry shall be provided for one “host”, and one “device” USB connector, and one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple (“dumb”) terminals to gain remote access to all unit operation information.

3. Building alarms: Five inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the UPS front panel display or via the RS232 (EIA / TIA-232) port.

4. External Emergency Power Off contacts: Shall be provided to connect an external remote emergency power off switch to shut down the UPS and de-energise the critical load. Normally open or normally closed contacts shall be acceptable.

10.14 COMMUNICATIONS

A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate three (3) plug-in communication devices

B. Remote Monitoring:

1. Optional WEB/SNMP communication capabilities will be available for all systems.

2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232, SNMP, BACnet and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.

The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System.
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

(NMS). The UPS must also be able to be monitored via any standard Internet browser. All optional hardware interfaces shall be “Hot-swappable” (UPS maintains power to critical applications while changing interfaces).

C. Shutdown:
   1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximisation of runtime on battery for more critical systems.
   2. The UPS shall also be capable of interfacing with an operating system’s built-in shutdown routine. This shall be done through a cable connection to the communication interface card.

D. Notification:
   1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.

PART 3 - EXECUTION

10.15 INSTALLATION
   A. Install in accordance with manufacturer’s instructions.

10.16 COMMISSIONING
   A. Factory start-up shall be provided on a 5x8 basis (7x24 optional). Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
      1. Pre-energise visit to inspect installation and provide guidance to installers as required.
      2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.

   B. The following procedures and tests shall be performed by Field Service personnel during the UPS start-up:
      1. Visual Inspection:
         a) Visually inspect all equipment for signs of damage or foreign materials.
         b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
      2. Mechanical Inspection:
         a) Check all the power connections for tightness.
         b) Check all the control wiring terminations and plugs for tightness or proper seating.
      3. Electrical Pre-check:
         a) Check the DC bus for a possible short circuit.
         b) Check input and Bypass power for proper voltages and phase rotation.
         c) Check all lamp test functions.
      4. Initial UPS Start-up:
         a) Verify that all the alarms are in a “go” condition.
         b) Energise the UPS module and verify the proper DC, walk-up, and AC phase on.
         c) Check the DC link holding voltage, AC output voltages, and output waveforms.
         d) Check the final DC link voltage and Inverter AC output. Adjust if required.
         e) Check for the proper synchronisation.
f) Check for the voltage difference between the Inverter output and the Bypass source.
g) Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.

5. Operational Training: Before leaving the site, the field service engineer shall familiarise responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

10.17 WARRANTY

All components of the UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner. Labour coverage is for 90 days after product start-up.

One-year service protection package shall include 7x24 on-site repair/replacement labour for UPS parts and batteries; 7x24 technical support coverage; and 7x24 remote monitoring service (with monthly reports for UPS and battery performance). Standard response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services consisting of: 5x8 Start-up service of UPS and batteries, with option for 7x24 Start-up. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts- and- labour coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

11.0 LIGHT FIXTURE

11.1 SCOPE OF WORK

The scope of work shall cover the supply, installation, and testing of various types of light fixtures.

15.2 CODES & STANDARDS

The following standards and rules shall be applicable:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS 1913(1969)</td>
<td>General and Safety requirements for electric lighting fittings.</td>
</tr>
<tr>
<td>Indian Electricity Act and Rules issued here under.</td>
<td></td>
</tr>
</tbody>
</table>

11.3 DESIGN BASIS & SITE CONDITIONS

11.4 TECHNICAL REQUIREMENTS

11.4.1 GENERAL REQUIREMENTS

All fixtures shall be complete with accessories and fixings necessary for installation whether so detailed under fixture description or not. All light fixtures should be with LED type only and integral
with ballast, internal and external surge protector, etc. as per below:

1. All light fixtures should be LM-79 and LM-80 certified along with CE certified

(All light fixture, fixing arrangement, Poles of external lighting, etc. all -which are to be installed- must be approved by consultant before finalization. Contractor must do sampling with as many options as required by consultant)

### LED Fixtures

The driver shall be CCCV isolated driver (Constant current constant voltage driver). All light fixtures should be with Opex lighting fixture. Type of PCB is MCPCB for External & FRPCB for external light.

General requirements for LED lighting:

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Types of Test/Specifications</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High bright white power LEDs shall be used in the luminaires and the wattage of these LEDs shall be &gt;1W and &lt;3W. *LED Technical datasheet for the LED source intended for supply of the project including packaging details to be submitted.</td>
<td>LM-80/IS 16105 test report including technical data sheet of LED Chip.</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturer should submit proof of procurement of LEDs and LM-80 Test Reports of specific LED used in the proposed. (No other chip details to be offered).</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Life span of the LEDs used in the Luminaire shall be more than 50,000 hours at 70% light output. (Manufacturer shall submit the proof – L70 &amp; TM 21 Test Report.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Color Rendering Index of the LEDs used in the luminaire shall be greater than 80.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LED chip efficiency shall be more than 110 Lumens/Watt at Tj 25 C (Manufacturer shall submit the proof – LED Technical Data Sheet to be submitted).</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Power Factor &gt;0.95</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>System Efficacy (Lumens/Watt) System Lumen output supported by LM79 report shall be submitted.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>CRI of Luminaires &gt;70 (LM 79 report to be submitted)</td>
<td>Test Report from NABL Accredited Lab</td>
</tr>
<tr>
<td>9</td>
<td>The luminaire light output shall be constant. The voltage variations/ fluctuations in the specified voltage range shall not impinge upon the lumen it produces. Maximum +/- 2% is allowed throughout in the input operating voltage range.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Operating Voltage 140 V to 270 V universal electronic driver with internal surge protection of 2.5 KV (Applicability IS 15885, Driver Safety 16104-1/2).</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Total harmonic Distortion &lt;10% THD – Test Method IEC:610003-2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>LED Efficiency Driver Efficiency &gt;90%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>13</td>
<td>The outdoor luminaire housing shall be made up of corrosion free High Pressure Aluminum die casting thus conforming the luminaire to minimum IP-65 for luminaire at 60 W or below/ IP-66 for wattage above 60 W-protection and safety as per IEC 60598/IS 10322. (NABL accredited Lab Report supporting the same shall be furnished at the time of supply). Necessary Guarantee &amp; Warranty certificate must be submitted at the time of bid submission. (Only single housing fixtures allowed). Embossing of supplier logo on housing.</td>
<td>NABL Accredited Lab report as per IS: 10322 part 5 Sec-3 / IEC: 60598-2-3.</td>
</tr>
<tr>
<td>14</td>
<td>The luminaire shall be equipped with distortion free, clear, heat resistant, toughened, UV stabilized glass cover or Polycarbonate cover in the front fixed to the die cast Aluminum frame which shall be fixed to the housing by means of stainless steel screws.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Frequency</td>
<td>50 Hz +/- 3%</td>
</tr>
<tr>
<td>16</td>
<td>Protections</td>
<td>IP65 up to 60 W and IP-66 for wattage above 60 W, IP-20 for Indoor areas and IP-65 for kitchen area. Surge protection 2.5 KV, IEC61000-4-5</td>
</tr>
<tr>
<td>17</td>
<td>Conformation Standards of luminaire (Test Reports of Luminaire)</td>
<td>The luminaire should conform to IEC 60598/ IS: 10322 The luminaire should be tested as per IEC 60598-2-3: 2002/ IS: 10322 Part 5 Sec-3 standards and following test reports should be submitted: Heat Resistance Test, Thermal Test, Ingress Protection Test, Drop Test, Electrical/ Insulation Resistance Test, Photometry Test (LM 79 report), Vibration Test</td>
</tr>
<tr>
<td>18</td>
<td>Conformation Standards of luminaire</td>
<td>LM80 (IS16105) NABL Acc. Lab certificate for LED And LM79 (IS16106), IEC60598/ IS: 10322 for LED Luminaire</td>
</tr>
<tr>
<td>19</td>
<td>Conformation Standards of luminaire</td>
<td>IS 16101/2/3/8 and 7</td>
</tr>
<tr>
<td>20</td>
<td>Surge Protection</td>
<td>Surge protection of 10 KV to be separately installed housed inside fixture for all wattages &gt;= 35 W.</td>
</tr>
<tr>
<td>21</td>
<td>Replacement Warrantee</td>
<td>05 YEARS</td>
</tr>
<tr>
<td>22</td>
<td>Working Temperature</td>
<td>-5 to +50 degree C</td>
</tr>
<tr>
<td>23</td>
<td>Heat Sink</td>
<td>Good thermal management System should be provided &amp; LED Must be mentioned on heat sink Conductive Al. bars with Suitable large Surface area by means Of fins to dissipate the heat to ambient temperature.</td>
</tr>
</tbody>
</table>

Contractor shall submit all test reports for LED lighting fixtures before dispatching of material at site. All tests shall be carried as per IES approved methods defined (LM-82). The replacement warranty for LED shall be 5 years.

11.5 **METHOD OF MEASUREMENT**

Supply of the fixture including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

11.6 **TRANSPORT, DELIVERY AND STORAGE**

The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of fixture or
site store. The fixture should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipment’s at site should form part of offer.

12.0 ADDRESSABLE FIRE ALARM SYSTEM:

12.1 General Scope of Works

12.1.1 This section of the specification includes the design, supply, installation, and connection of a microprocessor controlled; equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciator, power supplies, and wiring as per shop drawings and specified herein.

12.1.2 The system shall be designed such that each loop shall limited to only 80% of its total capacity at initial installation.

12.1.3 All equipment/components shall be new & the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

12.1.4 All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

12.1.5 All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

A Submittals and Shop drawings:

- Sufficient information shall be clearly presented and shall include manufacturer’s name, model numbers, power requirements, equipment layout, device arrangement and complete wiring.
- Sequence and description of operation.
- Product Data for each type of equipment, initiating device, signal device, peripheral device and cable provided on the project.
- Shop drawings shall include battery calculations, floor plans and wiring diagrams.

B Basic System

- The system shall be a complete, ELV supervised fire detection and evacuation system using fire fighter telephone with microprocessor-based operating system having the following; capabilities, features and capacities:
- Communication between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide displays. Any network node shall be capable of supporting a local system in excess of 4000 input/output points.
- The local system shall provide status indicators and control switches for all of the following functions:
a. Audible and visual notification alarm circuit zone control.
b. Status indicators for sprinkling system water-flow and valve supervisory devices. (if any)
c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

- Each intelligent addressable device or conventional zone on the system shall be displayed at the fire alarm control panel by a unique alphanumeric label identifying its location.

C Approvals

All the equipment shall have proper listing and/or approvals and shall comply to the requirements of the following recognized agencies.

UL – Underwriters Laboratories Inc. FM – Factory Mutual

The Fire Alarm Control Panel and all modules/devices shall meet the modular listing requirements of Underwriters Laboratories, Inc. and Factory Mutual. Each subassembly, including all printed circuits, shall include the appropriate UL/EN modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts. Systems that do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

D Quality Assurance:

a. Manufacturer:

- The manufacturer of the detection components shall have experience in the design and manufacture of similar types of detection systems and who refer to similar installations providing satisfactory service.

- The name of the manufacturer, part numbers and serial numbers shall appear on all major components.

- All detection devices, components and equipment shall be the products of the same manufacturer.

- All devices, components and equipment shall be new, standard products of the manufacturer’s latest design and suitable to perform the functions intended.

- All products ranging from PANEL to Detectors & Devices should be manufactured under single source of manufacturer to usher continuous line of support round the year.

E Fire Alarm Condition:

- Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm in a LCD display.

- Log to the system history archives all activity pertaining to the alarm condition.

- Print to system printer (where required) alarm condition information.

- Sound the ANSI 117-1 signal with synchronized audible and synchronized strobos.

- Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm
• Activation of any detector in a single elevator lobby or an elevator equipment room shall indicate at fire alarm control panel, cause the recall of that bank of elevators to the ground/stilt floor and the lockout of controls.

• HVAC shut down shall be accomplished by system operated duct detectors as per local requirements. PAC units will be shut down by control relay modules in the loop.

• Door closure devices shall operate by floor.

• Activation of stairwell pressurization fans, smoke purge and damper control shall be as required.

12.2 Performance Requirements

A General Performance: Comply with NFPA 72/EN and all contract documents and specification requirements.

B All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL/EN-Certificated.

C System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72/EN.

The system shall have Style 6 circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.

D The system shall be capable of the following configurations. Both configurations are permitted on the same network.

E The system shall support minimum three loops of 300 addressable devices & detector of any combination (unless specified otherwise by OEM) each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.

F The system shall have an optional digital alarm communication transmitter.

G The system shall provide an off-normal warning prior to reset for all active devices.

H The system shall be capable of remote monitoring, a proprietary software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.

I The system shall be capable of being configured via a PC Tool.

J In networked systems, each of control panels shall be configurable to be a global annunciator, capable of viewing all other control panels on the network.

K The system shall provide the following functions and operating features:

The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.

Provide Class A initiating device circuits.

Provide Style 7 signaling line circuits for the network.
Provide two Class A notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.

Strobes shall be synchronized throughout the entire building.

Provide ELV supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.

Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

1. Supervisory Condition:
   - Display the origin of the supervisory condition report at the fire alarm control panel graphic LCD display.
   - Activate supervisory audible and dedicated visual signal.
   - Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
   - Record within system history the initiating device and time of occurrence of the event.
   - Print to the system printer (where required) the supervisory condition.

2. Trouble Condition:
   - Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
   - Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
   - Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
   - Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
   - Print to the system printer (where required) the trouble condition.

3. Security Condition:
   - Display at the fire alarm control panel with LCD display, the origin of the security condition report. A dedicated security LED shall flash until the alarm has been acknowledged, then revert to a steady "ON" state.
   - The control system shall be capable of bypassing the alarms from an individual security system installed within selected areas. The pass code allowing this function shall be assignable to individual security personnel and each bypass
action shall be logged to system history. Intrusion alarms occurring during a bypass period shall be logged to history and displayed but no audible alarm shall occur at the control panel.

- Print to the system printer (where required) the security condition.
- The Fire Control Panel shall be “UL” 1076 listed or EN for security purposes.

4. Control Panel

The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.

- The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks.
- The system shall be capable of the following configurations. Both configurations are permitted on the same network.
- The control panel shall be capable of expansion in SLC loops. Each loop shall support minimum 125+125 analog/addressable devices & detectors for a system capacity of 800 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 80-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either company.
- The panel shall have a built-in power supply of and battery charger. Battery charger shall be able to charge the system batteries up to 200AH. The Panel shall have the capacity of connecting additional 200 panels or Network terminals using network card, with redundancy in the network, TCP/IP connectivity for Central Monitoring station

The system shall be capable of supporting unshielded wiring applications.

5. System Components:

- The System Periphery board / Fire Alarm Panel shall be capable of 125+125 intelligent devices & detector of any combination (unless specified otherwise by OEM) distributed between one, two, three, or four Class B SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED’s on the board shall provide annunciation for the following; Power, Gnd. Fault, Alarm, Trouble. This board is integral to the system.
- The system periphery board shall be capable of supporting two system drivers of 125+125 intelligent devices & detector of any combination (unless specified otherwise by OEM) distributed between one, two, three, or four Class B SLC circuits, for a total panel capacity of up to 800 addressable devices with additional loop cards. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED’s on the board shall provide
annunciation for the following: Power, Gnd. Fault, Alarm, Trouble. This board is integral to the system.

- The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.

- The standard Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked control panels, when configured as a global PMI.

- The LED Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked control panels, when configured as a global PMI. Additionally, the operator interface provides twelve multicolored configurable LEDs for annunciating system status.

- System response time from alarm to output shall be an average of three (3) seconds.
  
a. All system cards and modules shall have Flash memory for downloading the latest module firmware.
  
b. Passwords:
     Technician Level Password - There shall be a 4-character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:

     Arming and disarming devices.
     1. Activating and deactivating the History Log function and deleting obsolete entries.
     2. Changing the system time and date.

     Maintenance Level Password - There shall be a 4-character password that a user must enter into the control panel in order to access the panel's reporting functions and walk test functions.

     Acknowledge Silence able Reset Access - There shall be a key required to open a locked cabinet that a system user must use in order to acknowledge events, turn silence able audible and visuals on and off, and perform panel resets.

6. Power Supply

- The system Power Supply shall be a 170 Watt, 6-amp that provides 24VDC power for system operation. The power supply shall be filtered and regulated. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz.

- The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz.

- The battery charger shall be able to charge the system batteries up to 200 AH batteries. Battery charging shall be microprocessor controlled and programmed to select battery sizes.
7. **System Enclosures:**

- Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

- Provide the enclosure needed to hold all the cards and modules as specified. The enclosures shall be either black or red. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the cards in the enclosure.

8. **System Printer:**

- The system printer shall be operated from a Remote Printer Module, which shall be mounts outside the enclosure. This module shall provide a parallel port and 2 serial ports for RS 232 protocol. One of the serial ports shall be able to be programmed for RS485 protocol. Supervised network connection shall be either Style 4 or 7 as directed.

- This parallel printer shall be supervised for: On/Off line, out of paper, paper jam, power off, and connection the system. The printer shall be a; high speed, 24 dot matrix, wide carriage, and capable of using tractor or friction fed paper. The printer shall contain diagnostic LED’s for ease in maintenance.

9. **Intelligent Initiation Devices:**

- All initiation devices shall be insensitive to initiating loop polarity. Polarity insensitive wiring allows fire detection devices to operate flawlessly even when detector and devices wiring polarity are inverted on the wrong screw terminals. When wiring polarity doesn’t need to be observed, wiring troubleshooting is greatly reduced, this will also save time of installation Specifically, the devices shall be insensitive to plus/minus voltage connections on either Style 4 or Style 6 circuits.

- **The multi-criteria sensor detector** shall be an intelligent digital photoelectric detector with a programmable heat detector. The detector shall have a multicolor LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm. Detector shall have shock-resistant thermistor to sense temperature changes. The “on-board” Fire technology shall allow the detector to gather smoke and thermal data, and to analyze this information in the detector’s “neural network Neural Network is a dynamic detection technology system. It simulates the work pattern of human brain. It can develop the knowledge as to refine the level of detection technology. It means, neural network can analyze, learn and adapt according to environmental or physical conditions of premises and trigger the output accordingly. The characteristics of fire are stored in the memory patterns in the microprocessor of detector. Hence, the microprocessor can adapt the characteristics of the environment and able to distinguish between actual fire and deceptive phenomena.

- Detectors shall be listed for use as open area protective coverage, in duct installation and duct sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. Detectors shall be programmable as application specific, selected in software for a minimum of eleven environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the...
earliest possible real alarm condition report. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The system-controlled output functions shall be from an individual or unique input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber. The detector shall support the use of a relay and LED remote indicator at the same time. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling. Detector wiring shall not require any special shielded cable. It should have a multi detector status LED: Green for normal and red for alarm.

- **Thermal/ Rate of Rise Detectors** shall be rated at 135 degrees for fixed temperature. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector shall be made in system software and be changeable at any time without the necessity of hardware replacement. The detectors shall be installed according to the requirements of NFPA 72/EN for open area coverage.

10. Device Programming Unit

- Addressable smoke and thermal detectors shall provide dual alarm and power/polling bi-colour LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

- The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

- Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

- The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

- Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).

- Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
- Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

- A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

- Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep ELV box. An optional surface mount Lexan enclosure shall be available.

- Detectors / Bases with connection terminals exposed to Ceiling / False Ceiling shall be provided with Protective Insulation of the same make as of Detectors.


- Addressable manual call point shall send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

- All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

- Manual fire alarm boxes shall be constructed of Lexan / ABS Plastic with clearly visible operating instructions provided on the cover. The word FIRE / Fire Sign shall appear on the front of the stations.


1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

2. The two-wire monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep ELV box or with an optional surface back box.

3. The IDC zone shall be wired for operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.


1. Addressable control modules shall be provided to supervise and control the operation of one conventional devices of compatible, 24 VDC powered polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep ELV box, or to a surface mounted back box.

3. The control module shall be wired with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.
5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

14. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on a loop Class A. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the loop segment or branch. At least one isolator module shall be provided for each set of detectors (max 19 numbers).

2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep ELV box or in a surface mounted back box. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

15. Addressable Interface Devices shall be provided to monitor contacts for such items as conventional gas/agent release panels, water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each device and all physical devices shall require only one address on a signaling line circuit regardless of the number of circuits on an individual module. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive.

16. Notification Appliances:

The Horn or horn/strobe appliance as indicated on the drawings shall be a synchronized temporal horn with a synchronized strobe light with multiple candela taps to meet the intended application. The appliance shall be red or white as indicated on the drawings. The strobe light taps shall be adjustable for 15/75, 30/75, 75, and 110 candela. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

The electronic strobe as indicated on the drawings shall be a speaker with a tone card and have and adjustable range of 700 to 1300 Hz. The chime or chime/strobe shall be adjustable for either single stroke or continuous operation. The chime/strobe shall be available with adjustable strobe intensities of 15, 30, 75, and 110 candelas. The appliance shall be red for wall mounted and white for ceiling mounted. Ceiling mounted appliances shall be rated for that application.

17. EXECUTION

EXAMINATION

Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Proceed with installation only after unsatisfactory conditions have been corrected.

INSTALLATION:
Surface cabling should be neatly run and securely fixed at suitable intervals in accordance with the manufacturer’s recommendations.

Joints in cables, other than those within equipment enclosures should be avoided wherever possible.

Where a cable passes through an external wall it should be contained in a smooth bore sleeve of metal or other non-hygroscopic material sealed into the wall. This material will slope downwards towards the outside and should be sealed with a suitable waterproof compound.

Where cables, conduits or trunking pass through floors, walls, partitions or ceilings the surrounding hole shall be made good with a fire stopping material with sufficient fire resistance to maintain the integrity of the construction.

Each junction box will include the legend “Fire Alarm System” on its cover.

All wires shall be provided with an identifying permanent label within 25mm of its termination.

A consistent color code for fire alarm conductors will be used throughout the installation. Wiring within enclosures will be arranged to allow accessibility to equipment for adjustment & maintenance.

**BOXES, ENCLOSURES AND WIRING DEVICES**

Boxes shall be installed plumb and firmly in position.

Extension rings with blank covers shall be installed on junction boxes where required.

Junction boxes served by concealed conduit shall be flush mounted.

Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

**CONDUCTORS**

Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 5 cm of the wire termination. Marker legends shall be visible.

All wiring shall be supplied and installed in compliance with the requirements of the ELV Code and that of the manufacturer.

All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

**DEVICES**
Wiring within enclosures will be arranged to allow accessibility to equipment for adjustment & maintenance.

All devices shall be mounted to or in a suitable ELV box.

**COMMISSIONING**

The entire system shall be inspected & tested to ensure that it operates in accordance with this specification and the country requirements. In particular that:

All manual call points & automatic fire detectors function correctly.

All devices carry an accurate identification label.

All manual call points and automatic fire detectors when operated result in the correct text & zone indications at all necessary indicating equipment.

That sound pressure levels meet as per requirements.

That the systems cause and effects match the requirements of this specification.

The sitting of all manual call points & automatic fire detectors meet the country requirements.

**DOCUMENTATION**

On completion of the system the contractor shall provide 3 sets of soft & hard copies of following documentation:

Complete listings of fitted devices, their programmed parameters, texts and assignments.

Documentation of all programmed cause & effects.

Documentation of actual field wiring topology.

**TRAINING**

Training shall be provided as follows:

The contractor shall provide full training on system operation & user responsibilities to at least two persons nominated by the customer.

**CERTIFICATION**

Upon completion the contractor will provide the following certificates in accordance with the country regulation:

Design certificate.
Installation certificate.
Commissioning certificate.
Acceptance certificate.
Verification certificate.

### 13.0 VIDEO SURVEILLANCE / CCTV SYSTEM:

#### 13.1 Scope

This specification covers the general requirements for Supply, Installation, Testing, & Commissioning Closed-Circuit Television systems (CCTV) for Central monitoring of Building/campus Security.
### 13.2 IP based Indoor Fixed Dome Cameras with Built in Audio

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Image sensor &amp; Minimum Effective Pixels (Resolution) or better</td>
<td>1/2.8” or better CMOS or Equivalent &amp; Minimum 2 MP @25fps</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Shutter</td>
<td>1/30 to 1/100000 s or better</td>
</tr>
<tr>
<td>3</td>
<td>Min illumination/ light sensitivity (Colour) or better</td>
<td>Minimum 0.001 lux (30 IRE, F 2.0) or better</td>
</tr>
<tr>
<td>4</td>
<td>Min illumination/ light sensitivity (B/W)</td>
<td>Minimum 0.01 lux (30 IRE, F 2.0) &amp; 0 Lux on IR on</td>
</tr>
<tr>
<td>5</td>
<td>Wide Dynamic Range</td>
<td>Required Min. 120 dB</td>
</tr>
<tr>
<td>6</td>
<td>Backlight Compensation</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>7</td>
<td>IR Range</td>
<td>Min. 15 Mtr.</td>
</tr>
<tr>
<td>8</td>
<td>Focus</td>
<td>Automatic / Manual</td>
</tr>
<tr>
<td>9</td>
<td>Automatic Gain Control</td>
<td>Auto / Manual</td>
</tr>
<tr>
<td>10</td>
<td>Sharpness, Brightness, Contrast</td>
<td>Functionality Required</td>
</tr>
<tr>
<td>11</td>
<td>Frame Rate</td>
<td>25 FPS for 1920 x 1080 at H.265 Compression or better</td>
</tr>
<tr>
<td>12</td>
<td>Fixed Lens</td>
<td>2.8 mm/ 4 mm/ 6mm fixed lens as per site requirement</td>
</tr>
<tr>
<td>13</td>
<td>Video</td>
<td>Day and Night functionality: Automatic, Color, Mono Video Resolution: Minimum 2 MP @25fps Video Streams: Individually configurable 02 video streams (H.265, MJPEG) Intelligent Video: Motion detection, Tampering Alert</td>
</tr>
<tr>
<td>14</td>
<td>Compression</td>
<td>Dual H.264 (Recording &amp; Viewing): Required, Live stream 1080p should support min. 50/60 FPS and recording at lower resolution and frame rate or vice versa as may be configured.</td>
</tr>
<tr>
<td>15</td>
<td>Audio</td>
<td>Audio support: Built in Audio/Mic Audio Compression: Minimum G.711 or better AAC48KHz or better Two-way audio: Required Input / Output: 01 IN &amp; 01 OUT</td>
</tr>
</tbody>
</table>
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td><strong>Security</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Password Protection</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>HTTPS encryption</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>IEEE 802.1X</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Cyber Security Certification</td>
<td>PCI-DSS or equivalent</td>
</tr>
<tr>
<td>18</td>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operational temperature °C</td>
<td>0°C to 50 °C</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>0 to 80% RH non-condensing</td>
</tr>
<tr>
<td></td>
<td>IP rating</td>
<td>IP67, IK10</td>
</tr>
<tr>
<td></td>
<td>Power</td>
<td>PoE (Up to 15.4 Watt) OR eAC24V/ DC12V, 100-230VAC</td>
</tr>
<tr>
<td></td>
<td>Certifications</td>
<td>CE, FCC, UL and BIS</td>
</tr>
<tr>
<td></td>
<td>SD card</td>
<td>Camera should support SD card up to 128 GB and the bidder shall provide a data card of 128 GB with the device. In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged or can be merged manually as &amp; when required with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.</td>
</tr>
</tbody>
</table>

**13.3 IP based Indoor Fixed Dome Cameras without Audio**

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Image sensor &amp; Minimum Effective Pixels (Resolution) or better</td>
<td>1/2.8” or better CMOS or Equivalent &amp; Minimum 2 MP @25fps</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Shutter</td>
<td>1/30 to 1 / 100000 s or better</td>
</tr>
<tr>
<td>3</td>
<td>Min illumination/ light sensitivity (Colour) or better</td>
<td>Minimum 0.05 lux (30 IRE, F 1.4) or better</td>
</tr>
<tr>
<td>4</td>
<td>Min illumination/ light sensitivity (B/W)</td>
<td>Minimum 0.01 lux (30 IRE, F 1.4) &amp; 0 Lux on IR on</td>
</tr>
<tr>
<td>5</td>
<td>Wide Dynamic Range</td>
<td>Required</td>
</tr>
<tr>
<td>6</td>
<td>Backlight Compensation</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>7</td>
<td>IR Range</td>
<td>20-30 Meter</td>
</tr>
<tr>
<td>8</td>
<td>Focus</td>
<td>Automatic / Manual</td>
</tr>
<tr>
<td>9</td>
<td>Automatic Gain Control</td>
<td>Auto / Manual</td>
</tr>
<tr>
<td>10</td>
<td>Sharpness, Brightness, Contrast</td>
<td>functionality Required</td>
</tr>
<tr>
<td>11</td>
<td>Frame Rate</td>
<td>25 FPS for 1920 x 1080 at H.264 Compression or better</td>
</tr>
<tr>
<td>12</td>
<td>varifocal Lens</td>
<td>2.8 mm to 12 mm Motorized Varifocal</td>
</tr>
<tr>
<td>13</td>
<td>Video</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Day and Night functionality</td>
<td>Automatic, Color, Mono</td>
</tr>
<tr>
<td></td>
<td>Video</td>
<td>Minimum 2 MP, @25fps</td>
</tr>
<tr>
<td>SR No.</td>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Video Streams</td>
<td>Individually configurable 02 video streams (H.265, MJPEG)</td>
<td></td>
</tr>
<tr>
<td>Intelligent Video</td>
<td>Motion detection, Tampering Alert</td>
<td></td>
</tr>
<tr>
<td>Compression</td>
<td>Dual H.264 (Recording &amp; Viewing) Required, Live stream 1080p should support min. 25 FPS and recording at lower resolution and frame rate or vice versa as may be configured.</td>
<td></td>
</tr>
<tr>
<td>Audio</td>
<td>Audio support Required</td>
<td></td>
</tr>
<tr>
<td>Audio Compression</td>
<td>Minimum G.711 or better AAC48KHz or better</td>
<td></td>
</tr>
<tr>
<td>Two-way audio</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>Input / Output</td>
<td>01 IN &amp; 01 OUT</td>
<td></td>
</tr>
<tr>
<td>Network &amp; Interface</td>
<td>Interface RJ-45 for 10/100 base-T Ethernet</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>Through web browser, online, firmware upgrade</td>
<td></td>
</tr>
<tr>
<td>Network Protocols support</td>
<td>IPv4, IPv6, TCP/IP, HTTP, , DHCP, UDP, DNS, SMTP, RTP, RTSP, SNMP, UpnP, NTP, ICMP, IGMP</td>
<td></td>
</tr>
<tr>
<td>Alarm Event</td>
<td>Events / alerts send via FTP, HTTP, email, Pre-Post alarm video buffering.</td>
<td></td>
</tr>
<tr>
<td>Alarm I/O</td>
<td>1 potential Free 1 In &amp; 1 Out</td>
<td></td>
</tr>
<tr>
<td>Compliance</td>
<td>ONVIF Profile S or betterB39</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Password Protection Required</td>
<td></td>
</tr>
<tr>
<td>HTTPS encryption</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>IEEE 802.1X</td>
<td>Required</td>
<td></td>
</tr>
<tr>
<td>Cyber Security Certification</td>
<td>PCI-DSS or equivalent</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Operational temperature °C 0°C to 50 °C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>0 to 80% RH non-condensing</td>
<td></td>
</tr>
<tr>
<td>IP rating</td>
<td>IP66, IK10</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>PoE (Up to 15.4 Watt) OR eAC24V/ DC12V, 100-230VAC</td>
<td></td>
</tr>
<tr>
<td>SD card</td>
<td>Camera should support SD card up to 128 GB and the bidder shall provide a data card of 128 GB with the device. In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored, these recordings shall be automatically merged or can be merged manually as &amp; when required with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.</td>
<td></td>
</tr>
</tbody>
</table>

13.4  **IR Veri-Focal Bullet Camera**
<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Image sensor &amp; Minimum Effective Pixels (Resolution) or better</td>
<td>1/2.8” or better CMOS or Equivalent &amp; Minimum 5 MP @25fps</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Shutter</td>
<td>1/30 to 1 / 100000 s or better</td>
</tr>
<tr>
<td>3</td>
<td>Min illumination/ light sensitivity (Colour) or better</td>
<td>Minimum 0.007 lux (30 IRE, F 1.6) or better</td>
</tr>
<tr>
<td>4</td>
<td>Min illumination/ light sensitivity (B/W)</td>
<td>Minimum 0.007 lux (30 IRE, F 1.6) or better</td>
</tr>
<tr>
<td>5</td>
<td>Wide Dynamic Range</td>
<td>120 dB or higher required</td>
</tr>
<tr>
<td>6</td>
<td>Backlight Compensation</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>7</td>
<td>Lens</td>
<td>2.8-12mm Motorized Vari-focal DC-IRIS or Automatic.</td>
</tr>
<tr>
<td>8</td>
<td>Focus</td>
<td>Automatic / Manual</td>
</tr>
<tr>
<td>9</td>
<td>Automatic Gain Control</td>
<td>Auto / Manual</td>
</tr>
<tr>
<td>10</td>
<td>Sharpness, Brightness, Contrast</td>
<td>functionality Required</td>
</tr>
<tr>
<td>11</td>
<td>Frame Rate</td>
<td>25 FPS for 1920 X 1080 at H.265 Compression or better</td>
</tr>
<tr>
<td>12</td>
<td>Video</td>
<td>Day and Night functionality Automatic, Color, Mono</td>
</tr>
<tr>
<td></td>
<td>IR illuminator</td>
<td>Illuminator may be Internal or external &amp; visibility should be at least 100 m</td>
</tr>
<tr>
<td>13</td>
<td>Video Streams</td>
<td>Individually configurable 03 video streams (H.265, H.264, MJPEG)</td>
</tr>
<tr>
<td></td>
<td>Intelligent Video</td>
<td>Motion detection, Tampering Alert, Face Detection/ Audio Detection/ Tripwire/ Intrusion/ Object Abandoned/ Object Missing/ Trigger line/loitering</td>
</tr>
<tr>
<td></td>
<td>Compression</td>
<td>H.265/H.264/MJPEG (Recording &amp; Viewing) Required, Live stream 1080p should support min. 25 FPS and recording at lower resolution and frame rate or vice versa as may be configured.</td>
</tr>
<tr>
<td>14</td>
<td>Audio</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Audio support</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Audio Compression</td>
<td>Minimum G.711 or better AAC48KHz or better</td>
</tr>
<tr>
<td></td>
<td>Two-way audio</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Input / Output</td>
<td>01 IN &amp; 01 OUT</td>
</tr>
<tr>
<td>15</td>
<td>Network &amp; Interface</td>
<td>RJ-45 for 10/100 base-T Ethernet</td>
</tr>
<tr>
<td></td>
<td>Upgrade</td>
<td>Through web browser, online, firmware upgrade</td>
</tr>
<tr>
<td></td>
<td>Network Protocols support</td>
<td>IPv4, IPv6, TCP/IP, HTTP, , DHCP, UDP, DNS, SMTP, RTP, RTSP, SNMP, UpnP, NTP, ICMP, IGMP,</td>
</tr>
<tr>
<td></td>
<td>Alarm Event</td>
<td>Events / alerts send via FTP, HTTP, email, Pre-Post alarm video buffering.</td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

#### 16 Security

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Alarm I/O</td>
<td>1 potential Free 1 In &amp; 1 Out</td>
</tr>
<tr>
<td>16</td>
<td>Compliance</td>
<td>ONVIF Profile S or better B39</td>
</tr>
<tr>
<td>16</td>
<td>Password Protection</td>
<td>Required</td>
</tr>
<tr>
<td>16</td>
<td>HTTPS encryption</td>
<td>Required</td>
</tr>
<tr>
<td>16</td>
<td>IEEE 802.1X</td>
<td>Required</td>
</tr>
<tr>
<td>16</td>
<td>Cyber Security Certification</td>
<td>PCI-DSS or equivalent</td>
</tr>
</tbody>
</table>

#### 17 General

<table>
<thead>
<tr>
<th>SR No.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Operational temperature °C</td>
<td>0°C to 50 °C</td>
</tr>
<tr>
<td>17</td>
<td>Humidity</td>
<td>0 to 80% RH non-condensing</td>
</tr>
<tr>
<td>17</td>
<td>IP rating</td>
<td>IP67, IK10</td>
</tr>
<tr>
<td>17</td>
<td>Power</td>
<td>PoE (Up to 22.4 Watt) OR eAC24V/ DC12V, 100-230VAC</td>
</tr>
<tr>
<td>17</td>
<td>Certifications</td>
<td>CE, FCC, UL and BIS</td>
</tr>
<tr>
<td></td>
<td>SD card</td>
<td>Camera should support SD card up to 128 GB and the bidder shall provide a data card of 128 GB with the device. In the event of failure of connectivity to the central server the camera shall record video locally on the SD card automatically. After the connectivity is restored these recordings shall be automatically merged or can be merged manually as &amp; when required with the server recording such that no manual intervention is required to transfer the SD card based recordings to server.</td>
</tr>
</tbody>
</table>

#### 13.5 Network Video Recorder (Channel as per BOQ)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>Tower/Rack mount</td>
</tr>
<tr>
<td>2</td>
<td>No of channels</td>
<td>As per requirement</td>
</tr>
<tr>
<td>3</td>
<td>Number of Drives</td>
<td>Minimum 12xSATA II</td>
</tr>
<tr>
<td>4</td>
<td>Max Storage Per Drive</td>
<td>Maximum supported up to 10 TB</td>
</tr>
<tr>
<td>5</td>
<td>Max internal storage</td>
<td>up to 144 TB</td>
</tr>
<tr>
<td>6</td>
<td>RAID Level</td>
<td>Should support RAID 0, 1, 5, 6, 10</td>
</tr>
<tr>
<td>7</td>
<td>I/O Interface</td>
<td>Minimum 3 X USB 2.0 (for mouse, UPS); 1xeSATA (for DAS)</td>
</tr>
<tr>
<td>8</td>
<td>Voltage</td>
<td>100-240V</td>
</tr>
<tr>
<td>9</td>
<td>Power supply</td>
<td>1+1 750W hot plug redundant</td>
</tr>
<tr>
<td>10</td>
<td>OS</td>
<td>Windows 10 or better</td>
</tr>
<tr>
<td>11</td>
<td>Throughput</td>
<td>Supporting up to 128 channels of 2-Megapixel cameras, 250-550Mbps</td>
</tr>
<tr>
<td>12</td>
<td>Nos. of Camera Recording per server</td>
<td>Minimum 128 Nos.</td>
</tr>
<tr>
<td>13</td>
<td>Multiple codec support</td>
<td>H.264, MJPEG, MPEG4 and H.265</td>
</tr>
<tr>
<td>14</td>
<td>Video Output</td>
<td>Min 2 HDMI Outputs</td>
</tr>
</tbody>
</table>
15. Should Support Stream up to 64ch live viewing connections per server to multiple clients simultaneously
16. Should Support PTZ functioning, PTZ Joystick
17. Support continuous, scheduled, event based and I/O based recording
18. Schedule-based and input-triggered boosting record
19. Should support Scheduled Backup video to FTP location
20. Should support Watermark for video verification
21. Should support Dual gigabit Ethernet ports
22. Operating Temperature: 0°C-40°C
23. Humidity: Operating: 5%-95%
24. Should support 12MP Resolution Recording
25. Should have Minimum 320 Mbps Bandwidth
26. Should have support H.265/ H.264/ MPEG4
27. Powerful investigation and video archive search tools from remote client
28. Dynamic IP Camera Discovery – Automatically discover all compatible cameras connected
29. Multi-level user access rights for viewing and manages access to the functions
30. Advanced security features with encryption support for communication between desktop client to recorder and secure https login for Web Client and mobile apps
31. Should support integration with Access control system
32. Surrounding Cameras: Provide option to grant a user the ability to view a single camera surrounded by the cameras programmed as the “Surrounding Cameras”
33. The system shall support the ability to schedule recordings for each individual camera for times in the future
34. Capable of adjusting the contrast, brightness, and saturation settings for each camera independently
35. The Report facility shall include event history report and audit log report.
36. The offered VMS should support Integration with Access Control System, Fire Alarm System and should third party Video Analytics software.

### 13.6 55 inch Full HD LED Display

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description Model-Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55-inch Full HD LED Display</td>
</tr>
<tr>
<td>2</td>
<td>Screen Size: 55” LED Monitor, Commercial Series</td>
</tr>
<tr>
<td>3</td>
<td>Aspect Ratio: 16:9</td>
</tr>
<tr>
<td>4</td>
<td>Native Resolution: 1920 x 1080p</td>
</tr>
<tr>
<td>5</td>
<td>Brightness: 350 cd/m² or higher</td>
</tr>
<tr>
<td>6</td>
<td>Response Time: 8ms or lower</td>
</tr>
<tr>
<td>7</td>
<td>Input: HDMI x 2, RGB x 1 or more, USB x 2 or more, RCA x 1 or more</td>
</tr>
<tr>
<td>8</td>
<td>Operating Temperature: 0°C to 40°C</td>
</tr>
<tr>
<td>9</td>
<td>Operating Humidity: 20% to 90%</td>
</tr>
<tr>
<td>10</td>
<td>Built-In Speaker: 2 x 10W</td>
</tr>
<tr>
<td>11</td>
<td>Power Supply: 100-240V~, 50/60Hz</td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works)- Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description Model-</th>
<th>Compliance Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Power Consumption : Typ.: 94W or Lower</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Certification : IS 13252:2010</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Wall Mount Bracket : Required</td>
<td></td>
</tr>
</tbody>
</table>

#### 13.7 ABBREVIATIONS

- CCTV – Closed Circuit Television
- IEC - International Electro-Technical Commission
- CE-Conformité Européenne
- UL-Under writers Laboratories
- EN – Standards by European Committee for Standardization (CEN)
- CCD - Charged Coupled Device
- PAL - Phase Alternating Line
- MPEG - Moving Picture Experts Group
- IP- Ingress Protection
- NVR - Network Video Recorder
- HDD - Hard Disk Drive
- JPEG – Joint Photographic Experts Group
- PTZ - Pan, Tilt, Zoom
- POE – Power Over Ethernet

#### 14.0 PUBLIC ADDRESS SYSTEM:

**14.1 System Design Requirements**

**14.1.1** The voice alarm system shall be the integrated solution for EVAC. The voice alarm system shall be designed for public address and emergency evacuation. All the essential EVAC functionality—such as system supervision, spare amplifier switching, loudspeaker line surveillance, digital message management and a fireman’s panel interface—shall be combined.

**14.1.2** The system shall provide for emergency call (EMG), business call and, up to 5 zones, 8 call stations and two remote control panels. The voice alarm system shall be a one channel/two channel system. It shall be compatible with BGM and 100 V booster amplifiers. It shall be capable of connecting to EVAC compliant loudspeakers and accessories for an integrated public address and voice alarm solution.

**14.1.3** The system shall be fully IEC 60849 compliant. It shall have full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager for 255 pre-recorded messages and chimes. It shall be possible to merge messages to allow even more flexible use of pre-recorded announcements and evacuation messages. It shall be possible for each message to have any length within the total available capacity. The memory shall have a capacity of 16 MB. It shall
be possible to upload from a PC via USB into the memory, after which the unit shall operate without PC connection. The standard WAV-format shall be used for the messages and sample rates of 8kHz up to 24kHz with 16-bit word length (linear PCM) shall be supported.

14.1.4 Volume override relay contacts shall be provided for each zone separately for overriding local loudspeaker volume controls. All current override schemes shall be supported (3-wire and 4-wire override schemes i.e. standard 24V and failsafe). Upon a call or an activated trigger input these contacts shall be activated for the appropriate zones, together with an additional voltage free contact (Call Active) for control purposes.

14.1.5 A 24Vdc output shall be available to supply power to external relays, so no external power supply shall be required for that purpose. A LED VU-meter shall allow for monitoring of the master output.

14.1.6 The maximum allowed total cable length between the controller and the last router in the chain shall be 1000 meters. The maximum allowed total cable length between the controller and the last call station in the chain shall be 1000 meters. The maximum allowed total cable length between the controller and the RC panel shall be 1000 meters.

14.2 Device Description

14.2.1 Digital Integrated System Manager / controller

A Features

The Controller should have the following Features and Functions:
- Should support minimum Fifteen-zone with zone expandable routers
- Business and emergency control inputs
- The controller should be EN 54-16 and EN 60849 compliant

B Functions

- The controller should have two BGM source inputs and a mic/line input with configurable priority, speech filter & phantom power. The controller should have 16 priority levels can be specified for microphone, call stations and trigger inputs for optimum system flexibility.

- Configuration software should be provided on the CD included with the unit. The CD shall also include other useful programs, such as MP3-ripping software, a sample-rate converter, various audio and visual tools, and free, MP3-coded music.

- A separate 100 V call-only output provides addressing for an area where BGM is not required but where priority announcements are necessary. Six configurable volume-override output contacts should be available for overriding local volume controls during priority calls. The Controller should support both four-wire and three-wire schemes. There should be LED meter for monitoring the output.

- The Controller should support storage of 255 messages internal 8/16/32 MB Flash ROM, without a need for battery backup. Message can have any length within the total available capacity. Messages and configurations should be uploaded from a PC via USB 2 into the memory, after which the unit operates without a PC connection. The messages should be in standard WAV format and sample rates of 8 kHz up to 24 kHz with 16-bit word length (linear PCM) which would give up to 17 minutes of recording time with CD-quality signal-to-noise ratio.

- The unit should have 12 contact trigger inputs for business and emergency (EMG) calls. Each input shall be configured for a message consisting of a sequence of up to eight wave files. It shall be possible that some wave files may be used in various combinations with other messages, optimizing flexibility and the amount of storage
space used. Controller should have facility of multiple messages merged to form one integrated message.

## C Technical Specifications:

<table>
<thead>
<tr>
<th>ELV Mains Power Supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage:</td>
<td>230/115 VAC, ±15%, 50/60 Hz</td>
</tr>
<tr>
<td>Current inrush:</td>
<td>8 A</td>
</tr>
<tr>
<td>Max power consumption:</td>
<td>600 VA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Battery power supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage:</td>
<td>24 VDC, +15% / -15%</td>
</tr>
<tr>
<td>Current max:</td>
<td>14 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output power (rms/maximum):</td>
<td>240 W / 360 W</td>
</tr>
<tr>
<td>Power reduction on backup power:</td>
<td>-1 dB</td>
</tr>
<tr>
<td>Frequency response:</td>
<td>60 Hz to 18 kHz (+1/-3 dB at -10 dB ref. rated output)</td>
</tr>
<tr>
<td>Distortion:</td>
<td>&lt;1% at rated output power, 1 kHz</td>
</tr>
<tr>
<td>Bass control:</td>
<td>-8/+8 dB at 100 Hz</td>
</tr>
<tr>
<td>Treble control:</td>
<td>-8/+8 dB at 10 kHz</td>
</tr>
</tbody>
</table>

| Mic/line input:       | 1 x |
| Connector:            | XLR, 6.3 mm jack |
| Sensitivity:          | 1 mV (mic), 1 V (line) |
| Impedance:            | >1 k ohm (mic); >5 k ohm (line) |
| S/N (flat at max volume): | >63 dB (mic); >70 dB (line) |
| S/N (flat at min volume/muted): | >75 dB |
| CMRR:                 | >40 dB (50 Hz – 20 kHz) |
| Headroom:             | >25 dB |
| Speech filter:        | -3 dB at 315 Hz, high-pass, 6 dB/oct |
| Phantom power supply: | 12 V (mic mode only) |
| VOX trigger level:    | -20 dB (100 μV mic / 100 mV line) or via input contact |
| Limiter:              | Automatic |

| Line input:           | (BGM and PC call station) |
| Connector:            | Cinch, stereo converted to mono, unbalanced |
| Sensitivity:          | 200 mV |
| Impedance:            | 22 kohm |

| Loudspeaker outputs   |  |
| Connectors:           | MSTB 2.5 /16-ST, floating |
| 100 V output:         | 700 W rated per zone |
| Volumes override types: | 3-wire, 4-wire (24 V), 4-wire failsafe |
| BGM zone output:      | 70 / 50 /35 /25 / 18 / 13 V for |
| Attenuation:          | 0 / -3 / -6 / -9 / -12 / -15 dB 120 / 60 / |
### Power consumption

<table>
<thead>
<tr>
<th>Mains operation</th>
<th>30 / 15 / 8 /4 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max power:</td>
<td>550 W</td>
</tr>
<tr>
<td>-3dB:</td>
<td>440 W</td>
</tr>
<tr>
<td>-6dB:</td>
<td>340 W</td>
</tr>
<tr>
<td>Pilot tone*:</td>
<td>136 W</td>
</tr>
<tr>
<td>Idle:</td>
<td>60 W</td>
</tr>
</tbody>
</table>

### 24 VDC operations

<table>
<thead>
<tr>
<th></th>
<th>14.0 A (336 W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max power:</td>
<td>12.5 A (300 W)</td>
</tr>
<tr>
<td>-3 dB:</td>
<td>9.5 A (228 W)</td>
</tr>
<tr>
<td>Pilot tone:</td>
<td>2.5 A (60 W)</td>
</tr>
<tr>
<td>Idle:</td>
<td>0.9 A (22 W)</td>
</tr>
</tbody>
</table>

### Mechanical

- **Dimensions (H x W x D):** 144 x 430 x 370 mm (19" wide, 3U high)
- **Weight:** Approx. 21.17 kg
- **Mounting:** 19" rack
- **Color:** Charcoal

### Environmental

- **Operating temperature:** -10 ºC to +55 ºC (14 ºF to +131 ºF)
- **Storage temperature:** -40 ºC to +70 ºC (-40 ºF to +158 ºF)
- **Relative humidity:** <95%
- **Acoustic noise level of fan:** <48 dB SPL at 1 m (max output)

#### 14.2.2 120/240/480-Watt Power Amplifier

**A Features:**

- The amplifier should be of **120/240/480** rated amplifier.
- It should support 70V / 100V and 8 ohm outputs.
- Should support Dual inputs with priority switching.
- 100 V input for slave operation on 100 V speaker line.
- Temperature controlled forced front to back.
- Mains, battery back-up, and pilot tone supervision.
- EN 54-16 and EN 60849 compliant.

**B Functions:**

- The unit should operate both on mains power and on a 24 V battery power supply for emergency backup, with automatic switchover.
- A temperature-controlled fan should be provided for ensuring high reliability at high output levels and low acoustic noise at lower output levels. An overheat protection circuit switch should be provided for off the power stage and activates an LED on the
front panel, if the internal temperature reaches a critical limit due to poor ventilation or overload.

- For emergency and evacuation use, the following functions should be monitored: mains presence, battery present, pilot tone presence, amplifier operation. Front panel LEDs indicate the status of supervised functions.

- The LEDs of pilot tone supervision and battery status can be switched off for general public address use. Failsafe (normally energized) relays are provided for each supervised function. These relays are always active regardless of the switches on the rear panel.

**Inputs:**

- The system should have two balanced inputs with priority control, each with a loop-through facility, which would make it easy to connect remote systems that require priority control. An additional 100 V line input should be provided to connect the amplifier to a 100 V loudspeaker line, to provide more power to remote locations.

- Gain or level control must be located on the rear of the unit to avoid accidental setting change. A meter with LED-bar shows the output level.

**Output:**

- The amplifier should have 70 V and 100 V outputs for constant voltage loudspeaker systems and a low impedance output for 8-ohm loudspeaker loads.

- The Power Amplifier should have two separate priorities controlled 100 V outputs for zones that only need announcements made via the priority input, and for zones that will not get any announcements made via the priority input.

**C Technical Specifications:**

<table>
<thead>
<tr>
<th>ELV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mains Power Supply</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage:</strong></td>
<td>230/115VAC, ±15%, 50/60 Hz</td>
</tr>
<tr>
<td><strong>Current inrush:</strong></td>
<td>8 A</td>
</tr>
<tr>
<td><strong>Max power consumption:</strong></td>
<td>400 VA</td>
</tr>
<tr>
<td><strong>Battery power supply</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage:</strong></td>
<td>24 VDC, +15% / -15%</td>
</tr>
<tr>
<td><strong>Current max:</strong></td>
<td>6A</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Output power (rms/maximum):</strong></td>
<td>120W/ 240W / 480W</td>
</tr>
<tr>
<td><strong>Power reduction on backup power:</strong></td>
<td>-1 dB</td>
</tr>
<tr>
<td><strong>Frequency response:</strong></td>
<td>50 Hz to 20 kHz (+1/-3 dB @ -10 dB ref. rated output)</td>
</tr>
<tr>
<td><strong>Distortion:</strong></td>
<td>&lt;1% @ rated output power, 1 kHz</td>
</tr>
<tr>
<td><strong>S/N (flat at max volume):</strong></td>
<td>&gt;80 dB</td>
</tr>
<tr>
<td><strong>Line input:</strong></td>
<td>3X</td>
</tr>
<tr>
<td><strong>Connector:</strong></td>
<td>3-pin XLR, balanced</td>
</tr>
<tr>
<td><strong>Sensitivity:</strong></td>
<td>1V</td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance</td>
<td>20 kohm</td>
</tr>
<tr>
<td>CMRR</td>
<td>&gt;25 dB (50 Hz to 20 kHz)</td>
</tr>
<tr>
<td>Gain</td>
<td>40 dB</td>
</tr>
</tbody>
</table>

#### 100 V input
- Connector: Screw, unbalanced
- Sensitivity: 100 V
- Impedance: 330 kohm

#### Line loop-through output:
- Connector: 3-pin XLR
- Nominal level: 1 V
- Impedance: Direct connection to line input

#### Loudspeaker outputs:
- Connector: Screw, floating
- Direct output: 100 V, 70 V, 8 ohm
- Priority only (from input 1): 100V or 70 V internally selectable
- Music (non-priority) only: 100V or 70 V internally selectable

#### Power consumption:
- Max power: 990 W
- -3dB: 715 W
- -6dB: 510 W
- Pilot tone: 110 W
- Idle: 25 W

#### 24 VDC Operations
- Max power: 32 A (770 W)
- -3 dB: 26 A (625 W)
- -6 dB: 18 A (430 W)
- Pilot tone: 3.8 A (91 W)
- Idle: 0.7 A (17 W)

#### Mechanical:
- Dimensions (H x W x D): 100 x 430 x 270 mm
- Weight Approx.: 10.5 kg
- Mounting Standalone: 19"rack

#### Environmental:
- Operating temperature: -10 °C to +55 °C (14 °F to +131 °F)
- Storage temperature: -40 °C to +70 °C (-40 °F to +158 °F)
- Relative humidity: <95%
- Acoustic noise level of fan: <45 dB SPL @ 1 m (max output)

14.2.3 Call Station/ Paging Console
The call station shall be provided for making a manual or pre-recorded call to any pre-assigned zones or executing a predefined action. The call station shall have one key. The call station shall have a fixed microphone to transmit speech over the network and a press-to-talk key. The call station shall also have a headset socket. Once the headset is connected the microphone will be muted. The unit shall be certified to be compliant to IEC60849 and compliant to other relevant local standards.

a) The call station shall have a speech filter with a cut-off frequency at 340Hz to improve intelligibility and prevent clipping of the audio input on low-frequency signals.

b) The call station unit shall support connection with at least 6 call station keypad units via serial data communication links. should have minimum 2 nos. of 6 call station keypad from day 1.

c) The power supply to the call station keypad units shall be provided from the call station.

d) The call station shall have a volume control for the monitoring loudspeaker at the call station. The volume control shall also control the volume of the headset.

e) The call station shall be programmable for momentary actions on make contact and toggle actions without repeat on make contact.

f) It shall be possible to assign 256 priorities.

g) Analogue-to-digital audio conversion shall be performed at the call station itself.

h) The call station shall also have a digital signal processor, which can be used for audio processing. It can be used to adjust sensitivity, limiter and parametric equalizer.

i) The monitoring loudspeaker shall be on when that particular call station activates a chime or pre-recorded message and will be switched off when its own live audio channel is open.

**Interfaces**

a) System network connection

b) Serial data and power supply interfaces for call station keypad units

c) Headset socket

Number of connectors: 1  
Position: Front  
Type: 3.5 mm jack  
Maximum cable length: 1.5m  
Audio: Mono microphone signal, mono earphone signal

**Indications and controls**

- The call station must have three 2-color LEDs for the following indications:

  Power on and no system/call station fault  
  Power not available  
  Fault in the system and power on  
  Call station fault and power on  
  Chime on or pre-recorded message playing  
  Ready to talk/live speech  
  No call status to display

  Emergency announcement is on in the system. Possible to make normal calls to the zones which are not involved (emergency) indication has priority over other indications
• Lower-priority calls are on or reserved (to all or some of the pre-assigned zones of the PTT key of the call station and selected zones of the call station keypad unit if installed)

• Calls with higher or the same priority (not emergency) are on or reserved (to all or some of the pre-assigned zones of the PTT key of the call station and selected zones of the call station keypad unit if installed)

• No predefined or selected zones are in use or reserved by the system, nor is an emergency announcement being made

• Volume control for loudspeaker/headset

14.2.4 Voice Zone Expander or Router.

• Should have capability to expand the voice alarm system with six zones.

• Should have Minimum Six volume override output contacts.

• It should provide dual channel operation for calls and BGM simultaneously to a maximum of six different zones, using amplifiers.

• It should have set of relays for zone-switching the power amplifier output(s) to different loudspeaker groups. Each zone can be switched between:
  The call channel (call-station selection, all-call microphone, or emergency activation)
  The BGM channel (front panel selection)

• Interface requirements: Min 12Nos. of Speaker Output, Min Two external amp inputs, Call output, Rs232 Control port, System Cascading port, Min two external amp outputs.

• Controls and indicators: Eight system fault LEDs, 12 EMG call-zone status LEDs, Six BMG zone selector buttons, Six EMG call-zone selection buttons.

• ELV: Mains power supply - Voltage 230/115 VAC, ±10%, 50/60 Hz Max power consumption 50 VA

• Trigger Inputs 12 x (6 EMG, 6 business), Connectors MC1,5 / 14-ST-3,5, Activation Programmable, Supervision On EMG inputs, programmable, Supervision method Series / parallel resist

• 100 V input: Amp 1 100 V / 70 V / 0 V, Amp 2 100 V / 0 V, Power handling capacity 1000 W.

• Loudspeaker outputs 12 x (2 x 6 zones), 100 V output 700 W rated per zone, Volume override types 3-wire, 4-wire (24 V), 4-wire failsafe

• Environmental: Operating temperature -10 ºC to +55 ºC (14 ºF to +131 ºF)

• Storage temperature -40 ºC to +70 ºC (-40 ºF to +158 ºF)

• Relative humidity <95%

14.2.5 Volume Controllers

Volume Controllers have the following four types: 6W, 30W, 60W and 120W respectively. The features are as follows:

• Build-in 24V DC forced cut-off relay;

• 5 volume levels control;
- Applicable to 3-wire, 4-wire and 6-wire systems;
- Standard 86X86 installation base-shell.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power</td>
<td>6W/30W/60W/120W</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>100V</td>
</tr>
<tr>
<td>Frequency response</td>
<td>50Hz~20KHz</td>
</tr>
<tr>
<td>Attenuation</td>
<td>5X2dB + off</td>
</tr>
<tr>
<td>Current consumption</td>
<td>20mA, 24V DC</td>
</tr>
</tbody>
</table>

**Audio source**

The Integrated CD player supports the MP3 music files on removable disks, SD cards, DAB digital broadcasting and FM tuners.

- Two single CD/USB/SD and DAB/FM line outputs can play music applications in two areas.
- The volumes of the two line outputs can be adjusted separately.
- CD/USB/SD has three play modes: single play, all play and repeated play.

**14.2.6 Ceiling Speaker**

- 6W Ceiling speaker with metal grille and 6/3W taps

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max power</td>
<td>8W</td>
</tr>
<tr>
<td>Rated power</td>
<td>6W</td>
</tr>
<tr>
<td>Power taps @ 100V</td>
<td>6W / 3W</td>
</tr>
<tr>
<td>Sound pressure level at 6W/1W (1kHz,1m)</td>
<td>105 dB / 90 dB</td>
</tr>
<tr>
<td>Frequency range (-10dB)</td>
<td>150 Hz -15 kHz</td>
</tr>
<tr>
<td>Dispersion angle (1kHz/-6dB)</td>
<td>Minimum 160°</td>
</tr>
<tr>
<td>Rated input voltage</td>
<td>100 V / 70 V</td>
</tr>
<tr>
<td>Rated impedance</td>
<td>1.5 KO</td>
</tr>
<tr>
<td>Connection</td>
<td>Two Wire Cable or Equivalent</td>
</tr>
<tr>
<td>Dimensions (Φ x H)</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Hole cut-out size</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Size of speaker</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Weight</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Color</td>
<td>White (RAL 9010)</td>
</tr>
<tr>
<td>Weight of Magnet</td>
<td>As per OEM</td>
</tr>
</tbody>
</table>

**14.2.7 Wall Mount Cabinet Speaker**

- 30W Wall mount speaker with 30/15/10/5W taps
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Power</td>
<td>30 W</td>
</tr>
<tr>
<td>Maximum Power</td>
<td>45 W</td>
</tr>
<tr>
<td>Power taps @ 100V</td>
<td>30/15/7.5/3.75 W</td>
</tr>
<tr>
<td>Sound pressure level at Rated Power /1W (1kHz,1m)</td>
<td>Minimum 105 dB / 90 dB</td>
</tr>
<tr>
<td>Frequency range (-10dB)</td>
<td>100 Hz - 18k Hz</td>
</tr>
<tr>
<td>Rated impedance</td>
<td>8 ohm</td>
</tr>
<tr>
<td>Connection</td>
<td>Two Wire cable</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Weight</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Color</td>
<td>White (RAL 9010)</td>
</tr>
<tr>
<td>Weight of Magnet</td>
<td>As per OEM</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-25 ºC to +55 ºC (-13 ºF to +131 ºF)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ºC to +70 ºC (-40 ºF to +158 ºF)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>&lt;95%</td>
</tr>
</tbody>
</table>

14.2.8 **2-CORE 1.5 SQ MM ARMORED 1-PAIR TWISTED LS CABLE**

For connecting loudspeakers from power amplifier to power amplifier for zone wise as per tender specification.

14.3 **Training**

- Train the clients to know the system structure and principles.
- Train the clients to know and master the installation methods of the digital broadcasting systems.
- Train the clients to master the configuration methods of the digital broadcasting systems.
- Train the clients to use digital broadcasting system software.
- Train the clients to know basic troubleshooting and maintenance methods of the digital broadcasting systems.

15.0 **TELEPHONE AND DATA DISTRIBUTION:**

15.1 **Scope of work:**

15.1.1 Complete installation shall be done in accordance with installation practices for a well-structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals throughout the network.

15.1.2 Installation, termination and identification of wiring between station outlets, Telecom Rooms and the Equipment Room shall be considered part of the contractor’s work.

15.1.3 Wiring utilized for data and voice communications shall originate at owner provided hubs and concentrators either wall mounted, in vertical free standing equipment racks, and/or enclosed wall mounted vertical equipment racks located at the Telecommunications Equipment Room (ER), the Main Cross-connect (MC), the Intermediate cross-connect (IC), and/or the Telecommunications Room (TR) location(s). Wiring, terminations and patch bays between these designated demarcation points and outlet locations designated on the plans shall be
considered part of the contract. Telecommunication Outlets (TO) shall be furnished, wired and installed by the structured cabling distribution network system contractor.

15.1.4 The system shall utilize a network of unshielded twisted pair, riser, tie and station cables. Cables and terminations shall be provided and located as shown and, in the quantities, indicated on the drawings.

15.1.5 All cables and terminations shall be identified at all locations.

15.1.6 All cables shall terminate in an alphanumeric sequence at all termination locations.

15.1.7 All balanced twisted pair cable terminations shall comply with and be tested to TIA/EIA568-B standards for Category 3, Category 5e, Category 6 & Category 6 installations.

15.1.8 The contractor carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ. Also most current versions of software and applications shall be provided by the contractor, as applicable at the time of execution and commissioning.

15.1.9 The Contractor has to furnish working drawings and as-built drawings, which shall be an essential component of commissioning.

**Supported Applications, but not limited to:**

a) Ethernet Applications

b) IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)

c) Fiber Channel Applications

d) IEEE 802.11a/b/g Wireless LAN Applications

e) Digital Subscriber Loop (DSL) Applications

f) Voice, Video and ISDN Applications

g) Building Automation Systems (BAS) Applications

**References & Standards, but not limited to:**

a) TIA / EIA

b) International Electro technical Commission (IEC)

c) European Committee for Electro technical Standardization (CENELEC)

d) National Fire Protection Association (NFPA) / UL Listed

**It shall be the responsibility of the installer and OEM manufacturer to ensure that:**

a) The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use;

b) All Passive Components in the structured cabling distribution network meet or exceed the relevant component specification of the TIA 568-B series and ISO/IEC 11801: 2002 standards;
c) The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.

d) The Application Assurance covers the structured cabling distribution network compliant channels to support operations of the application(s) that the system was designed to support.

e) The site will be duly certified by OEM for a period of Twenty years from the date of issuance of the registration certificate or installation, whichever is earlier.

The Items, and the Specifications for the same in this section, applies to the following:

a) Jelly Filled Armoured Telephone Cable

b) Category 6 Data Networking UTP Cable and associated components such as CAT6 patch panels – 16/24/48 ports, IOs/RJ45 jacks, CAT6 patch cords, Face plates & SMBs

c) Single mode / Multimode Outdoor/Indoor Optic Fiber Cable and accessories such as – Light Guide Interface Unit (LIU), wall mount and rack mount, pigtail, splices, couplers, patch cords, splicing kit and splice trays

d) Networking Racks – for termination of networking cables

e) Equipment Racks – for servers and hardware

f) Wire-Less Access Point

g) Networking Switches – Simple Manageable, Layer 2 & Layer 3 inclusive of their options such as uplinks, transceivers for fiber transmission

Installation:

a) The installation of conduits shall generally be as specified under section `CONDUIT WIRING'.

b) All cables shall be on cable racks and neatly stitched together.

c) The connection at the tag blocks shall be silver soldered of IDC type so as to achieve minimum contact resistance gas tight connection.

d) The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows:

<table>
<thead>
<tr>
<th>Conduit Diameter</th>
<th>Inch/mm.</th>
<th>Max. No. of cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>25</td>
<td>3 Nos. Of CAT6 UTP Cables in single run.</td>
</tr>
<tr>
<td>1½&quot;</td>
<td>40</td>
<td>Single run of Riser and Fiber cable.</td>
</tr>
</tbody>
</table>

Mode of measurement:

a) The main telephone/data cables shall include supply and laying of multi pair cables on ceiling/wall/on cable trays/racks including all supports and shall be measured and paid on running length basis. Cable trays/racks shall be paid for separately.

b) The multi pair tag blocks shall consist of two telephone connector's strips, jumper interconnections silver IDC terminated soldered enclosure etc. and shall be measured
and paid as one unit.

c) The conduit wiring for telephone/data shall include single pair 0.6 diameter cable in heavy duty rigid, PVC conduits and shall include junction boxes, pull boxes, 2 pair 2 A connector in GI box, Perspex cover etc. and shall from one point.

15.2 Conduits

a) Conduits shall be as given below:

b) The conduit shall generally be as specified under section ‘Telephone and Data Distribution’.

15.3 Telephone/Data Networking

a) The electrical Installation work shall be carried out in accordance with Indian Standard Code of practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the local Electricity Supply Authority and Fire Insurance Regulations so far as these become applicable to the installation. Electrical work in general shall be carried out as per CPWD Specifications.

b) Wherever this specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification, then the specification here under shall take precedence over the said regulations and standards.

15.3.1 Category 6 UTP Cable

<table>
<thead>
<tr>
<th>ITEM No</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type, Unshielded twisted pair cabling system, TIA / EIA 568-C.2 Category 6 Cabling system</td>
</tr>
<tr>
<td>2</td>
<td>Network support, Supports ultrahigh speed data networks such as Gigabit Ethernet (1000 Base-T and 1000 Base-TX) and beyond.</td>
</tr>
<tr>
<td>3</td>
<td>TIA / EIA 568-B.1, ETL Verified, UL Listed and UL channel verified - All three Certificates are mandatory</td>
</tr>
<tr>
<td>4</td>
<td>IEEE 802.3ab, Zero-bit Error, ETL verified</td>
</tr>
<tr>
<td>5</td>
<td>Warranty, 25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs. Site certificate must be issued by OEM</td>
</tr>
<tr>
<td>6</td>
<td>Performance characteristics to be provided along with bid, Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-conductor channel</td>
</tr>
<tr>
<td>7</td>
<td>Manufacturer, All passive cabling must be from same OEM</td>
</tr>
<tr>
<td>8</td>
<td>Conductors, 23 AWG solid bare copper</td>
</tr>
<tr>
<td>9</td>
<td>Insulation, Polyethylene</td>
</tr>
<tr>
<td>10</td>
<td>Jacket, FRLS</td>
</tr>
<tr>
<td>11</td>
<td>Filler, PE</td>
</tr>
<tr>
<td>12</td>
<td>Approvals, UL Listed and UL Channel verified</td>
</tr>
<tr>
<td>13</td>
<td>Frequency tested up to, 600 MHz minimum</td>
</tr>
<tr>
<td>14</td>
<td>Outer dia, 6.2 mm</td>
</tr>
</tbody>
</table>

NIT No: IITB/DIPS/COPT/TENDER/02; Construction of COPT Building

Page: 323 of 450
### Category 6 modular patch panel, (8/16/24 Ports – 1U)

<table>
<thead>
<tr>
<th>ITEM No</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum Specifications</td>
</tr>
<tr>
<td>1.1</td>
<td>Shall be unloaded with individually replaceable 8/16/24 nos. Category-6 I/O Jacks complying with TIA-568.C.2</td>
</tr>
<tr>
<td>1.2</td>
<td>Shall be 19” rack mountable , angled and of 1U height &amp; complete with all mounting accessories, UL listed</td>
</tr>
<tr>
<td>1.3</td>
<td>Shall have labels for identification of ports</td>
</tr>
<tr>
<td>1.4</td>
<td>Should have integrated bonding bar for grounding individual jacks</td>
</tr>
<tr>
<td>1.5</td>
<td>Shall be RoHS Compliant</td>
</tr>
<tr>
<td>1.6</td>
<td>Shall have minimum 25-Year Extended Product Warranty and System Warranty</td>
</tr>
<tr>
<td>1.7</td>
<td>Shall be having a 6 port module construction for better cable dressing at the rear</td>
</tr>
<tr>
<td>1.8</td>
<td>Shall have Comprehensive port numbering on front</td>
</tr>
<tr>
<td>1.9</td>
<td>Shall be suitable for loading unshielded &amp; shielded jacks for different category systems (CAT 6 &amp; CAT 6A)</td>
</tr>
<tr>
<td>1.10</td>
<td>Shall be certified by independent labs like ETL/UL etc.</td>
</tr>
</tbody>
</table>
15.3.3 **Category 6 Information Outlet (IO)**

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PCB based Information Outlet (I/O) RJ45, TIA-568C Category-6, Termination of Category-6 UTP Cable, UL listed</td>
</tr>
<tr>
<td>1</td>
<td>Minimum Specifications</td>
</tr>
<tr>
<td>1.1</td>
<td>Shall conform to Category-6 as per the EIA/TIA-568C.2</td>
</tr>
<tr>
<td>1.2</td>
<td>Shall support network line speeds up to 1 Gbps</td>
</tr>
<tr>
<td>1.3</td>
<td>Shall have RJ-45 type connector with strain relief for securing IDC contacts from external forces. Shall have a feature to maintain the bend radius of the cable while entering the jack.</td>
</tr>
<tr>
<td>1.4</td>
<td>Shall have minimum durability of 750 mating cycles and 200 termination cycles</td>
</tr>
<tr>
<td>1.5</td>
<td>Shall Snap into standard faceplates, surface-mount boxes, consolidation point boxes, and Modular Panels.</td>
</tr>
<tr>
<td>1.6</td>
<td>Shall be mountable either at 90 degrees (straight) or 45 degrees (angled) in any faceplate.</td>
</tr>
<tr>
<td>1.7</td>
<td>Shall be certified by independent labs like ETL/GHMT for compliance to EIA/TIA-568C.2, (Report required).</td>
</tr>
<tr>
<td>1.8</td>
<td>Shall be RoHS Compliant.</td>
</tr>
<tr>
<td>1.9</td>
<td>Shall have minimum 25-Year Extended Product Warranty and system warranty</td>
</tr>
</tbody>
</table>

15.3.4 **Face plate for information outlet (Single / Dual)**

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Faceplate Single/ Dual/ Quad Port (Work Area End)</td>
</tr>
<tr>
<td>1</td>
<td>Minimum Specifications</td>
</tr>
<tr>
<td>1.1</td>
<td>Shall be Single/ Dual/ Quad Port (RJ45) square plate, dimension as per commercially available modular office furniture.</td>
</tr>
<tr>
<td>1.2</td>
<td>Shall have spring shuttered front access for preventing ingress of dust</td>
</tr>
<tr>
<td>1.3</td>
<td>Shall be supplied with Gang Box of the same size by System Integrator or OEM</td>
</tr>
<tr>
<td>1.4</td>
<td>Shall have Write on labels in transparent plastic window along with the plate</td>
</tr>
<tr>
<td>1.5</td>
<td>Shall have Screw hole covers along with the plate</td>
</tr>
<tr>
<td>1.6</td>
<td>Shall be able to support variety of jacks – UTP and STP Information outlets</td>
</tr>
</tbody>
</table>

15.3.5 **Category 6 patch cord (3 FEET / 7 FEET)**

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cat 6 UTP FRLS Patch Cable (Patch cord), TIA-568C Category-6, UL-listed</td>
</tr>
<tr>
<td>1</td>
<td>Minimum Specifications</td>
</tr>
<tr>
<td>1.1</td>
<td>Length shall be available in 1/2/3/5 meters or equivalent length in feet as per requirement considered in Estimate Proposal</td>
</tr>
<tr>
<td>1.2</td>
<td>All patch cords shall conform to Category 6 &amp; conductor shall be stranded for better flexibility</td>
</tr>
<tr>
<td>1.3</td>
<td>Shall support network line speeds up to 1 Gbps</td>
</tr>
<tr>
<td>1.4</td>
<td>Shall have RJ-45 jacks with transparent plugs at both the ends</td>
</tr>
<tr>
<td>1.5</td>
<td>All patch cords shall be factory crimped and packed</td>
</tr>
</tbody>
</table>
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Minimum Specifications / Functionalities / Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>Shall be RoHS Compliant</td>
</tr>
<tr>
<td>1.7</td>
<td>Shall have FRLS jacket for safety measures</td>
</tr>
<tr>
<td>1.8</td>
<td>Shall have a transparent / clear boot</td>
</tr>
<tr>
<td>1.9</td>
<td>Shall support applications such as 155 Mbps ATM, token ring &amp; VOIP.</td>
</tr>
<tr>
<td>1.10</td>
<td>Shall have minimum 25-Year Extended Product Warranty and system warranty</td>
</tr>
<tr>
<td>1.11</td>
<td>Colors- Blue, Grey, Yellow, Red &amp; Orange</td>
</tr>
</tbody>
</table>

15.3.6 Fiber Optic Cable

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

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

15.3.7  19" Wall mounted networking rack – 9U/ 15U – general specs

a) Floor Mount single section 2 fan provision 9U/ 15U 600W*600D
b) Should have Minimum 2 Nos. 230v AC Fans 90 CFM
c) Should have Minimum 1 Nos. A/C Box 6 Socket 5/15 amp metal
d) Should have Minimum 2 Nos. Cable Manager Metal - 1U
e) Should have Minimum 1 Nos. 19" Cantilever tray -1U

15.3.8  19" Wall mounted networking rack – 42U – general specs

a) Construction shall be single Section welded robust with ventilation holes on the sides
and top & bottom covers with provision to mount 2 fans
b) Top/ Bottom Covers and Side panels shall be of sheet steel and powder coated
c) Vertical 19" metric panel mounts and door trims shall be of sheet steel and powder coated
d) The top and bottom covers shall be provided with 35mm round cuts for cable entry and round cuts shall be edge protected with rubber grommets
e) Two pairs of 19" Equipment mounting angles with mounting holes conforming to IEC 297-3
f) Toughened glass front lockable door
g) Swinging door on hinges from left to right
h) Wall mounted 19" Networking rack shall be available in various heights
i) Cooling shall be achieved with the help of two fans, 900 CFM capacity each, mounted on top
j) Power - Power shall be provided in form 19" rack mountable power strip which shall consist of minimum four 5/15A power sockets. Power strip shall be provided with 20A MCB
k) Cantilever Shelf – Two number of front mounting 1U cantilever shelf shall be provided
l) Stationery Shelf – Two Number Stationery Shelf shall be provided for installing network equipment such as 8/16/24 port switch
m) 1U vertical cable managers on A/R (As Required Basis) for dressing of cables for 8/16/24 ports patch panel, 8/16/24 ports switch
n) Hardware Pack / Rack mounting accessories and hardware A/R
o) Horizontal managers on A/R basis for ensuring neat and aesthetically clean installation
p) Cabinet material – cabinet shall be made of 14 Gauge (2mm) thick cold rolled steel sheets or thicker
q) Finish – cabinet shall be black or grey epoxy powder-coated of durable quality
r) Load carrying capacity – min. 700 kg load of equipments should be mountable
s) Product must be UL listed and certified for use in Information Technology or Communication Equipment
t) EIA standard pattern design with 12-24 tapped holes (EIA-310-E compliant)
u) Dimensions – at least 42U usable height, 800mm (W), 800mm(D) (NETWORK RACK)
v) Dimensions – at least 42U usable height, 800mm (W), 1000mm(D) (SERVER RACK)

15.4 DATA NETWORKING PASSIVE FIBER OPTIC CABLE AND COMPONENTS

Manufacturer shall warrant the components and installation for a period of 15 years with test results.
The manufacturer shall have elaborate product & installation support system with toll-free telephone contact numbers available 24 x 7 365 days.

Following Technical Specifications Must have OEM, Warranty, and MAF as following criteria:

**OEM Criteria:**
1. No second Brand or Class B product of any O.E.M should be quoted
2. End to End Structured Cabling Products from Single Brand and Single OEM
3. The O.E.M should be ISO Certified
4. OEMs should have a minimum of 10 Years of presence in India. Proof of Documents should be attached.

**Warranty:**
1. Site certificates must be issued by OEM

**MAF:**
1. Bidder Must produce the manufacturer Authorization certificate from the OEM

### 16.0 ACCESS CONTROL SYSTEM:

#### 16.1 IP Based Door Controller with IP65

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Technical Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL</strong></td>
<td></td>
</tr>
<tr>
<td>Credential Support</td>
<td>Card+Fingerprint+face recognition</td>
</tr>
<tr>
<td>User Capacity</td>
<td>2000</td>
</tr>
<tr>
<td>IP65</td>
<td>Verified</td>
</tr>
<tr>
<td>Type of Card</td>
<td>EM Prox, HID Prox, HID iClass and Mifare (Card Module Required)</td>
</tr>
<tr>
<td><strong>DISPLAY</strong></td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>3.5” TFT Display with Capacitive Touch Panel</td>
</tr>
<tr>
<td>Display Size</td>
<td>320 x 240</td>
</tr>
<tr>
<td>Size of Wallpaper</td>
<td>512 Kb</td>
</tr>
<tr>
<td><strong>CAPACITY</strong></td>
<td></td>
</tr>
<tr>
<td>Cards Per User</td>
<td>2</td>
</tr>
<tr>
<td>Template Per User</td>
<td>Up to 10 (Single Template per Finger Mode)</td>
</tr>
<tr>
<td></td>
<td>Up to 5 (Dual Template per Finger Mode)</td>
</tr>
<tr>
<td>Events Buffer</td>
<td>5,00,000</td>
</tr>
<tr>
<td>Template Storage Capacity</td>
<td>9600 in 1:N Mode and 1 lac in 1:1 Mode</td>
</tr>
<tr>
<td><strong>COMMUNICATION</strong></td>
<td></td>
</tr>
<tr>
<td>Mobile Broadband</td>
<td>Yes (3G/4G Support)</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Yes (10/100 Mbps on Ethernet)</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Yes (802.11 b/g/n)</td>
</tr>
<tr>
<td>PoE</td>
<td>Yes (IEEE 802.3 af)</td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Technical Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERFACES</strong></td>
<td></td>
</tr>
<tr>
<td>Exit Switch</td>
<td>Yes</td>
</tr>
<tr>
<td>Door Status Sense</td>
<td>Programmable NO, NC, Supervised</td>
</tr>
<tr>
<td>Door Lock Relay</td>
<td>Form C, SPDT Relay (Max 2A@30 VDC)</td>
</tr>
<tr>
<td>Door Lock Power</td>
<td>Internal 12VDC @ 0.5A or External</td>
</tr>
<tr>
<td>Aux-IN</td>
<td>Programmable NO, NC, Supervised</td>
</tr>
<tr>
<td>Aux-OUT</td>
<td>Form C, SPDT Relay (Max 2A@30 VDC)</td>
</tr>
<tr>
<td>Reader Interface types</td>
<td>RS 232, and Wiegand IN/OUT</td>
</tr>
<tr>
<td>USB</td>
<td>1 USB Port (for Data Transfer and for 2G-3G Dongle)</td>
</tr>
<tr>
<td>Reader Types</td>
<td>1 Port for Card Reader / Finger Reader / Face Reader/Combo Reader / Third Party Wiegand reader</td>
</tr>
<tr>
<td><strong>AUDIO-VISUAL</strong></td>
<td>Buzzer Yes</td>
</tr>
<tr>
<td><strong>CONFIGURATION</strong></td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>800 MHz ARM Cortex A8 based Processor</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>256 MB Flash</td>
</tr>
<tr>
<td>RAM Memory</td>
<td>512 MB DDR3 RAM</td>
</tr>
<tr>
<td>Micro SD Card</td>
<td>Yes (Inbuilt 4 GB)</td>
</tr>
<tr>
<td><strong>ELECTRICAL</strong></td>
<td></td>
</tr>
<tr>
<td>Input Power</td>
<td>12 VDC @ 2A</td>
</tr>
<tr>
<td>Reader Power Output</td>
<td>Internal 12 VDC @ 0.5 A or External</td>
</tr>
<tr>
<td>Backup Battery</td>
<td>Yes/UPS backup</td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>5% to 85% RH Non-Condensing</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>0°C to + 50°C (32°F to 122°F)</td>
</tr>
<tr>
<td><strong>OTHERS</strong></td>
<td></td>
</tr>
<tr>
<td>System Integration</td>
<td>Software API for Software Integration</td>
</tr>
<tr>
<td>Operational Mode</td>
<td>Direct Door with Server</td>
</tr>
<tr>
<td>Tamper Detection</td>
<td>Yes</td>
</tr>
<tr>
<td>Certification</td>
<td>RoHS, CE, BIS</td>
</tr>
<tr>
<td>Shock Proof</td>
<td>Yes</td>
</tr>
<tr>
<td>Vibration Proof</td>
<td>Yes</td>
</tr>
<tr>
<td>Real Time Clock</td>
<td>Rechargeable RTC with NTP Server/ GPS Clock</td>
</tr>
<tr>
<td><strong>SENSOR SPECIFICATIONS</strong></td>
<td></td>
</tr>
<tr>
<td>Sensing Area</td>
<td>15.9mm x 17.9mm (0.62&quot; x 0.70&quot;)</td>
</tr>
<tr>
<td>Sensor Technology</td>
<td>Suprema Optical Sensor</td>
</tr>
<tr>
<td>Image Size in Pixels</td>
<td>288 x 288</td>
</tr>
<tr>
<td>Image Resolution in DPI</td>
<td>500</td>
</tr>
<tr>
<td>Identification Time</td>
<td>&lt; 1sec</td>
</tr>
<tr>
<td>Equal Error rate (ERR)</td>
<td>&lt; 0.1%</td>
</tr>
<tr>
<td>Water-proof</td>
<td>IP65, Scratch Resistance</td>
</tr>
</tbody>
</table>
### Parameters | Technical Details
--- | ---
Verification Time | < 1 sec (less than 3000 templates)
Template Size | 384 bytes
Fingerprint Module | ISO 19794-2 Compliant
ISO Card Support | No ISO Standards
Mifare Card - 13.56 MHz | ISO 14443 A Supported
HID iCLASS Card - 13.56 MHz | ISO 14443 and ISO 15693 Supported
DesFire Card - 13.56 MHz | ISO 14443 A Supported (Read Only)

### 16.2 Electronic Locking System

| Description | Details |
--- | ---
Power | 4.5 V DC |
Metal Finishes | Satin Chrome (Stainless Steel with PVD) |
Standard plastic color | Black RAL 9005 (RFID cover, end caps and battery cover) |
Handle options in standard range | Straight Handle (as standard) |
Emergency opening options | Electronic emergency opening with service unit and No mechanical cylinder |
User interface | 3 colored LED display (green, red, yellow) |
Locking mechanism | Electro-mechanical locking mechanism located in the lockcase |
System Software compatibility | Visionline and Vision |
Online compatibility | Wireless |
Tested operating temperature | Tested from -25 °C to 70 °C (-13 °F to 158°F), according to IEC 60068-2. |
Fire Certifications | Fire-listed for use on fire doors |
ISO Support | Compatible with the following standards: - a) ISO 14.443 A (MIFARE including Desire) b) ISO 14.443 B c) ISO 15.693 |

### 16.3 Software System

| Description | Details |
--- | ---
Mobile Access Compatibility | Mobile Access Compatible |
Validation period | Keycards are automatically activated upon check-in and keycards are automatically de-activated upon check-out |
Online room management | Block users, cancel access, reassign rooms, etc |
System integration | Add on to the system to include other product solutions |
Customized reports | Define criteria to create in report |
Counter | Use counters to limit the number of times guests can access certain areas |

17. Cat6 Cables, Patch Cords, Information Outlet, Face Plate and Switches:

a. Cat6 Cables:
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Type as per ANSI/TIA 568C.2 at 250MHz</td>
<td>U/ UTP, Cat 6 Cable tested upto 700MHz with Third party certificate.</td>
</tr>
<tr>
<td></td>
<td>Insulation</td>
<td>Solid PE Ø0.96 mm</td>
</tr>
<tr>
<td></td>
<td>Conductor</td>
<td>23 AWG solid bare copper with a Diameter ≥0.56 mm</td>
</tr>
<tr>
<td></td>
<td>Separator</td>
<td>X shaped separator</td>
</tr>
<tr>
<td></td>
<td>Type of Sleeve</td>
<td>PVC / LSZH</td>
</tr>
<tr>
<td></td>
<td>Maximum Attenuation</td>
<td>32.8 dB per 100m</td>
</tr>
<tr>
<td></td>
<td>Min Next (dB)</td>
<td>38.3</td>
</tr>
<tr>
<td></td>
<td>PS NEXT</td>
<td>36.3</td>
</tr>
<tr>
<td></td>
<td>ACRF (dB/100m)</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>Return Loss (dB)</td>
<td>17.3</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Electrical Specifications at 20 Deg C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type</td>
<td>Unshielded Twisted Pair, Category 6, as per IEC 61156-5</td>
</tr>
<tr>
<td></td>
<td>Max linear resistance</td>
<td>95 Ohms per KM</td>
</tr>
<tr>
<td></td>
<td>DC dielectric strength</td>
<td>1KV/ 1 minute</td>
</tr>
<tr>
<td></td>
<td>Minimum Insulation Resistance</td>
<td>5000 Mohm.km</td>
</tr>
<tr>
<td></td>
<td>Minimum Propogation Speed</td>
<td>&gt;65%</td>
</tr>
<tr>
<td></td>
<td>Characteristic Impedance from 1 to 100 MHz</td>
<td>100 Ohm ± 15%</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Mechanical Features</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diameter Over Insulation (mm)</td>
<td>1.02 ± 0.06</td>
</tr>
<tr>
<td></td>
<td>Cable Diameter (mm)</td>
<td>6.1 ± 0.3</td>
</tr>
<tr>
<td></td>
<td>Min. bending radius when laying (mm)</td>
<td>25</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>ENVIRONMENTAL FEATURES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usage Temperature</td>
<td>-20 to + 60 degree C</td>
</tr>
<tr>
<td></td>
<td>Transport temperature</td>
<td>0 to + 50 °C</td>
</tr>
<tr>
<td></td>
<td>Fire rating :</td>
<td>IEC 60332-1-2, EN 60332-1-2</td>
</tr>
<tr>
<td></td>
<td>EUROCLASS</td>
<td>EUROCLASS EN 13501-6 = Class Eca</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>STANDARDS AND APPROVALS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approvals</td>
<td>UL Certified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3P Certified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ETL verified to TIA / EIA Cat 6</td>
</tr>
<tr>
<td></td>
<td>Packing</td>
<td>Box of 305 meters</td>
</tr>
<tr>
<td></td>
<td>Color</td>
<td>Blue RAL 5015</td>
</tr>
<tr>
<td></td>
<td>Performance characteristics to be provided</td>
<td>The cable NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT test result should meet &amp; exceed the performance requirement as per as per ANSI/TIA 568C.2, ISO/IEC 11801, &amp; EN50173-1, EN 50288-6-1, ISO/IEC 11801 (ed. 2.2), IEC 61156-5, IEEE 802.3at : PoE+</td>
</tr>
<tr>
<td></td>
<td>Warranty</td>
<td>25-year systems warranty</td>
</tr>
</tbody>
</table>

---

**b. Patch Cord:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E</strong></td>
<td>Product Category: Copper Patch Cord</td>
<td></td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Type: CAT6 Patch cords - 1, 2, 3, 5 Mtr</td>
<td>U/ UTP, Cat 6 Patch Cord</td>
</tr>
<tr>
<td></td>
<td>Sleeve</td>
<td>PVC or LSZH</td>
</tr>
<tr>
<td></td>
<td>Performance at 250MHz</td>
<td>Should be as per Standards - IEC 61935-2 - Ed. 3.0 ISO/IEC 11801</td>
</tr>
<tr>
<td></td>
<td>Usage Temperature</td>
<td>– 20 to + 60°C</td>
</tr>
<tr>
<td></td>
<td>Minimum Next (dB)</td>
<td>Minimum NEXT (dB)</td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Meter</td>
<td>39.5</td>
</tr>
<tr>
<td></td>
<td>2 Meter</td>
<td>39.5</td>
</tr>
<tr>
<td></td>
<td>3 Meter</td>
<td>39.5</td>
</tr>
<tr>
<td></td>
<td>5 Meter</td>
<td>39.5</td>
</tr>
<tr>
<td></td>
<td>Return Loss (dB)</td>
<td>Return Loss (dB)</td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>1 Meter</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>2 Meter</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>3 Meter</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>5 Meter</td>
<td>14</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Technical and Mechanical Features</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type</td>
<td>UTP</td>
</tr>
<tr>
<td></td>
<td>Diameter over Insulation (mm)</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>Cable Diameter (mm)</td>
<td>6±0.2</td>
</tr>
<tr>
<td></td>
<td>No of Twists</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>No of insertions</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>AWG gauge</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Tensile Strength of the cord</td>
<td>≥ 50 N</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Electrical Features</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Characteristic impedance from 1 to 250 MHz</td>
<td>100 Ω ± 15</td>
</tr>
<tr>
<td></td>
<td>Loop resistance</td>
<td>&lt; 2 Ω</td>
</tr>
<tr>
<td></td>
<td>Contact Resistance</td>
<td>Less than 20 m Ohm</td>
</tr>
<tr>
<td></td>
<td>Total Resistance of the cord</td>
<td>Less than 5 Ohms</td>
</tr>
<tr>
<td></td>
<td>Resistance per 100m of cable with cord</td>
<td>Less than 14 Ohm</td>
</tr>
<tr>
<td></td>
<td>DC Dielectric Strength</td>
<td>1 KV/ 1 min</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>ENVIRONMENTAL FEATURES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Storage and transport temperature</td>
<td>0 to + 50°C</td>
</tr>
<tr>
<td></td>
<td>Usage temperature</td>
<td>– 20 to + 60°C</td>
</tr>
<tr>
<td></td>
<td>Fire resistance</td>
<td>IEC 60332-1, UL VW-1</td>
</tr>
<tr>
<td></td>
<td>STANDARDS AND APPROVALS</td>
<td>EN 50173 ISO/IEC 60603-7</td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works) - Additional / Particular Specifications

#### ISO/IEC 11801

**c. Information Outlet:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>CAT6 RJ45 Information Outlet</td>
<td>UTP Cat 6 RJ 45 Sockets</td>
</tr>
<tr>
<td></td>
<td>The electrical performance of installation outlet shall meet or exceed requirement as per - ISO/IEC 11801 Edition 2; - CENELEC EN 50173-1 2007; - ANSI/EIA/TIA 568-C.2; - IEC series 60603-7</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Standards and Approvals</td>
<td>The information outlet NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss should be verified</td>
</tr>
<tr>
<td>C</td>
<td>Performance characteristics to be provided for CAT6 @ 250 MHz</td>
<td>Should Accept RJ11 (4 contacts), RJ12 (6 contacts), RJ45 (9 contacts).</td>
</tr>
<tr>
<td>D</td>
<td>Connection of RJ 45</td>
<td>Single-wire: 0.5 to 0.65 mm, AWG 22 to 25 Multiple-wire: AWG 26 Polyethylene conductor insulation: max Ø with insulation 1.58 mm</td>
</tr>
<tr>
<td>E</td>
<td>Conductors Supported</td>
<td>Information outlet should have transparent shutter for protection against dust when not used.</td>
</tr>
<tr>
<td>F</td>
<td>Shutter</td>
<td>The information outlet termination should be of self crimping type without use of 110 punching tool requirement</td>
</tr>
<tr>
<td>G</td>
<td>Tool Less Crimping</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Material Specifications</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Body</td>
<td>Contacts :gold/nickel, minimum thickness of gold &gt; 0.8 μm</td>
</tr>
<tr>
<td>2</td>
<td>Metal parts: bronze, nickel, platinum, gold</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The information outlet shall be made of high impact PBT Polycarbonate plastic material</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>For STP Products the body and spreader are made of metal alloy with a copper-nickel coating.</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Electrical Specifications</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Break Down Voltage</td>
<td>Greater than or equal to 1000V</td>
</tr>
<tr>
<td>2</td>
<td>Contact Resistance</td>
<td>Less than or equal to 20mOhms</td>
</tr>
<tr>
<td>3</td>
<td>Insulation Resistance</td>
<td>Greater than or equal to 500 M Ohm at 100 V DC</td>
</tr>
<tr>
<td>4</td>
<td>Load Testing</td>
<td>Connector should be tested and guaranteed under PoE restrictions, IEEE 802.3af standard and PoE+, draft standard 802.3at, up to 2500 on-load connections / disconnections. Tested with 2 simultaneous PoE+ circuits for a minimum total power of 50 W</td>
</tr>
<tr>
<td>J</td>
<td>Mechanical Specifications</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Maximum no of Connections/ Reconnections</td>
<td>5 without refreshing the wiring.</td>
</tr>
<tr>
<td>2</td>
<td>Endurance</td>
<td>2500 movements (plug insertion/withdrawal). IK03</td>
</tr>
<tr>
<td>3</td>
<td>Temperature</td>
<td>-40 Deg C to +70 Deg C</td>
</tr>
</tbody>
</table>

**d. Face Plate:**
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Material</td>
<td>Polycarbonate Hi-Grade Plastic FR Grade &amp; UV Resistant 850 degree C/ Glow Wire Test</td>
</tr>
<tr>
<td>B</td>
<td>Compatibility</td>
<td>The face plate should be compatible for Cat5e, Cat6 and Cat6A range of RJ45 and AV connectors.</td>
</tr>
<tr>
<td>C</td>
<td>Size</td>
<td>The face plate Size should be of minimum 86x86mm</td>
</tr>
</tbody>
</table>

**e. Switches:-**

i. **Layer 3 – Core Switch**

<table>
<thead>
<tr>
<th>Layer 3 Full Manage 24 Port Giga Switch</th>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architecture</strong></td>
<td></td>
</tr>
<tr>
<td>Modular switch with 20<em>10/100/1000BASE-T ports, additional 4</em>Combo 10/100/1000BASE-T/SFP ports and additional 4 SFP+ ports for uplink to Switch/Servers or Stacking.</td>
<td></td>
</tr>
<tr>
<td>Switch should provide option of redundant power supply.</td>
<td></td>
</tr>
<tr>
<td>Switch shall have Min. 256 MB SD RAM &amp; 128 MB Flash Memory.</td>
<td></td>
</tr>
<tr>
<td>Switch shall have SD Card slot for easy file store &amp; restoration like firmware, configuration file, boot image, syslog etc.</td>
<td></td>
</tr>
<tr>
<td>Switch shall provide digital I/O design through external alarm port to have better security protection.</td>
<td></td>
</tr>
<tr>
<td>Switch shall be able to receive events detected by external sensors (e.g. temperature, smoking or anti-theft sensor). The switch shall be able to send a trap/log out to report the issue.</td>
<td></td>
</tr>
<tr>
<td>Switch shall be able to activate external air-conditioner/fan or ring the bell based on the condition defined by the user.</td>
<td></td>
</tr>
<tr>
<td><strong>Network Media</strong></td>
<td></td>
</tr>
<tr>
<td>Supported SFP Transceivers: 1000Base-LX, 1000Base-SX, 1000Base-TX, 1000Base-LHX, 1000Base-ZX and 1000Base-BX WDM.</td>
<td></td>
</tr>
<tr>
<td>Supported SFP+ Transceivers: 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-ZR, 10GBASE-LRM, 1000Base-LX, 1000ase-SX, 1000BASE-LHX and 1000BASE-ZX.</td>
<td></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>The Switch shall have Non-blocking wire speed switch fabric.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall have Min. 128Gbps Back plane or more.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall have Min.95Mpps or more.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall support Min. 32K Mac address or more.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall support Min. 4000 VLANs.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall support IPv4/IPv6 Routing including IPv6 Tunnel, ICMPv6, IPv6 Neighbor Discovery (ND), DHCPv6, RIPng and OSPFv3.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall have 40 Gigabit Stacking Backplane.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall be able to do Physical Stack up to 10 units per stack or more.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall be able to do IP Stacking up to 30 units per IP.</td>
<td></td>
</tr>
</tbody>
</table>
### Layer 3 Full Manage 24 Port Giga Switch

<table>
<thead>
<tr>
<th>Feature</th>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layer 3 Features</strong></td>
<td></td>
</tr>
<tr>
<td>The Switch should support Jumbo Frame (up to 9216 Bytes).</td>
<td></td>
</tr>
<tr>
<td>The Switch should have RIPIv1 (RFC1058)/RIPIv2 (RFC2453), RIIPng, OSPFv2, OSPFv3, MPLS, MPLS VPN, VRF, LDP.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have Policy Based Routing, BGP 4 &amp; VRRP.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have DVMRP v3, PIM-DM/SM/SDM for IPv4.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have IPv6 Tunneling.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have Up to 256 IP Interfaces &amp; 10K route entries or more.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have Multi Path Routing support for Equal cost &amp; Weighted Cost.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have per port Limit IP Multicast Address Range for Control Packet.</td>
<td></td>
</tr>
<tr>
<td><strong>Layer 2 Features</strong></td>
<td></td>
</tr>
<tr>
<td>The Switch should have IGMP Snooping v1, v2 and v3 &amp; MLD Snooping.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have Spanning tree 802.1d, 802.1w and 802.1s.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have 802.3ad Link Aggregation Up to 30 groups per device.</td>
<td></td>
</tr>
<tr>
<td>The Switch should have Port Mirroring One to one/Many to One &amp; RSPAN.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall have the capability to build the trunk across stack.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall support IEEE 802.3ah, IEEE 802.1ag, 802.1AX &amp; ITU-T Y.1731.</td>
<td></td>
</tr>
<tr>
<td>It shall support LLDP and LLDP-MED including client location information. It shall exchange link and device information in multi-vendor networks.</td>
<td></td>
</tr>
<tr>
<td><strong>VLAN</strong></td>
<td></td>
</tr>
<tr>
<td>The LAN switch shall have IEEE 802.1Q VLAN encapsulation. Up to 255 VLANs per switch and up to 4000 VLAN IDs.</td>
<td></td>
</tr>
<tr>
<td>It shall have Automatic Negotiation of Trunking Protocol, to help minimize the configuration &amp; errors.</td>
<td></td>
</tr>
<tr>
<td>It shall have centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the others switches automatically, thus reducing the overhead of creating/modifying/deleting VLANs in all the switches in turn eliminating the configuration errors &amp; troubleshooting.</td>
<td></td>
</tr>
<tr>
<td>It shall have support for Detection of Unidirectional links and to disable them to avoid problems such as spanning tree loops.</td>
<td></td>
</tr>
<tr>
<td>It shall support 802.1v &amp; Q-in-Q VLAN.</td>
<td></td>
</tr>
<tr>
<td><strong>Quality of Service</strong></td>
<td></td>
</tr>
<tr>
<td>It shall support 802.1p Priority Queues (8 Queues).</td>
<td></td>
</tr>
<tr>
<td>Queue handling mode: WRR &amp; Strict Mode.</td>
<td></td>
</tr>
<tr>
<td>Granular Rate Limiting functions on per port &amp; flow based to guarantee bandwidth in increments shall be as low as 64 Kilobits Per Second.</td>
<td></td>
</tr>
<tr>
<td>Switch shall support three color marker with CIR/PIR minimum granularity of 1 kbps.</td>
<td></td>
</tr>
<tr>
<td>Class of service shall be based on Switch port, DSCP, VLAN ID, TCP/UDP port, Protocol type, 802.1p queues, IPv4/v6 address, IPv6 flow label &amp; User defined packet content.</td>
<td></td>
</tr>
<tr>
<td><strong>Layer 3 Full Manage 24 Port Giga Switch</strong></td>
<td><strong>Compliance (Yes/No)</strong></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>Access Control List</strong></td>
<td></td>
</tr>
<tr>
<td>The LAN Switch shall have the capability to apply access list control based on IPv4/v6 address, Protocol type, IPv6 flow label, Time based ACL, VLAN-ID, MAC-ID, DSCP, IPv6 traffic class, TCP/UDP Port, Switch port &amp; user defined packet content.</td>
<td></td>
</tr>
<tr>
<td>The Switch shall support up to 1600 Access Control Entries minimum.</td>
<td></td>
</tr>
<tr>
<td><strong>Network Security</strong></td>
<td></td>
</tr>
<tr>
<td>The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.</td>
<td></td>
</tr>
<tr>
<td>The LAN switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent and respond to security threats and also to enable the switches to collaborate with third-party such as Microsoft for security-policy compliance and enforcement before a host is permitted to access the network.</td>
<td></td>
</tr>
<tr>
<td>It shall support for RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.</td>
<td></td>
</tr>
<tr>
<td>It shall support DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.</td>
<td></td>
</tr>
<tr>
<td>It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.</td>
<td></td>
</tr>
<tr>
<td>It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port. (up to 14 MAC-ID per port).</td>
<td></td>
</tr>
<tr>
<td>It shall have MAC-IP-Port binding up with support for ACL mode to 475 Entries per device.</td>
<td></td>
</tr>
<tr>
<td>It shall have Web &amp; MAC Based Access Control.</td>
<td></td>
</tr>
<tr>
<td>It shall have CPU Filtering to protect the CPU from Broadcast / Multicast / Unicast flooding &amp; protocol control packets attacks.</td>
<td></td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td></td>
</tr>
<tr>
<td>The LAN switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.</td>
<td></td>
</tr>
<tr>
<td>It shall have Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms and events) for enhanced traffic management, monitoring and analysis.</td>
<td></td>
</tr>
<tr>
<td>It shall support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location.</td>
<td></td>
</tr>
<tr>
<td>It shall support Network Timing Protocol (NTP/SNTP) to provide an accurate and consistent timestamp to all intranet switches.</td>
<td></td>
</tr>
<tr>
<td>It shall support SNMPv1, SNMPv2c, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management.</td>
<td></td>
</tr>
</tbody>
</table>
### Layer 3 Full Manage 24 Port Giga Switch

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It shall provide management functions for network segments (access links and individual circuits), monitors individual links.</td>
</tr>
<tr>
<td>It shall have traffic monitoring for all network ports effective at gigabit speed or higher, shall not impact the network performance while providing the real time &amp; historical data of all devices from Layer 2 to Layer 7.</td>
</tr>
<tr>
<td>It shall support configuration rollback to replace current configuration with any saved configuration file.</td>
</tr>
<tr>
<td>Switch shall be capable to store multiple image file and configuration.</td>
</tr>
<tr>
<td>Switch should have RFC3176 Flow</td>
</tr>
<tr>
<td>Switch shall consume less power through auto-detection of link status and cable length.</td>
</tr>
<tr>
<td>Certification</td>
</tr>
<tr>
<td>Switch should be CE, FCC, UL, VCCI, ERTL certified.</td>
</tr>
<tr>
<td>Switch should be functionally test and verified from ERTL and vendor need to present complete functional test report from ERTL.</td>
</tr>
</tbody>
</table>

### Layer 2 Manageable - TYPE - 1 (Non-PoE)

#### Layer 2 Manageable 8/16/24 Port Giga Switch

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
</tr>
<tr>
<td>Number of Ports: 8/16/24<em>10/100/1000 Mbps, Additional 2</em>Gigabit Combo Mini-GBIC SFP Port. RJ-45/RS-232 Console Port.</td>
</tr>
<tr>
<td>Port Standards &amp; Functions: IEEE 802.3 10BASE-T Ethernet, IEEE 802.3u 100BASE-TX Fast Ethernet, IEEE 802.3ab 1000BASE-T Gigabit Ethernet, 802.3ae 10 GbE, IEEE 802.3x Flow Control for Full-Duplex Mode, Auto-negotiation</td>
</tr>
<tr>
<td>Should support IEEE 802.3az Energy Efficient Ethernet.</td>
</tr>
<tr>
<td>Performance</td>
</tr>
<tr>
<td>Switching Capacity should be 56 Gbps or more.</td>
</tr>
<tr>
<td>64-byte Packet Forwarding rate should be 41.67 Mpps or more.</td>
</tr>
<tr>
<td>MAC Address Table should be 16K or more.</td>
</tr>
<tr>
<td>L2 Features</td>
</tr>
<tr>
<td>Should support Head of Line blocking prevention for lower latency and better performance.</td>
</tr>
<tr>
<td>Support Jumbo Frame up to 9000 Bytes or higher.</td>
</tr>
<tr>
<td>Should support IGMP Snooping, Able to create 500 or more IGMP groups and require support for Host-based IGMP Snooping Fast Leave.</td>
</tr>
<tr>
<td>Should support MLD Snooping</td>
</tr>
<tr>
<td>Should have 802.1D STP, 802.1w RSTP and 802.1s MSTP Spanning Tree Protocol.</td>
</tr>
<tr>
<td>Should support Loop Back detection.</td>
</tr>
<tr>
<td>Should support Multicast Filtering to filters or forward all unregistered groups.</td>
</tr>
<tr>
<td>Should have ERPS as per standard ITU-T G.8032 to provide sub-50ms protection for Ethernet traffic in ring topology.</td>
</tr>
<tr>
<td>VLAN</td>
</tr>
</tbody>
</table>
### Layer 2 Manageable 8/16/24 Port Giga Switch

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Require IEEE 802.1Q Tagged VLAN protocol.</td>
<td></td>
</tr>
<tr>
<td>Should support 4K VLAN Groups and configurable VLAN ID: 0 to 4094</td>
<td></td>
</tr>
<tr>
<td>Should support Auto Voice VLAN, GVRP, Asymmetric VLAN and Auto Surveillance VLAN</td>
<td></td>
</tr>
</tbody>
</table>

#### Quality of Service (QoS)
- Should support 802.1p Quality of Service with 4 queues per port.
- Should support Queue Handling with Strict Priority Queue, Weighted Round Robin, Deficit Round Robin (DRR) and SPQ + WRR.
- Should support CoS based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label.

#### Access Control List (ACL)
- Support at least 500 ACL rules, each rule should be applied on single/multiple ports.
- Should support Access Control List based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label.
- Should support Time-based ACL.

#### Layer 3 Features
- Should have IPv4 routing minimum up to 512 static route & up to 128 IP interface.
- Should support for CIDR
- DHCP Server:
  - Switch functions as an IPv4 DHCP Server serving IP addresses for multiple DHCP pools/scopes Support for DHCP options

#### Management
- Able to manage through Web-GUI, Fully functional CLI interface and Telnet.
- Should support SNMP v1, v2c, v3 and SNMP Traps and Remote Monitoring (RMON).
- Should have dual Image support to reduced down time for the switches.
- Should support Cable Diagnostics to test copper cables and determine the quality of the cables and the types of error.
- Should have SNTP/NTP protocol for time synchronization.
- Should have IPv4/v6 Dual Stack.
- Should support LLDP and LLDP-MED.

#### Physical/Environmental
- AC Input: 100 to 240 VAC, 50/60 Hz internal universal power supply
- Operating Temperature: -5 to 50 °C (41 to 122 °F)
- Certifications: CE, FCC, C-Tick, VCCI, BSMI, CCC

#### Safety: cUL, CB
- Switch should be supplied with the all necessary hardware accessories like Power cord, Rack-mount bracket, Installation Guide, etc. and necessary software image file to fulfill all above mention feature set from day 1.
## Layer 2 Manageable - TYPE - 2 (POE)

<table>
<thead>
<tr>
<th>Layer 2 Manageable 8/16/24 Port Giga Switch</th>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Number of Ports: 8/16/24<em>10/100/1000 Mbps, Additional 2</em>Gigabit Combo Mini-GBIC SFP Port. RJ-45/RS-232 Console Port.</td>
<td></td>
</tr>
<tr>
<td>Port Standards &amp; Functions: IEEE 802.3 10BASE-T Ethernet, IEEE 802.3u 100BASE-TX Fast Ethernet, IEEE 802.3ab 1000BASE-T Gigabit Ethernet, 802.3ae 10 GbE, IEEE 802.3x Flow Control for Full-Duplex Mode, Auto-negotiation</td>
<td></td>
</tr>
<tr>
<td>Should support IEEE 802.3az Energy Efficient Ethernet.</td>
<td></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Switching Capacity should be 56 Gbps or more.</td>
<td></td>
</tr>
<tr>
<td>64-byte Packet Forwarding rate should be 41.67 Mpps or more.</td>
<td></td>
</tr>
<tr>
<td>MAC Address Table should be 16K or more.</td>
<td></td>
</tr>
<tr>
<td><strong>L2 Features</strong></td>
<td></td>
</tr>
<tr>
<td>Should support Head of Line blocking prevention for lower latency and better performance.</td>
<td></td>
</tr>
<tr>
<td>Support Jumbo Frame up to 9000 Bytes or higher.</td>
<td></td>
</tr>
<tr>
<td>Should support IGMP Snooping, Able to create 500 or more IGMP groups and require support for Host-based IGMP Snooping Fast Leave.</td>
<td></td>
</tr>
<tr>
<td>Should support MLD Snooping</td>
<td></td>
</tr>
<tr>
<td>Should have 802.1D STP, 802.1w RSTP and 802.1s MSTP Spanning Tree Protocol.</td>
<td></td>
</tr>
<tr>
<td>Should support Loop Back detection.</td>
<td></td>
</tr>
<tr>
<td>Should support Multicast Filtering to filters or forward all unregistered groups.</td>
<td></td>
</tr>
<tr>
<td>Should have ERPS as per standard ITU-T G.8032 to provide sub-50ms protection for Ethernet traffic in ring topology.</td>
<td></td>
</tr>
<tr>
<td><strong>VLAN</strong></td>
<td></td>
</tr>
<tr>
<td>Require IEEE 802.1Q Tagged VLAN protocol.</td>
<td></td>
</tr>
<tr>
<td>Should support 4K VLAN Groups and configurable VLAN ID: 0 to 4094</td>
<td></td>
</tr>
<tr>
<td>Should support Auto Voice VLAN, GVRP, Asymmetric VLAN and Auto Surveillance VLAN</td>
<td></td>
</tr>
<tr>
<td><strong>Quality of Service (QoS)</strong></td>
<td></td>
</tr>
<tr>
<td>Should support 802.1p Quality of Service with 4 queues per port.</td>
<td></td>
</tr>
<tr>
<td>Should support Queue Handling with Strict Priority Queue, Weighted Round Robin, Deficit Round Robin (DRR) and SPQ + WRR.</td>
<td></td>
</tr>
<tr>
<td>Should support CoS based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label.</td>
<td></td>
</tr>
<tr>
<td><strong>Power Of Ethernet</strong></td>
<td></td>
</tr>
<tr>
<td>802.3af PoE delivered over any of the RJ-45 ports within the listed power budgets</td>
<td></td>
</tr>
<tr>
<td>Switches support 802.3af, 10/100 or Gigabit Ethernet port with 15.4W for PoE supported devices, until the PoE budget for the switch is reached . The total 180Watt power budget for switch</td>
<td></td>
</tr>
</tbody>
</table>
### Part C: Minor Component (E&M Works)- Additional / Particular Specifications

#### Layer 2 Manageable 8/16/24 Port Giga Switch

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Control List (ACL)</strong></td>
</tr>
<tr>
<td>Support at least 500 ACL rules, each rule should be applied on single/multiple ports.</td>
</tr>
<tr>
<td>Should support Access Control List based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label.</td>
</tr>
<tr>
<td>Should support Time-based ACL.</td>
</tr>
</tbody>
</table>

#### Layer 3 Features

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should have IPv4 routing minimum up to 512 static route &amp; up to 128 IP interface</td>
</tr>
<tr>
<td>Should support for CIDR</td>
</tr>
<tr>
<td>DHCP Server - Switch functions as an IPv4 DHCP Server serving IP addresses for multiple DHCP pools/scopes Support for DHCP options</td>
</tr>
</tbody>
</table>

#### Management

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to manage through Web-GUI, Fully functional CLI interface and Telnet.</td>
</tr>
<tr>
<td>Should support SNMP v1, v2c, v3 and SNMP Traps and Remote Monitoring (RMON).</td>
</tr>
<tr>
<td>Should have dual Image support to reduced down time for the switches.</td>
</tr>
<tr>
<td>Should support Cable Diagnostics to test copper cables and determine the quality of the cables and the types of error.</td>
</tr>
<tr>
<td>Should have SNTP/NTP protocol for time synchronization.</td>
</tr>
<tr>
<td>Should have IPv4/v6 Dual Stack.</td>
</tr>
<tr>
<td>Should support LLDP and LLDP-MED.</td>
</tr>
</tbody>
</table>

#### Physical/Environmental

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Input: 100 to 240 VAC, 50/60 Hz internal universal power supply</td>
</tr>
<tr>
<td>Operating Temperature: -5 to 50 °C (41 to 122 °F)</td>
</tr>
<tr>
<td>Certifications: CE, FCC, C-Tick, VCCI, BSMI, CCC</td>
</tr>
</tbody>
</table>

#### Safety: cUL, CB

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch should be supplied with the all necessary hardware accessories like Power cord, Rack-mount bracket, Installation Guide, etc. and necessary software image file to fulfill all above mention feature set from day 1.</td>
</tr>
</tbody>
</table>

iv. **Layer 2 Manageable - TYPE - 3**

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layer 2 Manageable 48 Port Giga Switch</strong></td>
</tr>
<tr>
<td>General</td>
</tr>
<tr>
<td>Port Standards &amp; Functions: IEEE 802.3 10BASE-T Ethernet, IEEE 802.3u 100BASE-TX Fast Ethernet, IEEE 802.3ab 1000BASE-T Gigabit Ethernet, 802.3ae 10 GbE, IEEE 802.3x Flow Control for Full-Duplex Mode, Auto-negotiation</td>
</tr>
<tr>
<td>Should support IEEE 802.3az Energy Efficient Ethernet.</td>
</tr>
</tbody>
</table>

#### Performance
### Layer 2 Manageable 48 Port Giga Switch

<table>
<thead>
<tr>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Capacity should be 104 Gbps or more.</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>64-byte Packet Forwarding rate should be 77 Mpps or more.</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>MAC Address Table should be 16K or more.</td>
</tr>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

### L2 Features

|  
| Should support Head of Line blocking prevention for lower latency and better performance. |
| Yes |
| Support Jumbo Frame up to 9000 Bytes or higher. |
| Yes |
| Should support IGMP Snooping, Able to create 500 or more IGMP groups and require support for Host-based IGMP Snooping Fast Leave. |
| Yes |
| Should support MLD Snooping |
| Yes |
| Should have 802.1D STP, 802.1w RSTP and 802.1s MSTP Spanning Tree Protocol. |
| Yes |
| Should support Loop Back detection. |
| Yes |
| Should support Multicast Filtering to filters or forward all unregistered groups. |
| Yes |
| Should have ERPS as per standard ITU-T G.8032 to provide sub-50ms protection for Ethernet traffic in ring topology. |
| Yes |

### VLAN

| Require IEEE 802.1Q Tagged VLAN protocol. |
| Yes |
| Should support 4K VLAN Groups and configurable VLAN ID: 0 to 4094 |
| Yes |
| Should support Auto Voice VLAN, GVRP, Asymmetric VLAN and Auto Surveillance VLAN |
| Yes |

### Quality of Service (QoS)

| Should support 802.1p Quality of Service with 4 queues per port. |
| Yes |
| Should support Queue Handling with Strict Priority Queue, Weighted Round Robin, Deficit Round Robin (DRR) and SPQ + WRR. |
| Yes |
| Should support CoS based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label. |
| Yes |

### Access Control List (ACL)

| Support at least 500 ACL rules, each rule should be applied on single/multiple ports. |
| Yes |
| Should support Access Control List based on 802.1p priority, VLAN, MAC address, Ether type, IP address, DSCP, Protocol type, TCP/UDP port number, DSCP of IPv6 Traffic Class and IPv6 flow label. |
| Yes |
| Should support Time-based ACL. |
| Yes |

### Layer 3 Features

| Should have IPv4 routing minimum up to 512 static route & up to 128 IP interface |
| Yes |
| Should support for CIDR |
| Yes |
| DHCP Server - Switch functions as an IPv4 DHCP Server serving IP addresses for multiple DHCP pools/scopes Support for DHCP options |
| Yes |

### Management

| Able to manage trough Web-GUI, Fully functional CLI interface and Telnet. |
| Yes |
| Should support SNMP v1, v2c, v3 and SNMP Traps and Remote Monitoring (RMON). |
| Yes |
### Layer 2 Manageable 48 Port Giga Switch

<table>
<thead>
<tr>
<th>Specification</th>
<th>Compliance (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should have dual Image support to reduce down time for the switches.</td>
<td></td>
</tr>
<tr>
<td>Should support Cable Diagnostics to test copper cables and determine the quality of the cables and the types of error.</td>
<td></td>
</tr>
<tr>
<td>Should have SNTP/NTP protocol for time synchronization.</td>
<td></td>
</tr>
<tr>
<td>Should have IPv4/v6 Dual Stack.</td>
<td></td>
</tr>
<tr>
<td>Should support LLDP and LLDP-MED.</td>
<td></td>
</tr>
</tbody>
</table>

**Physical/Environmental**

- **AC Input**: 100 to 240 VAC, 50/60 Hz internal universal power supply
- **Operating Temperature**: -5 to 50 °C (41 to 122 °F)
- **Certifications**: CE, FCC, C-Tick, VCCI, BSMI, CCC

**Safety: cUL, CB**

Switch should be supplied with the all necessary hardware accessories like Power cord, Rack-mount bracket, Installation Guide, etc. and necessary software image file to fulfill all above mention feature set from day 1.
TECHNICAL SPECIFICATIONS FOR HVAC SYSTEM

1.0 SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, fabrication, equipment and appliances necessary and required to completely install Air Conditioning & Ventilation system as required by the drawings and specified here in after or given in the Bill of Quantities.

1.2 Without restricting to the generality of the foregoing,

1.3 The Heating, Ventilation and Air-Conditioning (HVAC) system shall comprise of following:
   a. VRV/VRF System Indoor & Outdoor Units
   b. Treated Fresh Air Units & fresh air ducting work.
   c. Ventilation Fan for Lab areas, Toilet & Pantry area ventilation system with ducting work.
   d. Refrigerant & condensate drain piping inclusive of all valves and fittings.
   e. Cable Tray work Refrigeration Piping work & with covers for refrigeration pipes runs in the vertical shaft & at terrace level
   f. Control cabling between VRF Indoor to VRF Outdoor units & AHU units to VRF Outdoor units
   g. Sheet metal ducts inclusive of insulation, Grilles, Diffusers, Dampers etc.
   h. Thermal & Acoustic Insulation of Ducting
   i. Insulation of refrigeration pipes.
   j. Flow Controllers
   k. AHU kit for connection of VRF ODU with Third Party AHU Integration
   l. Underdeck Insulation for Exposed Roof area.
   m. Automatic controls and instruments.
   n. Vibration isolators for all HVAC equipment.
   o. Balancing, testing and commissioning of the entire HVAC system.

2.0 GENERAL REQUIREMENTS:

2.1 All the materials shall be of approved, best quality conforming to the specifications and subject to the approval of the Consultant / Client or his representative. If so directed, materials shall be tested in an approved testing laboratory (NABL) & the contractor shall produce the test certificate in original to the Engineer-in-charge of consultant / client & the entire charges for original as well a repeated tests shall be borne by the Contractor.

2.2 Contractor shall submit the technical data sheet for all the items, equipment’s after award of Contract and get it approved before procurement of the Items.

2.3 Contractor has to consider all civil work related to installation of HVAC system in their contract.
2.4 All the Execution, installation, shop drawings shall be prepared by the Contractor & shall furnish for the approval of the Client / Architect / Consultant.

2.5 Each item of equipment / material proposed shall be from the manufacturers given in list of approved makes and as per relevant standards and codes.

2.6 The contractor should make sure that all openings for pipes, cable trays, and ducts are closed and sealed correctly.

2.7 QAP (Quality Assurance Plan) , ATP (Acceptance Test Procedure) , Equipment's certificate of performance etc should be provided by OEM. FAT - Factory Acceptance tests shall be witnessed by IIT/IRS representative.

2.8 Contractor shall submit AS BUILT drawings when work in all respects is completed. These drawings shall be submitted in the form of four sets of CD's and four set of Hard copy – ‘A1’ Size color printout.

2.9 The system should be energy efficient and should be able to utilize Adiabatic pads at a later date upon retrofitting.

3.0 SPECIFICATION OF VRF HVAC SYSTEM

3.1 Variable Refrigerant Flow System.

The system selected is a modular system, with number of indoors connected to centrally located outdoor units, as per detail designing given in the tender. The outdoor units for all the system shall be air cooled type and having side discharge type location in the plumbing shaft.

All the VRF air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be precharged with first charge of Non HCFC (ECO Friendly) refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units.

The VRF system shall provide stable, trouble-free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air-conditioned area. The proportional operation shall be achieved by varying speed of the compressor in the outdoor units.

The operation of the VRF system shall be through independent wireless remote controllers as specified. The entire system shall be provided with BMS connectivity with MODBUS protocol and shall be provided with connectivity port ready to be integral with intelligent building management system in future.

3.2 Outdoor units.

Outdoors units of the VRF system shall be compact air-cooled type.

All the compressors of the outdoor units must be hermetically sealed scroll type. The compressor shall be of the high efficiency complaint scroll design with an EER of not less than 13.1 BTUH/watt (C O P of not less than 3.7) at ARI rating conditions.

Each compressor shall have in-built overloads, HP and LP controllers and mounted on vibration isolators. Each module of outdoor unit must have combination of Inverter Scroll Compressors, suitable to operate at heat load proportional to indoor requirement.

Coated Hydrophilic/PE Fins (with special acryl pre-treatment)” for Aluminum fins of Condenser Coils is mandatory for increased durability to salt corrosion. The system shall be
air-cooled, direct expansion type central air conditioning system consisting of one or more
Variable Refrigerant Flow Condensing unit (Outdoor Unit) and connected to one or more
Evaporator (Indoor Units) for cooling operation. Each having the capability of individual set
point control & the condensing unit should incorporate multiple scroll compressors.
Refrigerant used for system should be Non HCFC (Eco Friendly). Set of Outdoor Unit should
be able to connect up to 64 Indoor Units.

The condensing unit shall be modular type, manufactured / assembled in India, designed as
per Indian atmospheric conditions and should be capable to perform for outside ambient 52
Deg. C. Outdoor Units should be modular in type and should be equipped with high efficiency
DC inverter compressor, Wide Range of Capacity Control (15 to 100Hz) with minimum Steps
of 1Hz , 2 Stage Oil separating for improving reliability of system.

Each outdoor unit should have Inverter with variable speed compressor, capable of changing
the capacity in accordance to the cooling load requirement with highest COP/EER. Also, the
unit shall be capable of setting External Static Pressure up to 60Pa on site.

Outdoor unit should consists of DC variable speed motor for condenser fan with minimum 25
steps speed control to reduce input power, auto check function for connection error, auto
address setting. Unit should be equipped with a double stage highly efficient oil separation
management system to ensure minimum oil entrenchment and proper lubrication with high
reliability and stable operation with long refrigerant piping. The noise level of the base unit
shall be less than 60dB (A) when measured horizontally 1m away from cover surface and 1.5
m above floor level during night shift. Unit should assess demand function automatically and
perform with the help of Central Station. Units having Noise reduction mode will be preferred
but must be having back up operation function for emergency to avoid complete stop.

Outdoor unit should have feature of Rotation Operation function of Compressor to distri-
bute load. The condenser coil should be with AL- Cu internally grooved Cu tubes, mechanically
bonded to super slit aluminum fins. The surface of the condenser coil shall be coated with
suitable chemical coating to prevent deterioration due to climate.

Outdoor unit must have automatic judgment function to check whether or not the refrigerant
amount is sufficient in one refrigerant cycle. Reliable Transmission system should be used
between outdoor and indoor units. All necessary safety devices shall be provided to ensure
safe operation of the system.

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.

The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg
C to 52 Deg C, in cooling mode.

Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors
with minimum IP 65 protection. The outdoor unit condenser fan shall be able to develop
external static pressure up to 7.5 mm of H2O.

The entire operation of outdoor units shall be through independent remotes of indoor units.
No sepa-rate Start/ Stop function shall be required.

Soft Starters shall be provided for the Outdoor Unit compressors. 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.

All outdoor units stand height to be maintained at least 2’6” above the terrace floor level. All
ODUs are to be marked on a metal plate with the room / floor number and location where
indoor units are connected.

Outdoor units shall be complete with following safety devices:
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

- High pressure switch
- Fan driver overload protector
- Over current relay
- Inverter Overload Protector
- Fusible Plug

Unit shall be supplied with
- Installation manual
- Operation Manual
- Connection Pipes
- Clamps

3.3 Cassette Type Indoor Units

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise.

These units shall be installed between the bottom of finished slab & top of false ceiling.

The unit must have in built drain pump, suitable for vertical lift of minimum 850 mm for four-way type Cassette Unit.

The unit must have 3 – Speed fan motor

The unit casing shall be Galvanized Steel Plate.

The noise level of unit at the highest operating level shall not exceed 46 dB(A), at a vertical distance of 1.5 m from the grille of the unit.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling as per the heat load of the room.

Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (300 mm maximum).

The unit shall be supplied with anti-mould and antibacterial treatment filter. The filter shall be easy to remove, clean & re install.

The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through cordless remote specified in the “Bill of quantities”.

3.4 Ceiling Mounted Low & High Static Ductable Indoor Units

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling as per the heat load of the room.

The unit casing shall be Galvanized Steel Plate.

Unit shall have provision of connecting fresh air without any special chamber & must have in built drain pump.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling as per the heat load of the room.
3.5 Ceiling Mounted Treated Fresh Air Indoor Units

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.

These units shall be installed between the bottom of finished slab & top of false ceiling.

The unit shall have in built drain pump, suitable for vertical lift of 1000 mm.

The unit casing shall be Galvanized Steel Plate.

Unit shall be insulated with sound absorbing thermal insulation material, Polyurethane foam.

The noise level of unit at the highest operating level shall not exceed 48 dB (A), at a vertical distance of 1.5 m from the grille of the unit.

Treated Fresh air unit operates at outdoor ambient up to 40 deg. C in cooling mode.

The External static pressure of TFA unit allows the use of extensive ducting work.

The unit shall be supplied with High Efficiency Filter with dust collection efficiencies of 90% & Filter chamber.

The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities.

The unit to have provision for further connecting to Intelligent Building Management System it shall be possible to operate the unit through this IBMS system.

3.6 Control System for VRF HVAC System

Wired Remote Controller.

Wired remote controller shall be part of indoor units.

The controller must have large crystal display screen, which displays complete operating status.

The digital display must allow setting of temperature with 1 Deg 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.

It shall be possible to wire the remote up to 500 RMT.
Wireless Remote Controller.

Wireless remote controller shall be part of indoor units. The same operation modes & settings as with wired remote controllers must be possible.

Compact light receiving unit to be mounted in the Machine/Equipment.
Units shall be supplied with followings :

Operation Manual
Installation Manual
Paper Pattern for installation
Drain hose / Clamp metal / Insulation for fitting / Sealing Pads / Clamps / Screws

LCD MONITOR CENTRAL REMOTE CONTROLLER & POWER CONSUMPTION DISTRIBUTOR
LCD Central remote controller shall be supplied as specified in the “Bill of Quantities”

The controller must have LCD Touch screen, which displays complete operating status.

The digital display must allow setting of temperature with 1 Deg C interval.

Remote shall be able to individually program by timer the respective times for operation start and stop within a maximum of 1 Weeks time.

The controller shall be able to monitor room temperature & preset temperature by microcomputer & can select cool/ heat operation mode automatically for all the indoor units.

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.

Units shall be supplied with followings:

Operation Manual
Installation Manual
Paper Pattern for installation
All Kind of software if any

The Controller can give report in soft and hard copies for the indoor wise power consumed detail , the same shall be used for metering HVAC power consumption to RIL.

3.7 Testing & Commissioning of the VRF system

Following reading/ data shall be generated as a part of handing over of the VRF air conditioning system, apart from the handing over data for air side & indoor design conditions.

OUT DOOR UNITS
Inlet temperature
Discharge pipe temperature
Suction pipe temperature
Oil pressure
Condensing Pressure
Evaporating Pressure
Power supply voltage
Inverter compressor frequency
Inverter current
Fan operating current
Total ODU current

INDOOR UNITS
Indoor unit operation – On/ off from remote
Indoor unit operation – On/ off from thermostat
Remote control present temperature
Suction temperature
Indoor liquid pipe temperature
Indoor gas pipe temperature
Electronic expansion valve opening
Fan operating current

**CENTRAL CONTROLLER AND COMMUNICATION CABLE**

Central controller shall be BMS compatible & should have cloud-based monitoring & troubleshooting arrangement for all VRF indoor & outdoor units.

All communication cables between VRF IDUs & ODUs should be laid in hard PVC / GI conduit & it should be laid in the cable tray only.

**NOTE**

Bidders are requested to submit power consumption details at specified Load Conditions.

"Vendor" shall be submitted to derated chart.

Indoor condition & outdoor condition.

Copper pipe length.

### 4.0 REFRIGERANT PIPING

All refrigerant pipes and fittings shall be hard drawn copper tubes and wrought copper / brass fittings suitable for connection with silver solder / phos-copper.

All joints in copper piping shall be sweat joints using low temperature brazing and / or silver solder. Before jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide / nitrogen.

Refrigerant lines shall be sized to limit pressure drop between the evaporator and condensing unit to less than 0.2 kg per sq.cm.

Sight glass with moisture indicator and removable type combination dryer cum filter with MS housing and brass wire mesh / punched brass sheet shall be installed in liquid line of the refrigeration system incorporating a three valve by pass. After ninety days of operation, liquid line drier cartridges shall be replaced.

Heat exchanger shall be MS heavy duty pipe in pipe type and without any joint in the inner pipe.

Horizontal suction line shall be pitched towards the compressor and no reducers shall be provided for proper oil return.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using Freon mixed with nitrogen / carbon dioxide at a pressure of 20 kg per sq. cm (high side) and 10 kg per sq. cm (low side). Pressure shall be maintained in the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm of mercury and held for 24 hours. Vacuum shall be checked with a vacuum gage.

Piping shall be properly supported on, or suspended from, channels, clamps, and hangers as specified and as required. The Contractor shall submit a design and calculation report of all the brackets, saddles, anchors, clamps, supports channels and hangers and be responsible for their structural sufficiency.

All terrace level hard & soft copper piping should be laid in the cable tray with cover. All cable trays passing on the terrace must be placed at least 2’ above ground level. Cable tray shall be
placed such that they are not restricting water drain holes on the terrace and all drainage points are easily accessible.

Support Spacing of pipe supports shall not exceed the following:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>SPACING BETWEEN SUPPORTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12 mm</td>
<td>1.5 Meter</td>
</tr>
<tr>
<td>15 to 25 mm</td>
<td>2.0 meter</td>
</tr>
<tr>
<td>30 to 150 mm</td>
<td>2.0 meter</td>
</tr>
<tr>
<td>Over 150 mm</td>
<td>2.5 meter</td>
</tr>
</tbody>
</table>

Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor slab by clamps made of pre-galvanised steel and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping and high load bearing capacity. Vertical risers shall be supported at the base, which shall withstand the total weight of the pipe and fluid contained.

Insulated outdoor refrigerant lines should be lined with suitable bird, rodent, squirrel proof liner, possibly black fiber glass tape.

All piping work shall be carried out in workmen like manner, causing minimum disturbance to the building structure. The entire piping work shall be organized, in coordination with other agency's work, so that laying of pipe supports, pipes and pressure testing for each area shall be carried out in one stretch.

Cut outs in the floor slabs for installing the various pipes are indicated in the Drawings. Contractor shall carefully examine the cut outs provided and clearly point out where the cut outs shown in the Drawings do not meet with the requirements.

The Contractor shall make sure that the clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes.

5.0 DRAIN PIPING

Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan.

Drain piping of specified sizes and suitable of 6 Kg/Sq cm. pressure rating with watertight threaded connections, leading from the room unit to a suitable drain point.

Complete drain piping shall be made leak proof and watertight by means of precise installation and the use of leak proof sealant/adhesives.

Drain piping shall be PVC type as per relevant IS standard and insulated with 9 mm nitrile rubber insulation throughout the length.

6.0 AIR FLOW CONTROLLER

Mechanical system-powered controllers are an economic solution for the control of constant air flows. Constant Volume Air Flow Controller work without an external power supply, no wiring or commissioning is necessary. The controller contains a control damper supported by bearings. The aerodynamic forces of the air flow cause the damper to close. These forces are amplified by bellows. A mechanical unit consisting of a leaf spring and cam plate acts against the closure force keeping the flow rate constant as the duct pressure varies. The bellows also has the function of acting as an oscillation damper.
Systems operated with constant air flow offer energy savings potential if the air flow is reduced at unoccupied times.

7.0 AIR DISTRIBUTION SYSTEM

7.1 Sheet Metal Work

Ducts shall be made of galvanized steel sheet as specified in the BOQ and confirm to IS-655. The galvanized steel sheet shall confirm to IS-277 grade 120 gsm or better. The duct construction shall be as follows.

RECTANGULAR DUCT CONSTRUCTION-

For low pressure System (Upto static pressure of +/- 75mm wc)

<table>
<thead>
<tr>
<th>Max.Size</th>
<th>Min.thick</th>
<th>Trans joints</th>
<th>Reinforcement</th>
<th>Hanger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 750</td>
<td>24 G</td>
<td>25x3 eq.angle</td>
<td>Cross Breaking</td>
<td>10mm</td>
</tr>
<tr>
<td>751 to 1500</td>
<td>22 G</td>
<td>25x3 eq.angle</td>
<td>25x3 girth angle at 1250mm centre</td>
<td>10mm</td>
</tr>
<tr>
<td>1501 to 2250</td>
<td>20G</td>
<td>37x3 eq.angle</td>
<td>37x3 girth angle at 750</td>
<td>12mm</td>
</tr>
<tr>
<td>Above 2250</td>
<td>18G</td>
<td>40x6 eq.angle</td>
<td>40x6 girth angle at 600</td>
<td>12mm</td>
</tr>
</tbody>
</table>

Ducts shall be fabricated using lock forming machine. Longitudinal seams shall be of lock type. Flanges used for transverse joints shall be joined with each other with Galvanized Steel Bolts, washer and nuts. The bolts shall be of minimum M8 size and spacing between bolts shall be maximum 150 mm for low pressure ducting and 100mm for high pressure ducting.

For transverse angle flanged joints, neoprene gasket (3mm uncompressed thickness and width equal to flange face) adhered to the flange face shall be used. The bolt holes in the gasket shall be the same as bolt diameter and shall be punched prior to insertion of gaskets.

Angle shall have welded corners and shall be riveted to the ducts at 300 mm centers maximum.

If specified in Schedule of Quantities, sealing of the longitudinal and spiral seams shall be accomplished using RTV 732 sealants.

Rectangular duct shall be supported from ceiling using trapeze hangers. Ducts shall rest on supporting angle or channel and this supporting angle or channel shall be supported by CS rods or angles or channels on the both the side of the ducts with weld or bolts.

Zinc Coated anchor fasteners or embedded plates shall be provided for upper attachment to the building. The Successful Bidder shall provide the anchor fasteners. Bidder shall provide the embedded plates if marked in the drawings before casting of slabs. The Successful Bidder shall provide the duct supports from angle cleats welded to the embedded plates. Anchor fasteners shall be loaded to maximum 20% of the rated capacity specified by the manufacturer.

Wherever sheet metal duct connects to the intake or discharge of fan units, a flexible connection of fire retarding double layer of at least 150mm width shall be provided. The material shall be attached to the angle frames by means of steel band over the end of the flexible connections. The material shall be secured between the band and the angle frame by bolting. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both the ends. The flexible connections shall be suitable for fan intake and outlet pressures.
All bends, offset and branch connections shall be made for smooth and noiseless flow of air and minimum pressure drop. The Successful Bidder shall furnish the details of guide vanes i.e. number of vanes and locations etc. in the construction drawings. The flow of air to the branch duct shall be regulated by a splitter damper or volume control damper.

7.2 Dampers

All dampers shall be of 18 S.W.G. G.I sheets louver dampers of robust construction and tight fitting. The design, method of handling and control, shall be suitable for the location and service required. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation, control or setting in any desired position. Dampers and their operating devices shall be made robust, easily operable and accessible through suitable access door. Every damper shall have indication device clearly showing the damper position at all times. All the bushing will be of brass only.

7.3 Grilles and Diffusers

All grilles (SA & RA), diffusers (SA & RA) will be made from heavy gauge extruded Aluminum sections / M.S. (As specified in the BOQ) duly powder coated to match the interior requirements. All the supply air grilles/diffusers will be provided with opposed blade dampers fabricated from Aluminium. The damper should be suitable for operation from front face of grille/diffuser. All grills and diffusers are to be connected with collars or ducts directly without any gap.

7.4 Damper Actuator

Electronic actuators shall be electric, direct-coupled type capable of being mounted over the shaft of the damper. They shall be UL listed and the manufacturer shall provide a 2-year unconditional warranty from the date of commissioning. Power consumption shall not exceed 8 watts or 15 VA of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators.

The casing should be weatherproof suitable for Saline environment outdoor application.

Electronic overload protection shall protect actuator motor from damage. If damper j am Actuator shall not burnout.

Internal end switch type actuators are not acceptable. Actuators may be mechanically and electrically paralleled on the same shaft to multiply the available torque.

A reversing Switch shall be provided to change action from direct to reverse in relation to control signal as operation requires. Actuators shall be factory mounted and connected to the damper section and shall conform to UL 555S specifications.

7.5 Installation

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 the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams. In no case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.

All holes in concrete, masonry etc. made by Successful Bidder for fixing supports & also for all refrigerant piping etc. shall be made good and restored to original finish by the civil contractor.

7.6 Testing
After completion, complete system shall be tested for leakage.

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 inspection shall be recorded and submitted to the Consultant for approval before acceptance and taking over of the entire system by the Employer.

8.0 AIR HANDLING UNIT (AHU)

The specification for Double Skin Air handling unit comprises the design, manufacture, delivery at site, erection, commissioning and conducting performances test at site of Air handling units conforming to these specifications.

8.1 Scope:

The Scope of this section comprises the Design, Supply, Erection, Testing and Commissioning of double skin construction air handling units, conforming to these Specifications and in accordance with requirements of drawings and of the bill of Quantities. The equipment shall confirm to the requirements of the latest editions of applicable Indian/ASHRAE Standards. Nothing in this specification shall be construed to relieve the Contractor of his responsibility.

8.2 Type:

The air handling units shall be double skin construction with 43 mm thick thermal break section, draw-thru type comprising of various sections such as filter section, coil section and fan section as shown on drawings and included in bill of quantities.

AHU to be provided with Variable Frequency drive PLC panel with pressure transmitter.

8.3 Capacity:

The air handling capacities and static pressure as shown in Bill of Quantities.

8.4 Products:

Provide factory-built air handling units of the horizontal type or as shown in the drawings with coil requirements and capacities as listed in the BOQ & tender document.

Construct each air handling unit complete with casings, fans, vibration isolation, insulation, drain pans, cooling coils, filters, fan motors, belt guards, and belt drives, flexible connections.

8.5 Unit Casing

Construct each unit with an airtight sectionalized casing of “lock forming” quality galvanized steel. The outer wall shall be painted with baked polyester paint finish. The inner wall shall be galvanized steel. The paint for outdoor application shall be weather resistant. For maximum rigidity provide a perimeter frame with modular system based on standardized double wall panels. Removal of side panels shall not affect the structural integrity of the unit. Casing strength shall be designed to meet European standard EN1886:1998. The coil section and casing shall be SS 304 including moisture eliminators. All casing sections shall be coved at all corner joints for ease of cleaning.

Casing shall consist of a fan section, a coil section or filter section, mixing box section, and a drain pan. Provide suitable gaskets at all joints between casing sections. Provide stiffeners, if required, to prevent unit casing pulsation.

Completely enclose all connections, coil headers, and return bends in coil section. Do not use coil frames as structural members of the coil section. Construct the coil section in such a manner that the coils can be removed without affecting the structural integrity of the casing.
The casing shall be of panelized construction. The frame shall be made of non-corrosive extruded aluminum channels fitted with precession non-metal corner pieces. The casing shall be attached to the framework through a self-locking mechanism to give air tight construction to meet Eurovent class B air leakage requirement. The casing shall be able to withstand up to 8 mm of total static pressure. Closed cell foam gasketing shall be provided where the modules meet. The floor panel shall have double wall construction to allow maintenance personnel access without damage to the insulation. The whole unit shall be supported on a galvanized steel support work. The minimum gap between the true ceiling and above the false ceiling for AHU to be kept as per manufacturers recommendations and designed to ensure air circulation and avoid entrapment of moisture.

The panel shall be 43 +/- 2 mm double wall type with injected PUF for a rigid non-vibrating construction. The insulation shall not absorb moisture and shall be fire resistant. The panel shall be held in place by proper fasteners. The fixing of each panel shall be flush mounted. Sealing shall be achieved by means of non-hydroscopic seal compressed between the panel and the aluminum frame channels to prevent cold tracking and air leakage between the panel and the frame. Units which are exposed to atmosphere shall have PUF insulation and shall be designed with special construction to prevent sweating. The support sections shall have thermal break profile between the inner and outer wall.

Extend the drain pan under the complete coil section including access and plenum sections between multiple coils if any. The drain pan shall be rigid and watertight with pipe drain connection. Provide drain pan of the double pan insulated type with a galvanized outer pan and a 1mm thick stainless steel inner pan. Provide 30mm thick PUF insulation cemented and vapor sealed between the inner and outer pan. Drain connection shall be provided on both sides of the AHU coil and shall be GI with threaded connection.

Furnish access doors in the fan sections and mixing box section on all units to provide inspection of and/or access to internal parts. Access doors shall be constructed with double wall panel that compresses evenly or durable rubber seal on to a rigid frame. The rubber around the perimeter of the access door shall be used to prevent air leakage. Locate access doors on the most accessible side of the air handling unit as it is installed on this Project. Provide access doors with hinges / cam locks so that it can be lifted off or removed totally for easy access. The door design and panel shall incorporate thermal break feature for outdoor units. Provide a view window made of 4mm thick transparent Plexi-glass on inner and outer wall with a rubber grommet and fitted on the double wall panel.

8.6 Cabinet

The cabinet type unit shall be sectionalized construction consisting of fan section, coil section, filter section, mixing box section and drain pan. The sectionalized construction shall have minimum thickness of sheet as under:

<table>
<thead>
<tr>
<th>Section</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Casing Outer skin</td>
<td>0.8mm GI</td>
</tr>
<tr>
<td>Inner skin</td>
<td>0.6mm GI</td>
</tr>
<tr>
<td>b) Drain pan outer skin</td>
<td>1mm GI</td>
</tr>
<tr>
<td>Inner skin</td>
<td>1mm SS 304</td>
</tr>
<tr>
<td>c) Coil Section &amp; Eliminator Casing</td>
<td>0.6mm SS 304</td>
</tr>
<tr>
<td>Inner skin</td>
<td></td>
</tr>
</tbody>
</table>

8.7 Service light

A factory-mounted, weather-resistant (enclosed and gasketed), vapor-tight, light fixture shall be provided. Fixture shall be equipped with plastic switch box, single phase wiring, PL lamp comes with ballast and reflector. This shall be provided in fan section and filter section.

8.8 Fan Module

The vibration levels of the complete fan assembly (fan wheel, motor and drives assembled as a whole system) shall be checked and dynamically balanced in the factory. The testing and
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

rating standards shall be Eurovent / AMCA and ISO1940 equivalent. Fan shaft shall be properly size and protectively coated. Fan wheels shall be keyed to fan shaft to prevent slipping. Fan shafts shall be solid and designed so that fan shaft does not pass through its first critical speed as the unit comes up to its rated rpm. Fan modules shall be provided with an access door on the drive side of the fan. Access side for both side of fan shall be an option.

8.9 Fans

8.9.1 Backward Curved Fan Modules

Fan shall be double-width, double-inlet, and multi-blade type as produced by the unit manufacturer. Fan shall be backward curve (BC) as required for stable operation, high static pressure and optimum energy efficiency. The multiple blades shall be made of treated steel with paint for corrosion resistant. The solid shaft shall be made of carbon steel: C45, machined and polished to tolerance of standard ISO 286-2 Grade G6. Protective coat of anti-rusting shall be applied to all bare surfaces of shafts at the factory.

Select fan drives with a minimum belt horsepower capacity of 120% of the motor nameplate horsepower. Provide the fan drive components as follows

Provide non-adjustable type fan sheaves on all contact surfaces. Dynamically balance fan sheaves with other grooves. Statically balance fan sheaves with three grooves or less.

Provide standard “V-groove” belts suitable for the service intended with the capacities specified herein before. If in the opinion of the Engineer, the belts do not appear to be properly matched during operation, recheck and, if necessary, replace with another closely matched set of belts.

Provide fan shafts of one-piece design solid with solid stub. Two-piece shafts will not be acceptable. Do not cantilever fans. Fan shafts shall not pass through their first critical speed as the unit comes up to rated rpm.

Provide fan shafts with externally or internally mounted, grease-lubricated, self-aligning ball bearings on each end of the shaft. Bearings shall have an average life of 200,000 hours at design operating conditions. Life lubricated sealed bearings will not be acceptable. Provide for shafts with internally mounted bearings, grease lines extended with tubing so as to be readily accessible from the drive side of the unit. In addition, extend the grease line on the drive end of the shaft beyond the belt guard.

Provide belt guards for all fan drives mounted outside the unit casing. Guards shall conform to the contour of the drive assembly. Material, construction, and finish of the guard shall be similar to that of the unit casing. Guards shall be braced and fastened so that objectionable vibration will not occur. Provide tachometer openings at least 2” in diameter for checking fan and motor speeds. Tachometer hole must align with the shaft. Two section fan guards shall be designed in such a manner that either section can be removed without removing the adjacent section.

Motor shall be selected so that they will not overload if the static pressure drops one-quarter inch below the specified value listed in the “Schedule of Capacity”. Motor shall be mounted on the coil connection side unless indicated otherwise on the Drawings. Each motor shall be factory mounted on an adjustable base rigidly supported to the unit. Motor shall have an extended shaft to accommodate the adjustable pitch motor sheave specified herein. See the section for electric motor specification.

Mixing boxes sections shall be provided wherever required as indicated in the drawings or Bill of Quantities or as approved by the Consultant. Openings of appropriate size shall be provided for return air and fresh air. Exact location of openings shall be finalized during the drawing submission stage. Dampers shall be provided at the openings. The openings shall be made in such a way that no insulation shall stick out. Proper framing, bracing shall be done at
the openings. Prior to fabrication of mixing box section the manufacturer shall get the shop drawing approved showing all details of openings, access doors etc.

Fan section, including wheels and housing shall be fabricated from heavy gauges steel (3mm). Fan wheel shall be of the backward curved multi-blade type. Fan housing shall be made of die-formed side sheets with stream-lined inlet and guide vanes to ensure smooth air-flow into the fans. Fan motor shall be mounted on an adjustable vibration isolating base located on a common base plate in a fan section. A standard bell guard shall be provided to enclose the pulley sheaves and belts. Fan and motor to have a base frame with vibration isolators. Fan speed should not exceed 2000 rpm

Ceiling suspended Air handling units shall be provided with vibration eliminators having 95% efficiency. The inlet/outlet connection of the AHU to the main ducts shall be achieved by double flexible connections of fire retardant/type not less than 100mm width or as approved by the Consultant.

8.10 Coil Module
Coil shall be fabricated by the Air Handling manufacturer to maintain consistency in quality and reliability. Coil shall be installed such that unit casing enclose headers and return bends. Coil shall be designed to maximize the utilization of the availability unit cross-section area. Coil connections shall be clearly labeled on outside of units. Coil shall be cartridge type mounted on SS channel for easy removal. Coils shall have aluminum plate fins and seamless copper tubes. The fins shall be sine-wave design with slits for better heat transfer efficiency and moisture carry-over limit performance. Fins shall have collars drawn, belled and firmly bonded to tubes by mechanical expansion of the tubes. Soldering or tinning shall not be used in the bonding process. Capacities, pressure drops and selection procedure shall be designed in accordance with ARI Standard 410.

Provide manual air vent connections for all. Furnish Coils with manual drain connection extended outside the unit casing. Coils shall be circuited, and have connections arranged for counter flow of air and water with inlet on bottom and outlet on top of the coil headers. Coil casing shall be 1.5mm thick stainless steel with formed and supports and top and bottom channels. Coil casing shall be a series of drain holes at the bottom channels to insure condensate drainage.

If stacked coil in the unit, intermediate drain-pan shall be installed between coils to drain condensate to the main drain pans without flooding the lower coils air passing condensate through the airstream of the lower coil. The coil working pressure at site shall not exceed the leak test value on each coil type given below.

8.11 Filter Sections

FILTER MODULES

Filter sections shall have filter racks, an access door for filter removal and block-offs as required to prevent air bypass around filters. Modules shall be supplied with 2” flat filter as Prefilter (EU3). Filter shall be sized so as not exceed scheduled face velocities.

WASHABLE OR PERMANENT FILTERS

Filter media shall be non-woven synthetic media sandwiched between two layers of HDPE fibers capable of operating up to 600fpm face velocity without loss of filter efficiency and holding capacity. Filters shall have a rated average dust spot efficiency of not less than 25% to 35% when tested in accordance with ASHRAE 52-1-1992 atmospheric duct spot method. Filter media shall be layers of cleanable wire maze. Filter frame shall be constructed of galvanized steel. Filter access shall be accessed from either right or left hand side as standard. Back access shall be as option. Provide one complete set of commissioning filters with the Air Handling Units. Filters will be replaced after commissioning trials and before start of defects liability period. The filtration of air shall be as follows:
Filters that shall be provided before cooling coil single level of filtration as follows: Pre filtration using EU3 filters having filtration efficiency of 95% down to 20 microns.

8.12 Motors

Motor shall be mounted integral to an isolated fan assembly furnished by the unit manufacturer. Motor shall be mounted inside unit casing on a sliding base to permit adjustment of drive belt tension.

Standard motor shall be horizontal foot mounting, induction motor, squirrel cage totally enclosed fan-cooled meeting the requirement of IP65 protection with Class F insulation and suitable for operation at ambient temperature of 54˚ C.

Motors shall be of the squirrel cage induction motor type having the following features.

a. Frequency : 50 Hz ± 3%
b. Operating Voltage : 415 Volt ± 10% / 3 pH / 50Hz.
c. Standards : Latest editions of relevant BS / NEMA International Standards.
d. Efficiency : High efficiency
e. Direction of Rotation : Suitable for bi-directional rotation, or as specified in equipment specification.
f. Terminal box:
   a. Six terminals with shorting stripes to be provided.
   b. To be preferably located on right hand side when facing the driving end or on top.
   c. To be rotatable and to sized to accept armoured cables.
g. Earthing : Two external and one internal earthing terminal.
h. Starting duty : Motor up to 5.5kw suitable for soft starter starting & above 5.5 KW for star delta starting.
i. Painting : Synthetic Enamel manufacturer’s standard paint.
j. Inspection/testing : Test Certificate to be submitted.
l. Bearing : Grease Lubricating ball or roller bearing. Vertical motors shall have thrust bearings designed to carry maximum axial thrust.

8.13 Site Testing

Cooling capacity of various air-handling unit models to be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil.

Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage an input current.

Both Summer months (May - Jun) and Winter months (Dec - Jan) trials to be presented separately during commissioning depending when the works gets completed to ensure trouble free operation over all months.

8.14 Drain Piping
Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping of specified sizes and suitable of 6 Kg/Sq cm. pressure rating with watertight connections, leading from the room unit to a suitable drain point.

Complete drain piping shall be made leak proof and watertight by means of precise installation and the use of leak proof sealant/adhesives. Drain piping shall be PVC type as per relevant IS standard and insulated with 9 mm nitrile foam insulation throughout the length. PVC pipelines to be adequately supported intermittently at uniform distance with clamps, pipe supports with proper alignment in horizontal and vertical direction. The joints shall be properly sealed so that there is no water leakage. Proper grouping of condensate drainpipes & gradient to be maintained for the easy flow of condensate drain water.

8.15 Refrigerant Piping

The indoor units (AHUs) and outdoor units shall be connected with refrigerant copper piping. All piping connections for the units should be performed inside the unit. The refrigerant copper piping should be insulated with nitrile foam. All refrigerant piping to be done with hard copper pipes only. All refrigerant piping to be done with hard copper pipes only and should be selected from the manufacturer's catalogue for specific requirement of VRV/VRF system. Soft copper tubes if required & complying with VRV/VRF requirement should be shown in the shop/execution drawings & get it approved from the Consultant.

8.16 Temp and Pressure gauges should be provided for parameter monitoring with adequate pockets /adapters for this purpose in the system pipelines.

9.0 INSULATION FOR G.I. DUCTING

(A) Thermal Insulation- With Nitrile Rubber
The supply air duct shall be insulated with 19 mm thick Elastomeric Nitrile Rubber as specified in bill of quantities.
Method of applying insulation-
   a) Clean the duct surface to be insulated.
   b) Apply a thin layer of tar paints.
   c) Apply a thin coat of rubber solution to stick the insulation.
   d) Fix the insulation of specified thickness over the surface of the duct tightly and seal all the joints using BOPP tape. Secure the insulation with 16 Gauge G. I. wire or 10 mm wire PVC box strapping at a distance of 300 mm.

(B) Acoustic Insulation
First 3 meter length of supply air duct shall be acoustically insulated with 25 mm thick resin bonded glass wool density 32 Kg./Cu.M. with 25 mm x 25 mm GI section of 1.25 mm thick, at 600 mm center to center covered with Reinforced plastic tissue and 0.5 mm thick perforated aluminum sheet.
   a) Apply a thin layer of tar paints.
   b) Fix-up fiberglass slabs.
   c) Cover-up with perforated Aluminum sheets with the help of cadmium plated nuts, bolts, stick pins

(C) Under Deck Insulation:
Thermal lining below RCC slab insulated with Resin Bonded wool of density of 80 Kg/m³ and thickness of 50 mm covered with one side aluminum foil (Core material - without any outer facing, Confiming to ASTM E 84, NFPA 90A, 90B, LIFE SAFETY CODE NFPA101 & 120 Minutes fire rating as per building insulation requirements) , applied below slab with the help of screw & washer - Cross wire system and the joints shall be sealed with 72 mm wide self adhesive aluminum tape having high strength (70 microns). Thermal Resistance (R- value) shall be minimum 7 hr*ft²*˚F/BTU at 35 Deg C mean temperature.

10.0 VENTILATION FANS
10.1 Scope
The scope of this section comprises the supply, erection, testing and commissioning of centrifugal, in-line and propeller type fans and roof mounted units conforming to these Specifications and in accordance with the requirement of Drawings and Schedule of Quantities.

10.2 Type
Centrifugal, in-line propeller fans and roof mounted units shall be of the type as indicated on Drawings and identified in Schedule of Quantities.

10.3 Capacity
The air-moving capacity of fans shall be as shown on Drawings and in Schedule of Quantities.

10.4 Centrifugal Fan
Centrifugal fan shall be DWDI / SWSI Class I construction arrangement 3 (i.e. bearings on both the sides) for DWDI fans complete with access door, squirrel-cage induction motor, V-belt drive, belt guard and vibration isolators, direction of discharge / rotation, and motor position shall be as per the Approved-for-Construction shop drawings.

a. Housing shall be constructed of 14 gage sheet steel welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene / asbestos packing should be provided throughout split joints to make it air-tight.

18 gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout door with handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

b. Fan Wheel shall be backward-curved non-over loading type. Fan wheel and housing shall be statically and dynamically balanced. For fans upto 450 mm dia, fan outlet velocity shall not exceed 550 meter/minute and maximum fan speed shall not exceed 1450 rpm. For fans above 450 mm dia, the outlet velocity shall be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

c. Shaft shall be constructed of steel, turned, ground and polished.

d. Bearings : shall be of the sleeve / ball-bearing type mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil / grease pack pillow block type.

e. Motor : Fan motor shall be energy efficient and suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, squirrel-cage, totally enclosed, fan-cooled motor, provided with class F insulation, and of approved make. Motor name plate horsepower shall exceed brake horsepower by a minimum of 10%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1440 rpm. The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that sound level is lowest.

<table>
<thead>
<tr>
<th>HP</th>
<th>POWER FACTOR</th>
<th>EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FL 3/4L 1/2L</td>
<td>FL 3/4L 1/2L</td>
</tr>
<tr>
<td>0.50</td>
<td>0.71 0.62 0.50</td>
<td>73.00 73.00 68.00</td>
</tr>
<tr>
<td>0.75</td>
<td>0.74 0.64 0.50</td>
<td>78.00 78.00 70.00</td>
</tr>
<tr>
<td>1.00</td>
<td>0.76 0.67 0.55</td>
<td>82.50 82.50 77.00</td>
</tr>
<tr>
<td>1.50</td>
<td>0.77 0.70 0.57</td>
<td>83.80 83.80 80.00</td>
</tr>
<tr>
<td>2.00</td>
<td>0.77 0.70 0.57</td>
<td>85.00 85.00 81.00</td>
</tr>
<tr>
<td>3.00</td>
<td>0.82 0.74 0.60</td>
<td>86.40 86.40 84.00</td>
</tr>
</tbody>
</table>

NIT No: IITB/DIPS/COPT/TENDER/02; Construction of COPT Building Page: 359 of 450
f. Drive to fan shall be provided through belt with adjustable motor sheave and a standard belt guard. Belts shall be of the oil-resistant type.

g. Vibration Isolation: MS base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through resistoflex vibration isolators. The concrete foundation shall be at least 15 cm above the finished floor level, or as shown in approved-for-construction shop drawings.

h. Centrifugal fans for smoke extract application shall have external belt drive and motor. Fan & casing shall be internally rated for 300°C for 2 hours.

10.5 Performance Data

All fans shall be selected for the lowest operating noise level. Capacity ratings, power consumption, with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation.

10.6 Testing

Capacity of all fans shall be measured by an anemometer. Measured air flow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

11.0 COMMISSIONING STANDARDS- VRF SYSTEMS

Refrigerant pipe work

- Pressure test

Pressure testing and blowing of systems pipelines shall be carried with Nitrogen gas.

Good Practice; 5 Steps Strength and Leak Test.
1) 3 bar (N2) Minimum of 3 minutes.
2) 15 bar (N2) Minimum of 3 minutes.
3) 32 bar (N2) Minimum of 15 minutes.
4) 41.5 bar (N2) Strength test for a period of time that is acceptable to show any signs of deformation to the pipe work.
5) 33 bar (N2) after step 4, drop pressure to 33 bar for final leak test for minimum 24 hours. Pressure testing signage will be clearly visible on site during testing periods.

- Steps Evacuation.

On completion of strength/leak testing an evacuation is to be carried out to 2mm Hg (2 Torr).

This will eliminate the risk of any moisture being present within the pipe work installation. It is recommended that a triple evacuation process be carried as below. This should then be followed by a pressure rise test.
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

1) Evacuate the system to 10 Torr from both service valves. System manifold gauges "must not" be used to measure a vacuum. A Torr gauge must be used at all times.
2) Break the vacuum with OFN (N2) into "suction" service valve to 1 bar.
3) Evacuate to 5 Torr from "discharge valve".
4) Repeat step 2.
5) Evacuate to lowest pressure vacuum pump will achieve (2 Torr for 1 hour minimum).
6) Pressure rise test to be carried for a minimum of 30 minutes.

• Electrical Work

Appropriate glands will be fitted to each item of equipment in accordance with environmental conditions.

When running interconnecting control wiring it is essential to avoid the risk of electronic control signals being corrupted. Care should therefore be taken to avoid running control cables too close to power cables.

• Pre-commissioning.

The following items must be checked prior to any systems being switched on.

1. A marked up scale site drawing showing all units and refrigeration pipe work, address settings (for units and remote controllers and model/serial numbers will be produced.
2. Indoor units (AHUs), Outdoor Units addressing and screened wiring (greater than 1.25 mm²) as per the specifications.
3. All control wiring and remote controllers will be complete and connected but final connection shall be made by the Installation Engineer in charge from the manufacturer.
4. Before the Power Supply to outdoor unit is turned on, the mains wiring must be checked phase to neutral, neutral to earth. Once this is complete the mains isolator can be switched on to allow the crankcase heater to warm up the oil (minimum 24 hours).
5. Pressure test system refrigerant pipe work will be completed.
6. Evacuation of the system refrigerant pipe work will be completed as above.
7. Total lengths of liquid line pipe work installed, will be confirmed by installation Engineers and marked on drawings for additional refrigerant charge calculation.
8. Sufficient supply of refrigerant gas in dumpy cylinders will be on site adjacent to the Outdoor.
9) Units ready for use.
10) Now charge refrigerant into pipe work based upon the additional refrigerant charge calculation.
11) Outdoor Unit service valves will now be opened.

• Commissioning

1. Connect monitor tool and check system connect information is correct i.e. Outdoor Unit, BC port, Indoor Unit and Remote controller addresses.
2. Start up the system and run each Indoor Unit (AHUs) one by one in cooling mode to confirm correct operation.
3. Set up and configure all controllers/time clocks/centralized controllers.
4. Check operation of any accessory interlocks i.e. time clocks, centralized controllers etc.
5. Check operation of all condensate pumps if fitted.
6. Monitor operation for at least 1 hour. Observe and save all data.
8. Record all refrigerant usage in total compliance with F Gas.
   a. Checklist / proper register to be maintained at site for physical witnessing & ensuring that the laid down procedure are followed properly. The register to be signed by contractor & Consultant for every activity.
12.0 QUALITY ASSURANCE, INSPECTION, TESTING AND COMMISSIONING

12.1 Scope

The following quality assurance, inspection, testing and commissioning procedures shall be required to be carried out upon award of work.

I. Provide quality assurance program (QAP), works quality assurance program (WQAP), field quality assurance program (FQAP) and quality plan.

II. Tests at manufacturer’s works.

III. Perform site tests and commissioning.

12.2 Submittals

I. After award of work following information shall be submitted.
   a. Quality Assurance Program (QAP)
   b. Works Quality Assurance program (WQAP)
   c. Field Quality Assurance Program (FQAP)

II. For inspection and testing, submit inspection and testing procedures, programme, record sheets applicable at each hold point.

III. After completion of testing, submit test records, packaging, transportation and storage instructions and methods.

IV. For site installation and commissioning, submit installation methods or procedures, notification and procedures for pre commissioning and commissioning.

V. After commissioning, submit site test records, as-built drawings, manufacturer’s operation maintenance manuals and list of recommended spares and tools.

12.3 Quality Assurance Concept And Control

I. Minimum requirements for establishing and implementing a quality assurance program shall be applied to all aspects of the work necessary for carrying out the contract. Quality assurance shall extend to material parts, components, systems and services as a means of obtaining and sustaining the reliability of critical items, operating performance, maintenance and safety.

II. Acceptance of the Contractor’s quality assurance program does not relieve the Contractor’s obligation to comply with the requirement of the contract document. If the program is found to be ineffective, then the Owner’s site representative reserves the right to request for necessary revisions of the program.

III. The Contractor is required to produce readily identifiable documentary evidence covering the extent and details of both his own and his sub contractor’s quality assurances system as follows :
   a. Quality Assurance Program (QAP)
   b. Works Quality Assurance program (WQAP)
   c. Field Quality Assurance Program (FQAP)
   d. Quality Plan.

IV. These documents shall be prepared separately and submitted to the Owner’s site representative at the time of starting the work.

V. Quality Plan and Manual shall be prepared by the Contractor for all items and services to be supplied, after the contract has been placed, but before commencement of fabrication, and shall be subject to evaluation and acceptance by the Owner’s site representative before start of work.

12.4 Quality Assurance Manual (QAM)

I. The QAM shall be a general comprehensive document outlining the Contractor’s basic organization, policies and procedures. The information to be given in the QAM shall include but not limited to:
a. Quality Policy.
b. Quality Assurance Program
c. Organization Structure showing inter relationships.
d. Functional responsibilities and levels of authority.
e. Lines of communication.
f. Customer relations.
g. Laboratory Facilities.

12.5 Works Quality Assurance Program (WQAP)

I. The WQAP shall identify the Contractor’s Quality Assurance Program at works applicable throughout all phases of Contract performance, including design, procurement, manufacture, inspection and testing. It shall identify each of the program elements to be designed, developed, executed and maintained by the Contractor for the purpose of ensuring that all supplies and services comply with this specifications.

II. The information to be given under this program shall include but not limited to
   b. Contract Review.
   c. Design and Document Control.
   d. Procurement Control.
   e. Production Control.
   f. Control on Sub-contractors.
   h. In-process Quality Control and Traceability.
   i. Inspection and Testing.
   j. Control of Non-conformances.
   k. Corrective Action.
   l. Control of Inspection, Measuring and Test Equipment.
   m. Handling, Storage, Packaging and Delivery.
   n. Records.
   o. Quality Audits.
   p. After - Sales Servicing.

12.6 Field Quality Assurance Program (FQAP)

I. This program shall identify the Contractor’s Quality Assurance Program at site applicable throughout site construction, erection and commissioning. It is the underlying philosophy that the quality built into the product at works shall be maintained throughout the construction and commissioning stages.

II. While, in principle, the FQAP shall include the items discussed in WQAP, it shall, however, be approached differently to take into account site conditions.

III. The FQAP shall include, but not limited to the following information :
   a. Organization and responsibility.
   b. Control of Drawings and Documentation.
   c. Product Checklist.
   d. Control and Traceability of Purchased materials and services.
   e. Receipt Inspection of materials at site.
   f. Material Storage Control.
   g. Inspection and Examination Procedures.
   h. Control of Painting and Insulation Works.
   i. Pre-commissioning.
   j. Commissioning.
   k. Control of Non-conformances.
   l. Corrective Action.
   m. Control of Inspection, Measuring and Test Equipment.
   q. Records.
   r. Completion Documents.
   s. List of recommended spares and tools.
t. Personal Training.
u. Servicing during Defects Liability Period.

12.7 Quality Plan

I. The contractor shall be required to prepare manufacturing and construction/erection quality plans for all equipment items and services. The quality plan shall also define the involvement of Owner’s site representative in the inspection and test programs.

II. The Quality Plan shall incorporate as appropriate:
   a. Charts indicating flow of materials, parts and components through manufacturing quality control inspection and test to delivery and erection.

   b. The charts shall indicate the location of hold points for quality control, inspection and test beyond which manufacture shall not continue until the action required by the hold point is met, and the documentation required is generated.

   c. The control documents associated with each hold point, i.e. drawings, material, specification, Works Process Schedule (WPS), Process Quality Records (PQR), quality control methods and procedures and acceptance standards.

12.8 Site Quality Control Section

I. The Contractor’s Quality Control (Q.C.) section shall be headed by an experienced Quality Control Engineer. He shall be assisted by other supervisors. The section shall be an independent one, reporting to the contractor’s Site Manager only on administrative matters, but otherwise under full control by the Contractor’s Corporate Quality System Management.

II. The Contractor’s Q.C. Section shall liaise closely with the Owner’s site representative in charge of Quality Assurance/Quality Control, and to whom it shall give fullest cooperation. It is the underlying principle of this contract document that while the Contractor’s Q.C. Engineer implements the Contractor’s Quality Program, the adequacy and effectiveness of that implementation shall be audited by the Owner’s site representative whose recommendations on improving or maintaining quality shall be acted upon promptly by the Contractor’s Q.C. Section.

12.9 Inspection And Testing

I. All equipment and components supplied may be subjected to inspection and tests by the Consultant/Owner’s site representative during manufacture, erection/installation and after completion. The inspection and tests shall include but not be limited by the requirements of this contract document. Prior to inspection and testing, the equipment shall undergo pre-service cleaning and protection.

II. Tenderers shall state and guarantee the technical particulars listed in the Schedule of Technical Data. These guarantees and particulars shall be binding and shall not be varied without the written permission of the Owner’s site representative.

III. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated.

IV. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the Owner’s site representative may reject the item, or defective component thereof, whichever he considers necessary; and after adjustment or modification as directed by the Owner’s site representative, the contractor shall submit the item for further inspection and /or test.

V. The approval of the Owner’s site representative of inspection and/or test results shall not prejudice the right of the Owner’s site representative to reject an item of equipment if it
does not comply with the contract document when erected, does not or prove completely satisfactory in service.

VI. The Contractor shall be responsible for the timely transmission of the relevant and appropriate sections of the contract document to manufacturers and sub-contractors for the proper execution of all tests at their works as per contract specifications.

12.10 Tests At Manufacturer’s Works

I. All tests to be performed during manufacture, fabrication and inspection shall be agreed with the Consultant/Owner’s site representative prior to commencement of the work. The Contractor shall prepare the details of the schedule and submit these to the Consultant/Owner’s site representative for approval. It must be ensured that adequate relevant information on the design code/standard employed, the manufacture/fabrication/assembly procedure and the attendant quality control steps proposed are made available to the Consultant/Owner’s site representative who will mark in the appropriate spaces his intention to attend or waive the invited tests, or inspections. Contractor shall arrange inspection and factory witness test for centrifugal, screw chiller and vapour absorption chiller.

II. A minimum of twenty-one days’ notice of the readiness of equipment for test or inspection shall be provided to the Owner’s site representative by the Contractor (whether the tests be held at the Contractors of Sub-contractor’s works). The subject items should remain available for Owner’s site representative inspection and test up to a minimum 10 days beyond the agreed date of witnessing the test. Every facility in respect of access, drawings, instruments and manpower shall be provided by the Contractor and sub-contractor to enable the Owner’s site representative to carry out the necessary inspection and testing of the Plant.

III. No plant shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, all tests called for have been successfully carried out in the presence of the Owner’s site representative or approved for shipment, or alternatively inspection has been waived.

IV. Functional electrical, mechanical and hydraulic tests shall be carried out on completed assemblies in the works. The extent of these tests and method of recording the results shall be submitted to, and agreed by, the Owner’s site representative in sufficient time to enable the tests to be satisfactorily witnesses, or if necessary for any changes required to the proposed program of tests to be agreed.

V. The Consultant/Owner’s site representative reserves the right to visit the Manufacturer’s works at any reasonable time during fabrication of equipment and to familiarize himself with the progress made and the quantity of the work to date.

VI. Within 30 days of completion of any tests, triplicate sets of all principal test records, test certificates and correction and performance curves shall be supplied to the Owner’s site representative.

VII. These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Owner’s site representative or not. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the Contract reference title.

VIII. When all equipment has been tested, the test certificates from all works and site tests shall be compiled by the Contractor into volumes and bound in an approved from complete with index and four copies of each volume shall be supplied to Consultant/Owner’s site representative.

IX. Stage wise inspection of equipment in factory in waived.
12.11 Performance Tests At Manufacturer’s Works

I. All equipment may be subjected to routine performance tests at the Manufacturer’s Works in accordance with the relevant ANSI, ASME, ASTM, BIS standard including operating tests of complete assemblies to ensure correct operation of apparatus and components.

II. Pumps, fans, compressor, and other rotating equipment shall be given full load tests, and run to 15% over speed for 5 minutes to check vibration. Main and auxiliary gear boxes shall be subjected to shock load tests and a six-hour endurance run at rated speed and maximum torque.

III. The Contractor shall submit single line diagrams including the layout of the Plant together with the location of test instrumentation and the principal dimensions of the layout. All calculations to derive performance data shall be made strictly in accordance with format given in the approved standards. Any alterations or deviations from the approved standard test layout or formulae shall be subjected to the prior approval of the Owner’s Site Representative.

IV. The performance test shall be conducted over the full operating range of the pump to a closed valve condition and a minimum of five measurement points covering the full range shall be taken. Curves indicating Quality vs. Head, Quantity vs. Power absorbed, and Quantity vs. Pump efficiency shall be provided. In addition a curve of the NPSH required vs. Quantity shall be provided except when the suction conditions do not require this test. Any proposal for the omission of this test shall be to the approval of the Consultant/Owner’s site representative.

V. On completion of the tests the Contractor shall submit a report showing the test results obtained together with the curves corrected to the site operating conditions.
1.0 **SCOPE OF WORK**

1.4 Work under this section shall consist of furnishing all labour, materials, fabrication, equipment and appliances necessary and required to completely install wet riser, fire hydrant & sprinkler riser system as required by the drawings and specified here in after or given in the Bill of Quantities.

1.5 Without restricting to the generality of the foregoing,

1.6 The fire protection work shall include the following:

- a) Yard hydrants, Landing valves, hose reels, hose cabinets, branch pipe, nozzles, valves, orifice along with orifice flanges etc.
- b) Design of orifice and furnishing the same so as to allow required flow of water at various locations and each hydrant.
- c) Fire brigade inlets
- d) Fire Hydrant pump with motor, Diesel Engine driven pump, Sprinkler pump with motor, Jockey pump with motor, Air Vessel & Priming Tank in the Fire Pump Room
- e) Fire Booster Pump with Motor at Terrace Level
- f) GI Class ‘C’ suction, delivery & header pipe, fittings, flanges, strainers, bellows & valves, inside the Pump Room & terrace level
- g) GI Class ‘C’ pipe External Fire Hydrant, Wet Riser & Sprinkler line from Pump Room to the Building shaft.
- h) Fire extinguishers & sand buckets for Pump House, Electrical Room, Lift Machine Room etc.
- i) 4 Way & 2 Way Fire Brigade Inlet & Yard Hydrant with Single Headed Hydrant Valve, Fire Hose & Hose Cabinet
- j) GI Class ‘C’ Wet risers, Sprinkler risers, air release valve, orifice plates etc. with fittings.
- k) Double Headed Hydrant Valve, Fire Hose & Hose Reel Drum near both staircase fire shaft.
- m) Pressure Gauges, Pressure switches with accessories.
- n) Mounting hardware’s, companion flanges, Nuts & bolts, Gaskets, etc.
- o) Supports, clamps, anchoring with wall, ceiling, slab.
- p) Excavation, trenching, refilling, dewatering, etc., valve chambers & required civil work to complete the job.
- q) Painting, anti-corrosive tape wrapping & coating, hydraulic testing at 1.5 times the working pressure for minimum 2 hrs.
- r) Electrical System for the above installation like panel with starter, control, protections & indications, pressure switches interlocking with pumps.
- s) The Principal Contractor shall propose the sub-contractor/agency which it intends to appoint for execution of Fire Fighting (FF) works, with the submission of documentary proofs to prove the credentials of the agency and experience of earlier completed FF work for review and approval by the Client / Consultant. The Principal Contractor shall appoint the sub-contractor/agency only after approval of the Client / Consultant.
- t) All heavy equipment and machineries shall be fixed with bolts and spring washers for securing the foundations

2.0 **GENERAL REQUIREMENTS:**

2.1 All the materials shall be of approved, best quality conforming to the specifications and subject to the approval of the Consultant / Client or his representative. If so directed, materials shall be tested in an approved testing laboratory (NABL) & the contractor shall produce the test certificate in original to the Engineer-in-charge of consultant / client & the entire charges for original as well a repeated tests shall be borne by the Contractor.

2.2 Before welding, the pipe faces shall be cleared & then shall be welded conforming to IS: 9595. The electrodes used for welding shall comply with IS: 814. The laying of welded pipe
shall also comply to IS 5822. The welding joints shall be tested in accordance to IS:3600, Part 1973.

2.3 The welding procedure, types of electrodes etc. shall be in accordance with the following IS codes/specifications.
Welding procedure – IS: 823
Welding electrodes – IS: 814, but of approved makes only (ESAB, Advani Oerlikon)
Testing of welders – IS: 817
Qualified welders having qualification certificates shall be deployed at site for welding work.

2.4 Contractor shall submit the technical data sheet for all the items, equipment’s after award of Contract and get it approved before procurement of the items.

2.5 Contractor has to consider all civil work related to installation of fire protection system in their contract.

2.6 All the Execution, installation, shop drawings shall be prepared by the Contractor & shall furnish for the approval of the Client / Architect / Consultant.

2.7 Each item of equipment / material proposed shall be from the manufacturers given in list of approved makes and as per relevant standards and codes.

2.8 QAP (Quality Assurance Plan), ATP (Acceptance Test Procedure), Motor & Pump certificate of performance etc should be provided by OEM. FAT - Factory Acceptance tests shall be witnessed by IIT/IRS representative.

2.9 Diameter of various Orifices fitted in systems should be shared post handing over of system to IITB/Maintenance department.

2.10 Contractor shall submit AS BUILT drawings when work in all respects is completed. These drawings shall be submitted in the form of four sets of CD’s and four set of Hard copy – ‘A1’ Size color printout.

2.11 Upon completion and commissioning of system the contractor shall submit a comprehensive operating instruction, maintenance schedule and log sheets for all systems and equipment included in this contract. The contractor shall submit four set of Hard copy & soft copy of operating instructions and maintenance manuals. These manuals shall also include detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for period of maintenance of each equipment, operating instruction etc including training to Maintenance personnel of IIT / EMD dept shall be provided by OEM.

2.12 Contractor has to submit all Calibration certificates of pressure gauges, sensors, temp/pressure switches, safety cut outs and set values of safety valves, relief valves should be provided.


2.14 Acceptance of all types of Fire pumps and installation shall be in accordance with IS 15301 : 2003 and NFPA 20 and NFPA 25

3.0 **FIRE EXTINGUISHER:**

a. General:

The scope of work under this part of the specification covers supply and installation of internal appliances with ISI marked as per requirements specified in schedule & marked on drawings and instructions of engineer-in-charge.
Makes of all the appliances supplied and installed shall be as per the ‘List of Approved Make.’

Mounting accessories, indicator boards etc are part of the scope of supply of internal appliances.

b. Specifications:

Internal appliances with various fire extinguishing medium shall conform to the following specifications and shall be installed and maintained as per IS: 2190 / NFPA 10

IS: 2878 Fire extinguisher, portable CO₂
IS: 2171 Fire extinguisher, portable, dry powder type.
IS: 13849 Fire extinguishers, ABC stored pressure type

Portables Extinguishers of the following types shall be installed. Extinguisher to be mounted on wall.

1. Dry chemical Powder type
2. CO₂ type

c. Dry chemical powder type:

The Dry chemical powder type shall be of 6.0 Kg. Capacity and shall have the IS mark 2171 complete with powder and charged including with fixing bracket, fitted with gunmetal cap, and discharge hose and open grip nozzle.

d. CO₂ Type:

The CO₂ Extinguisher shall be ISI mark, with initial charge with high pressure cylinder, complete with wheel type valve, internal discharge tube, with high pressure discharge hose with horn and suspension brackets. The extinguisher shall have ISI mark of 2878 and capacity shall be 4.5 Kgs.

e. Bucket:

Galvanized mild steel fire bucket with ISI mark as per IS 2546-1974. The shape and the essential dimensions of fire bucket shall conform to IS 2546-1974, fire buckets (3 nos./set) of 24-gauge galvanized steel sheet, standard 9 litre capacity and of round bottom shape, painted white inside and black on the bottom, inscribed with letters "FIRE" in black and gold with dry clean fire sand. The scope shall also include the stand for mounting the sand bucket.

- MANUFACTURE

a. Body — The body shall be in two halves which shall be joined together by butt welding. The top rim of the body shall be wired and uniformly beaded. The beading shall be fully formed without gaps. The thickness of body shall be 1 mm and diameter of beading wire 3.55 mm.

b. Bottom — The bottom shall be dished and shall be joined to the body by butt welding so that there is no raw edge or crevice on the inside of the bucket. The thickness of the bottom sheet shall be 1 mm.

c. Ears — The ears shall be made of mild steel sheet and shall be fitted to the body at the top by means of welding with the flat head on the side. The thickness of sheet for ears shall be 2.8 mm
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

d. Top Handle — The top handle shall be of mild steel rod of 10 mm in diameter with its ends bent up.

e. Bottom Handle — The bottom handle shall be of mild steel rod of 10 mm in diameter and it shall be joined to the bottom by welding as shown in Fig. 1. The grip shall have no sharp edges.

f. General — All gas welds shall be free from porosity, blow holes and brittleness.

- FINISH
  a. All parts of the bucket shall be finished smooth and sharp edges rounded off.

b. The bucket shall be galvanized after manufacture as per IS : 2629-1966*. The thickness of coating of zinc conforming to IS: 13229-1991 Specification for zinc for galvanizing on any portion shall be not less than 0.06 g/cm² (both sides inclusive). Alternately, it may also be galvanized of lead tin alloy to a thickness of not less than 0.012 mm.

c. Bucket shall, in addition to galvanizing, be painted with two coats of white paint on the inside and two coats of red paint on the outside (see also 2.4). The handles and the ears shall be painted with two coats of black paint.

d. The word 'FIRE' shall be painted in black centrally on the outside; its letters shall be 75 mm high, and approximately 12 mm thick.

4.0 PIPE WORK:

General requirements:

a. All the materials shall be of ISO / ISI approved, best quality conforming to the specifications and subject to the approval of the Client or his representative. If so directed, materials shall be tested in an approved testing laboratory & the contractor shall produce the test certificate in original to the Engineer-in-charge & the entire charges for original as well as repeated tests shall be borne by the Contractor.

b. Before welding, the pipe faces shall be cleared & then shall be welded conforming to IS: 9595 – 1996. The electrodes used for welding shall comply with IS: 814. The laying of welded pipe shall also comply to IS 5822 – 2004. The welding joints shall be tested in accordance to IS: 3600, Part 1973.

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

d. 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.

e. Pipes shall be securely fixed to walls and ceilings by suitable clamps or supported at every 3 mtr. & at change of direction as required. Only approved type of anchor fasteners shall be used for RCC ceiling and walls.

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

G.I. PIPING

Pipes of the following types are to be used:

G.I. pipes as per IS: 1239, heavy duty (for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion.
GI pipelines up to 150 mm dia. shall have all fittings as per IS: 1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be fabricated from IS: 3589 Gr.320 pipes as applicable or from steel plates.

GI pipelines up to 50 mm dia screwed jointing shall be adopted, while for pipelines above 50 mm dia welded or flanged construction is to be carried out or as specified in Schedule of quantities.

Hangers and supports 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 Consultant / Client / Architect.

The piping system shall be capable of withstanding 150% of the working pressure including water hammer effects.

Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points (@ at every 15-20 mtr.) to facilitate erection and subsequent maintenance work.

Excavation for pipe line shall be in open trenches. Pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry supports at least 300mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand: 8 stone aggregate) of size 380 x 380 x 75 thick resting on firm soil.

Wherever required Contractor shall support all trenches or adjoining structures with adequate supports to prevent landslides.

On completion of testing and painting trenches shall be refilled with excavated earth in 15 cm layers and compacted.

Contractor shall dispose off all surplus earth within the site.

Contractor shall provide suitable cement concrete anchor blocks for overcoming pressure trusts in underground / external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.

5.0 PRESSURE REDUCING VALVE:

Gun Metal pressure reducing valve with ISI mark. Installation requirements referenced in the Standard for Installation of Fire protection Systems.

Filed-setting of the PRV Valve to provide required outlet pressures and flows for the given application.

- Testing of the PRV Valve after installation in Indian standard.
- Testing the PRV Valve tested periodically thereafter in accordance.

Maximum Inlet Pressure 250 psi (17,2 bar)

Factory Outlet “Set Pressure” 125 psi (8,6 bar)

Field Outlet “Set Pressure” Range 80 to 225 psi (5,5 to 15,5 bar) per FM Approval, or 80 to 150 psi (5,5 to 10,3 bar) per UL Listing.

Pressure Loss With Inlet Pressure Above “Set Pressure” The inlet pressure minus the outlet “set pressure” equals pressure loss.
6.0 BUTTERFLY VALVES

Butterfly valves as per IS - 13095 / 1991

- SCOPE - Fabricated valve will not be considered.
- This standard cover double flanged and wafer type of metal seated, resilient seated cast iron, ductile iron, and carbon steel and lined butterfly valves for general purpose. Valves covered under this standard are manually, pneumatically, hydraulically or electrically operated.
- It covers valves of nominal pressure designations up to and including 4 MPa. and class 300 with ends flanged in accordance with appropriate table of I.S 6418: 1971 ‘Cast iron and malleable cast iron flanges for general engineering purpose’ or wafer type valves with bodies designed to be accommodate between pipe work flanges in accordance with appropriate table of IS 6418 : 1971 or IS 6392 : 1971 ‘steel pipe flanges’ in nominal size DN 40 to DN 2000. It also covers valves up to class 300 and flanges as per the pressure/temperature ratings given in IS 13159 ( Part 1) : 1991 ‘steel pipe flanges and flanged fittings : part I dimensions’ and IS 6418 : 1971 ‘cast iron and malleable cast iron flanges for general engineering purposes’.

- REFERENCE
  - The applicable Indian standards are necessary adjuncts to this standard.

- TERMINOLOGY AND DEFINITIONS
  - Terminology and definition covered in IS 4854 (Part3) : 1974 are generally applicable.

- VALVE END CONNECTIONS
  - Double flanged valves
    - A valve having flanged ends for connection to pipe flanges by individual bolting.
  - Water valve
    - A valve for clamping between two pipe flanges using through bolting this may be single flange, lug type, U- section or flangeless type.

- SERVICE APPLICATIONS
  - Valves shall be suitable for one or more of the following applications.
    - Tight shut off - A valve having no visible leakage past the disc in closed position under test conditions.
    - Regulating - A valve intended for regulating purpose and which may have a clearance between the disc and the body in close position.
    - Low leakage - A valve which has specified maximum leakage rate past the disc in the closed position.

- VACUUM CONDITION
  - Where valve are to be used under vacuum conditions, purchaser shall mention specifically and the detailed design provision shall be mutually agreed between the purchaser and the manufacturer.

- NOMINAL SIZES
  - The range of nominal valve size (DN) in mm shall be as follows:
    - 40,50,65,80,100,150,200,250,300,350,400,450,500,600,700,800,900,1000,1200,1400,1600,1800 and 2000

- NOMINAL PRESSURES
  - Valve shall be designated by nominal pressure (PN) defined as the maximum permissible working pressure (Mpa) at 20 O C temperatures as follows:
    - PN 0.25, PN0.6, PN1.0, PN 1.25, PN 2.0 and PN 4.0.
    - The class designation for valves specified by nominal pipe size shall be class 125, class 150 and class 300.
• PRESSURE/TEMPERATURE RATINGS
  o Maximum permissible gauge working pressure and operating temperatures shall be in accordance with IS 6418 : 1971 and IS 13159 (Part I) : 1991 except that restriction on temperature may be placed by the manufacturer on valves in accordance with this standard by reason of valve type, trim materials or other factors. However, all valves shall be suitable for continuous use at their PN designation within the temperature range of -10°C to 65°C.

• BODY ENDS
  o Double Flanged Body Ends
    ▪ The dimensions of flanged body ends and drillings shall be in accordance with the requirement given in Annex B. Flanges as per any other specific requirements of the purchaser may also be given as agreed to between the manufacturer and the purchaser or as per I.S. 13159 (part I) : 1991.
    ▪ Flanges shall be at right angles to the axis of the bore and concentric with the bore.
      o Flanges shall be drilled unless otherwise specified and bolt holes shall be off centers. Tapped by the design of the valve.
      o Wafer Body Ends
    ▪ Body ends shall be capable of being fitted between the pipe flanges complying with the requirements of annex B flange drilling.
    ▪ The joint faces shall be at right angles to the axis of the bore and concentric with the bore.
      o Holes may be provided, where required by the design, for the passage of the bolts securing the flanges and the valve. Where through bolting is not practicable due to the presence of valve shaft, bearing housing, tapped holes may be provided for individual bolting of each flange.

• FACE TO FACE DIMENSIONS
  o Face to face dimensions of double flanged and wafer types of valve shall be as per Table 1.
  o Face to face dimensions given in Table 1 are exclusive of the sealing gaskets at both ends.
  o The manufacturer shall ensure that adequate space will be available between valve flanges for bolting when flanged valve with short body face to face or wafer long face to face are manufactured.
  o Tolerance on face to face dimension in Table 1 shall be as follow.

<table>
<thead>
<tr>
<th>Face to face dimension of Unlined valve MM</th>
<th>Tolerance MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over</td>
<td></td>
</tr>
<tr>
<td>Up to and including</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>250</td>
</tr>
<tr>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td>800</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>2400</td>
</tr>
</tbody>
</table>

• BODIES
  Bodies end ports shall be circular and the numerical valves of the diameter shall be as close as possible to the valve of DN.

• DISC AND SHAFT
  o The disc and shaft shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The shaft may be of one piece design or in two pieces separately attached to the disc. Any means of attachment between the shaft and the disc shall be such as to preclude components becoming loose in service.

• SEATING AND LININGS
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

- Non-integral seating, and lining where used, and their means of attachment shall be such as to preclude their becoming loose in service.

**BEARINGS**
- The bearings shall be suitable for the maximum loads imposed by the shaft during testing and in service.
- For valves DN 350 and above, a bearing shall be provided to take the axial thrust, spring retaining clips (cir clips) shall not be used as thrust bearing.
- Suitable sealing shall be provided for the shaft where it passes outside the pressure containing en closer.

**MATERIALS**
- This standard is based on materials specified in Table 2. Unless otherwise agreed, the materials shall be of a grade equivalent to those given in Table 2 or superior. Other material may be used as per agreement between the manufacturer and the purchaser.

**OPERATION**
- Manual Operation
  - All valves shall be capable of operated at a differential pressure across the disc as marked on the valve. Lever, worms gear/traveling nut type or any other suitable type of operator can be used.
  - Direction
    - Unless otherwise, specified manually operated valves shall be closed by turning hand wheel or lever in a clockwise direction when facing the hand wheel or lever. The design of lever when fitted shall be such that the lever may only be assembled to the valve so that it is parallel to the direction of flow when the valve is open.
    - All gear traveling nut operators shall be provided with suitable stops to prevent movement of the shaft beyond the limit corresponding to the fully closed position of the disc.
    - All gear traveling nut operators shall be packed with grease for lifetime operation. Gear/traveling nut operators shall be totally enclosed and weatherproof for general application. For special applications such as marine, submerged service etc. The purchaser may specify special en-closer.
    - All gear/traveling nut operators shall be self-locking type. All leaver operated valve shall be capable of being locked at least three intermediate positions.
    - The operating hand-wheels shall be marked ‘CLOSE’ or ‘SHUT’ to indicate the direction of closer.
    - The operator shall be provided with arrangement to indicate the disc position.

**TESTING**
- All valves shall hydrostatically tested by the manufacturer before dispatch. The pressure shall be obtained without any significant hydraulic shock. Testing shall be carried on before application of paint or other similar treatment unless otherwise agreed between the purchaser and the manufacturer. There shall be no air entrapped within the part of the valves subjected to test pressure.

**PERFORMANCE TESTING**
- Each valve shall be shop operated from fully closed to fully open position and reverse, under no pressure and no flow condition to demonstrate that the complete assembly is workable.

**BODY TEST**
- Completely assembled valve shall be tested as follows:
  - The body ends shall be blanked so that the valve is subjected to the full pressure in all directions include by the test pressure wafer valves may be tested in any suitable manner agreed between the purchaser and the manufacturer. The valve disc shall be in slightly open position and pressure equivalent to 1.5 times the maximum permissible working pressure shall be applied with water. The duration of this test shall be as in Table 3."
Part C: Minor Component (E&M Works)- Additional / Particular Specifications

- SEAT TEST
  - The seating surface of the valve shall be cleaned unless a surface treatment forms an integral part of the design or the use of a temporary surface treatment has been agreed between the manufacturer and the purchaser to avoid the possibility of damage under the condition of the test.

<table>
<thead>
<tr>
<th>NOMINAL DIA MM</th>
<th>MINIMUM TEST DURATION IN MINUTES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BODY TEST</td>
</tr>
<tr>
<td>Up to and including 50</td>
<td>0.25</td>
</tr>
<tr>
<td>65 to 150</td>
<td>1.0</td>
</tr>
<tr>
<td>200 to 300</td>
<td>2.0</td>
</tr>
<tr>
<td>350 to 1000</td>
<td>5.0</td>
</tr>
<tr>
<td>1200 to 2000</td>
<td>5.0</td>
</tr>
</tbody>
</table>

- Each valve shall be shop tested for leaks in close position. The test shall be conducted with the body flanges in a horizontal position. Pressure shall be applied to the upstream end of the valve, the downstream being open to atmosphere. The duration of test shall be as per Table 3. There shall be no indication of leakage past the valve disc during test and valves shall be drop tight. Seat test shall be carried out in both the direction of valve if agreed between the manufacturer and the purchaser. The seat pressure applied on upstream side shall be equivalent to 1.1 times the maximum permissible working pressure at 20°C and shall be applied with water.

- For regulating type valves seat test shall not be applicable.

- DISC STRENGTH TEST
  - The test shall be conducted with the body flanges in horizontal position. The test pressure shall be 1.5 times the maximum permissible pressure at 20°C. With disc in closed position, hydro test pressure shall be applied to the lower face of the disc for duration as per table-3. There shall be no damage to the valve disc nor shall any part of valve or disc be permanently deformed by the test. The purpose of this test is to provide evidence of the adequacy and structural integrity of disc and body. Any leakage past the seat shall not be the criteria for rejection of the valve (Sampling test sample as per IS 2500). For regulating type valves, disc strength shall not be applicable.

- Maximum permissible leakage shall be as per table 4.

- TEST CERTIFICATES
  - When specified by the purchaser, the manufacturer shall issue a test certificate conforming that the valves have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

<table>
<thead>
<tr>
<th>VALVE TYPE</th>
<th>LEAKAGE RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight shut-off</td>
<td>No visible leakage for duration of test</td>
</tr>
<tr>
<td>Low leakage</td>
<td>0.1 mm2 /s X DN (sec 5)</td>
</tr>
<tr>
<td>Regulating</td>
<td>Not specified. Outside the scope of this standard.</td>
</tr>
</tbody>
</table>

- INSPECTION
  - If inspection is required, this shall be stated in the enquiry/order. The purchaser or his authorized representative shall have access to the manufacturer’s works at all reasonable times to inspect assembled valve to his order.

- WITNESSING OF TESTS
  - When the purchaser desires to witness the tests, this shall be specifically agreed in advance.
• **MARKING**
  - Marking shall be cast integral on the body or on a plate securely attached to the body. The markings shall be in accordance with I.S. 9866: 1981.

• **PREPARATION FOR DESPATCH**
  - Valve shall be complete in all respects when shipped. Each valve shall be drained, cleaned, prepared and suitably protected with 2 coats of red oxide on unmachined surfaces and rust preventive coats on machined and flanged surfaces for dispatch in such a way as to minimize the possibility of damage and deterioration during transit and storage. Painting other than specified on the finished valve shall be as per the agreement between the manufacturer and the purchaser.
  - Disc shall be unseated when dispatched, but care shall be taken to ensure that there is no risk of damage to the disc.
  - When specified, the body ends shall be suitably sealed to exclude foreign matter during transit and storage.
  - Components shipped unattached shall be adequately protected and identified to permit correct field assembly.

7.0 **BALL VALVES**

**FORGED BRASS BALL VALVES**

**SCOPE**
The item includes provision of forged brass ball valves with hard chrome plated steel ball tested to a pressure not less than 15 kg/cm² with threaded or flanged joints including fixing and testing.

**MATERIAL**

a. All ball valves shall be heavy duty of approved make.
b. Valves shall have suitable for pressure of PN 15.
c. Ball valves up to 80 mm shall have forged brass body, SS spindle & Teflon seat rings.
d. Ball valve shall conform to IS: 9890 or BS: 1868.
e. Full way lever operated forged brass ball of brass body with forged brass hard chrome plated steel ball tested to a pressure not less than 15 kg/cm² with threaded or flanged joints. The weight of the full way valve shall be as per the table given below with a tolerance of 5 percent. For Hot water the same shall be suitable for temperature upto 85°C.

f. The valves shall have either screwed ends or flanged ends.

<table>
<thead>
<tr>
<th>Diameter in mm</th>
<th>Flanged arch (Kg)</th>
<th>Screwed arch (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>1.021</td>
<td>0.567</td>
</tr>
<tr>
<td>20</td>
<td>1.503</td>
<td>0.680</td>
</tr>
<tr>
<td>25</td>
<td>2.495</td>
<td>1.077</td>
</tr>
<tr>
<td>32</td>
<td>3.232</td>
<td>1.559</td>
</tr>
<tr>
<td>40</td>
<td>4.082</td>
<td>2.268</td>
</tr>
<tr>
<td>50</td>
<td>6.691</td>
<td>3.232</td>
</tr>
<tr>
<td>65</td>
<td>10.149</td>
<td>6.804</td>
</tr>
<tr>
<td>80</td>
<td>13.381</td>
<td>8.845</td>
</tr>
</tbody>
</table>

**FIXING**

a. The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts, flanges, hardware, gaskets, tail piece, etc.
b. During installation, flow direction on the valve shall be checked.
c. Valves shall be preferably installed in horizontal position with adequate supports.

**TESTING**

a. The valves shall be body & seat tested at manufacturer’s works as per the relevant standard & duly stamped. Test certificate shall be submitted for material & hydraulic testing.
b. After fixing in the pipelines, the system shall be hydraulically tested for 1.5 times working pressure or 22.5 kg/cm² whichever is higher for minimum 4 hrs without any pressure drop. In case of leakage, contractor shall rectify/replace valves at his own cost
c. Valves shall also be tested for its hand wheel / lever function by frequent on-off operation.

8.0 **REFLUX VALVE (NON-RETURN VALVE)**

Specifications shall conform to IS – 5312 or its latest update.

**MATERIALS** - The materials used for the manufacture of different component parts shall conform to the requirements given in IS 5312 – 2004 or its latest update.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Body, cover, door, bearing holder and Doors/Disc/Plate</td>
<td>Grey Cast Iron; IS 210 Gr. FG 260</td>
</tr>
<tr>
<td>(b)</td>
<td>Hinge Pin/ Door Pin and Dorr Suspension pin</td>
<td>Stainless steel; IS 6603</td>
</tr>
<tr>
<td>(c)</td>
<td>Body Seat rings</td>
<td>Leaded tin bronze, IS 318</td>
</tr>
<tr>
<td>(d)</td>
<td>Door Face ring</td>
<td>Leaded tin bronze</td>
</tr>
<tr>
<td>(e)</td>
<td>Bearing Bushes / Bearing Block</td>
<td>Leaded tin bronze</td>
</tr>
<tr>
<td>(f)</td>
<td>Plugs for hinge pin/ Air release plug</td>
<td>Leaded tin bronze</td>
</tr>
<tr>
<td>(g)</td>
<td>Bolts</td>
<td>Carbon Steel, IS 1363</td>
</tr>
<tr>
<td>(h)</td>
<td>Nuts</td>
<td>Carbon Steel, IS 1363</td>
</tr>
<tr>
<td>(i)</td>
<td>Gaskets</td>
<td>Rubber, IS 638</td>
</tr>
<tr>
<td>(j)</td>
<td>Hinges</td>
<td>Grey Cast Iron, IS 10</td>
</tr>
</tbody>
</table>

**DESIGN AND MANUFACTURE -**

**Body** - The body may be made in two parts - inlet shell and outlet shell. The inlet shell shall have duck foot support.

**Diaphragm** - Diaphragm shall be fitted between inlet and outlet shells. The parts in the diaphragm should be so designed as to induce minimum headloss in the flow through the valve.

**Water Way Area** - The area of the waterway through the multi- doors in the diaphragm shall not be less than the bore area except that this area may be reduced by not more than 15 percent for any proprietary designs.

**Inlet and Outlet Shell Connections** - The attachment of the inlet to outlet shell of the body shall be adequate to withstand the appropriate test pressures, service conditions and the mechanical loads encountered in the operation. All valves shall have bolted connection. Size of the bolts or studs shall not be less than 22 mm.

**Seats** - Seat rings shall be so fitted as to avoid their becoming loose in service. Standard countersunk screws shall not be used. 6.6 Door - The door shall be integral with the hinge and shall have a flat seating face.

**Lugs** - Suspension lugs shall be cast integrally on the diaphragm plate and shall be of adequate strength.

**Number of Doors** - The minimum number of doors ( discs ) in the diaphragm plate shall be two.
By-Pass Connection - By-passes are not standard items on valves to the design, but if required, it is recommended that they shall be made for connection between the inlet and outlet shell of the valve. By-passes shall conform to PN 1 of IS : 780-I984* and the minimum size of the by-pass arrangement shall be as indicated in respective IS.

COATING - All coatings shall be carried out after satisfactory testing of the valves prior to dispatch. All the un-machined ferrous surfaces of the valve (both inside and outside) shall be thoroughly clean, dry and shall be free from rust and grease before painting. All exposed machined ferrous surfaces shall be painted with one coat of aluminum red oxide primer. Two coats of black Japan conforming to Type B of IS 341 or paint conforming to IS9862 or IS2932 shall be applied by brush or spray for exterior application in colour as approved by the purchaser.

TESTING – Each valve shall be subjected to following hydrostatic tests as specified in IS.
   - Hydrostatic Body Test
   - Hydrostatic Seat Test

INSPECTION – The purchaser or his authorized representative shall have free access to the works of the manufacturer at all reasonable times to inspect the valve at any stage of manufacture and to reject any material which does not conform to the specified requirements.

MARKING – Following information shall be cast on each valve body in raised letter)
   - Manufacturer's name or trade-mark;
   - Nominal pressure of valve (PN1.0 or PN1.6);
   - Size of valve, mm;
   - Direction of flow; and
   - Heat No. of cast.

BIS Certification Marking – Each valve may also be marked with the Standard Mark.

Lowering and jointing in position

Supply of Material

Cast iron double-flanged valves with two tailpieces suitable to pipe conforming to the latest relevant IS shall be supplied and carted by the contractor to the site of work including loading, unloading and stacking at site. The valves and tailpieces shall be examined before laying for cracks and other flaws. They shall be undamaged in all respect. The valves shall be cleaned before laying. All grits and foreign materials shall be removed from the inside of the valves before placing. All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease. The tightening of gland shall be checked with a pair of inside-calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform all the sides.

Jointing Material

The contractor shall provide all necessary jointing materials such as nuts bolts, rubber packing, white zinc, jute, lead wool etc.

All tools and instruments, which are to be required for installation of sluice valve shall be provided by the contractor.

All jointing materials shall be got approved from the engineer-in-charge before use.

The nuts and bolts shall conform to the relevant IS.

The rubber packing shall conform all specifications as narrated in respective IS.

Installation
The valve shall be lowered in to the trench carefully, so that no part is damaged during lowering operation.

If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered in to the trench.

The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange with necessary holes and the sluice valve bore. It shall be even at both the inner and outer edges.

The flange faces thoroughly greased.

If flange faces are not free, the contractor shall use thin fibers of lead wool.

After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

The valve shall be tightly closed when being installed to prevent any foreign materials from getting in between the working parts of the valve.

Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.

The valve shall be installed in such a way that its Spindle shall remain in truly vertical position.

The other end of tailpiece shall be fitted with pipes so that continuous lines can work.

Extra excavation required for facility of lowering and fixing valve shall not be paid for.

**Testing**

After installation of valve the same is tested to 1½ times of its test pressure or as specified in the IS.

The joints of valve shall withstand the test pressure of pipelines.

Defects noticed during test and operation of valve shall be rectified by the contractor at his own cost without any extra claim to the entire satisfaction of the Engineer-in-charge.

**Measurement and payment:**

The rate shall be paid as per Schedule of Payment per number of valves fixed and tested as directed.

**9.0 STRAINER:**

Y-Type Strainers with ISI marked are used for filtering out the dirt, rust, and other debris in the water flow protecting the piping equipment such as pumps, meters, valves, and other equipment in the piping system. All strainers are equipped with a retainer cap which allows easy access to the stainless-steel screen for cleaning. Y-Type Strainer flanges are Ductile Iron ANSI B16.1, Class 125, with a maximum water working pressure of 300 psi (20.7 bar). ANSI B16.42, Class 125 flanges are not compatible with ANSI Class 250 or Class 300 flanges.

Butterfly nuts should be fixed on strainer body bolts for ease of removal of strainer cover for inspection of strainer buckets for cleaning.

BODY Ductile iron conforming to ASTM A-536, Grade 65-45-12

SCREEN AISI 304
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

COATING Fusion Bond Epoxy Coating (RAL 3000)

APPROVALS UL Listed

MODEL Flanged Type: YSF Grooved Type: YSG (Refer Table-I)

WEIGHT Refer Table-II

10.0 AIR VESSEL:

a. Scope

Supplying and installing Air vessel of 300 mm dia 1.5 meter. In height M.S. Tank fabricated from M.S. Black ERW pipe, conforming to IS 3589, having 6 mm thickness, dish end at both ends, duly welded with 300 mm dia pipe, having inlet of 100 mm dia, duly fitted with 100 dia sluice valve and 20/25 mm dia draw in with G.M. gate valve to be installed inside pump house along with provided M,S, angle tripod.

b. Material:

Air Vessel: MS ERW pipe confirming to IS 3589

Tripod: MS angle of size 75 X 75 X 5mm

c. Method of construction

300mm dia, 1.5meter height air vessel, Gate valve, flanges, MS angle Tripod including necessary labour, and use of required tools and plants.

11.0 PRESSURE SWITCH:

The pressure with ISI marked switch shall be industrial type single pole double throw electric pressure switch designed for starting or stopping of equipment when the pressure in the system drops or exceeds preset limits. It shall comprise of a single pole change over switch, below element assembly and differential spindle.

All pressure switches shall have ¼” BSP (F) inlet connection and screwed cable entry for fixing cable gland. All control cabling shall be provided.

12.0 PRESSURE GAUGE:

All pressure gauges with ISI marked shall be dial type with Borden tube element of SS 316. The dial size shall be of 100 mm diameter and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0-10 kg.sq.cm or as specified in BOQ. The pressure gauges shall be complete with CI isolation cock, siphon tubing, etc.

13.0 EXPANSION BELLOW:

a. SCOPE:

Design, fabrication, testing and installation of ISI marked metallic expansion bellows with necessary hardware to be provided at suction & delivery side of each pump and on header or as per drawing.

b. GENERAL:

Expansion bellows shall be designed as per the details furnished in the data sheet and shall be in accordance with the EJMA / ASME standard. All expansion bellows shall be free from dirt, moisture, grease, oil, etc. and all reports for hydrostatic test shall be furnished. Fatigue life expectancy to be considered for the bellows is 7000 cycles.
The bellows shall be metallic corrugated design and shall have double flange. The material for Bellows shall be SS 304.

c. CLEANING:
Prior to factory inspection, all manufacturing waste such as metal chips debris and all other foreign material shall be removed from interior of bellows. All mill scale, rust, oil, grease, chalk and all other deleterious material shall be removed from the interior and exterior surfaces.

d. PAINTING:
Bellows shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

Bellows used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could import any taste or odour to the water.

e. INSPECTION:
Bellows shall be tested as per the relevant Standards with latest revisions. Bellows shall be offered for visual inspection and dimensional checks. The hydrostatic and water tightness testing shall be witnessed by the Client. ISO 15348:2002 is to be followed for Inspection of Bellows.

f. TENDER DRAWINGS:
The Dimensional drawings with material of construction shall be submitted by tenderer along with their offer.

14.0 SPRINKLER ALARM VALVE:
Sprinkler alarm valve shall be provided with all accessories for wet sprinkler system to ensure positive water flow. It shall have flange connection & shall have DI body & steel trims. The valve shall conform to the specifications given by NFPA/UL/LFA.

15.0 SINGLE HEADED HYDRANT:
Internal hydrant shall be provided at each landing or at suitable location consisting of single / twin headed gunmetal landing valve as indicated in BOQ with 63 mm dia oblique female instantaneous pattern with caps & chains. Outlet and 80 mm inlet (IS: 5290-1993) with separate shut off valve. Landing valves shall be 63 mm dia. oblique female instantaneous pattern with caps and chains. Landing valves shall be of gunmetal and fitted with instantaneous coupling conforming to IS: 901. The valve body, stop valve, checks valve, nut, instantaneous female outlet and blank cap shall be of leaded-tin bronze conforming to Grade-II of IS: 318-1962. The valve spindle shall be of brass rod conforming IS: 320 - 1962. The hand wheel shall be mild steel or cast-iron washers gaskets shall be of rubber conforming to IS:638 - 1965 or leather conforming to IS:581: 1969. The coupling shall be fitted with an internal plug secured by chain landing valves shall be installed on hydrant riser at a height of 1.0 to 1.2 meter from the floor level.

Each internal hydrant shall be provided with two nos. 63 mm. Diameter 15 mtr. Long hose pipe with gunmetal male and female instantaneous type coupling, machined wound with G.I. wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe with nozzle conforming to IS:903.

16.0 HYDRANT STAND POSTS (YARD HYDRANT):
Yard or External Hydrants shall be as per IS: 908 and the valve as per IS: 5290. The hydrant shall consist of stand post assembly and a masonry base 200 mm X 200 mm X 200 cm high and shall be made at the point where it comes out of the soil. The valve shall complete with
hand wheel, quick coupling connection spring and blank cap. The hydrant shall be laid on 150
dia. or as mentioned in BOQ.

Yard or External hydrant shall be controlled by a cast iron sluice valve. Hydrant shall have
oblige female instantaneous pattern 63 mm diameter outlets with caps and chains. The
hydrant shall be of gunmetal and flange inlet and single outlet conforming to IS: 5290, a duck
foot bends and flanged riser of required height to bring the hydrant to level above ground. The
valve body, stop valve, checks valve, nut, instantaneous female outlet and blank cap shall be
of leaded-tin bronze conforming to Grade-II of IS: 318-1962. The valve spindle shall be of
brass rod conforming IS: 320 - 1962. The hand wheel shall be mild steel or cast iron washers
gaskets shall be of rubber conforming to IS:638 - 2003 or leather conforming to IS:581 : 1969.

Each external hydrant shall be provided with two nos. 63 mm. Diameter 15 mtr. Long hose
pipe with gunmetal male and female instantaneous type coupling, machined wound with G.I.
wire hose of IS 636 type A and couplings to IS:903 with IS certification, gunmetal branch pipe
with 20 mm nozzle conforming to IS:903.

17.0 RRL HOSE PIPE:

Hoses pipes shall be of fabric reinforced rubber lines as per IS:636 Type II or canvas hose as
per IS:4927, with nominal size of 63 mm and lengths of 15 meter or 7.5 meter, as per
quantities specified for in schedule or bill of quantity.

All hose pipes shall carry ISI marking on the body of the hose.

The hose shall have instantaneous spring lock-type coupling on ends. The instantaneous
coupling shall be as per IS: 901. It shall be fixed to each other by copper rivets and
galvanized M.S. wires and leather bands. All coupling shall be interchangeable with each
other and shall bear ISI markings.

18.0 FIRE HOSE CABINET:

Each hydrant shall be housed in a Hose cabinet of suitable size. The hydrant cabinet shall
hold double / single headed hydrant as specified, 2 hoses and one branch pipe as required.
Internal hydrants shall normally fit the size of the niche made for it. The cabinet shall be of
minimum 16 SWG M.S. sheet with center opening, double glass front doors (cleat glass of
4mm thickness). The glass shall be firmly fixed by means of steel clips and screw with rubber
beading. Hinges shall also be screwed and not welded. The corner members (frame) shall be
of 25 x 25 x 3 mm thick angle. The hose box shall be firmly fixed to the wall/support by means
of brackets and dash fasteners. The steel work shall have one coat of primer and two coats of
red paint. The words “Yard Hydrant”, “Hydrant” etc. should be painted in white or red on the
glass in 75 mm high letters. The hose box shall be lockable for internal hydrant installation.

fire hose cabinet stand mount type for external of suitable size house fire hydrant & hose,
including all other related accessories fabricated from M.S. sheet (14 Gauge) of fully welded
construction having front door with locking arrangement, partially glazed with 4 mm thick
glass. Cabinet shall be powder coated & painted with post office red colour of size as
mentioned in drawing (or as approved by the Architect) to house 15 mtr.x2 No. hoses

19.0 WALL MOUNTED FIRST AID FIXED TYPE FIRE HOSE REEL:

The hose reel shall be directly tapped from the riser through a 25 / 32 mm dia pipe, the drum
and the reel being firmly held against the wall by use of dash fasteners. The hose reel shall
be fixed type and the entire drum, reel etc. shall be as per IS: 3876 and IS: 884. The rubber
tubing shall be of best quality and the nozzle shall be shut off type

For external Stand Mounted type first aid fixed type with MSEP Fabricated Stand fire hose
reel of braided rubber suitably reinforced 25 mm size & 40 m standard length with 5 mm
tapering branch nozzle ,32mm dia. Pipe to connect to riser with cut off ball valve attachment.
Hose to be fixed type wall mounted drum & fixed to suit location including fixing with lead anchor fasteners & bolts (including drum and fixing type arrangement) etc.

20.0 STAINLESS STEEL ORIFICE PLATES:
Specially designed stainless steel orifice plates (minimum 8 mm plate thickness) on hydrant outlets of landing valves including distant pieces of suitable size for reducing delivery pressure up to 3.5 kg/ sq.cm at hydrant valve, as required by LFA complete with necessary accessories, etc.

a. Scope:
   Supplying and erecting orifice plate having 6 mm. thick with specified outer diameter and suitable inner diameter to reduce the pressure as per requirement.

b. Material:
   Body: Stainless Steel 8 mm thick
   Method of construction:
   The orifice plate shall be placed before the hydrant valve.

c. Mode of Measurement:
   Executed quantity shall be measured on number basis

21.0 AIR RELEASE VALVE:

a. Scope:

b. Supplying and erecting Air release cock 25 mm dia made from gunmetal with necessary G.I. coupling for fixing on top of air vessel or on wet riser with 25 mm dia ball valve on inlet side and pressure gauge with isolating cock.

c. Material:
   Air release valve: Stainless Steel
   Coupling: G.I

d. Method of Construction:
   Air release valve with necessary GI coupling shall be fixed on top of wet riser with required labour, tools, etc.

e. Mode of Measurement:
   Executed quantity shall be measured on number basis.

22.0 STAINLESS STEEL BRANCH PIPE:
Branch pipe shall be of stainless steel and should conform to IS: 903. One end of the branch pipe will receive the coupling while the other end shall have a nozzle screwed to it. It shall bear ISI marking.

23.0 2-WAY AND 4-WAY FIRE BRIGADE SERVICE INLET:
A fire brigade inlet connection with a non-return valve shall be provided to facilitate the fire brigade to pump water into the installation by the use of their own equipment. Four way or 150 mm dia connection to the system shall comprise of four instantaneous pattern 63 mm dia. male inlets shall be with caps and chains complete with 150 mm dia. sluice valves, non-return valve housed in a M.S. cabinet with glass fronted door. The cabinet shall be suitable for recess mounting.
Two way or 100 mm fire brigade inlet connection to the system shall comprise of two instantaneous pattern 63 mm dia. male inlets shall be with caps and chains complete with 100 mm dia sluice valve, non-return valve housed in a M.S. cabinet with glass fronted door. The cabinet shall be suitable for recess mounting.

24.0 FIRE BRIGADE DRAW OUT CONNECTION:

Supply, installation, testing and commissioning of fire brigade draw out connection with 100 mm MS suction pipe & 100 mm dia foot valve. The scope shall also include required valves, piping, M.S cabinet as required.

25.0 SLUICE VALVE:

10.1 Scope:

Design, supplying of CI double flanged sluice valves, including all taxes, insurance, transportation, freight charges, octroi, inspection charges, loading, unloading, conveyance to departmental stores, stacking etc., fixing, testing & commissioning complete.

Standards

The C.I. sluice valves to be manufactured, supplied and delivered under the scope of this contract shall be manufactured in accordance with and conforming to Indian standard specifications IS 14846 as given below : with ISI certification mark on each sluice valves.

Design Requirements For Sluice Valves

- Valves shall be provided with back seating arrangement.
- Renewable body and wedge rings shall be provided.
- Collared drain plugs of gunmetal shall be provided for all valves.
- Stuffing box gland shall be of bolted type.
- Valves shall be with non-rising spindle type.
- Valves shall be flanged and drilling shall conform to the standard as specified in data sheet.
- Face to face dimension shall be as per IS 14846- PD dimension (short body).
- Gear operation when provided for 400 mm & above, the gear shall be grease packed enclosed (spur / worm) type. These gear boxes shall be sealed in such a way that there shall be leakage of oil / grease even after long use.
- Valves of sizes 400 mm above shall be provided with a drain plug and an air plug.
- Valves of sizes 300 mm and above shall be provided with machined shoe channel arrangement.
- All face and seat rings shall be force fitted and additionally shall be riveted to the recesses in the C.I. casting.
- Valves shall be provided with appropriate bushing arrangement for replacement of packing without leakage for sizes 300 mm and above.

Cleaning

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the valve. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

Painting

Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint.

The resulting coating shall be uniform and smooth and adhere perfectly to the surface. Valve used in pipes carrying water, the inside coating shall not contain any constitute soluble in water or any ingredient which could import any taste or odor to the water.

Direction of Flow
Direction of flow shall coincide with the flow direction indicated by “arrow” cast on the valve body.

**Tests and Inspection**
Valve of each size shall be dismantled & shall be offered for material check & visual inspection and dimensional check.

Valve shall be tested as per IS 14846 with latest amendments.
The hydrostatic testing shall be witnessed by the purchaser.
Valve shall be dispatched only after visual inspection and clearing instruction for dispatch.

**Temperature Variation**
All sluice valves manufactured, supplied and delivered shall be subjected to drinking water under variable temperature condition ranging from 40°C to 45°C.

**MARKING**
The legible marking upon each valve shall indicate the following:
- ISI certification mark on each sluice valve only
- Manufacturer’s brand name and/or trade mark
- Size of valve and nominal pressure of valve
- Serial number of cast
- Serial number in punch

Any other important matter that the manufacturer deems fit to be inscribed embossed.

**TEST CERTIFICATE**
The contractor shall always provide manufacture’s test certificate in accordance with every batch/lot as valves so manufactured and supplied.

The contractor shall also produce, in addition to manufacture’s test certificate the inspection certificate issued by the authorized person/agency appointed by Engineer/board for the same purpose. The inspection charges of the authorized person/agency as fixed by CLIENT shall have to be borne by the contractor and the necessary payment to the inspecting agency shall be paid by the contractor as per the terms and condition of CLIENT.

**NOMINAL PRESSURE**
Sluice valves shall be designed by nominal pressure (PN) defined as the maximum permissible gauge working pressure in Mpa as “PN-1” (Mpa= 10 kgf/m² approx)

The nominal size shall refer to the nominal bore at any point, shall not be less than the nominal size required.

**MATERIAL :**
The materials for the different component parts of the sluice valve shall confirm to requirements given in following Table:

<table>
<thead>
<tr>
<th>SR. NO</th>
<th>COMPONENT</th>
<th>MATERIAL</th>
<th>REF. TO</th>
<th>GRADE OF DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body, bonnet wedge stuffing box, gland thrust plate, cap</td>
<td>Grey cast iron</td>
<td>210-FG 1978(1)</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>Stem</td>
<td>High tensile brass</td>
<td>320-1962(2)</td>
<td>Ally 1 of 2</td>
</tr>
<tr>
<td>3</td>
<td>Wedge nut</td>
<td>Leaded tin bronze</td>
<td>318-1962(3)</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Body seat ring, wedge facing ring</td>
<td>Leaded tin bronze</td>
<td>318-1962(3)</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Bolts</td>
<td>Carbon steel</td>
<td>1367-1967(4)</td>
<td>Class 4.6</td>
</tr>
<tr>
<td>6</td>
<td>Nuts</td>
<td>Carbon steel</td>
<td>1367-1967(4)</td>
<td>Class 4</td>
</tr>
<tr>
<td>7</td>
<td>Bonnet gasket</td>
<td>Compressed fiber Board</td>
<td>2712-1971(5)</td>
<td>C</td>
</tr>
</tbody>
</table>
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>8</th>
<th>Gland packing</th>
<th>Jute &amp; hemp</th>
<th>5414-1969(6)</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Specification for gray iron castings (third revision).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>Specification for high tensile brass roads and sections (revised).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>Specification for leaded tin bronze ingots and casting (revised).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>Specification for technical supply condition threaded fasteners (first revision)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>Specification for compressed asbestos fiber jointing (first revision)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>Specification for gland packing, jute and hemp.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

END CONNECTIONS
Sluice valve bodies for 80 mm to 900 mm size valves shall be provided with double flanged ends connection.

FLANGES
The flanges and their dimensions of drilling shall be in accordance with IS 6392, PN 1 N/mm² (Specification for MS Flanges or its latest revision).

MEASUREMENT
Measurement shall be paid on number basis as per relevant diameter.

TENDER DRAWINGS
The following drawings shall be submitted by Bidder along with the quotation.
- Preliminary outline dimensional drawings.
- Typical cross section drawings.
- Flow v/s head loss curve for valves.

HANDWHEEL
A hand wheel shall be provided for emergency operation. The hand wheel drive shall be mechanically independent of the motor drive and any gearing should be such as to permit emergency manual operation in a reasonable time.

TECHNICAL DATA SHEET FOR SLUICE VALVE

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>DESCRIPTION</th>
<th>PARTICULARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Size range and quantity</td>
<td>As per BOQ</td>
</tr>
<tr>
<td>2.0</td>
<td>Fluid</td>
<td>Water</td>
</tr>
<tr>
<td>3.0</td>
<td>Pressure Rating</td>
<td>PN : 2.0</td>
</tr>
<tr>
<td>4.0</td>
<td>Stem</td>
<td>Extended type with non rising</td>
</tr>
<tr>
<td>5.0</td>
<td>Ends</td>
<td>Flanged, flat faced flanges as per IS-1538 Table IV &amp; VI having off center bolt holes</td>
</tr>
<tr>
<td>6.0</td>
<td>Bonnet</td>
<td>Bolted</td>
</tr>
<tr>
<td>7.0</td>
<td>Disc.</td>
<td>Solid wedge</td>
</tr>
<tr>
<td>8.0</td>
<td>Operation</td>
<td>Hand wheel operated upto 250 mm &amp; gear operation for more than 250 mm Suction valve: Hand wheel with gear arrangement Delivery valve – Electrical Operation Header valve – Electrical Operation Bypass valve - Hand wheel operation</td>
</tr>
<tr>
<td>9.0</td>
<td>Seat</td>
<td>Body - Renewable Disc - Renewable</td>
</tr>
<tr>
<td>10.0</td>
<td>Other requirements</td>
<td>Valves shall close in clockwise rotation of the hand wheel.</td>
</tr>
<tr>
<td>11.0</td>
<td>Body / bonnet</td>
<td>C.I. IS 210 GR 200</td>
</tr>
<tr>
<td>12.0</td>
<td>Disc</td>
<td>C.I. IS 210 GR 200</td>
</tr>
<tr>
<td>13.0</td>
<td>Stem</td>
<td>S.S. BS 970 Gr 316</td>
</tr>
<tr>
<td>14.0</td>
<td>Body seat</td>
<td>SS</td>
</tr>
<tr>
<td>15.0</td>
<td>Disc seat</td>
<td>SS</td>
</tr>
<tr>
<td>16.0</td>
<td>Stem nut</td>
<td>SS</td>
</tr>
<tr>
<td>17.0</td>
<td>Back Seat Bush</td>
<td>Bronze IS 318 GR LTB2</td>
</tr>
</tbody>
</table>
26.0 PUMP

Scope of Work

A. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated pumps for fire hydrant installations as required by the drawings and specified hereinafter or given in the schedule of quantities.

B. Without restricting to generality of the foregoing the pumps and the ancillary equipment and shall include the following:

a. Electrically operated pumps with motors base plate and accessories.

b. Pump suction and delivery headers, valves, air vessel and connections.

c. Pressure gauges / pressure switch.

d. Only single point 3 phase supply will be made available to the Contractor. From there, all provision viz. Electrical switchboard, wiring, cabling, cable tray, control panel, earthing, etc. shall be made.

C. General Requirement

a) Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in concrete foundations.

b) Pumps and motors shall be truly aligned with suitable instruments.

c) All pump connections shall be standard flanged type with appropriate number of bolts.

d) Manufacturer instructions regarding installation connections and commissioning shall be followed with respect to all pumps, switch gear and accessories.

D. Fire and Jockey Pumps

a) The main Fire hydrant, Sprinkler pumps, Jockey pump shall be horizontal Centrifugal Multistage Multoutlet (twin outlet low pressure & high pressure) OR Vertical inline type having following specifications.

b) Shut off head should not exceed 140% of rated head. Pump shall not develop less than 65% of rated head at 150% of rated capacity.

MATERIALS OF CONSTRUCTION

<table>
<thead>
<tr>
<th>Part</th>
<th>Material</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>DESCRIPTION</th>
<th>PARTICULARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.0</td>
<td>Shoe &amp; Channel Linings</td>
<td>Bronze IS 318 GR LTB2</td>
</tr>
<tr>
<td>19.0</td>
<td>Stuffing box</td>
<td>C.I. IS 210 GR 200</td>
</tr>
<tr>
<td>20.0</td>
<td>Gland</td>
<td>C.I. IS 210 GR 200</td>
</tr>
<tr>
<td>21.0</td>
<td>Packing</td>
<td>Graphite Asbestos</td>
</tr>
<tr>
<td>22.0</td>
<td>Bolts, studs &amp; nuts</td>
<td>Carbon Steel IS :1367 Class 4.6 / 4</td>
</tr>
<tr>
<td>23.0</td>
<td>Shell test</td>
<td>15 Kg / Cm²</td>
</tr>
<tr>
<td>24.0</td>
<td>Seat test</td>
<td>10 Kg / Cm²</td>
</tr>
<tr>
<td>25.0</td>
<td>Back seat test</td>
<td>6 Kg / Cm²</td>
</tr>
<tr>
<td>26.0</td>
<td>Drawings</td>
<td>Overall Dimensional drawings with material of construction to be submitted</td>
</tr>
</tbody>
</table>
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

<table>
<thead>
<tr>
<th>Part C: Minor Component (E&amp;M Works) - Additional / Particular Specifications</th>
</tr>
</thead>
</table>

- **Casing**: Cast Iron  
- **Impeller**: Bronze IS: 318, Gr. LTB 2  
- **Casing Wearing**: SS  
- **Shaft**: AISI – 410 / Stainless Steel  
- **Shaft Sleeve**: S.S. 316  
- **Stuffing Box**: Gland Packed

c) Pumps shall be provided with pressure gauge with isolation cock on the delivery side.

d) In case of motor driven pump, the motor rating should be adequate to drive the motor rating should be adequate to drive the pump at 150% of rated discharge.

e) The pump and its prime mover (Electric motor or Diesel Engine) shall comply with all the equipment of the Rules of the Traffic Advisory Committee.

f) All pumps shall have positive suction & shall be provided with suction strainer of SS & CI bell mouth. In case of negative suction suitable priming arrangement shall be provided.

g) In first phase only, all pumps shall be installed. Pump head shall be considering ultimate phase.

E. Jockey Pump

Starting and stopping of Jockey Pump set shall be automatic at predetermined levels through pressure switch. However, arrangements for manual start and stop of the pump shall also be made. Jockey Pump shall take care of small leakages in the piping system and pumps cushion tanks.

F. Electric Driven

Electrically driven pumps shall be provided with totally enclosed fan cooled, foot mounted, squirrel cage induction motors suitable for fire pumps with IP-55 enclosure.

The motors should be rated not to draw more than 4.5 times the starting current.

Motors shall be at least equivalent to the horse power required to drive the pump at 150% of its rates discharge.

The motors shall be wound for class-F insulation and windings shall be vacuum impregnated with heat and moisture resisting varnish, glass fiber insulated.

G. Diesel Engine

a) Diesel engine shall have suitable no. of cylinders with individual heat assemblies. The engine shall be water cooled and shall include heat exchanger and connecting piping strainer, isolating pressure reducing valves, bye-pass line, exhaust pipe, silencer, day tank for fuel all interconnected piping etc., complete in all respects.

b) Engine shall be direct injection type with low noise and exhaust omission levels.

c) The speed of engine shall match the pump speed for direct drive.

d) The engine shall be capable of being started without the use of the wicks, cartridge heater plugs or either at engine room temperature of 4°C and shall take full load within 15 seconds from the receipt of the signal to start.

e) The engine shall effectively operate at 46°C ambient temperature at 150 meter above mean sea level.

f) Engine shall be suitable for running on high-speed diesel oil.
Part C: Minor Component (E&M Works) - Additional / Particular Specifications

- The system shall be provided with a control panel with push button starting arrangement also wired to operate the engine on differential pressure gauge. It should be provided with other safety cut outs such as Over speed, High Lube oil temp, high fresh water temp along with differential pressure cut out.

- The entire system shall be mounted on a common structural base plate with anti-vibration mounting, Dunlop make, and flexible connections on the suction and delivery piping.

- Contractor provides one fully mounted and supported Day Oil Tank fabricated form 6mm thick MS sheet electrically welded for 8 hours working load and having suitable capacity of oil. Provide level indicators – low level and full level in the Day Oil Tank on the control panel through float switches and a breather. Day Oil Tank shall also be provided with filling connection (Threaded) with cap, gauge glass indication and cocks, drain cock, inspection / cleaning cover with gasket and nuts / bolts. MS dyke to hold 150% of the Day Tank capacity to be built around the Day Tank.

- Contractor to provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gasses to outside in open air as per site conditions (Contractor to check the site).

- Contractor to provide all accessories, fittings and fixtures necessary and required for a complete operating engine set. The exhaust pipe shall be taken outside the building with minimum number of bends (approx. length 30 Meters) and shall be duly heat insulated with 50mm thick glass wool covered with 24-gauge aluminum cladding.

- Noise & Vibration level of the pump driven by motor/engine shall be within the acceptable limits of ISO 2372, IS 11727.

H. BOOSTER PUMP:

- A booster pump shall be provided at terrace to pressurize the wet riser system. The pump shall be centrifugal end suction / mono block type. Terrace Booster pump should be housed in recess to avoid ingress of rainwater or adequately sheltered.

I. BASE PLATE

- Pumps and motors shall be mounted on a common structural base plate and installed as per manufacturer’s instructions.

Commissioning of System

A. Pressurized the fire hydrant system by running the main fire pump and after attain required pressure shut off the pump.

B. Open bye-pass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the pre-set pressure. If necessary, adjust the pressure switch for the jockey pump. Close bye-pass valve.

C. Open bye-pass valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the preset pressure and should not cut-out automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However, the jockey pump should cut out as soon as the main pump starts.

D. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

E. When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant simultaneously and allow the hose pipe to discharge water into the fire
tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

F. Diesel engine / DG set driven pump should also be checked in the same manner as given in Para above by running for 8 hours.

G. Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting which is found to be incompatible and does not fit into the other properly, shall be replaced by the Contractor. Landing valves shall also be checked by opening and closing under pressure.

27.0 SPRINKLERS:

A. General:

To supply, install, testing and commissioning of sprinkler system as per drawing and Sprinkler heads spacing shall be in conformity with the drawings and properly coordinated in reflected ceiling with electrical fixtures, ventilation ducts and grills and other services along the ceiling.

Sprinkler heads shall be brass / gunmetal with quartz bulb with temperature rating of 57/68/98 degree Celsius. Sprinkler heads shall be of type and quality approved by the local fire brigade authority/NFPA 13. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special side type. All sprinklers shall conform to the specifications given by IS, NFPA, FOC, UL & FM.

Sprinklers Pipelines shall have adapters for flushing the system with Low pressure Air for drainage of water post operation to keep it clean and dry and corrosion free.

B. Pendent /Upright Type Sprinkler Head

Sprinkler heads shall be quartzite bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal diameter outlets.

The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall be shatter when the temperature of the surrounding air reaches at 57/68/98 degree Celsius.

The nominal bore shall 15 mm diameter and color of liquid shall be as per temperature rating.

C. Concealed Type / With Rossete Sprinkler Head

Adjustable concealed sprinklers shall be provided as specified in S.O.Q. in areas where an attractive appearance is primary concern. Concealed Sprinkler heads shall be infinitely adjustable for a full 15 mm so as to compensate for uneven ceiling heights & allow adjustment of the sprinkler cover at any timer. The sprinkler shall be of approved make and type with 15 mm nominal diameter outlets.

The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall be shatter when the temperature of the surrounding air reaches at 57/68/98 degree Celsius.

The nominal bore shall 15 mm diameter and color of liquid shall be as per temperature rating.

D. Sprinkler Heads
Sprinkler heads shall be provided at approximate spacing so as to cover 12 sq.mtr. per sprinkler head in case of ordinary hazard & 17 sq.mtr. in case of light hazard. The spacing shall however be in uniformity with the drawings and properly coordinated with electrical fixtures, ventilation ducts and grilles and other services along the ceiling. Sprinkler heads shall be gunmetal quartz bulb type with a temperature rating of 57°C /68°C / 98°C. Sprinkler heads shall be of upright conventional type with fusible link for operation. Sprinkler head shall be approved by the under writers Laboratories (U.L.) or Fire Officers Committee (FOC). The finish shall be as specified in bill of quantities.

Contractor shall install cabinet (fabricated from 16 Gauge M. S. sheets with lockable glass shutters. Shelves for keeping spare sprinklers and spanner at locations approved by the Engineer-in-Charge and given in the schedule of quantities. The contractor shall also give required tools for removing and fixing of different types of sprinkler free of cost as directed by Engineer-in-Charge.

E. Drain assembly:

The sprinkler system shall have installation control valve (Flow switch with Isolation Valve and Drain arrangement) along with all piping & sight glass etc. complete Test assembly at entry of main header in each floor.

F. Flow switch:

Flow switch shall have a paddle made up of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make/ break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Fire alarm panel. The seat shall be of stainless steel. The flow switch shall have IP: 55 protections.

The flow switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a retard to compensate for line leakage or intermittent flows.

G. SS corrugated Flexible pipes:

SS corrugated Flexible pipes braided type UL listed of 1000/1500 MM. with the following accessories to complete the installation. Square bar, bracket for square bar, brackets for sprinkler and nipple barrel, reducer, isolation ring and boring.

28.0 MS SUPPORTS, GUIDES, ANCHORS:

Hydrant and Sprinkler Pipe Support for RCC Slab

The Firefighting pipe should be simply suspended by Sprinkler Clamp having knurled nut.

The Sprinkler Clamp should be pre-galvanized with one-piece design for safe hanging of sprinkler pipes. It should have height adjustable arrangement so as to incorporate the suspended threaded rod.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to VdS or UL /FM Approval.

The riser and hydrant / sprinkler pipe support installation should be as per National Building Code.

The Riser Pipes should be mounted on the support channel with the help of a split clamps DIN 3567.

The support channel should be made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or
**DIN EN 1993-1-1**

The Support channel should be pre-galvanized with **minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes** on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer’s documents and should be monitored according to **RAL - GZ 655-C**

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors used for the suspension of the rods should be **ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked** and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be **as per Vds and FM guideline** provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 15</td>
<td>1.8</td>
<td>65</td>
<td>3.7</td>
<td>250</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>2.4</td>
<td>80</td>
<td>3.7</td>
<td>300</td>
<td>6.1</td>
</tr>
<tr>
<td>25</td>
<td>2.4</td>
<td>100</td>
<td>3.7</td>
<td>350</td>
<td>10.0</td>
</tr>
<tr>
<td>32</td>
<td>2.7</td>
<td>125</td>
<td>3.7</td>
<td>400</td>
<td>10.5</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
<td>150</td>
<td>4.5</td>
<td>450</td>
<td>11.0</td>
</tr>
<tr>
<td>50</td>
<td>3.0</td>
<td>200</td>
<td>5.6</td>
<td>500</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Typical Arrangement for sprinkler and hydrant pipe support From RCC slab

Hydrant and Sprinkler Pipe Support for PEB structure

The Firefighting pipe should be simply suspended by **Sprinkler Clamp having knurled nut**.

The Sprinkler Clamp should be pre-galvanized with one-piece design for safe hanging of sprinkler pipes. It should have height adjustable arrangement so as to incorporate the suspended threaded rod.
The Mounting according to static requirements should undertake into account the manufacturer’s documents and should be monitored according to VdS or UL /FM Approval.

The riser ad hydrant pipe support installation should be as per National Building Code. The Riser Pipes should be mounted on the support channel with the help of a split clamps DIN3567.

The support channel should be made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1

The Support channel should be pre-galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer’s documents and should be monitored according to RAL - GZ 655-C

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

For parallel to beam application.

The Girder cleat for attachment of support channel to steel girder Girder cleat should be Vds approved. For perpendicular to beam application

The Girder clamp for suspension of threaded pins and threaded rods for support channels. Girder clamps should be FM and Vds Approved.

The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be as per Vds and FM guideline provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 15</td>
<td>1.8</td>
<td>65</td>
<td>3.7</td>
<td>250</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>2.4</td>
<td>80</td>
<td>3.7</td>
<td>300</td>
<td>6.1</td>
</tr>
<tr>
<td>25</td>
<td>2.4</td>
<td>100</td>
<td>3.7</td>
<td>350</td>
<td>10.0</td>
</tr>
<tr>
<td>32</td>
<td>2.7</td>
<td>125</td>
<td>3.7</td>
<td>400</td>
<td>10.5</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
<td>150</td>
<td>4.5</td>
<td>450</td>
<td>11.0</td>
</tr>
<tr>
<td>50</td>
<td>3.0</td>
<td>200</td>
<td>5.6</td>
<td>500</td>
<td>12.0</td>
</tr>
</tbody>
</table>
Hydrant Pipe Support for Building Shaft

The Riser Pipes should be mounted on the support channel with the help of a split clamps or STATO BRACKET.

The support channel should be made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1

The riser and hydrant / sprinkler pipe support installation should be as per National Building Code.

The Support channel should be pre-galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C

The Threaded Rods used for fixing pipe clamp with support channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors used for fixing channel with building shaft that should be ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be as per Vds and FM guideline provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 15</td>
<td>1.8</td>
<td>65</td>
<td>3.7</td>
<td>250</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>2.4</td>
<td>80</td>
<td>3.7</td>
<td>300</td>
<td>6.1</td>
</tr>
<tr>
<td>25</td>
<td>2.4</td>
<td>100</td>
<td>3.7</td>
<td>350</td>
<td>10.0</td>
</tr>
<tr>
<td>32</td>
<td>2.7</td>
<td>125</td>
<td>3.7</td>
<td>400</td>
<td>10.5</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
<td>150</td>
<td>4.5</td>
<td>450</td>
<td>11.0</td>
</tr>
<tr>
<td>50</td>
<td>3.0</td>
<td>200</td>
<td>5.6</td>
<td>500</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Typical Arrangement for sprinkler and hydrant pipe support From PEB structure
The Riser Pipes should be mounted on the support channel with the help of a split clamps DIN 3567 or STATO BRACKET.

The support channel should be made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1

The riser and hydrant / sprinkler pipe support installation should be as per National Building Code.

The Support channel should be pre-galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C

The Threaded Rods used for fixing pipe clamp with support channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors used for fixing channel with building wall that should be ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be as per FM guideline provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
<th>Nominal Pipe Dia (mm)</th>
<th>Support Distance (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 15</td>
<td>1.8</td>
<td>65</td>
<td>3.7</td>
<td>250</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>2.4</td>
<td>80</td>
<td>3.7</td>
<td>300</td>
<td>6.1</td>
</tr>
<tr>
<td>25</td>
<td>2.4</td>
<td>100</td>
<td>3.7</td>
<td>350</td>
<td>10.0</td>
</tr>
<tr>
<td>32</td>
<td>2.7</td>
<td>125</td>
<td>3.7</td>
<td>400</td>
<td>10.5</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
<td>150</td>
<td>4.5</td>
<td>450</td>
<td>11.0</td>
</tr>
<tr>
<td>50</td>
<td>3.0</td>
<td>200</td>
<td>5.6</td>
<td>500</td>
<td>12.0</td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATIONS FOR PLUMBING WORKS

1.0 SCOPE OF WORK

1.7 Work under this section shall consist of furnishing all labour, materials, fabrication, equipment and appliances necessary and required to completely install internal & External water supply & drainage work as required by the drawings and specified here in after or given in the Bill of Quantities.

1.8 Without restricting to the generality of the foregoing,

1.9 The Plumbing work shall include the following:

a. Supply erection and commissioning of internal as well as external Water supply & Distribution system including domestic & flushing water with all pumps, piping & fittings, valves, instruments & gauges with all required accessories.

b. Supply erection and commissioning of Drainage (Sewage) system including internal & external system with piping, gully chambers, sewer traps, inspection chambers, manholes, etc. complete

c. Supply erection and commissioning of (Storm water) system including internal & external system with piping, catchment pits, manholes, open channels, gratings, etc. complete

d. Connection to the incoming water supply line with water meter & connection to the main existing sewer / drain line of IITB master plan.

e. Excavation, dewatering, trenching, bedding, refilling, etc. with necessary civil work for laying of water supply / drainage pipe with good practice. RCC NP -3 hume pipes for all road crossings.

2.0 GENERAL REQUIREMENTS:

2.1 All the materials shall be of approved, best quality conforming to the specifications and subject to the approval of the Consultant / Client or his representative. If so directed, materials shall be tested in an approved testing laboratory (NABL) & the contractor shall produce the test certificate in original to the Engineer in-charge of consultant / client & the entire charges for original as well a repeated tests shall be borne by the Contractor.

2.2 Contractor shall submit the technical data sheet for all the items, equipment’s after award of Contract and get it approved before procurement of the items.

2.3 All the Execution, installation, shop drawings shall be prepared by the Contractor & shall furnish for the approval of the Client / Architect / Consultant.

2.4 Each item of equipment / material proposed shall be from the manufacturers given in list of approved makes and as per relevant standards and codes.

2.5 Color Coding of the all pipe line shall be as per Norms.

2.6 QAP (Quality Assurance Plan), ATP (Acceptance Test Procedure), Motor & Pump certificate of performance etc should be provided by OEM. FAT - Factory Acceptance tests shall be witnessed by IIT/IRS representative.

2.7 Contractor shall submit AS BUILT drawings when work in all respects is completed. These drawings shall be submitted in the form of four sets of CD’s and four set of Hard copy – ‘A1’ Size color printout.

2.8 Upon completion and commissioning of system the contractor shall submit a comprehensive operating instruction, maintenance schedule and log sheets for all systems and equipment.
included in this contract. The contractor shall submit four set of Hard copy & soft copy of operating instructions and maintenance manuals. These manuals shall also include detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for period of maintenance of each equipment, operating instruction etc including training to Maintenance e personnel of IIT /EMD dept shall be provided by OEM

3.0 SANITARY FIXTURES & C.P. FITTINGS:

3.1 Scope

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

3.2 General Requirements

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

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

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

All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings & in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions.

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

All fitting shall be of the chromium plated materials.

Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, and hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.

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

European W.C.

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

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

Concealed flush tank shall be of the best approved quality procurable with C.P. Flush plate and C.P. flush pipe etc.
The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.

Alternatively if flushing cistern to be used shall conform to the requirements of IS: 774-2004. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the D.T.A./Authority. The cisterns shall be mosquito proof & shall fulfil the requirements of the local Authority.

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

**Wash Basins**

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

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

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

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

**Urinals**

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Authority’s Representative.

Urinals shall be flushed by means of “NO-TOUCH” infrared operated flush valves.

Waste pipes for urinals shall be any one of the given materials as directed by the Authority’s Representative:

**Pipe & Fittings**

Rigid PVC/High density polyethylene.

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

**BIB Cock**

These shall be of C.P. brass bib cocks of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Angle Valve**

These shall be of C.P. brass angle valve with C.P. copper connecting pipe 450 mm long and nuts, washer and brass flange complete, including cutting and making good the wall where required.

**Kitchen / Pantry Sinks**

Sinks shall be of stainless-steel material as specified in the Bill of Quantities/Drawings. Each sink shall be provided with R. S. brackets and clips and securely fixed. Countertop sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Authority’s Representative.
Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.

**Sink Mixer**
Sink mixer of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Sink Cock**
Sink cock of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Concealed Stop Cock**
Concealed Stop Cock with Exposed Part Kit of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**2 Way Bib Cock**
These shall be of C.P. 2 Way bib cock with angle Valve of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Health Faucet**
Hand Shower (Health Faucet), with 8mm Dia, 1 -1.2mtr Long flexible Tube and Wall Hook with accessories of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Long Body Bib Cock**
These shall be of C.P. long body brass bib cocks of best quality necessary fittings with wall Flange etc. complete in all respects including cutting and making good the walls etc.

**Shower Head**
These shall be of C.P. brass overhead shower in round shape single flow with air effect (abs body & face plate chrome plated) with necessary fitting etc complete in all respect complete the item.

**Shower Arm**
These shall be of C.P. brass shower arm with 15 or 20 mm inlet with Casted Long Heavy Body Shape For Wall Mounted Showers with Wall Flange etc. complete including cutting and making good the walls etc.

**Shower Mixer**
Shower Wall Mixer with provision for Overhead Shower with Bend Pipe on Upper Side, Connecting Legs Wall Flanges of best quality necessary fittings etc. complete in all respects including cutting and making good the walls etc.

### 4.0 INTERNAL DRAINAGE (SOIL, WASTE, VENT AND RAINWATER PIPES):

#### 4.1 Scope:

Work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified here in after and given in the Bill of Quantities.

Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:

- vertical and horizontal soil waste and vent pipes, rainwater pipes and fittings, joints clamps and connections to fixtures.
- Floor traps, floor drain clean out plugs, inlet fittings and rainwater roof drain, area/local drains, trench drain...
Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

Waste pipes connections from all fixtures e.g. wash basins, sinks, kitchen equipment.
Testing of all pipes.
Connection of main.

4.2 General Requirements

All materials shall be new of the best quality conforming to specifications and subject to the approval of Authority’s Representative.

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

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 by suitable clamps at intervals specified.

Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

All works shall be executed as directed by Authority’s Representative.

4.3 UPVC Pipes and Fittings:

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designated by external diameter and shall conform to IS: 4985 – 2000/ IS 13592 - 2013.

a) Fittings:

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

b) Laying and Jointing:

The pipes shall be laid and fixed as per engineering support section.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and “O” rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Authority’s Representative. Where UPVC pipes are to be used for rainwater pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Authority’s Representative.

c) Supports:

UPVC pipes require supports at close intervals as per engineering support section. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on engineering support. Pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified in the engineering support and as required.

d) Repairs:

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the
damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

e) Testing:

All lengths of PVC rainwater pipes shall be fully tested for water tightness by means of water test maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 1.5-meter head of water head. The test pressure shall, however, not exceed 6-meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

f) Measurements:

Waste/soil, waste, vent and rainwater pipes shall be measured over all along the centre line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, engineering support, solvent cement joints for UPVC and all other items described in the Bill or Quantities. The portion of the pipe within the collar for C.I./UPVC pipe at the joint shall not be included in the length of the pipe work.

4.4 Hubless Centrifugally Cast-Iron Pipes and Fittings

Soil, waste, vent and anti-siphonage pipes shall be Hubless centrifugally cast iron pipes and fittings (Epoxy coated inside and outside) as per ISO-6594/IS-15905 standard and jointing with ASTM C 1277 marked stainless steel shielded coupling with a double stainless steel bolt & screw housing incorporating a elastomeric rubber gasket and inclusive of all necessary specials like bends, tees, offsets, junctions, cowl end plug, inspection pipe, etc. laid under floor/fixed on walls and in pipe shafts.

a) Fittings

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and watertight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

b) Jointing:

All soil, waste and vent pipes including fixture connections between traps and soil pipes shall be jointed with ASTM C 1277 marked stainless steel shielded coupling with a double stainless-steel bolt & screw housing incorporating a elastomeric rubber gasket

Vent pipes penetration through roof shall be by means of sleeves. The sleeve will be kept 100mm higher the finish roof level and annular space filled with fireproof materials like putty, fire seal etc.

Pipe, Hangars, Support, Clamp, Bracke etc. :

All pipe support shall be as per engineering support section.

c) Testing:

All pipe work shall be tested before connecting any appliances and then again after connection of appliances. Pipe shall be tested after installation by one of the test given below as directed by the Client’s Representative.

Before use at site, all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes at 3 meter head. After filling, pipes shall be struck with a hammer and inspected
Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

d) Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not 3 M exceed. The level of water in the stack shall not drop within 8 hours. If there is a drop in level of water the leak shall be detected and rectified, and test shall be re-conducted until satisfactory result is achieved.

e) Smoke Test:

Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlet and outlet connections.

The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Client’s Representative.

4.5 Multi Floor Traps/P-Trap:

Floor traps/P-TRAP shall be of Cast Iron Hubless material and are designed to withstand continuous internal hydraulic pressure of 6 Kg/cm so as to ensure life-long trouble-free working.

The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and cantering for the blocks. Size of the block shall be 30 x 30 cm of the required depth. The trap shall be installed at lowest point ensure no pending occurs at perimeters of the drain.

4.6 Khurra:

Khurras 45x45cm with average minimum thickness of 5 cm. cement concrete 1:2:4 (1 cement:2 coarse sand :4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1mx1mx400micron, finished with 12mm cement plaster 1:3 (1 cement: 3 coarse sand) and a QUOTE of neat cement rounding the edge sand making and finishing the outlet complete.

4.7 Inlet mouth:

Inlet mouth of rainwater pipe with cast iron grating 15cm diameter not less than 440 gram.

4.8 Gully Trap

Providing and fixing square mouth Cast Iron Hubless P-Trap complete with C.I. grating brick masonry chamber with first class bricks and Recess FRP heavy duty cover with frame of 300 x 300 mm internal size.

i. **Excavation:** The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer-in-Charge.

ii. **Fixing:** The gully/P traps shall be fixed on cement concrete foundation 65 cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of Cast Iron Hubless pipe.

iii. **Brick Masonry Chamber:** After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 mm (inside) in brick work of specified class in cement mortar 1:4 (1 cement: 4 fine sand) shall be built with a half brick thick brick work round the gully
trap from the top of the bed concrete up to ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating. Recess FRP heavy duty cover with frame 300 × 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth. The finished top of cover shall be left about 4 cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

iv. **Measurements:** The work shall be enumerated. Excavation shall be measured separately under relevant item of earth work.

v. **Rate:** The rate shall include the cost of materials and labour involved in all the operations described above, except earth work which shall be paid for separately.

4.9 **Manholes and Chambers:**

All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.

All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

All manholes shall be provided with cement concrete benching in 1:2:4 nominal mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size). The benching shall have slope of 1:10 towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

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

All manholes with depths greater than 0.8m shall be provided with 20 mm square or 25 mm round CI footrests set in cement concrete blocks 250x100 mm in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size), at 300 mm center to center vertically and staggered. Footrests shall be coated with coal tar before embedding.

All manholes shall be provided with Steel Fibers Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities or given above.

a) **Measurement and Rates:**

SW pipe shall be measured for the finished length of the pipeline per linear meter.

Lengths between manholes shall be recorded from inside face of one manhole to inside face of other manhole.

Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside face of manhole. Rate shall include all items given in the Schedule of Quantities and specifications.

b) **Gully Traps:**

Gully traps shall be measured by the number and rate shall include all excavation, backfilling, foundation, concrete brick masonry, cement plaster inside and outside, CI grating and sealed cover and frame etc. complete.
c) Manholes:

All manholes shall be measure by numbers and shall include all items specified above and necessary excavation in all types of soils, refilling, compaction and disposal of surplus earth.

Manholes with depths greater than that specified under the main items shall be paid for under “extra depth” and shall include all items as given for manholes. Measurement shall be done to the nearest centimeter. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

5.0 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES

CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing though it.

Diameter and wall thickness of CPVC pipes are as per given in Table 18.16 below.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Nominal size (mm)</th>
<th>Nominal outer diameter (mm)</th>
<th>Mean Outside Diameter (mm)</th>
<th>Outer diameter at any point (mm)</th>
<th>Wall Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>15</td>
<td>15.9</td>
<td>15.8</td>
<td>15.8</td>
<td>Class 1, SDR 11</td>
</tr>
<tr>
<td>(ii)</td>
<td>20</td>
<td>22.2</td>
<td>22.1</td>
<td>22.0</td>
<td>Class 3, SDR 17</td>
</tr>
<tr>
<td>(iii)</td>
<td>25</td>
<td>28.6</td>
<td>28.5</td>
<td>28.4</td>
<td></td>
</tr>
<tr>
<td>(iv)</td>
<td>32</td>
<td>34.9</td>
<td>34.8</td>
<td>34.7</td>
<td></td>
</tr>
<tr>
<td>(v)</td>
<td>40</td>
<td>41.3</td>
<td>41.2</td>
<td>41.1</td>
<td></td>
</tr>
<tr>
<td>(vi)</td>
<td>50</td>
<td>54.0</td>
<td>53.9</td>
<td>53.7</td>
<td></td>
</tr>
<tr>
<td>(vii)</td>
<td>60</td>
<td>70.3</td>
<td>70.2</td>
<td>70.2</td>
<td></td>
</tr>
<tr>
<td>(viii)</td>
<td>80</td>
<td>88.9</td>
<td>88.7</td>
<td>88.1</td>
<td></td>
</tr>
<tr>
<td>(ix)</td>
<td>100</td>
<td>114.3</td>
<td>114.1</td>
<td>113.5</td>
<td></td>
</tr>
<tr>
<td>(x)</td>
<td>150</td>
<td>168.3</td>
<td>168.0</td>
<td>166.5</td>
<td></td>
</tr>
</tbody>
</table>

Notes
1. For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

i. Dimensions of Pipes

The outside diameter, outside diameter at any point and wall thickness shall be as given in Table 18.16.

Diameter: The outside diameter and outside diameter at any point as given in Table 18.16 shall be measured according to the method given in IS 12235 (part 1).

Diameter at any point: The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

ii. 0.5 mm, and
iii. 0.012 dn rounded off to the next higher 0.1 mm.
**Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works**

**Wall Thickness**  The wall thickness of the pipes shall be as given in Table 18.16. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, nondestructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

iv. **Tolerance on Wall Thickness**

a. For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness (eMin) and the wall thickness at any point (e), (e - eMin) shall be positive in the form of +y, where y=0.1 eMin+0.2 mm.

b. For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of +y, where y would be applied in two parts.

c. The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values.

d. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1 eMin+0.2 mm (see Table 18.16).

e. The maximum wall thickness at any point shall be within the range 0.15eMin (see Table 18.16).

f. The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

**Effective Length (Le):** If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

**Pipe Ends**

The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

**Physical and Chemical Characteristics**

**Visual Appearance:** The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted.

The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

**Opacity:** The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

**Effect on Water:** The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

**Reversion Test:** When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.

**Vicat Softening Temperature:** When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.
**Density:** When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m³ and 1650kg/m³.

v. Mechanical Properties

**Hydrostatic Characteristics:** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 18.17. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

**TABLE 18.17**

Requirements of Pipes for Internal Hydrostatic Pressure Test *(Clause 18.9.5.1)*

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test</th>
<th>Test Temperature Min</th>
<th>Test Period</th>
<th>Hydrostatic (Hoop) Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(3)</td>
</tr>
<tr>
<td>(i)</td>
<td>Acceptance</td>
<td>20</td>
<td>1</td>
<td>43.0</td>
</tr>
<tr>
<td>(ii)</td>
<td>Type</td>
<td>95</td>
<td>165</td>
<td>5.6</td>
</tr>
<tr>
<td>(iii)</td>
<td>Type</td>
<td>95</td>
<td>1000</td>
<td>4.6</td>
</tr>
<tr>
<td>(iv)</td>
<td>Type</td>
<td>95</td>
<td>8760</td>
<td>3.6 (Test for thermal stability)</td>
</tr>
</tbody>
</table>

**Thermal Stability by Hydrostatic Pressure Testing:** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given in Table 18.17, Sl. No. (iv), the pipe shall not burst or leak during the prescribed test duration.

**Resistance to External Blow at 0°C:** When tested by the method prescribed in IS 4985, with classified striker mass and drop height as given in Table 18.18, the pipe shall have a true impact rate of not more than 10 per cent.

**TABLE 18.18**

Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test *(Clause 18.9.5.3)*

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Nominal Pipe Size</th>
<th>Mass of Falling Weight</th>
<th>Falling Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>(i)</td>
<td>15</td>
<td>0.5±0.5%</td>
<td>300±10</td>
</tr>
<tr>
<td>(ii)</td>
<td>20</td>
<td>0.5±0.5%</td>
<td>400±10</td>
</tr>
<tr>
<td>(iii)</td>
<td>25</td>
<td>0.5±0.5%</td>
<td>500±10</td>
</tr>
<tr>
<td>(iv)</td>
<td>32</td>
<td>0.5±0.5%</td>
<td>600±10</td>
</tr>
<tr>
<td>(v)</td>
<td>40</td>
<td>0.5±0.5%</td>
<td>800±10</td>
</tr>
<tr>
<td>(vi)</td>
<td>50</td>
<td>0.5±0.5%</td>
<td>1000±10</td>
</tr>
<tr>
<td>(vii)</td>
<td>65</td>
<td>0.8±0.5%</td>
<td>1000±10</td>
</tr>
<tr>
<td>(viii)</td>
<td>80</td>
<td>0.8±0.5%</td>
<td>1200±10</td>
</tr>
<tr>
<td>(ix)</td>
<td>100</td>
<td>1.0±0.5%</td>
<td>1600±10</td>
</tr>
<tr>
<td>(x)</td>
<td>150</td>
<td>1.6±0.5%</td>
<td>2000±10</td>
</tr>
</tbody>
</table>

**Flattening Test:** When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.
**Tensile Strength**: When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at 27 ± 2°C.

**Sampling and Criteria for Conformity**

The sampling procedure and criteria for conformity shall be as given in Annexure F.

**Marking**

Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

(a) Manufacturer’s name or trade-mark
(b) Outside diameter,
(c) Class of pipe and pressure rating, and
(d) Batch/lot number

**BIS Certification Marking**: Each pipe may also be marked with the Standard Mark.

vi. **Fittings**

The fittings shall be as follows:

(a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
(b) Brass threaded fittings.
(c) Valve from size 15 mm to 160 mm
(d) **Brass Threaded Fittings**: All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information:

1. Manufacturer's name/trademark.
2. Size of fitting

vii. **Piping Installation Support and Spacing**

**Concealed Piping**: Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly. **DO NOT USE NAILS FOR HOLDING OF PIPES IN THE CHASES.**

**External Installations**: For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement.

All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

**Recommended Support Spacing (Distance between Pipe Clamps Horizontal Support)**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Horizontal Support (In meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23°C</td>
</tr>
<tr>
<td>16 mm (1/2&quot;)</td>
<td>1.22</td>
</tr>
<tr>
<td>20 mm (3/4&quot;)</td>
<td>1.53</td>
</tr>
<tr>
<td>25 mm (1&quot;)</td>
<td>1.68</td>
</tr>
<tr>
<td>32 mm (1 1/4&quot;)</td>
<td>1.83</td>
</tr>
</tbody>
</table>
Expansion LOOP: CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 400°C temperature change. Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Length of Run (Meter), Loop length in cms.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 meter</td>
</tr>
<tr>
<td>15 mm</td>
<td>43</td>
</tr>
<tr>
<td>20 mm</td>
<td>48</td>
</tr>
<tr>
<td>25 mm</td>
<td>53</td>
</tr>
<tr>
<td>32 mm</td>
<td>58</td>
</tr>
<tr>
<td>40 mm</td>
<td>63</td>
</tr>
<tr>
<td>50 mm</td>
<td>71</td>
</tr>
</tbody>
</table>

viii. Testing

All water supply systems shall be tested to hydrostatic pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

ix. Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work, which shall include CPVC pipe and fittings including plain and Brass threaded fittings and jointing solvent cement.

6.0 HDPE PIPE & FITTINGS (IS 4984, PE100, PN16):

6.1 Scope:

This specification covers the requirements for manufacture, supplying, lowering, laying, jointing, testing and commissioning Polypropylene (PE 100) HDPE pipe with fittings, transit, saddles, etc. required for the conveyance & distribution system for above ground as well as below ground installation with required civil work for domestic water application.

6.2 Codes & standards:

The manufacturing, testing, supplying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred.

6.3 Excavation of Trenches

Trenches for pipes shall be excavated to lines and levels described and sketched or as otherwise instructed by the DTA.

The Contractor shall dispose of all excavated material off site in approved locations, as soon as it is removed from the trench. It shall not be used for backfilling. Stockpiling of excavated material alongside the trench will not be permitted.

The Contractor shall cut completely through all concrete surfaces and asphalt surfaces prior to commencing trench excavation.
Trenches shall be excavated in lengths of not more than 50 metres. A length shall be at least 2/3 complete before excavation can start on the subsequent length. Portable pedestrian bridges across the open trenches shall be provided at 10m intervals. Trenches shall not be left uncovered overnight. They shall be covered with steel sheets or equivalent.

The Contractor shall include in his price for bracing and strutting where required and shall conform to all relevant local safety requirements.

6.4 Width of Excavation

The width of excavation in all cases shall be the minimum necessary for the construction works. In addition to the approval in writing by the DTA, the work with any approved length must have been completed satisfactorily by the Contractor before starting work in another section.

6.5 Collapse and Slides

The Contractor will take care and all the necessary measures to prevent collapse and slides along the trench excavations.

6.6 Backfilling

Backfill material shall be evenly graded and not include constituents exceeding 50mm or any clay or organic material. All backfill material shall be approved by the DTA.

Backfill will compacted by distributing and compacting it in horizontal layers with a uniform thickness and thickness of non-compacted material not exceeding 300mm. The value of moisture content of the soil shall be checked carefully.

The compaction shall be done by mechanical rollers, compactors, vibrators or other machinery approved and such that provide a dry density not less than 95% of the maximum dry density.

During backfilling, the Contractor shall do the necessary tests under the supervision of the DTA to guarantee the required parameters.

6.7 Monitoring of Backfill

The Contractor shall monitor the backfill and shall ensure that at all times during, and at the end of the period of maintenance all finished levels are in accordance with those established in the Contract.

6.8 Reinstatement of Surfaces

All surfaces of roads, driveways and foot-paths, etc., whether public or private that are disturbed during execution of the works, shall be reinstated by the Contractor.

Trenches, channels, drainage ditches, kerbs shall be reinstated to the condition in which they were before execution of the works.

Road surfaces shall be reinstated to at least the previous condition.

6.9 Dewatering

All excavations shall be kept free of water at all times during the construction of the Works. The Contractor shall carry out all dewatering, groundwater lowering, pumping, temporary drainage, etc., which may be necessary for the purpose of removing water from the excavations.
6.10 Construction of Pipelines

The Contractor shall provide all skilled and unskilled labour to complete the installation of all pipelines included under the Contract.

It shall be the Contractor's responsibility to safeguard by means of temporary or permanent support or otherwise all pipes, structures and other items which would be liable to suffer damage as a result of his work, if such precautionary measures were not taken.

Excavation of pipe trenches shall follow the details shown in the designs and drawings. Deviations from the drawings shall be agreed by the DTA and are fully at the Contractor's risk. Deviations will be permitted only with the written consent of the DTA.

Trench bottom must be compacted and levelled.

Trench bottom will be covered by a 150mm layer of granular material (single size 10mm) or sand, which has to be carefully levelled. Pipe-laying and jointing have to follow instructions of the manufacturers of pipes. Pipes shall be properly and completely bedded on the bedding material.

Pipe Tests

The applied test pressure shall be 1.6 times the working pressure. The leakage rate shall be restricted to applicable standard.

The Contractor shall provide all necessary labour, materials, water and equipment for the testing.

The Contract shall include for any pressurizing pipe, blank flanges, pressure gauges, etc., required for the purpose of pressure testing all pipe-work. The pressure tests shall be carried out according to DIN 4279, ISO 4427 or other equivalent standard.

The Contractor shall carry out final testing of the equipment and commissioning of all pipelines to the satisfaction of the DTA.

Disinfection of Pipelines, Valves and Fittings

The pipelines, valves and fittings will be incorporated in a public water supply, and the Contractor shall be responsible for the thorough cleaning and sterilization of all parts in contact with water in accordance with the requirement of the waterworks department.

High Density Polyethylene Pipes

Polyethylene pipes and fittings for water supply services shall comply with the provisions of IS 4984/1995, ISO 4427:1996, DIN 16963, or equivalent

The raw material must also have the following features;

Colour of the pipe (the raw material must be dark blue or black with blue stripes, which are internationally recognized as potable water pipe colours and must have UV additives to increase resistance against sunlight.

Dimensions

Normal outside diameters and normal pressures shall be in accordance with the requirements of ISO 161 –1:1996, Part 1, Metric series.

6.11 Pipe Laying and Jointing

Joints
HDPE pipes shall be joined by butt fusion welding, electro fusion welding compression fittings, flanges or mechanical couplings, as appropriate to the pipe, fittings and location.

Polyethylene butt fusion joints and fittings for use with cold potable water shall comply with the relevant provisions of ISO 121761:1998.

Mechanical joint compression fittings for use with cold potable water shall comply with the relevant provisions of ISO 142361:2000.

Electro-fusion fittings shall comply for use with cold potable water shall comply with the relevant provisions of ISO 121762:2000.

**Laying**

HDPE pipes up to DN 125mm can be delivered in rolls. For larger diameter, pipe shall be delivered in 5/6 m lengths.

**Handling**

The Contractor shall ensure that during transport, handling and storage, each ITEM (pipe and fitting) is free from damage prior to installation. Damaged pipes and fittings shall be discarded. The protection of the pipe ends is particularly important. Pipes and fittings should never be dropped to the ground. They should be unloaded from the transport either by hand or using slings and lifting equipment.

Pipes shall be cut by an approved method which provides a clean square cut of the pipe and lining (if applicable) without damage. All cut or trimmed ends shall be cleaned before the pipes are laid.

**Installation of HDPE pipes**

Polyethylene piping shall be laid in accordance with the pipe manufacturer's recommendations and to the approval of the DTA.

0.3 m above the crown of the pipes a 150mm wide blue polyethylene marker tape 100m thick shall be laid along the whole length of all water mains laid. It shall include the wording “caution water-main below” or similar in Turkish. The tape shall incorporate a tracer wire to facilitate tracing of the pipeline route from above finished ground level.

When placing concrete on HDPE pipeline care should be taken to avoid encasing the pipe completely. A thin membrane, such as bituminized paper, thin roofing felt or polythene film shall be applied between the concrete and the HDPE pipe.

The Contractor shall forward to the DTA certificates showing that the materials have been tested and comply with the requirements of this Specifications and the relevant Standard.

The Contractor shall provide, install and maintain temporary protective caps or discs to prevent water, animals or extraneous material entering pipelines during construction. Such caps or discs shall not be removed until the pipes are jointed.

All buried pipes shall be jointed using electro fusion welding techniques.

Small diameter pipes (DN<63mm), pipes within structures and pipes connecting to metal fittings shall be jointed using mechanical jointing techniques.

**Thrust Blocks:**

Thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on everyone meter and all bends as directed by the Authority’s Representative.
7.0 NON-RETURN VALVE (GUN METAL)

A non-return valve permits water to flow in one direction only and is provided on the ascending part of the main to check return flow. The non-return valve shall be of Gun metal and shall be of horizontal or vertical flow type as specified.

The valve shall be of quality approved by the Engineer-in-Charge and shall generally conform to IS 778.

8.0 BALL VALVE

male/ female screw ended full way lever operated forged ISI marked brass ball valves with brass body with forged brass hard chrome plated ball / stem, union. Rated to temperature of 85 Deg C. The valves to be PN16kgm class on CPVC or GI pipe lines. (For cold and hot water supply lines)

9.0 BALL FLOAT VALVE

The ball valve shall be of high-pressure class and shall be confirm to IS: 1703 of sizes as specified. The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball shall be of brass or gun metal as specified and the float shall be of polythene sheet. The minimum gauge of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia and 0.55mm for float exceeding 115mm dia and shall be special in shape. The valve shall be constructed to permit replacing without console of the valve body from the valve line and the system shall not blow out under pressure. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by bracing. Plastic float may also be used if specified. The body of ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5 Kg/Sq.cm. All ball valves shall be capable of withstanding a pressure of 14 Kg/Sq.cm.

The ball valve shall generally conform to IS specifications No. 1703-2000.

10.0 AIR RELEASE VALVE

10.1 Scope:
Supplying and erecting air release cock of 25mm made from GM with necessary G.I. coupling for fixing on pipeline.

10.2 Material:
Air release valve: Gun metal
Coupling: G.I.

10.3 Method of Construction:
Air release valve with necessary G.I coupling shall be fixed on pipe line with required labour, tools etc.

10.4 Method of measurement:
Executed quantity shall be measured on number basis.

11.0 RCC PIPES:

All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes NP2 for general and NP3 where road crossing. Pipes shall be true and straight with uniform bore throughout. Cracked, wrapped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.
The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS: 458 - 1971. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The pipes shall be R.C.C. light duty, NP2 and NP3 type.

LAYING:

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

JOINTING (RIGID SPIGOT AND SOCKET JOINT):

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and one part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

CURING:

The joint shall be cured for at least seven days.

CEMENT CONCRETE FOR PIPE SUPPORTS:

a) Unless otherwise directed by the Client’s Representative cement concrete for bed, all round or in haunches shall be laid as follows:

<table>
<thead>
<tr>
<th></th>
<th>Upto 1.5m depth (5')</th>
<th>Upto 3m depth (10')</th>
<th>Beyond 3m depth (10')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (no sub soil water)</td>
<td>all round (1:5:10)</td>
<td>in haunches (1:3:6)</td>
<td>all round (1:5:10)</td>
</tr>
<tr>
<td>RCC/C.I. pipes in sub soil water</td>
<td>all round (1:3:6)</td>
<td>in haunches (1:3:6)</td>
<td>in haunches (1:3:6)</td>
</tr>
<tr>
<td>RCC/C.I. pipes (in all conditions)</td>
<td>all round (1:3:6)</td>
<td>in haunches (1:3:6)</td>
<td>in haunches (1:3:6)</td>
</tr>
<tr>
<td>RCC/C.I. pipes under road or building</td>
<td>all round (1:3:6)</td>
<td>all round (1:3:6)</td>
<td>all round (1:3:6)</td>
</tr>
</tbody>
</table>

b) RCC pipes or CI pipes may be supported on brick masonry or pre-cast RCC or in situ cradles. Cradles shall be as shown on the drawings.

c) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

TESTING:

All lengths of the sewer and drain shall be fully tested for water tightness by means of water head maintained for not less than 30 minutes. Testing shall be carried out from manhole to
manhole. All pipes shall be subjected to a test pressure of at least 1.5 meters head of water at the highest point of the section under test. The pipes shall be plugged preferably with standard drain plugs (with rubber rings) on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

Permissible drops in water head should not exceed ......................

MEASUREMENT:

a) Excavation:
   Measurement for excavation of pipes trenches shall be made per linear meter.

b) Trenches shall be measurement between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 meter or as given in the Bill of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the Bill of Quantities and above the rate for depth upto 1.5 m.

EXCAVATION

The ground shall be excavated by such methods and to such dimensions and depths as shall allow for the proper construction of the works and safety of personnel and equipment used on excavation. Slopes required for stable formation of sides shall be provided. The excavation shall include excavation in earth and murrum shall be carried out to the correct levels required and specified and no clearance, plus or minus (ie. no overcuts), shall be permitted. However, if any overcuts / depressions are formed due to fault of contractor, they shall be made good by filling with M-10 concrete up to the bottom layer of the footing/raft without any extra cost implication. When excavation has reached within 300 mm of the required formation level, further excavation shall be carried out carefully to avoid any overcuts / depressions.

i. Excess Excavation (Excluding Overcuts / Depressions As In (Cl. 1.2) To Be Made Good

In case of excess excavation by the Contractor (beyond that specified in drawings), the contractor shall, at his own expense, if directed, remove from the pits all material resulting from excess excavation and shall make good the same with such kind of fill material or in such class of concrete as may be reasonably required by Employer's Representative having regard to the circumstances.

The Contractor shall backfill such excess excavation with concrete, rubble, stone or rock fill as directed by the Employer's Engineer / PMC. Filling other than concrete shall be placed in layers not exceeding 300 mm in thickness, shall be thoroughly compacted and have adequate fines content to fill the voids.

ii. Pipe Trenches

Trench excavation (as previously defined) means excavation of trenches into which pipes and cables are to be laid and the term pipes shall mean pipes of all kinds and for whatever purpose.

The line and level of trenches shall be as shown on the drawings or as may be directed by the Employer's Engineer/ PMC. Before commencing trench excavation, the route of the trench shall be pegged out accurately and the natural ground levels shall be agreed with the Employer's Engineer / PMC. Strong sight rails shall then be fixed and maintained at each change of gradient and at as many intermediate points as may be necessary. On these rails shall be marked the centre line and the level to which the excavation is to be carried out, such rails being not more than thirty meters apart.

iii. Trench Excavation Generally
Trench excavation shall be carried out by such methods and to such lines, dimensions and depths as shall allow for the proper construction of the works, provided always that, unless the Employer’s Engineer / PMC permits otherwise, no trench excavation shall be less than 500mm in width.

Any hard rock in trench excavation shall be so excavated that the clearance between the pipe when laid and the hard rock side and bottom of the trench is kept to the minimum limits necessary to provide for working space and the specified thickness of bedding haunching and surround to the pipe.

The sides of trench excavation shall be vertical unless the Employer’s Engineer / PMC permits otherwise. Any widening or deepening of trench excavations necessary to accommodate curves, joints or bends in the pipe as required or when ordered by the Employer’s Engineer / PMC shall be provided.

No length of trench excavation shall be started until the pipes to be laid in that length are available on the site.

iv. Trench Excavation in Roads and Footpaths

All trench excavation and other work carried out within the limits of any road shall be completed as rapidly as possible and not more than half of the width of the carriage way shall be obstructed at one time. Road drains and grills shall be kept free from obstruction. In any event the Contractor’s shall take special precautions, which shall include the continuous support of the sides of the excavation in begun until the refilling of the trench is placed to ensure that there is no disturbance of the adjacent road or road foundation.

Where excavated material has temporarily been deposited on a grass margin or road pavement, the margin or road pavement shall on completion of refilling be entirely to its original condition and left free from loose stones.

v. Trench excavation in fields, etc.

The term “fields” includes fields, moor lands, grass verges and the like and all private lands, and no length of trench excavation located in fields shall be commenced until suitable temporary fencing has been erected around that length unless the Employer’s Engineer / PMC permits otherwise. Temporary fencing shall not be removed without the Employer’s Engineer / PMC permission, which will not normally be given until the trench excavation had been refilled and reinstated to the original ground condition or as directed by the Employer’s Engineer / PMC.

vi. Supporting Trench Excavations

The Contractor shall well and effectively support the sides of trench excavations to prevent any fall or run from any portion of the ground outside the excavation and to prevent settlement of or damage to structures adjacent to the excavation. The Contractor shall be deemed to have made his own allowance for any extra excavation necessary to provide space for such support and for any other working space. If for any reason any portion of trench excavation shall give way, the Contractor shall at his own expense take all necessary remedial measures including the excavation and removal of all the ground thereby disturbed and making good the same.

Where the Contractor elects and is permitted by the Employer’s Engineer / PMC to execute trench excavations with battered sides instead of providing support as a foresaid they shall be excavated to stable slopes and heights.

vii. Trimming Trench Excavations
When excavating to required levels for trench excavations or to required limits from the face of any structure therein required to abut undisturbed ground, the Contractor shall not excavate the last 150 mm until immediately before commencing constructional work except where the Employer’s Engineer / PMC permits otherwise. Should the Contractor have excavated to within 150 mm above these required levels or to within 150 mm of these required limits before he is ready or able to commence the constructional work he shall, where required by the Employer’s Engineer / PMC, excavate further so as to remove not less than 150 mm of material immediately before commencing the constructional work.

Where no bedding material is required to be laid beneath the pipe, the bottom of trench excavations shall be carefully boned in and trimmed true to grade with the aid of a straight edge at least six metres long so as to ensure a continuous support for the pipes.

The trench bottom shall then be pricked over with a fork and any stones or flints either likely to cause the pipe to bed unevenly or to damage the pipe and its coating or greater than 20 mm in size shall be picked out the pipe bed and any holes so formed shall be filled in with soft material and trimmed to the correct level.

Where no bedding material is required, all shattered and loose material shall be removed from the bottom of the trench excavation so that the bedding material rest on a solid and clean foundation.

viii. Trenches Not to be Left Open

Trench excavation shall be carried out expeditiously and, subject to any specific requirements of the Contract, the refilling and surface reinstatement of trench excavations shall be commenced and completed as soon as reasonably practicable after the pipes have been laid and jointed.

Pipe laying shall follow closely upon the progress of trench excavation, and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. The Contractor shall take precautions to prevent flotation of pipes in locations where open trench excavations may become flooded, and these precautions may include the partial refilling of the trench leaving pipe joints exposed while awaiting tests of the joints.

If the Employer’s Engineer / PMC considers that the Contractor is not complying with any of the foregoing requirements he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trench excavation.

ix. Refilling of Trench Excavations

Trench excavations shall be refilled using suitable materials selected from excavations carried out at site or borrow areas as directed by the Employer’s Engineer / PMC.

Soft material (free from stones greater than 75 mm in size for pipes without bitumen sheathing and 20 mm in size for pipes with bitumen sheathing) shall be deposited in 150 mm layers and thoroughly rammed under and around the pipe with suitably shaped rammers working alternately on either side of the pipe (particular care being taken to avoid damage to the pipe and any sheathing) until the trench has been refilled up to the swell of the pipe, thereafter until the soft filling has been carried up at least 300 mm above the top of the pipe.

The remainder of the refilling may consist of coarse material (including broken rock from excavation in hard rock) free from boulders and clods of earth larger than 150 mm in size provided that the compacted backfill is, in the opinion of the Employer’s Engineer / PMC sufficiently dense to prevent material from the superimposed layers being washed into the voids in such backfill. This coarse material shall be spread in layers of not greater depth than 225 mm and be thoroughly rammed by an approved mechanical rammer. The
coarse filling is to be carried up to the level at which (in roads and footpaths) surface reinstatement is to commence or (elsewhere) to such level as with the surface reinstatement of the whole of the topsoil will leave the finished work sufficiently "proud" to allow for future settlement to the original ground level.

Hard material such as broken rock and original road metaling shall normally be used only for the surface reinstatement of roads as specified but where it is suitable and available in sufficient quantity it may be used in place of or as well as the aforesaid coarse material.

Where necessary the Contractor shall adjust the moisture content of the refill material either by drying out or by adding water to assist the compaction of the material.

Should the material being placed as refilling, while acceptable at the time when approved, become unacceptable to the Employer’s Engineer / PMC due to exposure to weather conditions or due to flooding or have become puddle, soft or segregated during the progress of the works, the Contractor shall at his own expense remove such damaged, softened or segregated material and replace it with fresh approved material. Where directed by the Employer’s Engineer / PMC trench excavations shall be refilled with concrete.

x. Surface Reinstatement in Fields. Etc.

After he has refilled trench excavation in fields and grass verges in the manner and to the level specified, the Contractor shall replace all topsoil previously removed and it shall be evenly distributed and leveled over the full extent of the stripped area. Such of the working areas occupied by the Contractor as were originally down to grass shall be sown with grass seed of equivalent quality and maintained until the new grass is properly established.

Other areas not originally down to grass shall be dressed with suitable fertilizers harrowed in so as to restore the original level of fertility.

xi. Surface Reinstatement in Roads and Footpaths

Surface reinstatement of refilled trench excavations in roads and footpaths shall consist of approved backfill material which has been well compacted and brought up to the sub grade level of the adjacent road surface. The balance portion shall be made good with similar material as that of adjacent road, and shall be so maintained (including topping up when necessary) until the end of the Defects Liability Period or until taken over for permanent reinstatement by the appropriate authority, whichever is sooner.

xii. Other Structures In The Pipeline

The Contractor shall carry out farther excavation as may be necessary to accommodate structures such as thrust blocks and valve chambers. Such excavation shall include for disposal of surplus material and, where appropriate, for backfilling around the structures.

xiii. Existing Service

Where trench excavation is carried out close to or across the line of sewers, pipes, cables and other services, the Contractor shall, where necessary, provide temporary supports or slings and where such sewer, pipe, cable or other service is temporarily disturbed it shall be replaced.

Where, in the opinion of the Employer’s Engineer / PMC, construction of the pipeline cannot reasonably be carried out unless the sewer, pipe, cable or other service is permanently severed or permanently diverted or permanently supported by concrete he shall order the Contractor to undertake such work.
Notwithstanding any relevant information furnished by the Employer’s Engineer / PMC, the Contractor shall be responsible for ascertaining from his own inspection of the site and from the respective supply authorities and other public bodies the position of all mains, pipes and cables whether underground or overhead, within or near the site.

xiv. Hedges, Fences And Walls

Where the trench excavation crosses barriers such as hedges, fences and walls, the Contractor, as a temporary measure during construction of the pipeline, shall provide temporary fencing for any parts of such barriers as have had to be removed.

After trench excavation has been reinstated, the Contractor shall carry out such work as the Employer’s Engineer / PMC may order for permanent restoration of such barriers.

xv. Crossing watercourses etc.

Where the pipeline crosses rivers, culverts and other water-courses, the Contractor shall be deemed to have allowed for all the additional measures necessary for the proper construction of the pipeline at these crossings including maintaining the full flow of water across the trench.

REFILLING

For protection of the pipe, the side filling and initial back filling operations should be carried out as soon as possible, after the pipes have been laid and tested.

The entire pipe work outside the building shall be covered with wooden box and shall be provided with proper identification tags/wires to avoid damage of pipes due to Heavy vehicle movement or any further excavation work in that area.

The material should be placed and compacted by hand in layers not more than 100 mm thick and should extend over the crown of the pipe to a depth of 100 mm for 110 mm pipe and 150 mm for pipes of larger diameter. It should extend over the full width of the trench as excavated. If ‘as –dug’ material contains stones larger than 40mm, or the pipe is deeper than 2 meter in poor ground, extend the processed granular material for at least 100 mm above the pipe crown. In both cases, hand tamps the material fully at the sides of the pipe simultaneously, while tamping lightly over the crown. Continue hand tamping until a finished layer of 300 mm has been placed over the pipe. Mechanical compactors, other than hand vibrators, should not be used until the total depth of backfill over the pipe is 450mm.

BEDDING

The bedding should be thoroughly compacted in layers not more than 150 mm thick to give a uniform bed, true to gradient on which the pipe may be laid so that they maintain substantially continuous contact with the bed. Excavation should be made under the bell of each pipe so that the entire length of the pipe, except the bell, will be supported on the bottom of the trench. If due to steep gradient or waterlogged conditions, the bedding tends to act as a drain for subsoil water, the insertion of water stops by means of puddle clay dams across the trench may be necessary to resist the passage of water.

Provide concrete encasement to pipeline where indicated to dimensions and lengths specified on the drawings. Concrete for encasement shall have compressive strength of not less than 21.0 M Pa. Protect pipeline from damage or displacement by the encasement operations. Provide appropriate concrete saddles to support pipes prior to encasement. Concrete encasement shall be discontinued for a length of 150 mm each side of the centre line of each pipe joint, to maintain flexibility of the pipeline.

The prepared under-bed should consist of bedding material laid to the correct gradient and depth over the full width of the trench as excavated and should give uniform support to the pipe over its entire length. In normal clay excavation, the thickness of the bedding under the
barrel of the pipe should not be less than 1/3rd of the diameter, and a minimum of 100mm. in rock, a thickness of a least 150 mm should be provided.

With flexible pipes it is of great importance that the side fill should be firmly compacted between the sides of the pipe and the soil sides of the trench. The bedding should be thoroughly compacted in layers not more than 150 mm thick to give a uniform bed, true to gradient, on which the pipe may be laid. Pipes should be laid directly on this bedding. Bricks or other hard materials must not be placed under the pipes for temporary support. Further bedding material should be placed around the pipe and be thoroughly compacted in 75 mm layers by careful tamping up to the crown of the pipe, eliminating all cavities under the two lower quadrants of the pipe.

The same material should then be placed over the crown of the pipe for not less than 2/3rd of the diameter, with a minimum height of 300 mm and be thoroughly compacted. The process of filling and tamping should proceed equally on either side of the pipe, so as to maintain equal pressure on both sides.

12.0 INSTALLATION OF ENGINEERED SUPPORT SYSTEM

Plumbing pipe support from RCC slab

The Plumbing Pipes should be simply supported by Split Clamps. Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber** lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to **18 dB and 22dB** for waster water pipe.

Pipe clamp should be as per **DIN 3576** if support for metal pipe. The support installation should be as per **international plumbing code**. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.

The Drop-in anchors used for the suspension of the rods should be **ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nomin al Pipe Dia</th>
<th>Maximum Support Spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UPVC PIPE</strong></td>
<td><strong>POLYETHYLENE PIPE Class D,</strong></td>
</tr>
<tr>
<td><strong>Nomin al Pipe Dia</strong></td>
<td><strong>Maximum Support Spacing (m)</strong></td>
</tr>
<tr>
<td><strong>UPVC PIPE</strong></td>
<td><strong>POLYETHYLENE PIPE Class D,</strong></td>
</tr>
</tbody>
</table>
Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

<table>
<thead>
<tr>
<th>(mm)</th>
<th>Horizont E6,7</th>
<th>Vertical</th>
<th>Horizont E6,7</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto10</td>
<td>- 0.6 0.3 0.5</td>
<td>65 1.2 1.4 0.6 0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>- 0.6 0.4 0.6</td>
<td>80 1.4 1.5 0.6 0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>- 0.7 0.4 0.6</td>
<td>100 1.5 1.7 0.7 1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>- 0.8 0.4 0.6</td>
<td>125 1.7 1.9 - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>- 0.8 0.5 0.7</td>
<td>150 1.8 2.1 - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>- 0.9 0.5 0.7</td>
<td>175 2.0 2.3 - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>1.1 1.2 0.6 0.9</td>
<td>200 2.1 2.5 - -</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig P. Typical Arrangement for plumbing pipe support from RCC slab

Plumbing pipe support from PEB Structure

The Plumbing Pipes should be simply supported by Split Clamps.

Split Clamps should be per-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB and 22dB for waster water pipe.

Pipe clamp should be as per DIN 3576 if support for metal pipe. The support installation should be as per international plumbing code.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1

The Support channel should be pre galvanised with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

For parallel to beam application.
The Girder cleat for attachment of support channel to steel girder
Girder cleat should be **Vds approved**. For perpendicular to beam application

The Girder clamp for suspension of threaded pins and threaded rods for support channels. Girder clamps should be **FM and Vds Approved**.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

| Nomin-
| Dia (mm) | Maximum Support Spacing (m) | Nomin-
| Pal Pipe | Horizont| Vertic| Horizont| Vertic| Maximum Support Spacing (m) | POLYETHYLENE |
| UPVC Pipe | al | al | al | al | POLYETHYLENE |
| | | | | | PIPE Class D, |
| | | | | | E,6,7 |
| Upto 10 | - | 0.6 | 0.3 | 0.5 | 65 | 1.2 | 1.4 | 0.6 | 0.9 |
| 15 | - | 0.6 | 0.4 | 0.6 | 80 | 1.4 | 1.5 | 0.6 | 0.9 |
| 20 | - | 0.7 | 0.4 | 0.6 | 100 | 1.5 | 1.7 | 0.7 | 1.1 |
| 25 | - | 0.8 | 0.4 | 0.6 | 125 | 1.7 | 1.9 | - | - |
| 32 | - | 0.8 | 0.5 | 0.7 | 150 | 1.8 | 2.1 | - | - |
| 40 | - | 0.9 | 0.5 | 0.7 | 175 | 2.0 | 2.3 | - | - |
| 50 | 1.1 | 1.2 | 0.6 | 0.9 | 200 | 2.1 | 2.5 | - | - |

Plumbing pipe support from Terrace

The Plumbing Pipes should be simply supported by **Split Clamps**.

Split Clamps should be per-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slippering high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to **18 dB and 22dB** for waster water pipe. Pipe clamp should be as per **DIN 3576** if support for metal pipe.

The support installation should be as per **international plumbing code**.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.
In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.

The Support channel should be pre galvanised with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.

In the case of pipe sizes beyond 4” for the steel pipe, it should be clamped with either a Split pipe clamp with all round welded nut or by using a Pipe strap.

The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors or stud anchor used for the channel fixing with terrace that should be ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nomin al Pipe Dia (mm)</th>
<th>Maximum Support Spacing (m)</th>
<th>Maximum Support Spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UPVC Pipe</td>
<td>POLYETHYLENE PIPE Class D, E,6,7</td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
<td>Vertical</td>
</tr>
<tr>
<td>Upto 10</td>
<td>-</td>
<td>0.6</td>
</tr>
<tr>
<td>15</td>
<td>-</td>
<td>0.6</td>
</tr>
<tr>
<td>20</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>32</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>40</td>
<td>-</td>
<td>0.9</td>
</tr>
<tr>
<td>50</td>
<td>1.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Plumbing pipe support from Wall

The Plumbing Pipes should be simply supported by Split Clamps.
Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an EPDM rubber lining which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

Pipe clamp should be as per DIN 3576 if support for metal pipe.

The support installation should be as per international plumbing code. The Clamp should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1

The Support channel should be pre galvanized with minimum GSM of 275 and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible round and long holes on back of the rail.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to RAL - GZ 655-C.

In the case of pipe sizes beyond 4" for the steel pipe, it should be clamped with either a Split pipe clamp with all round welded nut or by using a Pipe strap.

The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

The Drop-in anchors or stud anchor used for the channel fixing with terrace that should be ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

<table>
<thead>
<tr>
<th>Nomin al Pipe Dia (mm)</th>
<th>Maximum Support Spacing (m)</th>
<th>Nomin al Pipe Dia (mm)</th>
<th>Maximum Support Spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Polyethylene Pipe Class D, E,6,7</td>
<td>UPVC Pipe</td>
<td>Polyethylene Pipe Class D, E,6,7</td>
</tr>
<tr>
<td></td>
<td>Horizo ntal</td>
<td>Verti cal</td>
<td>Horizo ntal</td>
</tr>
<tr>
<td>Upto 10</td>
<td>-</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>15</td>
<td>-</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>20</td>
<td>-</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>32</td>
<td>-</td>
<td>0.8</td>
<td>0.5</td>
</tr>
<tr>
<td>40</td>
<td>-</td>
<td>0.9</td>
<td>0.5</td>
</tr>
<tr>
<td>50</td>
<td>1.1</td>
<td>1.2</td>
<td>0.6</td>
</tr>
</tbody>
</table>
13.0 WATER TRANSFER PUMP

Scope:
Panel mounted microprocessor-based pump controller, IP 55 enclosure, ON-OFF and Trip Indicating lamps in each incomer and outgoing feeders. The PLC shall support MODBUS-IP communication for its compatibility to integrate with 3rd party BAS system. The Microprocessor shall authorize Read/Write command via BMS, interlocking arrangement, earthing, level controller with operational mode as one pump working at low level, both pumps at high level with a hooter alarm and cut off at dry level, cascade operation, working / standby selection with provision of remote on/off operation complete as require. The on/off operation for all pumps shall be available on the central BMS system. Each incomer and Outgoing feeder should be capable for protection against Overload, Short Circuit and Phase reversal condition and shall be capable to communicate with BMS. Scope shall also include supply, laying, termination of power cables of adequate size, and arrangement of cable tray from Pump to Control panel etc. to complete the job.

SITC of electronic type low water level controller with LED panel to operate pump (necessary contacts along with minimum one PLC operated spare contacts required), shall prevent the pump from dry running.

Mounting Height: SITC of electronic type Medium & high-water level controller with LED panel to operate pump (necessary contacts along with minimum one PLC operated contacts required),level controller with operational mode as one pump working at low level and cut off at High level complete the job.

Set of accessories such as GI C Class headers of suction and discharge for (working and stand by pump assembly) with CED Coating, control valves, non-return valves, pressure switches, pressure transducers, pressure gauge of PN 10 etc. complete the job. Require complete company fitted ready-to-connect packaged system.

The pumping system shall be as per GRIHA Norms.

Codes and standards:
The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

Design features:
The pump shall be capable of developing the required total head at rated capacity.
Impeller shall be enclosed type and shall be dynamically balanced.

The pump shall have non overloading characteristics.

The pump shall have positive suction.

**Constructional features:**

The casing shall be of rigid construction and shall have central delivery pipe.

The casing shall be of Cast Iron EN-GJL-250.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss in case of moonset pumps.

Impeller shall be of one piece and shall be of Bronze.

The shaft shall be of SS 304 and its surface shall be properly finished.

Shaft sleeves shall be provided to protect shaft from any damage.

Bearing shall be ball or roller type.

Mechanical seals shall be provided to avoid any leakage.

**Inspection And Testing:**

The pump shall be offered for visual inspection before dispatch.

Material test certificates for the various pump components shall be furnished for purchaser’s approval.

Hydrostatic test shall be carried out at 1.5 times the maximum discharge pressure. All the tests shall be witnessed by the purchaser.

Motor and Pump tests as per IS 9542 - 1980 and Pump characteristics curves / data to be provided.

**Manifolds, Valves, Base frame & Accessories**

- Suction and Delivery manifolds in Hot Dip Galvanized steel. (80-110micron)
- DIN standard flange connections.
- One non-return valve and isolating valves for each pump is provided in delivery side and one isolating valve is provided in suction side.
- Manifolds and valves are suitable for 16bar pressure rating.
- Pumps should be mounted on the common base frame. Pumps fixed with Spring washer with SS bolts for foundation securing.
- Base frame and panel side support is in Galvanized steel.
- A suitable range of pressure gauges and pressure transmitter should be connected at the discharge manifolds.
- Vibration dampening pad for minimize the noise and vibration in the system.
- Concrete foundation as per manufacturer recommendation. (1.5 times X the weight of the Pumping system).

**Drawings:**

Following drawings shall be furnished by the CONTRACTOR:

1. Overall dimensional drawing.
2. Cross-sectional drawings with Bill of Material and Material of Construction

### TECHNICAL SPECIFICATIONS FOR CENTRIFUGAL PUMPS

<table>
<thead>
<tr>
<th>Particular</th>
<th>Data to be filled by Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump</strong></td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>Type &amp; Model: Centrifugal Monoblock / Monoset / End suction</td>
<td></td>
</tr>
<tr>
<td>Discharge in cum/hr</td>
<td></td>
</tr>
<tr>
<td>Head (Meters of WC)</td>
<td></td>
</tr>
<tr>
<td>Number of Pumps</td>
<td></td>
</tr>
<tr>
<td>Total system flow (cum/hr)</td>
<td></td>
</tr>
<tr>
<td>Shut off Head (Meters of WC)</td>
<td></td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td></td>
</tr>
<tr>
<td>No. of Stages</td>
<td></td>
</tr>
<tr>
<td>Suction End I.D.</td>
<td></td>
</tr>
<tr>
<td>Delivery End I.D.</td>
<td></td>
</tr>
<tr>
<td>Details of N.P.S.H.</td>
<td></td>
</tr>
<tr>
<td>Vibration Isolation Detail</td>
<td></td>
</tr>
<tr>
<td>Skid Details</td>
<td></td>
</tr>
<tr>
<td>Operating Weight</td>
<td></td>
</tr>
<tr>
<td>Overall Dimension (MM)</td>
<td></td>
</tr>
<tr>
<td>Mechanical Seal Detail</td>
<td></td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td></td>
</tr>
<tr>
<td>Pump Head - Cast Iron</td>
<td></td>
</tr>
<tr>
<td>Pump Base- Cast Iron</td>
<td></td>
</tr>
<tr>
<td>Impeller-SS 304</td>
<td></td>
</tr>
<tr>
<td>Chamber-SS 304</td>
<td></td>
</tr>
<tr>
<td>Shaft-SS304</td>
<td></td>
</tr>
<tr>
<td>Motor stool-Cast Iron</td>
<td></td>
</tr>
<tr>
<td>Shaft seal Cartridge type (SiC/Carbon)</td>
<td></td>
</tr>
<tr>
<td>Rubber parts-EPDM</td>
<td></td>
</tr>
<tr>
<td><strong>Motor</strong></td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>Power Requirement (HP / KW)</td>
<td></td>
</tr>
<tr>
<td>R.P.M.</td>
<td></td>
</tr>
<tr>
<td>Efficiency class-IE3</td>
<td></td>
</tr>
<tr>
<td>Insulation class-F</td>
<td></td>
</tr>
<tr>
<td>No. of pole: 2 pole</td>
<td></td>
</tr>
<tr>
<td>Enclosure class-IP 55</td>
<td></td>
</tr>
<tr>
<td>Supply Frequency-50Hz</td>
<td></td>
</tr>
<tr>
<td>Supply voltage-3X380-415V</td>
<td></td>
</tr>
<tr>
<td>Built in Thermistor-PTC</td>
<td></td>
</tr>
<tr>
<td><strong>Control Panel</strong></td>
<td></td>
</tr>
<tr>
<td>Enclosure class-IP 55</td>
<td></td>
</tr>
<tr>
<td><strong>DETAILS OF PLC</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ACCESSORIES &amp; SERVICES REQUIRED</strong></td>
<td></td>
</tr>
<tr>
<td>Base Plate</td>
<td></td>
</tr>
<tr>
<td>Foundation bolts</td>
<td></td>
</tr>
<tr>
<td>Companion flanges</td>
<td></td>
</tr>
<tr>
<td>Spare parts required</td>
<td></td>
</tr>
<tr>
<td>Maintenance tools required</td>
<td></td>
</tr>
<tr>
<td>Cut in pressure</td>
<td></td>
</tr>
<tr>
<td>Cut off pressure</td>
<td></td>
</tr>
<tr>
<td>Plant room suction matching flange &amp; outside plant room</td>
<td></td>
</tr>
<tr>
<td>Particular</td>
<td>Data to be filled by Contractor</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>flange</td>
<td></td>
</tr>
<tr>
<td>Suction &amp; delivery piping: MS, hot dipped galvanized, Class ‘C’ with CED Coated</td>
<td></td>
</tr>
<tr>
<td>Suction, delivery valves &amp; header valves: Required, flanged Cast Iron valves with SS internal parts</td>
<td></td>
</tr>
<tr>
<td>Make : Kirloskar / KSB / AUDCO/ FLOVEL</td>
<td></td>
</tr>
<tr>
<td>Flanged Ball / Butterfly valve on suction and delivery of each pump &amp; Flanged Non slam, spring operated dual plate type check valve on delivery side of each pump &amp; on header</td>
<td></td>
</tr>
<tr>
<td>Control Panel: With Starter. One pump of similar rating shall have VFD</td>
<td></td>
</tr>
<tr>
<td>Required with all protections &amp; sequential timer for main pumps.</td>
<td></td>
</tr>
<tr>
<td>Also required Finolex / CCI / Gloster make cable from motor to panel</td>
<td></td>
</tr>
<tr>
<td>Level Transmitter: Required for 0-5 mtr. Range and shall be panel mounted and interlocking with pump</td>
<td></td>
</tr>
<tr>
<td>Pressure Transmitter</td>
<td></td>
</tr>
<tr>
<td>Pressure Gauge: Required at delivery header.</td>
<td></td>
</tr>
<tr>
<td>Gaskets: ‘Champion ’make</td>
<td></td>
</tr>
<tr>
<td>Hardware: Zinc coated</td>
<td></td>
</tr>
</tbody>
</table>
TECHNICAL SPECIFICATIONS FOR DIESEL GENERATOR SET

The scope of this section consists of but not necessarily limited to the following in accordance with Technical specification prescribed in tender:-

1. The contractor shall supply, deliver to site, hoisting into position, install, test and commission the power generating set together with the necessary controls and switchboards as specified. Protection circuits, control wiring and interlock circuits not specified or indicated in the Drawings, but deemed necessary for the safe operation of the generating system shall be provided without any additional cost to complete the system.

2. Provide manufacturer's factory representative services, including co ordination and start-up and testing supervision.

3. Testing (factory and field), start-up supervision, training and providing necessary documentation and tools for operation.

A. Diesel Generator Specification:-

Refer CPWD Specification 2013

B. Reference Appendix:-

I. Appendix 1 - Retrofitted emission control equipment or devices (RECD) (Ref.: PCLS/12/2021-22) (Dated 01/02/2022):-

For Test Method, Testing Equipment and related Procedures for Type Approval testing of retrofitted emission control equipment used for Particulate control measure of Gensets up to 800 kW Mechanical Gross Power.

II. Appendix 2 - COMPLIANCE TO EMISSION and NOISE LIMITS - DG SET – 2016:-

For Pollution Control & Noise Measurement standards issued vide GSR 281(E) on 7th March 2016.

Diesel Generator Set to be manufactured as per the GSR 804(E) - CPCB IV+_221104_181658.
TECHNICAL SPECIFICATIONS FOR ELEVATORS

1. IIT Bombay proposes to erect two numbers of 20 passenger (1360KG) elevators and one number of 2500KG Freight Lift in Centre of Propulsion Technology at IIT Bombay.

2. SCOPE

The scope of Bid is to cover design, manufacture, supply, install, test, commission, obtain all necessary statutory approval and maintenance of Lifts during the Guarantee Period in the Building complex as per the Bid documents and Bid drawings.

During the guarantee period of Two years after successful commissioning, handing over of Lift and taking over by the Employer, the Bidder shall carry out comprehensive maintenance of Lift free of cost. After this guarantee period, the Employer will reserve the right to enter into Annual Maintenance Contract as described in the Bid document.

Employer reserves the right to select different agencies for the above works and award the work either directly or through the Main Contractor by nomination as specified elsewhere in the Bid.

3. The equipment supplied and erected shall be in accordance to updated version of IS-4666/1968, 1860/1968 & 1980 and 3534/1979. Fire protection requirement as per IS and local authority’s requirement shall also be complied with. The Lifts in accordance with any other International Standards, which are superior than IS standard, shall also be considered.

4. The Bidder shall note the following in the Lift Service particulars covered herein.
   a) Capacity & Numbers.
   b) Travel height, number of stops and openings.
   c) Type of Drive,
   d) Type of Safety Gear, door safety
   e) Type of Control and operation.
   f) Interface leads to be left for Building Management / Automation System.
   g) Amenities and finishes in Lift Car.

5. The Bidder shall furnish any other details relevant to the work and not covered in the Bid with financial bearing, if any, explicitly.

6. As the Bid documents shall form part of the Agreement, the provisions covered therein should be noted carefully and any deviation felt necessary therefrom shall be highlighted at the time of bidding only and not after. For this a statement of deviation, if any shall be prepared by Bidder and shall be enclosed in the first envelope super scribed “Technical Bid”. If no deviation is proposed, still this form shall be submitted with an entry “No deviation proposed”. No deviation in commercial conditions is acceptable.

7. The Bidder shall give rates for all items given in the schedule of quantities.

8. The current statutory requirement as per Lift Rules of Local Authority as applicable shall be complied with, No extra payment shall be considered either due to escalation or amendments/modifications to Local Authority Rules issued during the contract period.

9. The Bidder / Contractor shall be responsible to obtain necessary License from Lift Authority, Government of Maharashtra.

10. Terminal points:

The terminal point(s) Viz. Civil work and other services shall be as follows:

Civil works:

The Main Contractor shall complete the Lift shaft and pit to the required dimensions including plastering and painting. Hoist way / openings and the Machine room of required sizes shall be made available by the Main Contractor for erection of equipment well before its receipt at site. The Main Contractor shall be responsible for water proofing of the lift pit. The Main Contractor shall also complete lift machine room / closed required hoist way with lockable doors and windows in all
respects including lighting. All other civil activities for Lift installation shall be within the scope of the Lift Contractor and shall fall within the Lift Contractor’s responsibility.

All minor civil works under Lift Contractor’s responsibility include Cutting, Chasing and making good of the same at all levels, conceal the conduits and boxes for Panels. etc. The minor Civil work shall also include items connected with fixing of Sill plate / Sill slab projection, fixing of buffer springs in the lift, fixing and mounting beams, bearing plate etc. at the Lift Machine room if applicable.

Electrical Works:

Power supply – 1&3 Phase, 230/400 Volts 50 Hz Power supply will be provided at panel in ground floor by the Institute by a main switch in main panel.

The signals from the Fire mode services of the Lifts shall be integrated into the over all fire alarm system, forming part of the work site / building. For this purpose, sufficient potential free leads shall be left by the lift vendor at appropriate locations from which the building will connect the interface to institute.

All bidders should visit the site before quoting. So it will be assumed that the work has been quoted considering present site condition and the work will be completed in all respect without claiming any extra cost/ work.

### Particulars of Lift Service requirement (2500 KG Freight Lift):

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Recommended</th>
<th>Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application</td>
<td>Freight, PWD Compatible</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>Goods Auto Gearless with Machine Room</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Capacity</td>
<td>2.5 Tons</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Load</td>
<td>2.5 Tons</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Number of Lifts</td>
<td>1 (One)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Speed</td>
<td>1.0 meters per second (minimum)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Level</td>
<td>7 Levels (G+6)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Travel</td>
<td>As per the drawings</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Servicing</td>
<td>Lift should serve from Ground Floor to Six Floor with stops at all landings. Thus servicing 7 (seven) levels and 7 (seven) openings for each lift shaft. All doors open on the same side.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Size of the Lift Car</td>
<td>To be given to suit to available lift shaft</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pit Depth</td>
<td>As per the standard (To be specified by the bidder / lift vendor)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Drive System</td>
<td>Microprocessor based VVVF</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Control System</td>
<td>Microprocessor Based Simplex Selective Collective Control, AC VVVF</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Machine</td>
<td>Permanent Magnet Gearless Motor with Regenerative Drive</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>BMS Compatibility</td>
<td>Potential free contacts and RS 485/ Modbus /BACNet card in the controller shall be provided for monitoring position, up and down movement of lift etc which can be used in later stage</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Car Enclosure</td>
<td>Inner surface of Car door shall be honeycomb finish stainless steel all as per General specification. Ceiling finish: SS 304 Mirror finish. Size to be given</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Car Lighting</td>
<td>LED Lighting</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Car Doors</td>
<td>Minimum opening - 2200 mm (H) x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Car Door Protection</td>
<td>Multi beam full height infrared detector</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Landing Doors</td>
<td>SS doors with SS frame, Automatic (Power Operated) (Centre Opening) (Minimum 1 Hour Fire Rated)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Entrance Height</td>
<td>To be specified by bidder considering finished size of the door – 2200 mm (H) (Minimum).</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Hoist way Dimensions</td>
<td>Currently provided in the design - 3100mm (W) x 3100mm (D)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Vision Panel</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Car Floor</td>
<td>Aluminum chequered plate of 4- 6 mm appropriate thickness with hard underlay of MS plate.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Ventilation</td>
<td>Shall be cross flow blower / fan with louver with at least 2 Nos. fans in recess.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Signal System - Position Indicator</td>
<td>Digital floor position indicator in the car and at all landing TFT / LED type. <strong>Additional position indicator at rear side of the lift cabin.</strong></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Travel Indicator</td>
<td>Detailed travel direction indicator in the car and at all landings is to be provided.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gongs and visual indications at all landing for arrival of the car.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overload warning audio and visual indicator inside the car (Lift should not start on overload)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battery operated Alarm Bell and Emergency Light</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Car Operating Panel on side middle panel with Luminous Buttons and 3-way Intercom with (Vandal Proof Covers) (At a height easily accessible to wheelchair bound or visually impaired passenger).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Luminous hall buttons at all landings and inside the car with Braille language signage.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firemen’s switch at ground floor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Display inside the car shall be TFT / LED type with time and date indication.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lift in use / lift out of order sign / indication shall be in built with floor position indicator.</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Power Supply</td>
<td>400 / 415V, 3 Phase AC, 50 Hz, AC</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Auxiliary Power Supply</td>
<td>230V, +5% to -10%, 50 Hz, AC</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Leveling Accuracy</td>
<td>+ / - 5mm</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Speed Variation</td>
<td>+ / - 10% of the rated speed</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Counter Weight</td>
<td>Cast iron fillers fitted in steel channel frame of size and numbers as per manufacturer’s standard</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Car and Counter weight</td>
<td>Machined guiderails of suitable size</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guiderails and fish plates.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Handrails</td>
<td>Handrails on three sides with height not more than 900mm from floor.</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Emergency Supply</td>
<td>Inverter / UPS backup for at least 30 minutes and with maintenance free batteries.</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Firemen’s Switch</td>
<td>Firemen Drive Provision for Firemen drive to be made to bring the car to the main floor immediately after the firemen switch is operated. Thereafter, the car is for operation by the rescue person. All landing calls are ignored. Lift answers one car call at a time. The rescue person controls opening and closing of the doors at a floor. Returns to normal when firemen’s switch is opened. Firemen’s switch shall be provided at ground floor.</td>
<td></td>
</tr>
</tbody>
</table>
| 38 | Intercom - 3 Way | The intercom system provided in the lift car has to be handsfree and with lifting cradle in the lift machine room and security desk of IITB. With telephone/ intercom wiring. 
**Pocket provision shall be made inside the car to provide IITB intercom to be flush to car which will be connected to IITB EPABX system.** |
| 39 | Automatic Rescue Device | ARD should monitor the normal supply in the main controller and shall activate rescue operations within 10 seconds of normal supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor, the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with doors open. After the operation is completed by the ARD, the elevator is automatically switched over to normal operation as soon as power supply resumes. 
In case the normal supply resumes during ARD in operation, the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal supply resumes when the elevator is at the landing, it will be automatically be switched to normal power operations. 
All the lift safeties shall remain active during the ARD mode of operation. 
Battery capacity should be adequate |
so as to operate the ARD at least 7 times a day. Provided the duration between usages is at least 30 minutes.

40 Voice Announcement System  To announce the position of the elevator as the car stops at a level / floor served by elevator.

41 Transmission  Steel Ropes / Belts

42 Hall Fixtures  LED / TFT hall position indicators to benefit visually impaired and physically handicap users.

Hall lanterns with car arrival going at a height not more than from finished floor level.

43 Infra red  Full-length infrared safety light curtain infrared operated doors safety system to be provided. The Light Curtain to consist of infrared light beams passing between Car Door Entrances and one side of the Entrance the light source is being sensed by sensors. If an object cuts the light beams, the receivers will sense and give door command to the door operating system. This is to sense the passenger movement without being getting in to physical contact of doors with human being or other materials like trolley, etc., which ensures the highest safety to the passenger and other items transported by Elevator.

44 Standard Features  • Full Height 2D Electronic Cross Beam Detectors
• Overload Warning with audio visual indicators
• Auto Fan Cut-off
• Door open / Door close Button in the car
• Anti Nuisance Car Call Protection
• Independent Service.
• Nudging
• Door Time Protection
• Emergency Alarm Button
• Extra Door Time of Lobby and Parking
• Manual Rescue Operation

45 Tests  Tests at Site:- The following tests, specifications, shall be carried out to the satisfaction of the Engineer-In-Charge:-

1. The car shall be loaded until the weight on the rope is twice the combined weight of the car and the specified load. The load must be carried on for about 30 minutes, without any sign of weakness, temporary set or permanent elongation of the suspension rope.
Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

2. The following shall be tested:-
   a. No load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   b. Half load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   c. Full load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   d. Stalling current and voltage and time taken to operate overload.
   e. Overload Protection.
   g. Safeties
   h. Emergency operations.
   i. Emergency Rescue
   j. ARD testing as per specifications
   k. SPP
   l. Speed test
   m. Phase reversal
   n. Final limits
   o. Working of firemen’s switches

Tests on completion shall also be performed to the satisfaction of the Inspector of Lifts.

46 Machine Room

Height to be specified by bidder.
Cross ventilation is required for Machine Room.
Emergency Light to be provided.
I/O point required.
Floor Finish thickness to be specified by bidder.

47 Miscellaneous

Smoke Window in the lift shaft is required.

Particulars of Lift Service requirement (20 passenger (1360 KG) Lifts):-

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Recommended</th>
<th>Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application</td>
<td>Passenger, PWD Compatible</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>Passenger Auto Lift (20 Passengers)</td>
<td>Gearless with Machine Room</td>
</tr>
<tr>
<td>3</td>
<td>Capacity</td>
<td>20 Passengers</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Load</td>
<td>1360 KG</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Number of Lifts</td>
<td>2 (Two)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Speed</td>
<td>1.5 meters per second (minimum)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Level</td>
<td>7 Levels (G+6)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Travel</td>
<td>As per the drawings</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Servicing</td>
<td>Lift should serve from Ground Floor to Six Floor with stops at all landings. Thus servicing 7 (seven) levels and 7 (seven) openings for each lift shaft. All doors open on the same side.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Size of the Lift Car</td>
<td>To be given to suit to available lift</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pit Depth</td>
<td>As per the standard (To be specified by the bidder / lift vendor)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Drive System</td>
<td>Microprocessor based VVVF</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Control System</td>
<td>Microprocessor Based Simplex Selective Collective Control, AC VVVF</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Machine</td>
<td>Permanent Magnet Gearless Motor with Regenerative Drive</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>BMS Compatibility</td>
<td>Potential free contacts and RS 485/Modbus/BACNet card in the controller shall be provided for monitoring position, up and down movement of lift etc which can be used in later stage</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Car Enclosure</td>
<td>Inner surface of Car door shall be honeycomb finish stainless steel all as per General specification. Ceiling finish: SS 304 Mirror finish. Size to be given</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Car Lighting</td>
<td>LED Lighting</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Car Doors</td>
<td>Minimum opening - 2100 mm (H) x 1000 mm (W) SS doors with SS Honeycomb finish (Minimum 1 Hour Fire Rated)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Car Door Protection</td>
<td>Multi beam full height infrared detector</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Landing Doors</td>
<td>SS doors with SS frame, Automatic (Power Operated) (Centre Opening) (Minimum 1 Hour Fire Rated)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Entrance Height</td>
<td>To be specified by bidder considering finished size of the door – 2100 mm (H) (Minimum).</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Hoist way Dimensions</td>
<td>Currently provided in the design - 2400mm (W) x 2860mm (D)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Vision Panel</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Car Floor</td>
<td>Granite Flooring</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Ventilation</td>
<td>Shall be cross flow blower / fan with louver with at least 2 Nos. fans in recess.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Signal System - Position Indicator</td>
<td>Digital floor position indicator in the car and at all landing TFT / LED type. <strong>Additional position indicator at rear side of the lift cabin.</strong></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Travel Indicator</td>
<td>Detailed travel direction indicator in the car and at all landings is to be provided. Gongs and visual indications at all landing for arrival of the car. Overload warning audio and visual indicator inside the car (Lift should not start on overload) Battery operated Alarm Bell and Emergency Light Car Operating Panel on side middle panel with Luminous Buttons and 3-way Intercom with (Vandal Proof Covers)</td>
<td></td>
</tr>
</tbody>
</table>
### Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(At a height easily accessible to wheelchair bound or visually impaired passenger).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Luminous hall buttons at all landings and inside the car with Braille language signage.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Firemen’s switch at ground floor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display inside the car shall be TFT / LED type with time and date indication.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lift in use / lift out of order sign / indication shall be in built with floor position indicator.</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Power Supply</td>
<td>400 / 415V, 3 Phase AC, 50 Hz, AC</td>
</tr>
<tr>
<td>30</td>
<td>Auxiliary Power Supply</td>
<td>230V, +5% to -10%, 50 Hz, AC</td>
</tr>
<tr>
<td>31</td>
<td>Leveling Accuracy</td>
<td>+ / - 5mm</td>
</tr>
<tr>
<td>32</td>
<td>Speed Variation</td>
<td>+ / - 10% of the rated speed</td>
</tr>
<tr>
<td>33</td>
<td>Counter Weight</td>
<td>Cast iron fillers fitted in steel channel frame of size and numbers as per manufacturer's standard</td>
</tr>
<tr>
<td>34</td>
<td>Car and Counter weight Guiderails</td>
<td>Machined guiderails of suitable size and fish plates</td>
</tr>
<tr>
<td>35</td>
<td>Handrails</td>
<td>Handrails on three sides with height not more than 900mm from floor.</td>
</tr>
<tr>
<td>36</td>
<td>Emergency Supply</td>
<td>Inverter / UPS backup for at least 30 minutes and with maintenance free batteries.</td>
</tr>
<tr>
<td>37</td>
<td>Fire Lifts</td>
<td>Designated Lifts shall be used as fire lifts. Firemen switch shall be provided at ground floor to enable the fire service personnel to ground the lift in case of emergency. The word ‘Fire Lift’ shall be conspicuously displayed in fluorescent paint on all the fire lifts landing doors.</td>
</tr>
<tr>
<td>38</td>
<td>Firemen’s Switch</td>
<td>Firemen Drive Provision for Firemen drive to be made to bring the car to the main floor immediately after the firemen switch is operated. Thereafter, the car is for operation by the rescue person. All landing calls are ignored. Lift answers one car call at a time. The rescue person controls opening and closing of the doors at a floor. Returns to normal when firemen’s switch is opened. Firemen’s switch shall be provided at ground floor.</td>
</tr>
<tr>
<td>39</td>
<td>Intercom - 3 Way</td>
<td>The intercom system provided in the lift car has to be handsfree and with lifting cradle in the lift machine room and security desk of IITB. With telephone/intercom wiring. <strong>Pocket provision shall be made inside the car to provide IITB intercom to be flush to car which will be connected to IITB EPABX</strong></td>
</tr>
<tr>
<td></td>
<td>System</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td><strong>Automatic Rescue Device</strong></td>
<td></td>
</tr>
</tbody>
</table>
|   | ARD should monitor the normal supply in the main controller and shall activate rescue operations within 10 seconds of normal supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor, the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with doors open. After the operation is completed by the ARD, the elevator is automatically switched over to normal operation as soon as power supply resumes. 

In case the normal supply resumes during ARD in operation, the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal supply resumes when the elevator is at the landing, it will be automatically be switched to normal power operations. 

All the lift safeties shall remain active during the ARD mode of operation. 

Battery capacity should be adequate so as to operate the ARD at least 7 times a day. Provided the duration between usages is at least 30 minutes. |
| 41 | **Voice Announcement System**                                         | To announce the position of the elevator as the car stops at a level / floor served by elevator. |
| 42 | **Transmission**                                                       | Steel Ropes / Belts |
| 43 | **Hall Fixtures**                                                      | LED / TFT hall position indicators to benefit visually impaired and physically handicap users. 

Hall lanterns with car arrival going at a height not more than from finished floor level. |
| 44 | **Infra red**                                                         | Full-length infrared safety light curtain infrared operated doors safety system to be provided. The Light Curtain to consist of infrared light beams passing between Car Door Entrances and one side of the Entrance the light source is being sensed by sensors. If an object cuts the light beams, the receivers will sense and give door command to the door operating system. This is to sense the passenger movement without being getting in to physical contact of doors with human being or other materials like trolley, etc., which ensures the highest safety to the passenger and other items transported |
### Standard Features

- Full Height 2D Electronic Cross Beam Detectors
- Overload Warning with audio visual indicators
- Auto Fan Cut-off
- Door open / Door close Button in the car
- Anti Nuisance Car Call Protection
- Independent Service.
- Nudging
- Door Time Protection
- Emergency Alarm Button
- Extra Door Time of Lobby and Parking
- Manual Rescue Operation
- Mirror on Rear Side Panel

### Tests

**Tests at Site:-**
The following tests, specifications, shall be carried out to the satisfaction of the Engineer-In-Charge:

1. The car shall be loaded until the weight on the rope is twice the combined weight of the car and the specified load. The load must be carried on for about 30 minutes, without any sign of weakness, temporary set or permanent elongation of the suspension rope strands.

2. The following shall be tested:
   a. No load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   b. Half load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   c. Full load current and voltage readings both on ‘Up’ and ‘Down’ Circuits.
   d. Stalling current and voltage and time taken to operate overload.
   e. Overload Protection.
   g. Safeties
   h. Emergency operations.
   i. Emergency Rescue
   j. ARD testing as per specifications
   k. SPP
   l. Speed test
   m. Phase reversal
   n. Final limits
   o. Working of firemen’s switches

Tests on completion shall also be
Part C: Minor Components – Electrical, Mechanical and Fire Fighting (E&M) Works

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>performed to the satisfaction of the Inspector of Lifts.</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>47</strong></td>
<td><strong>Machine Room</strong></td>
</tr>
<tr>
<td></td>
<td>Height to be specified by bidder. Cross ventilation is required for Machine Room. Emergency Light to be provided. I/O point required. Floor Finish thickness to be specified by bidder.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>48</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Miscellaneous</strong></td>
</tr>
<tr>
<td></td>
<td>Smoke Window in the lift shaft is required.</td>
</tr>
</tbody>
</table>

**Note:-**

1. The Contractor has to arrange at their own cost including supply, fabricate and erect in position structural steel required for support of machine, brackets for guide rails, fascia plates at all landings etc., including three coats of anti corrosive paint of approved make and connected civil works including necessary scaffolding in/out of lift wells, floors on partitions together and making good holes for fixing brackets in lift walls, grouting of all bolts, sills, brackets / control board/ button boxes, limit switches etc., all in position for all lifts together.

2. Provision shall also be made available in the controller and wherever necessary for the lift(s) to directly travel to ground floor on any signal from Fire Alarm Control Panel having lead to lift machine room, automatically, ignoring direction of travel and other pending commands as per special condition of the Bid.

3. The offer shall include identification of Fireman’s Lift, having break glass panel and other specific functional requirement. Requirements indicated in the National Building Code of India (Equivalent to BS) in respect of Fire Protection requirements of lifts (Clause ‘D-1.5’ – Latest Issue) shall be fully complied with in respect of Design, Manufacturing and Erection of the Lifts.

4. Contractor shall provide full set of tools required for maintenance of lifts in the Lift Machine Room.

5. Notice required from the statutory authority shall be obtained.

6. Cost Includes; Factory inspection is to be arranged for two persons.

QAP for factory inspection may be submitted
LIST OF RECOMMENDED MATERIALS FOR MECHANICAL AND ELECTRICAL WORKS

Note:

1. The Contractor shall obtain prior approval from the Dean (IPS) before placing order for any specific material or engaging any of the specialized agencies. The contractor shall make a detailed submittal with catalogues and highlighted proposed specifications as well as full details of the works proposed to be executed by the specialized agency as specified

2. Wherever applicable, the Dean (IPS) may approve any material equivalent to that specified in the tender subject to proof being offered by the contractor for equivalence to his satisfaction.

3. Unless otherwise specified, the brand/make of the material as specified in the item nomenclature, in the particular specifications and in the list of approved materials attached in the tender, shall be used in the work.

4. Any other / additional Material (Not mentioned below) – Shall be approved from Dean (IPS) before use at site.

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>Equipment / Material</th>
<th>Recommended Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ELECTRICAL &amp; ELV SYSTEM</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>LT Panel- TTA (As per IEC 61439)</td>
<td>Zenith / Sinerco/ Marine Electrical / Peaton Electrical Company Ltd / ABAK / Pristine / Adlec / Legrand / L&amp;T / SCHNIEGER</td>
</tr>
<tr>
<td>2</td>
<td>LT Panels - Normal Fabricated</td>
<td>Peaton Electrical Company Ltd/ ABAK /Pristine /Adlec, Marine Electricals, Sinerco</td>
</tr>
<tr>
<td>3</td>
<td>Distribution Boards</td>
<td>Legrand / Schneider / Panasonic /Siemens / Hager/ L&amp;T / ABB /Havells</td>
</tr>
<tr>
<td>4</td>
<td>Low Voltage Cable</td>
<td>Havells/Finolex / KEI/ Polycab / RR Kabel / Ravin, Radiant</td>
</tr>
<tr>
<td>5</td>
<td>Cable Tray (Ladder Type / Perforated) &amp; Raceway</td>
<td>OBO Bettermann / Legrand / Indiana / Profab /Dudhat/MK/Erico</td>
</tr>
<tr>
<td>6</td>
<td>UPS</td>
<td>Eaton / APC-Schneider / Numeric / Vertiv / Socomec / Hitachi / Pegasus / Microtek / Luminious</td>
</tr>
<tr>
<td>7</td>
<td>SPD (Surge Arrester)</td>
<td>OBO /Indelec/ABB fuse/Purcel/Eltech</td>
</tr>
<tr>
<td>8</td>
<td>LT Switchgear (ACB)</td>
<td>Legrand-DMX3/Schneider-Masterpact /Nw/Siemens-3WL/L&amp;T-U Power Omega/ABB-Emax</td>
</tr>
<tr>
<td>9</td>
<td>LT Switchgear (MCCB)</td>
<td>Legrand-DPX3/Schneider-NSX/CVS /Siemens-3VA/3VM/ L&amp;T-Dsine /ABB-Tmax</td>
</tr>
<tr>
<td>10</td>
<td>LT Switchgear (MCB)</td>
<td>Legrand/Schneider/Siemens/L&amp;T/ABB/Panasonic/Havells/ Hager</td>
</tr>
<tr>
<td>11</td>
<td>LT Switchgear (Contactor, Relay, MPCB)</td>
<td>Legrand / Schneider / Siemens / L&amp;T / ABB</td>
</tr>
<tr>
<td>12</td>
<td>Auto Transfer Switch (ATS)</td>
<td>Schneider/Siemens/L&amp;T/Legrand/ABB/Legrand/Vertive/G E</td>
</tr>
<tr>
<td>13</td>
<td>Meters (Analog)</td>
<td>Legrand/ L&amp;T /ABB/Siemens/ Nippen / Schneider-Conserve / Trinity/AE</td>
</tr>
<tr>
<td>SR. NO.</td>
<td>Equipment / Material</td>
<td>Recommended Manufacturers</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>14</td>
<td>Meters/Energy Meters &amp; Load Managers (Digital)</td>
<td>Legrand/L &amp; T /ABB/Siemens/ Nippen / Schneider-Conserve / Trinity</td>
</tr>
<tr>
<td>15</td>
<td>Indicating Lamps</td>
<td>Schneider / L &amp; T / Salzer/ GE/ ABB/ As Per OEM Standard</td>
</tr>
<tr>
<td>16</td>
<td>Electric Timer</td>
<td>Siemens / Legrand / L&amp;T / Legrand / MECO/ Siemens/ BCH</td>
</tr>
<tr>
<td>17</td>
<td>Rotary Switch</td>
<td>Siemens / Keycee / Salzer / As Per OEM Standard</td>
</tr>
<tr>
<td>18</td>
<td>Push Button and Push Button Set</td>
<td>siemens / schneider electric / L &amp; T / Legrand / C &amp; S / ABB/ GE</td>
</tr>
<tr>
<td>19</td>
<td>Selector Switch</td>
<td>Keycee / Salzer / MECO/ Siemens/ L&amp;T/ Schneider/ ABB/ As Per OEM Standard</td>
</tr>
<tr>
<td>20</td>
<td>APFC Relay</td>
<td>Enercon / L &amp; T / Trinity / Beluk/ Ducati/ Siemens/ EPCOS/ ABB/ Schneider</td>
</tr>
<tr>
<td>21</td>
<td>LT Capacitors</td>
<td>L &amp; T / Legrand / Schneider/ Vishay / Ducati/ ABB/Siemens</td>
</tr>
<tr>
<td>22</td>
<td>Lugs/Cable termination</td>
<td>Dowells / 3D / Hex / Jainson / Comet / HMI/ CCI/ Braco</td>
</tr>
<tr>
<td>23</td>
<td>Bimetallic Lugs/Termination</td>
<td>Dowells / 3D / Hex / Jainson / Comet / HMI/ CCI/ Braco</td>
</tr>
<tr>
<td>24</td>
<td>Cable Gland</td>
<td>3d / Comet / HMI/ Grippwell/ Dowels/Polycab/Braco</td>
</tr>
<tr>
<td>25</td>
<td>PVC Conduits and Accessories</td>
<td>Precision / AKG/BBC / Polycab/ Anchor By Panasonic/Asian</td>
</tr>
<tr>
<td>26</td>
<td>M.S. Conduit and Accessories</td>
<td>Akg / BEC / Steelcraft/ Anchor By Panasonic / Precision</td>
</tr>
<tr>
<td>27</td>
<td>Modular Switches, Sockets &amp; Other Accessories</td>
<td>MK – Blenze Plus &amp; Element / Legrand-Myrirus &amp; Arteor / Schnieder-opale / Norisy /Panasonic- Europa/Cabtree-Athena/L &amp;T- Englaze / GM Modular (GX10 Series or equivalent) &amp; model shall be as approved as per architect.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contractor to provide minimum 3 nos. sample of different make for approval of Client &amp; Architect</td>
</tr>
<tr>
<td>28</td>
<td>Metal Clad Socket With MCB</td>
<td>Legrand / Hensel / Schneider / Hager/ L&amp;T/ ABB/ Siemens</td>
</tr>
<tr>
<td>29</td>
<td>PVC Tape</td>
<td>Steel Grip</td>
</tr>
<tr>
<td>30</td>
<td>PVC Junction Box</td>
<td>Hensel / Clipsal / Spelsberg / Scame / Sintex</td>
</tr>
<tr>
<td>31</td>
<td>Wires for Internal Wiring</td>
<td>Finolex / Havells / Polycab / RR Kabel / Kei/ Anchor , Radiant</td>
</tr>
<tr>
<td>32</td>
<td>Connectors (Colours as per Phase &amp; Neutral)</td>
<td>WAGO / Phoenix Contact/ Connect well</td>
</tr>
<tr>
<td>33</td>
<td>Control Transformer [ PT/ CT]</td>
<td>Ashmor / Kappa / Elmex/ Ae/ Precise/ Pragati/ / ECS/ Kalpa/L&amp;T</td>
</tr>
<tr>
<td>34</td>
<td>Ceiling Fan / Exhaust Fan</td>
<td>Crompton / Bajaj / Orient / Havells/ Anchor by Panasonic/ Usha/Atomberg-Gorilla/Super Fan</td>
</tr>
<tr>
<td>35</td>
<td>Floor Trunking</td>
<td>MK / Legrand / OBO Batterman/ Schneider</td>
</tr>
<tr>
<td>36</td>
<td>Floor Junction box</td>
<td>Legrand / MK / OBO Batterman/ Schneider</td>
</tr>
<tr>
<td>37</td>
<td>Chemical Earthing</td>
<td>OBO Bettermann / JEF /JMV/Axis/Dehn/eltech/indelec</td>
</tr>
<tr>
<td>38</td>
<td>Conventional</td>
<td>OBO Bettermann / JEF /JMV/Axis/Dehn/ Eltech/ Indelec</td>
</tr>
<tr>
<td>SR. NO.</td>
<td>Equipment / Material</td>
<td>Recommended Manufacturers</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>39</td>
<td>SMF Battery for UPS</td>
<td>Excide / Amararaja / Rocket / Amaron/ Standard/ AMCO/ Prestolite</td>
</tr>
<tr>
<td>40</td>
<td>Transformer</td>
<td>Voltamp/Powerlite/ Schneider/Kirlosker/Crompton/T&amp;R</td>
</tr>
<tr>
<td>41</td>
<td>EV Charging Station</td>
<td>ABB/Panasonic/Exicom</td>
</tr>
<tr>
<td>42</td>
<td>Fire Alarm Panel</td>
<td>Siemens-Fire finder/Simplex- TYCO/ Honeywell- Notifier/ BOSCH</td>
</tr>
<tr>
<td>43</td>
<td>Fire Alarm &amp; Music Wire</td>
<td>Lapp India / Finolex / Caliplast / Polycab /RR Kabel/ TYCO/Havells</td>
</tr>
<tr>
<td>44</td>
<td>Connectors (Colors as Per Phase &amp; Neutral)</td>
<td>WAGO / Phoenix Contact / Connectwell</td>
</tr>
<tr>
<td>45</td>
<td>IP PA System</td>
<td>Bosch / Bose / ATIES / Honeywell/ Ahuja</td>
</tr>
<tr>
<td>46</td>
<td>RACK</td>
<td>RITTAL /APC /Valrack / Dlink / Vallrack</td>
</tr>
<tr>
<td>47</td>
<td>IPBX</td>
<td>UTC-Kidde / Siemens-Sinorix / TYCO</td>
</tr>
<tr>
<td>48</td>
<td>Telephone Cable</td>
<td>Delton / Finolex / Legrand / Lapp India / Havells / Polycab/Caliplast/Dlink/Molex</td>
</tr>
<tr>
<td>49</td>
<td>Coaxial TV Cable</td>
<td>Delton / Finolex / Legrand / Lapp India / Havells / Polycab/Caliplast/ Dlink/RR Kabel</td>
</tr>
<tr>
<td>50</td>
<td>Data Signal Cable</td>
<td>Delton / Finolex / Legrand / Lapp India / Havells / Polycab/Caliplast/Dlink/RR Kabel</td>
</tr>
<tr>
<td>51</td>
<td>Multicore Flexible Cable</td>
<td>Delton / Finolex / Legrand / Lapp India / Havells / Polycab/Dlink/Molex/Radiant cables</td>
</tr>
<tr>
<td>52</td>
<td>CCTV Monitor</td>
<td>Samsung / Sony / LG</td>
</tr>
<tr>
<td>53</td>
<td>IP CCTV Camera System</td>
<td>Prama / Sony / Samsung / Honeywell / Bosch / Avtron / Axis/DVtel/VIVOTEK</td>
</tr>
<tr>
<td>54</td>
<td>Access Card System</td>
<td>Siemens / Honeywell / Bosch / HID/ Matrix/Fortuna Impex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electronic Locking System, Software, Cards – Visionline (Vingcard), Onity, Dormakaba</td>
</tr>
<tr>
<td>55</td>
<td>Data Switch &amp; Accessories</td>
<td>Cisco / HP / Netgear/Dlink</td>
</tr>
<tr>
<td>56</td>
<td>Patch &amp; Jack Panel, CAT-6 &amp; IT’S I/O, Fiber &amp; IT’S I/O, Patchcord</td>
<td>Tyco / Systimax / Legrand / Siemens / Molex/ Panduit/AMP/Dlink/TP link/Cisco</td>
</tr>
<tr>
<td>57</td>
<td>Rack</td>
<td>Rittal/APC/Vallrack/ Dlink /Cisco/Wipro</td>
</tr>
<tr>
<td>58</td>
<td>EPABX</td>
<td>Cisco / Avaya / NEC / Alcatel Lucent/Stl-Neox / Matrix</td>
</tr>
<tr>
<td>59</td>
<td>Fire Barrier</td>
<td>HILTI / OBO / 3M</td>
</tr>
<tr>
<td>60</td>
<td>WIFI</td>
<td>ARUBA / RUCKUS</td>
</tr>
<tr>
<td>61</td>
<td>LIU</td>
<td>AMP/Dlink/Cisco</td>
</tr>
<tr>
<td>62</td>
<td>Fibre optic cable</td>
<td>Legrand/AMP/Dlink/Molex</td>
</tr>
<tr>
<td>63</td>
<td>Telephone tag box</td>
<td>ADC Krone/Legrand/Cisco</td>
</tr>
<tr>
<td>64</td>
<td>Telephone socket/TV antenna socket/data socket (RJ 45)</td>
<td>MK – Blenze Plus &amp; Element / Legrand-Myrias &amp; Arteor / Schnedier-opale / Norisys /Panasonic- Europa/Cabtree- Athena/L &amp;T- Englaze / GM Modular (GX10 Series or equivalent) &amp; model shall be as approved as per architect.</td>
</tr>
</tbody>
</table>

Contractor to provide minimum 3 nos. sample of different
### Part C: Minor Components  E&M Works - Recommended materials

#### Recommended Manufacturers

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>Equipment / Material</th>
<th>Recommended Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>make for approval of Client &amp; Architect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Philips/GE/Wipro/Trilux</td>
</tr>
<tr>
<td></td>
<td>Telephone junction box &amp; module</td>
<td>ITL/Krone/MALSON</td>
</tr>
<tr>
<td></td>
<td>DWC/Hume pipe</td>
<td>Rex/Natni/Polymer/Gemini</td>
</tr>
<tr>
<td></td>
<td>Fire alarm detectors, Response indicators, CM, MM &amp; all accessories</td>
<td>Bosch/Edwards/Simplex/Honeywell-Notifier/Siemens</td>
</tr>
<tr>
<td></td>
<td>NVR/DVR, software &amp; accessories</td>
<td>Sony/Samsung/Honeywell/Bosch/Avtron/Axis</td>
</tr>
<tr>
<td></td>
<td>Rodent System</td>
<td>Star electronics/MaserIndia/R-scat</td>
</tr>
<tr>
<td></td>
<td>HDMI Cable / USB Cable / Audio Cable</td>
<td>Legrand/AMP/Dlink/Molex</td>
</tr>
<tr>
<td></td>
<td>Workstation</td>
<td>HP/Dell/Lenovo</td>
</tr>
<tr>
<td></td>
<td>Monitor Display</td>
<td>Samsung/HP/Dell/LG</td>
</tr>
</tbody>
</table>

#### DG SET

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>Equipment / Material</th>
<th>Recommended Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alternator</td>
<td>Kirloskar Green/Crompton/Stamford, Leroy Somer, Elmot</td>
</tr>
<tr>
<td>2</td>
<td>Engine</td>
<td>Cummins/Caterpillar/Volvo Penta/Kirloskar/Perkins/Greaves</td>
</tr>
<tr>
<td>3</td>
<td>Battery</td>
<td>Exide/Tata Green/Amron/Emco/Tudor/Cummins Pulselite</td>
</tr>
<tr>
<td>4</td>
<td>Integrators</td>
<td>Powerica,Goel Power, Sterling &amp; Wilson, Jackson/Captiva,Cooper,Sudhir,Cummins Power</td>
</tr>
<tr>
<td>5</td>
<td>AMF Panel</td>
<td>Accusonic(Pune),Antia Electricals,Indochem Industries,Powerica,Popular switchgear,Scoot Engineering,Stirlingand Wilson,Zenith Engineering,Arrow Engineering,ABAK,Goel Power</td>
</tr>
</tbody>
</table>

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.

#### HVAC

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>Equipment / Material</th>
<th>Recommended Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VRF/VRF SYSTEM INDOOR / OUTDOOR UNITS</td>
<td>MITSUBISHI/DAIKIN/TOSHIBA/O GENERAL/HITACHI</td>
</tr>
<tr>
<td>2</td>
<td>DOUBLE SKIN AHU</td>
<td>ZECO/EDGETECH/NEWTECH</td>
</tr>
<tr>
<td>3</td>
<td>GI DUCTING AND DIFFUSERS</td>
<td>JINDAL/SAIL/TATA</td>
</tr>
<tr>
<td>4</td>
<td>CENTRIFUGAL FANS</td>
<td>KRUGER/NICOTRA/SYSTEM AIR</td>
</tr>
<tr>
<td>6</td>
<td>VIBRATION ISOLATORS</td>
<td>DUNLOP/Cori/BDK/RESISTOFLEX</td>
</tr>
<tr>
<td>7</td>
<td>FIRE DAMPERS</td>
<td>CARYAIRE/AIRTECH/RAVISTAR</td>
</tr>
<tr>
<td>8</td>
<td>DAMPER ACTUATOR</td>
<td>SIEMENS/HONEYWELL</td>
</tr>
<tr>
<td>10</td>
<td>PRESSURE GAUGE / RELAYS</td>
<td>DANFOSS/INDFOSS/HONEYWELL/H GURU/ALCO/WIKA</td>
</tr>
<tr>
<td>11</td>
<td>THERMOSTAT</td>
<td>SIEMENS/DANFOSS/HONEYWELL/ALCO/EMERSON/JOHNSON/RADIX/SCHNEIDER</td>
</tr>
<tr>
<td>12</td>
<td>MOTOR</td>
<td>BHARAT BIJLEE/CROMPTON/SIEMENS/NARHARI</td>
</tr>
<tr>
<td>No.</td>
<td>Item</td>
<td>Brand(s)</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>13</td>
<td>STARTER PANEL</td>
<td>SINERCO POWER / MARINE ELECTRICAL / SYMTRONICS / POWER CONTROL</td>
</tr>
<tr>
<td>14</td>
<td>REFRIGERANT COPPER PIPING</td>
<td>Mandev / Totaline / Maxflow</td>
</tr>
<tr>
<td>15</td>
<td>INSULATION MATERIAL</td>
<td>LLOYDS / BEARDESELL / COOLINE NAVAIR / PYROGUARD / UP TWIGA/KIMMCO</td>
</tr>
<tr>
<td></td>
<td>RESINBONDED WOOL</td>
<td>VIDOFLEX / ARMA FLEX / ARMA CELL / THERMOBREAK</td>
</tr>
<tr>
<td></td>
<td>NITRILE RUBBER</td>
<td>K FLEX/ ARMA CELL / SUPERLON</td>
</tr>
<tr>
<td>16</td>
<td>VARIABLE FREQUENCY DRIVE</td>
<td>SIEMENS / ABB / SCHNEIDER / DANFOSS</td>
</tr>
<tr>
<td>17</td>
<td>REFRIGERANT COPPER PIPING &amp; PVC INSULATION</td>
<td>KFLEX/ARMACELL/SUPERLON/THERMOBREAK</td>
</tr>
<tr>
<td>18</td>
<td>PVC PIPE</td>
<td>PRINCE / FINOLEX/SUPREME /ASTRAL</td>
</tr>
<tr>
<td>19</td>
<td>HEPA FILTER</td>
<td>AIRTECH/ THERMODYNE/ UCCOMECH/ ANFILCO/ PUROLATOR/ SPECTRUM</td>
</tr>
<tr>
<td>20</td>
<td>ADHESIVES</td>
<td>ARMAFLEX 520/ PIDLITE SR 998/ FOSTER IIDL</td>
</tr>
<tr>
<td>21</td>
<td>CENTRAL CONTROLLER</td>
<td>DAIKIN/TOSHIBA/MITUBISHI/O GENERAL</td>
</tr>
<tr>
<td>22</td>
<td>CORDED/CORDLESS REMOTES</td>
<td>DAIKIN/TOSHIBA/MITUBISHI/O GENERAL</td>
</tr>
<tr>
<td>23</td>
<td>FLOWCONTROL DEVICE</td>
<td>ALDES/TRANSMONK/AIRFLOW/BELIMO/SEIMENS/SC HNEIDER/FLOWCOM</td>
</tr>
</tbody>
</table>

### Fire Fighting Works

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Brand(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIRE EXTINGUISHERS</td>
<td>KANEX / MINIMEX / SAFEX / KALPEX / VIJAY / SABRE</td>
</tr>
<tr>
<td>2</td>
<td>AUTO GLOW SIGNAGES</td>
<td>AUTOFLOW / GLOWLITE / PROLITE / AUTOGLO</td>
</tr>
<tr>
<td>3</td>
<td>PIPES</td>
<td>TATA / JINDAL / SAIL /</td>
</tr>
<tr>
<td>4</td>
<td>PIPE FITTINGS</td>
<td>JAINSONS / UNIK / VR</td>
</tr>
<tr>
<td>5</td>
<td>COATING &amp; WRAPPING</td>
<td>IWL / RUSTEK / NEOTAPE</td>
</tr>
<tr>
<td>6</td>
<td>PAINTING</td>
<td>ASIAN / NEROLAC / BERGER/AKZO NOBEL</td>
</tr>
<tr>
<td>7</td>
<td>RCC PIPES</td>
<td>INDIAN HUME PIPE / PRANALI / ALCOCK/ RSK / NITYANAND</td>
</tr>
<tr>
<td>8</td>
<td>PRESSURE SWITCHES</td>
<td>SWITZER / INDFOSS / DANFOSS / HONEYWELL/ NIVELCO / NIVO</td>
</tr>
<tr>
<td>9</td>
<td>PRESSURE GAUGE</td>
<td>H. GURU / FIEBIG / HD FIRE / WAREE/ WIKA/ BAUMER</td>
</tr>
<tr>
<td>10</td>
<td>FIRE HYDRANTS VALVE</td>
<td>NEWAGE/ PADMINI/ OMEX/ MINIMAX/ SUPEREX</td>
</tr>
<tr>
<td>11</td>
<td>RRL HOSE</td>
<td>NEWAGE / PADMINI / OMEX / MINIMAX / SUPEREX</td>
</tr>
<tr>
<td>12</td>
<td>FIRE HOSE, COUPLING BRANCH PIPE, NOZZLES, FIRE BRIGADE INLET</td>
<td>NEWAGE / PADMINI / OMEX / MINIMAX / SUPEREX / VIJAY</td>
</tr>
<tr>
<td>13</td>
<td>FIRE HOSE REEL</td>
<td>NEWAGE / PADMINI / OMEX / MINIMAX / SUPEREX</td>
</tr>
<tr>
<td>14</td>
<td>PUMPS</td>
<td>KIRLOSKAR / KSB / WILO/ CROMPTONS/ SPX/ ROYSON ENGG/ DESMI</td>
</tr>
<tr>
<td>Part C: Minor Components  E&amp;M Works- Recommended materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>15</strong></td>
<td>MOTOR</td>
<td>KEC / SIEMENS / CGL / ABB / NARHARI / ALMOT</td>
</tr>
<tr>
<td><strong>16</strong></td>
<td>DIESEL ENGINE</td>
<td>CUMMINS/ GEMMCO / PERKINS/ KOEL / GREAVES COTTON / COOPER /</td>
</tr>
<tr>
<td><strong>17</strong></td>
<td>BATTERY</td>
<td>EXIDE / AMCO / AMARON / AMARAJA</td>
</tr>
<tr>
<td><strong>18</strong></td>
<td>BATTERY CHARGER</td>
<td>SERVILINK / HBL / CHHABI / Numeric</td>
</tr>
<tr>
<td><strong>19</strong></td>
<td>SPRINKLERS</td>
<td>H.D / TYCO / VIKING / GRINNELL</td>
</tr>
<tr>
<td><strong>20</strong></td>
<td>FLOW SWITCHES</td>
<td>DANFOSS / FORBES / MARSHALL / SWITZER / SYSTEM SENSOR / POTTER / HONEYWELL</td>
</tr>
<tr>
<td><strong>21</strong></td>
<td>SS CORRUGATED FLEXIBLE PIPES BRAIDED TYPE</td>
<td>H.D. FIRE / TYCO / VIKING / NEW AGE / RAPIDROP / VICTAULIC / FM APPROVED</td>
</tr>
<tr>
<td><strong>22</strong></td>
<td>ADJUSTABLE ROSSET PLATE</td>
<td>H.D. FIRE / TYCO / VIKING</td>
</tr>
<tr>
<td><strong>23</strong></td>
<td>ENGINEERED SUPPORT SYSTEM</td>
<td>MUPRO / GRIPPLE / VALRAVEN / SHATKI FIRE</td>
</tr>
<tr>
<td><strong>24</strong></td>
<td>CAST IRON GRATING</td>
<td>KAPILANSH / NECO</td>
</tr>
<tr>
<td><strong>25</strong></td>
<td>PUMP ON OFF SWITCH</td>
<td>JAIN INSTRUMENTS / N.K. TECHNO FAB / RSS</td>
</tr>
<tr>
<td><strong>26</strong></td>
<td>BUTTERFLY VALVE</td>
<td>AUDCO / KITZ / L&amp;T / LEADER / ADVANCE / MESON / ZOLOTO / KIRLOSKAR / HAWA / MESON / GOVARDHAN DAS</td>
</tr>
<tr>
<td><strong>27</strong></td>
<td>SLUICE VALVE</td>
<td>MESON / AUDCO / KITZ / LEADER / ADVANCE / ZOLOTO / KIRLOSKAR / HAWA / MALHAR / GOVARDHAN DAS</td>
</tr>
<tr>
<td><strong>28</strong></td>
<td>BALL VALVE</td>
<td>MESON / AUDCO / KITZ / LEADER / ADVANCE / ZOLOTO / KIRLOSKAR / HAWA / MALHAR</td>
</tr>
<tr>
<td><strong>29</strong></td>
<td>STRAINER</td>
<td>AUDCO / KITZ / L&amp;T / LEADER / ADVANCE / ZOLOTO / MALHAR</td>
</tr>
<tr>
<td><strong>30</strong></td>
<td>PRESSURE REDUCING VALVE</td>
<td>HONEYWELL / BERMAD / MALHAR / LEADER</td>
</tr>
<tr>
<td><strong>31</strong></td>
<td>ANTICORROSIVE TAP</td>
<td>PIPEKOT / IWL / RUSTECH</td>
</tr>
<tr>
<td><strong>32</strong></td>
<td>AIR RELEASE VALVE</td>
<td>SANT / ZOLOTO / SHAH BHOGILAL</td>
</tr>
<tr>
<td><strong>33</strong></td>
<td>LEVEL INDICATOR</td>
<td>TECHNICA / WAAREE / NIVO</td>
</tr>
<tr>
<td><strong>34</strong></td>
<td>WELDING ELECTRODES</td>
<td>ADVANI / MARUTI / ESAB</td>
</tr>
<tr>
<td><strong>35</strong></td>
<td>CLAMPS / FASTENERS</td>
<td>HILTI / FISCHER / MUPRO</td>
</tr>
<tr>
<td><strong>36</strong></td>
<td>TEST DRAIN ASSEMBLY WITH SIGHT GLASS</td>
<td>TYCO / VIKING / GRINNEL</td>
</tr>
<tr>
<td><strong>37</strong></td>
<td>SOLENOID VALVE</td>
<td>ROTEX / ASCO / SWITZER / DANFOSS</td>
</tr>
<tr>
<td><strong>38</strong></td>
<td>PRIMER</td>
<td>ASIAN PAINTS / BERGER / NEROLAC / AKZO NOBEL</td>
</tr>
<tr>
<td><strong>39</strong></td>
<td>SS EXPANSION BELLOW</td>
<td>FLEXATHERM / METALLIC BELLOWS</td>
</tr>
<tr>
<td><strong>40</strong></td>
<td>AIR VESSEL</td>
<td>NEMA / GOLDEN DEER / ZENITH, AS PER CPWD</td>
</tr>
</tbody>
</table>
### Part C: Minor Components  E&M Works - Recommended materials

<table>
<thead>
<tr>
<th></th>
<th>SPECIFICATIONS TESTED UP TO 25KG/ SQRMTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>ALARM CONTROL VALVE, INSTALLATION CONTROL VALVE</td>
</tr>
<tr>
<td></td>
<td>TYCO, HD, NEWAGE (MUMBAI), NEWAGE (SURENDRANAGAR), VIKING, GLOBE</td>
</tr>
<tr>
<td>42</td>
<td>ANTI-VIBRATING MOUNTING PADS, EXPANSION JOINTS</td>
</tr>
<tr>
<td></td>
<td>DUNLOP, RESISTOFLEX, EASY FLEX, FLEXIONICS, VIMPA, IRMRA</td>
</tr>
<tr>
<td>43</td>
<td>DIESEL DRIVEN FIRE PUMP</td>
</tr>
<tr>
<td></td>
<td>KIRLOSKAR/PUMPSENSE /PEW/LUBI/JACKSON/WPIL</td>
</tr>
<tr>
<td>44</td>
<td>FIREMAN AXE</td>
</tr>
<tr>
<td></td>
<td>NEW AGE/SAFEGUARD</td>
</tr>
</tbody>
</table>

#### D  ELEVATORS

<table>
<thead>
<tr>
<th></th>
<th>Elevators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kone Elevators India Pvt Ltd</td>
</tr>
<tr>
<td></td>
<td>Otis Elevator Company (I) Ltd</td>
</tr>
<tr>
<td></td>
<td>Johnson Lifts Pvt Ltd</td>
</tr>
<tr>
<td></td>
<td>Schindler India Pvt Ltd.</td>
</tr>
<tr>
<td></td>
<td>M/s Omega Elevators</td>
</tr>
</tbody>
</table>
3. TENDER DRAWINGS (MECHANICAL & ELECTRICAL WORKS):

-Enclosed as an Attachment to Part C-3.
PART D: COMMERCIAL BID

BILL OF QUANTITIES (COMPOSITE WORKS)

D.1: Percentage on Estimated amount and Tendered amount

D.2: Schedule of Quantities for Composite Works
PART: E

OTHER DOCUMENTS
1. NOC approvals
   i. MCGM,
   ii. Fire
   iii. Tree
       - Enclosed as an Attachment

2. Geotechnical Survey Report:
   - Enclosed as an Attachment