TENDER DOCUMENT

Name Of Work: C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

NIT No: - 01/C/D3/2020-21/01

Note-1:- The intending bidder must read the terms and conditions carefully. He should submit his bid only if he considers himself eligible and he is in possession of all the documents as required.

Note-2:- The intending bidder must upload all the documents as detailed in Para 25 on page- 13 of this document.

Note-3:- Applicants are advised to keep visiting www.iitk.ac.in/iwd/tenderhall.htm, https://eprocure.gov.in/eprocure/app & www.tenderhome.com, from time to time (till the deadline for bid submission) for any updates in respect of the tender documents, if any. Failure to do so shall not absolve the applicant of his liabilities to submit the applications complete in all respect including updates thereof, if any. An incomplete application may be liable for rejection.

Note-4:- The EMD shall be prepared in favour of The Director, IIT Kanpur payable at Kanpur as detailed in the tender document. A part of EMD is acceptable in the form of bank guarantee as per the details in the tender document. This bank guarantee shall also be in favour of The Director, IIT Kanpur.

Note-5:- The defect liability period is 36 months from the date of handing over the completed building to the engineer in charge except for the items specifically mentioned in this tender document. Other related details are elaborated in the tender document.

Note-6:- Pre-bid meeting shall be held on 12/06/2020 at 11:00 AM as detailed in this document

Note-7:- The construction work is to be carried out at IIT Kanpur campus.
Name of work:- C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

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<th>Page No</th>
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This NIT amounting to Rs. 42,10,25,505/- contains 550 pages numbered from 01 to 550

Executive Engineer (C)  Executive Engineer (E)  Executive Engineer (AC)

Superintending Engineer
The Superintending Engineer, IWD, IIT Kanpur on behalf of Board of Governors of IIT Kanpur invites online percentage rate open bids on **Engineering Procurement and Construction (EPC) Contract basis** form eligible firms/contractors of repute in two bid system (Elibile cum Technical & Financial Bid) for the following work:

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Name of Work</th>
<th>Estimated Cost</th>
<th>Earnest money (in Rs)</th>
<th>Period of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.</td>
<td>Rs. 42,10,25,505 i/c Civil works: 33,20,75,761/- Electrical &amp; Lift works: 6,64,39,744/- HVAC works: 2,25,10,000/-</td>
<td>52,10,255/-</td>
<td>15 Months</td>
</tr>
</tbody>
</table>

Last date & time of submission of bid on 01.07.2020 upto 5.00 PM. All details are available on website, [https://eprocure.gov.in/eprocure/app](https://eprocure.gov.in/eprocure/app), [www.tenderhome.com](http://www.tenderhome.com) & [www.iitk.ac.in/iwd/tenderhall.htm](http://www.iitk.ac.in/iwd/tenderhall.htm). The bids can only be submitted online at [https://eprocure.gov.in/eprocure/app](https://eprocure.gov.in/eprocure/app). Any corrigendum regarding this tender will be published only on above mentioned websites.

No. IWD/CO/2020-21/ 1096 Dated: 01.06.2020

For publication in the news paper:
Financial Express-All India Editions
Section-A

Technical BID
(Eligibility Bid)

Name of work: C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur

Note:- The intending bidder must read the terms and conditions carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents as required.
The Superintending Engineer, IWD, IIT Kanpur on behalf of Board of Governors of IIT Kanpur invites online percentage rate open bids on Engineering Procurement and Construction (EPC) Contract basis form eligible firms/contractors of repute in two bid system (Eligibility cum Technical & Financial Bid) for the following work:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>NIT No.</th>
<th>Name of work &amp; Location</th>
<th>Estimated cost put to bid</th>
<th>Earnest Money</th>
<th>Period of completion</th>
<th>Last date &amp; time of technical &amp; financial bid for online submission</th>
<th>Last date &amp; time for submitting hardcopy of EMD and other documents as specified in the bid documents</th>
<th>Time and date of opening of Technical bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>01/C/D3/2020-21/01</td>
<td>C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.</td>
<td>Rs.42,10,25,505 i/c Civil works: 33,20,75,761/- Electrical &amp; Lift works: 6,64,39,744/- HVAC works: 2,25,10,000/-</td>
<td>Rs.52,10,255/- 15 Months</td>
<td>Upto 5:00 P.M. on 01/07/2020</td>
<td>Upto 3:00 P.M. on 06/07/2020</td>
<td></td>
<td>At 04:30 P.M. on 06/07/2020</td>
</tr>
</tbody>
</table>

1. The bidder should carefully read the milestones (Appendix- II) and conditions.
2. Contractors who fulfil the following requirements shall be eligible to apply. **Joint ventures and Special Purpose Vehicles are not accepted**

Should have satisfactorily completed the works as mentioned below during the last Seven years ending previous day of last date of submission of tenders.
(i) Three similar works each costing not less than Rs **1684.10** lacs

OR
(ii) Two similar works each costing not less than Rs. **2526.15** lacs
    OR
(iii) One similar work costing not less than Rs. **3368.20** lacs.

**Similar work** shall mean works of “Construction of building in RCC framed structure having minimum one building of five storied (G+4) or completing balance construction work of one building (including structural work) minimum up to five storey including Internal water supply, Sanitary installation, Drainage and Internal electrical installations all executed under single agreement”. The five storied building should have firefighting system or lift or Fire alarm system or HVAC executed under the said agreement.

**Note:**
1. Basement/stilt, if any will be considered as storey. In case, if any RCC framed structure is having basement and stilt both, it will be considered two storey. Mummy and machine room will not be counted as storey for this purpose.
2. One building of the specified storeys, as mentioned in the definition of similar work constructed in each work of the financial magnitude as specified above.

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 the previous day of last date of submission of tenders.

(b) Should have had average annual financial turnover of Rs. **2105.13** lacs on construction works during the last three years ending 31st March, 2019.
(c) Should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending 31st March, 2019
(d) Should have net worth certificate of minimum **Rs.631.54** Lacs issued by a certified Chartered Accountant.
(e) Should have a solvency of Rs. **1684.10** lacs.
(f) Should have the calculated bidding capacity equal to or more than the estimated cost of the work.
(g) The bidder should not have been barred /black listed by the central/state government, or any entity controlled by it, from participating in any tender, and the bar subsists as on the bid due date, would not be eligible to submit the bid.

3. The intending bidder must read the terms and conditions carefully. He should submit his bid only if he considers himself eligible and he is in possession of all the documents required.
4. Information and Instructions for bidders posted on website shall form part of bid document.
5. The bid document consisting of Technical (eligibility) & the Financial bid i/c plans, 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 contractor
whose bid may be accepted and other necessary documents can be seen in the office of the Engineer-in-Charge between hours of 11:00 AM and 4:00 PM from date of publicity of tender to date of submission of tender every day except on Saturday & Sunday and public holidays or can be seen on website www.iitk.ac.in/iwd/tenderhall.htm, https://eprocure.gov.in/eprocure/app & www.tenderhome.com

6. Applicant has to deposit earnest money of rupees **52,10,255.00** in the form of receipt/ Treasury Challan or Demand Draft or Pay order or Banker’s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of Director IIT Kanpur) along with tender document.

7. **Earnest Money in the form of Treasury Challan or Demand Draft or Pay order or Banker’s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of “Director IIT Kanpur”)** shall be scanned and uploaded to the e-Tendering website within the period of bid submission. The original EMD should be deposited in the office of Superintending Engineer along with PQ documents in separate envelop mentioning “EMD for the work” on 06.07.2020 up to 3.00 PM.

- A part of earnest money (EM) is acceptable in the form of bank guarantee also. In such case, **minimum 50% of earnest money or Rs. 20 lac, whichever is less, shall have to be deposited in shape prescribed above, and balance may be deposited in shape of Bank Guarantee of any scheduled bank having validity for six months or more from the last date of receipt of bids** which also is to be scanned and uploaded by the intending bidders.

Copy of certificate of work experience and other documents as specified in the technical bid/eligibility bid document shall be scanned and uploaded to the e-Tendering website https://eprocure.gov.in/eprocure/app.

within the period of bid submission. **However, copy (original/self-certified as mentioned in para 25) of all the scanned and uploaded documents as specified in bid document shall have to be submitted by the all bidders on 06.07.2020 up to 3.00, physically in the office of tender opening authority.**

**Online technical bid documents** submitted by intending bidders shall be opened only of those bidders whose original EMD deposited and other documents scanned and uploaded are found in order.

**Online financial bid document submitted by the bidders shall be opened only of those bidders who on the basis of pre-qualification documents uploaded by them within the period of bid submission, qualify in accordance with the provision of technical bid. The financial bid shall be opened at the notified time, date & place in presence of qualified bidders or their representative.**
8. The intending bidder must have valid class-III digital signature to submit the bid.

9. On opening date, the contractor can login and see the bid opening process. After opening of bids he will receive the competitor bid sheets.

10. Contractor can upload documents in the form of JPG format and PDF format.

11. **Certificate of Financial Turn Over:** At the time of submission of bid, contractor has to upload Affidavit/Certificate from CA mentioning Financial Turnover on construction work of last 5 years or for the period as specified in the bid document and further details if required may be asked from the contractor after opening of technical bids containing pre-qualification documents. The balance sheet in case of private public limited company shall include its standalone finance statement and consolidated financial statement both. There is no need to upload entire voluminous balance sheet.

12. **If a tenderer does not quote any percentage above/ below on the total amount of the tender or any section/sub head in the percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.**

13. The **Technical bid** shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the technical bid shall be communicated to them at a later date.

14. **Pre Bid Meeting** shall be held either in the office of Superintending Engineer IWD, IIT Kanpur or through Video Conferencing (the V.C. details shall be shared on website) at **11.00 AM on 12-06-2020** to clear the doubt of intending bidders/associates, if any. For physical attendance in pre bid meeting only one representative of firm shall be allowed to maintain the physical distance. Bidders are advised to send their queries/doubts by email to the executive engineer on email id vpsingh@iitk.ac.in at least one day prior to the pre-bid meeting. A bidder can send multiple mails with different queries/doubts in each mail. The bidder may also raise query on the date of prebid meeting. If found necessary, an addendum/corrigendum to the tender document and/or minutes of meeting shall be issued and same shall be uploaded on the website and no further queries after pre-bid meeting shall be entertained. Such addendum/corrigendum shall become part of tender.

15. The department reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.

16. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

17. **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,**
scaffolding at all heights irrespective of any location, wastages, watch and ward, other inputs, all incidental charges, all taxes, cess, duties, levies, etc. required for execution of the work. GST shall be paid extra along with the bills at prevailing rates.

Protocols pertain to COVOD-19 to be followed at site by the contractor as decided by the Government of India time to time. Nothing extra shall be payable on this account.

18. Copy of certificate of work experience and other documents as specified in the technical bid/eligibility bid document shall be scanned and uploaded to the e-Tendering website within the period of bid submission. However, copy (original/self-certified as mentioned in para 25 below) of all the scanned and uploaded documents as specified in bid document shall have to be submitted by the all bidders within specified date, physically in the office of tender opening authority.

19. Online technical bid documents submitted by intending bidders shall be opened only of those bidders who have deposited Earnest Money.

20. Online financial bid document submitted by the bidders shall be opened only of those bidders who on the basis of pre-qualification documents uploaded by them within the period of bid submission, qualify in accordance with the provision of technical bid. The financial bid shall be opened at the notified time, date & place in presence of qualified bidders or their representative.

21. The bid submitted shall become invalid if:
   (i) The bidder is found ineligible.
   (ii) The bidder does not deposit original EMD along with other bid documents in the office Superintending Engineer, IWD IIT Kanpur.
   (iii) The bidder does not uploaded all the documents (including GST registration) as stipulated in the bid document.
   (iv) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically by the bidder in the office of bid opening authority.
   (v) If a bidder quotes nil rates against each item in scheduled of quote of tender or does not quote any rate in any section/sub head in rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.

20. The contractor have to insure the all provisions during execution of work for 3 Star GRIHA rating. Nothing extra shall be payable on this account.

21. 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
bidders 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 bidders 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 Government and local conditions and other factors having a bearing on the execution of the work.

22. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable for rejection.

23. The contractor shall not be permitted to bid for works in the IWD in which his near relative is posted as 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 Institute Works Department IIT Kanpur.

24. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the contractor’s service.
25. List of **Documents** to be filled in by the bidders in various forms as indicated in Section III and other documents, to be **scanned & uploaded** within the period of bid submission and deposited in hard copy:

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Treasury challan /Demand draft/Pay order or Banker’s Cheque/ Deposit at Call Receipt/Fixed Deposit Receipt of a Scheduled Bank/ Bank Guarantee of any Scheduled Bank against EMD</td>
</tr>
<tr>
<td>2</td>
<td>Letter of transmittal</td>
</tr>
<tr>
<td>3</td>
<td>Certificate of Financial Turnover for the last five years from Charted Accountant <em>(Form 'A').</em></td>
</tr>
<tr>
<td>4</td>
<td>Bank Solvency Certificate from a Scheduled Bank <em>(Form 'B').</em></td>
</tr>
<tr>
<td>5</td>
<td>Networth certificate of minimum Rs. 631.54 lacs issued by a certified Chartered Accountant. <em>(Form 'B1').</em></td>
</tr>
<tr>
<td>6</td>
<td>Details of eligible similar nature of works completed during the last seven years ending previous day of last date of submission of tenders <em>(Form 'C').</em></td>
</tr>
<tr>
<td>7</td>
<td>Details of Projects under execution <em>(Form 'C-1').</em></td>
</tr>
<tr>
<td>8</td>
<td>Performance report of works referred to in Form 'C' <em>(Form 'D').</em></td>
</tr>
<tr>
<td>9</td>
<td>Performance report of works referred to in Form 'C-1' <em>(Form 'D1').</em></td>
</tr>
<tr>
<td>10</td>
<td>Structure &amp; Organisation <em>(Form 'E').</em></td>
</tr>
<tr>
<td>11</td>
<td>Details of works in progress or works awarded as on the last date of submission of tenders <em>(Form 'F').</em></td>
</tr>
<tr>
<td>12</td>
<td>Affidavit as per provision of CPWD-6 <em>(Form 'G').</em></td>
</tr>
<tr>
<td>13</td>
<td>GST Registration Certificate of the State in which the work is to be taken up, if already obtained by the bidder. If the bidder has not obtained GST registration in the State in which the work is to be taken up, Or as required by GST authorities then in such a case bidder shall furnish undertaking as given in <em>(Form 'H').</em></td>
</tr>
<tr>
<td>14</td>
<td>Permanent Account Number (PAN) as issued by the Incom Tax Department</td>
</tr>
<tr>
<td>15</td>
<td>Copy of Registration of the concern department.</td>
</tr>
<tr>
<td>16</td>
<td>Copy of EPF &amp; ESIC registration.</td>
</tr>
</tbody>
</table>

**Superintending Engineer**
SECTION- I
BRIEF PARTICULARS OF THE WORK

1. Salient details of the work for which bids are invited are as under:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of work</th>
<th>Estimated Cost</th>
<th>Period of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C/o Centre for Engineering in Medicine including Water supply, Sanitary installations, Internal Electrical installations, Fire Fighting, Fire Alarm system, CCTV/LAN, HVAC (Low side) and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.</td>
<td>Civil works: Rs. 33,20,75,761/- Electrical &amp; lift Works: Rs. 6,64,39,744/- HVAC: Rs. 2,25,10,000/-</td>
<td>15 Months</td>
</tr>
</tbody>
</table>

**Total**: Rs. 42,10,25,505

2. The work is situated at IIT Kanpur campus of IIT Kanpur(UP) Pin: 208016.

3. General features and scope of the work is as under:

   The scope of the work will be as per section-1, part-B and part-C. In case of any conflict between these components, higher scope of work shall prevail. The decision of the engineer-in-charge shall be final and binding on the contractor.

   The proposed building is of (G+5) RCC frame which includes execution of work including foundation, structure & finishing complete in all respect and services and handing over the assets after making them fully functional including maintaining the assets for three years in all aspects. The work is to be executed on EPC (Turn key) basis. The cost of labour, material, tools and plants and machinery required for execution of the whole project as per approved layout plan and detailed architectural, structural, plumbing, firefighting, Electrical and HVAC, drawings are within the scope of this work. It has Brick work / AAC block on the external, and in the internal walls of the building. It is decided to construct the complete RCC frame. The brief scope of work is as follows:-

4. General features and major components of the work are as under:

   **Civil Works**:

   The Building is Ground + 5 storeyed RCC framed structure with Column/ Shear Wall,
Beam, Slab construction using M25 Grade Concrete.

**Areas are as under:**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Floor</th>
<th>Area (sq.m.)</th>
<th>Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Level 1</td>
<td>1774.92</td>
<td>Seminar hall &amp; stage, Labs – 3nos, Faculty rooms - 3nos, Special faculty rooms – 3nos, Central instrumentation, Autoclave, Faculty office, Entrance hall &amp; Waiting Lounge, Foyer, Cold room, BMS/ Tech. staff, Departmental office, Office, Reception, Lobbies &amp; Corridors, Pantry, UPS/ ELV room, Chemical store, Gas store, Main electric room, AHU’s, Common Toilets, Staircases- 3nos, Service staircase, Emergency Showers, Passenger lifts – 2nos, Service lift, Service shafts</td>
</tr>
<tr>
<td>2</td>
<td>Level 2</td>
<td>1429.27</td>
<td>Labs – 4nos, Faculty rooms – 4nos, Special faculty rooms - 4nos, Central instrumentation, Autoclave, Faculty office, Cold room, BMS/ Tech. staff, Meeting room, Foyer, Lobbies &amp; Corridors, UPS/ ELV room, Chemical store, Pantry, AHU’s, Common Toilets, Staircases- 3nos, Service balcony – 2nos, Service staircase, Emergency Showers, Passenger lifts – 2nos, Service lift, Service shafts</td>
</tr>
<tr>
<td>3</td>
<td>Level 3</td>
<td>1369.73</td>
<td>Labs – 4nos, Faculty rooms – 4nos, Special faculty rooms - 4nos, Central instrumentation, Autoclave, Faculty office, Cold room, BMS/ Tech. staff, Meeting room, Common Room/ Lounge, Foyer, Lobbies &amp; Corridors, UPS/ ELV room, Chemical store, Pantry, AHU’s, Common Toilets, Staircases- 3nos, Service balcony – 2nos, Service staircase, Emergency Showers, Passenger lifts – 2nos, Service lift, Verandah, Service shafts</td>
</tr>
<tr>
<td>4</td>
<td>Level 4</td>
<td>1334.61</td>
<td>Labs – 4nos, Faculty rooms – 4nos, Special faculty rooms - 4nos, Central instrumentation, Server room, Faculty office, Cold room, BMS/ Tech. staff, Teaching Lab, Common Room/ Lounge, Foyer, Lobbies &amp; Corridors, UPS/ ELV room, Chemical store, Pantry, AHU’s, Common Toilets, Staircases- 3nos, Service balcony – 2nos, Service staircase, Emergency Showers, Passenger lifts – 2nos, Service lift, Verandah, Service shafts</td>
</tr>
<tr>
<td>5</td>
<td>Level 5</td>
<td>1121.57</td>
<td>Labs – 3nos, Faculty rooms – 3nos, Special faculty rooms - 3nos, Clean room, Autoclave, Virus room, Faculty office, Cold room, BMS/ Tech. staff, Lobbies &amp; Corridors, UPS/ ELV room, Chemical store, Pantry, AHU’s, Common Toilets, Staircases- 3nos, Service balcony – 2nos, Service staircase, Emergency Showers, Passenger lifts – 2nos, Service lift, Verandah, Service shafts</td>
</tr>
</tbody>
</table>
The mumty, Lift machine room & RCC overhead water tank will not be counted as storey. It shall not be considered for plinth area calculation.

a) Only 50% of the area of the verandahs & porch has been considered in plinth area calculation irrespective of top being protected or not protected above.

b) Plinth area does not include shafts open to sky above 2 sq.m. area. However, the shafts/ lift wells covered at top shall be counted at one floor level only.

The work should be executed as per drawing, schedule of finishes, schedule of hardware, latest CPWD Specifications, relevant IS codes of latest edition and other standard specifications except otherwise mentioned in bidding document.

This document is to be read in conjunction with other documents issued by the Institute along with tender. In case of any discrepancy between design drawings and CPWD conditions, the decision of Engineer-in-Charge shall be followed. The Contractor shall refer the drawings while bidding and will read them in conjunction with specifications/ schedules, etc.

The work shall be strictly carried out in accordance with the specifications. The equipment & material supplied at site will also be selected out of the list of approved makes. The contractor shall submit technical documentation for the shortlisted make of material/ equipment, as well as prepare shop drawings for various items/ works, as required for proper execution, whether the same have been indicated in drawings or not. Actual execution shall be based on shop drawings & documents approved from Institute representative. Nothing extra shall be payable on account of items required to be executed as per approved shop drawing.

The contractor shall be required to demonstrate satisfactory operation of entire system (including equipments supplied by Client and installed by contractor) and furnish required labour, material & tools to install & commission the system/s.

Contractor shall also be required to undertake the following, for which nothing extra shall be payable:

- Liaisoning and obtaining approval from Local Authorities prior & post installation for operation of equipments (lifts, panels, solar systems, fire systems, etc.)
- Commissioning of the plant including test reports to demonstrate satisfactory working prior to handing over.
- Provide as-built drawings and handing over document comprising of list of recommended spares, catalogues and service schedule for each equipment/material
- Training of Client’s staff
- The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable. In case the specifications and drawings contained in this document call for higher
standard than those required by prevailing regulations, then these specifications & drawings shall become applicable. However, in case of any conflict or violation between the document/drawings and prevailing laws, then the applicable laws & regulations shall be governing & binding.

Following shall be the procedure followed by contractor while preparation of shop drawings:

- The contractor shall refer the design drawings for understanding the scope and proposed routes to be followed during execution.
- Collect latest architectural backgrounds from the Client representative.
- Examine all related works/services drawings but not limited to structural, finishes, plumbing, electrical, HVAC and others including as-built works before starting the work. Any discrepancy must be reported to the Client’s site representative in writing and obtain approval for go-ahead.
- Within one week of award of work, the Contractor shall prepare a list of shop drawing along with submission schedule for approval of Institute representative. The list of drawings must include layouts for all steel work, aluminium work, structural glazing, glass railing, space frame, electrical panel rooms, lighting, power, cable, cable tray layouts, earthing, lightning protection, SLD, lifts, typical drawings showing exact location of supports, bends, tee connections, reducers, detailed drawings showing exact location and type of supports, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

Maximum headroom shall be maintained at all points and in case the same is inadequate, then written approval from Institute representative must be obtained prior to execution at site.

Ceramic/ Vitrified, stone/ tile dado and panelling, shall be executed at site by the Contractor in symmetrical pattern as far as possible.

These shop drawings shall depict information required to complete the Project as per specifications and as required by the Institute representative. These shop drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all items of equipment/materials/works.

- The contractor shall thereafter furnish six sets of detailed shop drawings to Institute representative for obtaining comments/approval. The Contractor will make unlimited number of re-submissions of shop drawings unless Institute representative approval is obtained.
- The Contractor will thereafter submit six sets of final shop drawings to the Institute representative for their exclusive use and all other agencies.
- No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/ installation.
- In case installation is carried out without following above process or obtaining a waiver to follow the procedure from Institute representative, the work shall be rejected, and contractor shall rectify the same at their own cost.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

The contractor prior to supplying material at site, will submit the following documentation to Consultant/Client representative for approval:

- Manufacturers’ drawings, catalogues, pamphlets and other documents in triplicate. Each item shall be properly labelled, indicating the specific services/works for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- Samples of all materials shall be submitted to the Institute representative prior to procurement. These will be submitted in two sets for approval and retention by Client’s representative and shall be
kept in their site office for reference and verification till the completion of the Project. Wherever
directed, a mock-up or sample installation shall be carried out for approval before proceeding for
further installation.

The contractor to ensure that all materials and equipment supplied shall be new and of best available
quality conforming to the relevant Indian Standard Specifications and to these specifications. Makes shall
be strictly in conformity with list of approved manufacturers/ vendors as provided herein. The Institute
reserves the right to reject any item which in their assessment is second hand or of inferior quality/
make.

**E& M Works:**

The scope of Electrical, Mechanical Services & Lifts have been provided in Part
‘C’ – Volume-I & II of NIT documents.
SECTION- II
INFORMATION & INSTRUCTIONS FOR BIDDERS

1.0 General:

1.1 The Indian Institute of Technology, Kanpur, is an institution of premier repute, decided to construct "C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

1.2 It is a very prestigious and a time bound project being monitored by the highest authority.

Important Note: The construction conditions and milestones have been specifically drafted to complete the project in time.

1.3 Letter of transmittal and forms for deciding eligibility are given in Section III.

1.4 All information called for in the enclosed forms should be furnished against the relevant columns in the forms. 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 a 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 bid being summarily disqualified. Bids made by telegram or telex and those received late will not be entertained.

1.5 The bid should be type-written. The bidder should sign each page of the application.

1.6 Overwriting should be avoided. Correction, if any, should be made by neatly crossing out, initialing, dating and rewriting. Pages of the eligibility criteria document are numbered. Additional sheets, if any added by the contractor, should also be numbered by him. They should be submitted as a package with signed letter of transmittal.

1.7 References, information and certificates from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent.

1.8 The bidder may furnish any relevant 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 eligibility criteria document
unless it is called for by the Employer.

2.0 Definitions:

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

2.2 Employer: Means the Board of Governors, IIT Kanpur, acting through the Superintending Engineer, IWD IIT Kanpur.

2.3 Bidder and/or contractor: Means the individual, proprietary firm, firm in partnership, limited company private or public or corporation.

2.4 "Year" means "Financial Year" unless stated otherwise.

3.0 Method of application:

3.1 If the bidder is an individual, the application shall be signed by him above his full type written name and current address.

3.2 If the bidder is a proprietary firm, the application shall be signed by the proprietor above his full typewritten name and the full name of his firm with its current address.

3.3 If the bidder is a firm in partnership, the application 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 later case a certified copy of the power of attorney should accompany the application. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.

3.4 If the bidder is a limited company or a corporation, the application shall be signed by a duly authorized person holding power of attorney for signing the application accompanied by a copy of the power of attorney. The bidder should also furnish a copy of the Memorandum of Articles of Association duly attested by a Public Notary.

4.0 Final decision making authority.

The employer reserves the right to accept or reject any bid and to annul the process and reject all bids at any time, without assigning any reason or incurring any liability to the bidders.

5.0 Particulars provisional

The particulars of the work given in Section I are provisional. They are liable to change and must be considered only as advance information to assist the bidder.

6.0 Site visit

The bidder is advised to visit the site of work, at his own cost, and examine it and its surroundings to himself collect all information that he considers necessary for proper assessment of the prospective assignment.
7.0 **Initial criteria for eligibility**

7.1 Bidder should have satisfactory completed works as mentioned below, during the last seven years ending previous day of last date of submission of tenders. For this purpose cost of work shall mean gross value of the completed work. This should be certified by an officer not below the rank of Executive Engineer / Project Manager or equivalent. In case of works executed for private organizations, the certificate shall be signed by the chief consultant and countersigned by the owner of the project.

1. Three similar works each costing not less than **Rs. 1684.10 lacs**
   OR
2. Two similar works each costing not less than **Rs. 2526.15 lacs**
   OR
3. One similar work costing not less than **Rs. 3368.20 lacs**.

**Similar work shall mean works of “Construction of building in RCC framed structure having minimum one building of five storeys or completing balance construction work of one building (including structural work) minimum upto five storey including Internal water supply, Sanitary installation, Drainage, Internal electrical installations all executed under single agreement”. The five storied building should have firefighting system or lift or Fire alarm system or HVAC executed under the said agreement.**

**Note:**
1. Basement/Stilt, if any will be considered as storey. In case, if any RCC framed structure is having basement and stilt both, it will be considered two story. Mumty and machine room will not be counted as storey for this purpose.

2. One building of the specified storeys, as mentioned in the definition of similar work constructed in each work of the financial magnitude as specified above.

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 the previous day of last date of submission of tenders.

7.2 The bidder should have had average annual financial turn over (gross) of **Rs. 2105.13 lacs** on Civil/Electrical construction work during the last three consecutive years balance sheets duly audited by Charted Accountant. Year in which no turnover is shown would also be considered for working out the average.

7.3 The bidder should not have incurred any loss (profit after tax should be
positive) in more than two years during available last five consecutive balance sheets, duly certified and audited by the Chartered Accountant.

7.4 Should have net-worth certificate of minimum Rs. 631.54 lacs issued by a certified Chartered Accountant.

7.5 The bidder should have a solvency of Rs. 1684.10 lacs certified by his Bankers.

7.6 Should have the calculated bidding capacity equal to or more than the estimated cost of the work.

The bidding capacity shall be = (2*N*A-B), where
A = maximum turnover in construction works executed in any one year during the last five years taking into account the completed as well as works in progress. The value of the completed work shall be brought to current costing level by enhancing at a simple rate of 7% per annum.
N = Number of years prescribed for the completion of the work for which the bids have been invited.
B = Value of the existing commitments and ongoing works.

7.7 The bidder should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder shall have to submit a list of these employees stating clearly how these would be involved in this work within 15 days of award of work.

8.0 Evaluation criteria
8.1 The detailed submitted by the bidders will be evaluated in the following manner:

8.1.1 The initial criteria prescribed in para 7.0 above in respect of experience of eligible similar works completed, loss (Profit after tax), solvency, financial turn over, bidding capacity, etc will first be scrutinized and the bidder’s eligibility for the work be determined.

8.1.2 The bidders qualifying the initial criteria as set out in para 7.0 above will be evaluated for following criteria by scoring method on the basis of details furnished by them and on the basis of inspection of ongoing and completed work carried out by the scrutiny committee duly constituted the Director, IIT Kanpur.

| (a) Financial strength (Form ‘A’, ‘B’ & ‘B1’) | Maximum 20 marks |
| (b) Experience in eligible similar nature of work during last seven years (Form ‘C’ & ‘C1’) | Maximum 20 marks |
| (c) Performance on works (Form ‘D’) – Time over run | Maximum 20 marks |
| (d) Performance on works (Form ’D’ &’D-1’) – Quality | Maximum 40 marks |
| **Total** | **100 marks** |
To become eligible for short listing the bidder must secure at least fifty percent marks in each (section a, b, c & d) and sixty percent marks in aggregate.

The department, however, reserves the right to restrict the list of such qualified contractors to any number deemed suitable by it.

**Note-** The average value of performance of works for time over run and quality for completed works shall be taken on the basis of performance report and on the basis of inspection of ongoing and completed work carried out by the scrutiny committee duly constituted by the Director, IIT Kanpur of the eligible similar works.

9.0 Evaluation of performance
Evaluation of the performance of contractors for the eligibility shall be done by the scrutiny committee. All the eligible Similar Works executed and submitted by the bidders may be got inspected by the committee. The marks for the quality shall be given based on this inspection, if inspection is carried out. Scoring method of evaluation: The scoring for evaluation mentioned in these columns shall be done as given in Annexure-1.

10.0 Financial information
Bidder should furnish the following financial information:
Annual financial statement for the last five year in (Form “A”) and solvency certificate in (Form “B”) and networth certificate in (Form- B1)

11.0 Experience in works highlighting experience in similar works
Bidder should furnish the following:
(a) List of eligible similar nature of work successfully completed during the last seven years in (Form “C”) and ongoing works as well in (Form-C-1).
(b) Performance report of works referred in form “C” (In Form “D”) signed by officer not below the rank of Executive Engineer /Project Manager or equivalent. The performance report should explicitly mention that the work includes —An RCC framed structure of five storied (G+4) or more storied including water supply, sanitary installation, electrical installation, in single agreement. It should also mention that the stories mentioned are excluding the Machine Room and Mumty. The detail shall also specify, whether or not the work contains HVAC or fire fighting system or Lifts or fire alarm system in the said agreement and shall mention the services executed and included in the agreement.
(c) Performance reports (corresponding to work mentioned in Form – C1) in Form-D1 (information in FORM-D should be complete & no completed work of more than Rs 1000 lacs (as mentioned in FORM-C) should be left out).

12.0 Organisation information
Bidder is required to submit the information in respect of his organization in Form “E”.

13.0 Letter of transmittal
The bidder should submit the letter of transmittal attached with the document.

14.0 Opening of Price bid

After evaluation of Pre-Qualification Documents, a list of short listed agencies will be prepared. Thereafter the financial bids of only the qualified and technically acceptable bidders shall be opened at the notified time, date and place in the presence of the qualified bidders or their representatives. The bid shall remain valid for 90 days from the date of opening of Technical (eligibility) bid.

15.0 Award criteria

15.1 The employer reserves the right, without being liable for any damages or obligation to inform the bidder, to:
(a) Amend the scope and value of contract to the bidder.
(b) Reject any or all the applications without assigning any reason.

15.2 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.
SECTION- III
INFORMATION REGARDING
ELIGIBILITY LETTER OF TRANSMITTAL

From
The Superintending Engineer
IWD IIT Kanpur
Kanpur.

To
Subject: C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

Sir,

Having examined the details given in press notice and bid document for the above work, I/we hereby submit the relevant information.

1. I/we hereby certify that all the statement made and information supplied in the enclosed forms A to J and accompanying statement are true and correct.

2. I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.

3. I/we submit the requisite certified solvency certificate and authorize the Superintending Engineer, IWD IIT Kanpur to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I/we also authorize Superintending Engineer, IWD IIT Kanpur 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 knowledge and capability for having successfully completed the following eligible similar works:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of work</th>
<th>Certificate from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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</table>

Certificate:

It is certified that the information given in the enclosed eligibility bid of 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: Seal of bidder

Date of submission: Signature(s) of Bidder(s).
FORM ‘A’

FINANCIAL INFORMATION

1. Financial Analysis – Details to be furnished duly supported by figures in balance sheet/ profit & loss account for the last five years duly certified by the Chartered Accountant, as submitted by the applicant to the Income Tax Department (Copies to be attached).

Financial Year

<table>
<thead>
<tr>
<th>Year</th>
<th>2015-16</th>
<th>2016-17</th>
<th>2017-18</th>
<th>2018-19</th>
<th>2019-20</th>
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<tbody>
<tr>
<td>Gross Annual turnover on construction works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Profit (After tax) / Loss on construction works.</td>
<td></td>
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</tbody>
</table>

Note-1: The bidder should give information strictly in above format.
Note-2: The balance sheet in case of Private/Public limited company shall include its standalone finance statement and consolidated financial statement both.

Signature of Chartered Accountant with Seal

Name of Chartered Accountant

--------------------------------------
Membership No. ICAI

Signature of Bidder(s).
FORM “B”

FORM OF BANKERS’ CERTIFICATE FROM A SCHEDULED BANK

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 upto a limit of
Rs..................................(Rupees..................................................)
..............................................................). This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

(Signature)
For the Bank

NOTE:
(1) Bankers 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.
(3) Solvency certificate should not be more than 6 months old.
FORM “B1”

FORM FOR CERTIFICATE OF NET WORTH FROM CHARTERED ACCOUNTANT

— It is to certify that as per the audited balance sheet and profit & loss account during the financial year ...... the Net Worth of M/s

.............................................................. (Name & Registered Address of individual/firm/company), as on 01.04.2020 after considering all liabilities. It is further certified that the Net Worth of the company has not eroded by more than 30% in the last three years ending on 01.04.2020.”

Signature of Chartered Accountant

.................................................. Name of Chartered Accountant

.................................................. Membership

No. ICAI

Date and Seal
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 of sponsoring organization</th>
<th>Cost of work</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</th>
<th>Whether the work was done on back to back basis</th>
<th>Yes/No</th>
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<tbody>
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<td>1</td>
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</table>

* Indicate gross amount claimed and amount awarded by the Arbitrator.

Signature of Bidder(s)

**Note:** The agency should give list of only those eligible works which are of 'SIMILAR NATURE'.

FORM ‘C-1’

PROJECTS UNDER EXECUTION
(Works with estimated cost put to tender more than Rs. 20.00 Crore)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name of work / project and Locations</td>
</tr>
<tr>
<td>2</td>
<td>Owner or sponsoring organization</td>
</tr>
<tr>
<td>3</td>
<td>Cost of work in Crores of Rupees</td>
</tr>
<tr>
<td>4</td>
<td>Date of commencement as per contract</td>
</tr>
<tr>
<td>5</td>
<td>Stipulated date of completion</td>
</tr>
<tr>
<td>6</td>
<td>Up to date percentage progress of work</td>
</tr>
<tr>
<td>7</td>
<td>Slow progress if any and reasons there of</td>
</tr>
<tr>
<td>8</td>
<td>Name and address (Postal address &amp; E-mail) / Telephone Number / Mobile number of officer to whom reference may be made.</td>
</tr>
<tr>
<td>9</td>
<td>Remarks</td>
</tr>
</tbody>
</table>

Certificated that the above list of works is completed, and no work has been left out and that the information given is correct to my / our knowledge and belief.

Signature of Bidder(s)
## FORM ‘D’

**PERFORMANCE REPORT OF WORKS REFERRED TO IN FORMS “C”**

1. **Name of work/project & location**
2. **Agreement no.**
3. **Estimated cost**
4. (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. (a) **Whether case of levy of compensation for delay has been decided or not**
   Yes/No
   (b) **If decided, amount of compensation levied for delayed completion, if any**
8. **Performance Report**
   (1) **Quality of work**
   Outstanding/Very Good/Good/Poor
   (2) **Financial soundness**
   Outstanding/Very Good/Good/Poor
   (3) **Technical Proficiency**
   Outstanding/Very Good/Good/Poor
   (4) **Resourcefulness**
   Outstanding/Very Good/Good/Poor
   (5) **General Behaviour**
   Outstanding/Very Good/Good/Poor

**Dated:**

**Executive Engineer or Equivalent**

**Note:** *If Name of Work is not clearly defining scope of work as specified in the definition of similar work, bidders are advised to upload 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 ‘D-1’

Assessment of Quality for Completed as well as Ongoing Works

Name of work : 
Date of Inspection : 
Date of submission of report : 

<table>
<thead>
<tr>
<th>A. General observations &amp; 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 &amp; 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 of Govt. guidelines are adequate or not.</td>
<td></td>
</tr>
<tr>
<td>8. Whether the welfare facilities provided to labour as per Clause- 19H 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>
<tr>
<td>9. If cladding done, observation on efficiency / quality of cladding / brick work</td>
<td></td>
</tr>
<tr>
<td>10. Quality of internal electrification work</td>
<td></td>
</tr>
<tr>
<td>11. Quality of DBs, EBDs &amp; Panels</td>
<td></td>
</tr>
<tr>
<td>12. Quality of E&amp;M equipments, panels &amp; feeder pillar</td>
<td></td>
</tr>
<tr>
<td>13. Quality of Fire alarm system / fire fighting system</td>
<td></td>
</tr>
<tr>
<td>14. Quality of Air Conditioning work</td>
<td></td>
</tr>
<tr>
<td>15. Any other aspect (To be elaborated)</td>
<td></td>
</tr>
</tbody>
</table>

Average marks (to be awarded out of 100 marks based on average of marks assessed on each attribute mentioned at B above).

Note:
1. All the above parameters may be considered for assessing the overall quality of work executed by the contractor.
2. In case, any attribute is not applicable, the same may not be included in assessment and mentioned are not applicable (N/A)
3. The works as assessed above shall be converted on a scale of 25/15 marks for completed/ ongoing works respectively.
4. In case of eligible completed works as well as ongoing works being more than one the maximum marks assigned for completed works and ongoing works will be equally distributed among the work.
FORM “E”
STRUCTURE & ORGANISATION

1. Name & 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)
   (a) An Individual
   (b) A proprietary firm
   (c) A firm in partnership
   (d) A limited company or Corporation

4. Particulars of registration with various Government Bodies (attach attested photocopy)

<table>
<thead>
<tr>
<th>Organisation/Place of registration</th>
<th>Registration No.</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>
</tbody>
</table>

5. Names and titles of Directors & 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 been convicted by the court of law? If so, give details.

8. In which field of Civil Engineering construction the bidder has specialization and interest?

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

Signature of Bidder(s)
## FORM ‘F’

**LIST OF PROJECTS UNDER EXECUTION OR AWARDED**

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Name of work/project and location</th>
<th>Owner of sponsoring organization</th>
<th>Cost of work in crore of rupees</th>
<th>Date of commencement as per contract</th>
<th>Stipulated date of completion</th>
<th>Upto 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 to be made</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Certificated that the above list of works is completed, and no work has been left out and that the information given is correct to my / our knowledge and belief.

Signature of Bidder(s)
FORM “G”

Affidavit

I/we undertake and confirm that our firm/partnership firm has not been blacklisted and/or debarred by any state/Central Departments/PSUs/Autonomous bodies during the last 7 years of its operations. Further that, if such information comes to the notice of the department then I/we shall be debarred for bidding in IIT Kanpur in future forever. Also, if such information comes to the notice of department on any day before date of start of work, the Engineer-in-charge shall be free to cancel the agreement and to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

I/We undertake and confirm that I/We have not abandoned any of the work entrusted to me/us nor any of the work entrusted to me/us have been rescinded by any of the Central/State Govt Departments, Undertakings, Autonomous institutions, Agencies, Societies, Enterprises and Companies during last 7 (seven) years ending previous day of last date of submission of bid. Further that, if such information comes to the notice of the department then I/we shall be debarred for bidding in IIT Kanpur in future forever. Also, if such information comes to the notice of department on any day before date of start of work, the Engineer-in-charge shall be free to cancel the agreement and to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

NOTE: Affidavit to be furnished on a ‘Non-Judicial’ stamp paper worth Rs.100/- (Scanned copy of this notarized affidavit to be uploaded at the time of submission of bid)

Signature of Notary with seal

Signature of Bidder(s) or an authorized Officer of the firm with stamp
FORM “H”

**Undertaking regarding obtaining GST registration Certificate of The State, in which work is to be taken up**

If work is awarded to me, I/we shall obtain GST registration Certificate of the State, in which work is to be taken up within one month from the date of receipt of award letter or before release of any payment by IWD, IIT Kanpur whichever is earlier, failing which I/We shall be responsible for any delay in payments which will be due towards me/us on a/c of the work executed and/or for any action taken by Institute or GST department in this regard.

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

Signature of Notary with seal

Signature of Bidder(s) or an authorized Officer of the firm with stamp
ANNEXURE- 1
CRITERIA FOR EVALUATION OF THE PERFORMANCE OF CONTRACTORS FOR PRE-ELIGIBILITY

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Financial strength (20 marks)</td>
<td></td>
</tr>
<tr>
<td>(i) Average annual Turnover</td>
<td>(i) 60% marks for minimum eligibility criteria</td>
</tr>
<tr>
<td>(In case of Private/Public limited company, the lower of the value calculated based on standalone finance statement and consolidated financial statement value shall be considered.)</td>
<td>(ii) 100% marks for twice the minimum eligibility criteria or more</td>
</tr>
<tr>
<td>(ii) Solvency Certificate</td>
<td>In between (i) &amp; (ii) – on pro-rata basis</td>
</tr>
<tr>
<td>(iii) Networth Certificate</td>
<td>2 marks</td>
</tr>
<tr>
<td>(b) Experience in similar Class of works (20 marks)</td>
<td>(i) 60% marks for minimum eligibility criteria</td>
</tr>
<tr>
<td>(ii) 100% marks for twice the minimum eligibility criteria or more</td>
<td></td>
</tr>
<tr>
<td>In between (i) &amp; (ii) – on pro-rata basis</td>
<td></td>
</tr>
<tr>
<td>(c) Performance on works (20 marks)</td>
<td>(i) 60% marks for minimum eligibility criteria</td>
</tr>
<tr>
<td>(time over run)</td>
<td>(ii) 100% marks for twice the minimum eligibility criteria or more</td>
</tr>
<tr>
<td>Parameter Calculation For points</td>
<td>In between (i) &amp; (ii) – on pro-rata basis</td>
</tr>
<tr>
<td>Score</td>
<td>Maximum Marks</td>
</tr>
<tr>
<td>If TOR = 1.00</td>
<td>20</td>
</tr>
<tr>
<td>2.00</td>
<td>15</td>
</tr>
<tr>
<td>3.00</td>
<td>10</td>
</tr>
<tr>
<td>&gt;3.50</td>
<td>0</td>
</tr>
<tr>
<td>(i) Without levy of compensation</td>
<td>20</td>
</tr>
<tr>
<td>(ii) With levy of Compensation</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>-5</td>
</tr>
<tr>
<td>(iii) Levy of compensation not decided</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

TOR = AT/ST, where AT=Actual Time; ST=Stipulated Time (+) Justified Period of Extension of Time.

Note: 1. The contractor shall produce documents to ascertain the Justified Period of Extension of Time given to him by the employer. If no such document is provided by him to ascertain his claim, the Justified Period of Extension of Time shall be treated as NIL. For the case where levy of compensation is not decided, the justified extension of time shall be considered only for the period for which the contractor produces supporting documents from the employer of the executed work, to establish his claim.

2. Marks for value in between the stages indicated above is to be determined by straight line variation basis.

<table>
<thead>
<tr>
<th>Performance of works (quality) as per assessment in Form D-1:</th>
<th>Maximum 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed works (max. 25 marks)</td>
<td></td>
</tr>
<tr>
<td>Ongoing works (max. 15 marks)</td>
<td></td>
</tr>
<tr>
<td>Total marks assessed</td>
<td></td>
</tr>
</tbody>
</table>
SECTION-B
PART-A

FINANCIAL BID
CPWD-6 FOR e-Tendering

The Superintending Engineer, IWD IIT Kanpur invites on behalf of Board of Governors, online percentage rate open bids on Engineering, Procurement and Construction (EPC) Contract basis from eligible firms/contractors of repute in two bid system (Eligibility cum Technical bid & Financial Bid) for the work of - C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

1. The work is estimated to cost Rs. 42,10,25,505.00. This estimate, however, is given merely as a rough guide.
2. Contractors who fulfil the following requirements shall be eligible to apply. **Joint ventures and Special Purpose Vehicles are not accepted.**

Should have satisfactorily completed the works as mentioned below during the last seven years ending previous day of last date of submission of tenders.

(i) Three similar works each costing not less than Rs. 1684.10 lacs
OR
(ii) Two similar works each costing not less than Rs. 2526.15 lacs
OR
(iii) One similar work costing not less than Rs. 3368.20 lacs.

**Similar work** shall mean works of “Construction of building in RCC framed structure having minimum one building of five storeys or completing balance construction work of one building (including structural work) minimum up to five storey including Internal water supply, Sanitary installation, Drainage and Internal electrical installations all executed under single agreement.” The five storied building should have firefighting system or lift or Fire alarm system or HVAC executed under the said agreement.

**Note:**
1. Basement/stilt, if any will be considered as storey. In case, if any RCC framed structure is having basement and stilt both, it will be considered two stirey. Mumty and machine room will not be counted as storey for this purpose.
2. One building of the specified storeys, as mentioned in the definition of similar work constructed in each work of the financial magnitude as specified above.

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 the previous day of last date of submission of
tenders.

(b) Should have had average annual financial turnover of Rs. **2105.13 lacs** on construction works during the last three years ending 31st March, 2019.

(c) Should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending 31st March, 2019.

(d) Should have net worth certificate of minimum **Rs.631.54 Lacs** issued by a certified Chartered Accountant.

(e) Should have a solvency of Rs. **1684.10 lacs**.

(f) Should have the calculated bidding capacity equal to or more than the estimated cost of the work.

(g) The bidder should not have been barred /black listed by the central/state government, or any entity controlled by it, from participating in any tender, and the bar subsists as on the bid due date, would not be eligible to submit the bid.

3. Agreement shall be drawn with the successful bidders on prescribed Form No. **CPWD 7** which is available as a Govt. of India Publication and also available on website www.iitk.ac.in/iwd/tenderhall.htm, https://eprocure.gov.in/eprocure/app & www.tenderhome.com, but the bids can only be submitted online through, https://eprocure.gov.in/eprocure/app. His rates including all applicable taxes but **excluding GST** as per various terms and conditions of the said modified form which will form part of the agreement.

3. The time allowed for carrying out the work will be **15 Months** 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 bid documents.

4. i) The site for the work is available.

   ii) The architectural, structural, Electrical & HVAC drawings are available. Further details if any shall be made available in phased manner as per requirement of the same as per approved programme of completion submitted by the contractor after award of work.

5. The bid document consisting of plans, specifications to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions of Contract Form can be seen on website www.iitk.ac.in/iwd/tenderhall.htm, https://eprocure.gov.in/eprocure/app & www.tenderhome.com free of cost but the bids can only be submitted online through, https://eprocure.gov.in/eprocure/app.

6. After submission of the bid the contractor can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

7. While submitting the revised bid, contractor can revise the rate of one or more item(s) any number of times (he need not re-enter rate of all the items) but
8. This bid is invited in two bid system.

9. a) Applicant has to deposit earnest money of Rs. 52,10,255.00 in the form of receipt/ Treasury Challan or Demand Draft or Pay order or Banker’s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of Director IIT Kanpur) along with tender document.

   i) Earnest Money in the form of Treasury Challan or Demand Draft or Pay order or Banker’s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of the Director, IIT Kanpur) shall be scanned and uploaded to the e-Tendering website within the period of bid submission.

   ii) The original EMD and other relevant documents shall be submitted in the hard copy to the office of the Superintending Engineer up to 3.00 PM on 06.07.2020.

   iii) A part of earnest money (EM) is acceptable in the form of bank guarantee also. In such case, minimum 50% of earnest money or Rs. 20 lac, whichever is less, shall have to be deposited in shape prescribed above, and balance may be deposited in shape of Bank Guarantee of any scheduled bank having validity for six months or more from the last date of receipt of bids which also is to be scanned and uploaded by the intending bidders.

   b) Copy of certificate of work experience and other documents as specified in the technical bid/eligibility bid document shall be scanned and uploaded to the e-Tendering website within the period of bid submission. However, copy (original/self-certified as mentioned in para 25 of technical/eligibility bid (under the heading Invitation of Bids)) of all the scanned and uploaded documents as specified in bid document shall have to be submitted by the all bidders in the hard copy to the office of the Superintending Engineer up to 3.00 PM on 06.07.2020.

   Online qualification bid documents submitted by intending bidders shall be opened only of those bidders who have deposited Earnest Money.

   Online financial bid document submitted by the bidders shall be opened only of those bidders who on the basis of pre-qualification documents uploaded by them within the period of bid submission, qualify in accordance with the provision of technical bid. The financial bid shall be opened at the notified time, date & place in presence of qualified bidders or their representative.

   The technical (eligibility) bid submitted shall be opened at 04:30 PM on 06.07.2020.
8. The bid submitted shall become invalid if:

(i) The bidder is found ineligible.

(ii) **The bidder does not deposit original EMD & other documents in hard copy in the office of Superintending Engineer, IWD, IIT Kanpur.**

(iii) The bidder does not uploaded all the documents (including certificate of registration for GST) as stipulated in the bid document including original EMD.

(iv) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted **physically by the bidder** in the office of bid opening authority.

(v) If a tender quotes nil rates against each item in item rate tender or does not quote any percentage above/below on the total amount of the tender or any section/sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.

9. The contractor whose bid is accepted will be required to furnish **performance guarantee of 5% (Five Percent)** of the bid 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. 10000/-) 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 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 prescribed form. In case the contractor fails to deposit the said performance guarantee within the period as indicated in Schedule 'F', including the extended period if any, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor. **The earnest money deposited alongwith bid shall be returned after receiving the aforesaid performance guarantee.** The contractor whose bid is accepted will also be required to 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 sub contractors, if any engaged by the contractor for the said work and Programme Chart (Time and Progress) within the period specified in Schedule F.

10. **Description of the work is as follows:**

C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction
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 bidders 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 bidders 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 Government and local conditions and other factors having a bearing on the execution of the work.

11. The competent authority on behalf of the Board of Governors, IIT Kanpur does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

12. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable for rejection.

13. The competent authority on behalf of Board of Governors, IIT Kanpur 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.

14. The bid for the works shall remain open for acceptance for a period of Ninty (90) days from the date of opening of technical bid. If any bidders withdraws his bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the bidders shall not be allowed to participate in the rebidding process of the work.

15. 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 22 days from the stipulated date of start of the
work, sign the contract consisting of:-

(a) The Notice Inviting Bid, all the documents including additional conditions, specifications and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.

(b) Standard C.P.W.D. Form 7 i/c upto date amendments and duly modified for EPC work or other Standard C.P.W.D. Form as applicable.

16. For Composite Bids

18.1.1 The Executive Engineer in charge of the major component will call bids for the composite work. The cost of bid document and Earnest Money will be fixed with respect to the combined estimated cost put to tender for the composite EPC bid.

18.1.2 The financial bid document will include following components: Volume-I

Part A:- CPWD-6, CPWD-7 including schedule A to F for the major component of the work, Standard General Conditions of Contract 2019 for EPC projects, as amended/modified up to as specified in schedule F.

Part B:- General / specific conditions, specifications applicable to major component of the work.

Part C:- Schedule A to F for minor component of the work. General/specific conditions, specifications applicable to minor component(s) of the work.

Part D:- Soil investigation report attached in PDF form

Part E:- Schedule of financial quote

Volume-II – Details of Part C

Volume-III – Drawings for Execution Architectural, Plumbing, Fire fighting drawings, structural drawings, Electrical & HVAC drawings

18.1.3 The bidders must associate himself, with agencies of the appropriate class eligible to bid for each of the minor component individually as per details given in respective minor component.
18.1.4 The eligible bidders shall quote rates after considering all the major as well as minor components.

18.1.5 After acceptance of the bid by competent authority, the SE in charge of the work shall issue letter of award on behalf of the Board of Governors, IIT Kanpur. After the work is awarded, the main contractor will have to enter into one agreement with EE in charge of major component and has also to sign two or more copies of agreement depending upon number of EE's of minor components. One such signed set of agreement shall be handed over to EEs of minor component(s). EE of major component will operate Part A and Part B of the agreement. EEs of minor component(s) shall operate Part C along with Part A of the agreement.

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

18.1.7 Security Deposit will be worked out separately for each component corresponding to the estimated cost of the respective component of works.

18.1.8 The main contractor has to associate specialized agency(s) for specialized items of work of major component and also has to associate agency(s) for minor component(s) conforming to eligibility criteria as defined in the bid document and has to submit detail of such agency(s) to Engineer-in-charge of major/minor component(s) (as applicable) within prescribed time. Name of the agency(s) to be associated shall be approved by Engineer-in-charge of major/minor (as applicable) component(s).

18.1.9 In case the main contractor intends to change any of the above agency/agencies during the operation of the contract, he shall obtain prior approval of Engineer-in-charge of minor component. The new agency/agencies shall also have to satisfy the laid down eligibility criteria. In case Engineer-in-charge is not satisfied with the performance of any agency, he can direct the contractor to change the agency executing such items of work and this shall be binding on the contractor.

18.1.10 The main contractor has to enter into agreement with contractor(s) associated by him for execution of specialized/minor component(s). Copy of such agreement shall be submitted to EEs of each specialized/minor component as well as to EE in charge of major component. In case of change of associate contractor, the main contractor has to enter into agreement with the new contractor/agency associated by him.

18.1.11 The requirement of technical staff given in various specialized works in
Part-C (Electrical/ HVAC works) is in addition to the requirement given in clause 32 in section- B of NIT. The actual deployment of these technical staff will be as per execution of work and direction of Suprintending Engineer, IWD, IIT Kanpur.

18.1.12 Running payment for the major component shall be made by EE of major discipline to the main contractor. Running payment for minor components shall be made by the Engineer-in-charge of the discipline of minor component directly to the main contractor.

18.1.13A. 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 Engineer-in-charge of major component after record of completion certificate of all other components.

18.1.13B. Final bill of whole work shall be finalized and paid by the EE of major component. Engineer(s) in charge of minor component(s) will prepare and pass the final bill for their component of work and pass on the same to the EE of major component for including in the final bill for composite contract.

Superintending Engineer
Tender for the work of: **C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.**

(i) Last date and time of technical and financial bid for online submission of e-tenders is up to **5.00 PM on 01.07.2020**

(ii) Time and Date of opening of technical bid in presence of tenders who may be present on **4.30 PM on 06.07.2020** in the office of the Superintending Engineer, IWD, IIT Kanpur.

(iii) The pre-qualification bids shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the technical bid shall be communicated to them at later date.

**TENDER**

I/We have read and examined the notice inviting tender, schedule, A, B, C, D, E & F Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rate & other documents and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified for the Board of Governor, IIT Kanpur within the time specified in Schedule ‘F’ viz., schedule of quantities and in accordance in all respect with the specifications, designs, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in respect of accordance with, such conditions so far as applicable.

We agree to keep the tender open for **ninety (90) days** from the due date of its opening and not to make any modification in its terms and conditions.
A sum of Rs 52,10,255.00 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. If I/We, fail to furnish the prescribed performance guarantee within prescribed period. I/We agree that the said President of India or his successors, in office 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 Board of Governor, IIT Kanpur or the successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely, otherwise the said earnest money shall be retained by him towards security deposit 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 tender form. Further, I/We agree that in case of forfeiture of Earnest Money & Performance Guarantee as aforesaid. I/We shall be debarred for participation in the re-tendering process of the work.

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 Department, then I/We shall be debarred for tendering in IWD, IIT Kanpur in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

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 therefrom 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.
ACCEPtANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for an on behalf of the Board of Governors, IIT Kanpur for a sum of Rs. ........................................ (Rupees .................................................................)

The letters referred to below shall form part of this contract agreement:

(a)
(b)
(c)

For & on behalf of Board of Governors, IIT Kanpur

Signature ........................................

Dated: ................................................

Designation ........................................
**PROFORMA OF SCHEDULES**

(Separate Performa for Civil, Elect. & HVAC. Works in case of Composite Tenders)
(Operative Schedules to be supplied separately to each intending tenderer)

**SCHEDULE 'A'**
Schedule of financial quote in Part E of NIT

**SCHEDULE 'B'**
Schedule of materials to be issued to the contractor.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of item</th>
<th>Quantity</th>
<th>Rates in figures &amp; words at which the material will be charged to the contractor</th>
<th>Place of issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>---------NIL-----------------</td>
<td></td>
</tr>
</tbody>
</table>

**SCHEDULE 'C'**
Tools and plants to be hired to the contractor

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Hire charges per day</th>
<th>Place of Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---------NIL-----------------  

**SCHEDULE 'D'**
Extra schedule for specific requirements/document for the work, if any.

**SCHEDULE 'E'**
Reference to General Conditions of contract : General condition of contract 2019 for EPC projects as amended / modified upto last date of submission of bid.

**Name of Work:** C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

<table>
<thead>
<tr>
<th>Estimated cost of the work:</th>
<th>Civil Items of Work-</th>
<th>Rs. 33,20,75,761.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical &amp; Lift Items of Work-</td>
<td>Rs. 6,64,39,744.00</td>
<td></td>
</tr>
<tr>
<td>HVAC Items of Work-</td>
<td>Rs. 2,25,10,100.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Rs. 42,10,25,505.00</td>
<td></td>
</tr>
</tbody>
</table>

**Earnest money**
Rs. 52,10,255.00
(To be returned after receiving performance guarantee)

**Performance Guarantee**
5% of the tendered value of the work

**Security Deposit**
2.5% of the tendered value of the work
SCHEDULE 'F'
GENERAL RULES & DIRECTIONS

<table>
<thead>
<tr>
<th>Officer inviting tender</th>
<th>Superintending Engineer, IWD, IIT Kanpur</th>
</tr>
</thead>
</table>

**Definitions:**

2(v) **Engineer-in-Charge**

- For Civil items of work: Executive Engineer (Civil), IWD, IIT Kanpur
- For Electrical items & Lift items of work: Executive Engineer (Elect.) IWD, IIT Kanpur
- For HVAC items of work: Executive Engineer (Air-Conditioning) IWD, IIT Kanpur

2(vii) **Accepting Authority**

Superintending Engineer

2(x) **Percentage on cost of materials and labour to cover all overheads and profits**

15%

2(xi) **Standard Schedule of Rates:**

- Plinth Area rates 2014 + cost Index
  - Civil Items of Work: D.S.R. 2018 & Market Rate
  - Electrical & Lift Items of Work: DSR 2018 & Market Rate
  - HVAC items of Work: DSR 2018 & Market Rate

- All the above with correction slips upto the last date of submission of bid

2(xii) **Department:**

Institute Works Department, IIT Kanpur

9(ii) **Standard CPWD contract Form:**

- GCC 2020, for EPC projects as amendment/modified upto last date of submission of bid.

(Whether correction vide latest circulars are incorporated or not in this document).
Clause 1

i) Time allowed for submission of Performance Guarantee 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: 15 Days

ii) Maximum allowable extension with late fee @ 0.1% per day of Performance Guarantee amount beyond the period as provided in (i) above: 7 Days

Clause 1A

The defect liability period shall be 3 years after the date of completion of work of contract agreement.

Clause 2

Authority for fixing Compensation under Clause 2 Superintending Engineer, IWD, IIT Kanpur

Clause 2 A

Whether Clause 2A shall be applicable: No

Clause 5

Number of days from the date of issue of letter of acceptance for reckoning date of start: 22 Days

Clause 5.2

Nature of hindrance register: Physical (either Physical or Electronic)

Clause 5.4

Schedule of rate of recovery for delay in submission of the modified programme in terms of delay days

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Contract Value</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>More than Rs. 20 Crores</td>
<td>Rs. 5000/-</td>
</tr>
</tbody>
</table>

Milestone/Bar Chart(s)- As per construction programme on Appendix-II

Time allowed for execution of work: 15 Months

Authority to decide

(i) Extension of time: Superintending Engineer, IWD IIT Kanpur

(ii) Rescheduling of milestone: Superintending Engineer, IWD IIT Kanpur
### (iii) Shifting of date of start in case of delay in handing over of site.

Superintending Engineer, IWD IIT Kanpur

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
<th>Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clause 6, 6A</strong></td>
<td>Clause applicable</td>
<td></td>
</tr>
<tr>
<td><strong>Clause 7</strong></td>
<td>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.</td>
<td>Rs. 150.00 lacs</td>
</tr>
<tr>
<td><strong>Clause 7A</strong></td>
<td>Whether clause 7A shall be applicable.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Clause 8 B</strong></td>
<td><em>(i)</em> This shall not apply for maintenance or <em>upgradation contracts not involving any services.</em> <em>(ii)</em> For other works, the limit shall be as below:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>More than Rs. 20 Crores</em></td>
<td>Rs. 50,000/-</td>
</tr>
<tr>
<td><strong>Clause 10A</strong></td>
<td>List of testing equipment to be provided by the contractor at site lab.</td>
<td>As per Section B of NIT</td>
</tr>
<tr>
<td><strong>Clause 10 B</strong></td>
<td><em>(ii)</em> Whether clause 10-B (ii) shall be applicable.</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td><em>(iii)</em> Whether clause 10-B (iii) shall be applicable.</td>
<td>No</td>
</tr>
<tr>
<td><strong>Clause 10 C</strong></td>
<td>Component of labour expressed as percentage of value of work</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>
 Clause 10 CA

<table>
<thead>
<tr>
<th>Materials covered under this clause.</th>
<th>Nearest material (other than cement*, reinforcement bars and structural steel) for which All India Wholesale Price Index is to be followed.</th>
<th>Base price and corresponding period of all the materials covered under clause 10 CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cement (PPC)</td>
<td>NIL</td>
<td>Rs 4531/- October, 2019</td>
</tr>
<tr>
<td>2. Steel (TMT Bars) reinforcement</td>
<td>NIL</td>
<td>Rs. 38500/- October, 2019</td>
</tr>
<tr>
<td>3. Structural Steel</td>
<td>NIL</td>
<td>Rs. 36500/- October, 2019</td>
</tr>
</tbody>
</table>

* Includes cement component used in RMC brought at site from outside approved RMC plants, if any.

Clause 10 CC

Clause 10 CC to be applicable in contracts with stipulated period of completion exceeding the period shown in next column

Schedule of component of other Materials, Labour, POL etc. for price escalation

- Component of civil (except materials covered under clause 10CA) /Electrical construction Materials expressed as percent of total value of work - Xm
- Component of Labour expressed as percent of total value of work - Y
- Component of P.O.L. expressed as percent of total value of work – Z

Note: Payment under this clause is admissible when contractor submits proof of having paid wages due to every worker through bank or ECS or online transfer to his bank

Clause 11

 Specification to be followed for execution of work:

For Civil items of work
CPWD Specifications 2009 Vol. 1 and Vol. 2 with correction slips up to the last date of receipt of tenders (Hereinafter called CPWD specifications also)

For Electrical/ HVAC items of work
As per electrical/ HVAC component
<table>
<thead>
<tr>
<th>Clause 12</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of work</td>
<td>Project and original work</td>
</tr>
<tr>
<td>12.2</td>
<td>Extra/ substitute item</td>
</tr>
</tbody>
</table>
**Clause 16**
Competent Authority for Deciding reduced rates: Superintending Engineer, IWD, IIT Kanpur

**Clause 17**
Defect Liability period: 36 months from the date of handing over the complete work

**Clause 18**
List of mandatory machinery, tools & plants to be deployed by the contractor at site: Appendix-III

**Clause 25**
Constitution of Dispute Redressal Committee (DRC)

<table>
<thead>
<tr>
<th>DRC shall constitute one Chairman and two members</th>
<th>Competent Authority to appoint DRC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Director, IIT Kanpur</td>
</tr>
</tbody>
</table>

**Place of Arbitration:** To be decided by Arbitral Tribunal in consultation with both Parties. Failing any such agreement, then the Arbitral Tribunal shall decide the venue.

Clause 31/31-B – Clause 31 (The contractor shall have to make his own arrangement of water. The withdrawal of water from the network of Institute shall not be allowed. No charges shall be recovered if the contractor develops tubewell at site and pumping arrangement at his own cost. The contractor shall have to seek permission digging tube well etc for water arrangement from the Engineer –in-charge).

**Clause 32** Requirement of Technical Representative(s) and Recovery Rate

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Requirement of Technical staff (of major + minor component)</th>
<th>Minimum experience in Year</th>
<th>Designation</th>
<th>Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 32</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qualification Number</td>
<td>(of Major + Minor component)</td>
<td>Figures Words</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Position</td>
<td>Experience</td>
<td>Salary</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------</td>
<td>------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Graduate Engineer (Major component)</td>
<td>20 (and having experience of one similar nature of work)</td>
<td>Rs. 1,00,000/- per person</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Graduate Engineer</td>
<td>12 (and having experience of one similar nature of work)</td>
<td>Rupees Sixty Thousand only per month</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Graduate Engineer Or Diploma Engineer</td>
<td>5 or 10 respectively</td>
<td>Rupees Forty Thousand only per month</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Graduate Engineer</td>
<td>8</td>
<td>Rupees Forty Thousand per month</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Diploma Engineer</td>
<td>8</td>
<td>Rupees Thirty Thousand per month</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Graduate Engineer</td>
<td>6</td>
<td>Rupees Forty Thousand per month</td>
<td></td>
</tr>
</tbody>
</table>
Assistant Engineers retired from Government services who are holding Diploma will be treated at par with Graduate Engineers.

**Clause 38**

<table>
<thead>
<tr>
<th>(i)</th>
<th>(a) Schedule/statement for determining theoretical quantity of cement, bitumen etc. on the basis of Delhi Schedule of Rates</th>
<th>Delhi Schedule of Rates 2018 with correction slips up to the last date of receipt of tenders</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ii)</td>
<td>Variations permissible on theoretical quantities:</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Cement</td>
<td>±(plus/minus) 3% (Three percent)</td>
</tr>
<tr>
<td>(b)</td>
<td>Bitumen for all works</td>
<td>+ (plus) 2.5% (Two point five percent) only and nil on – (minus) side.</td>
</tr>
<tr>
<td>(c)</td>
<td>Steel Reinforcement and structural steel sections for each diameter, section and category</td>
<td>+ (plus) 2.0% (Two percent) only and nil on – (minus) side.</td>
</tr>
<tr>
<td>(d)</td>
<td>Paint</td>
<td>As per co-efficient of standard Delhi Analysis of Rate 2018.</td>
</tr>
<tr>
<td>(e)</td>
<td>Any other item viz fire rated paint etc.</td>
<td>As per manufacturer specification</td>
</tr>
</tbody>
</table>
## RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of Item</th>
<th>Rates in figures and words at which recovery shall be made from the Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Excess beyond permissible variation</td>
</tr>
<tr>
<td>1</td>
<td>Cement (PPC)</td>
<td>NIL</td>
</tr>
<tr>
<td>2</td>
<td>Steel Reinforcement</td>
<td>NIL</td>
</tr>
<tr>
<td>3</td>
<td>Structural Steel</td>
<td>NIL</td>
</tr>
</tbody>
</table>

Superintending Engineer
## Mile Stone Chart

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of mile stone</th>
<th>Period for completion from date of start</th>
<th>Withheld amount for non achievement of mile stone.</th>
</tr>
</thead>
</table>
| 1       | **A- Activity Completion of Civil Work:**  
  (a) RCC of Foundation upto plinth level  
  **B- Activity completion of E&M/HVAC work:**  
  (a) Submission of eligibility documents of associate agencies for E&M and HVAC works as per eligibility condition.  
  (b) Submission of shop / layout drawings for conduits / equipments of EI, Fire fighting, Lift, CCTV etc. as required for all E&M services.  
  (c) Submission of HVAC shop/layout drawings of chilled water piping, AHU, FCU, Ducting, VFD, VAV and BMS system i/c input output summary with proposed specifications  
  or  
  Gross value of work done not less than 10 % of the accepted tendered value. | 03 months | 0.5% of the accepted tendered value. |
| 2       | **A- Activity completion of Civil Work:**  
  (a) RCC slab upto floor level 3  
  (b) Brick work upto floor level 1  
  (c) Sample lab at ground floor i/c all complete  
  *(Floor level shall be defined as per CPWD Specification-2009, Vol-1)*  
  **B- Activity completion of E&M/HVAC work:**  
  (a) Slab conduiting upto floor level 3  
  (b) Wall conduiting upto floor level 1  
  (c) Sample lab at ground floor with all wiring, switch, Socket, fan, fitting etc installed & complete  
  (d) Sample lab at ground floor with installation of chilled water pipeline, AHU, Ducting, VAV and VFD complete etc  
  or  
  Gross value of work done not less than 30 % of the accepted tendered value. | 06 months | 0.5% of the accepted tendered value. |
<table>
<thead>
<tr>
<th></th>
<th><strong>A- Activity completion of Civil Work:</strong></th>
<th><strong>B- Activity completion of E&amp;M/HVAC work:</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a) RCC slab upto floor level 6 (terrace level)</td>
<td>(a) Slab conduiting upto level 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Brick work upto floor level 4</td>
<td>(b) Wall conduiting, socket boxes and DBs upto level 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Internal work i/c flooring upto floor level 2</td>
<td>(c) Making of holes in toilets, labs/rooms, lift lobby, lift shaft, etc. pressurization, fire fighting and exhaust etc. upto level 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) Water proofing of toilets, internal plumbing work, upto floor level 2</td>
<td>(d) Installation of chilled water piping, ducting and AHU installation, BMS wiring and conduiting upto level 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>B- Activity completion of E&amp;M/HVAC work:</strong></td>
<td><strong>or</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Submission of inspection call at OEM premises for all major materials such as panels, lift, UPS, equipments, cables etc. and any other materials as required.</td>
<td>Gross value of work done not less than 50% of the accepted tendered value.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Over Head water tank, Machine room, Brick coba complete</td>
<td><strong>A- Activity completion of Civil Work:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Completion of Brick work</td>
<td><strong>B- Activity completion of E&amp;M/HVAC work:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Toilet work including internal plumbing work, wall tiling work upto level 5</td>
<td>Submission of inspection call at OEM premises for all major materials such as panels, lift, UPS, equipments, cables etc. and any other materials as required.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) completion of all Flooring work etc upto level 5</td>
<td>(a) Wall conduiting, socket boxes and DBs of all floors</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>or</strong></td>
<td>(b) Making of holes in toilets, labs/rooms, lift lobby, lift shaft, etc. pressurization, fire fighting and exhaust etc. upto all floors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gross value of work done not less than 75% of the accepted tendered value.</td>
<td>(c) Wiring, laying of raceway work upto level 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Installation of chilled water piping, ducting and AHU installation, BMS wiring and conduiting upto level 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>or</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gross value of work done not less than 75% of the accepted tendered value.</td>
<td></td>
</tr>
</tbody>
</table>
| 5 | **A- Activity completion of Civil Work:**  
(i) Completion of internal & external painting, false ceiling of all buildings and flooring,  
(ii) Completion of external plumbing, sewerage work, drainage and road work.  
| **B- Activity completion of E&M/HVAC work:**  
(a) Installation of fan, switch & socket and fittings in all floors of the building complete.  
(b) Testing and commissioning of lifts.  
(c) Completion & testing of fire fighting and fire alarm work in all building including pump room & yard hydrant work and submission for inspection by CFO.  
(d) Service connection to substation and outdoor lighting.  
(e) Complete Installation of chilled water piping, ducting and AHU installation, BMS wiring and conduting.  
| Or  
Gross value of work done not less than 90% of the accepted tendered value.  
| 14 months | 1.0% of the accepted tendered value. |

| 6 | **Completion of all works in all respect including testing and commissioning** | 15 Months | 1.0% of the accepted tendered value. |
# Appendix-III

## List of Basic Minimum Required Machinery, Tools & Plants to Be Deployed by the Contractor at Site

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Equipment</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavators (various sizes)</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>2</td>
<td>Builder’s hoist</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Equipment for Concrete work</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Automatic weight batching plant</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>4</td>
<td>Concrete mixer (electrical)</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>5</td>
<td>Needle vibrator (electrical)</td>
<td>5 Nos.</td>
</tr>
<tr>
<td>6</td>
<td>Needle vibrator (petrol)</td>
<td>5 Nos.</td>
</tr>
<tr>
<td>7</td>
<td>Surface and Plate vibrator</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Equipment for Building work</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bar bending Machine</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>9</td>
<td>Bar cutting machine</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>10</td>
<td>Drilling machine</td>
<td>1 No.</td>
</tr>
<tr>
<td>11</td>
<td>Welding machine i/c transformer</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>12</td>
<td>Cube testing machines automatic (Digital 100 MT)</td>
<td>1 No.</td>
</tr>
<tr>
<td>13</td>
<td>Steel shuttering</td>
<td>3000 sqm</td>
</tr>
<tr>
<td>14</td>
<td>M.S. pipes/telescopic props and other accessories.</td>
<td>As per requirement for the shuttering area given at s.no. 17 above.</td>
</tr>
<tr>
<td>15</td>
<td>Steel scaffolding system (cup lock type)</td>
<td>As per requirement of the project and milestones.</td>
</tr>
<tr>
<td>16</td>
<td>Grinding/polishing machines</td>
<td>2 No.</td>
</tr>
<tr>
<td>17</td>
<td><strong>Equipment for transportation</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tippers</td>
<td>As per requirement of the project and milestones.</td>
</tr>
<tr>
<td>18</td>
<td>Trucks</td>
<td>As per requirement of the project and milestones.</td>
</tr>
<tr>
<td>19</td>
<td><strong>Pneumatic equipment</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air compressors (diesel)</td>
<td>Nil</td>
</tr>
<tr>
<td>20</td>
<td><strong>Dewatering equipment</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pump (diesel)</td>
<td>As per requirement of project</td>
</tr>
<tr>
<td>21</td>
<td>Pump (electric) (Desirable)</td>
<td>As per requirement of project</td>
</tr>
<tr>
<td>22</td>
<td><strong>Power equipment</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel generator (to meet requirement at site for uninterrupted work)</td>
<td>As per requirement of project</td>
</tr>
<tr>
<td>Survey equipments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>23 Total Work Station</td>
<td>1 No.</td>
<td></td>
</tr>
<tr>
<td>24 Vernier Callipers</td>
<td>1 No.</td>
<td></td>
</tr>
<tr>
<td>25 Weighing Machine</td>
<td>1 No.</td>
<td></td>
</tr>
<tr>
<td>26 Earth Compactor</td>
<td>1 No.</td>
<td></td>
</tr>
</tbody>
</table>

Superintending Engineer
APPENDIX –IV

SPECIFICATIONS

"C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur."

Shall be executed as per CPWD specification with their upto date correction slip.

1. The order of preference in case of any discrepancy as indicated in condition No. 8.1 under "Conditions of Contract" given in standard CPWD contract form may be read as the following:
   
i) Particular specifications and special conditions if any.

   ii) Architectural Drawings

   iii) CPWD specifications.

   iv) Indian standard specifications of B.I.S.

   v) Sound Engineering Practice

A reference made to any Indian Standard specification in these documents, shall imply to the latest version of that standard. Including such revision/amendments as issued by the bureau of Indian standard upto last date of receipt of tenders. The contractor shall keep at his own cost all such publications of relevant Indian standard applicable to the work at site.

2. Except for the items, for which particular specifications are given or where it is specifically mentioned otherwise in the description of items in work shall generally be carried out in accordance with the CPWD specification. Wherever CPWD specifications are silent the latest IS codes/specification shall be followed.
INTEGRITY PACT

To,

…………*……………..
…………*……………..
…………*……………..

Sub: NIT No. ______________ for the C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

Dear Sir,

It is hereby declared that IWD, IIT Kanpur 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 Tenderer will sign the integrity Agreement, which is an integral part of tender/tender documents, failing which the tenderer will stand disqualified from the tendering process and the tender of the tenderer 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 Board of Governor, IIT Kanpur.

Yours faithfully

Superintending Engineer
INTEGRITY PACT

To,

Superintending Engineer
IWD, IIT Kanpur

Sub: Submission of Tender for the work of **C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low Side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.**

Dear Sir,

I/We acknowledge that IWD, IIT Kanpur is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/tender 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 TENDER SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE 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 main contract, which will come into existence when tender/tender is finally accepted by IWD, IIT Kanpur. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 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/tender, IWD, IIT Kanpur shall have unqualified, absolute and unfettered right to disqualify the tenderer and reject the tender in accordance with terms and conditions of the tender.

Yours faithfully

(Duly authorized signatory of the Tenderer)
INTEGRITY AGREEMENT

This Integrity Agreement is made at ..........*........ on this ......*..... day of ......* 2020

BETWEEN

Board of Governors, IIT Kanpur represented through Superintending Engineer,
IWD IIT Kanpur,

(Name of Division)

(Hereinafter referred as the 'Principal/Owner', which (Address of
Division)
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 to as the
(Details of duly authorized signatory)

"Tenderer/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. 01/C/D3/2020-
21/01) (hereinafter referred to as "Tender/Bid") and intends to award, under laid
down organizational procedure, contract for C/o Centre for Engineering in
Medicine Building (G+5) including Water supply, Sanitary installation,
Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts,
CCTV/LAN, HVAC (Low Side) and development works and all other
related works to make the building functional on Engineering,
Procurement and Construction (EPC) contract basis at IIT
Kanpur. 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 Tenderer(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/Tender documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the
parties hereby agree as follows 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 Tenderer(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Tenderer(s) the same information and will not provide to any Tenderer(s) confidential / additional information through which the Tenderer(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 Tenderer(s)/Contractor(s)

1) It is required that each Tenderer/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / 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 Tenderer(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 Tenderer(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 Tenderer(s)/Contractor(s) will not enter with other Tenderer(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 tenders or any other actions to restrict competitiveness or to cartelize in the tendering process.
c) The Tenderer(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Tenderer(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 Tenderer(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Tenderer(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 tender in a tender but not both. Further, in cases where an agent participate 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 Tenderer(s)/Contractor(s) will, when presenting his tender, 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 Tenderer(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4) The Tenderer(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a willful 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 Tenderer(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 Tenderer(s)/Contractor(s) and the Tenderer/ Contractor accepts and undertakes to respect and uphold the Principal/Owner’s absolute right:
1) If the Tenderer(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 Tenderer(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Tenderer/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 Tenderer(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 Tenderer/Contractor.

3) **Criminal Liability:** If the Principal/Owner obtains knowledge of conduct of a Tenderer or Contractor, or of an employee or a representative or an associate of a Tenderer 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 Tenderer 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 Tenderer 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 Tenderer/Contractor as deemed fit by the Principal/Owner.

3) If the Tenderer/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 Tenderers/Contractors/Subcontractors

1) The Tenderer(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Tenderer/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Sub-contractors/sub-vendors.

2) The Principal/Owner will enter into Pacts on identical terms as this one with all Tenderers and Contractors.

3) The Principal/Owner will disqualify Tenderers, who do not submit, the duly signed Pact between the Principal/Owner and the tenderer, 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/Vendor 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 tenderers, 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, IWD, IIT Kanpur.

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 intensions.

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 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/Contract 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:

........................................*........................................
(For and on behalf of Principal/Owner)

........................................*........................................
(For and on behalf of Tenderer/Contractor)

WITNESSES:

1. ........................................*........................................
   (signature, name and address)

2. ........................................*........................................
   (signature, name and address)

Place:
Dated:

* To be filled in by the Executive Engineer & tenderer as the case may be
Details of Electrical Contractor

(To be submitted before award of work)

i. Name of Electrical Contractor: M/s …………………………………………

ii. Address:………………………………………………

iii. Class of Licence:………………………………………………

(A Class government approved)

iv. Details of Registration of the Electrical Contractor

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Department</th>
<th>Registered Yes/No</th>
<th>Registration No.</th>
<th>Tendering limits Rs. Lacs</th>
<th>Validity of Registration</th>
<th>Debarred from Tendering Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>3</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: All columns of above Proforma must be filled in.

Contractor’s signature

**CONSENT LETTER**

I hereby give my consent to work as electrical contractor till the completion of work. Also I will be responsible for necessary action to hand over the installation and for rectification of defects and repair during the obligatory maintenance period. I will execute the work as per CPWD Specifications and Additional Conditions of the Contract.

I will also engage suitable Engineer for the work as per condition of the contract. I further certify that the above particulars pertaining to me are correct.

Dated:

Signature of Electrical Contractor
Details of HVAC Contractor

(To be submitted before award of work)

ii. Name of HVAC Contractor: M/s ........................................

ii. Address: .................................................................

v. Class of Registration if any: ...........................................

(Specialised eligible agencies)

vi. Details of Registration of the HVAC Contractor

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Department</th>
<th>Registered Yes/No</th>
<th>Registration No.</th>
<th>Tendering limits Rs. Lacs</th>
<th>Validity of Registration</th>
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<tr>
<td>1</td>
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<td>3</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: All columns of above Proforma must be filled in.

Contractor’s signature

CONSENT LETTER

I hereby give my consent to work as HVAC contractor till the completion of work. Also I will be responsible for necessary action to hand over the installation and for rectification of defects and repair during the obligatory maintenance period. I will execute the work as per CPWD Specifications and Additional Conditions of the Contract.

I will also engage suitable Engineer for the work as per condition of the contract. I further certify that the above particulars pertaining to me are correct.

Dated:

Signature of HVAC Contractor
PART–B

GENERAL CONDITIONS AND MATERIAL AND QUALITY ASSURANCE
Name of Work: “C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.”

1. The tenderer is advised to read and examine the tender documents for the work and the set of drawings available with Engineer-in-charge. He should inspect and examine the site and its surroundings by himself before submitting his tender.

2. Separate conditions & specification and scope are included in this tender. The contractor shall quote the amount/rates lump-sum in figures and words accurately in schedule of financial quote so that there is no discrepancy in figures and words.

3. Time allowed for the execution of work is 15 months.

4. The contractor(s) shall submit a detailed program of execution in accordance with the master programme/milestone within fifteen days from the date of start of the work.

5. Quality of the project is of utmost importance. This shall be adhered to in accordance with the provisions of CPWD specifications and guidelines given in the relevant paras.

6. Temporary Electric connection (Single/ Three phase) shall be provided by the Institute from its distribution network and the charges shall be realized prevalent commercial tariff of the institute presently recovery rate is Rs. 9.19 Per unit on the basis of actual consumption through the separate meter under the control of Engineer-In-Charge. If the rates are revised in future the same shall be applicable to the contractor. The contractor at his own cost shall arranged the cables for the service connection and the sub meter.

7. No labour huts/jhuggies shall be allowed to construct in the campus except for the security persons at work site with proper sanitation arrangements after due approval of Superintending Engineer.

8. The contractor has to appoint qualified safety officer for proper adhering safety requirements during the entire period of contract.

9. In case of any serious accident at work site, the Institute may cause an enquiry/ investigation into the accident and depending on the outcome of such enquiry/ investigation, the Institute may take such action against the contractor as may be deemed fit and appropriate in the discretion of the Director, which may also lead to termination of the contract, and/ or the contractor may be debarred from applying for further works in the campus for a specified period.

10. Cement shall be arranged by the contractor himself.
Steel Reinforcement shall be arranged by the contractor himself.

Contractor has to engage specialized agencies for specialized items of works such as water proofing, aluminium & glazing works, fire doors and fittings, plumbing work, all type of false ceiling, expansion joint system and other specialized items as mentioned in the tender documents. Only those specialized agencies/firms who have satisfactorily executed works as per following criteria during last seven years are eligible for the specialized works-

(a) Three works each costing not less than 40% of estimated cost for concerned sub head.  
Or
(b) Two works each costing not less than 60% of estimated cost for concerned sub head.  
Or
(c) One work costing not less than 80% of estimated cost for concerned sub head.

The value of specialized 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 of specialized work to upto one month of award of this work.

Estimated cost of the specialized item/work for various items/schemes shall be determined by Engineer-in-charge based on market rate. The decision of Engineer-in-charge shall be final and binding on the contractor. The various specialized items of works under this agreement in respect of civil construction are evolved as water proofing treatment, plumbing/sanitary work, Aluminium works etc.

Approval of the specialized agencies for each specialized work shall be obtained from the Engineer-in-Charge within one month of award of work. Even if, such specialized items of work shall be executed by the specialized agencies, the work shall be deemed to be executed by the tenderer for all purposes and the responsibility of the quality of items of works executed etc. shall continue to be that of the tenderer only.

Contractor has to deploy basic minimum required machinery on the project to complete the work in time as stipulated in the tender in annexure -III.

The contractor shall submit the running bills in the shape of the computerised MB in pages of A-4 size as per the standard format of department and shall act as per modified Clause 6 A of CPWD-7

Contractor has to provide reinforcement cover blocks made of approved proprietary pre packed free flowing mortars (Conbextra as manufactured by M/s Fosroc Chemical India Ltd. or approved equivalent) of high early strength.
(FOR CIVIL WORKS)
1. The contractor shall ensure quality control measures on different aspects of construction including materials, workmanship and correct construction methodologies to be adopted. He shall have to submit quality assurance programme within two weeks of the award of work. The quality assurance programme should include method statement for various items of work to be executed along with check lists to enforce quality control.

2. The contractor shall get the source of all other materials, not specified else where in the document, approved from the Engineer-in-Charge. The contractor shall stick to the approved source unless it is absolutely unavoidable. Any change shall be done with the prior approval of the Engineer-in-Charge for which tests etc. shall be done by the contractor at his own cost. Similarly, the contractor shall submit brand/ make of various materials not specified in the agreement, to be used for the approval of the Engineer-in-Charge along with samples and once approved, he shall stick to it.

3. The contractor shall submit shop drawings of staging and shuttering arrangement, aluminum & glazing work, fire doors and fittings, plumbing work and other works as desired by Engineer In Charge for his approval before execution. The contractor shall also submit bar bending schedule for approval of Engineer-in-charge before execution.

4. Frequency and type of tests of various Materials/items/ article shall be conducted as per specifications and relevant BIS-Codes. The test results confirm to the specification/codes.

5. **Test Laboratories :**

A) **Laboratory at site :**

The contractor shall establish a testing lab at site and provide testing equipment and materials for the field tests mentioned in the list of mandatory tests given in CPWD specifications 2009 Vol. 1 & 2. Nothing extra shall be payable to him on this account. In case of delay in establishment of Lab at site, an non refundable recovery of Rs. 1000/- per day shall be made from Running account bill of the contractor for each delayed days.

The representatives of the department shall be at liberty to inspect the testing facilities at site and conduct testing at random in consultation with Engineer in charge. The contractor shall provide all necessary facilities for the purpose. The laboratory shall be equipped, inter alia, with the following equipments:

a) **Balances:**
   i) 7 kg to 10 kg capacity, semi-self indicating type – Accuracy 10 gm.
   ii) 500 gm capacity, semi-self indicating type Accuracy 1 gm.
   iii) Pan Balance- 5 kg Capacity- Accuracy 10 gm.

b) **Ovens-** Electrically operated, thermostatically controlled upto 1100C- Sensitivity 10C.

c) **Sieves:** as per IS: 460
i) IS Sieves – 450 mm internal dia of sizes 100 mm, 80 mm, 63 mm, 50 mm, 40 mm, 25 mm, 20 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75 mm, complete with lid and pan.

ii) IS Sieves – 200 mm internal dia (brass frame) consisting of 2.36 mm, 1.18 mm, 500 microns, 425 microns, 300 microns, 212 microns, 150 microns, 90 microns, 75 microns with lid and pan.

d) Sieve shaker capable of 200 mm and 300 mm dia sieves, manually operated with timing switch assembly.

e) Equipment for slump test- slump cone, steel plate, taping rod, steel scale, scoop.

f) Equipment for concrete testing

i) Concrete cube moulds 15x15x15cm. 18 Nos.

ii) Pruning Rods 2Kg weight length 40cm and ramming face 25mm 2 No.

iii) Extra Bottom plates for 15cm cube mould 6 Nos.

iv) Standard Vibration table for cubes 1 No

v) Dial gauges 25 mm travel- 0.01 mm/division Least count- 1 No.

vi) Automatic compression testing machine of 100 tonne capacity. 1 No.

Not less than 90% tests for material be performed at site lab with above stated equipment’s, however at least 10% testing of materials shall be got done from external laboratories. However, for the tests to be carried out through the Institute structure lab, the contractor shall supply free of charge all the materials required for testing, including transportation.

The cost of the all passed tests conducted through Institute labs shall be borne by the IIT Kanpur and the cost of failed tests should be borne by the contractor. The testing charges for coupler if used shall be borne by the contractor

B) Other Laboratories :

The all such tests which are not available in the Institute lab but required to be carried out from outside Institute laboratories the cost of such tests shall be borne by the contractor i/c all arrangements for conducting such tests.

C) Sampling of Materials :

C1 Sample of building materials fittings and other articles required for execution of work shall be got approved from the Engineer-in-Charge. Articles manufactured by companies of repute and approved by the Engineer-in-Charge shall only be used. Articles bearing BIS certification mark shall be used in case the above are not available, the quality of samples brought by the contractor shall be judged by standards laid down in the relevant BIS specifications. All materials and articles brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge.
which shall be preserved till the completion of the work.

C2 The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-Charge.

C3 BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the Engineer-in-Charge besides testing of other materials as per the specifications described for the item/materials. Wherever BIS marked materials are brought to the site of work, the contractor shall if required, by the Engineer-in-Charge furnish manufacturers test certificate to establish that the material produced by the contractor for incorporation in the work satisfies the provisions of BIS codes relevant to the material and/or the work done.

C4 The contractor shall procure all the materials in advance so that there is sufficient time to testing and approving of the materials and clearance of the same before use in work.

C5 All materials brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use.

C6 The contractor shall be fully responsible for the safe custody of the materials issued to him even if the materials are in double lock and key system.

C7 The Stone aggregate/stone, sand shall be brought from any quarries subjected to the said materials confirm CPWD specifications.

5 The day to day receipt and issue accounts of different grade/brand of cement shall be maintained separately in the standard proforma by the Jr. Engineer/Assistant Engineer - in-Charge of work and which shall be duly signed by the contractor or his authorised representative.

6 The contractor shall render all help and assistance in documenting the total sequence of this project by way of photography, slides, audio-video recording etc. Nothing extra shall be payable to the contractor on this account.

7 The contractor shall be fully responsible for the safe custody of materials brought by him issued to him even though the materials are under double lock key system.

8 Cement register showing the receipt of the PPC shall be maintained at site. The contractor shall construct godown for storage of PPC at site and nothing extra on this account shall be payable.

9 Cement issued shall be for consumption at site only. No cement for factory made items and those not manufactured at site shall be issued.
In case there is any discrepancy in frequency of testing as given in the list of mandatory test and that in the individual sub-head of work as per CPWD specification 2009 Vol. 1 & 2 the higher of the two frequencies of testing shall be adopted.

Maintenance of Registers:

(i) All the registers of tests to be carried out at construction site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-Charge in the same manner as being issued to IWD field staff.

(ii) The test registers to be issued to the contractor are:

a) Materials at site account register such as steel, bricks, AAC blocks, coarse aggregates etc.

b) Cement register.

c) Master test registers.

d) Cube test register.

e) Paint register.

f) Any other test register as required.

(iii) All the entries in the register will be made by the designated engineering staff of the contractor and same should be regularly reviewed by JE/AE/EE.

(iv) Contractor shall be responsible for safe custody of all the test registers.

(v) Submission of copy of all test registers, material at site register along with each alternate running account bill and final bill shall be mandatory. These registers should be duly checked by Engineer-in-Charge.

Ultrasonic Pulse velocity Method of Test for RCC: Ultrasonic pulse velocity method of test for RCC shall be done as routine test for all the concrete beams and columns as per IS 13311 (Part-I): 1992, after 28 days of casting. Concrete quality grading shall be done and concrete having graded as good and excellent shall be accepted. Necessary testing equipment's and facilities shall be provided by the contractor. The record shall be maintained by the contractor and shall be verified by the engineer-in-charge or his authorized representative. This report shall be submitted with each bill. Nothing extra shall be paid for the same.

Third party quality control/assurance: Third party quality control/assurance may be conducted by IIT/NIT/Government Engineering College/Government Institutes or any other Empanelled agency, if directed by Engineer-in-Charge. The contractor has to provide all necessary assistance and has to submit compliance report within targeted time frame.
1. The contractor shall procure 43 grade Portland Pozzolana Cement conforming to IS: 1489 (Part-I) as required in the work, from reputed manufacturers of cement, such as A.C.C., Ultratech, Vikram, Shree cement, Ambuja, Jaypee Cement, Century Cement & J.K. Cement. 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.

Supply of cement shall be made in 50 kg. bags bearing manufacturer’s name and ISI marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of the relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS code the same shall stand rejected and 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.

2. The cement shall be brought at site in bulk supply of approximately 50 tonnes or as decided by the Engineer-in-Charge. The cement godown of the capacity to store a minimum of 2000 bags of cement shall be constructed by the contractor at site of work for which no extra payment shall be made.

3. 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 key 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.

4. 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 test laboratories. The cost of tests shall be borne by the contractor/department in the manner indicated below:

   a) By the contractor, if the results show that the cement does not conform to relevant CPWD Specifications / BIS code or specification mentioned else where in the documents.

   b) By the department, if the results show that the cement conforms to relevant CPWD Specifications / BIS code or specification mentioned else where in the documents.

5. 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 42 of the contract and shall be governed by conditions laid therein. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate show prescribed shall be made. In case of excess consumption no adjustment need to made.

6. The cement brought to site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in-Charge.

7. The damaged cement shall be removed from the site immediately by the contractor on receipt of a notice in writing from the Engineer-in-Charge. If he does not do so within three days of receipt of such notice, the Engineer-in-Charge shall get it removed at the cost of the contractor.

8. Wet curing period shall be enhanced to a minimum of 10 days or its equivalent. In hot & arid regions, the minimum curing period shall be 14 days or its equivalent.

9. Till the time, BIS makes it mandatory to print the % age of fly ash on each bag of cement, the certificate from the PPC manufacturer indicating the same shall be obtained and permission obtained from Engineer-in-Charge before use of such cements in works.

10. The contractor may use OPC in place of PPC only after written permission of Engineer-in-Charge. In such case, no extra payment shall be made in any form to the contractor by the Department.
The contractor shall procure TMT bars of Fe 500D/Fe 550D grade (the grade to be procured is to be specified) from primary steel producers such as SAIL, Tata Steel Ltd, RINL, Jindal Steel & Power Ltd., and JSW Steel Ltd. or any other producer as approved by CPWD who are using iron ore as the basic raw material/input and having crude steel capacity of 2.0 million tonnes per annum and above.

1.1 The TMT bars procured from primary producers shall conform to manufacture's specifications.

1.2 TMT bars procured from primary producers, the specifications shall meet the provisions of IS 1786: 2008 pertaining to Fe 500 D/Fe 550D grade of steel.

2. The contractor shall have to obtain vouchers and furnish test certificates to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work.

3. Samples shall also be taken and got tested by the Engineer-in-charge as per the provisions in this regard in the relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications as defined under para 1.1 and 1.2 above, 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 of written orders from the Engineer-in-charge to do so.

4. The steel reinforcement shall be brought to the site in bulk supply of 50 tonnes or more or as directed by the Engineer-in-charge.

5. The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent distortion & 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.

6. 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 at frequency not less than that specified below:

<table>
<thead>
<tr>
<th>Size of bar</th>
<th>For consignment below 100 tonnes</th>
<th>For consignment over 100 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 10 mm dia bars</td>
<td>One sample for each 25 tonnes or part thereof</td>
<td>One sample for each 40 tonnes or part thereof</td>
</tr>
<tr>
<td>10 mm to 16 mm dia bars</td>
<td>One sample for each 35 tonnes or part thereof</td>
<td>One sample for each 45 tonnes or part thereof</td>
</tr>
<tr>
<td>Over 16 mm dia bars</td>
<td>One sample for each 45 tonnes or part thereof</td>
<td>One sample for each 50 tonnes or part thereof</td>
</tr>
</tbody>
</table>

7. The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of the all passed
tests conducted through the Institute labs shall be borne by the Institute & the cost of failed tests shall be borne by the contractor.

8. The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by the 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 need to be made.

9. The steel brought to the site and the steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.

10. Steel bars brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use. The contractor shall supply free of charge the steel required for testing including its transporation to testing laboratories. The cost of the all passed tests conducted through the Institute labs shall be borne by the Institute & the cost of failed tests shall be borne by the contractor.

11. If the quantity of steel actually used in the work is found to be more than the theoretical quantity of steel including authorised variation, nothing extra shall be payable to the contractor on this account. In the event of it being discovered that after the completion of the work the quantity of steel used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated in clause 42). The cost of quantity of steel so less used shall be recovered from the contractor at rate as specified in schedule ‘F’. Decision of the Engineer-in-Charge in regard to theoretical quantity of steel which should have been actually used and recovery of the rate specified shall be final and binding on the contractor.

12. In case the contractor brings surplus quantity of steel the same after completion of the work will be removed from the site by the contractor at his own cost after approval of the Engineer-in-Charge.

13. Reinforcement including authorised spacer bars and lappages shall be measured in length of different diameters, as actually (not more than as specified in the drawing) used in the work, nearest to a centimeter. Wastage and unauthorised overlaps shall not be measured.

14. The standard sectional weights referred to as in Table 5.4 under para 5.3.4 in CPWD specifications for works 2009 Vol. 1 will be considered for conversion of length of various sizes of MS bars, Tor steel bars and TMT bars into standard weight.

15. Records of actual sectional weight shall also be kept dia-wise & lot-wise. The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The decision of the Engineer-in-Charge
shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute one single lot for the purpose. The weight of steel by conversion of length of various sizes of bars based on the actual weighted average sectional weight shall be termed as derived actual weight.

16. If the derived weight as in para 15 above is lesser than the standard weight as in para 14 above, the derived actual weight shall be taken for payment.

If the derived actual weight is found more than the standard weight then the standard weight as worked out in para 14 above shall be taken for payment. In such case nothing extra shall be paid for the difference between the derived actual weight and the standard weight.

17. Mixing of different type of steel/different grades of steel shall not be allowed in the same structural members as main reinforcement to satisfy clause 26.1 of IS:456.

18. Tolerances on Nominal Mass (individual sample) shall be as under:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Nominal size mm</th>
<th>Tolerances on the Nominal Mass, percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upto and including 10</td>
<td>-8%</td>
</tr>
<tr>
<td>2</td>
<td>Over 10 upto &amp; including 16</td>
<td>-6%</td>
</tr>
<tr>
<td>3</td>
<td>Over 16</td>
<td>-4%</td>
</tr>
</tbody>
</table>
GENERAL TERMS AND CONDITIONS

1 In the case of discrepancy between the specifications and / or the drawings, the following order of preference shall be observed:-

i) Nomenclature of items as per schedule of quantities.
ii) Particular specification and special condition, if any.
iii) Architectural Drawings
iv) CPWD specifications.
v) Indian standard specifications of B.I.S.
vi) Sound Engineering Practice
vii) Decision of Engineer-in-Charge.

A reference made to any Indian Standard specification in these documents, shall imply to the latest version of that standard. Including such revision/amendments as issued by the bureau of Indian standard upto last date of receipt of tenders. The contractor shall keep at his own cost all such publications of relevant Indian standard applicable to the work at site.

2 Except for the items, for which particular specifications are given or where it is specifically mentioned otherwise in the description of items in the schedule of quantities the work shall generally be carried out in accordance with the "CPWD specifications 2009 Vol. 1 and Vol. 2 with upto date corrections slips (hereinafter to be referred to as CPWD specifications) and instructions of Engineer-in-Charge. Wherever CPWD specifications are silent the latest IS codes/specification shall be followed.

3 Existing roads of campus may be used for transport purpose, upto the point where the same is available and allowed with the specific permission of IIT Kanpur authorities in the interest of work. However, restrictions on the existing roads of campus may be imposed by the security personals regarding route available, speed, honking, ply timing etc which shall be strictly observed. Also no claim whatsoever shall be made on this account by the contractor.

4 The proposed building is a prestigious project and quality of work is paramount importance. Contractor shall have to engage well experienced skilled labour and deploy modern T&P and other equipment to execute the work. Many items like, stone flooring, aluminium, glazing, stainless steel, & plumbing work and other specialised works will specially require engagement of skilled workers having experience particularly in execution of such items.

5 a) The contractor (s) shall inspect the site of work before tendering and acquaint himself with the site conditions and no claim on this account shall be entertained by the department.

b) The contractor (s) shall get himself acquainted with nature and extent of the work and satisfy himself about the availability of materials from kiln or
approved quarries for collection and conveyance of materials required for construction.

6. The contractor(s) shall study the soil investigation report for the site, available in the office of the Engineer-in-Charge and satisfy himself about complete characteristics of soil and other parameters of site. However, no claim on the alleged inadequacy or incorrectness of the soil data shall be entertained.

7. The tenderer shall see the approaches to the site. In case any approach from main road is required by the contractor, the same shall be made good, improved and maintained by the contractor at his own cost. No payment shall be made on this account.

8. The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night speed limit boards red flags, red lights and providing barriers. He shall be responsible for all dangers and incidents caused to existing/new work due to negligence on his part. No hindrances shall be caused to traffic during the execution of the work.

9. Contractor shall provide permanent bench marks and other reference points for the proper execution of work and these shall be preserved till the end of work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings.

10. Other agencies doing works related with this project may also simultaneously execute their works and the contractor shall afford necessary facilities for the same. The contractor shall leave such necessary holes, openings etc. for laying/burying in the work, pipes cables, conduits, clamps, boxes and hooks for fan clamps etc. as may be required for the other agencies. Nothing extra over the Agreement rates shall be paid for doing these.

11. Some restrictions may be imposed by the security staff etc. on the working and for movement of labour, materials etc. The contractor shall be bound to follow all such restrictions/instructions and nothing extra shall be payable on account of the same.

12. The contractor shall fully comply with all legal orders and directions of the Public or local authorities or municipality and adhere by their rules and regulations and pay all fees and charges for which he may be liable in this regard. Nothing extra shall be paid/reimbursed for the same.

13. The building work shall be carried out in the manner complying in all respects with the requirements of the relevant bylaws and regulations of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-charge and nothing extra shall be paid on this account.

14. The contractor shall give a performance test of the entire installation(s) as per standing specifications before the work is finally accepted by making his own
arrangements for water supply, electricity etc. and nothing extra whatsoever shall be payable for the same.

15 Huts for labour are not to be erected at the site of work, the contractor shall be required to provide such accommodation at a place as is acceptable to the local body and nothing extra shall be paid on this account.

16 It shall be ensured by the contractor that no electric live wire is left exposed or unattended to avoid any accidents in this regard.

17 The structural and architectural drawings shall at all times be properly co-related before executing any work.

18 The contractor shall maintain in perfect condition, all portions executed till completion of the entire work allotted to him. Where however phased delivery of work is contemplated these provisions shall apply separately to each phase.

19 The entire royalty at the prevalent rates shall have to be paid by the contractor on all the boulders, metals, shingle sand, earth etc. collected by him for execution of the work, directly to the Revenue authority or authorized agents of the State Government concerned or the Central Government, as the case may be.

20 Defects Liability Period (DLP)

20.1 Defects liability period shall be taken as thirty six (36) months from the date of completion of the work for building as a whole, wherein all the defects shall be rectified by the contractor at his own cost.

20.2 Defects of serious nature causing inconvenience such as leakage, reverse floor slopes affecting the drainage (ponding of water), warping and opening of joints in doors and window shutters etc shall be undertaken by the contractor immediately on receipt of the complaint but not exceeding one week time, failing which the defects will be got removed at his risk and cost plus 25% as supervision and establishment charges.

20.3 All other defects notified to the contractor during the DLP shall be rectified to the entire satisfaction of Engineer-in-Charge or item replaced as soon as possible but not later than one month in any case. Failure to do so in a reasonable period the Engineer-in-Charge shall get it done at his cost plus 25% as supervision and establishment charges after final notice of 10 days. The decision of Engineer-in-Charge regarding a defect being of serious nature or otherwise shall be final and binding.

20.4 The scope of the defect liability for the civil items will be as under:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Description</th>
<th>Defect Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Concrete work</td>
<td>(a) Rectification of structural /superficial/non-structural cracks. (b) Rectification of dampness/leakages/seepage in roof slab/junctions &amp; sunken portion, depressed portion, through RCC slab, vertical ties, bands, walls, base slab, junction of RCC walls with base slab and</td>
</tr>
</tbody>
</table>
| (ii) Brick work | (a) Rectification of cracks in confined masonry panel wall/partition wall in full length or in part portion.  
(b) Cracks / settlement of main wall, partition wall or dwarf walls.  
(c) Rectification of efflorescence, dampness. |
| (iii) Woodwork & Joinery | (a) Replacement of warped / bent / weather affected joinery, termite & borer affected joinery of wooden door / window shutters and frames.  
(b) Cracks in panels, bars / rails / styles of wooden door / window shutters etc. |
| (iv) Building Hardware | (a) Repairs / Replacement of loosened / premature failure of fittings including lever mechanics in door locks, hydraulic door closers, handles, tower blots, cupboard locks etc.  
(b) Tightening / Replacement of sag in mosquito proofing SS net. |
| (v) Steel & iron work | a) Rectification / Replacement of defective part of girders, gate, shutter, etc.  
(b) Redoing of defective portion in fabrication / welding including painting thereon.  
(c) Structural steel work and SS railing.  
(d) Windows, grills, gates etc. – Defects to be rectified. |
| (vi) Roof treatment | (a) Rectification of leakage / seepage in roof slab, expansion/ seismic joints, floor junctions, inadequate/ faulty slope, drain outlets, including covering at junction till guarantee period. |
| (vii) Finishing work | (a) Rectification of structural / superficial cracks.  
(b) Rectification of protruding / peeling off plaster.  
(c) Rectification of efflorescence, dampness appeared.  
(d) Undulation / unevenness in plaster.  
(e) Paint & polishing. |
| (viii) Flooring work | (a) Rectification of sunken / deflected / depressed portion of plinth protection flooring in rooms, toilets, entrance foyer, staircase and other locations.  
(b) Rectification / Replacement of settled floors.  
(c) Settlement of foundation & floors and resultant undulation of door finishes.  
(d) Rectification / Replacement of floor tiles which are sunken / uneven / undulating at joints / different in colour, texture, etc. |
| (ix) Aluminium work/structural glazing/ACP/stone cladding | (a) Rectification / Replacement of defective part of Aluminium frame / shutters / false ceiling.  
(b) Any defect (normal ageing effect not included) in the stone cladding and any installation error etc. |

**Note:** The above list is illustrative for civil work and not exhaustive. The rectification will include all Civil and Electromechanical works including internal and external services without any exclusion.
20.5 Release of Security Deposit: 25% security deposit will be released after expiry of 12 months from the date of completion of work on satisfactory performance during defect liability period, next 25% of the security deposit will be released after expiry of 15 months from the date of completion of work on satisfactory performance during defect liability period and remaining 50% of the security deposit will be released after expiry of 36 months from the date of completion of work on satisfactory performance during defect liability period.

20.6 Maintenance during DLP:

20.6.1 Maintenance during DLP: The maintenance including manpower and materials of the assets (Assets created under this agreement) for one year after occupation of the building or after completion of the building, whichever is later, shall be done by the contractor free and no payment shall be made for the same. (The date of occupation of the building shall be informed to the contractor by the Engineer-in-charge in writing for taking up of maintenance by the contractor). Prior to the occupation of the building, the contractor shall be given a list of defects, which have been noticed after completion of the building. The contractor shall rectify these defects so that the building is occupied for use.

20.6.2 The maintenance will aim at an effective and economic means of keeping the building and associated services utilizable for which these were intended to. The ordinary use for which building and associated services are designed is a prime factor in determining the standard of care. The scope of work under maintenance shall include day to day Civil / Electrical maintenance, E&M services, repairs, etc of the buildings and associated services constructed under the contract. The scope shall be inclusive of all the necessary cost of skilled / non skilled labourers, cost of required materials, equipments / Tools & Plants, scaffolding, ladders, trolleys / cycle rickshaws / battery operated rickshaws / shotcreting / guiniting machines, welding sets, electric generators, etc required for maintenance of the Assets created under agreement. However, the above maintenance shall not include “Additions / Alterations/Up-gradation”, day to day operating of the services, providing consumables for operation of various items, “Housekeeping”, any façade item cleaning and “Security”.

20.6.3 Day to Day Maintenance:

20.6.3.1 Day to day maintenance / repairs is to be attended on day to day basis through a service centre. These services shall be provided through a service centre operating round the clock with all the required manpower, materials, T&P, etc for all days including Sundays and Holidays. A suitable space for service centre may be provided to the contractor free of cost in the IIT kanpur campus. The responsibility of running and maintenance of service centre including receiving complaints through emails, phones etc, operating staffs, computers & peripherals, software, internet / broadband connection, etc shall rest with the contractor at his cost. The operation of service centre shall include the following:

(a) Downloading the complaints received online on daily basis.
(b) Recording the complaints received at service centre in person or telephonically.
(c) Assigning the work to the workers of respective trade.
(d) Uploading the status of attending of the complaints on daily basis.
(e) Preparing the abstract of attended / unattended complaints on daily, weekly and monthly basis.
20.6.3.2

a) The contractor shall deploy all the required manpower for day to day maintenance/repairs work. The contractor shall have to arrange licensed wireman for attending day to day complains related to E & M complaint / service. At least 5% of inventory of EI including different types of LED fitting shall always be available in the next five months, and thereafter suitable percentage of spare parts shall be kept as per site requirement and past usage record / experience, at site to avoid delay. No payment shall be made for the spare parts and its usage.

b) The B-check & C-check of DG set of firefighting system shall have to be carried out by the authorized service provider of the DG set supplied, for which no payment shall be made during the maintenance period.

c) Records of servicing / preventive maintenance of all the E & M service during their warranty period shall be kept by the contractor.

d) For the E & M services which are to be maintained comprehensive by the manufactures at a notice least three months before the expiry of warranty period is to given by the contractor to the engineer-in-charge and also to his authorized representative(s).

20.6.3.3 Other Conditions:

(a) The execution of items shall be carried out in accordance to relevant CPWD specifications. For the items which are not covered under CPWD Specifications, the Particular Specifications / B.I.S. Specifications shall have to be followed. The decision of Engineer-in-Charge shall be final in this regard.

(b) The contractor shall make his own arrangement of water required for the work.

(c) The contractor shall make his own arrangements for obtaining electric connection for carrying out any maintenance activity and make necessary payment to the department concerned. In the absence of electric connection or failure of power supply, the contractor shall make his own arrangements of generators.

(d) No residential accommodation shall be provided to any of the staff engaged by the contractor. The contractor shall also not be allowed to erect any temporary set up for his staff in the campus.

(e) No claim of the labourers shall be entertained including that of providing employment, regularization of services etc.

(f) The contractor shall take immediate action to attend any complaint received from occupants. In all cases, he shall attend the complaints in the specified duration as mentioned below:-

i. No delay complaints—Complaints of emergent nature such as electricity/data networking not being available due to construction fault, plumbing or sewerage systems not working due to construction fault, etc shall be attended on emergent basis but in no case delayed beyond 3 hours.

(g) Minor complaints – Complaints relating to the trades of mason, carpenter, air-conditioning due to construction fault, are to be attended within 48 hours.

(h) Major complaints – Complaints other than no delay & minor complaints.

(i) In case of any complaint mentioned under column (i) and (ii) above is registered again with a period of 7 days, it will treated as if the complaint registered earlier was not attended.

(j) In case of failure to meet deadlines to attend a complaint, a lump sum amount of Rs. 200/- (Rupees two hundred only) per complaint per day from the date / time of expiry of attending the respective complaint will be recovered from any sum due to the contractor.
(k) Any malba / building rubbish generated is to be removed from the site within 24 hours and to be stacked at a pre-designated place. The malba / building rubbish so stacked shall be disposed off as soon as one truck load is accumulated (approx 4 cum) from such designated place.

(l) In case the malba / building rubbish is not removed either from the site of original malba generation point or from the designated malba stacking place within a period as specified above, recovery of Rs. 1,000/- per day shall be effected from any sum due to the contractor.

i. This malba / building rubbish has to be disposed off to the dumping ground as approved by the Engineer-in-Charge in consultation with IITK. The rates quoted by the contractor are inclusive of all operations, labour, leads and lifts from site of work to the dumping ground.

ii. Maintenance Engineer/Supervisor shall carry mobile telephone (s) to enable the Engineer-in-Charge / occupants to have easy and quick communication. Nothing extra shall be paid to the contractor on this account and his quoted rates for various items under this contract will be inclusive of this obligation.

(m) The replaced materials used shall have same or richer specifications to the original materials and compatible to the work.

(n) The staff employed by the contractor should be well behaved and any complaint of misbehavior shall be taken very seriously and such staff will have to be removed by the contractor immediately from the site.

(o) The dismantled materials shall be taken away and disposed off by the contractor at his cost. Nothing extra shall be paid / recovered on account of this.

(p) The contractor shall make all safety arrangements required for the labour engaged by him at his cost. All consequences due to negligence on behalf of security / safety or otherwise shall be on the contractor. The department shall not be responsible for any mishap, injury, accident or death of the contractor’s staff. No claim in this regard shall be entertained / accepted by the department.

(q) Contractor shall be fully responsible for any damages caused to government property by him or his labour in carrying out the work and shall be rectified by the contractor at his cost.

(r) Chases, holes, etc shall be done using power operated tools in a workmanship manner.

(s) Each worker shall maintain a complaint diary and get the feedback recorded from the allottee regarding attending the complaint. In case, it is found that the complaint has not been attended satisfactorily, it will be considered as unattended.

21 The contractor shall be required to maintain sufficient quantity of spares at site to meet with the requirement of attending the complaints as per direction of Engineer-in-Charge

22 PROGRAMME CHART

The contractor shall submit a Detailed construction programme (Time and Progress Chart) for execution of work in stipulated period of completion considering each mile stone within 15 days of date of issue of letter of acceptance. The Engineer-in-charge may within 30 days thereafter, if required modify, and communicate the programme approved to the contractor failing which the programme 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, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate programme has been agreed upon) complete the work as per milestones given in Schedule “F”.

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.

The approval by the Engineer-in-charge of such programme shall not relieve the contractor of any of the obligations under the contract.

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.

The program chart should include the following: -

a) Descriptive note explaining sequence of various activities.

b) BAR CHARTS prepared in mutually agreed software or in other format decided by Engineer-in-charge which will indicate resources in financial terms, manpower and specialized equipments for every important stage.

c) Program for procurement of materials by the contractor.

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

e) Program of deployment of machinery / equipments having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor.

f) Programme for achieving milestones.

The submission for approval by the Engineer-in-charge of such programme or such particulars shall not relieve the contractor of any of the 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.

23 The submission for approval by the Engineer-in-Charge of such programme 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.

24 If the work is carried out in more than one shift or during night no claim on this accounts shall be entertained.
25 Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar services encountered in the course of the execution of work shall be protected against the damage by the contractor at his own expense. 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.

26 The contractor shall be responsible for the watch and ward/guard of the buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the department. No extra payment shall be made on this account.

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

28 The contractor shall take instructions from the Engineer-in-charge for stacking of materials. No excavated earth or building materials etc. shall be stacked/collection in areas where other buildings, roads, services, compound walls etc. are to be constructed.

Any trenching and digging for laying sewer lines/water lines/cables etc. shall be commenced by the contractor only when all men, machinery’s and materials have been arranged and closing of the trench(s) thereafter shall be ensured within the least possible time.

29 The contractor shall submit for the approval of Engineer-in-Charge names of specialized agencies of repute along with their technical capacity proposed to be engaged by him, who must have executed satisfactorily works of value as specified in mandatory conditions.

i) The works shall be carried out in accordance with the Architectural drawings and structural drawings. Before commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work and satisfy himself that the information available there of is complete and unambiguous.

The discrepancy, if any shall be brought to the notice of the Engineer-in-Charge before execution of the work. The contractor alone shall be responsible for any loss or damage executing by the commencement of work on the basis of any erroneous and or incomplete information.

ii) The contractor shall take all precautions to avoid accidents by, exhibiting caution boards day and night, speed limit boards, red flags, red light and providing necessary barriers and other measures required from time to time. The contractor shall be responsible for all damages and accidents due to negligence on his part.

iii) Other agencies will also simultaneously execute and install the works of
electrification, air conditioning, lifts, fire-fighting etc. for this work and the contractor shall provide necessary facilities for the same. The contractor shall leave such recesses, holes openings etc. as may be required for the electric, air-conditioning and other related works (for which inserts, sleeves, brackets, conduits base pinion, clamps etc. shall be supplied free of cost by the department unless otherwise specifically mentioned) and the contractor shall fix the same at time of casting of concrete, stone work & brick work, if required and nothing extra shall be payable on this account.

iv) The contractor shall conduct work so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer-in-Charge and shall as far as possible arrange his work and shall place and dispose off the materials being used or removed so as not to interfere with the operations of other contractor or he shall arrange his work with that of the others in an acceptable and coordinated manner and shall perform it in proper sequence to the complete satisfaction of others.

30 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.

31 The works to be undertaken by the contractor shall inter-alia include the following:

(i) Preparation of detailed SHOP drawings and AS BUILT drawings wherever applicable.
(ii) Obtaining of Statutory permissions where-ever applicable and required.
(iii) Pre-commissioning tests as per relevant standard specifications, code of practice, Acts and Rules wherever required.
(iv) Warranty obligation for the equipments and / or fittings/fixtures supplied by the contractor. Contractor shall provide all the shop drawings or layout drawings for all the co-ordinated 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 Engineer-in-Charge before implementation and this shall be binding on the contractor. The contractor shall submit material submittals along with material sample for approval of Engineer-in-Charge prior to delivery of material at site.

32 Samples of all materials and fittings to be used in the work in respect of brand manufacturer and quality shall be got approved from the Engineer-in-Charge, well in advance of actual execution and shall be preserved till the completion of the work. Articles bearing BIS certifications mark shall only be used unless no manufacturer has got BIS mark for the particular material. Any material/fitting whose sample has not been approved in advance and any other unapproved material brought by the contractor shall be immediately removed as soon as
33 PREVENTION OF NUISANCE AND POLLUTION CONTROL

a) 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 Engineer-in-Charge, 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 Engineer-in-Charge.

b) The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes or are carrying construction material like cement, sand and other allied materials are fully covered.

c) The contractor shall ensure that the construction materials including transportation of earth are covered by tarpaulin.

34 Security and Traffic Arrangements

a) In the event of any restrictions being imposed by the Institute authorities/ 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.

b) No payment shall be made for any damages caused by rain, snowfall, flood, earthquake 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.

c) The contractor shall construct suitable godowns, yard at the site of work for storing all 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.

d) 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 local body 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 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 Department 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.

e) For works below ground level the contractor shall keep that area free from water. If dewatering or bailing out of water is required the contractor shall do the same at his own cost and nothing extra shall be paid.

f) 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.

g) 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.

h) 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.

35 Setting out

a. 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.

b. 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.

c. 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.

d. The approval by the Engineer-in-Charge, 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.

e. 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.

f. The rates quoted by the Contractor are deemed to be inclusive of site clearance, setting out work (including marking of reference points, center lines of buildings), construction and maintenance of reference bench mark(s), taking spot levels, construction of all safety and protection devices, barriers, 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.

36 The contractor 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 Department 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.

37 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.

38 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.

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 Department/authority/persons concerned, by the Contractor at his own cost.

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 whatsoever 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 the Department (IWD) 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 Engineer-in-Charge shall not be made intermediary or arbitrator.

42 The work should be planned in a systematic manner so as to ensure proper coordination of various disciplines viz. sanitary & water supply, drainage, rain water harvesting, electrical, fire fighting & fire alarm system, information technology, communication & electronics and any other services.

43 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.

44 He shall protect and indemnify the Department 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.

45 The Contractor shall assume all liability, financial or otherwise in connection with this contract and shall protect and indemnify the Department from any and all damages and claims that may arise on any account. The Contractor shall indemnify the Department 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 Department in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

46 Supervision of work

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 Kanpur 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 Engineer-in-Charge 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.

47 Cleanliness of site

a. 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 Engineer-in-Charge, 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.

b. The contractor shall take instructions from the Engineer-In-Charge 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.

c. 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.

48 Inspection of work

Institute authorities, MHRD, HEFA, Local authorities and other Govt. authorities 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.

a. 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.
b. Entrance and area surrounding to be kept cleaned.

c. Display layout plan key plan, Building drawings including plans, elevations and sections.

d. Upto date displays of Bar chart, CPM and PERT etc.

e. Keep details of quantities executed, balance quantities, deviations, possible Extra item, substituted Item etc.

f. Keep plastic / cloth mounted one sets of building drawings.

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

49 Insurance Policy

(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 Engineer-in-Charge proper Contractor All Risk Insurance Policy for amount 1.25 times the contract amount for this work, with Engineer-in-Charge as the first beneficiary.** The insurance shall be obtained in joint names of Engineer-in-Charge and the Contractor (who shall be second beneficiary). Also, he shall indemnify the Department from any liability during the execution of the work.

(ii) The Contractor shall, from time to time, provide documentary evidence as regards payment of premium for Insurance Policy for keeping them valid till the completion of the work. Without prejudice to any of its obligations and responsibilities specified above, the Contractor shall within 15 days from the date of letter of acceptance of the tender and thereafter at the end of each quarter submit a report to the Department giving details of the Insurance Policy along with Certificate of this insurance policy being valid, alongwith documentary evidences as required by the Engineer-in-Charge. No work shall be commenced by the Contractor unless he obtains the Insurance Policy as mentioned above. Also, no payment shall be made to the Contractor on expiry of insurance policy 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 this accounts.

50 On completion of work, the contractor shall submit at his own cost four prints of “as built” drawings to the Engineer-in-Charge within 30 days of completion of work. These drawings shall have the following information:

a. Route of all piping and their diameters including soil waste pipes & vertical stacks.

b. Ground and invert levels of all drainage pipes together with locations of
all manholes and connections upto outfall.

c. Route of all water supply lines with diameters, location of control valves, access panels etc.

51 Condition regarding secured advance :-
Secured advance shall be admissible only on those bonafide materials which are likely to be used in the work in a period not exceeding six months from the date of secured advance payment. If agency fails to use the material (in respect of which secured advance have been paid) in the work in this specified period of six month, the said component of secured advance shall be recovered from next running account bill paid to the agency.

52 Personal Safety Measures for Labour
Contractor shall provide the following items for safety of workers employed by contractor and associate agencies:

(i) Protective footwear / helmet and gloves to all workers employed for the work on mixing, cement, lime mortars, concrete etc. and openings in water pipeline/sewer line.

(ii) Welder’s protective eye-shields to workers who are engaged in welding works.

(iii) Safety helmet and Safety harness/ belt Provide adequate sanitation/safety facilities for construction workers to ensure the health and safety of the workers during construction, with effective provisions for the basic facilities such as sanitation, drinking water and safety equipments or machinery.

(iv) All the workers should be wearing helmet and shoes all the time on site.

(v) Masks and gloves should be worn whenever and wherever required.

(vi) Adequate drinking water facility should be provided at site, adequate number of decentralized latrines and urinals to be provided for construction workers.

(vii) Full time workers (if any with the approval of Engineer-in-Charge) residing on site should be provided with clean and adequate temporary hutment.

(viii) First aid facility should also be provided.
Overhead lifting of heavy materials should be avoided. Barrow wheel and hand-lift boxes should be used to transport materials onsite.

Tobacco and cigarette smoking should be prohibited onsite.

All dangerous parts of machinery are well guarded and all precautions for working on machinery are taken.

Maintain hoists and lifts, lifting machines, chains, ropes and other lifting tackles in good condition. Provide safety net of adequate strength to arrest falling material down below.

Use of durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.

Ensure that walking surfaces or boards at height are of sound construction and are provided with safety rails and belts. Provide protective equipments such as helmets.

Provide measure to prevent fire. Fire extinguisher and buckets of sand to be provided in fireprone area and elsewhere.

Provide sufficient and suitable light for working during night.

Ensure that measures to protect workers from materials of construction, transportation, storage and other dangers and health hazards are taken.

Ensure that the construction firm/division/company have sound safety policies.

Comply with the safety procedure, norms and guidelines (as applicable) as outlined in NBC 2005 (BIS 2005c). All workers shall be provided regular safety training by the designated safety officer of the contractor before allowing them to work at site.

Adopt additional best practices and prescribed norms as in NBC 2005 (BIS2005).

53 Water Pollution
i. The Contractor shall take all precautionary measures to prevent the wastewater during construction to accumulate anywhere.

ii. The wastewater arising from the project is to be disposed off in the manner that is acceptable to the Engineer –in-charge.

54 Air and Noise Pollution

Contractor shall use dust screens and sprinkle water around the construction site to arrest spreading of dust in the air and surrounding areas.

1. Contractor shall ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that emission levels comply with environmental emission standards/norms.

2. For controlling the noise from Vehicles, Plants and Equipments, the Contractor shall confirm the following:

   (i) All vehicles and equipment used in construction will be fitted with exhaust silencers.
   (ii) Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.

3. Noise emission from compactors (rollers) front loaders, concrete mixers, cranes (movable), vibrators and saws should be less than 75 dB(A).

4. As per the standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) sets, noise emission in dB(A) from DG Set (15-500 KVA) should be less than 94+10 log 10 (KVA). The standards also suggest construction of acoustic enclosure around the DG Set and provision of proper exhaust muffler with insertion loss of minimum 25 dB(A) as mandatory.

5. Construction Vehicles, Equipment and Machinery

   a. All vehicles, equipment and machinery to be procured for construction shall conform to the relevant Bureau of India Standard (BIS) norms.
b. Emission from the vehicles must conform to environmental norms.

c. Dust produced from the vehicular movement and other site activities is to be mitigated by sprinkling of water.

d. Noise limits for construction equipments shall not exceed 75 dB(A), measured at one meter from the edge of the equipment in free area, as specified in the Environment Protection Act, 1986, schedule VI part E, as amended on 9th May, 1993. The maximum noise levels near the construction site should be limited to 65 dB (A) Leq (5 min) in project area.

55. Construction Wastes Disposal

(i) The pre-identified dump locations will be a part of solid waste management plan to be prepared by the Contractor in consultation with Engineer-in-charge.

(ii) Contractor shall get approved the location of disposal site prior to commencement of the excavation on any section of the project location.

(iii) Contractor shall ensure that any spoils of material / construction waste will not be disposed off in any municipality solid waste collection bins.

(iv) No construction waste shall be allowed to be thrown directly on the ground from the higher floors of the building. The required number of chutes shall have to be provided by the contractor for the disposal of construction waste. Nothing extra shall be paid on this account.

56. Procurement of Construction Materials

(i) All vehicles delivering construction materials to the site shall be covered to avoid spillage of materials and maintain cleanliness of the roads.

(ii) Wheel Tyres of all vehicles used by the contractor, or any of his sub contractor or materials suppliers shall be cleaned and washed clear of all dust/mud before leaving the project premises. This shall be done by routing the vehicles through tyre washing tracks.
Contractor shall arrange for regular water sprinkling at least twice a day (i.e. morning and evening) for dust suppression of the construction sites and unpaved roads used by his construction vehicles.

a. Identify roads on-site that would be used for vehicular traffic. Update vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral type that make up the surface base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10 -20%. Limit vehicular speed on site 10km/h. Nothing extra will be payable for this.

b. All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust/particulate emissions.

c. Ensure that water spraying is carried out by wetting the surface by spraying water on:

(i) Any dusty material.
(ii) Areas where demolition work is carried out.
(iii) Any unpaved main-haul road and.
(iv) Areas where excavation or earth moving activities are to be carried out.

d. The contractor shall ensure the following:

(i) Cover and enclose the site by Providing, erecting & maintaining 5.00 metre high temporary barricading with MS tubular members of appropriate sizes out of which brand new profile sheet of 3.00 metre height & rest 2.00 metre height covered with green garden cloth which also covered entire height of profile sheet as approved by Engineer-in-charge on the construction site. After completion of work, the contractor will take away all the barricading materials
(ii) Covering stockpiles of dusty material with impervious sheeting.
(iii) Covering dusty load on vehicles by impervious sheeting before they leave the site.
(iv) Transferring, handling/storing dry loose materials like bulk cement and dry pulverized fly ash inside a totally enclosed system.

(v) Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled material does not become a source of fugitive dust and also to prevent seepage of pollutant laden water into the ground aquifers. When cleaning up
the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas. Clear vegetation only from areas where work will start right away.

e. Adopt measures to prevent air pollution in the vicinity of the site due to construction activities. There is no standard reference for this. The best practices should be followed (as adopted from international best practice documents and codes).

f. The contractor shall provide experienced personnel with suitable training to ensure that these methods are implemented. Prior to the commencement of any work, the method of working, plant equipment and air pollution control system to be used on-site should be made available for the inspection and approval of the Engineer–in-Charge to ensure that these are suitable for the project.

g. Employ measures to segregate the waste on-site into inert, chemical or hazardous wastes. Recycle the unused chemical/hazardous wastes such as oil, paint, batteries and asbestos. The inert waste is to be disposed off to Municipal Corporation/local bodies dump yard and landfill sites.

h. To preserve the existing landscape and protect it from degradation during the process of construction. Select proper timing for construction activity to minimize the disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater. The construction management plan including soil erosion control management plan shall be prepared accordingly for each month. The application of erosion control measures includes construction of gravel pits and tyre washing bays of approved size and specification for all vehicular site entry/exits, protection of slopes greater than 10%. Sedimentation Collection System and run-off diversion systems shall be in place before the commencement of construction activity. Preserve and protect the existing vegetation by not-disturbing or damaging to specified site areas during construction.

i. The Contractor should follow the construction plan as proposed by the Engineer-in-charge / landscape consultant to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site.
j. Spill prevention and control plans should clearly state measures to stop the source of the spill. Measures to contain the spill and measures to dispose the contaminated material and hazardous wastes. It should also state the designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners and petroleum products.

k. The contractor shall prepare and submit ‘Spill prevention and control plans’ before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

l. The contractor shall ensure that no construction leaches (Ex: cement slurry) is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant –laden water directly to the treatment device or facility (municipal sewer line).

m. All lighting installed by the contractor around the site and the godowns, offices shall be of LED lights of the appropriate illumination levels. This condition is a must, unless specifically prescribed otherwise.

57. No extra payment will be made for operation/activity mentioned at Sl. No. 1 to 1.20 above unless specifically mentioned otherwise

58. NATIONAL GREEN TRIBUNAL BUILDING
   (i) The contractor shall not store/dump construction material or debris on metalled road.
   (ii) The contractor shall get prior approval from Engineer-in-charge for the area where the construction material or debris can be stored beyond the material road. This area shall not cause any obstruction to the free flow of traffic/ inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage.
   (iii) The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purpose/or are carrying construction material like
cement, sand and other allied material are fully covered. The contractor shall take every necessary precautions that the vehicles are properly cleaned and dust free to ensure that enroute their destination, the dust, sand or any other particles are not released in air/contaminate air.

(iv) The contractor shall provide mask to every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.

(v) The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission.

(vi) The contractor shall ensure that C&D waste is transported to the C&D Waste site only and due record shall be maintained by the contractor.

(vii) The contractor shall compulsory use of wet jet in grinding and stone cutting.

(viii) The contractor shall comply all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010.

(ix) The contractor shall carry out on-Road-Inspection for black smoke generating machinery.

(x) The contractor shall use cleaner fuel.

(xi) The contractor shall ensure that all DG sets comply emission norms notified by MoEF.

(xii) The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a larger extent by reducing the speed of a vehicle to 20 kmph. Speed bumps shall be used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive, the contractor shall divert traffic to nearby paved areas.

(xiii) The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.

(xiv) The paving of the path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects.

(xv) The natural drainage system should be maintained by the contractor at his own cost. Local Bye-law/ provisions on Rain Water Harvesting should be followed.

(xvi) No extra payment shall be made for operation/activity mentioned at Sl No. 33 i to xvi above.
59 **Project Monitoring**

(i) The Agency shall prepare the phase wise (monthly) resource chart (materials, manpower and machinery) based on the project execution schedule as per clause 5.1 of GCC.

(ii) The Agency shall submit the photographs & videos of progress of work on fortnightly basis to make it possible to create a short film of the entire execution of the work to be kept in archive.

(iii) Agency shall submit a detailed Monthly progress & program report to the Engineer-in-charge by 5th of every month. The format of monthly progress & program report shall be as approved by Engineer-in-Charge.

(iv) The Agency will make it possible to be represented by a senior level executive who have sufficient financial powers to take decisions required for completing the project in time.

(v) The agency shall stick to the construction schedule, if there is any hindrance or delay due to any reason the same shall be mitigated through engaging extra manpower, material and machinery.

60. **Documentation of Work:** Agency shall make documentation in regard to the various stages of progress of work. Nothing shall be paid on this account to the contractor. The scope includes:

(i) Colour photography of the work at every three month interval or lesser interval as per direction of Engineer-in-charge and at the completion of work covering the entire work up to that stage and supplying the same in soft copy with storage instrument of required capacity as per direction of Engineer-in-Charge.

(ii) Videography of the execution of work every six months or lesser interval and at completion of work i/c preparation of documentary with voice over showing the progress of work as directed by Engineer-in-Charge.

(iii) Each photograph/video shall be suitably captioned and dated.

(iv) The photographs/video and materials including soft copy shall form a part of the records of IWD and the prints cannot be supplied to anybody else or published without the written permission of Engineer-in-Charge.

All documents i/c photograph/video and other documents in hard copy shall be submitted by the agency to the Engineer-in-charge on quarterly basis for record purpose.
PART-B1
(General Conditions for work)

scope of Work

The work shall be executed in accordance with the layout plan, architectural, structural drawings and services drawings on EPC Turnkey basis to completion and handing over in fit condition ready for occupation.

The land is free from encroachment and there is no hindrance to execute the work. The agency shall fix a permanent bench mark at the site of work. Plinth level shall be fixed above the General finished ground level as per drawings and decided by Engineer-in-charge. The data provided in this document are for general guidelines. Changes, if any, would not affect the agreed rates and no claim on this account shall be entertained.

To carry out survey of the site for execution of the project and shall verify the site dimensions as per the site plan provided with bid document.

Providing, erecting & maintaining 5.00 metre high temporary barricading with MS tubular members of appropriate sizes out of which brand new profile sheet of 3.00 metre height & rest 2.00 metre height covered with green garden cloth which also covered entire height of profile sheet as approved by Engineer-in-charge on the construction site. After completion of work, the contractor will take away all the barricading material. There should be only one temporary gate in the temporary barricading erected for the site.

Planning, designing wherever required and execution of all internal services like internal sanitary, water supply, drainage system etc. complete for the buildings planned including all its fittings, fixtures, testing etc. complete is in scope. Execution of all external services like water supply, sewerage, drainage system, roads, paths and all connected sub-structures and superstructures within the premises, as per bye-laws and norms of the local bodies including making connections with the peripheral services after getting the services approved from Engineer-in-charge are the part of the scope.

The scope also includes Planning, designing wherever required and construction/installation of underground reservoirs, pump houses for water supply, for firefighting tank including installing of pumps, standby pumps as per approved drawings/specifications or as directed by Engineer-in-charge.

Complete leveling/dressing including filling of earth, its supply, disposal of surplus earth is to be completed as directed by the Engineer-in-charge.

Taking all precautionary measures to safeguard safety measures against any accidents for the agency’s employees, labour, public, and staff of IWD by providing all necessary safety equipment, helmets etc. at work site.
Defects liability period shall be 36 months from the date of recording of completion certificate by the competent authority.

The Agency shall construct/provide one site office (semi-permanent structure) with modern outlook and having Air Conditioning, for use by Engineer-in-charge and his staff consisting of 1 room with toilet (not less than 40 sqm). The location and plan shall be got approved from Engineer-in-Charge. Specification for the site office shall be suitable and matching for running an office which shall be got approved from Engineer-in-charge. The Agency shall provide a typical plan of site office (having light fixtures, wiring & AC etc.) with specification within 15 days of award of work and shall construct after approval of Engineer-in-Charge. All running cost & charges (i/c one office attendant, one data entry operator and AMC etc.) for office including Electricity bill, water supply bills, RO/drinking water bills etc. shall be provided and cost shall be borned by the agency.

The agency shall provide the following furniture (new) for use of IWD staff at site office and will take them away these items after completion of work.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Articles</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>1.</td>
<td>Office Tables</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>2.</td>
<td>Office Chairs</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3.</td>
<td>Steel Almirah (Big)</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>4.</td>
<td>Visitor chairs</td>
<td>6 Nos.</td>
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</tbody>
</table>

The scope as described above is only indicative and not exhaustive. In additions to the above the agency shall be responsible for executing all the items required for completing the building in all respect to make the building fully functional and ready for occupation with electrical, air-conditioning works complete as per direction of Engineer-in-charge.

The above scope of work includes cost of all materials, manpower, equipment’s, T&P fixtures, accessories, royalties, all taxes (excluding GST) watch & ward till handing over the complete premises to the department and all other essential elements for completion Any change, modification, revision etc. required to be done by IWD, CFO, local bodies, proof consultants etc. in accordance with applicable standards and byelaws will have to be done at agency’s cost and nothing extra shall be payable.

**External Bulk Services** with detailed planning and execution upto completion for

1. Water supply, 2. Sewerage system, 3. Storm water drains, 4. Roads, 5. Paths, differently able person friendly corridors/ramps, as per area norms are in the scope of work.

Detailed planning and execution to complete for Internal Electrification, Fire Alarm System, Fire-fighting system, CCTV/LAN, Point wiring, Lifts, HVAC (Low Side) with all equipment’s and external lighting, and any other external and internal essential services as per requirement of the Engineer-in-charge and also required for
satisfactory completion of project etc. are within the scope of work.

**Local Body Approvals**

The status of local body approvals is as under: - Obtaining local body approvals form different sub-bodies is the responsibility of the master consultant who has been already appointed by the Client. The master consultant/Architect shall obtain approvals relating to building drawings.

Approvals/NOC/permissions etc if any other than mentioned above shall be obtained by the contractor at his own level.

<table>
<thead>
<tr>
<th>No.</th>
<th>Details</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Department of Fire services (DFS)</td>
<td>Case is being submitted to DFS. Contractor has to pursue and obtain provisional and final approval from the fire department.</td>
</tr>
<tr>
<td>2</td>
<td>Charges / fee to be payable to the authority / local body</td>
<td>Shall be paid by the Department</td>
</tr>
</tbody>
</table>
CONSTRUCTION PHASE AND WORKER FACILITIES

1.2.1 The contractor shall specify and limit construction activity in pre-planned and pre-designated areas and shall start construction work after securing the approval for the same from the Engineer-in-Charge. This shall include areas of construction, storage of materials, and material and personnel movement.

1.2.2 Preserve and Protect Landscape during Construction

a) The contractor shall ensure that no trees, existing or otherwise, shall be harmed and damage to roots should be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the tree, or, from a safe distance from the tree/plant by means of barricading. Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material. Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree is not to be permitted.

b) The contractor shall take steps to protect trees or saplings identified for preservation within the construction site using tree guards of approved specification.

c) Contractor should limit all construction activity within the specified area as per the Construction Management Plan (CMP) approved by Engineer-in-Charge.

d) The contractor shall avoid cut and fill in the root zones, through delineating and fencing the drip line (the spread limit of a canopy projected on the ground) of all the trees or group of trees. Separate the zones of movement of heavy equipment, parking, or excessive foot traffic from the fenced plant protection zones.

e) The contractor shall ensure that maintenance activities during construction period shall be performed as needed to ensure that the vegetation remains healthy.

1.2.3 Contractor shall be required to develop and implement a waste management plan, quantifying material diversion goals. He shall establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. A project-wide policy of "Nothing leaves the Site" should be followed, in such a case when strictly followed, care would automatically be taken in ordering and timing of materials such that excess doesn't become “waste”. The Contractor’s ingenuity is especially called towards meeting this prerequisite/ credit (as per GRIHA). Designate a specific area(s) on the construction site for segregated or comingled collection of recyclable material, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. The diversion may include donation of materials to charitable organizations and salvage of materials on-site.

1.2.4 Contractor shall collect all construction waste generated on site and segregate these wastes based on their utility and examine means of sending such waste to manufacturing units which use them as raw material or other site which require it for specific purpose. Typical construction debris could be broken bricks, steel bars, broken tiles, spilled concrete and mortar etc.

1.2.5 The contractor shall provide potable water for all workers

1.2.6 The contractor shall provide the minimum level of sanitation and safety facilities for the workers at site. The contractor shall ensure cleanliness of workplace with regard to the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard. Adequate toilet facilities shall be provided for the workman within easy access of their place of work. The total number to be provided shall not be less than 1 per 30 employees in any one shift. Toilet facilities shall be provided from the start of building
operations, connection to a sewer shall be made as soon as practicable. Every toilet shall be so constructed that the occupant is sheltered from view and protected from the weather and falling objects. Toilet facilities shall be maintained in a sanitary condition. A sufficient quantity of disinfectant shall be provided. Natural or artificial illumination shall be provided.

1.2.7 The contractor shall ensure that air pollution due to dust/generators is kept to a minimum, preventing any adverse effects on the workers and other people in and around the site. The contractor shall ensure proper screening, covering stockpiles, covering brick and loads of dusty materials, wheel-washing facility, gravel pit, and water spraying. Contractor shall ensure the following activities to prevent air pollution during construction:

(a) Clear vegetation only from areas where work will start right away
(b) Vegetate / mulch areas where vehicles do not ply.
(c) Apply gravel / landscaping rock to the areas where mulching / paving is impractical.
(d) Identify roads on-site that would be used for vehicular traffic. Upgrade vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral types that make up the surface & base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10 – 20%.
(e) Water spray, through a simple hose for small projects, to keep dust under control. Fine mists should be used to control fine particulate. However, this should be done with care so as not to waste water. Heavy watering can also create mud, which when tracked onto paved public roadways, must be promptly removed. Also, there must be an adequate supply of clean water nearby to ensure that spray nozzles don’t get plugged.

(f) Water spraying shall be done on:
   i. Any dusty materials before transferring, loading and unloading.
   ii. Area where demolition work is being carried out.
   iii. Any un-paved main haul road.
   iv. Areas where excavation or earth moving activities are to be carried out.

(g) The contractor shall ensure that the speed of vehicles within the IIT campus is limited to 15 km/hr.

(h) All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.

(i) Spills of dirt or dusty materials will be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / cleaned up immediately before they can infiltrate into the soil / ground or runoff in nearby areas.

(j) Cover stockpiles of dusty material with impervious sheeting.
(k) Cover dusty load on vehicles by impervious sheeting before they leave the site.

1.2.8 Contractor shall be required to provide an easily accessible area that serves the entire building and is dedicated to the separation, collection and storage of materials for recycling including (at a minimum) paper, corrugated cardboard, glass, plastics, and metals. He shall coordinate the size and functionality of the recycling areas with the anticipated collections services for glass, plastic, office paper, newspaper, cardboard, and organic wastes to maximize the effectiveness of the dedicated areas. Consider employing cardboard balers, aluminium can crushers, recycling chutes, and collection bins at individual workstations to further enhance the recycling program.

1.2.9 The contractor shall ensure that no construction leachate (e.g. cement slurry etc.), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The
contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line).

1.2.10 Staging (dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time) should be done to separate undisturbed land from land disturbed by construction activity and material storage.

1.2.11 A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to causalities. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.

1.2.12 The contractor shall ensure the safety measures as listed in the General Conditions of Contract (GCC) for construction workers are followed. Some additional measures and few repetitions from “GCC” are listed below:

(a) Guarding all parts of dangerous machinery.
(b) Precautionary signs for working on machinery
(c) Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in good condition.
(d) Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
(e) Ensuring that walking surfaces or boards at height are of sound construction and are provided with safety rails or belts.
(f) Provide protective equipment; helmets etc.
(g) Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.
(h) Provide sufficient and suitable light for working during night time.

1.2.13 The storage of material shall be as per standard good practices as specified in Storage, Stacking and Handling practices, NBC 2016 and shall be to the satisfaction of the Engineer in Charge to ensure minimum wastage and to prevent any misuse, damage, inconvenience or accident. Watch and ward of the Contractor’s materials shall be his own responsibility. There should be a proper planning of the layout for stacking and storage of different materials, components and equipments with proper access and proper maneuverability of the vehicles carrying the materials. While planning the layout, the requirements of various materials, components and equipments at different stages of construction shall be considered.

1.2.14 The contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labelled in both Hindi and English with suitable symbols.

1.2.15 The contractor shall prepare and submit ‘Spill prevention and control plans’ before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

Contractor shall collect & submit the relevant material certificates for materials with high recycled (both post-industrial and post-consumer) content, including materials like RMC mix with fly-ash, glass with recycled content, calcium silicate boards etc.

1.2.16 Contractor shall collect the relevant material certificates for rapidly renewable materials such
as bamboo, wool, cotton insulation, agri-fiber, linoleum, wheat board, strawboard and cork etc.

1.2.17 Contractor shall adopt an IAQ (Indoor Air Quality) management plan to protect the HVAC system during construction, control pollutant sources, and interrupt pathways for contamination. He shall sequence installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile, and gypsum wallboard. He shall also protect stored on-site or installed absorptive materials from moisture damage.

1.2.18 The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise an opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, polishes, etc. Wherever required, Contractor shall meet and carry out documentation of all activities on site, supplementation of information, and submittals in accordance with GRIHA program standards and guidelines.

a. The Contractor shall remove from site all rubbish and debris generated by the Works and keep Works clean and tidy throughout the Contract Period. All the serviceable and non-serviceable (malba) material shall be segregated and stored separately. The malba obtained during construction shall be collected in well formed heaps at properly selected places, keeping in a view safe condition for workmen in the area. Materials which are likely to cause dust nuisance or undue environmental pollution in any other way, shall be removed from the site at the earliest and till then they shall be suitable covered. Glass & steel should be dumped or buried separately to prevent injury. The work of removal of debris should be carried out during day. In case of poor visibility artificial light may be provided.

b. The contractor shall provide O & M Manuals wherever applicable.

c. The contractor shall make himself conversant with the Site Waste Management Program Manual and actively contribute to its compilation by estimating the nature and volume of waste generated by the process/installation in question.

d. MATERIALS & FIXTURES FOR THE PROJECT

i. Contractor will produce wherever feasible certificate regarding distance of the source of the relevant material.

ii. The contractor shall ensure that all paints, polishes, adhesives and sealants used both internally and externally, on any surface, shall be Low VOC products. The contractor shall get prior approval from the Engineer-in-Charge before the application of any such material.

iii. The contractor shall ensure that all composite wood products/agro-fibre products used for cabinet work, etc do not contain any added urea formaldehyde resin.

1.2.19 CONSTRUCTION WASTE

a) All construction debris generated during construction shall be carefully segregated and stored in a demarcated waste yard. Clear, identifiable areas shall be provided for each waste type. Employ measures to segregate the waste on site into inert, chemical, or hazardous wastes.

b) All construction debris shall be used for road preparation, back filling, etc, as per the instructions of the Engineer in Charge, with necessary activities of sorting, crushing, etc.

c) No construction debris shall be taken away from the site, without the prior approval of the Engineer-in-Charge.

d) The contractor shall recycle the unused chemical/hazardous wastes such as oil, paint, batteries, and asbestos.

e) If and when construction debris is taken out of the site, after prior permissions from the Engineer-in-Charge, then the contractor shall ensure the safe disposal of all wastes and will only dispose of any such construction waste in approved dumping sites.

1.2.20 Documentation:
a) The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer-in-Charge on a monthly basis:

i) Water consumption in litres

ii) Electricity consumption in ‘kwh’ units

iii) Diesel consumption in litres

iv) Quantum of waste (volumetric/weight basis) generated at site and the segregated waste types divided into inert, chemical and hazardous wastes.

v) Digital photo documentation to demonstrate compliance of safety guidelines as specified here and in the Appendix on Safety Conditions.

b) The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer in Charge on a fortnightly basis:

i) Quantities of material brought into the site, including the material issued to the contractor by the Engineer-in-charge.

ii) Quantities of construction debris (if at all) taken out of the site

iii) Digital photographs of the works at site, the workers facilities, the waste and other material storage yards, pre-fabrication and block making works, etc as guided by the Engineer-in-Charge.

c) The contractor shall submit a document after construction of the buildings, a brief description along with photographic records to show that other areas have not been disturbed during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction.

d) The contractor shall submit to the Engineer-in-Charge after construction of the buildings, a detailed as built quantification of the following:

i. Total materials used,

ii. Total earth excavated

iii. Total waste generated,

iv. Total waste reused,

v. Total water used,

vi. Total electricity, and

vii. Total diesel consumed.

e) The contractor shall submit to the Engineer-in-Charge, before the start of construction, a site plan along with a narrative to demarcate areas on site from which soil has to be gathered, designate area where it will be stored, measures adopted for soil preservation and indicate areas where it will be reapplied after construction is complete.

f) The contractor shall submit to the Engineer-in-Charge, a detailed narrative on provision for safe drinking water and sanitation facility for construction workers and site personnel.

g) Provide supporting document from the manufacturer of the cement specifying the fly-ash content in PPC used in reinforced concrete.

h) Provide supporting document from the manufacturer of the cement specifying the fly-ash content in PPC used in cement procured for works other than RCC.

i) Provide supporting document from the manufacturer of the pre-cast building blocks specifying the fly ash content of the blocks used in an infill wall system.
j) The contractor shall, at the end of construction of the buildings, submit to the Engineer-in-Charge, submit following information, for all material brought to site for construction purposes, including manufacturer's certifications, verifying information, and test data, where Specifications sections require data relating to environmental issues including but not limited to:

k) Indoor Air quality and Environmental Issues: Submit emission test data, sourced from the manufacturers, produced by acceptable testing laboratory listed in Quality Assurance Article for materials as required in each specific Specification section.

i. Certifications from manufacturers of Low VOC paints, adhesives, sealant and polishes used at this particular project site.

ii. Certification from manufacturers of composite wood products/agro fibre products on the absence of added urea formaldehyde resin in the products supplied to them to this particular site.

iii. Submit environmental and pollution clearance certificates for all diesel generators installed as part of this project.

iv. Provide total support to Engineer-in-Charge and Consultants appointed by the Engineer-in-Charge in completing all Green Building related formalities, including signing of forms, Providing signed letters in the contractor’s letterhead whenever required.

1.2.21 EQUIPMENT

a) To ensure energy efficiency during and post construction all pumps, motors and engines used during construction or installed, shall be subject to approval and as per the specifications of the Engineer-in-Charge.

b) In case any of the above condition given here is in conflict of any other condition given in this document elsewhere the later shall prevail.

c) The contractor is required to execute the work in a befitting manner to suit the above GRIHA rating standards. Nothing extra is payable on above account.

Environment Authority Conditions:

1. The contractor shall not store/dump construction material or debris on metalled road.

2. The contractor shall get prior approval from Engineer-in-Charge for the area where the construction material or debris can be stored beyond the metalled road. This area shall not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage.

3. The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and/or other similar material to ensure that no construction material dust fly outside the plot area.

4. The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand and other allied material are fully covered. The contractor shall take every necessary precautions that the vehicle are properly cleaned and dust free to ensure that enroute their destination, the dust, sand or any other particles are not released in air/contaminate air.

5. The contractor shall provide mask to every worker working on the construction site and involved in loading, unloading and carriage of
construction material and construction debris to prevent inhalation of dust particles.

6. The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission.

7. The contractor shall ensure that C&D waste is transported to the C&D waste site only and due record shall be maintained by the contractor.

8. The contractor shall compulsorily use jet in grinding and stone cutting.

9. The contractor shall comply all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010.

10. The contractor shall carry out on-Road-Inspection for black smoke generating machinery. The contractor shall use cleaner fuel.

11. The contractor shall ensure that the DG sets comply emission norms notified by MoEF.

12. The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle. In cases where speed reduction cannot effectively reduce fugitive dust, the contractor shall divert traffic to nearby paved areas.

13. The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.

14. No extra payment will be made for operation/activity mentioned at Sl. No. 1 to 13 above unless and until specified in this tender document.
SPECIAL CONDITIONS (Major component-Civil)

1. The contractor shall execute the whole work in the most substantial and workmanlike manner in strict accordance with the specifications, approved design, drawings, particular specifications, special conditions, additional conditions and instructions of the Engineer-in-Charge.

2. Before tendering, the contractor shall inspect the site of work and structures and shall fully acquaint himself about the conditions prevailing at site, availability of materials, availability of land and suitable location for construction of go-downs, stores, site office, transport facilities, constraints of space for establishing design mix plants, weather condition at site, the extent of leads and lifts involved in execution of work etc., which may affect or influence the tenders. No claim whatsoever on account of above factors shall be entertained.

3. Labour huts at site shall not be allowed. The contractor shall make own arrangement on rent or otherwise, outside the IIT campus for labour hutment etc at his own cost.

4. The contractor shall at his own expense and risk arrange land for accommodation of labour.

5. Subject to availability and further with the restrictions as imposed by IIT Kanpur authorities, a small parcel of land may be provided on as is basis to the contractor near the work site (within 1000 mtrs distant from the construction site) for setting up of site office, storage of materials, erection of temporary workshops, small rest room and construction of approach roads to the site of work, including land required for carrying out of all jobs connected with the completion of the work. The contractor shall have to abide by the regulations of the authorities concerned and the directions of the Engineer-in-Charge strictly for use of land available at the site of work. Also if it becomes necessary during construction to remove or shift the stored materials, shed, workshop, access roads, etc to facilitate execution of the work included in this agreement or any other work by any other agency, the contractor shall have remove or shift these facilities as directed by the Engineer-in-Charge and no claim shall be entertained on such account. Also no claim on the basis of inadequacy, unsuitability or any other ground whatsoever regarding land provided shall be entertained.

6. It shall be deemed that the contractor has satisfied himself as to the nature and location of the work, availability of labour, materials, transport facilities, availability and suitability of land for setting up of camp, etc with respect to the work to be executed. The department will bear no responsibility for lack of such knowledge and the consequences thereof.

7. The contractor shall have to make approaches to the site, if so required and keep them in good condition for transportation of labour and materials as well as inspection of works by the Engineer-in-Charge. Nothing extra shall be paid on this account.

8. The contractor shall carry out true and proper setting out of the work in co-ordination with the Engineer-in-Charge or his authorized representatives and shall be responsible for the correctness of the positions, levels, dimensions and alignment of all parts of the structure. If at any time during the progress of the work any error appears or arises in the position, level, dimensions or alignment of any part of the work, the contractor shall rectify such error to the entire satisfaction of Engineer-in-charge. The checking by the Engineer-in-Charge or his authorized representatives shall not relieve the contractor of his responsibility for the correctness of any setting out of any line or level.
The contractor shall carefully protect and preserve all bench marks, pegs and pillars provided for setting out of works. Nothing extra shall be paid on this account.

9. All setting out activities concerning establishment of bench marks, theodolite stations, centre line pillars, etc. including all material, tools, plants, equipments, theodolite and all other instruments, labour, etc. required for performing all the functions necessary and ancillary thereto at the commencement of the work, during the progress of the work and till the completion of the work shall be carried out by the contractor and nothing extra shall be paid on this account.

10. The work shall be carried out in such a manner so as not to interfere or adversely affect or disturb other works being executed by other agencies, if any.
11. Any damage done by the contractor to any existing works or work being executed by other agencies shall be made good by him at his own cost.

12. The work shall be carried out in the manner complying in all respects with the requirement of relevant rules and regulations of the local bodies under the jurisdiction of which the work is to be executed and nothing extra shall be paid on this account.

13. The contractor may have to work in two or more shifts for completing the work in time, and no claims whatsoever shall be entertained on this account, notwithstanding the fact that the contractor will have to pay or may have paid to the labourers and other staff engaged directly or indirectly on the work according to the provisions of the labour regulations and the agreement entered upon and/or extra amount for any other reasons.

14. The contractor shall make his own arrangements for electricity including obtaining electric connection required and make necessary payments directly to the State / Central Govt. department concerned. Similarly the Contractor shall make his own arrangement for water and also get the water tested from laboratory approved by the Engineer-in-charge at regular interval as per the CPWD Specifications.

15. The contractor alone shall be responsible for any loss or damage caused by the commencement of work on the basis of any erroneous and or incomplete information.

16. 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.

The works to be undertaken by the contractor shall inter-alia include the following:

(i) Preparation of detailed shop drawings and as built drawings wherever applicable.

(ii) Obtaining of Statutory permissions where-ever applicable and required.

(iii) Pre-commissioning tests as per relevant standard specifications, code of practice, Acts and Rules wherever required.

(iv) Warranty obligation for the equipments and / or fittings/fixtures supplied by the contractor. Contractor shall provide all the shop drawings or layout drawings for all the co-ordinated 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 Engineer-in-charge before implementation and this shall be binding on the contractor. The contractor shall submit material sample for approval of Engineer-in-charge get it approved prior to bulk supply of the material at site.

17. No payment shall be made to the contractor for damage caused by rain, whatsoever during the execution of works and any damage to the work on this account shall have to be made good by the contractor at his own cost.

18. The rates 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.

19. Ancillary and incidental facilities required for execution of work like labour camp, stores, fabrication yard, offices for Contractor, watch and ward, temporary ramp required to be made for working at the basement level, temporary structure for plants and machineries, water storage tanks, installation and consumption charges of temporary electricity connection, telephone, water etc. required for execution of the work, liaison and pursuing for obtaining various approvals, no objection certificates, completion certificates from local bodies etc, protection works, etc. during execution
shall be deemed to be included in rates quoted of the contractor, for various items in the schedule of quantities. Nothing extra shall be payable on these accounts. Before start of the work, the Contractor shall submit to the Engineer-in-Charge, a site / construction yard layout, specifying areas for construction, site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc.

20. No claim whatsoever for idle labour, additional establishments, costs of hire and labour charges for tools and plants, scaffolding etc, would be entertained under any circumstances. Similarly it is term of the contract that if the work gets delayed due to any site hindrance like trees, service lines, or for any other reasonable cause whatsoever only suitable extension of time for the contract shall be given but no claims whatsoever including claims of idle labour, idle machinery, cost of idle establishments, loss of profit etc on the ground of extension of contract beyond stipulated period shall be entertained even if the Extension is granted without levy of compensation by the Engineer in charge.

21. The Contractor(s) shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night, speed limit boards, red flags, red lights and providing safety nets (Safety to labours in case of fall from height), safety belts etc and other safety norms as specified in the general conditions of contract. In case of any accident of labours/ contractual staffs/third party 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. The contractor shall be keep the department indemnified against any claim generated on any such account at all times.

22. Contractor shall within two weeks of award of work, submit to the Engineer-in-Charge for his approval, list of measures for maintaining safety of manpower deployed for construction and avoidance of accidents.

23. 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 scaffolding system until specifically got approved otherwise from Engineer in charge, 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. It shall be ensured that no damage is caused to any structure due to the scaffolding. Nothing extra shall be payable on this account.

24. Royalty if any payable and all other incidental expenditure shall have to be paid by the contractor on all the boulders, metal shingle, earth, sand bajri, etc. collected by him for the execution of the work, direct to the concerned Revenue Authority of the State or Central Govt. and the amount paid shall not be reimbursed in any form whatsoever.

25. Other agencies working at site may also simultaneously execute the works entrusted to them and to facilitate their working, the contractor shall make necessary provisions e.g. holes, openings, etc. for laying/burying pipes, cables, conduits, clamps, hooks, etc. as may be required from time to time. Nothing extra over the agreement rates shall be paid for doing this. The required materials/fixtures shall however be provided by department. Similarly other nearby projects may also be in progress in the campus and thus all reasonable coordination and assistance needs to be extended in order to avoid any hindrance to the nearby works. The contractor shall extend full co-operation to other agencies for smooth execution of works by
other agencies. The final finishing of the work is to be executed in co-
ordination with other agencies as directed by the Engineer-in-Charge.

26. Stacking of materials and excavated earth shall be done as per the directions
of the Engineer-in-Charge. Double handling of materials or excavated earth if
required shall have to be done by the contractor at his own cost.

27. The amount quoted shall be considered as inclusive of pumping/baling out
water, if necessary, and no extra payment shall be made for pumping/baling
out water. This includes water from any source such as rain, broken water
mains or drains and seepage, surface and sub-soil water, rain etc. and shall
apply to the execution in any season.

28. The contractor shall give a performance test of the entire installation(s) as
per specifications before the work is finally accepted by making his own
arrangements for water supply, electricity etc and nothing extra whatsoever
shall be payable to the contractor for the performance test.

29. The steel work in railing includes fish tailing of the section to be embedded in
concrete and fixing the same.

30. Some restrictions may be imposed by the State Government on quarrying of
sand, stones etc, from certain areas. The contractor shall have to bring such
materials from other quarries located elsewhere for timely completion of
work and nothing extra shall be paid on this account.
31. The contractor shall give ten years guarantee in the prescribed proforma for water proofing items specified in the schedule of quantities. In addition to this, 10% of the executed cost of items shall be retained either in cash / fixed deposit or in the form of bank guarantee, which shall be released after the expiry of ten years from the date of completion if no defects is found in water proofing or the defects are made good. This amount shall be adjusted against the expenses incurred on making good the defects if the contractor commits breach of guarantee.

32. To facilitate gas connection, holes (if required by the Engineer-in-Charge) including suitable rubber gasket shall be provided in the kitchen platform of RCC slab/granite/marble/other stone slab etc. Nothing extra will be paid on the account and rates quoted for relevant items are inclusive of making such provision.

33. The contractor shall arrange to keep the premises neat and clean. The rubbish/malba and unserviceable materials shall be removed on day to day basis.

34. The Contractor shall arrange electricity, water and other facilities at his own cost for testing of the various electrical installations, fire pumps, wet riser / fire fighting equipments, fire sprinklers etc. and also testing water supply, sanitary and drainage lines, water proofing of underground sump, over head tanks. Nothing extra shall be payable on this account.

35. Bar Chart
   (i) The contractor shall give scientifically analyzed detailed bar chart for all the activities including man, material, important activity etc of the work within 15 days from the date of issue of letter of acceptance of tender.
   (ii) While preparing the above detailed bar chart, effort shall be made to take all possible items of work simultaneously.
   (iii) Similarly bar chart should be prepared separately for arrangement of labour.
   (iv) The bar chart so finalized and accepted by department should be got reviewed by the department, once in a month regularly. Modified / revised bar chart shall be prepared in the event of not adhering to the targets mentioned in the earlier bar chart. The contractor shall augment additional resources, materials and man power for achieving the targets.
   (v) In addition to the above bar chart, the contractor shall submit detailed programme of activities CPM and PERT chart using Primavera software. He shall furnish the details both in hard copies as well as soft copies.

SUBMISSION OF PROGRESS REPORTS:
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. Atleast 10 digital photographs showing all the parts of construction site along with atleast 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.

d) Man-power statement indicating:
   · Individually the names of all the staff deployed on the work, along with their designations.
   · No. of skilled workers (trade wise) and total no. of unskilled workers deployed on the work and their location of deployed on the work and their location of deployment i.e. blocks.

e) Financial statement, indicating the broad details of all the running account payment received up to date, such as gross value of work done, advances taken, recoveries effected, amount withheld, net payments details of all payment received, extra/substituted/deviation items if any, etc.

36. QUALITY ASSURANCE

(i) The proposed work is a prestigious campus development project and quality of work is of paramount importance. Contractor shall have to engage well-experienced skilled labour and deploy modern T&P’s and other equipment in the execution of the work. Many items like specialized flooring work, silicon sealant and backer rod fixing in expansion joints, factory made door/window shutters, proper slope maintaining in toilet units, sanitary- water supply installation, water proofing treatment, will specially require engagement of skilled workers having experience particularly in execution of such items.

(ii) The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond the set out tolerance limit shall be summarily rejected by the Engineer-in-Charge and the contractor shall be bound to replace/remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor at his own risk & cost.

(iii) In addition to the supervision of work by Institute works Department (IWD) engineers, the Committee of IIT, Kanpur and/or the Consultants deployed by IIT, Kanpur shall also be carrying out regular and periodic inspection of the ongoing activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by IWD engineers to the contractor. Upon receipt of instructions from Engineer-in-Charge these are also to be made good
(iv) **Third party quality assurance.** The department shall engage third party quality assurance system and the contractor shall render all the necessary assistance and make arrangement for the inspection of work similar to various clauses of the agreement.

(v) The Contractor shall submit, within 15 days after the date of 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 Engineer-in-Charge.

(vi) All materials and fittings brought by the contractor to the site for use shall conform to the specification and the samples approved by the Engineer-in-Charge.

(vii) The Contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the tender documents. 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 for non-availability of the brand specified and also subject to independent verification by the Engineer-in-Charge. In exceptional cases, where such approval is required, material shall be procured only after written approval of the Engineer-in-Charge.

(viii) All materials shall be got checked by the Engineer-in-Charge or his authorized supervisory staff on receipt of the same at site before use.

(ix) To avoid delay, contractor should submit all samples well in advance so as to give timely orders for procurement.

(x) 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 possessing required qualification and experience specified in the Schedule F 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 and forwarding of samples for outside laboratory tests and for maintaining test records.

(xi) All the registers of tests carried out at Construction Site or in outside laboratories and all material at site (MAS) registers including cement register shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-charge. All the entries in the registers will be made by the designated Engineering Staff of the contractor and same shall be regularly reviewed by AE/AEE/EE. Contractor shall be responsible for safe custody of all the registers. The Xerox copy of the same shall be submitted by contractor duly signed by him and representative of Engineer-in-charge along with the bills for review.
(xii) The contractor shall at his own cost submit samples of all materials sufficiently in advance and obtain approval of Engineer-in-Charge. The materials to be used in actual execution of the work shall strictly conform to the quality of samples approved by the Engineer-in-Charge and nothing extra shall be paid on this account. The acceptance of any sample or material on inspection shall not be a bar to its subsequent rejection, if found defective.

(xiii) The contractor shall at his own cost, make all arrangements and shall provide necessary facilities as the Engineer-in-Charge may require for collecting, preparing, packing, forwarding and transportation of the required number of samples for tests and for analysis at such time and to such places as directed by the Engineer-in-Charge. Nothing extra shall be paid for the above operations including the cost of materials required for tests and analysis.

The necessary tests shall be conducted in the laboratory approved by the Engineer-in-Charge. The samples for carrying out all or any of the tests shall be collected by the Engineer-in-charge or on his behalf by any other officer of IWD. The contractor or his authorized representative shall associate himself in collection, preparation, packing and forwarding of such samples for the prescribed tests and analysis. In case the contractor or his authorized representative is not present or does not associate him in the aforesaid operation the results of such tests and consequences thereon shall be binding on the contractor. The testing of materials shall be carried out in one of the following laboratories as decided by Engineer-In-charge as listed below:-

a. In any of the IITs,

b. In any of the NITs,

c. In any other Government laboratory/college,

d. In a NABL accredited lab. which has been specifically approved for the work

e. Any other laboratory as per the approval of the Engineer-in-charge.

(The Engineer-in-charge may inspect the laboratory before according approval to any of the above mentioned laboratory)

(xv) Materials used on work without prior inspection and testing (where testing is necessary) and without approval of the Engineer-in-Charge are liable to be considered unauthorized, defective and not acceptable. The Engineer-in-Charge shall have full powers to require the removal of any or all of the materials brought to site by contractor which are not in accordance with the contract specifications or do not conform, in character or quality to the samples approved by the Engineer-in-Charge. In case of default on the part of the contractor in removing rejected materials, the Engineer-in-Charge shall be at liberty to have them removed at the risk and cost of the contractor.

(xvi) In case of concrete and reinforced concrete work, the contractor shall be required to make arrangement for carrying out compressive strength tests at his own cost. He shall render all assistance for the preparation of cubes, safe custody of the same, proper curing and
carriage up to the laboratory where the test is to be performed; the cube
tests can be performed at any
laboratory approved by the Engineer-in-Charge.

(xvii) 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 the work site 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
works, as per the field of their expertise. If during the course of
execution of work, the Engineer-in-Charge 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. Nothing extra shall be
payable on this account.

37. Specialized Agencies to be engaged for specialized items:
The list of specialized items for the major component – civil works which
are to be got executed only through specialized agencies are mentioned
below:

CIVIL WORKS:

a. Anti-termite treatment
b. Acoustic work.

(i) The main contractor shall submit the credential of specialized agencies well in
advance as per the direction of Engineer-in-charge. After verification of the
same, written approval will be conveyed to main contractor in this regard. The
credentials and expertise of the specialized agencies in the similar works should
be commensurate the quantum and nature of the specialized works as per the
guidelines provided in this tender document. The main contractor shall not
change the specialized agency without taking prior approval of Engineer-in-
Charge. However before making any such change he has to enter into
agreement with new agency and submit the same to Engineer – in – Charge for
approval. This shall however be without any change in the accepted rates of the
contract agreement and without any cost implications to the Department. The
main contractor himself can also execute the specialized work in case he has
executed the similar specialized work himself previously, under direct contract
or on back to back basis, and submits experience credentials to the satisfaction
of engineer in charge in this regard of having executed the specialized work
commensurate the quantum and nature of the specialized works as per the
guidelines provided in this tender document.
(ii) It shall be the responsibility of main contractor to sort out any dispute / litigation with the Agencies without any time & cost overrun to the Department. The main 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 / sub-contractor(s). No claim of hindrance in the work shall be entertained from the Contractor on this account. No extension of time shall be granted and no claim what so 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.

38. 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 should deploy adequate and suitable 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 intended for use in the construction of this work and they shall not be shifted/ removed from site without the permission of the Engineer-in-Charge.

39. INSURANCE POLICIES:
The contractor in his own interest before commencing the execution of work, without in any way limiting his obligations and liabilities under this contract, 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.

40. WARNING / CAUTION BOARDS:
All temporary warning / caution boards / glow signals display such as "Construction Work in Progress", "Keep Away", "No Parking", Diversions & protective Barricades etc. shall be provided and displayed during day time by the Contractor, wherever required and as directed by the Engineer-in-Charge. These glow signals and red lights shall be suitably illuminated during night also. The Contractor shall be solely responsible for damage and accident caused, if any, due to negligence on his part. Also he shall ensure that no hindrance, as far as possible, is caused to general traffic during execution of the work. These signals shall be dismantled & taken away by the Contractor after the completion of work, only after approval of the Engineer – in – Charge. Nothing extra shall be payable on this account.
41. **DISPLAY BOARDS:** The Contractor shall provide and erect a display board of size and shape as required, in a legible and workman like manner showing the salient features of the project as directed by the Engineer-in-Charge.

42. **Preparation of Sample units:**
The contractor shall prepare in actual position sample unit for important items if required by Engineer-in charge and obtain approval of same before execution en masse. Nothing extra on account of preparation of such sample units shall be admissible. The E-in-charge may however solely as per his discretion permit the sample unit to be accounted as main work if the sample unit is found okay to his satisfaction. However if decided otherwise then the same shall be removed by the contractor.

43. **Inspection of work:**
(i) In addition to the provisions of relevant clauses of the contract, the work shall also be open to inspection by IWD, the committee of IIT, Kanpur constituted for the purpose and the representative of the IIT, Kanpur’s Consultants. The contractor shall at times during the usual working hours and at all times at which reasonable notices of the intention of the Engineer-in-charge or other officers as stated above to visit the works shall have been given to the contractor, either himself be present to receive the orders and instructions or have a responsible representative duly accredited in writing, to be present for that purpose.
(ii) Inspection of the work by IIT, Kanpur: The committee/consultant appointed by IIT, Kanpur may inspect the works including workshops and fabrication factory to ensure that the works in general being executed according to the design, drawings and specifications laid down in the contract. Their observations shall be communicated by the Engineer-in Charge and compliance is to be reported by the contractor to the Engineer-in-Charge.

44. **IIT, Kanpur Authorities shall be inspecting the on-going work at site at any time with or without prior intimation. The contractor should keep up-to-date the following:**

a) 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.
b) Entrance and area surrounding to be kept clean.
c) Display layout plan key plan, Building drawings including plans, elevations and sections.
d) Display of upto date program chart etc prepared in the approved computer software.
e) Keep details of quantities executed, balance quantities, deviations, possible Extra item, substituted Item etc.
f) Keep one sets of plastic / cloth mounted building drawings.
g) Sets of Helmets and safety shoes for exclusive use for officers/dignitaries visiting at site.

45. **PROJECT REVIEW MEETINGS:**
The contractor, immediately on award of work shall submit details of his key personnel to be engaged for the work at site. In addition, he shall furnish to the Engineer-in-charge detailed site organization set up diagram. The contractor shall present the programme, target, progress and status at various review meetings as required.
(i) Weekly Review Meetings: Shall be attended by Local Team headed by Project-in-charge of the Contractor and specialized agencies engaged by the Contractor.

<table>
<thead>
<tr>
<th>Agenda</th>
<th>a) Weekly programme v/s actual achieved in the past week and detailed programme for next two week.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b) Remedial actions and hold up analysis.</td>
</tr>
<tr>
<td></td>
<td>c) Any decision on queries raised either by contractor/PMC.</td>
</tr>
</tbody>
</table>

(ii) Fortnightly Review Meetings: Shall be attended by Project–in–charge and the Management Representative of the Contractor who can take independent decisions and Management Representative of the specialized agencies engaged by the Contractor as per the contract conditions who is to take decisions.

<table>
<thead>
<tr>
<th>Agenda</th>
<th>a) Progress Status/Statistics v/s program in target.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Completion Outlook.</td>
</tr>
<tr>
<td>c)</td>
<td>Major hold ups/slippages and remedial action.</td>
</tr>
<tr>
<td>d)</td>
<td>Assistance required.</td>
</tr>
<tr>
<td>e)</td>
<td>Critical issues.</td>
</tr>
<tr>
<td>f)</td>
<td>Any decision on queries raised either by Contractor/PMC.</td>
</tr>
<tr>
<td>g)</td>
<td>Anticipated cash flow, financial progress and monthly requirement for next three months.</td>
</tr>
</tbody>
</table>

(iii) Apart from the above meeting the Engineer-in-Charge may convene meeting at any time according to the necessity and the Contractor is bound to attend the meeting with his team and specialized agencies with requisite details.

46. Unless otherwise specified, nothing extra whatsoever shall be paid for executing the work as per the above SPECIAL CONDITIONS from serial number 1 to 45.
1. No land shall be given for installation of the batch mix plant for concrete production inside the IIT Campus. The agency shall procure RMC of appropriate grade/quality from external sources. This concrete shall be manufactured in fully automatic batching plant having capacity of 18 cum /hr or more with print outs facility. The agency is permitted to install his own batching plant outside the Campus at his own cost. However, in due course, if a land is allotted by IIT authorities and the agency requests for installation of his batch mix plant, recovery @ Rs. 150/-per cum of concrete produced, shall be deducted from the bill. The record of the quantity shall be as per the computer output or as per the detailed measurement, whichever is more.

2. The various ingredients for mix design / laboratory tests shall be sent to the structural Engineering lab of IIT Kanpur through the Engineer-in-Charge and the samples of such ingredients sent shall be preserved at site till completion of work or change in Design Mix / Ready Mix whichever is earlier. The contractor is permitted to initiate the job mix design after issue of letter of acceptance if requested by him in writing. The Engineer in charge shall give written permission to such request. The date of start of work shall however be not altered and it shall remain as defined in schedule F. The sample shall be taken from the approved materials which are proposed to be used in the work. The cost of packaging, scaling, transportation, loading, unloading, cost of samples and the mix design charges in all cases shall be borne by the contractor. The concrete should have sufficient workability for pumping through concrete pump (CPWD Specifications and BIS codes to be followed). Admixtures shall be used during concrete production, as per the approved design mix formula.

3. The maximum permitted water cement ratio is 0.50.

4. The concrete shall be transported to site for all leads in transit mixer, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C from transit mixer to site laying.

5. Steel reinforcement for R.C.C. work shall be Thermo-Mechanically Treated bars of grade Fe-500D or higher confirming.

6. Slump required for the work shall be maximum 120 mm at the plant and minimum 80mm during pouring for which contractor is permitted to use approved admixtures confirming to relevant IS codes.

7. For each change of source or quality / characteristic properties of the ingredients during the work, from that approved and used in the concrete mix, a fresh mix design shall be got done by the contractor. Revised trial mix test shall be conducted and shall be submitted by the contractor as per the direction of the Engineer-in-Charge. The cost of revised design mix shall be bourne by the contractor.
8. The various ingredients for mix design / Job mix and laboratory tests shall be sent to the lab/ test houses through the Engineer-in-charge and the samples of such aggregates sent shall be preserved at site by the department.

9. All cost of mix designing / Job mix and testing, connected therewith, including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix / job mix whenever required & as directed by Engineer-In-Charge. The testing charges for this design mix shall not be reimbursed by the engineer-in-charge.

10. The standard deviation to be adapted for design mix shall be for “Good” quality control as per IS code 456.

11. The agency can use nominal mix as per DSR Item no 5.3 for non-structural member like lintels, kitchen plate-form, AAC bands etc, after necessary design of these non-structural concrete member.

12. The printout of computerized batch mix reports of the concrete procured from the RMC/DMC Plants shall be submitted. The concrete from different sources shall not be mixed and shall be used for casting at different location /members.

**Conditions related to site restrictions and/or site facilities available for the work:-**

1. Arrangement for water shall be the responsibility of the contractor and no claim on this regard shall be entertained. This is also elaborated in the tender documents. However, the contractor may apply to the appropriate authority (as applicable) and to the Executive Engineer for the permission of bore wells. The Executive Engineer shall assist in obtaining the necessary permission from the appropriate authority but does not guarantee for the permission of the bore well or for the water supply from the borewell.

2. Arrangement for electricity shall be the responsibility of the contractor and no claim on this regard shall be entertained. This is also elaborated in the tender documents. However, the contractor may apply to the appropriate authority (as applicable) and to the Executive Engineer for the necessary electricity connection on payment basis. The contractor shall adhere to the applicable terms and conditions related to the electrical connections. The Executive Engineer shall assist in obtaining the necessary permission from the appropriate authority but does not guarantee for the necessary connection.

3. Justified quantum of space within the IIT campus, free of cost, shall be provided for the infrastructure facilities like material stock yard, site office etc. However, labour hutments shall not be allowed inside the campus. Similarly space for batching plant shall not be provided inside the campus.

4. Under normal circumstances, the working hours for labour are 08:00 AM to 06:00 PM. For working beyond 06:00 PM or prior to 08:00 AM, the contractor has to apply to the security personals alongwith the name of labours. Permission is normally granted for the extended hours.

5. It is clarified that normally the entry of vehicles is allowed between 08:00 AM to 10:00 PM. After 10:00 PM the vehicles with materials are not allowed to ply inside the campus. In exceptional circumstance (Procurement of Ready mix concrete or the like) permission can be obtained from the competent authority. However, as detailed in the tender conditions, restrictions on the existing roads of campus may be imposed by the security personals regarding route available, speed, honking, ply timing etc which shall be strictly observed.

6. Barricading shall be provided as detailed in this tender document.
7. The excavated earth shall continuously be dumped/carried to the dumping location as indicated in the tender document. Similarly the earth to be refilled shall be continuously carried from the dumping location as indicated in the tender document for refilling. Contractor is not permitted to stack more than 30 cum of earth excavated/to-be-refilled at the proposed building construction site.
PART-B2

PARTICULAR SPECIFICATION FOR CIVIL/ PLUMBING/ FIRE PROTECTION SYSTEM WORK
PARTICULAR SPECIFICATION & SPECIAL CONDITION OF WORK

1. Scope of work:
Scope of work shall cover, design drawing wherever required execution, preparation of shop drawing, supply, installation, testing, labour & workmanship etc. required to be provided in this said scheme/project. The design of component/items/scheme where ever required also includes in the scope. Work shall be executed as per scope and specification and drawing. If any service and item and component and provision required making building/scheme functional/habitatable if not specifically mentioned in the scope of this tender, the same shall be deemed to be included within the scope of this tender and nothing extra shall be paid on this account.

The rates quoted in schedule of financial quote shall be inclusive of all material, labour workmanship, all taxes (excluding GST) and other incidental charges (The GST shall be paid along with the running bills at the prevailing rates).

The Contractor shall be fully responsible for the execution and supervision of all works. He shall engage a Professional Engineer and Specialist Professional Engineer to undertake work in accordance with statutory requirements and condition of this contract.

2. Soil Investigation Report:
Soil investigation report/ major characteristic of soil for site has been uploaded separately in PDF.

The Contractor’s attention is drawn to the presence of existing services, drain line, sewer line, power cables, concrete platform (@ 950 sqm i/c PCC), boundary wall (@ 65 Meter length with 2.2 m height), at site, and shall make the necessary provision for the removal, due to such encumbrances. The works shall be done on ground as available; therefore, no claim for extra cost or time shall be entertained for this account.

3. Technical specification for construction:
The Contractor shall be responsible to work in accordance to the complete set of Technical Specifications, Architectural Drawings, Interior Finishing drawings and other related drawings of services as per NIT.

The Contractor shall ensure that the quality and workmanship shall be as per
4. **Safety and working Conditions:**

   The Contractor has to fully comply with all the safety requirements of the latest Factories / Labour Act and all other relevant local Bye-laws, Acts, Regulations, Safety, Health and Environment Handbook 2019, GCC for CPWD 2014 & SCC etc. of the tender. The workmen’s compassion policy as per the labour employed at site is to be taken throughout the contract period by the contractor.

   The Contractor shall also comply with Authorities' requirements regarding the removal and discharge of any spoil, surplus materials, debris or other materials.

5. **Materials:**

   The quality of the works throughout and workmanship shall be to the satisfaction of Engineer-in-charge or his Representative.

   All materials and workmanship shall be comply with the latest relevant Indian standard. However, there may be requirement to use of material & workmanship as per standards of British standard or American Specifications and/or Code of Practice the work and workmanship shall be done and to be used by the contractor without extra payment. The Contractor is deemed to be conversant with the relevant IS, BS, ACI / AISC / ASTM / AWS, and CPWD standards referred to and shall allow for complying therewith. All materials which do not comply with this Contract and BIS code, shall be removed from the Site at the Contractor's own expense.

6. **Guarantee Bond:**

   Three years guarantee for aluminum work & 10 year guarantee for water proofing work in prescribed proforma attached shall be given by the contractor, in token of his overall responsibility. 10% (Ten Percent) of the cost of these items would be retained as guarantee to the performance of the work done. The guarantee against these item of works shall be in addition to the security deposit mentioned elsewhere in the contract form. If any defects or deficiencies are noticed during the guarantee period the same shall be rectified by the contractor within seven days of issue of the written notice by the Engineer-in-charge, failing which the defects/deficiencies would be got removed by the Engineer-in-charge from other agency at the risk and cost of the contactor. However this amount of guarantee can be released in full, if bank guarantee of equivalent amount for the required period is produced and deposited with the department.

**Particular Specification**

**CIVIL WORK**

**Earthwork**

1. **General**

   All types of excavation work shall be done in accordance with CPWD specifications
Any trenching and digging for laying sewer lines / water lines /cables etc. shall be commenced by the contractor only when all men, machinery's and materials have been arranged and closing of the trench(s) thereafter shall be ensured within the least possible time.

The excavation through the mechanical means shall only be taken after conforming that there are no power cables in that area proposed for excavation.

2. Setting Out:
The Contractor shall be responsible for accurately setting out the Works to the specified positions, dimensions, levels, and building lines and also checking the site survey for dimensional and level accuracy and reporting any discrepancies before any commences. Any errors in position, level, dimension or alignment of any part of the Works at any time shall be rectified by the Contractor at his own expense. The Contractor shall provide the Engineer with all facilities, equipment and labour to enable him to check the setting out and levels of the Works at all times. The checking of any setting out point, line or level by the Engineer shall not in any way relieve the Contractor of his responsibility. All setting out points, benchmarks, site rails, pegs and other survey points shall be clearly marked and protected from damage or disturbance during the execution of the Works as per CPWD Specifications.

3. Applicable Standards:
The contractor shall ensure to follow the applicable BIS and IS Standards related to the excavation and local building regulations and statutory regulations.

4. Labour and Equipment:
The Contractor shall provide all labours, equipment, materials and any incidentals necessary to complete all aspects of work included in the drawings and specifications. The Contractor shall submit Earth Management Plan which is to be approved by the Employer or Engineer’s Representative before commencing the work.

i. Related Works:
1. Clearing, grubbing, and removing all vegetation from the site.
2. Excavation including getting out and necessary dressing to make surface ready to receive blinding.
3. Filling and back filling and compaction of fill.
4. Removal and disposal of surplus material.
5. Dewatering.
6. Road and Compound Wall Works

Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas/ foundation trenches including getting out and disposal of excavated earth all leads and lifts upto all heights as per structural drawing, for all kinds of soil including ordinary rock if any, as directed by Engineer-in-charge. Any deviation in earthwork in excavation as per site
condition will be ignored and nothing extra shall be paid. Topsoil up to 300mm shall be preserved and used in future landscaping development, as per specification and direction of Engineer-in-charge. Excavation for the foundation depth shall be minimum 2600 mm from below natural ground level (NGL). In case the proposed ground level (PGL) is below the natural ground level, the foundation depth shall be considered w.r.t. PGL. If the PGL is lower than the NGL, the Contractor shall cut the earth upto the PGL all around the building upto 3000mm (from outermost edge of the building in straight line to be considered).

Sub-soil water table at work site is reported to be at approx. 12.9 m. below the general ground level. The contractor shall make at his own cost all necessary arrangements for lowering water level, in the area where works are under execution low enough so as not to cause any harm to the work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains, subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing suitable system approved by the Engineer-in-charge.

All Excavated material/ earth of the building for any component should be stacked within 3 Km at the designated place indentified by Engineer-in-Charge & the earth shall be brought back for back filling of foundation, plinth & development of plot area nothing extra shall be paid on this account.

Filling available excavated earth (excluding rock) except unsuitable earth (black cotton soil, etc.) in trenches, plinth, sides of foundations, etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, in all lead and lift. If sufficient quantity of suitable filling earth is not available from excavated earth, the contractor shall bring local ganga sand (including royalty) from outside by mechanical transport upto all lead and lifts. The work shall also include ramming and watering in layers not exceeding 20 cm in depth in trenches, plinth, sides of foundation etc. complete as per direction of Engineer-in-Charge. If the proposed ground level is above the natural ground level, the Contractor shall fill local ganga sand upto the PGL all around the building upto 3000mm (from outermost edge of the building in straight line to be considered).

Filling with sand in plinth under floors 150mm depth, and below lifts pit as per drawing, including watering, ramming, consolidating and dressing, complete as per directions of Engineer-in-Charge.

Injecting chemical emulsion for post-constructional anti-termite treatment Bayer Premise (Imidacloprid 30.5% m/m SC (use 1% dilution or as per manufacturer's specification), as
a) Along external wall where the apron is not provided using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300 mm including excavation channel along the wall & rodding etc. complete with as per direction of Engineer-In-Charge.

b) Treatment of soil under floors by flooding over sand filling layer using chemical emulsion @ 15 litre per sqm. as per direction of Engineer-In-Charge.

5. CONCRETE WORK:

Plain Cement Concrete / Lean concrete in required thickness as per design shall be laid below the raft and all type foundation works, below kerb stone, under floors or wherever required as per CPWD Specifications Volume - I & II with correction slips up to the last date of submission of tender documents.

Base concrete below the footing, brick foundations, grade beam, grade slab, plinth beam, under floors, below plinth protections, steps, ramps, etc. and wherever specified in structural/ architectural drawings, shall be in 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size). Thickness of PCC should not less than 100mm.

The lightweight cement concrete shall be as per the specification for the cement concrete works given in CPWD Specifications except for the material used as coarse aggregate. The coarse aggregate used for the lightweight cement concrete works shall be lightweight aggregates like “Siporex”, or Ultratech or Aerocon or equivalent as approved by the Engineer-in-charge. The grading of the light-weight coarse aggregate shall be the same as that of the specified size of the coarse aggregate. In case of non-availability of the specific or required sizes of the light-weight aggregates, it shall be broken into required sizes by using mechanical crushers or any other method approved by the Engineer-in-charge. The oven dry density of the lightweight aggregate shall not be more than 650 kg / cum for Sunken portions for toilets, kitchen and similar locations above ground shall be filled with Light weight cement concrete 1:5:10 (1 cement : 5 course sand : 10 broken block of 20 mm nominal size specific gravity of of light weight aggregate shall not be more than 650 kg/ cum)

Providing and laying damp-proof course 50mm thick with cement concrete 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 12.5mm, nominal size) mixed with water proofing material in cement concrete in damp-proof course, to be provided below all brick work/ AAC block work at ground floor plinth level and including applying a coat of residual petroleum bitumen of grade of VG-10 of approved quality using 1.7kg per square metre on damp proof course after cleaning the surface with brushes and finally with a piece of cloth lightly soaked in kerosene oil.

Plinth protection and pathways all around the building, should be provided with 25mm thick rough Kotah stone/ flame-finished granite with polished granite band, pattern and
locations as per shown on the drawing, over 100mm thick PCC 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size). The edges of the plinth protection and pathways to be with brickwork 230mm wide and 300mm deep with common burnt clay F.P.S. (non-modular) bricks of class designation 7.5, over 100mm thick PCC 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size).

a. Reinforced Cement Concrete Work:
The work shall be done as per CPWD specifications Volume - I & II with correction slips up to the last date of submission of tender documents.

i. If the quantity of cement actually used in the work is found to be more than the theoretical quantity of cement including authorised variation, nothing extra shall be payable to the contractor on this account. In the event of it being discovered even after the completion of the work, the quantity of cement used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated in clause 42) the cost of quantity of cement so less used shall be recovered from the contractor at the rate as specified in schedule ‘F’. Decision of the Engineer-in-Charge in regard to the quantity of cement which should have been actually used as per the schedule and recovery at the rate specified shall be final and binding on the contractor.

ii. For non-scheduled items, the decision of the Chief Engineer cum Executive Director, CPWD regarding theoretical quantity of the cement which should have been actually used shall be final and binding on the contractor.

iii. 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.

iv. In case the contractor brings surplus quantity of cement the same after completion of the work will be removed from the site by the contractor at his own cost after approval of the Engineer-in-Charge.

v. Cement register for the cement shall be maintained at site.

Cement bags shall be stored in separate godowns to be constructed by the contractor at his own cost as per sketch (which is only indicative and actual size will depend on the site requirements) given in CPWD specifications with weather proof roofs and walls. Each godown shall be provided with a single shutter door with two locks. The key of one lock shall remain with Engineer-in-charge or his authorized representative and that of the other lock with the authorized agent of the contractor at the site of work so that the cement is issued from the godown according to the daily requirements with the knowledge of both parties and proper account for the same is maintained in the standard Performa.
vi. **DESIGN MIX CONCRETE:**

The contractor shall be required to submit two separate design mix of concrete with and without using plasticizers, separately for machine batched mix concrete & RMC. The decision of the engineer-in-charge to specify the design mix of concrete based on above shall be final.

vii. Coarse aggregate: As per CPWD Specifications

viii. Fine Aggregate: As per CPWD Specifications.


x. Cement: Cement arranged by the contractor will be PPC (in bags) conforming to IS: 1489-Part-I. If for any reasons, cement other than that specified in this para for example OPC of grade 43 or higher grade is brought to site by contractor, the issue, payments rate as well as the quantity to be used in the design mix concrete will remain unchanged.

xi. Slump: Design slump should be clearly specified in the mix design.

xii. Admixtures shall not be used without approval of Engineer-in-charge. Wherever required, admixtures of approved quality shall be mixed with concrete as specified. The admixtures shall conform to IS: 9103. The chlorides content in the admixture shall satisfy the requirements of BS: 5075. The total amount of chlorides admixture mixed concrete shall also satisfy the requirements of IS: 456. The contractor shall not be paid anything extra for admixture required for achieving desired workability.
xiii. Grade of Concrete: The compressive strength of various grades of concrete shall be given as below:

<table>
<thead>
<tr>
<th>Grade designation</th>
<th>Compressive strength on 15 cm cubes min. 7 days (N/mm²)</th>
<th>Specified characteristic compressive strength at 28 days (N/mm²)</th>
<th>Minimum cement quantity (Kg per cum. Mtr.)</th>
<th>Maximum water cement ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>i M 25</td>
<td>As per design</td>
<td>25</td>
<td>330</td>
<td>0.50</td>
</tr>
<tr>
<td>ii M 30</td>
<td>As per design</td>
<td>30</td>
<td>340</td>
<td>0.45</td>
</tr>
<tr>
<td>iii M 35</td>
<td>As per design</td>
<td>35</td>
<td>350</td>
<td>0.45</td>
</tr>
<tr>
<td>iv M 40</td>
<td>As per design</td>
<td>40</td>
<td>360</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Note-

1. In the designation of a concrete mix letter M refers to the mix and number to the specified characteristic compressive strength of 15 cm x 15 cm x 15 cm – cube 28 days expressed in N/mm²

2. The minimum/maximum cement content for design mix concrete shall be maintained as per the quantity mentioned above. In case where the quantity of cement required is higher than the minimum specified above to achieve desired strength based on an approved mix design extra shall become payable to the contractor.

3. Design slump has to be constantly monitored and maintained during placing of concrete through slump tests carried out as per CPWD specification 2009 Vol. 1 for Mortar, Concrete and RCC works, and records maintained accordingly.

The concrete mix design / laboratory tests with and without admixture shall be got done by contractor at his own cost and will be carried out by the contractor through IIT Kanpur laboratory.

The various ingredients for mix design / laboratory tests shall be sent to the test houses through the Engineer-in-Charge and the samples of such aggregate & cement shall be preserved at site by the department.

xiv. The contractor shall submit the mix design report from any of above approved laboratory for approval of Engineer-in-Charge within 30 days
from the date of issue of letter of acceptance of the tender. No concreting shall be done until the mix design is approved by the Engineer-in-charge. In case of white portland cement and the likely use of admixtures in concrete with PPC/white portland cement the contractor shall design and test the concrete mix by using trial mixes with white cement and/or admixtures also for which nothing extra shall be payable.

xv. In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-Charge.

b. The water to be used in concreting is to be tested from Institute lab.

c. APPROVAL OF DESIGN MIX

The mix design for a specified grade of concrete shall be done for a target mean compressive strength $T_{ck} = F_{ck} + 1.65 \times s$.

Where $F_{ck} =$ Characteristic compressive strength of 28 days

$s =$ Standard deviation which depends on degree of quality control

The degree of quality control for this work is “good” for which the standard deviation ($s$) obtained for different grades of concrete shall be as bellow:

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>For “Good” quality of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 25</td>
<td>4.00</td>
</tr>
<tr>
<td>M 30</td>
<td>5.00</td>
</tr>
<tr>
<td>M 35</td>
<td>5.00</td>
</tr>
<tr>
<td>M 40</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Of the six specimen of each set three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days.

d. All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the contractor.

e. The batching plant shall conform to IS:4925. It shall have the facilities of presetting the quantity to be weighed with automatic cutoff when the same is
achieved. Concreting at places may have to be resorted to through concrete pump for which nothing extra shall be paid.

f. All other operations in concreting work like Mixing, Slump, Laying Placing of concrete, compaction curing etc. not mentioned in this particular specification for Design Mix of concrete shall be as per CPWD specification.

g. WORK STRENGTH

TEST TEST SPECIMEN

Work strength test shall be conducted in accordance with IS: 456 on random sampling. Each test shall be conducted on six specimens, three of which shall be tested at 7 days and remaining three at 28 days. Additional samples shall be prepared, if required, as per direction of Engineer in charge for testing samples cured by accelerated method as described in IS: 9103.

TEST RESULTS OF SAMPLE

The test result of the sample shall be the average of the strength of three specimen. The individual variation shall not be more than 15 percent of the average. If more the test results of the sample are invalid. 90% of the total test shall be done at the laboratory established at site by contractor and remaining 10% in the laboratory of CPWD or in any other laboratory as directed by the Engineer-in-Charge.

Lot size

The minimum frequency of sampling of concrete of each grade shall be according to the following:-

<table>
<thead>
<tr>
<th>Quantity of concrete in the work cubic metre per day</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>1</td>
</tr>
<tr>
<td>6-15</td>
<td>2</td>
</tr>
<tr>
<td>16-30</td>
<td>3</td>
</tr>
<tr>
<td>31-50</td>
<td>4</td>
</tr>
<tr>
<td>51 &amp; above</td>
<td>4 + one additional sample for additional 50 cubic meters or part thereof.</td>
</tr>
</tbody>
</table>

Note: At least one sample shall be taken from each shift.

h. STANDARDS OF ACCEPTANCE

(i) In case the test result of all the samples is above the characteristic compressive strength, the concrete shall be accepted.

(ii) In case the test result of one or more samples fails to meet the requirement (i) above it shall be accepted if both the following conditions are met:

a) Any individual test result is not less than (Fck - 4) N/mm²

b) The mean of test result from any group of four consecutive samples is more than (Fck+4) N/mm².

(iii) Concrete of each grade shall be assessed separately
iv. Concrete is liable to be rejected if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge for which nothing extra is payable to the contractor.

i. Only MS centering/shuttering and scaffolding material unless otherwise specified shall be used for all RCC. Work to give an even finish of concrete surface. However marine ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor on approval by the Engineer-in-Charge.

j. In case of actual average compressive strength being less than specified strength which shall be governed by para “Standard of Acceptance” as above the rate payable shall be worked out accordingly on prorata basis.

k. In case of rejection of concrete on account of unacceptable compressive strength governed by para “Standard of Acceptance” as above the work for which samples have failed shall be redone at the cost of contractors. However the Engineer-in-Charge may order for additional test (like cutting cores, ultrasonic pulse velocity test, load tests on structure or part of structure etc.) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The contractor shall take remedial measures necessary to retain the structure as approved by the Engineer-in-Charge without any extra cost. However for payment the basis of rate payable to contractor shall be governed by the 28 days cube test results.

l. Necessary arrangements shall be made for field tests and all required equipment’s shall be arrange by establishing field lab by the Agency for mandatory tests of the materials as specified in CPWD specifications or as per direction of Engineer-in-Charge. No extra payment shall be paid on this account.

The foundation shall be with RCC M25 Raft type footing as per structural drawing. Columns are connected by grade beams/plinth beams below ground/plinth level as per structural drawing, and, wherever necessary, additional tie beams provided in between grade beams/plinth beams.

All structural concrete works below plinth level and above the plinth level up to floor VIII level (approx. 26 meter from ground level), are to be ready mixed M-25 grade concrete for reinforced cement concrete work as per structural drawings, using cement content as per approved design mix, manufactured in fully automatic
batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying, including cost of all centering, shuttering, finishing, reinforcement, admixtures (in recommended proportions as per IS:9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability) as per direction of the Engineer-in-charge.

Shuttering / Form Work - Formworks material should be in steel with rubberized joints. Centring and shuttering including strutting, propping etc. and removal of form work including cost of de-shuttering and de-centring at all levels, for all heights and depths. The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I& Vol. II with upto date correction slips. Steel shuttering and 12 mm thick BWP grade film faced plywood shuttering to be used by contractor as per direction of engineer in charge. All shuttering should be new/fresh.

- Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.
- The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.
- The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd or equivalent.
- Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter:
  a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.
  b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.
- Shuttering surface before concreting should be free from any defect/ deposits and fully cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.
- Form work including centring, shuttering, propping, staging shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete.
Form work shall be properly designed for self-weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centring exceeds 3.50 meters, the prop may be provided in multi-stages.

Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.

Camber: Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the E-I-C, so as to offset the subsequent deflection. For cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the E-I-C.

1.1 Tolerance in Finished Concrete - The formwork shall be so made as to produce a finished concrete true to shape, lines, level, plumb and dimensions as shown in the drawings subject to the following tolerance unless otherwise specified in this specification or drawings.

<table>
<thead>
<tr>
<th>Variation from the plum</th>
<th>± 6mm</th>
<th>Upto 3m height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation from the plumb of conspicuous liner</td>
<td>± 6mm</td>
<td>Upto 6m height</td>
</tr>
<tr>
<td>Variation in the size of wall openings</td>
<td>(+)15mm (-) 6mm</td>
<td></td>
</tr>
<tr>
<td>Variation in parapet wall thickness Upto 30cm thickness</td>
<td>± 6mm</td>
<td></td>
</tr>
</tbody>
</table>

LUMN/ FINS:

SLAB, BEAM & GIRDER FORMS:
Variation from the level or from the specified grid for beam soffit before removal of shores,

(a) In any 3m | ± 6mm |
(b) In any 6m | ± 10mm |

All the tolerances mentioned above shall apply to concrete dimensions only, and not to positioning of vertical steel or dowels. The tolerances given above are specified for local aberration in the finished concrete surface and should not be taken as tolerance for the entire structure taken as whole for the setting and alignment of formwork. Any error, within the above tolerance limits, or any other if noticed in any of the structure after part or portion stripping of forms, shall be corrected in the subsequent work to bring back the structure to its true line, level and alignment.

1.2 Workmanship of concrete - Contractor shall account for all material and labour etc. to achieve the required finishes to the satisfaction of the Engineer-in-charge.
Erection of form work may be from pre-moulded, prefabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting. The tie rods shall be terminated at least 40mm inside the finished surface.

Joints shall be water-tight, and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.

Prefabricated or site forms shall be assembled, so as to de-shutter without any jerk to the green concrete. For this double wedge shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while de-shuttering.

Prefabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.

Props shall be of steel only. Size and verticality shall be approved by the E-I-C. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.

In repeated use, panels shall be clearly marked for using at defined locations.

Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.

In fill pieces and panels shall be well dressed, levelled and jointed with main formwork so as to achieve smooth, even natural finish.

Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.

Props, shores shall be securely braced with firm bearing.

Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.

Sloping, brackets, chajjas etc shall be well secured and firmly restrained.

Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.

Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.

Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.

Heavy, medium and light duty props shall not be mixed up.

Beams and slabs shall have camber of 4 mm per metre or as directed by the E-I-C.

All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a triangle of 25x25mm.
• Props of steel shall be provided with adequate horizontal and cross-bracing. Steel props shall use steel pipes and steel couplers. If use of timber is not permitted.

• At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
  a) Openings for cleaning prior to start of concreting.
  b) Pouring points shall avoid high drops and provide easy access to vibrator needles.

• Surfaces shall be treated with mould releasing oil or emulsion as approved by the Engineer-in-charge prior to reinforcement laying. The following point shall be observed very carefully:
  a) Joints of moulds shall be water-tight & should be checked from bottom to make sure that no light is visible.
  b) Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
  c) Tie bars in beams, walls and columns shall be at the correct place and fully tight.
  d) Wedges shall be fully secured and nailed with head left out for easy removal.
  e) All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
  f) Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.

• Opening/inserts: All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.

• In case of multi-storey building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the E-I-C. The concreting of upper floor shall be done only after lower floors have attained the strength.

In case of shear walls, lift walls, internal walls, the form work shall be done by removable type tie rods within PVC sleeves.

Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete, with Thermo-Mechanically Treated bars of grade Fe-500D or more at all levels. Couplers of approved manufacturers/brand of suitable length as per structural requirement to be provided for columns reinforcement bars for more than 25mm dia as directed by the Engineer-in-charge. Overlapping of bars should be as per mentioned in structural drawing. Overlapping length should be closed tied with binding wire as per CPWD specification and where there is two layers in beam reinforcement suitable dia spacer bars/spacer blocks not less than 25mm of between two layers of reinforcement should be provided, as per IS Code SP:34. In case of slab/raft etc. chairs of dia minimum 12mm dia to 25mm of required length in double mesh portion should be provided @ 1 no. per sq.m.
directed by the Engineer-in-charge. The dia of chair should be such that they do not bend or buckle under the weight of reinforcement and other incidental load during construction. Bar bending schedule to be prepared and provided by the Contractor, as per structural drawings

i. Clear overhead space, hoisting hooks, exhaust fan opening, etc. are to be provided, as required for proper commission of lifts, as per manufacturer’s specifications and approved shop drawings

ii. Form work shall be placed and removed as per time line provided in CPWD- specifications.

Plaster drip course of size 25mm x 12mm in plastered surface or moulding to be provided for all R.C.C. projections/ chajjas, etc

6. MASONRY WORK

a. The work shall be carried out as per the CPWD specifications.

The work shall be done in accordance with CPWD specifications Volume - I & II with correction slips up to the last date of submission of tender documents.

Brick work with common burnt clay F.P.S. (non-modular) bricks of class designation 15.0 ( Local first class bricks) in foundation and plinth in cement mortar 1:6 (1 cement : 6 coarse sand) as per drawings

Autoclaved aerated cement blocks masonry with AAC blocks of thickness 150/ 250mm to be provided as per architectural drawings. The AAC blocks to be affixed with approved polymer modified adhesive mortar with split strength of 0.4 N/ Sq mm and compressive strength of 18 N/ sq mm with 3mm thickness.

RCC grade M-25 band 75mm thick to be provided at sill level and lintel level with 2 nos of 8mm dia TMT steel bar & 8mm dia TMT steel stirrups @ 200mm c/c to be provided. In case of AAC block works, span more than 6-meter length, RCC grade M25 vertical column (250mm x AAC block width) with 4 nos of 10mm dia TMT steel bar & 8mm dia TMT steel stirrups @ 200mm c/c to be provided.RCC M25 mullion (200mm x AAC block width) with 4 nos of 10mm dia TMT steel bar & 8mm dia TMT steel stirrups @ 200mm c/c to be provided at vertical jambs of doors & windows, all complete as per direction of Engineer-in-Charge.

The AAC block shall conform to grade I of IS : 2185 part 3 (1984). The precast AAC blocks shall be procured from approved manufactures only and shall not be permitted to be cast at site. Acceptance criteria- The Blocks shall be of grade I confirming to S.No. (ii) or S.No (iii) of table No.1 of IS 2185 Part-3. Drying shrinkage shall not be more than 0.05 %. The maximum variation in the length of the units shall not be more than ± 5mm for length and ± 3mm for width compressive strength of AAC blocks shall be not less than 5 N/mm² conforming to IS 2185/1984
b. Autoclaved Aerated Concrete Block

masonry work Dimensions &
Tolerances:

Autoclave Aerated Concrete Block shall be made in sizes and shapes to fit different concrete needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, partition block and concrete floor units.

Autoclave Aerated Concrete Block shall be referred to by its normal dimension the term ‘normal’ means that the dimension includes the thickness of the mortar joints. The actual dimension shall be 10mm short of the normal dimension (or 6mm short in special areas finer joints as specified). The normal dimension of the concrete block shall be as follows:

Length: 400, 500 or 600 mm
Height: 200, 250 or 300 mm
Width: 100, 150, 200 or 250 mm

In addition, Autoclave Aerated Concrete Block shall be manufactured in half length of 200, 250 or 300 mm correspond to the full lengths. The nominal dimensions of the units are so designed that taking account of the thickness of mortar joints, they will produce wall lengths and heights which will conform to the principles of modular co-ordination.

Block of sizes other than those specified above, may also be used if so specified in the case of special Autoclave Aerated Concrete Block such as jallie or screen wall and ornamental block, the specified size may not necessarily apply.

The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.

The faces of Autoclave Aerated Concrete Block shall be flat & Rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angle to the face of the Blocks. The Autoclave Aerated Concrete Block with special faces shall be manufactured and supplied if so specified.

The autoclaved Autoclave Aerated Concrete Block shall be classified in two grades according to their compressive strength as indicated in table below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Density in oven dry condition (kg/m²)</th>
<th>Compressive Strength (Min)</th>
<th>Thermal Condition in Air dry condition (W/m.k)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grade-I (N/mm²)</td>
<td>Grade-II (N/mm²)</td>
</tr>
</tbody>
</table>

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All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units impair the strength or performance of the construction. Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

**Block Density** – The Block density shall conform to the requirements specified in above table, when tested accordance with IS 6441 (Part-1) -1972.

**Compressive Strength** – The min. compressive strength being the average of twelve block units shall be as prescribed in above table, when tested accordance with IS 6441 (Part-5) -1972

**Thermal Conductivity** – The thermal conductivity shall be not exceed the values specified in above table when tested accordance with IS 3346 -1980

**Drying Shrinkage** – The drying shrinkage shall be not more than 0.05% for grade –1 block and 0.10% for grade-2 block when tested accordance with IS 6441 (Part-2) -1972.

**Number of tests**

A sample of 24 blocks shall be selected at random. All the 24 Blocks shall be checked for dimensions and inspected for visual defects. Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified as above. One samples shall be tested for every 200 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 200 cum. If required, Engineer-in-Charge 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 and precast AAC blocks) from the factory itself.

The contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.

**Criteria for conformity**

The number of blocks with dimensions outside the tolerance limit and or with visual...
defects, among those inspected, shall not be more than two. For density, the mean value shall be within the range as specified in above Table. For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition: X - 0.6 R > minimum value specified in above Table. For thermal conductivity, the mean value shall be equal to or less than the value specified in above Table. For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

**Manufacturer's Certificate**

The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

**Marking**

Each lot of concrete masonry units manufactured in accordance with this specification shall be suitably marked with information-

i The identification of the manufacture.

ii The grade and block density of the unit.

iii The month and year of manufacturing.

**Autoclaved Aerated Concrete Block** confirming the IS Code – 2185 (Part-3) 1984 (Reaffirmed 2005)

Polymer modified adhesive mortar shall be used for construction of masonry walls as per the approval of Engineer in Charge and manufacturer’s instructions.

For Low height Masonry Walls RCC Coping shall be provided of required sizes as per Architectural Drawings.

**7. DOORS, WINDOWS AND GLAZINGS (INTERNAL & EXTERNAL):**

35 mm thick ISI marked flush door shutters to be provided as per architectural drawings, conforming to IS : 2202 (Part I) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters, including ISI marked 4 nos. of stainless steel hinges of size 125x64x2.50mm (heavy type) as per approved make, with necessary stainless steel screws. The flush doors shall be finished with both-side factory-pressed 1.5mm thick decorative high pressure laminated sheet of plain/ wood grain in gloss/ matt/ suede finish with high density protective surface layer, glued to shutter with adhesive bonding quality conforming to IS:2046 Type S, as per schedule of finishes/ drawings/ schedule of hardware. Thickness of flush door shall be 38mm after pressing of laminate.

Lipping with 2nd class teak wood battens 12 mm minimum depth on all edges of all the flush door shutters to be provided.
Aluminium work for doors, windows of AIS REGAL non thermal or equivalent. The extruded aluminium sections are made from 6063 alloy homogenized billets and tempering T6 with aluminium composition tolerances and suited for anodizing (20-25 micron). Wall Thickness is in range of 1.2mm-1.8mm. The dimension tolerances are in compliance with IS-6477-1983 and chemical composition as per IS-1285-1975 standards. Corner joints are punched casting cleat with spring loaded and the Glazing Bead joint is Mitre cut. Sealing system shall be 2 barrier in case of casement, and sliding system shall have plastic brush seal. Internal and external gaskets are PVC+EPDM.U Shaped glazing gasket ensures perfect water-tightness. Wool pile brush is made of high-quality polypropylene multifilament yarn and has a central polypropylene fin to provide additional protection for tightness. Wool piles are extended till the height of shutters. Aluminium sections for sliding system construction depth is 40-180 mm and Casement system construction depth is 45 mm. In sliding system, the glass infill supported shall be 5-28 mm while in casement it shall be 5-28 mm. The hardware is single point/ multi-point Locking of premium makes (Alutect/ Savio/ Master/ MR) in glossy black/ white powder-coated finish. The hardware cycle/durability test shall be for min. 3000 cycles. Product performance supported 3500Pa, Air infiltration upto 75 Pa, and Static water penetration of 700 Pa. Both the systems shall be tested as per ASTM E 331 (Static Water Penetration), ASTM E 283 (Air Infiltration), and ASTM E 330 (structural performance). The sliding profile is gradient to drain water from cavity. The profile also has rain guard sealing for avoiding rain droplets. Rollers available in single or double carriage in 80 kg and 120 kg capacity with both fixed and adjustable versions. Rollers are tested for 25000 cycles. The rollers roll on anodized rail fitted on the tracks which ensure smooth sliding experience and long life of the rollers. The aluminium finish shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, aluminium snap beading for glazing / panelling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.

Filling the gap 5mm depth and 5mm width between aluminium frames and adjacent RCC/ Brick/ ACC work by providing weather silicon sealant over backer rod of approved quality as per direction of Engineer-in-charge complete

Toughened glass panes of 6 mm thickness of PlanibelClearlite (AIS) or equivalent to be provided in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber/ neoprene gasket etc. complete as per schedule of finishes and directions of Engineer-in-charge. The specification of the double glass is under:

a. **Light properties as per EN 410**

Light transmittance: \( \tau_v \% \) 89; External light reflection: \( \rho_v \% \) 8; Internal light reflection: \( \rho_i \% \) 8; Colour rendering index: \( Ra \% \) 99;

b. **Energy properties as per EN 410**

Solar factor : \( g \% \) 86; External energy reflection : \( pe \% \) 7; Internal energy reflection : \( pei \% \) 8; Direct energy transmission : \( te \% \) 85; Total energy absorption : \( oe \% \) 8; Shading coefficient : SC 0.99; UV transmission : \( \tau_{uv} \% \) 64
Double glazed hermetically sealed glazing in aluminium windows, doors, ventilators and partition etc. with 6 mm thick toughened glass of PlanibelClearlite (AIS or equivalent) both sides, having 12 mm Argon 90%, including providing EPDM gasket, perforated aluminium spacers, desiccants, sealant (Both primary and secondary sealant) etc. to be provided as per schedule of finishes/ specifications, drawings and direction of Engineer-in-charge. The specification of the double glass is under:

**a. Light properties as per EN 410**

Light transmittance: \( \tau_v \text{ [%]} \) 81; External light refection: \( \rho_v \text{ [%]} \) 14; Internal light refection: \( \rho_{vi} \text{ [%]} \) 14; Colour rendering index: \( Ra \text{ [%]} \) 98;

**b. Energy properties as per EN 410**

Solar factor: \( g \text{ [%]} \) 77; External energy refection: \( \rho_e \text{ [%]} \) 13; Internal energy refection: \( \rho_{ei} \text{ [%]} \) 13; Direct energy transmission: \( \tau_e \text{ [%]} \) 73; Energy absorption glass 1: \( \alpha_{e1} \text{ [%]} \) 8; Energy absorption glass 2: \( \alpha_{e2} \text{ [%]} \) 6; Total energy absorption: \( \alpha_e \text{ [%]} \) 14; Shading coefficient: \( SC \text{ 0.89} \); UV transmission: \( \tau_{uv} \text{ [%]} \) 49

**c. Thermal properties as per EN 673 - Thermal transmittance (vertical): Ug [W/(m2.K)]**

\[ 5.7 \]

**d. Acoustic properties** = Direct airborne sound insulation - EN 12758: 31 (-2;-3) \( Rw (C;Ctr) \text{ [dB]} \)

2 nos stainless steel 316 grade tubular handlebar 32 mm outer dia, 3.0 mm thick & 300 mm long with SS screws etc. to be provided for each aluminium door shutters as per hardware schedule, complete as per direction of Engineer-in-Charge.

Brass 100mm mortice latch and lock with 6 levers without pair of handles (best make of approved quality) to be provided as per hardware schedule for each aluminium door including necessary cutting and making good etc.

Double action hydraulic floor spring of approved brand and manufacture conforming to IS: 6315, having brand logo embossed on the body/ plate with double spring mechanism and door weight upto 125 kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. to be provided as per hardware schedule, complete as per the direction of Engineer-in-charge. Stainless steel cover plate minimum 1.25 mm thickness to be provided.

Suspended Spider Glazing system designed to withstand the wind pressure as per IS 875 (Part-III). The Suspended System held with Spider Fittings of satin finish SS-316 Grade Steel of approved manufacturer, of approved manufacturer with 13.52 mm
thick Ecosence Enhance Clear Nectar solar control laminated toughened glass of AIS or equivalent held together with SS- 316 Grade Stainless steel Spider & bolt assembly with clear laminated glass fins 21.52 mm thick. The Glass fins and glass panel assembly shall be connected to Slab/ beams by means of SS- 316 Grade stainless steel brackets & Anchor bolts and at the bottom using SS channel of 50x25x2mm using fastener & anchor bolts, non-staining weather sealants of approved make, Teflon/ nylon bushes and separators to prevent bi-metallic contacts, all complete to perform as per specification and approved drawings. The complete system to be designed to accommodate thermal expansion & seismic movements etc. The joints between glass panels (6 to 8 mm) and gaps at the perimeter & in U channel of the assembly to be filled with non-staining weather sealant, so as to make the entire system fully waterproof & dust proof. The works shall include all design, Engineering and shop drawing including approval from structural designer, labour, T&P, scaffolding, other incidental charges including wastage, enabling temporary services all fitting fixers nut bolts, washer, Buffer plates, fastener, anchors, SS channel laminated glass etc. all complete. The works shall include all design, Engineering and shop drawing including approval from structural designer, labour, T&P, scaffolding, other incidental charges including wastage, enabling temporary services all fitting fixers nut bolts, washer, Buffer plates, fastener, anchors, SS channel laminated glass etc. all complete.

Frameless AIS or equivalent patch fitting in SS304 grade, SS finish. Glass door with 13.52 mm thick Ecosence Enhance Clear Nectar solar control laminated toughened glass AIS or equivalent to be provide as per drawing. 4 nos of handle in SS-304 gradeH-type of size 32X1300mm height & 2nos locks to be provided in each door, complete, as per the direction of Engineer-in-charge.

Entrance Automatic sliding door of AIS 11.52 mm thick Ecosence Enhance Clear Nectar solar control laminated tempered glass frameless glass AIS or equivalent, including providing and fixing necessary AIS make Automatic Sensor Door fittings, necessary locks & handles and making necessary holes etc. for fixing required door fittings, to be complete in all respects, as per drawing and the direction of Engineer-in-charge.

Anodized aluminium louvered panels to be provided at plumbing/ service shaft, fabricated out of extruded sections conforming to IS 733 and wall thickness not less than 2 mm of specified size and shape with powder coating not less than 50 micron, including supplying and fixing the frame with expansion bolts/ screws, hardwood subframe, and providing and fixing fixed powder coated aluminium louvres 1.45 to 1.7 mm thick and of approved make and profile within the panels, in accordance with the drawings etc. complete, as directed by the Engineer-In-Charge, at all heights. This would include providing and fixing anodized aluminium openable louvered panels alongwith stainless steel hinges, SSmat-finished handles, locking arrangement, etc. as per drawings and as per direction of Engineer-In-Charge.

Vision panel in doors shutters to be provided as per architectural drawings.

Frosted 6mm thick toughened glass panes to be provided in windows & ventilator shutters for toilets.
Stainless steel finished brass 100 mm mortice latch and lock with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete, to be provided in doors as per hardware schedule

Following Stainless steel fittings, with nuts and screws etc. complete, as per approved make, to be provided at all doors & windows, as per approved make & hardware schedule and as per directions of the Engineer-In-Charge
a) Sliding door bolts - 300x16 mm for double leaf doors and 250x16 mm for single leaf doors
b) Tower Bolt – 250/ 200mm x 10 mm
c) Handles300 mm
d) Hanging floor door twin rubber stopper, of approved size and shape

3D butt hinges in anodized/ powder coated extruded aluminium body with stainless steel pin, shall be provided for doors & windows shutters as specified in the schedule of hardware

Flush Handle for sliding windows - 170 mmx 25 mm, aluminium extruded material, Black smooth finish, push to open. 1 no. for each panel (AIS or equivalent make)

75mm transparent rubber buffers with washers and necessary screws etc. complete to be provided as per Hardware schedule (best make of approved quality)

GreenlamSturdo Classique Grandeur or equivalent Toilet Cubical as per drawings, (of following standard dimension which includes 600mm door size width) made of heat, bacteria, water, chemical, scratch, impact anti-bacterial resistant 18mm thick solid compact laminate panels tested by Shriram Test House. Finish of the compact laminate should be Suede / *Raw Silk, which includes doors, pilasters & intermediate panels finished with approved texture/shade as per the detail drawings & as per IS 2046 (Indian Standard) and as per fire retardant BS-476/97 standard. The product should have Green Guard Certificate. This also includes providing and fixing in position necessary hardware made out of Stainless steel (Grade 304) as per manufacturer’s specifications & Engineer-in-charge instructions like (1) Door Knob 2 nos, (2) Gravity Hinges 3 nos, (3) Thumb turn lockset indicator 1 no, (4) Coat hook 1 no, (5) U-Channels, (6) SS-Shoe Box Plate (7) MS-Base Plate, (8) Rubber noise deafening tape (9) Screws & wall Plugs. All screws will of 304 Grade in stainless steel with satin finish. All pilasters are supported by MS-Base steel Bottom Cladding with Stainless Steel Shoe Box Plate. The base of the stainless steel shoe box will be anchored to the floor with a clearance height upto 110mm. Fixing of intermediate panels to the wall shall be stainless steel ‘L’ – Bracket or stainless U-Channel section are fixed into wall with screw inserts.

Fire resistant doors for Seminar hall

a. Hollow metal Insulated fire rated doors as per IS 3614 part-1, for stability and integrity. Pressed galvanized GrainTek steel confirming to IS 277 with the following specification. Recommended fire door shall be tested to IS 3614 part 2 / ISO 834-1 Part 1 / BS476 Part 20 & 22, CBRI / Cerifire or third party certified or equivalent
lab, for maximum rating of 120mins, in latched/unlatched condition (if used with deadbolts and pull handles). Labeled doors with certification shall be with vision glass as a part of complete assembly. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied shall be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.

b. Door frame shall be single rebate grooved profile of size 125 x 55mm made out of 1.60mm (16gauge) minimum thick galvanized graintek steel sheet. Frames shall be mitered and field assembled with self-tabs. Frames to have inbuild grooved sealing system and shall be site fitted with fire rated EPDM gasket as standard. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening.

c. Door leaf shall be 46mm thick fully flush double skin door, Un-insulated without vision lite. Door leaf shall be manufactured from 1.2mm (18guage) minimum thick galvanised graintek steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be 95kg high density mineral wool insulation material. Intumescent seals 15x2mm to be provided all around the door in addition to the grooved smoke seal. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf. The glass should be 6mm clear borosilicate fire rated glass of relevant rating of the door.

d. All doors and frames shall be wood stained and lacquered finish and shall have passed minimum 500 hours of salt spray test.

e. Works shall include supply and installation of door and hardware as a complete assembly as mentioned in the door and hardware schedule. Once frame installed should be filled with PUF as recommended by the manufacturer or engineer.

f. 120Mins Fire Rated Door insulated 30minutes Double leaf of size as per drawing with hardware set of 8nos 100x75x3mm ball bearing butt hinges, double door Panic bar with external trim, door closer on both shutter of spring size 3-5 with slide arm, door coordinator, intumescent seal for all side of shutter and smoke seal.

Fire resistant doors for Staircases

a. Hollow metal Insulated fire rated doors as per IS 3614 part-1, for stability, integrity & insulation. Pressed galvanized steel confirming to IS 277 with the following specification. Recommended fire door shall be tested to IS 3614 part 2 / ISO 834-1 Part 1 / BS476 Part 20 & 22, CBR1 / Cerifire or third party certified or equivalent lab, for maximum rating of 120mins with 30minutes of insulation, in latched/unlatched condition (if used with deadbolts and pull handles). Labelled doors with certification shall be with vision glass as a part of complete assembly. Manufacturer test certificate shall cover doors both single and double leaf and all
doors supplied shall be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.

b. Door frame shall be single rebate grooved profile of size 125 x 55mm made out of 1.60mm (16 gauge) minimum thick galvanized steel sheet. Frames shall be mitered and field assembled with self-tabs. Frames to have inbuilt grooved sealing system and shall be site fitted with fire rated EPDM gasket as standard. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Frames shall be filled with fire rated puff.

c. Door leaf shall be 46mm thick fully flush double skin door, insulated with vision lite. Door leaf shall be manufactured from 1.2mm (18 gauge) minimum thick galvanised steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be high density insulation material. Intumescent seals 15x2mm to be provided all around the door in addition to the grooved smoke seal. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturers recommendation with a clipon arrangement. The glass should be 6mm clear borosilicate fire rated glass of relevant rating of the door.

d. All doors and frames shall be finished Pure Polyester Powder coated and shall have passed minimum 500 hours of salt spray test.

e. Works shall include supply and installation of door and hardware as a complete assembly as mentioned in the door and hardware schedule. Once frame installed should be filled with PUF as recommended by the manufacturer or engineer.

f. 120Mins Fire Rated Door insulated 30minutes Double leaf of size as per drawing with vision panel of size as per drawing on both shutter with hardware set of 8nos 100x75x3mm ball bearing butt hinges, double door Panic bar with external trim, door closer on both shutter of spring size 3-5 with slide arm, door coordinator, intumescent seal for all side of shutter and smoke seal.

Specified openings (Labs and central facilities etc.) to be provided to be with Cleanroom doors as per following specifications:

a. Hollow stainless-steel doors made of pressed stainless steel 304 grade confirming to IS 277 with the following specification. Doors shall be with vision glass and louver as a part of complete assembly.

b. Door frame shall be single rebate grooved profile of size 125 x 55mm made out of minimum 1.20mm (16 gauge) thick stainless-steel sheet. Frames shall be metered and field assembled with self-tabs. Frames to have inbuilt grooved sealing system and shall be site fitted with PVC seal as standard. All provision should be mortised, drilled
and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. Frames shall be filled with puff.

c. Door leaf shall be 46mm thick fully flush double skin door, with vision lite. Door leaf shall be manufactured from minimum 0.8mm (18guage) thick stainless-steel sheet. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core. All doors shall be factory prepped for receiving appropriate hardware and provided with necessary reinforcement for hinges, locks, and door closers. The edges should be interlocked with a bending radius of 1.4mm. For pair of doors integrated astragals has to be provided on the meeting stile for both active and inactive leaf. Vision lite wherever applicable should be provided as per manufacturers recommendation with a clip-on arrangement. The glass should be 5mm clear toughened glass of relevant rating of the door.

d. Works shall include supply and installation of door and hardware as a complete assembly as mentioned in the door and hardware schedule. Once frame installed should be filled with PUF as recommended by the manufacturer or engineer.

e. Stainless steel Clean room double door size as per drawing with flush vision panel of 450x750mm on both shutter hardware set of 8nos 100x75x3mm ball bearing butt hinges, double door Panic bar with external trim, door closer on both shutter of spring size 3-5 with slide arm, door coordinator, intumescent seal for all side of shutter and smoke seal.

Glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c, including applying a coat of approved fire resistant primer/powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc complete in all respect as per direction of Engineer-in-charge. The glass shall be clear, toughened, interlayered, non-wired fire resistant having 11 mm thickness of approved brand with 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 15 min of insulation (EI15) and having a sound reduction of 37dB and LT of 86%. Glass shall be compliant to class 2(B)2 category of Impact Resistance as per EN 12600. The glass should be manufactured in UL & TUV audited Facility and including UL-EU Certification. The maximum glazing size shall not be more than 1100 mm x 2200 mm (w x h) or 2.42 sq. mts in total area. The test report for the complete system (Glazed Door or Partition) will be considered valid only if it contains the stamp and signature of the authorized signatory from the glass manufacturer.

25mm bright /matt finished Stainless Steel handles as per hardware schedule to be fixed to the fire doors shutters, of approved quality & make with necessary screws etc all complete.

Panic bar/ latch (Double point) as per hardware schedule to be provided at all fire doors/ lab doors, fitted with a single body, trim latch & lock on back side of the Panic Latch of reputed brand and manufacture, to be approved by the Engineer- in- charge, all complete.
Aluminium extruded section body tubular type universal hydraulic door closer (having brand logo and IS:3564 mark embossed on the body) for door weights upto 36 to 80 kg and door widths from 701 to 1000 mm, with double speed adjustment, complete with necessary accessories and screws etc., to be provided at doors as per hardware schedule.

1mm thick M.S. sheet door to be provided at mumty& Gas store, with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, Using M.S. angles 40x40x6 mm for diagonal braces with ISI marked oxidised M.S. sliding door bolts, tower bolt, handles, etc. including T-iron frames for doors, of mild steel Tee-sections, joints mitred and welded, along with fixing of 8 nos. of ISI marked oxidised M.S. pressed butt hinges with necessary screws etc. of size 125x65x2.12 mm and applying a priming coat of approved steel primer and two coats of synthetic enamel paint of approved make & shade to the entire doors. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size), as directed by Engineer-in-charge & as per architectural drawings.

120 minutes rated Fire Curtain with Galv. MS Head Top Box (200mm x 200mm minimum dimensions), Powder Coated Side Guides (100mm x 53mm minimum dimensions), Adjustment Channels and Bottom Bars with geared motors for power up operation with Standard Battery backup and operated system Safe fixed into Steel rollers with woven glass fibre fabric, reinforced with stainless steel wire having micronized aluminium polymer coating on each side of the fabric (silver/grey) with its control panel and all installation assemblies & accessories required to complete the installation. The operation shall be suitable for dedicated 230 Volts UPS, 50 Hz AC supply. Complete system tested in accordance with BS EN 1634-1 (for 120 minutes Integrity & tested at 1000°C) to BS 476-22.8 and BS 7346-3. The Emergency Retract Switch is needed on both side of the curtain. The curtain should reset automatically when Fire Control Panel is reset. Vendor / Manufacturer to submit valid Test Report for the complete systems and not just for fabric from an independent international accredited laboratory.

The automatic smoke or fire curtain control panel require a UPS supply or 220v-240v (Selectable) (AC) 3core 1.5mm thickness wire supply in order to keep the batteries charged up. The mains supply does not have any other function apart from keeping the batteries charged-up, this is because the current required for driving the system is taken from the lead-acid cells; however it is advise that the panel should have an uninterrupted mains supply under normal conditions, where possible to ensure correct functionality of the system. (FC-01)

Accessories per Curtains- Control Box including 12V 2.2/2.3ah battery, override switches, Key Switches on both side and all other accessories required to make the functional.

The Fire Curtains including Top box, Side Guides, Curtains, barrel including motor,
8. STEEL WORK:

All the specifications for structural steel works shall be as per CPWD Specifications Volume - I & II with correction slips up to the last date of submission of tender documents.

Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position using structural steel, and applying a priming coat of approved steel primer and two coats of synthetic enamel paint of approved make & shade, as required for gratings, frames, guard bar, ladder, railings, brackets, grills, gates and similar works, as per architectural drawings.

MS structural platform in shaft, staircases for mumty roof, water tank etc. to be provided, as per shop drawing if not mentioned in architectural/structural drawing. Shop drawing to be got approved from Engineer-In-Charge.

Stainless steel (Grade 304 18/8 composition) railing to be provided as per the architectural drawings/ schedule of finishes, made of hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners, stainless steel bolts, cover plates, etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge.

15mm thick clear toughened glass railings to be fixed from bottom using aluminium bracket cover from both the side using continuous cover Stainless steel profile, brackets to be fixed with zinc-coated fasteners100mmX12mm using required chemicals and SS Allen bolt by 8mmX25mm bracket using EPDM rubber gasket, top hand rail shall be 40mmX40mm stainless steel profile fixed on glass using EPDM gasket and all type of modular joinery as required such as corner 90 degree bend, ribs live wall conceal.

The railing system to be provided at double height entrance hall balcony as per location marked in architectural drawing. Overall height of the railing should be 1000mm from finished level.

All stainless steel sections should be protected against scratching with polyethylene wrap stickers till completion of the building/ handover of the building whichever is later. If any damage or scratches are visible in stainless steel sections, the same shall be rectified on contractor’s risk and cost.

All steel works and SS works shall be executed through approved specialized agency. Approval shall be accorded by the Engineer-in-charge.

All other incidental works not specified herein mentioned but necessary for the satisfactory completion of the works, shall be deemed to be included.
9. FLOORING

Specifications for Flooring & Dado

a) Cladding:

General (applicable for all kinds of flooring and dado / cladding works under this sub-head):

Various types of flooring, skirting, dado and window sill work shall be carried out by the contractor referring the floor finishing layouts as per Architectural drawings. Contractor needs to refer room data sheet / schedule of finishes and material palette attached with tender document.

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 Engineer-in-Charge. The Engineer-in-Charge 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 Department shall bear the cost of such visits of the officers of the Department.

Based on the samples approved by the Engineer-in-Charge for various flooring and dado / cladding materials as specified hereinafter, the contractor shall prepare mock up(s) at site of work as specified under relevant 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. Otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge 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.

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.

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 CC/Brick/AAC masonry works required for such fixing is deemed to be included in the cost of masonry. Nothing extra shall be payable on this account.
Proper gradient shall be given to flooring for toilets, verandah, kitchen, courtyard etc. so that the wash water flows towards the direction of floor trap. Any reverse slop if found, these shall be made good by the contractor by ripping open the floor/grading concrete and nothing shall be paid for such rectifications.

The flooring and skirting will be executed as per pattern shown in the architectural drawings. Skirting height will be executed as per approved architectural drawings.

Samples of flooring material are to be deposited well in advance to the Engineer-in-Charge for approval. Approved samples should be kept at site with the Engineer-in-Charge and the same shall not be removed except with the written permission of Engineer-in-Charge. No payment whatsoever will be made for these samples.

For flooring work, the joints between the different types of flooring shall be located as per the architectural drawings. 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.

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.

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/acid cleaners shall not be used to clean the marks and other scratches.

Pattern for any type of flooring / dado shall be as per detail drawings submitted. The cost of flooring work is inclusive all material, workmanship, labour, pattern, colour, style, skirting etc. complete. No extra payment on this ground shall be entertained. The joints for all flooring to run in a straight line.

For steps upto 2 metre length, marble/ granite/ kotah stone flooring in treads & riser to be provided in single piece stone

Providing and laying cushioning layer in cement mortar 1:4 (1 cement: 2 coarse sand) for difference of thickness in flooring of granite/ kota stone & vitrified/ rectified tile 8/15 mm as directed by the Engineer-in-Charge.

**b) Kota Stone Work:**

This can be read for Flooring / Skirting / Dado / Steps.
The work to be carried out in areas as mentioned in flooring layouts and material palette and as per the CPWD Specifications Volume I and II with correction slips up to the last date of submission of tender documents. The provision of IS Codes listed in CPWD
specifications shall form a part of this document with all latest codes.

22 to 25mm thick Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and mirror polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) to be provided as per the drawings/ schedule of finishes.

22 to 25mm thick rough Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) to be provided in plinth protection, ramps, paths, etc., as per the drawing/ schedule of finishes.

Kota stone slabs 22 to 25 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and mirror polishing complete as per drawing/ schedule of finishes.

c) Vitrified / Ceramic Tile Work:

The work shall be carried out in areas as mentioned in Architectural drawings and as per the CPWD Specifications Volume I and II with correction slips up to the last date of submission of tender. The tiles shall be confirming to the related BIS codes up to the latest revisions. The testing shall also be got done from approved labs in accordance with the BIS codes for the various parameters and as referred. Contractor to obtain prior approval of Engineer in charge for tiles make, sizes, shade and color as per Architectural drawings and material palette before bringing it to site.

Vitrified tiles flooring of approved make, colour, shade, pattern & size as given in the drawing/ schedule of finishes to be provided (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3kg/sqm including grouting the joints with white cement and matching pigments etc., complete with as per direction of the Engineer-In-Charge.

Skirtings and dado of vitrified tiles to be provided as per approved make, colour, shade, pattern & size as given in the drawing/ schedule of finishes (thickness to be specified by manufacturer), with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shade, in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), jointing with grey cement slurry @ 3.3kg/sqm including grouting the joint with white cement & matching pigments etc. complete with as per direction of the Engineer-In-Charge.

Ceramic floor tiles (anti-skid/ matt finish) of approved make to be provided as per schedule of finishes. Colour, shade, pattern & size given in the drawing/ schedule of finishes (thickness to be specified by the manufacturer) and as approved by
Engineer-in-Charge, of 1st quality conforming to IS:15622, laid on 20 mm thick cement mortar 1:4 (1 Cement: 4 Coarse sand), jointing with grey cement slurry @ 3.3kg/sqm including grouting the joints with white cement and matching pigments etc., complete.

1st quality ceramic glazed wall tiles conforming to IS:15622 to be provided as per schedule of finishes (thickness to be specified by the manufacturer), of approved make, in any colour, shade & pattern, of any size, as per schedule of finishes and as approved by Engineer-in-Charge, in skirting, risers of steps and dado as the case may be, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3 kg/sqm including pointing in white cement mixed with pigment of matching shade complete.

Ceramic glazed tiles for floor of the overhead RCC water tank to be provided (thickness to be specified by the manufacturer), in 1st quality conforming to IS : 15622 of approved make in White/ Ivory colour, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), Jointing with grey cement slurry @ 3.3 kg/sqm including pointing the joints with white cement and matching pigment etc., complete.

1st quality ceramic glazed tiles for walls of overhead RCC water tank to be provided, conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in White/ Ivory colour, of any size as approved by Engineer-in-Charge over 12 mm thick bed of cement Mortar 1:3 (1 cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.

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 Engineer-in-charge prior to the execution of the item.

The mock up (one each) shall be prepared for flooring and dado, for vitrified tiles etc.

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.

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.

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.
The Contractor shall obtain and submit to the Department 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.

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.

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. All the tiles should be procured only from mother plant of the manufacturer.

**Granite/ Marble stone work**

i. The Contractor shall procure and submit the samples of different types of granite stones, for the approval of the Engineer-in-charge prior to the execution of the item.

ii. The mock up (one each) shall be prepared in staircase, lift wall and lift lobby, kitchen counter and window sill.

iii. 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 Engineer-in-Charge, 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.

iv. 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 Engineer-in-Charge.

v. 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 Engineer-in-Charge 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.

vi. 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.

vii. 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.

viii. 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 Engineer-in-Charge. 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 Engineer-in-Charge. 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 Engineer-in-Charge.

ix. The specifications for dressing, laying, curing, finishing, 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.

x. Granite of any colours and shades, 18 mm thick gang-saw cut stones, mirror polished, pre-moulded and pre-polished, machine cut for flooring/ flooring bands to be provided as per the drawings and schedule of finishes, of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels.

xi. Granite of any colour, 18 mm thick gang-saw cut, mirror polished, pre-moulded and pre-polished, machine cut for skirting, riser for steps, dado, etc., to be provided as per the drawings and schedule of finishes, of
xii. Granite of approved colour and shade 18 mm thick gang saw cut, mirror polished, pre-moulded and pre-polished, machine cut for kitchen platforms, vanity counters, window sills, copings, facias to be provided as per the drawings and schedule of finishes, of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand) or with epoxy resin based adhesive, joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels.

xiii. Flamed-finish/ Leather-finish granite stone slab Jet Black, Cherry Red, Elite, Brown, Cat Eye or equivalent for flooring/ flooring bands in required design and patterns, all complete to be provided as per the architectural drawings/ schedule of finishes with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge.

xiv. Edge moulding to be provided for all stones used for counters, vanities, steps, copings etc., including machine-polished edges to give high gloss finish etc. complete as per design approved by Engineer-in-Charge.

xv. Marble/ granite stones, in fascia, jambs and soffits (as per schedule of finishes/ drawings) upto 150 mm wide to be fixed with epoxy resin-based adhesive other shall be fixed with cement mortar 1:3 (1 cement : 3 coarse sand)

xvi. Opening of required size & shape for wash basin/ kitchen sink in kitchen platform, vanity counter, etc., in marble/ granite/ stonework to be provided, including necessary holes for pillar taps etc. and moulding, rubbing and polishing of cut edges etc. complete.

xvii. Granite stone slab of approved shade, with table rubbed, edges rounded and polished, of size 75x50 cm deep and 18 mm thick, fixed in urinal partitions by cutting a chase of appropriate width with chase cutter and embedding the stone in the chase with epoxy grout or with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) and finished smooth, as per drawing and direction of Engineer-in-charge.
NOTES:
1. For Vitrified tiles, Rectified tiles, ceramic tiles and ceramic glazed tiles shall be not less than 10% recycled material content to be used as per GRIHA norms for which necessary certificated to be submitted by contractor.

2. 18mm thick Gang saw Cut Granite slab while bringing to site minimum size should be 2700mm X 900mm and maximum size 3300mm X 2000m. Nothing extra shall be payable towards cutting/ wastage of stone for executing the flooring works as per approved flooring patterns. Less than minimum size and thickness mentioned above shall not be allowed at site.

### 10. Roofing & False ceiling

General (applicable for all kinds of roofing works under this sub-head):

i. 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.

ii. 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 per the architectural drawings.

iii. 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 Engineer-in-Charge prior to execution of the item.

iv. 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. 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 for the work, otherwise, it shall be dismantled by the contractor as directed by the Engineer-in-Charge 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.

   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. The installation shall be got done through an experienced installer, executing similar works.

v. 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.

vi. 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.

vii. The Contractor shall obtain and submit to the Department the manufacturer’s test certificate / report for compliance of the material to the relevant standards alongwith each lot of material supplied for the work.

viii. 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.

ix. 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.

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.. 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.
Gola at roof, 75x75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge) to be provided, including finishing with cement mortar 1:3 (1 cement : 3 fine sand) as per standard design in 75x75 mm deep chase.

Making khurras 45x45 cm 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 1 m x 1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and finally finishing the top surface with broken white glazed tiles with cement and grouting the joints with white cement. and finishing the outlet complete.

8mm thick Calcium Silicate Board made with Calcareous & Siliceous materials reinforced with cellulose fibre manufactured through autoclaving process false ceiling to be provided as per schedule of finishes/ drawings at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of calcium silicate board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cut-outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge.

20 mm thick bevelled Tegulareddges mineral fibre false ceiling tile (Minimum NRC 0.9) mineral fibre false ceiling tiles to be provided at meeting room as per drawings/schedule of finishes, at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling.
using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main “T”. The system should rest on periphery walls/partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge.

Thermal insulation of ceiling (under deck insulation) to be provided at topmost ceiling of the building with Resin Bonded Rockwool conforming to IS:8183,density 48 kg/m3, 50 mm thick, wrapped in 200 G VirginPolythene bags fixed to ceiling with metallic cleats (50x50x3 mm)@ 60 cm and wire mesh of 12.5mm x 24 gauge wire mesh.

Hook on perforated/ non perforated Aluminium metal ceiling system to be provided as per schedule of finishes/ drawing of Durlum, SAS, DAMPA, Invantage, Dynamix, with 0.70 thick. Aluminium ceiling planks/sheet with up to 300/600mm width and length up to 1100/2200mm and having 60 microns electro statically polyester powder coating or digital printing. The ceiling tile/plank shall have square edge & bend to 30 to 50mm deep hook shaped. The tile/plank shall be hooked into U/Z profile made of GMS (galvanised mild steel with the size of 20X50X30mm & 1.25mm thick). The U/Z profile shall be connected to Slotted Angle made of GMS (Galvanised Mild steel with the size of 30X30X1mm) at the spacing of 1200mm c./c. with the help of 25X6mm size nut-bolts. The angle shall be powder coated. The secondary angle shall be hanged from roof with the help of 25X6mm dia fastener and 6mm threaded suspenders. Whole the ceiling system must be green building product. All properly levels & finishes completes as per approved pattern /design and direction of Engineer in charge

Micro perforated ceiling panel made of aluminiumsheet (exposed side powder-coated) to be provided in seminar hall & stage, design & size as per drawing, have NRC equal to or better than 0.80, Micro holes dia. 0.04 - 0.08mm, water resistant, no back material, warranty 20 years, electromagnetic immunity – 40% than general aluminium, dust proof, incombustibility Class A, Acid/ Alkali resist water tolerant, Non-toxic recyclable install with hook-on system. All material to be approved by the Architect prior to installation. The design, colour and shape of the panel shall be approved by the Architect, including the hook-on system of main runners, cross tees, wall angles and hanger wires complete with hanging arrangement to suspend from the main ceiling/slab. All Makes and models of all items/samples should be approved by the Architect prior to the installation.

UniStone SAFS ALWOOD non-combustible Extruded Aluminium Batten System in approved wooden shades to be provided in false ceiling as per drawing/ schedule of finishes, in minimum thickness from 2.2mm to 3.5mm as per approved design in profile size of 50mm X 100mm (50mm gap between the battens) with corner radius and aluminium End Caps and 7-8mm male-female system for fixing support mechanism using extruded grooved rail profile in minimum 3mm thickness and
aluminium cleats on sub-frame allowing linear thermal expansion and contraction. The battens, cleats and support rail and all flashings and starter etc. must be 6063 in T6 temper supported with MTC. The wooden texture/colour on aluminium plank shall be done using Super Durable Powder coating and heat film transfer up to 80micron and warranted for minimum 15 years in exterior conditions to meet or exceed qualicoat/AAMA 620 specification.

Backlight stretch ceiling with aluminium profile & all accessories (German Quality) to be fixed as per schedule of finishes, complete as per details drawing, as specified & as directed by architect, white code (4011), Net weight 200-250/m², Afford weight 1.95kg/m², Thickness 0.18mm, Fire resist,100% Recyclable, Translucent rate 75%, Working temperature -30-60 degrees, (10 years guaranty) including supply & installation of GOQ LED powered by Samsung made in Korea 1.08 W along with drivers, 3 year warranty, Colour Temperature As approved by architect.

In all the false ceilings, trapdoor/inspection door in false ceiling for services inspection shall be provided. For location & size of trap door, shop drawing to be provided by the contractor for approval by Engineer-In-Charge.

The contractor shall prepare coordinated shop drawing/s for false ceiling, taking into consideration lights, HVAC grilles, fire sprinkler, smoke detector, etc. For seminar hall, interior & acoustic works shall also be considered and the scheme shall be prepared in totality, for approval of Engineer in charge.

11. FINISHING WORK:
The work shall be done in accordance with CPWD specifications Volume - I & II with correction slips up to the last date of submission of tender documents.

Wherever directed by the Engineer in Charge, all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. Where grooves are not called for, the joints between concrete members and masonry in filling shall be covered by 24-gauge 8 mm size galvanised chicken wire mesh of approved width to be provided at all the junctions of concrete and brick work and other locations called for including necessary laps and U shape galvanised wire nails, complete as per direction of the Engineer-In-Charge, at all heights.

Smooth finishing of the exposed surface of R.C.C. work with 6 mm thick cement mortar 1:3 (1 Cement : 3 fine sand) at all heights.

20 mm cement plaster in external walls mixed with waterproofing compound in recommended proportion, as per manufacturer’s instructions, on the rough/ fair side of single or half brick wall/ AAC block wall, columns & beams of mix : 1:4 (1 cement: 4sand, which should be 50% course fine sand & 50% fine sand) at all heights.
12 mm cement plaster in internal walls on the side of ACC block wall, brick wall, parapets walls, columns & beams of mix :1:6 (1 cement: 6 sand, which should be 50% course fine sand & 50% fine sand))

Distempering (two or more coats) over cement primer, and including water-thinnable priming coat, with 1st quality acrylic distemper (ready mixed) having VOC content less than 50 gms/litre, of approved manufacturer, of required shade and colour complete as per schedule of finishes and as per manufacturer’s specification.

Finishing walls with Premium Acrylic Smooth exterior paint with Silicone additives of required shade (two or more coats applied @ 1.43 litre/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm) as per schedule of finishes.

Wall painting with acrylic emulsion paint of approved brand and manufacture to give an even shade, two or more coats, as per schedule of finishes.

Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade, two or more coats over an under coat of suitable shade with ordinary paint of approved brand and manufacture as per drawing and schedule of finishes.

All the cement plastering to be added with Synthetic Polyester triangular fibre of length 6mm of approved brand and manufacturer, effective diameter 10-40 microns and specific gravity of 1.34 to 1.40 in cement plaster/mortar by using 125 gms. of synthetic Polyester triangular fibre for 50 Kgs cement used in cement mortar as per directions of Engineer-in-Charge.

White cement-based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete to be provided as per schedule of finishes.

All the external surfaces of the building to be finished with texture paint finish (SKK Eleganstone Sagan colour ES-005, groove colour light grey). This stone texture coating ceramic stone finish, consisting of water based Natural fine ceramic stone material which is highly abrasion & scratch resistant, with 6 coat system & PU Based clear topcoat which shall be highly water repellent, anti-algae & anti-fungal in nature. The coating shall also cover hairline cracks with application method which includes Surface Preparation, 2 coats of two component silicate based primer (a two-component silicate-based inorganic polymer undercoat), Making groove, 2 coats of Fine Ceramic Stone finish (wet on wet) & 2 coats of PU based clear top coat (Turpen-based, mild solvent, super-dirt resistant NAD type two pack polyurethane clear topcoat) complete as per direction of the Engineer-In-Charge.

24-gauge 8 mm size galvanised chicken wire mesh of approved width to be provided at all the junctions of concrete and brick work and other locations called for including necessary laps and U shape galvanised wire nails, complete as per direction of the Engineer-In-Charge, at all heights.
18 mm thick granite, gang-saw cut, mirror polished, pre-moulded and pre-polished, machine cut for coping, etc., to be provided as per the drawings and schedule of finishes, of required size, approved shade, colour and texture over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels.

Acoustic wall Panelling (66 mm) with finishing of 16 mm thick Grooved wooden acoustic panel of size 575mm x 2420 mm, Groove Size 3.2mm at an interval of 28 mm c/c to be provided at seminar hall & stage as per acoustic design / Engineer-in-Charge approval, The wooden acoustic panels to be backed with black acoustic fleece. All joints of wooden acoustic panel should have dowel connection to avoid any sagging /unevenness. All wooden acoustic panels should be fixed on GI 'Z' clamp made out of 1 mm thick GI sheet of size 30 mm x 30 mm collar and 50 mm high to match with the installed GI frame. The grooved acoustic panel laminated in desired shade as per Engineer In charge approval. The 'U' channel grid of size – 50 x 32mm thick made out of GI sheet, 0.5 mm thick, ISI mark. The grid size will be – 600 x 900mm fixed to wall using all screws of Stainless steel. Cavity of grid shall be filled with Tissue fibre paper laminated Rockwool density 64 kg/cum confirming to IS 8183 to achieve the 1.0 NRC value and finally and finally wooden acoustic panel fixed on GI Channel grid as final finish. Panels to be tested as per IS:8225/ISO: 354/ASTM 423C, Test report form OEM to be submitted. All Makes and models of all items/samples should be approved by the Architect prior to the installation.

Compressed Polyester fibre acoustical panels, 9 mm thick acoustic polyester fibre pad pasted on 16 mm thick perforated wooden panels by rubber-based adhesive for rigid fixation to be provided at seminar hall. The Polyester fibre acoustic panels to be backed with black acoustic fleece. Total thickness of the Composite Acoustic panel will be 25 mm. All joints of Polyester fibre acoustic panel should have dowel connection to avoid any sagging /unevenness. All Polyester fibre acoustic panels should be should be fixed on GI 'Z' clamp made out of 1 mm thick GI sheet of size 30 mm x 30 mm collar and 50 mm high to match with the installed GI frame. The edges of the polyester fibre pad to be taper cut by special purpose machine to produce a 'V' joint at all four ends. The Polyester fibre acoustic panel of size 600 mm x 600 mm / 600 x 1200 mm, with a perforated pattern of dia. 08/10 mm or as per acoustic design / Architects approval for better absorption. The polyester fibre to be chemically treated for fire retardancy. The system will be installed with a 42 mm thick acoustic backing of Tissue fibre paper laminated Rockwool density 64 kg/cum, confirming to IS 8183 to achieve 0.9 NRC value. The Panels color and pattern shall be as per approved design. All Makes and models of all items/samples should be approved by Consultant prior to the installation.

UniStone SAFS ALWOOD non-combustible Extruded Aluminium Batten System in approved solid shades to be provided at building elevation as per drawing/schedule of finishes, in minimum thickness from 2.2mm to 3.5mm as per approved design in profile size of 50mm X 50mm (50mm gap between the battens) with corner radius and aluminium End Caps and 7-8mm male-female system for fixing support mechanism using extruded grooved rail profile in minimum 3mm thickness.
and aluminium cleats on sub-frame allowing linear thermal expansion and contraction. The battens, cleats and support rail and all flashings and starter etc. must be 6063 in T6 temper supported with MTC. The wooden texture/colour on aluminium plank shall be done using Super Durable Powder coating and heat film transfer up to 80micron and warranted for minimum 15 years in exterior conditions to meet or exceed qualicoat/AAMA 620 specification.

All Aluminium sections should be protected against scratching with polyethene wrap stickers till completion of the building/ handover of the building whichever is later. If any damage or scratches are visible in aluminium sections at handing over, the same shall be rectified on contractor’s risk and cost. The polyethene wrap stickers are compulsorily to be removed upon completion, before use of the building.

All aluminium works shall be executed through approved specialized agency. Approval shall be accorded by the Engineer in charge.

12. WATER PROOFING & MISCALLOUS WORKS:

General
The Contractor shall be responsible for the water proofing design, proper installation and performance of waterproofing systems to make the sub grade and superstructure completely watertight.

The Contractor shall engage a qualified waterproofing specialist sub-contractor, preferably manufacturer authorized applicator to install or supply & install the waterproofing system, all in accordance with the manufacturer’s recommendations & approved water proofing details.

For the Quality assurance and quality of workmanship, waterproofing specialist applicator should be proficient in handling and installing water proofing membrane and the applicator shall be approved by CPWD qualification criteria.

Waterproofing specialist applicator should have the proven track record, technical reliability, capability and agreement to supply full technical assistance, expert supervision during installation and performance guarantee. The Contractor shall submit the name of his Specialist waterproofing contractor (waterproofing applicator) for approval along with work experience certificate of satisfactorily completion of similar nature of three works each costing not less than 40% of estimated cost of water proofing work or two works or one work each costing not less then 60% or 80% respectively of estimated cost of water proofing work. The determination of estimated cost of water proofing work under this item shall be done by the Engineer-in-charge on prevailing market rates whose decision shall be final in binding on the contractor.

All Waterproofing system to be Green Certified product.
Integral crystalline admixture for water proofing treatment to RCC structures of overhead water tank to be provided at the time of transporting of concrete into the drum of the ready-mix truck, using integral crystalline admixture @ 0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer’s specification in reinforced cement concrete at site of work. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the Engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.

Integral cement-based water proofing treatment with average thickness of 150 mm and minimum thickness at khurra as 65 mm including preparation of surface as required for treatment of roofs, mumty, terraces etc consisting of following operations:

a. Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.

b. Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand ) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.

c. After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer in-charge.

d. Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the top surface with broken white glazed tiles with cement and grouting the joints with white cement.
The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test."All above operations to be done in order and as directed and specified by the Engineer-in-Charge.

Water proofing in sunken portion of WCs, bathrooms, balconies, usable terraces, etc. to be provided as follows:

a. Highly elastomeric, self-levelling two component polyurethane based waterproofing coating with 100% solids, having elongation of 600% and tensile strength of 6Mpa, crack bridging ability of 3mm, bonding strength to concrete @1.5N/mm2 and tear strength of 30N/mm, applied at 1.7kg/Sqm to achieve a minimum thickness of 1.5mm. The system includes base preparation of cleaning, brushing and removal of flaky materials, grouting the porous area with cementitious grout, proper coving between slab and wall junctions and priming the surface with epoxy resin-based primer applied @ 150gms/Sqm. The entire system of supply of material and installation should be done directly by the manufacturer through in-house team with a guarantee of 10 years against leakages, to be supported by an insurance backed system guarantee (for both supply and application) for a period of 5 years of waterproofing works, complete as per direction of the Engineer-In-Charge.

b. 120gsm Geotextile over the entire horizontal area maintaining proper overlaps including slope making and protection to the waterproofing treatment with 40 mm avg. thick M25 grade screed for floors, complete as per direction of the Engineer-In-Charge.

c. Vertical protection in 15 mm thick with CM 1:4 for wall plastering admixed with integral waterproofing compound admixed @ 0.2litre/bag of cement as per manufacturer’s specifications including curing etc. Complete as per direction of the Engineer-In-Charge.

Orange colour safety foot rest to be provided at overhead water tanks during casting of concrete, maximum distance between foot rest not more than 300mm c/c at each manhole opening, of minimum 6 mm thick plastic encapsulated as per IS : 10910, on 12 mm dia steel bar conforming to IS: 1786, having minimum cross section as 23mm x 25mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to withstand the bend test and chemical resistance test as per specifications and having manufacture’s permanent identification mark to be visible even after fixing.

C.I. cover with frame 455x610 mm rectangular C.I. cover (light duty) not less than 15 kg the weight of the cover to be not less than 23 kg to be provided at overhead water tank. Two nos. of cover should be provided at each RCC overhead water tank.

NOTE: All Waterproofing works shall be executed through approved specialized agency / Authorised applicator of Water Proofing material manufacturing company.
13. **ROADS AND PARKING**

i.

250 mm thick Vacuum dewatered cement concrete M25 laid to required slope and camber including consolidation, finishing and tamping complete, over 100mm thick PCC 1 : 4 : 8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size) over 100mm thickstone soling under roads including packing with smaller stones and consolidation with road roller including spreading and consolidation of blinding material, moorum or earth etc. consolidation of sub grade with power road roller of 8 to 12 tone capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade. Hard drawn steel wire fabric 100mm c/c both ways, 3.15mm dia, reinforcement should be provided in cement concreate pavements.

De-vacuumization shall be done for removing the voids. The whole concrete surface shall be leveled, compacted by ramming and trowelling. Prepared surface shall be allowed to set. Excessive trowelling shall be avoided. After the initial set, further compaction shall be done by steel trowelling. Final brushing where required (to achieve desired surface finish) shall be made before the floor top becomes too hard. Curing shall be done as per CPWD Specifications.

25mm Mild steel dowel/tie bars including greasing, PVC pipe of approved make and size, etc. to be provided in concreate pavements as per drawing/direction of Engineer-in-charge.

Bitumen impregnated fibre board conforming to IS:1838 including primer, sealing compound with polysulphide sealant to be provided in expansion/construction joints of roads/parkings/concrete pavements as per drawing/direction of Engineer-in-charge.

Exposed precast cement concrete factory made kerbs of size 150mm x 300mm in design mix M25, set in cement mortar 1:3 (1 cement : 3 course sand) and finished smooth over 150mm thick PCC1 : 4 : 8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size) as per drawing/direction of Engineer-in-charge. Thickness of joints except at sharp curve shall not to more than 5mm. The works including making drainage opening wherever required complete etc. as per direction of Engineer-in-charge.
14. PLUMBING WORK

Section – 1

General Requirements

The general character and the scope of work to be carried out under the contract is illustrated in Specification, Drawings, Specifications and Schedule. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer-in-charge. The contractor shall furnish all labour, materials and equipment as listed under Schedule F and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing and Fire Protection system described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

Work shall be executed as per drawing, latest CPWD specifications, relevant IS code of latest addition, NBC -2016 and other local bye laws whichever is stringent.

1.0 Scope of work

Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary as required to finish the job. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the plumbing specifications of quantities and/or shown on the plumbing drawings.

1.1 Plumbing Works includes:

i) Sanitary Fixture and CP Fittings:

- Supply and fixing of Sanitary Fixtures
- Supply and fixing of C.P. fittings
- Testing and commissioning of Sanitary fixture and C.P. fittings

ii) Water supply hot and cold water:

- Internal Water supply piping treated water and potable water.
- Connection of building water supply connection to the existing external mains and water meter including inspection chambers for both STP treated water and potable water.
- GI pipe of sizes as per drawings and per CPWD Specifications (Only from Valve chamber to OHT for domestic water and flushing water)
- SS 304 pipe and fittings for all internal, shaft and terrace for hot water an domestic water.
iii) Soil, Waste & Vent Water Piping:

- PP Pipe and fitting for Vertical and horizontal Soil, Waste and Vent pipe.
- PP vertical and horizontal pipes for laboratory waste.
- R.C.C. NP2 pipes for sewage external piping on site level till nearby existing sewer line.
- HDPE external piping for laboratory waste on site level till ETP/Holding tank.
- Floor traps, floor drain, clean out plug inlet fittings rainwater roof drain as per IS codes.
- Testing of all pipes for water tightness.
- PP Pipe and fitting connections from all fixtures e.g. wash basin, sinks.

iv) Storm Water drainage system:

- Rainwater – PP Vertical pipe up to first catch basin and R.C.C. NP2 pipes for storm water external piping on site level.
- The storm water pipe shall be connected to the rain water harvesting recharge pit through disilting chamber.
- Overflow from rain water harvesting recharge pit to connect to the existing drain as per site.

v) Water Supply:

- Potable Water: Main Inlet line from valve chamber shall be with 65mm dia GI pipe, exposed on wall/shaft domestic supply with 65 mm dia connection to overhead tank including water meter.
- Flushing Water: Main Inlet line from valve chamber shall be with 25mm dia GI pipe, exposed on wall/shaft flushing supply with 25mm dia connection to overhead tank.

vi) Drinking Water:

- Standalone Water fountain including RO and online chiller.

2.0APPLICABLE CODES AND STANDARDS:

The following codes of practice and design manuals are being referred for designing the Sanitary Plumbing and Fire Fighting Systems:

- Handbook on Water Supply & Drainage (with Special Emphasis on Plumbing), Bureau of Indian Standards SP-35
- Manual on Water Supply & Treatment (Ministry of Urban Development)
- Manual on Sewerage & Sewage Treatment (Ministry of Urban Development)
- CPWD Specifications

3.0QUALITY ASSURANCE AND QUALITY CONTROL:
3.1 The work shall conform to high standard of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.

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

3.3 The Engineer-in-charge shall be free to carry out such tests as may be decided by him at their sole direction, from time to time, in addition to those specified in this Document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.

3.4 The test shall be conducted at Standard Laboratory approved by Engineer-in-charge. Contractor shall keep the necessary testing equipment such as hydraulic testing machine, smoke testing machine, gauges and other necessary equipment required at site.

3.5 In case of any testing required on the direction of Engineer-In-Charge, the Contractor's representative shall transport the samples to the laboratory.

3.6 Testing charges shall be borne by the Contractor.

Section – 2: Sanitary Fixtures and Fittings:

1.0 Scope:

Work under this section shall consist of transportation, providing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary pipes, fixtures, brass and chromium plated fittings and accessories as mentioned in plumbing schedule.

General Requirements

1.1 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition mentioned in drawings.

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

1.3 Fixing screws shall be half round head chromium plated brass with C.P. washers as per requirement.
1.4 All fittings and fixtures shall be fixed in a neat workmanship 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. Faulty locations shall be made good and any damage to the finished floor, wall surfaces shall be made good at Contractors cost.

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

1.6 All fittings shall be of the chromium plated materials.

1.7 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.

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

2.0 Sanitary Fixtures & C.P Brass Fittings

Plumbing fixtures, Chrome Fittings and accessories will be as per IS: 781-1984.

Porcelain fixtures of fairly high quality as given below.

Inventory of Fixtures & fittings:( quantities are tentative)

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Providing and fixing white vitreous china white type <strong>water closet</strong> THE GAP ROUND WC WH Rimless with S&amp;C The Gap Round (Supralit) FF 4 Ltr HF 2 Ltr RS3460NL000 RA801D12001 (Roca Make or equivalent)</td>
</tr>
<tr>
<td>1.2</td>
<td>Providing and fixing <strong>Kitchen sink with drain board</strong> (40” L x 20” W x 8” D) C853199 Parryware make or equalant Single Bowl with Drain Board Folded Edge - Gloss Finish including painting of fittings and brackets ,cutting and making good the walls wherever required:</td>
</tr>
<tr>
<td>1.3</td>
<td>Providing and fixing RE890010200 RE890195001 Slendra plus concealed cistern for <strong>wall hung wc</strong> (Roca Make or GROHE OR DURAVIT)</td>
</tr>
<tr>
<td>1.4</td>
<td>Providing and fixing <strong>Bottle trap</strong> 32 mm (syphon type) with 110 mm inlet &amp; 330 mm outlet connection pipes RF9066A1 Roca or equivalent and as per the direction of Engineer-in-charge.</td>
</tr>
<tr>
<td>1.5</td>
<td>Providing and fixing <strong>CP Brass Single lever telephonic</strong> wallmixer of quality &amp; make as approved by Engineer in charge. RT5A0109C02 Wall mixer with hand shower Roca make or equivalent</td>
</tr>
<tr>
<td>1.6</td>
<td>Providing and fixing <strong>beveled edge</strong> mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.</td>
</tr>
<tr>
<td>1.7</td>
<td>Providing and fixing 600x120x5 mm <strong>glass shelf with edges round off</strong>, supported on anodised aluminium angle frame with C.P. brass brackets and guard rail complete fixed with 40 mm long screws, rawlplugs etc., complete RA816372001 Roca or Equivalent</td>
</tr>
<tr>
<td>1.8</td>
<td>Providing and fixing <strong>toilet paper holder</strong>: RA816384001 (Roca or equivalent)</td>
</tr>
<tr>
<td>1.8.1</td>
<td>Providing and fixing <strong>white vitreous china extended wall mounting water closet</strong> of size 780x370x690 mm of approved shape including providing &amp; fixing white vitreous china cistern with dual flush fitting, of flushing capacity 3 litre/6 litre (adjustable to 4 litre/8 litres), including seat cover, and fittings, nuts, bolts and gasket etc. RS346237000 RA801230004 Roca make or equivalent (Disabled) complete.</td>
</tr>
<tr>
<td>1.8.2</td>
<td>Providing and fixing of RS327230000 Access wash basin for disabled complete as per requirement (Roca make or equivalent)</td>
</tr>
<tr>
<td>1.8.3</td>
<td>Providing and fixing of T4414A1 Basin mixer for disabled with long handle (Parryware make or equivalent)</td>
</tr>
<tr>
<td>1.8.4</td>
<td>Providing and fixing of Soap Dispenser with all accessories as required and making good the walls wherever required. RA816391001 Roca or equivalent</td>
</tr>
<tr>
<td>1.8.5</td>
<td>Providing and fixing SS 316 grab bar 600 mm long complete with brackets fixed to wooden cleats with CP brass screws with concealed fittings arrangement of approved quality and colour. RA816671001 (Roca make or equivalent)</td>
</tr>
<tr>
<td>1.8.6</td>
<td>Providing and fixing Grab Bar Vertical Swing, complete with brackets fixed to wooden cleats with CP brass screws with concealed fittings arrangement of approved quality and colour. T6608A1 (Parryware or equivalent)</td>
</tr>
<tr>
<td>1.13</td>
<td>Providing and fixing Health Faucet ABS with double lock 1.2 m long 8mm dia and SS flexible hose and wall hook includin CP flange. 15mm dia. RF9060A1 (Roca or equalant)</td>
</tr>
<tr>
<td>1.15</td>
<td>Providing and fixing of Over counter wash basin and waste coupling RF5054019A1 RS327520000 Size 500 x 3700 mm Roca Make or equalant</td>
</tr>
<tr>
<td>1.16</td>
<td>Supply, installation , testing &amp; commissioning of 15mm CP brass single lever emergency shower with adjustable type arm with wall flange with slip fit connection &amp; hand shower with flexible pipe with bracket complete as required by the engineer in charge.</td>
</tr>
<tr>
<td>1.17</td>
<td>Providing and fixing Coat Hook RA816650001 (Roca Make or equivalent)</td>
</tr>
<tr>
<td>1.18</td>
<td>Providing and fixing of RT525165003 RT5A8202A0N RS35364P460 Urinal sensor battery with Gap back inlet urinal Size 325 x 270 x 510mm complete as per manufacturers specification and direction of Engineer-in-charge.</td>
</tr>
<tr>
<td>1.19</td>
<td>Providing and fixing uplasticized connection pipe with brass union:</td>
</tr>
<tr>
<td>1.19.1</td>
<td>45 cm length</td>
</tr>
<tr>
<td>1.19.2</td>
<td>15 mm nominal bore</td>
</tr>
<tr>
<td>1.20</td>
<td>Providing and fixing of Bib tap with decor base plate, easy clean coin shape aerator, quarter turn operation RT5A3C09C0N (Roca Make or equalant)</td>
</tr>
<tr>
<td>1.21</td>
<td>Providing and fixing 2 in 1 Panel (Tissue Roll Dispenser + Waste Receptacle) Multifunction Washroom Panel (Consisting of Tissue Dispenser + Waste Receptacle),Wall Opening Required : 390mm (W) x 1377mm (H) x 100mm (D)</td>
</tr>
<tr>
<td>1.21</td>
<td>Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality RF525164500 (Roca Make or equivalent)</td>
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</table>

**RO SYSTEM**

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</table>
Supply of wall hanging drinking online water cooler with bottle filler facility, made by stainless steel top and heavy duty galvanized steel frame. With cooling capacity, ADA Compliant, size 472 mm Depth X 447 mm width, flexible bubbler guard, operated between 50 to 120 PSI, Chiller unit Suitable to R134a Refrigerant, Adjustable thermostat control, suitable for 220-230v/50-60 hz A/C Supply Complete with all accessories which include MD-CU29, which is an EPA registered antimicrobial copper that fights off microorganisms which include MRSA and e-coli. The water Fountain shall possess NSF-USA, Green building, energy star saving certification, and to be placed at different location of building. installing the Water Fountain for proper functioning and aesthetic view as directed by the engineer-in-charge without any extra cost.

- Neo sense Filter-10” X 2.5” Dia, Resin filter-10” X 2.5” Dia, Carbon Filter-10” X 2.5 ” Dia, Activated Carbon Block Filter, Booster Pump To Pressurize 300 GPD –2 Nos, Membrane 300 GPD – 2 Nos, Pressure Meter-1 Nos, Auto Flushing Solenoid Valve -1 Nos, Production Rate-Up to 50-60 Lph. Feed Water 1000 ppm. Max. (Raw Water) Recovery Appx. 60%, Power Consumption 24 Volt DC -1 Nos 60 ltr pressure tank Pressure wave enclosed tank Single diaphragm, NSF Certified, virgin polypropylene liner, tow part polyurethane, epoxy primed paint finish, leak free, o ring sealed air valve cap. UV Light Alfa uv light.

3.0 Sample Toilet and Trial Assembly:

The contractor shall assemble at least one set of each of the sanitary fixtures and fittings for determining the required supply and disposal connections on the basis of plumbing drawings and specifications approved in sample toilet by Engineer-in-charge. The installation shall also be as per the relevant instructions from the manufacturers of the fittings/fixtures.

The sample toilet shall be made as per the actual final layout, to determine the exact location of puncture holes, holding devices etc. The sample toilet shall be subject to final approval by Engineer-in-charge.

4.0 Supporting and Fixing Devices:

The fixing devices to install the sanitary fixtures securely in position shall be provided in drawing. The fixing devices shall be rigidly anchored into the building structure and shall be fixed in a neat and uniform manner, so as not to present unsightly appearance in the final assembly. The fixing devices shall be rust proof for durability. Wherever aesthetics demands, the Architect may instruct the tenderer to provide chromium plated finished fixing devices, complete with appropriate vibration isolation pads, gaskets and washers etc.
5.0 **Final Installation:**

The approved sample toilet and the approved Plumbing drawings shall form the basis for final installation of all sanitary fixtures. The installation shall be complete with supply and waste connections and the proper unions/flanges shall be provided for easy removal/replacement of sanitary fixtures without disturbing the piping system. All flanges/union shall match in appearance with exposed fittings. All the fixtures shall be rigid mounted, plumb and in alignment.

The possibility of movement and settlement shall be kept in mind while mounting the fixtures. The outlets of water closet and similar appliances shall be examined to ensure that outlet ends are butting on receiving pipes before making the joints. Checks shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances. Proper overflow connections shall also be ensured.

6.0 Every necessary precaution shall be taken by the Contractor to protect all sanitary fixtures against damage, misuse, pilferage, cracking, staining, chipping etc., by proper wrapping and locking arrangement till completion of the installation. The fixtures shall be cleaned, disinfected and polished prior to handing over. Any fixtures found with any of the damage outlined above, or any other defect/damage shall be removed and new fixtures free from any defects installed at no extra cost, to complete the installation.

Rate for providing and fixing of sanitary fixtures, accessories, should be include all items and operations stated in the respective specifications, and nothing extra is payable.

Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

**SECTION – 3: WATER SUPPLY (COLD / HOT WATER)**

1.0 **SCOPE:**

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings.

Without restricting to the generality of the foregoing, the water supply system shall include the following:

i. Pipe protection.
ii. Connections to all plumbing fixtures, tanks etc.
iii. Control valves.
iv. Internal water supply piping inside the toilets shaft/terrace.
v. Testing all line and fixtures as specified.
vi. Connection from existing external to the building riser including valve chamber and water meter.

2.0 GENERAL REQUIREMENTS:

- All materials shall be new of the best quality and shall be furnished, delivered, erected, connected and finished in every detail conforming to specifications and subject to the approval of Engineer – in-charge/Client.
- Pipes and fittings shall be fixed truly vertical, horizontal as required in a neat workmanlike manner.
- Short or long bends shall be used on all main pipelines as far as possible. Use of elbows shall be restricted for short connections.
- Pipes shall be fixed in a manner as to provide easy accessibility for repair, maintenance and shall not cause obstruction in shafts, passages etc. and shall be selected and arranged so as to fit properly into the allocated building space.
- Pipes shall be securely fixed to walls by suitable clamps at intervals as specified in CPWD specifications.
- Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.
- As per site requirement shaft size can be increased for easy maintenance purpose.
- All pipes running in sunken area shall be provided with desired slope.
- Sanitary fixtures & fittings may be re-located as per site requirement without paying additional cost.

**Unions:**

Contractor shall provide adequate no. of unions on all pipes to enable dismantling later and for servicing. Union shall be provided near each valve.

3.0 INTERNAL WORKS:

**GI PIPES & FITTINGS**

- Potable Water: Main Inlet For domestic water Supply from valve chamber to RCC over head tank should be with 65 mm GI pipe on exposed on wall /Shaft.
- Flushing water: Main Inlet For Flushing water Supply from valve chamber to RCC over head tank should be with 25mm GI pipe on exposed on wall /Shaft.
All terrace water supply pipe should be 25 mm to 100mm dia as per drawing.

From RCC over head terrace tank to individual toilets shall be SS 304 pipe with 100mm/80mm/65mm/50mm/40mm/32mm/25mm exposed on wall as per drawing.

Internal water supply line shall be with 15mm/20mm/25mm/32m SS 304 pipe concealed on wall as per drawing.

3.1 DESCRIPTION

GI Pipe shall be tough, rigid, corrosion resistant, chemical resistant, low thermal expansion, lower bacterial growth, superior installation, hot & cold water compatible, no scale, pit or leach formation, low pressure loss, higher flow rates & unaffected by chlorine in the water.

SS 304 Pipe and Fittings: SS pipes and fittings shall be confirming to JIS 3448 standard complete with press type fittings for hot and cold water supply, RO and domestic water supply system capable to withstand temperature upto 130 C and pressure upto 15 bar made of JIS 304 grade of annealed and pickled stainless steel sheet, with ends debarred at 90 and with length of 3 m. Pipe qualifying to 100% eddy current, 100% hydrostatic tested and air-under water tested 10kgs.

Fittings shall confirm to JWWA G116 standard in JIS 304 grade SS such as tees, coupling, elbow, male adapter, connectors etc with o-ring of EPDM material which can withstand temperature upto -20 C to 110 C of approved make including connection as per site requirements. Direct contact of SS pipe and fittings to galvanized iron should be avoided by inserting approved type of filler material as per Engineer In charge. Flanges, clamps with hanger at a spacing of 2m centre minimum or as required etc necessary adapters, jointing, sundries, cutting holes in walls, floors, slabs and complete in all manner.

4.0 JOINTING PIPES & FITTINGS

4.1 DEBURRING & BEVELLING:

Burrs and fillings can prevent proper contact between tube and fittings during assembly and should be removed from outside and inside of the pipe. Debarking tool, pocked knife or files are suitable for this. A slight bevel on the end of the tubing will ease entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

4.2 HORIZONTAL & VERTICAL Supports:

Horizontal and Vertical runs of pipe should be supported by pipe clamps or by hangers located on the horizontal connection close to the riser hangers should not have rough or sharp edges, which come in contact with the pipe as per CPWD specifications.
5.0 TESTING:

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permitted.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least twenty four hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

6.0 Hot Water System (Electrical Water heaters and Piping on pantry area only)

General

This chapter details Supply, Installation, Testing & Commissioning requirements for Hot Water System. Hot water shall be executed as per drawing. Entire Hot Water Requirement of the building shall be met from Energy Efficient Electric Geysers (for Electrical Geyser provision only) (min. BEE 3 star Rated).

6.1 Hot Water Piping and Insulation.

Piping shall be similar of water supply specified above. Insulation material for Pipe insulation shall be closed cell cross linked polyethylene foam. Thermal conductivity shall not exceed 0.038 W/m K or 0.0313 Kcal / Mhr C or 0.212 BTU / (Hr-ft2-F/inch) at an average temperature of 40°C. The product shall have temperature range of –40 °C to 105 °C. Density of material shall not be less than 0.06 gm/cm3. The insulation shall have fire performance such that it passes minimum CLASS 1 as per BS476 part 7 for surface spread of flame. Water vapor permeability shall not exceed 0.024 per inch (3 x 10-14 Kgs / m.sec.Pa). The material shall have approval from the Chief Fire Officer.

Thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer test certificate for thermal conductivity values. Samples of insulation material from each lot delivered at site may be selected by Owner’s site representative and gotten tested for Thermal conductivity and density at Contractor’s cost all joints shall be sealed properly with adhesive, which shall provide similar vapor barrier as the original insulating material.

All hot water piping shall be insulated in the manner specified herein. Before applying insulation, all pipe shall be brushed and cleaned. Thermal insulation shall be applied as follows or as specified in drawings or schedule of quantity:

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### R.O. Water System

This chapter details Supply, Installation, Testing & Commissioning requirements for R.O. Water System. R.O. water shall be executed as per drawing. The R.O. system consists of 50 LPH capacity along with 60 litres of pressure tank including online chiller. Entire R.O. Water Requirement of the building shall met from individual Drinking water fountains at required points in the building as per drawings. The water fountain shall possess NSF-USA, Green building, energy saving certification.

### VALVES:

### Butterfly Valves:

All the isolation valve 50mm and above on the equipment and water lines, where specified or shown on drawings shall be wafer type butterfly valves. They shall be designed to fit without gaskets, the watertight seal being obtained by Nitrile Rubber seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of M.S. pipe flanges and high tensile steel bolts of dimensions recommended by suppliers of valves. The valves shall comply with following specifications:

a) **Type** : Body 24 Bar seat 16 bar

b) **Valve Component** : Material of Construction
   
i) **Body** : Cast Iron,
   
ii) **Disc** : SS 304
   
iii) **Seal** : Nitrile
   
iv) **Rating** : PN 16

### Installation:

Valve shall be installed in a manner that allows future removal and service of the valve.

Packing and gasket shall not contain asbestos.

The valve shall be of the same size as the pipe to which they are install.
8.2 Ball Valves

Ball Valves shall be of IS 9890, Bronze with screwed female ends to IS 554, flanged ends to ASME B 16.5.

Provide full bore, quarter turn, lever operated ball valves with S/S ball and SS (AISI 410) spindle with Teflon seating and gland packing. All ball valves shall have locking handles to allow servicing and removal of equipment.

Provide lever handle with plastic sleeve on all ball valves unless otherwise noted. Provide extension stem for all ball valves to be installed on insulated piping.

8.3 Pressure Reducing Valve Set:

Pressure Reducing Valve Sets are required where the pressure in the system is more than the pressure required to operate those fittings. To regulate the required pressure the pressure reducing valves shall be provided at appropriate locations or as per drawing where operation and maintenance can be done.

Pressure reducing valve set shall be complete with pressure reducing or pressure regulating valve comprising of isolation valve on outlet, pressure gauges on inlet and outlet, pressure relief valve on inlet and outlet and filter on inlet to remove the foreign materials from the water to protect the pressure reducing valve from damages or malfunctioning.

Pressure reducing valve shall contain loading neoprene diaphragm and full floating, self aligning ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. Pressure should be adjusted as per site and as per NBC 2016 norms with satisfaction of Engineer-in-charge.

Pressure reducing valve set shall be capable of operating and maintaining automatically the respective delivery pressure and flow rate as specified and shall not be liable to creep. Pressure reducing valve set shall also be capable of maintaining the pre-set down stream pressure under static condition.

The filter provided on inlet of pressure reducing set shall be of replaceable porous sintered metal type.

The pressure relief valve provided on outlet of the pressure reducing set shall be fully enclosed type and fitted with hand easing gear.

Pressure relief valve in a pressure reducing set shall be of the same flow capacity for which the pressure reducing set flow.

Pressure gauges provided on inlet and outlet of the pressure reducing set shall be constructed of die cast aluminum and stove enameled. Pressure gauge shall be of weatherproof with an IP SS enclosure and shall be a stainless steel Bourdon tube type pressure gauge with a scale range from 0 – 16kg/sq.cm and shall be constructed as per IS :3524. Pressure gauge shall have a siphon tube connection. The shut of arrangement shall
be by Ball Valve.

8.4 Testing:

All valves shall be tested while installed in pipe by hydrostatic pressure of 1.5 time of the working pressure 7.5 Kg/Sq.cm whichever is more.

8.5 Valve Chamber:

This chapter details construction of masonry Chamber 90x90x100 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for valve, with C.I. surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with surface box with lockable arrangement, i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size ) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per approved drawing with common burnt clay F.P.S.(non modular) bricks of class designation 7.5

SECTION – 4 Internal Drainage (Soil, Waste, Vent and Rainwater Pipes & Fittings)

1.0 Scope:

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required in drawings.

1.1 Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings: -

i. PP vertical and horizontal soil, waste, vent and along with all necessary fittings, joints clamps and connections to fixtures.

ii. PP vertical and horizontal waste pipe in every laboratory area and along with all necessary fittings, joints clamps and connections to fixtures.

iii. PP vertical and horizontal rainwater pipes and along with all necessary fittings, joints clamps and connections to fixtures.

iv. Waste Pipe.

- Wash basin, Sink to Floor trap 40mm dia.
- Floor Drain to Floor trap 50mm dia.

v. Testing of all pipes.

vi. Connection of up to manhole.

2.0 GENERAL REQUIREMENTS
2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer – in – Charge.

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

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

2.4 Pipes shall be securely fixed to walls by suitable clamps at intervals in are specified in drawing or chart mention below.

2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

2.6 All works shall be executed as per drawing.

3.0 PP PIPES & FITTINGS

PP pipe shall be Multilayer Polypropylene piping system as per EN 1451-Part 1-6 with 3 layer pipe made of PP + PP-MD + PP and one layer fittings in PP MD, push-fit type, Halogen and Cadmium free, having high impact resistance as per DIN EN ISO 291:2008-08, Ring stiffness SN6 6KN/m2 as per ISO 9969, offering sound levels of 19 dBA as per EN 14366 at a flow rate of 4 l/s, water tightness as per EN 1451-1 minimum of 0.5 bar for 15 minutes, density of pipe = 1.2-1.4 gms/cm3, elongation = 0.09mm/mn/K and E modulus 2300-3000 as per ISO 178, along with factory fitted EPDM lip ring, Fire Behavior Classification according to EN 13501-1:2009 & classified D-s2-d2 (EN 13501-1), meets the requirements of EN 4102-2 with Fire Classification B2, Smoke Development Category Q1 & Drip Formation category TR1.

3.1 Tolerance

Acceptable tolerance for pipes to IS: 15905 shall be as follows: -

a) Wall thickness -15%
b) Length ± 20 mm
c) Weight ± 10%

3.2 Fittings

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal. Wherever soil and waste pipes are connecting to vertical stack, fittings with access door have to be provided.
3.3 Pipes, Hangers, Supports, Clamps, Brackets etc.:

All vertical soil and waste pipes shall be fixed by Clamps of approved design and size as directed by Engineer-in-charge and painted with synthetic enamel paint with approved primer truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Clamps shall be of approved design as per PP pipe requirement.

Slotted angle/channel supports on walls shall be provided shown in drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC walls shall be neatly drilled by electric drills and no manual chiseling will be allowed. The spacing of supports horizontally shall not exceed 2 M. Wherever clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 (mix 1 cement :2 coarse sand :4 stone aggregate 20mm nominal size) as directed by the Client’s Representative. Bottom bend shall be supported by concrete block as per required shape & size as directed by Engineer-in-charge.

3.4 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 Consultant/Client.

Before use at site, all soil pipes shall be tested by filling up with water for at least 4 hours at 5 meter head. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

3.5 Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not exceed 3 M. The level of water in the stack shall not drop within 24 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.

3.6 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 Engineer-in-charge.
4.0 Waste Pipe from Appliances:
   i) Waste pipe from appliances e.g. wash basins, sinks, shall be of PP
   ii) Waste pipe from laboratory sinks shall be of Polypropylene pipes.
   iii) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase or as per drawings.

5.0 TRAPS:

5.1 Floor Traps:
   Nahani traps or floor traps shall be cast iron, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with waterproof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. The trap shall be installed at lowest point ensure no ponding occurs at perimeters of the drain or as per drawing.

5.2 Floor Trap Inlet
   Bathroom traps and connections shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a galvanized class –B of 100mm dia inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to ‘P’ trap with at least 50mm seal.

5.3 Stainless Steel Cockroaches Trap:
   Floor and traps shall be provided with round Stainless steel cockroaches trap grating as per drawing with rim, of approved design and shape.

6.0 Puddle Flange:
   G.I pipe class - C, puddle flanges for FIRE, domestic OHTs, sizes shall be as per drawing.

Section – 5: External Building Drainage

1.0 Scope:
   Work under this section shall consist of furnishing all labour, materials and appliances necessary and required to completely install the drainage system as required per drawings.
   - Sewer and Waste including lab waste
     1. RCC pipe for sewerage including GTs, manholes and of sizes as per drawings.
II. HDPE Pipe for Laboratory waste including manholes and of sizes as per drawings.

- Storm – RCC pipe for storm including manholes and of sizes as per drawings

**GENERAL REQUIREMENTS:**

All materials shall be new of the best quality conforming to specifications.

Drainage lines shall be laid to the required gradients and profiles.

**2.0 RCC PIPES:**

2.1 All underground storm water drainage pipes and sewer lines shall be RCC pipes NP2. 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.

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 molding. The pipes shall be R.C.C. pipes NP2.

2.2 Laying:

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre-cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance.

2.3 Sewer Appurtenances:

2.3.1 Inspection Chambers and Manholes:

i. **Size of Chambers/Manholes:**
   The size for the chambers, manholes, GTs given in drawings shall be internal finished sizes. The work shall be done strictly as per drawing and following specifications.

ii. **Bed Concrete:**
   Shall be in 1:4:8 cement concrete 230 mm thick.

iii. **Brick Work:**
   Brick work shall be with best quality bricks in 1:6 cement mortar with non-modular class designation 7.5

iv. **Plaster:**
Inside of the walls of chamber/manhole shall be plastered with 12/15 mm thick cement plaster 1:3 (1 cement :3 coarse sand) and finished smooth with a floating coat of neat cement. Manholes shall be plastered from outside as above but with rough plaster.
Water proofing compound as approved by the Consultant/client shall be added in the cement sand mortar ratio as specified by manufacturer.

v. Manhole Covers and Frames:
Medium duty S.F.R.C. manhole covers for sewage having Load bearing capacity of 10 MT.

2.3.2 Catch Basin:
The location given in drawings shall be internal finished size. The work shall be done strictly as per drawing and following specifications.

I. Bed Concrete:
Shall be in 1:4:8 cement concrete 230 mm thick).

II. Brick Work:
Brick work shall be with best quality bricks in 1:6 cement mortar with non-modular class designation 7.5

III. Plaster:
Inside of the walls of chamber/manhole shall be plastered with 12 mm thick cement plaster 1:3 (1 cement :3 coarse sand) and finished smooth with a floating coat of neat cement. Manholes shall be plastered from outside as above but with rough plaster.

IV. Catch Basin Covers and Frames:
R. C. C. perforated Cover and SFRC Frame having Load bearing capacity of 10 MT.

2.3.3 Foot Rests:
All manholes deeper more than 0.6 m shall be provided with plastic foot rests (Polypropylene is injection moulded around a 12mm dia steel reinforcing bar). These shall be embedded 20cm, deep with 20 x 20 x 10cm blocks of cement concrete 1:2:4 (1 cement :2 coarse sand :4 graded stone aggregate 20cm, nominal size). The block with plastic foot rest placed it’s centre shall be cast in situ along the masonry and surface finished with 12mm thick cement plaster 1:3 (1 cement :3 coarse sand) finished smooth.

All cast iron and Mild Steel items shall be provided with two coats of bitumastic paint.

2.3.4 Gully Trap:
Gully traps shall be fixed in cement concrete 1:5:10 mix and a brick masonry chamber 30 x 30cms C.I. sealed cover and frame weighting not less than 7.3 Kgs to be constructed as per standard drawings. Where necessary, sealed cover shall be replaced with C.I. grating.
of the same size (1 cement: 5 coarse sand: 10 stone aggregate: 40mm nominal size).

Gully traps shall be including all excavation, foundation, concrete, brick masonry, cement plaster inside and outside, CI grating and sealed cover and frame.

3.0 HDPE PIPES:

3.1 All underground laboratory sewer lines shall be HDPE pipes. 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.

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.

3.2 Laying:

H.D.P.E spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre-cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance.

4.0 Rain Water Harvesting Pit:

Rain water harvesting pit of 3m dia and of total minimum effective water volume of 20 m3 with 3m water depth per structure including all earth work in excavation, back filling with available excavated earth, with disilting and oil trap, necessary compaction and shifting of surplus earth outside by mechanical means as directed by the Engineer-in-charge, including drilling with RC/DC/Calyx rig having 400/450mm dia bore size in all kind of strata except hard rock, PCC 1:5:10, 200mm thick foundation concrete, brick work in cement mortar 1:4 (1 cement : 4 coarse sand)/RCC as per structural design to be approved PVC coated safety steel foot rest of 12mm dia MS bars grouted rigidly in cement concrete 1:2:4 @300mm c/c, 200mm thick RCC tank cover slab in cement concrete M20 i/c providing and placing necessary steel raft, bars and to keep the provision of removable slab of approx. 1 m x 1m size, filling 300mm, 300mm & 300mm thick of 40-65mm nominal size graded stone aggregate, small stone and sand layer respectively, 100mm dia CI vent pipe, 250mm dia uPVC slotted pipes 6Kg./sq cm working pressure, filling around the slotted pipes and packing 3mm to 6mm sized graded and screened rounded pea gravel duly washed fabricating and placing grating at the mouth of pipes, placing 2 nos. 560mm dia SFRC manhole cover with frame etc. i/e all necessary materials and equipments required for all relevant operations. The depth of drilling and slotted pipes shall be approximately to terminate above the underground aquifer.
4.0 Desilting Chamber:

Constructing Desilting chamber/Oil Trap of brick work with bricks of class 75 with cement mortar 1:5 (1 cement:5 fine sand) plastering internal face with cement mortar 1:3 (1 cement: 3 fine sand and rough plaster on outer face with a floating coat of neat cement. R.C.C top slab with medium duty CI manhole cover and frame of 600 mm dia. The weight of cover to be not less than 58 kg & frame not be less than 58 kg as per standard design. Including excavation, dewatering, refilling, watering, ramming and removing the surplus excavated material complete as required. (All sizes are clear internal sizes). Size 1500 x 1000 mm (Total Depth shall be as per invert level of site shown in the drawings).

FIRE FIGHTING SYSTEM

1.0 General

This chapter details Supply, Installation, Testing & Commissioning requirements of Fire Fighting Works. Fire Fighting system shall comprise of hose reel System, Fire Extinguishers, Fire Brigade Inlet Connection set. Suitable size shafts, cut-outs, Niche, openings etc shall be provided to facilitate installation of Pipelines etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cut-outs, Niche, openings etc provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016. The ratings and capacities of various equipment's are based on NBC 2016 Part - IV and subject to revision during detailed designing stage.

The fire-fighting system is proposed on basis of type of occupancy as per NBC 2016 Part -IV and building Height. First Aid Hose reel at regular intervals according to type of building. The distribution system will be finally connected to ring main system for firefighting.

Work should be executed as per drawing, latest CPWD specification, relevant IS code of latest addition, NBC -2016 and other standard specification. Expect otherwise mentioned in bidding document.

The following standards, bye-law, manual has been followed in designing the firefighting system:

- Relevant IS codes published by Bureau of Indian Standards.
- National Building code Part IV for fire Protection System 2016.
- Pumps, Valves and Accessories shall be of UL listed and FM approved
- CPWD General Specifications for Electrical Works-part V (Wet Riser & Sprinkler System-2006)
2.0 Water Requirements:

Water services for hose reel and hydrant system shall be stored in overhead tanks.

Overhead storage fire tank:

Overhead fire water tanks on the terrace will be provided for hose reel system and as supplementary fire storage as per NBC -2016 requirement/ Bye laws.

3.0 System Description:

The Fire Fighting System shall consist of hose reel system with terrace pumps, Pressure vessel, associated instruments, cabling, piping (internal & external), valves, Fire Brigade inlet connections, fire signage's, extinguishers. has to be provided as per NBC 2016 requirements.

3.1 Shafts & Cut Outs Provisions:

Minimum size of shafts to be provided to accommodate down comer /drainpipes etc. will be 1200 X 600 MM (approx.) and to be provided at suitable locations as per specified in drawings or to be provided per relevant codes & standards, whichever is stringent. Shafts & Inspection doors shall be minimum of 120 minutes fire rated or as desired by relevant codes.

4.0 Pumps & related Equipment/Piping & Related Accessories:

- Fire booster pump of capacity shall be installed as per drawings.
- Fire pumps shall be with positive suction arrangements.
- Capacity of fire pump terrace fire pump 900 lpm with 35 meter head.
- All Foundation (PCC/RCC) for Equipment including foundation bolts & vibration isolation springs/pads to be provided.
- Mild steel 'C' pipes confirming to IS: 1239/3589 including all fittings like bends, elbows, tees, anchor fasteners, couplings etc. shall be used in Fire Fighting system.
- Suspenders, Brackets & Floor/Wall supports for suspending / supporting pipes to be provided.
- Suction dia. & discharge dia. Of pumps shall be as per pump discharge as per OEM standards.
- The entire pipe work (above ground), pump etc. shall be painted with one coat of primer & two or more coat of red color shade no. 536 of IS:5 (synthetic enameled red paint) as per directions of Engineer-in-Charge.
- At terrace level hydrant, minimum 3.5 kg/sqcm pressure shall be maintained.
- All pipes below ground will be protected against soil corrosion by wrapping & coating material as per IS: 10221.
• Pipes of 150 mm dia. & below, will conform to IS: 1239. Pipes of 200 mm dia. & above will conform to IS: 3589.
• All necessary valves of PN 16 rating (min.) like butterfly/globe/gate/non return/slurce, Y/Pot Strainers, pressure gauges etc. to be considered as per requirement (controlling flow/isolating/one-way flow etc.) & meeting the functionality.
• Pressure vessels shall be provided with terrace booster pumps.
• Vibration Isolators/Anti Vibration Pads needs to be provided for all pumps to absorb vibration at source.
• Air cushion tanks with air release valves needs to be provided for all risers of hydrant pipes.

5.0 Hose Reel

• It shall consist of swinging type First Aid hose reel in red colour drum with 36 mtr long and 20 mm dia. heavy duty rubber water hose, 20 mm dia. globe valve stop cock, terminating with G.M. Coupling& nozzle of 5mm outlet with shut off valve, 63mm dia. and suitable size of MS door made up of 16 gauge MS Sheet capable of accommodating fire hose reel. The door shall have a front glass with lock and key arrangement & shall be painted with one coat of primer & two coat of finished stove enameled post office red colour paint & "Hose Reel" written on front.

• One no. pressure gauge to be provided in each hose reel at per floor.
• No. of risers/floor in each building shall be governed by the max. Travel distance as specified in NBC 2016.
• Fire Brigade Inlet Connections.

• 2 Way Fire Brigade Inlet connection complete with all accessories (sluice valve/NRV etc.) shall be provided for connection to down comer system.

6.0 Portable Fire Extinguishers: -

• The quantity as per drawings of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /Ammonium Phosphate Type/ Mechanical Foam etc.) shall be provided at all levels of the building, plant room, basement, substation etc. at strategic locations as per requirements, generally to follow NBC-2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C. As per requirement.
• Location of the Fire Extinguishers shall be considered near all the fire hose reel, LT Panel Room, Lift Machine Room, Fire Control Room, Room etc.
• All Fire Extinguishers shall be Holon Free.

7.0 Fire Signage: -

• Various types of signage are proposed in the complex as per NBC 2016 Part -4. Material of signage shall be of acrylic/aluminum of required dimensions. At every floor near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE USE STAIRS UNLESS INSTRUCTED OTHERWISE'. The signage shall be above call push button in Lift Lobby. Floor Signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape route. These Signage shall be with photo Luminescent
8.0 **Electrical Works related to Fire Fighting System:**

- Power cabling of suitable size from fire-fighting panel/Isolator to fire pumps to be laid. Control cabling from fire pumps to firefighting panel & firefighting panel to pressure switch to be done. All detailed cable sizes and isolator sizes are covered in electrical specification document.
- Suspenders and/or cable trays for laying cables to be used.
- Motor shall be TEFC squirrel cage AC induction type. The motor shall be suitable for continuous duty & rating necessary to drive the pump at 150% of its rated discharge with at least 65% rated head. Motor shall be with class F insulation & IE-2 class efficiency. DOL/star delta starter to be provided as per H.P rating of motors.
- Adequate no. of NO/NC contacts for interlocks, indicating lamps, remote operation etc. shall be provided on starter/contactor.
- Metallic body of all motors, medium voltage equipment etc. shall be connected by 2 separate & distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment to another.

9.0 **Indicative Fire Fighting Parameters to be provided:**

Fire-fighting requirement to be provided as per NBC 2016 Part-4 and as mentioned in the drawings.

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<thead>
<tr>
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<th>Building Classification – Educational Building under Group-B Category Subdivision B-2</th>
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<td>Overhead Fire Static Tank</td>
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<td>6</td>
<td>Fire Fighting Pumps at Terrace</td>
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Note:-

The Tables provided above has been prepared considering Buildings as per present scope of work. The requirements indicated in the column “Deliverable” are minimum to be provided by the EPC Contractor.
Notwithstanding anything mentioned in above table above, additional firefighting provision specifically contained in the Bye laws, if any, shall have to be additionally provided.

Any building not appearing in the above table shall be dealt with as per NBC 2016 norms & Bye law’s provisions.
A. Codes and reference standards referred to in the contract shall be understood to form a part of the contract.

B. Alternative reference standards produced by different standards authorities may be specified in a Section. Standards of any of the specified authorities may be acceptable, however, materials specified in the Section shall be incorporated in the works from only one of the specified standard authorities to ensure compatibility in the performance of the materials.

C. The contractor shall be responsible for adherence to reference standard requirements by subcontractors and suppliers.

D. Where edition date is not specified, consider that reference to manufacturer’s and published codes, standards and specifications are made to the latest edition (revision or amendment) approved by the issuing organization current at issue date of the Tender.

E. Reference standards and specifications are quoted in the specification to establish minimum standards. Works of quality or of performance characteristics that exceed these minimum standards will be considered to confirm.

Should regulatory requirements or the contract conflict with specified reference standards or specifications, the more stringent in each case shall govern.

F. Where reference is made to manufacturer’s directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erection, applying or other matters concerning the materials pertinent to their use in the works and their relationship to materials with which they are incorporated.

G. LIST OF CODES (INDIAN STANDARD CODES)

Standards, specifications, associations, and regulatory bodies are generally referred to throughout the specifications by their abbreviated designations. The materials workmanship shall be in accordance with the requirement of the appropriate CP, I.S code wherever applicable together with any building regulations or byelaws governing the works.

The following list is included for guidance only and the omission of any CP, I.S. codes from the list does not relieve the contractor from compliance therewith:

The more important Codes, Standards and Publications applicable to this section are listed hereinafter:

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<td>SP : 6 (1)</td>
<td>Structural Steel Sections</td>
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<tr>
<td>IS : 27</td>
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<td>IS : 325</td>
<td>Three Phase Induction Motors</td>
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<tr>
<td>IS : 554</td>
<td>Dimensions for pipe threads where pressure tight joints are</td>
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required on the threads.

- **IS : 694** - PVC insulated cables for working voltages upto & including 1100 V.
- **IS : 779** - Specification for water meters (domestic type).
- **IS : 782** - Specification for caulking load.
- **IS : 800** - Code of practice for general construction in steel
- **IS : 1068** - Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.

- **IS : 1172** - Code of Basic requirements for water supply drainage and sanitation.
- **IS : 1367 (Part 2)** - Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
- **IS : 1554 (Part 1)** - PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1100 V.
- **IS : 1554 (Part 2)** - PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV upto and including 11 KV.
- **IS : 1726** - Specification for cast iron manhole covers and frames.
- **IS : 2064** - Selection, installation and maintenance of sanitary appliance code of practice.
- **IS : 2065** - Code of practice for water supply in buildings.
- **IS : 2104** - Specification for water meter for boxes (domestic type)
- **IS : 2373** - Specification for eater meter (bulk type)
- **IS : 2379** - Colour code for identification of pipe lines.
- **IS : 2629** - Recommended practice for hot dip galvanizing on iron and steel.
- **IS : 3114** - Code of practice for laying of cast iron pipes
- **IS : 4853** - Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
- **IS : 5329** - Code of practice for sanitary pipe work above ground for buildings.
- **IS : 5455** - Cast iron steps for manholes.
- **IS : 6159** - Recommended practice for design and fabrication of material, prior to galvanizing.
- **IS : 8321** - Glossary of terms applicable to plumbing work.
- **IS : 8419 (Part 1)** - Requirements for water filtration equipment: Part 1 Filtration medium sand and gravel.
- **IS : 8419 (Part 2)** - Requirements for water filtration equipment: Part 2 under drainage system.
- **IS : 9668** - Code of practice for provision and maintenance of water supplies and fire fighting.
- **IS : 9842** - Preformed fibrous pipe insulation.
2. Pipes and Fittings

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<td>IS : 458</td>
<td>Specification for precast concrete pipes (with and without reinforcement)</td>
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<td>IS : 651</td>
<td>Salt glazed stone ware pipes and fittings.</td>
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<td>IS : 1239</td>
<td>Mild steel, tubes, tubular and other wrought steel fittings</td>
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<tr>
<td>IS : 1536</td>
<td>Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.</td>
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<tr>
<td>IS : 1537</td>
<td>Vertically cast iron pressure pipes for water, gas and sewage.</td>
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<tr>
<td>IS : 1538</td>
<td>Cast Iron fittings for pressure pipes for water, gas and sewage.</td>
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<td>IS : 1729</td>
<td>Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.</td>
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<td>IS : 1879</td>
<td>Malleable cast iron pipe fittings.</td>
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<td>IS : 1978</td>
<td>Line pipe</td>
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<td>IS : 1979</td>
<td>High test line pipe.</td>
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<td>IS : 2643</td>
<td>Dimensions for pipe threads for fastening purposes</td>
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<td>IS : 3468</td>
<td>Pipe nuts.</td>
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<td>IS : 3589</td>
<td>Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).</td>
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<tr>
<td>IS : 3989</td>
<td>Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.</td>
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<td>Cast iron and malleable cast iron flanges for general engineering purposes.</td>
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<td>IS : 7181</td>
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<td>Specification for copper alloy gage, globe and check valves for water works purposes.</td>
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<td>IS : 780</td>
<td>Specification for sluice valves for water works purposes (50 mm to 300 mm size).</td>
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<td>IS : 1703</td>
<td>Specification copper alloy float valves (horizontal plunger type) for water supply fittings.</td>
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<td>Specification for sluice valves for water works purposes (350 mm to 1200 mm size)</td>
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<td>Specification for surface boxes for sluice valves.</td>
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<td>IS : 5312</td>
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4. **Pumps & Vessels**

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<td>Steel plates for pressure vessels for intermediate and high temperature service including boilers.</td>
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5. **Fire Fighting Equipment**

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<td>IS : 884</td>
<td>Specification for first aid hose reel for fire fighting.</td>
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<td>IS : 901</td>
<td>Specification for couplings, double male and double female, instantaneous pattern for fire fighting.</td>
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<td>Suction hose couplings for fire fighting purposes.</td>
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<td>Specification for 2-way and 3-way suction collecting heads for fire fighting purposes.</td>
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<td>Specification for fire hydrant, stand post type.</td>
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<tr>
<td>IS : 2171</td>
<td>Specification for portable fire extinguishers dry powder (cartridge type)</td>
</tr>
<tr>
<td>IS : 2190</td>
<td>Selection, installation and maintenance of first aid fire extinguishers – Code of practice.</td>
</tr>
<tr>
<td>IS : 2878</td>
<td>Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted).</td>
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<tr>
<td>IS : 3844</td>
<td>Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.</td>
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<tr>
<td>IS : 5290</td>
<td>Specification for landing valves.</td>
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<tr>
<td>IS : 5714</td>
<td>Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.</td>
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| IS : 8423     | Specification for controlled percolation type hose for fire
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<th>Specification</th>
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<tbody>
<tr>
<td>10658</td>
<td>Specification for higher capacity dry powder fire extinguisher (trolley mounted).</td>
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<tr>
<td>3989</td>
<td>Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.</td>
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<tr>
<td>11149</td>
<td>Rubber Gaskets</td>
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</tbody>
</table>
LIST OF APPROVED MAKES/AGENCIES

FOR WORKS COVERED UNDER THIS CONTRACT

1) All materials and products used in the work shall conform to the relevant standards/specifications and shall be of approved make and design. Lists of approved manufacturers/vendors for Plumbing works, Fire fighting, are given herein below. The approval of a manufacturer/vendor shall be given only after review of the sample/specimen by the Engineer-in-charge. The complete system and installation shall also be in conformity with the "Applicable Codes Standards and Publications".

2) The Engineer-In-charge/consultant reserves the right to select any of the brands indicated in the list of approved make. The tenderer shall quote his rates on the basis of price of best quality product of the brand/make stipulated in the items of works as described in specifications as well as in the list of approved make. The contractor cannot claim anything extra if the Engineer In-charge/Client changes the make but within the list of approved make.

3) When certain makes are missing in the below list, the make will be decided as per the approval of consultant/Engineer In-charge.

CIVIL

APPROVED MAKES/ AGENCIES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item/ Work</th>
<th>Approved Make/ Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cement</td>
<td>ACC, Jaypee Cement, Ultratech, Vikram, Shri cement, Ambuja, Century Cement &amp; JK Cement</td>
</tr>
<tr>
<td>2.</td>
<td>White cement</td>
<td>Birla White, J.K. White</td>
</tr>
<tr>
<td>3.</td>
<td>Steel (Reinforcement Fe 500D &amp; structural)</td>
<td>SAIL, Tata Steel Ltd, RINL, Jindal Steel &amp; Power Ltd, JSW Ltd</td>
</tr>
<tr>
<td>4.</td>
<td>Binding Wire</td>
<td>TATA, JSW</td>
</tr>
<tr>
<td>5.</td>
<td>Factory Made Cement Concrete Cover Blocks grade M25 and M35</td>
<td>A.S.R. Cover Blocks, JK, Conbextra, KGM, KK Manhole</td>
</tr>
<tr>
<td>6.</td>
<td>Block board, Plywood</td>
<td>Duroply Industries Ltd., Green Ply, Century, Merino</td>
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<td>7.</td>
<td>Aluminium Extruded Profiles</td>
<td>Aluk, AIS, Grunn</td>
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<td>8.</td>
<td>Aluminium fabricators</td>
<td>Glaspex (AIS), Designkraft, DK Glazing</td>
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<td>9.</td>
<td>Stainless steel cleanroom doors</td>
<td>Shakti-Hormann, MPP, Signum</td>
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<td>10.</td>
<td>Float Glass, Mirrors</td>
<td>AIS Asahi India Glass Ltd., Gujarat Guardian (Modiguard), Saint Gobain</td>
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<tr>
<td>11.</td>
<td>AAC Block</td>
<td>Max Blocks, Biltech, Aerocon, Siporex, Ultratech Magicrete, JK Lakshmi Cement Ltd., Ecolite</td>
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<tr>
<td>12.</td>
<td>Hermetically-sealed double insulated toughened glass/ laminated toughened double glass/ toughened glass</td>
<td>GSC Trutuf, Saint Gobain, AIS Asahi India Glass Ltd.</td>
</tr>
<tr>
<td>S.No.</td>
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<td>Approved Make/ Agency</td>
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<td>13.</td>
<td>Hardware (stainless steel, brass)</td>
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<tr>
<td></td>
<td>a</td>
<td>Mortise lock, multipurpose lock</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Floor spring, Door closer</td>
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<tr>
<td></td>
<td>c</td>
<td>Window Turn Handles (Aluminium)</td>
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<td></td>
<td>d</td>
<td>Handles, Tower Bolts, Hinges, Aldrop, Floor stopper, casement stay, safety chain, Magnetic door Catcher, Magic eye, Drawer Glides, floor stopper, Panic bar/ Push bar</td>
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<tr>
<td></td>
<td>e</td>
<td>Dash fasteners</td>
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<tr>
<td></td>
<td>f</td>
<td>Sliding Door Mechanism</td>
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<td></td>
<td>g</td>
<td>Stainless Steel fire rated Hardware</td>
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<tr>
<td>14.</td>
<td>Laminates</td>
<td>Greenlam, Merino, Greenpanel</td>
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<td>15.</td>
<td>Veneer</td>
<td>Greenlam, Duro, Merino</td>
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<tr>
<td>16.</td>
<td>Rectified Ceramic tiles, Ceramic tiles, Vitrified tiles, Heat resistance tile</td>
<td>RAK, Restile, Nitco, Somany</td>
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<tr>
<td>17.</td>
<td>1st quality acrylic distemper, acrylic/plastic emulsion, synthetic enamel paint, acrylic exterior paint, Epoxy Paint</td>
<td>ICI, Asian, Berger</td>
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<tr>
<td>18.</td>
<td>Cement Primer</td>
<td>Nerolac, BP White (Berger), Decoprime WT (Asian), White primer (ICI)</td>
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<tr>
<td>19.</td>
<td>Steel Primer (Red Oxide Zinc Chromate Primer)</td>
<td>Asian paints, Nerolac, Berger, ICI</td>
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<td>20.</td>
<td>Cement Admixture/ Plasticizer</td>
<td>Fosroc, Sika, Pidilite, Cico, BASF</td>
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<tr>
<td>21.</td>
<td>Dash Fasteners/ Anchor Fasteners/ Cramps</td>
<td>Hilti/ Fischer/ Bosch/ Canon</td>
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<td>22.</td>
<td>Thermal insulation/Rockwool/ glass wool/Mineral wool/PUF</td>
<td>Twiga, M/s Lloyd Insulations India Limited, Owens Corning, Polyglass</td>
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<tr>
<td>23.</td>
<td>Adhesive for Door Work</td>
<td>Fervicol, Vamicol, Dunlop</td>
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<td>24.</td>
<td>Sealant</td>
<td>Dow Corning, Becker, Sika, Wacker, GE</td>
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<td>25.</td>
<td>Crystalline water proofing admixture and compound</td>
<td>Penetron, Kryton, Pidilite, Fosroc</td>
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<tr>
<td>26.</td>
<td>AAC blocks Adhesive</td>
<td>Pidilite, Bal Endura, Ferrouscrete, Laticrete</td>
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<td>27.</td>
<td>White cement Putty</td>
<td>Birla White, Asian, Berger</td>
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<td>28.</td>
<td>Fire- Retardant paint</td>
<td>Viper, Nippon Paint</td>
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<td>29.</td>
<td>Fire-rated Glass</td>
<td>Schott, AIS (Asahi India), Saint Gobain</td>
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<td>31.</td>
<td>Anti-Termite Treatment chemical</td>
<td>Bayer, BASF, Dursban,Gibralttor</td>
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<td>Bitumen</td>
<td>IOC/ Tikky Tar</td>
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<td>33.</td>
<td>Tile Adhesives, Epoxy Grout, Silicone Spray, Polysulphide Sealant</td>
<td>Laticrete, Roffe, Pidilite</td>
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<tr>
<td>34.</td>
<td>False ceiling framing system</td>
<td>India Gypsum, Gyproc, Armstrong</td>
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<tr>
<td>35.</td>
<td>Acoustic false ceiling</td>
<td>Ecophon, Armstrong, Twiga</td>
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<td>S.No.</td>
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<td>Approved Make/ Agency</td>
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<td>36.</td>
<td>Calcium Silicate boards/ tiles</td>
<td>Hilux (Ramco Industries Ltd.), Aerolite, Gyproc</td>
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<td>37.</td>
<td>Backlit stretch ceiling</td>
<td>XXtracel, Barrisol, Eurolux</td>
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<td>38.</td>
<td>Fire curtain</td>
<td>Orient Fire Curtains India Pvt Ltd, Coopers Fire, Colt</td>
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<td>39.</td>
<td>External Finish Texture paint</td>
<td>SKK (S) Pvt Ltd, Suzuka (Ultratech)</td>
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<td>40.</td>
<td>Wood-grains finish fire doors</td>
<td>Shakti-Hormann, MPP, Signum</td>
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<tr>
<td>41.</td>
<td>Fire doors</td>
<td>Shakti-Hormann, Navair, Promat International</td>
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<td>42.</td>
<td>Hook on perforated/ non perforated</td>
<td>Durlum, SAS, DAMPA</td>
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<td>aluminium metal ceiling system</td>
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<td>43.</td>
<td>Thermal insulation</td>
<td>Twiga, Supreme</td>
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<tr>
<td>44.</td>
<td>Waterproof Coatings PU, PUF Spray</td>
<td>Pidilite, BASF, Technonicol</td>
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<td></td>
<td>(including application)</td>
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<td>45.</td>
<td>Aluminium Batten Louver system</td>
<td>UnistoneAlwood, Makintosh</td>
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<td>46.</td>
<td>Automatic sliding door</td>
<td>AIS (Asahi India), Guardian Glass, Saint Gobain</td>
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<tr>
<td>47.</td>
<td>Acoustic wall panelling</td>
<td>Anutone,Cineview, Armstrong</td>
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<tr>
<td>48.</td>
<td>Compact laminate sheet Cubicals for toilet</td>
<td>Merino, Greenply, Archidpy</td>
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<td>49.</td>
<td>Aluminium honeycomb sandwich panel</td>
<td>Aludcor, Ecoearth, Honylite</td>
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<tr>
<td>50.</td>
<td>Spider Fittings for Structural Glazing</td>
<td>Dorma, Kich, Hafele</td>
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<tr>
<td>51.</td>
<td>Stainless steel pipe (Railing) (18/8 SS 30)</td>
<td>Jindal Stainless Steel Ltd., Dorma, Kich, Geze, Hardwyn</td>
</tr>
<tr>
<td></td>
<td>and its accessories</td>
<td></td>
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<tr>
<td>52.</td>
<td>Glass Railing with stainless steel clamps</td>
<td>S-Grip, D-line, Q-railing</td>
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<td></td>
<td>&amp; cover</td>
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<td>53.</td>
<td>Ethylene Propylene Diene Monomer (EPDM)</td>
<td>Hanu, Anand, Lescuyer, Supreme</td>
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<td>Gasket</td>
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<td>54.</td>
<td>Polyester powder coating.</td>
<td>Nerolac, Berger, Jenson &amp; Nicholson</td>
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<td>55.</td>
<td>Polysulphide Sealant</td>
<td>Pidilite (Pidiseal), Techseal, BASF, SIKA, FOSROC</td>
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<td>56.</td>
<td>Stainless Steel Wire Mesh</td>
<td>Champion, GKD</td>
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<td>57.</td>
<td>Stainless Steel Nuts, Bolts and Screws</td>
<td>Hilti, Fisher, Kundan, Arrow</td>
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<td>58.</td>
<td>Ball Bearing Hinges and Spring Hinges</td>
<td>Dorma, Hafele, Dorset</td>
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<td>59.</td>
<td>Stainless Steel Screws</td>
<td>Kundan, Arrow, GKW</td>
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<td>60.</td>
<td>Door closer lock/ Panic exit device</td>
<td>Dorma, Doortech, Geze, Kich</td>
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<td>61.</td>
<td>Structural sealent and Weather Sealants</td>
<td>Dow Corning, Wacker, GE</td>
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<td>62.</td>
<td>Welding rods</td>
<td>Victor, Essar, Advani</td>
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<td>1</td>
<td>SANITARY FIXTURES AND CP FITTINGS</td>
<td>ROCA GROHE TOTO</td>
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<td>2</td>
<td>WC CONNECTOR</td>
<td>ASTRAL SUPREME DURAVIT</td>
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<td>3</td>
<td>LOW FLOW CISTERN</td>
<td>GEGERIT ROCA</td>
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<td>4</td>
<td>KITCHEN/PANTRY SINK</td>
<td>KINGSTON NIRALI PARYWARE</td>
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<td>HAND DRIER</td>
<td>EURONICS UTEC SYSTEM KOPAL</td>
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<td>6</td>
<td>PAPER TOWEL DISPENSER</td>
<td>EURONICS ROCA GROHE</td>
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<td>8</td>
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<td>EURONICS ROCA GROHE</td>
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<td>9</td>
<td>PESSMATIC TAP</td>
<td>ROCA GROHE</td>
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<td>10</td>
<td>URINAL SENSORS</td>
<td>ROCA GROHE TOTO</td>
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<td>11</td>
<td>COCKROACH PROOF GRATING AND SS GRATING</td>
<td>CHILLY VIKING</td>
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<td>GI PIPES AND FITTINGS</td>
<td>JINDAL APOLLO TATA</td>
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<td>13</td>
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<td>SUPREME ASTRAL</td>
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<td>PP PIPE AND FITTINGS</td>
<td>POLOPLAST RHEAU HULIOT</td>
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<td>ARMACELL SUPREME THERMAFLEX</td>
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<td>LEAD FREE BALL VALVE</td>
<td>LEHRY L&amp;T HONEYWELL</td>
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<td>17</td>
<td>BALL VALVE</td>
<td>L&amp;T ZOLOTO DRP</td>
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<tr>
<td>18</td>
<td>BUTTERFLY VALVE</td>
<td>L&amp;T ZOLOTO DRP</td>
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<tr>
<td>19</td>
<td>NON RETURN VALVE</td>
<td>L&amp;T ZOLOTO DRP</td>
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<td>PRANALI KK INDIAN HUME PIPE</td>
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<td>DUNLOP RESISTOFLEX EASYFLEX</td>
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<td>OASIS EUREKA FORBES ION EXCHANGE</td>
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<td>JINDAL HISSAR SURYA TATA</td>
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<td>MS FITTING</td>
<td>VS DRP UNIK</td>
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<td>PAINT</td>
<td>BERGER ASIAN PAINTS SHALIMAR PAINTS</td>
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<td>HOSE BOX</td>
<td>NEWAGE MINIMAX SAFEGUARD</td>
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<td>11</td>
<td>HOSE REEL DRUM</td>
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<td>L&amp;T AMBIT DRP</td>
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<td>H GURU FIEBEG WIKA</td>
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<td>FIRE EXTINGUISHERS</td>
<td>NEWAGE MINIMAX SAFEGUARD</td>
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<td>GRUNDOFESS XYLEM LUBI</td>
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<td>KEI POLYCA RALLISON</td>
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<td>COMET DOWELL JAINSON</td>
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<td>MEM RMCON LS POWER</td>
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<tr>
<td>26</td>
<td>GI Pipe</td>
<td>Jindal Apollo TATA</td>
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</tbody>
</table>
# SCHEDULE OF FINISHES

<table>
<thead>
<tr>
<th>S. No</th>
<th>Space</th>
<th>Flooring</th>
<th>Walls</th>
<th>Ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Double-height Entrance Hall</td>
<td>18mm thick Blue Pearl polished Granite (B1), with bands in different approved shade of blue pearl granite and patterned motif in combination of granites as per approved shades &amp; design; tow wall below spider glazing and skirting with 18mm thick Blue Pearl polished Granite (B1)</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty; Glass railing over balcony as per design and specifications; Spider glazing with laminated double glass, on external faces, as per design and specifications</td>
<td>Backlit stretch ceiling with aluminium profile as per design and specifications</td>
</tr>
<tr>
<td>1</td>
<td>Entrance Hall, Foyer, Waiting Lounge, Front lobbies</td>
<td>18mm thick Blue Pearl polished Granite (B1), with bands in different approved shade of blue pearl granite; 100mm high skirting in 18mm thick Blue Pearl polished Granite (B1)</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty)</td>
<td>Calcium silicate false ceiling &amp; Acrylic emulsion paint (White colour of Asian Paints or equivalent); Backlit stretch ceiling with aluminium profile as per design and specifications</td>
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<td>2</td>
<td>Reception, Office, Department Office, Faculty Meeting Room, Meeting Room, Teaching Lab, Common Room/Lounge</td>
<td>18mm thick Chima Pink Granite Shade-1 (G1) and 100mm high skirting with same granite</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty)</td>
<td>Calcium silicate false ceiling &amp; Acrylic emulsion paint (White colour of Asian Paints or equivalent)</td>
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<td>3</td>
<td>Autoclave, Central Instrumentation Room, Virus Room, Clean Room</td>
<td>Combination of 18mm thick Chima Pink Granite Shades (G1 &amp; G2) with 11mm thick Granamite (Restile) Vitrified Tiles Sienna 600x600mm or equivalent, as per design; 100mm high skirting in 18mm thick Chima Pink Granite Shade G1</td>
<td>Ceramic Tiles up to ceiling Johnson Nebulia LT (300x600mm) or equivalent</td>
<td>Acrylic emulsion paint (White colour, of Asian Paints or equivalent) over 6 mm thick Cement Plaster 1:3 and white cement-based putty/ Calcium silicate false ceiling &amp; Acrylic emulsion paint (White colour of Asian Paints or equivalent) as per drawing</td>
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<td>4</td>
<td>Faculty &amp; Special Facility Rooms, Faculty Office, Server Room</td>
<td>18mm thick Chima Pink Granite Shade-1 (G1) and 100mm high skirting with same granite</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty</td>
<td>Acrylic emulsion paint (White colour, of Asian Paints or equivalent) over 6 mm thick Cement Plaster 1:3 and white cement-based putty/ Calcium silicate false ceiling &amp; Acrylic emulsion paint (White colour of Asian Paints or equivalent) as per drawing</td>
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<td>4</td>
<td>Labs</td>
<td>Combination of 18mm thick Chima Pink Granite Shades (G1&amp; G2) with 11mm thick Granamite (Restile) Vitrified Tiles Sienna 600x600mm or equivalent, as per design; 100mm high skirting in 18mm thick Chima Pink Granite Shade G1</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty</td>
<td>Acrylic emulsion paint (White colour, of Asian Paints or equivalent) over 6 mm thick Cement Plaster 1:3 and white cement-based putty/ Calcium silicate false ceiling &amp; Acrylic emulsion paint (White colour of Asian Paints or equivalent) as per drawing</td>
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<td>5</td>
<td>Seminar Hall, Stage</td>
<td>18mm thick Chima Pink Granite Shade-3 (G3) and 100mm high skirting with same granite</td>
<td>Acoustic wall Panelling (66 mm) with finishing of 16 mm thick Grooved wooden acoustic panel of size 575mm x 2420 mm / Compressed Polyester fibre acoustical panels, 9 mm thick acoustic polyester fibre pad pasted on 16 mm thick perforated wooden panels upto 2350mm height;</td>
<td>Micro perforated ceiling panel made of aluminium sheet (exposed side powder-coated and calcium silicate board false ceiling &amp; Plastic emulsion paint White colour of Asian Paints or equivalent)</td>
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<td>From 2350mm height above upto ceiling - Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty</td>
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<td>6</td>
<td>Room (level-6)</td>
<td>25mm thick Kotah Stone and 100mm high skirting of same stone</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty</td>
<td>Calcium silicate false ceiling &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent</td>
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<tr>
<td>7</td>
<td>Corridors, lobby, Cold Rooms</td>
<td>Patterned 18mm thick Chima Pink Granite Shade-1 (G1), with bands and 100mm high skirting in Chima Pink Granite shade G2</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/15mm thick Cement Plaster 1:6 and white cement-based putty</td>
<td>Hook on perforated/ non perforated G.I. metal ceiling system of Durlum India</td>
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<tr>
<td>8</td>
<td>Toilets, Pantry</td>
<td>Matte Vitrified Tiles (600x600mm) Toilets : NitcoSandstone Dune or equivalent Pantry : NitcoSandstone Lt Grey or equivalent</td>
<td>Glazed vitrified tiles 600x600mm upto ceiling Toilets : NitcoSandstone Khaki or equivalent Pantry : NitcoHercules Frostor equivalent</td>
<td>Calcium silicate false ceiling &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent</td>
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<tr>
<td>9</td>
<td>Emergency shower</td>
<td>18mm thick Leather-finished Chima Pink Granite Shade-2 (G2)</td>
<td>Glazed vitrified tiles 600x600mm upto ceiling NitcoSandstone Khaki or equivalent</td>
<td>Plaster &amp; OBD (6mm thick Cement Plaster 1:3, white cement based putty &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent)</td>
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<tr>
<td>10</td>
<td>Chemical Stores</td>
<td>25mm thick Kotah Stone</td>
<td>Ceramic Tiles up to ceiling Johnson Nebulia LT (300x600mm) or equivalent</td>
<td>Calcium silicate false ceiling &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent</td>
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<td>11</td>
<td>Technical Staff/ BMS, AHUs, Electrical Room, UPS/ ELV Room,</td>
<td>25mm thick Kotah Stone and 100mm high skirting of same stone</td>
<td>Plaster &amp; OBD (12/ 15mm thick Cement Plaster 1:6, Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent)</td>
<td>Calcium silicate false ceiling &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent) for Technical Staff/ BMS</td>
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<tr>
<td>12</td>
<td>Service corridors</td>
<td>25mm thick Kotah Stone and 100mm high skirting of same stone</td>
<td>As per External Finish</td>
<td>Acrylic emulsion paint (Asian Paints Apex Ultima or equivalent, as per approved shade) over 6 mm thick Cement Plaster 1:3 and white cement-based putty; UniStone SAFS ALWOOD non-combustible Extruded Aluminium Batten System as per approved design inprofile size of 50mm X100mm (50mm Gap between the battens)ceiling system at Ground floor</td>
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<td>13</td>
<td>Staircases</td>
<td>Front Staircase from Level-1 to Level-2 - 18mm thick Blue Pearl polished Granite (B1) in treads and 100mm high skirting same granite; For riser, shade B2 to be used of same granite; Front Staircase from Level-2 upwards - 18mm thick Chima pink polished Granite shade G1 in treads, and 100mm high skirting in same granite); For risers, shade G2 to be used of same granite; Central staircase - 18mm thick Chima pink polished</td>
<td>Acrylic emulsion paint (Shade L104 Cotton Wool of Asian Paints or equivalent) over 12/ 15mm thick Cement Plaster 1:6 and white cement-based putty</td>
<td>Acrylic emulsion paint (White colour, of Asian Paints or equivalent) over 6 mm thick Cement Plaster 1:3 and white cement-based putty</td>
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<td>Granite shade G1 colour in tread, alongwith 100mm high skirting in same granite; For risers, shade G2 to be used of same granite</td>
<td>Other staircases &amp; service staircase - 25mm thick Kotah Stone and 100mm high skirting of same stone;</td>
<td>Note: For treads three line grooves to be provided</td>
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<tr>
<td>14</td>
<td>Passenger Lifts (machine-room less), Service Lift</td>
<td>18mm thick BluePearl Polished Granite for lift car floor</td>
<td>Patterned SS Finish</td>
<td>SS Finish/ Light Panels</td>
</tr>
<tr>
<td>15</td>
<td>Verandahs</td>
<td>Matt Vitrified Tiles (600x600mm) GVT Crust Monte of Johnson make or equivalent</td>
<td>As per External Finish</td>
<td>Acrylic emulsion paint (Asian Paints Apex Ultima or equivalent, as per approved shade) over 6 mm thick Cement Plaster 1:3 and white cement-based putty</td>
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<tr>
<td>16</td>
<td>Gas Store, Service Lift, Machine Room</td>
<td>25mm thick Kotah Stone and 100mm high skirting of same stone</td>
<td>Gas Store - As per External Finish; Machine Room - Plaster &amp; OBD (6mm thick Cement Plaster 1:3, white cement based putty &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent)</td>
<td>Plaster &amp; OBD (6mm thick Cement Plaster 1:3, white cement based putty &amp; Distempering with 1st quality acrylic distemper White shade of Asian Paints or equivalent)</td>
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</table>

**EXTERNAL/ OTHER FINISHES**
<p>| S. No. | Space                        | Flooring                                                                 | Walls                                                                                           | Ceiling                                                                 |
|-------|------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1     | External walls Finish        | Acrylic-resin Texture coat having incorporating natural texture of sandstone with clear coat (SKK Eleganstone Sagan colour ES-005 in body, ES-004 in bands, ES-008 in recessed panels; groove colour light grey) over 20mm thick cement plaster 1:4 mixed with waterproofing compound |
| 2     | Internal Doors &amp; Glazing     |                                                                          |                                                                                                |
| A     | Labs &amp; central facilities    | Cleanroom doors with frames and shutters in stainless steel; each shutter shall have vision panel of toughened glass in size 450x750mm. Shakti-Hormann or equivalent |
| B     | Fire doors for seminar hall  | MS Powder-coated Wood grain finish as per specifications. Shakti-Hormann or equivalent |
| C     | Fire doors for staircases    | MS powder coated with glass vision panel as per specifications. Shakti-Hormann or equivalent |
| D     | Balance Internal Doors &amp; Glazing | Anodised Aluminium frames and shutters (Aluk or equivalent) with single clear 6mm thick toughened glass, as per approved shade and finish, and have polished granite fascia/ trims |
| E     | Toilets, AHU and other internal opaque doors | Door frames&amp; shutterframes in Anodised Aluminium (Aluk or equivalent) as per approved shade and finish; shutter insert to be 21mm thick AluminiumHoneycomb core ALU 9mm sandwich panel with both side 1.5mm thick anodised aluminiumskin, as per approved shade and finish |
| 3     | External Windows &amp; Glazing   | Anodised Aluminium windows/ glazings(AIS or equivalent) with double glass, as per specifications and approved shade &amp; finish. Composition of DGU to be two layers of 6mm thick AIS PlanibelClearlite (of Asahi India make or equivalent)with a gap of 12mm filled with 90% Argon gas. Should have Transmission 81%, Reflection: Ext 14% &amp; Int 14%, CRI 98% |
| 4     | Lifts                        | Fire curtains                                                            |                                                                                                |
| 5     | External Shafts              | Anodised Aluminium louvered shutters                                      |                                                                                                |
| 6     | External elevation louvers   | UniStone SAFS ALWOOD non-combustible Extruded Aluminium Batten System as per approved design in profile size of 50mm X50mm (50mm Gap between the battens) for louvers in service balcony |
| 7     | Staircase Railing            | Stainless steel Pipe (Grade 304, Heavy class); Baluster at every step, and 300 mm c/c at landings, Baluster OD 33.40mm with wall thickness 3.37mm and cover plate; Top rail OD 48..26mm with wall thickness 3.68mm and intermediate runners 2 nos. of OD 26.67mm with wall thickness 1.68mm |
| 8     | Pergola                      | As per External Finish                                                   |                                                                                                |
| 10    | Copings                      | 18mm thick Polished Ruby Red granite                                      |                                                                                                |
| 11    | Waterproofing - Toilets, Balconies, Usable Terrace | Self-leveling two component polyurethane based waterproofing coating, Pidilite or equivalent |
| 12    | Waterproofing - Terraces     | Coba treatment; Matt vitrified tiles (600x600mm Johnson Crust Monte or equivalent) on usable terraces, broken white glazed tiles on top roof terrace |
| 13    | External landscaping upto double-height entrance | 18mm thick Leather-finished Silver Grey granite with bands of 18mm thick Zed-Black polished granite |</p>
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Space and drop-off</th>
<th>Flooring</th>
<th>Walls</th>
<th>Ceiling</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>25mm thick Rough Kotah Stone</td>
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<td>15</td>
<td>Service Court, Road &amp; Parking</td>
<td>Vacuum dewatered Cement Concrete</td>
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<tr>
<td>16</td>
<td>Toilets/ Pantry</td>
<td>a) Counter top &amp; fascia Pantry : 18mm thick White Granite with Black + Olive fine dots Toilets : 19mm thick Corian Canyon shade or equivalent</td>
<td>Frosted toughened glass as per specifications</td>
<td>Laminated Partition &quot;Merino&quot; or equivalent</td>
</tr>
</tbody>
</table>
### SCHEDULE OF HARDWARE

<table>
<thead>
<tr>
<th>S. No</th>
<th>Doors/Windows</th>
<th>Aluminium 3D Butt hinge</th>
<th>Stainless steel Tower bolt</th>
<th>Stainless steel Handle</th>
<th>Stainless Steel Door Closer</th>
<th>Stainless Steel sliding door bolt</th>
<th>Rubber buffer</th>
<th>Floor spring</th>
<th>SS Mortise latch with handle</th>
<th>SS Mortise lock without handle</th>
<th>SS Mortise lock for single shutter with handle</th>
<th>SS Mortise lock for double shutters with 4 nos. handle</th>
<th>Sliding window handle</th>
<th>Case ment window handle</th>
<th>Aluminium 3D butt hinge for window</th>
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<td>Hardware fittings as per toilet cubical specification to be provided</td>
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**Automatic sliding door fittings with toughened glass as per specification to be provided**

| IDW3 | 4 | 1 | 1 | - | 1 | - | - | 1 | - | - | - | 1 | - | - | - | - |
| IDW4 | 4 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| IDW5 | 8 | 4 | - | - | 2 | 2 | - | - | 2 | - | - | - | - | - | 1 | - | - | - |
| IDW6 | 4 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| IDW7 | 4 | 1 | 1 | - | 1 | 1 | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| IDW8 | - | 4 | - | 4 | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 | 3 |
| IDW9 | - | 4 | - | 4 | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 | 3 |
| IDW10 | - | 4 | 1 | 1 | 2 | 1 | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| W1L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W2L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W3L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W4L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W5K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W6L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W7L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W8L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W9K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W10K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W11L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W12L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W13K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W14L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W15L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W16K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W17L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W18L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W19L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W20L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W21L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W22L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W23L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W24L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W25L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| W26L | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW1K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW2K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW3K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW4K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW5K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW6K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW7K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW8K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW9K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| IW10K | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |

**Note:** All the supporting annexures and schedules attached along with this NIT are to be read and co-related with the architectural and structural drawings in accordance with latest CPWD specifications in order to make building fully functional in every aspect. The annexures and schedules are not exhaustive and merely convey the major items.
that are to be executed. Any further requirement of item deemed necessary by the Engineer-in-charge in order to make building functional shall be provided by the contractor and no extra payment shall be made on this account.

Tri Party Agreement: Tri Party Agreement is to be provided by the contractor for all items which are under warranty by the manufacturer like sanitary fittings, Door and Window hardwares & fittings, False Ceiling etc.
PART-B3

Proforma (Water Proofing, Aluminium & Bank Guarantee)
The Agreement made this __________ day of ______ Two thousand and _____ between
____________________________ son of ______________________(hereinafter
called the Guarantor on the one part) and the PRESIDENT OF INDIA (hereinafter called the
Government on the other part).

WHEREAS THIS agreement is supplementary to a contract (hereinafter called the
contract) dated ______________ and made between the GUARANTOR OF THE
ONE part and the Government of the other part, whereby the contractor, inter alia,
undertook to render the buildings and structures in the 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 10 (Ten) years to be reckoned from
the date Completion of the building.

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 Completion of
the building.

Provided that the Guarantor will not be responsible for the 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 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 proofing treatment is removed
in parts.

(c) The decision of the Engineer-in-charge with regard to cause of leakage/seepage
shall be final.

During this period of guarantee the guarantor shall make good all defects and in
case of any defect being found, render the building water proof to the satisfaction of the
Engineer-in-charge at his cost and shall commence the work for the rectification within
seven days from the date of issue of the notice from the Engineer-in-charge calling upon
him to rectify the defects failing which the work shall be done by the department by some
other agency contractor at the GUARANTOR’s risk and cost. The decision of the Engineer-in-charge as to the cost payable by the Guarantor shall be final and binding.

That if guarantor fails to make good all defects or commits breach there under then the Guarantor will indemnify the principal and his successors against all loss, damage, cost expense otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Government the decision of the Engineer-in-Charge will be final and binding on the parties.

IN WITNESS WHEREOF these presents have been executed by the Obliger and by and for and on behalf of the PRESIDENT OF INDIA on the day, month and year first above written SIGNED, SEALED AND delivered by OBLIGOR in the presence of:

1. ............................................
2. ............................................

SIGNED FOR AND ON BEHALF OF THE PRESIDENT OF INDIA BY ............................................ in the presence of:

1. ............................................
2. ............................................
GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF ALUMINIUM DOORS, WINDOWS, VENTILATORS & STRUCTURAL GLAZING WORKS

The agreement made this ______________day of __________Two Thousand and ____________ between __________________________ son of __________________________ (hereinafter called the GURANTOR on the one part) and the PRESIDENT OF INDIA (hereinafter called the Government on the other part.)

WHEREAS THIS agreement is supplementary to a contract (Hereinafter called the Contract) dated ____________ and made between the GUARANTOR OF THE ONE PART AND the Government of the other part, whereby the contractor inter alia, undertook to render the work in the said contract recited structurally stable, leak proof and sound material, workmanship, anodizing, colouring, sealing.

AND WHEREAS THE GURANTOR agreed to give a guarantee to affect that the said work will remain structurally stable, leak proof and guaranteed against faulty material and workmanship, defective anodizing, colouring, sealing and finishing for 3 (Three) years to be reckoned from the date Completion of the building prescribed in the contract.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable, leak proof and guaranteed against faulty material and workmanship, defective anodizing, colouring, sealing and finishing for 3 (Tthree) years to be reckoned from the date Completion of the building.

The decision of the Engineer-in-charge with regard to nature and cause of defects shall be final.

During this period of guarantee, the guarantor shall make good all defects to the satisfaction of the Engineer-in-charge at his cost and shall commence the work for such rectification within seven days from the date of issue of the notice from the Engineer-in-charge calling upon him to rectify the defects failing which the work shall be got done by the Department by some other contractor at the Guarantor’s risk and cost. The decision of the Engineer-in-Charge as to the cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all the defects or commits breach thereunder, then the guarantor will indemnify the principal and his successor against all loss, damage, cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Government, the decision of the Engineer-in-charge will be final and binding on both the parties.

IN WITNESS WHEREOF these presents, have been executed by the obligator
INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

and________________________ by________________________ for________________________ and
on behalf of the PRESIDENT OF INDIA 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 THE PRESIDENT OF INDIA BY __________________________in the presence of:
1. __________________________
2. __________________________
Form of Performance Security (Guarantee)

BANK GUARANTEE BOND

In consideration of the President of India (hereinafter called “the Government”) having agreed under the terms and conditions of agreement No.________ dated -_________ made between_________ and ___________ (hereinafter called “the contractor(s)”) for the work_________ (hereinafter called “the said agreement”) having agreed to production of a irrevocable Bank Guarantee for ________ (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, we ____________ (hereinafter referred to as “the Bank”) hereby undertake to pay to the Government an amount not exceeding ₹____________________ (only) on demand by the Government.

2. We_________________________________ do hereby undertake to pay the amounts due and payable (Indicate the name of the Bank) under this Guarantee without any demur, merely on a demand from the Government stating that the amount claimed is 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 by the bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding `________ (Rupees __________________________ only).

3. We, the said bank further undertake to pay to the government any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or tribunal relating thereto, our liability under this present being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment thereunder and the contractor(s) shall have no claim against us for making such payment.

4. We_________________________________ further agree that the guarantee herein contained (Indicate the name of the Bank) shall remain in full force and effect during the period that would be taken for performance of the said agreement and that it shall continue to be enforceable till all the dues of the Government 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 government 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 further agree with the Government that the Government (Indicate the name of the Bank) shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder 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 government against the said contractor(s) and to forebear 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 government or any indulgence by the Government 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. WeLastly undertake not to revoke this guarantee except with (Indicate the name of the Bank) the previous consent of the Government in writing.

8. This guarantee shall be valid up to _______, unless extended on demand by Government. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to $_____________________(_______ only) and unless a claim 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)
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 Engineer-in-Charge, 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

WITNESS .................. SEAL

(SIGNATURE, NAME AND ADDRESS)

*Date to be worked out on the basis of validity period of 6 months from last date of receipt of tender.
PART-B4
List of Drawings
## LIST OF DRAWINGS

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Total 186 drgs
PART- C-1

[ELECTRICAL COMPONENT]

Name of work :- c/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

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<td>SITC CCTV, Access Control System for building security comprising of controller E&amp;M lock reader smart card &amp; LAN Networking SITC</td>
</tr>
<tr>
<td>Part C-4</td>
<td>Lifts</td>
</tr>
</tbody>
</table>
Scope of Work

1. Scope of work covers planning, designing, supply, installation, testing and commissioning of E & M services required to be provided in the said scheme. The work shall be executed as per scope of work, as per layout plans, drawings for E & M schemes, Inventories of Fittings, Fixtures, Equipments etc & specifications of E & M works given hereafter in respective head / part of the scheme sub-head. If any services required to make the building / scheme habitable, is not specifically mentioned in the scope of services, the same is deemed to be included within the scope of this tender and nothing extra shall be paid on this account.

   a) Internal Electrical Installation including service connection: Planning, designing, supply, installation, testing and commissioning of complete Internal and External Electrical Works for building and landscape which includes FRLS copper wiring in recess steel conduit, LED luminaires and lighting controls, fans, modular switch, sockets, DBs, MCBs, RCCBs, ACBs, ELCBs, MPCBs, Rising Mains, tap off boxes, end feed unit, raceways, earthing, lightning arrestor, cable TV wiring in steel conduit, wiring for telephone system, call bell system, street light, compound light, bollard etc as required, lighting the dome of building with LED lights, Electrical supply connection to the building being constructed in this tender is to be made from Electrical sub station No.1 by laying cable in ground/ in trench / in GI pipe as required of suitable size and numbers as required as per connected load calculation and voltage drop consideration.

   b) Fire Alarm System: Supplying, installation, testing & commissioning of Automatic Fire alarm system with PA system. It shall be as per NBC 2016 and Local bylaws and as per approval of Local Fire Service. The work shall also include planning, designing, preparing drawings and getting the drawings approved from the Engineer-in-Charge and its subsequent execution. Scope of work also includes integration of Automatic Fire alarm system provided in the building as per NBC 2016 requirements to the main control room located inside the building. Fire alarm system will be interconnected through fire survival cable. Wherever, cable is to be laid in wall, it should be laid through steel conduit

   c) Lifts: Planning, designing, supplying, installation, testing & commissioning of 2 Nos. 13 Passenger, 1.0 MPS Lifts serving all the floors, 1 Nos. 2 Ton Goods lifts Passenger, 1.0 MPS Lifts serving all the floors (G+5) including 5 year comprehensive maintenance including Defect Liability Period complete with internal EI work with LED fittings, exhaust fan, power point, DB, MCB, Bulkhead light for out side of machine room including suitable size power cable from rising main / panel to lift DB, 2 Nos GI plate earthing for each lift including earth strip from earth pit to DB and lift controller, suitable size copper conductor from DB to controller and copper conductor separate for light control etc. as required.

   d) CCTV and Networking System: Planning, designing, supply, installation, testing and commissioning of complete CCTV security system including installation of Cameras, Switches, 2 Nos. 43 inches LED screen TV 30 days storage capacity for complete system and all other accessories/ item as required for functioning of the system.

   i) SITC of 10G base networking system for the building with required number access point for Wifi of complete building including wiring (CAT6A) in steel conduit, laying of fibre optic cable from source point to layer 3 core switch, layer 2 switch, wall mounted rack with patch panels, POE switches, 3 KVA UPS for each LAN shaft for networking system etc. as required.

2. The above schemes of all the E&M works shall have to meet all the requirements of local bodies / CEA/ NBC norms as applicable & also meet the technical specifications of various
3. All the above schemes shall be approved by respective local bodies / CFO etc. as applicable before commencement of execution of work at site. During execution, if the local bodies etc. require a modification, the same shall be executed without any extra cost. Finally, after execution, obtaining clearances from CEA (central electrical authority) shall be the responsibility of the contractor All statutory fees / charges required for obtaining clearances from CEA shall be paid by the contractor. Final Fire NOC is to be obtained from CFO, Varanasi by agency before handing over.

4. INSPECTION BEFORE DISPATCH
   4.1 All routine tests shall be conducted before dispatch of equipments. No equipment shall be dispatched from the manufacture’s premises without such tests being conducted and test result recorded. These test certificates shall be given along with the supply of equipments. The Engineer In-charge shall, if he so desires inspect and witness the pre-delivery tests. For this purpose, the contractor shall give 15 days’ advance notice. Agency shall arrange for inspection by the department. Department shall bear expenses for inspection as far as traveling, boarding and / lodging is concerned. However, waiver if any, for inspection shall be at the discretion of the department without any cost implication but ROUTINE TEST & TYPE TEST Certificates shall have to be submitted for equipments.

   4.2 Prior to dispatch, all equipments shall be adequately protected & insured for the whole period o transit, storage and erection against corrosion and incidental damages etc. from the effect of vermin sunlight, rain, heat and humid climate.

5. INSPECTION AND TESTING AT SITE
   5.1 The installation shall be subject to necessary inspection during every stage of erection, by the Engineer In-charge or his authorized representative. The successful tenderer shall provide all facilities and assistance for the purpose.

   5.2 The completed installation shall be inspected and tested by the Engineer-in-Charge in the manner as will be laid down by him, in consultation with the contractor.

   5.3 All instruments and facilities necessary for the tests shall be provided by the contractor.

6. QUALITY OF MATERIAL AND WORKMANSHIP
   6.1 All parts of the equipment shall be of such design, size and material so as to function satisfactorily under all rated conditions of operation. All components of the equipments shall have adequate factor of safety. The work of fabrication and assembly shall conform to sound engineering practice and on the basis of “Fail Safe Design”. The mechanical parts subject to wear and tear shall be easily replaceable type. The construction of the equipments shall be such as to facilitate easy operation, inspection, maintenance and repairs. All connections and contacts shall be designed to minimize risk of accidental short circuits caused by animals, birds and vermin etc. All identical items and their component parts should be completely, interchangeable including spare parts.

7. Quality Assurance PLAN for E&M Services
   i) Quality to be ensured at the execution stage and works to be executed as per contract conditions and CPWD General Specification for Electrical Works.

   ii) All the materials, equipments and work shall conform to the Agreement.

   iii) Makes of all the material and equipments etc. shall be strictly as per agreement.

   iv) The model numbers of various equipments and work approved by Engineer-in-charge shall be checked for their conformity to the agreement.

   v) The technical data sheet and manufacturing drawing for all equipments and materials as per contract specifications shall be prepared by the respective manufacturer’s and will be submitted by contractor dully signed before placing the order or manufacturing the material. The engineer-in-charge shall approve as per contract conditions.

   vi) For the tests to be conducted at manufacture’s works, the tests shall be conducted in the presence of engineer-in-charge or his authorized representative.
8. TESTING PLANS
8.1 The testing plan for quality control for major E&M equipments shall be as per CPWD Specifications.
8.2 The material to be supplied against the contract shall be not older more than 6months from date of receipt at site.
8.3 To procure the genuine material from suppliers/authorized dealer etc shall bethe responsibility of contractor who shall preserve copies of invoice/ excise gate pass/ proof of dispatch and the same shall be made available for specially to engineer-in-charge.
8.4 As per guideline only routine test as prescribed in IS/ CPWD specifications shall be carried at manufacture works/ third party labs. Type test/ special test/ optional test shall be carried out only if stipulated in Bid Document/ Contract.
8.5 All items to be used and workmanship shall be thoroughly checked physically and for their performance as per agreement.
8.6 As per guideline only routine test as prescribed in IS/ CPWD specifications shall be carried at manufacture works/ third party labs. Type test/ special test/ optional test shall be carried out, wherever stipulated in Bid Document/ Contract.
8.7 The testing charges shall be borne by the agency who work is awarded including cost of requisite samples for testing.

9. COMPLETENESS OF WORK
The installations shall be completed in all respects and put in to operation even where certain details are not specifically mentioned in these specifications and the same is deemed to be included within the scope of this tender.

10. Completion Plan
Contractor shall periodically submit completion drawings for all the E&M services as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of four sets of CD’s/ Pen Drive and four in hard copy (594 x 841 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate following:
   i) Location and details of equipments and other particulars.
   ii) Complete wiring diagram, as installed and scheduled showing all connections in the complete electrical system.
   iii) Single line diagram, power schematic, control schematic with detailed bill of materials, showing makes, types and description of all components and accessories.

11. Successful contractor shall also furnish the Manufacturer’s instructions on Installation, Operation & Maintenance for all the installed items as required.
12. GUARANTEE
All equipments shall be guaranteed for a period of 36 months from the date of completion of work and taking over of the installation by the department. This guarantee is required against un-satisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer in-charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of Engineer-in-charge in this regard shall be final.

13. All E&M services such as Internal Electrical installations, lifts, fire fighting system, CCTV & Networking system, fire alarm system with PA system shall be declared as completed only after successful commissioning and completion of trial run of 1 month. However, maintenance of these installations during the warranty period of 36 months shall be carried out by the agency. During trial run of 1 month, cost of all consumables items shall also be borne by the main contractor.

Tests at Manufacturer’s Works
All tests to be performed during manufacture, fabrication and inspection shall be agreed with the IWD to commencement of the work. The EPC Contractor shall prepare the details of the schedule and submit these to the IWD or his authorised representatives for endorsement. 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 IWD or his authorised representatives who will mark in the appropriate spaces his intention to attend or waive the invited tests, or inspections. EPC Contractor shall arrange inspection and factory witness test.

A minimum of fifteen days’ notice of the readiness of equipment for test or inspection shall be provided to the IWD by the EPC Contractor (whether the tests be held at the Subcontractor of EPC Contractor’s works). The subject items should remain available for IWD 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 Subcontractor and EPC Contractor to enable the IWD to carry out the necessary inspection and testing.

No equipment/ materials 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 IWD or alternatively inspection has been waived.

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 IWD 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.

The IWD 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.

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 IWD.

These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the IWD 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.

When all equipment has been tested, the test certificates from all works and site tests shall be compiled by the EPC Contractor into volumes and bound in an approved from complete with index and four copies of each volume shall be supplied to IWD.

**Performance Tests at Manufacturer’s Works**

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.

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.

The EPC 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 endorsement of the IWD.

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 endorsement of the CPWD or his authorised representatives.

On completion of the tests the EPC Contractor shall submit a report showing the test results obtained together with the curves corrected to the site operating conditions.

**SITE CONDITIONS**

<table>
<thead>
<tr>
<th>Location</th>
<th>IIT Kanpur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>As per drawing</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>44 deg. C</td>
</tr>
<tr>
<td>Minimum</td>
<td>7 deg. C</td>
</tr>
</tbody>
</table>

**Notes:** All equipment shall give required output under the above conditions.
APPENDIX – I

GUARANTEE PROFORMA

GUARANTEE FOR ELECTRICAL SYSTEM INSTALLATION

We hereby guarantee the year round Electrical System which we have installed in the Complex described below:

Building : CEM Building IIT Kanpur

Location : Kanpur

Client : IIT

For a period of 36 months from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Engineer-in-charge, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorize the Engineer-in-charge to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand. WE ALSO HEREBY UNDERTAKE to test the entire installation upon completion and ensure that all units are functioning satisfactorily.

SIGNATURE OF CONTRACTOR
for ELECTRICAL INSTALLATION

DATE : SEAL
INFORMATION FOR CONTRACTORS FOR E-TENDERING

Main Contractor has to associate agencies for following packages as per eligibility criteria mentioned here under and in the terms and conditions of respective packages. Names and required eligibility documents of associate agencies for all packages have to be submitted at the earliest award of work so the that the approval from the department can be specialized agency within one month from date of start. After getting eligibility criteria of associate agency satisfactory, approval will be issued for specialized agencies. Department will also take around 10 days time to verify eligibility criteria of specialized agencies. In view of this, contractor has to submit credentials at the earliest to get the approval within one month from date of start, failing which a penalty of Rs. 10000/- per week shall be levied for each package. The order of all associate agencies for all packages will be places by contractor within 7 days from approval of agencies by department. If the agencies are not found eligible, main firm has to submit the names of another associate agency (Eligible as per mentioned criteria) within next 15 days, failing which respective package work shall be withdrawn from the scope of work of the main firm and will be got executed by another agency at the risk and cost of the main firm.

There shall be Pre-bid meeting on 26.12.2019 at 11:00 AM in the office of the Superintending Engineer, IWD, IITK for clarifications of doubts of the intending tenderers or for modification on any condition of the contract, specification etc. Any doubt over any technical specification, condition and schedule items has to be discussed by intending tenderers in the said meeting only. And necessary clarifications or changes, if required/deemed necessary by the department, shall be issued accordingly (in consultation with the Consultant/ any other person deemed appropriate by department). There shall not be any change permissible in any item description, specifications, conditions etc. later on and contractor shall have to provide items as per schedule and specifications only.

In the event of non-compliance of tender specifications and schedule later on, the respective package work shall be withdrawn from the scope of work of the main firm and will be got executed by another agency at the risk and cost of the main firm.

Main Contractor has to associate agencies for following packages as per eligibility criteria mentioned here under and in the terms and conditions of respective packages.

However the composite category main contractor shall also be eligible to carryout himself any or all of these E &M works without associating any specialized agency provided

a. He fulfils the prescribed eligibility criteria respectively for these work (s)

OR

b. He directly procures the equipment of approved make from manufacturer and get it installed from authorized agency / service provider of the manufacturer or specialized agency as per criteria mentioned in NIT. Agency will have to submit required declaration, MOU, willingness certificate etc as required for each work in this respect.

Names and required eligibility documents of associate agencies for all packages have to be submitted at the earliest award of work so the that the approval from the department can be specialized agency within one month from date of start. After getting eligibility criteria of associate agency satisfactory, approval will be issued for specialized agencies. Department will also take around 10 days time to verify eligibility criteria of specialized agencies. In view of this, contractor has to submit credentials at the earliest to get the approval within one month from date of start, failing which a penalty of Rs. 10000/- per week shall be levied for each package. The order of all associate agencies for all packages will be places by contractor within 7 days from
approval of agencies by department. If the agencies are not found eligible, main firm has to submit the names of another associate agency (Eligible as per mentioned criteria) within next 15 days, failing which respective package work shall be withdrawn from the scope of work of the main firm and will be got executed by another agency at the risk and cost of the main firm.

In the event of non-compliance of tender specifications and schedule later on, the respective package work shall be withdrawn from the scope of work of the main firm and will be got executed by another agency at the risk and cost of the main firm.
Eligibility Criteria for specialized firm

1. The firms/ Contractors who fulfill the following requirements shall be eligible to apply. Joint Ventures are not accepted. Specialized firm who have successfully completed work of **Internal Electrical installation including service connection, Fire Alarm system, CCTV, Acess Control System and lifts** as mentioned below during last 7 years ending previous day of last date of submission of tender.

   a. Three similar works each costing not less than Rs.2657 lacs
   OR

   b. Two similar works each costing not less than Rs.3986 lacs
   OR

   c. One similar work costing not less than Rs.5315 lacs.
   OR

   Similar work shall mean “Supply, installation, Testing & Commissioning of Internal Electrical installation including external service connection, Fire Alarm system, CCTV, Acess Control System and lifts”.

2. The values of executed work shall be brought to current costing level by enhancing the actual value of work at simple rate of interest of 7% per annum, calculated from the date of completion to the last date of receipt of application for tender.

3. The firm should be registered with GST.

4. Self attested copies of completion certificate(s) issued by the officer of the client department, not below the rank of Executive Engineer or equivalent, for works executed in Government and in cases of private works certificates signed by the consultant in charge and counter-signed by the owner of the building for whom the work has been carried out, will have to be furnished along with the application. The completion certificate must clearly indicate:
   a. Name of Work
   b. Stipulated date of start and actual date of completion.
   c. **Value of Electrical installation i/c external service connection (from substation No. 1 distance of substation about 600 Mtr. From site.) LT cable as per load of building), fire Alarm, CCTV, Access Control system, street light poles complete with all accessories and lift work.**
   d. That the work has been completed satisfactorily.
   e. Full address of the client, officer issuing certificate and location, where work is executed.
   f. TDS. (for private works only)

5. The intending bidder must read the terms and conditions of CPWD-6 carefully. He should only sub
mit his bid if he consider himself eligible and he is in possession of all the documents required

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description /Type of work</th>
<th>The firm should be</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal Electrical Installation including service connection</td>
<td>The contractor should be registered in any of CPWD, BSNL, MES, PWD, Railways, Central PSUs/ State PSUs in the appropriate class.</td>
<td>The firm should submit details of enlistment and valid Electrical Licence as reqd. for approval.</td>
</tr>
<tr>
<td>2</td>
<td>Automatic Fire Alarm System</td>
<td>Specialized agency with appropriate experience, credentials as specified.</td>
<td>The firm should submit details of experience, credentials as reqd for approval</td>
</tr>
<tr>
<td>3</td>
<td>CCTV, LAN Networking</td>
<td>Specialized Agency with appropriate experience and other conditions if any as specified.</td>
<td>The firm should submit details as per eligibility criteria.</td>
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</table>

**SPECIAL CONDITIONS FOR E&M WORKS**

The 1st lowest tenderer (main firm) has to submit the following documents for association of eligible E&M contractors at least 7 days prior to depositing performance guarantee.

1. The applicant should submit the willingness from eligible E&M contractors to get associated with the applicant for execution of each E&M component of work in wholesome manner and as per the conditions set out in the MOU to be entered into between the one who is awarded the work and the associated eligible E&M contractors.

2. In support of the eligibility conditions of the proposed associated E&M contractors, copy of their registration documents, Electrical Contractor’s License, Sales Tax Documents, Work experience certificates and other documents as required in the eligibility conditions duly attested by the applicants (Main Contractor and associate contractors) shall be submitted to the EE(C) who will submit these documents to the competent authority for deciding the eligibility within three days of receipt of the same. Each such an E&M contractor will certify that they are not debarred as on the day of application for sale of tender.

3. The main contractor will submit MOU (for each package) signed with eligible registered contractors of CPWD/ Central PSUs/ State PSUs /specialized E&M contractors. The MOU in the enclosed form shall be signed by both the
parties i.e. main contractor as 1st party and associated E&M contractor as 2nd party.

4. In the event of the concerned E&M agency not performing satisfactorily or failure of associate contractor to complete the E&M work, the main contractor on the written direction of the department, shall remove the Associate contractor deployed on the work and shall submit name of new associate who fulfill the conditions mentioned in NIT to execute the leftover work without any loss of time or variation in cost to the department in this regard. Such associates shall also enter into tripartite Agreement/Contract along with the main tenderer and the departmental officer and shall meet all the guarantees for the equipment's already supplied for which payment has been released by the Deptt. in part. If any equipment supplied for the work, during the currency of the earlier Associate contractor and paid partly by the Deptt., becomes redundant / not in a position to be installed and commissioned and put to beneficial use due to change in agency for execution of E&M work, the main contractor shall be liable for replacement of the equipment(s) at no cost to Department. No change of E&M Contract will be allowed without prior approval of the Engineer-in-charge of respective component.

5. Executive Engineer (E) shall be the Engineer-in-charge as far as E&M works are concerned. Separate tender schedule abbreviated CPWD-8 and Conditions for E&M Works are appended with this tender. It will be obligatory on the part of the contractor/tenderer to sign the tender documents for all the component parts. After award of the work, the contractor will have to execute separate agreements for E&M components of the work with Executive Engineer (E), IWD, IIT Kanpur

6. The main contractor shall be responsible and liable for proper and complete execution of all the E&M works and ensure coordination and completion of both civil and E&M works.

7. The associate contractor shall sign a tripartite Agreement/Contract along with the main tenderer and the departmental officer, for technical compliance of specification, guarantee etc.

8. The associate contractor shall attend the inspection of the work by the Engineer-in-Charge of E&M works as and when required.

9. The Agency holding the award of work shall execute the work by selecting such make of items specified in the Schedule of work, which mandatorily comply Public procurement (Preference to Make in India), Order 2017

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Hire charges per day</th>
<th>Place of issue</th>
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<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td></td>
<td>Hire charges per day</td>
<td>Place of issue</td>
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(Operative schedules shall be supplied separately to each intending tenderer)

**SCHEDULE ‘A’**

SITC of Internal Electrical Installation

Schedule of Quantities (as per PWD-3)

As per separate sheets attached for Electrical Items of Work.

**SCHEDULE ‘B’**

Schedule of materials to be issued to the contractor:

Rates in figures & words at which the material will be charged to the contractor

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description of item</th>
<th>Quantity</th>
<th>Place of issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
<td>3</td>
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<td>2</td>
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<td>5</td>
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</tbody>
</table>

**SCHEDULE ‘C’**
SCHEDULE ‘D’
Extra schedule for specific requirements/document for the work, if any: As attached in tender form

SCHEDULE ‘E’
Reference to General Conditions of contract – GCC 2019, EPC Projects CPWD as modified and corrected upto 30.11.2019

Name of Work: Centre for Engineering in Medicine (CEM) at Indian Institute of Technology Kanpur.

Estimated cost of work:

i) Earnest money: Included in schedules of Civil component
ii) Performance Guarantee: Included in schedules of Civil component
iii) Security deposit: 2.5% of the tendered value of the work

GENERAL RULES & DIRECTIONS:
Officer inviting tender: E.E. (Elect.)
IWD, IIT Kanpur

Tools and plants to be hired to the contractor
Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses 12.2 & 12.3
## Clause- 10 –A & 18

List of mandatory machinery, tools and plants & testing Equipment to be deployed by the contractor at site

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Steel/Aluminium Ladder 1.5 m to 8 m.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>2.</td>
<td>Chase cutting machines.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3.</td>
<td>Electrical wire drawing equipment.</td>
<td>2 Set.</td>
</tr>
<tr>
<td>4.</td>
<td>Torque wrench for nut/bolt/screws.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>5.</td>
<td>Conduit die set.</td>
<td>2 Set.</td>
</tr>
<tr>
<td>6.</td>
<td>Pipe vice.</td>
<td>1 No.</td>
</tr>
<tr>
<td>7.</td>
<td>Bench vice.</td>
<td>1 No.</td>
</tr>
<tr>
<td>8.</td>
<td>L.T.Meggar 500/1000 volts.</td>
<td>1 No.</td>
</tr>
<tr>
<td>9.</td>
<td>Tong Tester.</td>
<td>1 No.</td>
</tr>
<tr>
<td>10.</td>
<td>Multimeter.</td>
<td>1 No.</td>
</tr>
<tr>
<td>11.</td>
<td>Hydraulically operated &amp; hand operated crimping machine.</td>
<td>1 No.</td>
</tr>
<tr>
<td>12.</td>
<td>Earth tester.</td>
<td>1 No.</td>
</tr>
<tr>
<td>13.</td>
<td>Portable Ordinary drilling machine.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>15.</td>
<td>Overhead conduit puller.</td>
<td>1 No.</td>
</tr>
</tbody>
</table>
MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN

1] M/S [Name of the firm with full address)
   Enlistment Status
   Valid Upto:
   [Henceforth called the main contractor]
   And

2] M/S [Name of the firm with full address)
   Enlistment Status
   Valid Upto:
   [Henceforth, called Associated Electrical Contractor or Electrical Contractor]

Name of Work:- “C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.”

as per schedule, specifications, terms and conditions of the tender.

We state that M.O.U. between us will be treated as an agreement and has legality as per Indian Contract Act (amended up to date) and the department (IWD) can enforce all the terms and conditions of the agreement for execution of the above work. Both of us shall be responsible for the execution of work as per the agreement to the extent of this MOU allows.

We have agreed as under:

1- The associated electrical contractor will execute all electrical works in the wholesome manner as per terms and conditions of the agreement. Any type of internal transaction between the electrical contractor and main contractor shall be as per their convenience and mutual understanding without involving the department. Security deposit shall be deducted as per agreement.

2- The electrical contractor shall be liable for disciplinary action and other legal actions as per agreement if he fails to discharge obligation as per this agreement besides forfeiture of the security deposit.

3- All the machinery and equipments, tools and tackles required for execution of the electrical works. As per agreement shall be the responsibility of the electrical contractor.

SIGNATURE OF MAIN CONTRACTOR

Date
Place

SIGNATURE OF ASSOCIATED ELECTRICAL CONTRACTOR

Date
Place

COUNTERSIGNED
EXECUTIVE ENGINEER (E)
WILLINGNESS CERTIFICATE

Name of Work- C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

I hereby give my willingness to work as associated contractor for Internal Electrical installation including service connection, Fire Alarm system, CCTV, Access Control System and Lifts). in the above mentioned work.

I will execute the work as per specifications and conditions for the agreement and as per direction of the Engineer-in-charge. Also I will employ full time technically qualified supervisor for the works. I will attend inspection of officers of the department as and when required.

Date: ___________________________  Signature of Contractor
ADDITIONAL SPECIFICATION

GENERAL

The brief Scope of Internal Electrical Installation works includes following:

A. C/o Centre for Engineering in Medicine Building (G+5) including Water supply, Sanitary installation, Internal Electrical installations, Fire Fighting, Fire Alarm system, Lifts, CCTV/LAN, HVAC (Low side) and development works and all other related works to make the building functional on Engineering, Procurement and Construction (EPC) contract basis at IIT Kanpur.

Illumination, ceiling fan as per Architectural Drawing subject to compliance to the CPWD Specification & NBC 2016.

2) Only LED Light fittings to be provided.

3) The work shall be executed as per scope of work, as per layout plans, drawings for E & M schemes, Tentative Inventories of Fittings, Fixtures, Equipments etc & specifications of E & M works.

Note: All wiring should be done with 1100 V grade FRLS (Flame Retardant low smoke), unsheathed, flexible, copper conductor wires.

4) 2 Nos. Minimum 630 Amps. & 2 Nos. Minimum 400 Amps. Sandwich type Rising mains with Al. Bus-Bars for elect. supply to various floors shall be provided. 2 Nos. separate Sandwich type rising mains with al. bus-bars of required rating shall be provided for uninterrupted power supply to various services. The supply shall be given from Main LT panel to end feed unit of each rising mains through suitable size and rating XLPE cable. From rising main, suitable capacity tap off box shall be provided to connect the vertical TPDB with incomer of suitable size 4 pole MCCB through XLPE Cable. Separate tap off box for light and power shall be provided from vertical TPDB, the supply shall be connected to different Horizontal TPDBs at different locations for further distribution to the circuits through MCBs with suitable size copper conductor cables in MS conduit. MCCB of 100 mA sensitivity shall be used in the incomer for all DBs (other than vertical TPDBs). MCB of required rating (matching with the load current) shall be provided for protection of each circuit.

5) Power distribution (Light and power load) shall be made inside the building at various floors with the help of 3 nos. suitable capacity (400 Amps & 630 Amps) Sandwiched type rising mains suitable for use on 3 Phase, 4 Wire, 415 Volts, 50 Hz AC supply with metal clad enclosures made of 1.6 mm thick steel sheet duly powder coated with Nos. Aluminium bus bars (100% neutral), necessary joints, elbow joints and, expansion joints, fire barriers at regular interval of 3 Meter approx. (Each floor crossing), Continuous earthing with two nos. GI strip of suitable size (one on each side) including GI clamping brackets, suspenders, angle iron brackets, steel fasteners, connecting to earthing system. Opening in rising mains for tap off box shall be at regular interval of one meter.

6) Providing and fixing suitable capacity and size outdoor/ Indoor type as required Essential & Non-Essential panel.

B. DEVELOPMENT

(i) LED Bollard and Compound Lighting with LED lighting placed on Octagonal Poles of suitable height & spacing along the Road and Boundary Wall.

(ii) Gates of the campus/ building are to be provided with appropriate Illumination as per Architectural Considerations.

(iii) The Electrical panel board for out door lights shall be with Timer controller. Only MCB/ MCCB shall be used no fuses to be provided in the panel.

(iv) Detailed Inventory attached
C. QUALITY ASSURANCE PLAN

1. Internal Electrical Installations
   b) Safety procedures given in Chapter 10 of CPWD General Specifications for Electrical works Part-1(Internal) shall be followed.
   c) Safety recommendation as per IE rules 1956 as per Appendix “C”.
   d) The materials shall be tested from 3rd Party laboratories are conduit, wires, cables etc.
   e) Provisions and fixing of check-nuts for conduit work as per CPWD Specifications.
   f) No. of wires in one conduit shall be ensure as per CPWD Specifications.
   g) Colour coding of wires to be ensure.
   h) Lugs and thimbles at cable/ wire ends in switch boxes as per CPWD Specifications.
   i) Labeling of switch boxes shall be ensured.
   j) Termination of earth terminals in earth pits, switch box, DBs and accessories to be ensured. Earth chamber to be constructed and proper marking to be done.
   k) A comprehensive schematic diagram is prepared starting from the main board up to the final DBs. All such boards are duly marked and numbered.
   l) The pre-commissioning testing of the installation shall be carried out such as
      i) Insulation resistance test.
      ii) Polarity test of switch.
      iii) Earth continuity test.
      iv) Earth electrode resistance test.
   m) All the tests at site shall be carried out for the completed installations, in the presence of and to the satisfaction of the Engineer in Charge by the contractor. All the test results shall be recorded and submitted to the Department.
   n) On completion of an electrical installation (or an extension to an installation), a certificate shall be furnished by the electrical contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix “E” of CPWD General Specifications for Electrical Works Part-1(Internal) in addition to the test certificate required by the local electric supply authorities.
   o) All hardware items such as screws, thimbles, G.I. wires etc. which are essentially required for completing an item as per specifications will be deemed to be included in the item even when the same have not been specifically mentioned. All hardware materials such as nuts/bolts/screws/ washers etc. to be used in the work shall be zinc/cadmium plated iron.
TECHNICAL SPECIFICATIONS FOR WORK

1. CPWD General Specifications for Electrical Works Part I Internal – 2013,
2. CPWD General Specifications for Electrical Works Part II External – 1994,
3. CPWD General Specifications for Electrical Works Part III (Lift & Escalator) – 2003,
4. CPWD General Specifications for Electrical Works Part IV Sub Station–2013,
5. CPWD General Specifications for Electrical Works Part V Wet Riser & Sprinkler System – 2006,
6. CPWD General Specifications for Electrical Works Part VI Fire Alarm System – 2018,
7. CPWD General Specifications for Electrical Works Part VII DG Sets 2013,
8. CPWD General Specifications for Electrical Works Part VIII Gas Based Fire Extinguishing System – 2013,
9. CPWD General Specifications for Heating, Ventilation & Air-Conditioning – 2017 amended upto date and as per direction of Engineer-in-Charge. The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.
10. NBC 2016
11. IE Rules and IE Act and relevant IS codes as amended up to date.
12. If there is any ambiguity among specifications to be followed, tighter/ Tougher shall be followed.
13. All hardware items such as screws, thimbles, G.I. wires etc. which are essentially required for completing an item as per specifications will be deemed to be included in the item even when the same have not been specifically mentioned.
14. All hardware materials such as nuts/bolts/screws/washers etc. to be used in the work shall be zinc/cadmium plated iron.
15. Any conduit which is not be wired by the contractor shall be provided with GI fish wire for wiring by some other agency subsequently. Nothing extra shall be paid for the same.
16. While laying conduit, suitable junction boxes shall be left for pulling the wires.
17. Copper wire shall be FRLS PVC insulated multi-stranded conductor. Termination of multi-stranded conductors shall be done using crimping type thimbles at both the ends. Nothing extra shall be paid for the same.
18. Material to be used in the work shall be ISI marked. The makes of material have been indicated in the list of acceptable makes. No other make will be acceptable. The material to be used in the work shall be got approved from the Engineer-in-Charge before its use at site. The Engineer-in-Charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.
19. Where switches/sockets/telephone outlets are to be provided, the same shall be of only one make.
20. The MCB distribution boards shall be factory fabricated in the works of the manufacturer of the MCB’s of any of the makes specified. The MCBs and the MCB distribution board
shall be of the same make.

21. The earthing shall be carried out in the presence of the Engineer-in-Charge or his authorized representative. All fittings/fans will be earthed as per specifications.

22. All repairs & patch work shall be neatly carried out to match with the original finish & all damages caused to the building installation during the execution of work shall have to be made good by the contractor immediately at his own cost to the entire satisfaction of Engineer-in-charge. In case contractor fails to comply with the instructions of the Engineer-in-charge, Engineer-in-charge shall be at liberty to get the work done by any other agency and recover such amount as paid to the other agency from the bill(s) of the contractor. Contractor shall have no claim, whatsoever, on the extent of such amount.

23. Wherever ceiling roses are not required to be provided in the light/fan/exhaust fan points, due to site conditions, the contractor shall use suitable three pin connectors for which nothing extra shall be paid. Wiring shall be carried out with FRLS wires.

24. Contractor shall provide polythene/PVC plastic cover for all MDB’s/SDB’s/DB’s to protect them from rust/damages, during execution of work till the work is actually completed and handed over to the department.

25. The loose wire boxes/cable end boxes (adaptor boxes) shall be provided on the various electrical boards to facilitate the termination of the wiring in the various mountings. The boxes shall be made from powder coated aluminium section frame with 3 mm thick ACP sheet with lockable handle as desired by the Engineer-in-charge. The length of such boxes shall be same/or more as the width of the electrical switchboard. Such loose wire boxes are deemed included in the scope of the work and no extra payment shall be made for them.

26. All debris/melba resulting due to electrical work shall be removed on daily basis and completion of the work shall only be accepted after the site has been cleaned of all melba. In case, contractor fails to comply, the same shall be got removed by the other agency and the payment so made shall be recovered from the bill(s) of the contractor.

27. The contractor shall have to make arrangements, at his own risk and cost, for transportation of materials from the point of issue of stores to site of work, if any.

28. Makes of all items that are not covered in the schedule of work/additional specifications shall be got approved from the Engineer-in-Charge and shall conform to relevant Indian Standard as applicable.

29. The contractor shall ensure that the staff employed by him for execution of the electrical work, possess the valid electrical license issued by competent authority. Consequences arising due to the default of the contractor in not complying with the above condition shall be the responsibility of the contractor.

30. Lugs shall be provided for terminating copper/aluminum/GI earth wire to all switchboards for which nothing extra shall be paid. All multi stranded / stranded wires shall be terminated through copper lugs.
31. All concealed work and earthing shall be done in the presence of the Engineer-in-charge or his authorized representative.

32. The GA Drawings of the various electrical cubical panels shall be got approved from the Engineer-in-charge before fabrication and shall comply with CPWD specifications and Indian Electricity Rules. The panels shall conform to IS: 8623/1993. All panels shall be powder coated inside out, in shade approved by the Engineer-in-charge.

33. All floor-mounted panels shall be mounted on 75mmX75mmX6mm thick M.S. channel on all the sides. It shall have a continuous earth bus of the same size and material as the main phase running continuously along the length of the panel extending on either side for earth connection.

34. The doors of all cubicle panels shall be hinged type including those of bus bar chambers and cable alleys. The locking shall be with chrome plated metal key locks. All doors shall be earthed with copper conductor wire as approved by the Engineer-in-charge.

35. The work shall be carried out according to GFC drawing approved by the Engineer-in-charge. The layout once approved can only be changed by the Engineer-in-charge as per requirement at site. It shall be the responsibility of the contractor to plan the layout and get the approval from the Engineer-in-charge before laying the conduits etc.

36. The MCB should be ‘C’ type of the same make as that of MCB DB’s and having a minimum breaking capacity of 10 KA. Contractor shall obtain approval of the Engineer-in-charge before procurement of MCB DB’s.

37. All model of modular accessories required for the work shall be got approved from the Engineer-in-charge from among the approved makes. The base plate shall be preferably in sheet steel or otherwise in unbreakable polycarbonate. The cover plates shall be screw less type in shade approved by the Engineer-in-charge.

38. Contractor shall have to check the Site Order Book for any instructions of the Engineer-in-charge or his authorized representative and sign the site order book. He shall be bound to ensure compliance with the instructions recorded therein.

39. The MCCB’s shall be compatible for reliable protection and accurate measurement. The rated Service breaking capacity (ka) shall be 100% of Ultimate breaking capacity (ka). All MCCB’s shall be current limiting type with features as per relevant IS codes and CPWD specification. The MCCB shall be of thermal release type.”

40. MCCB’s shall be used with terminal spreaders and all terminals shall be shrouded to avoid direct contact.

41. Mechanical Castle key interlock shall be provided among the incomer MCCB’s, wherever, as applicable, two different incomer sources are provided in the panel as per the directions of the Engineer in charge. The same is deemed included in the scope of work.

42. All measuring and indicating instruments shall be protected through fuses/ MCB’s and isolating switches.
43. General arrangement drawing of the switchboard shall be got approved from the Engineer-in-Charge before commencement of manufacturing.

44. For the items like LT panels, feeder pillars and accessories, etc., the firm shall arrange for inspection in the factory and provide for all facilities for testing. The cost of the visit of Engineer-in-Charge or his representative shall be borne by department. However, firm will be responsible for arranging the inspections as required.

45. Conduit layout as per switching arrangement shall be prepared by contractor and got approved from the Engineer-in-Charge before slab casting.

46. All Accessories of MS conduit shall have ISI marked.

47. To facilitate drawing of wires 16/18 SWG G.I fish wire shall be provided along with laying of recessed conduit for which no extra payment shall be made to contractor.

48. Conduit and termination to SDB and main board adapter box i/c connection wires to MCB's inter connection between SDB and main board etc shall be included in the tendered rates and nothing extra shall be paid for the same.

49. The contractor shall provide junction boxes / looping boxes of required sizes and such boxes shall be measured as part of conduit / batten wiring without any extra payment.

50. Only brass screws along with brass washers will be used for fixing Phenolic laminated sheet covers and at other places aluminum alloy/ brass / cadmium plated screws will be used.

51. M.S. dash fastner shall be used for installation of fittings and fixtures in ceiling and for providing suspenders for the angle support, conducting, cable tray etc. for which nothing extra shall be paid

52. All CI/metal boxes & junction boxes should be cleaned properly and painted from inside before wiring & fixing the accessories.

53. CONDUIT LAYOUT shall be prepared by contractor and got approved before execution of work. In case contractor does not do so before start of work, recovery @ 2(two)% of tendered amount of I.E.I. works shall be made from the bill. Minimum No.of Junctions to be kept, & if required junctions to be kept underneath the fitting locations in corridor/rooms so that junctions are not visible after fittings are fixed/in position. Drop of conduit shall be well planned w.r.t. location of fitting/D.B. and criss crossing to be avoided. All chases in walls shall be cut using electrical chisels/cutters. For this purpose electricity shall be arranged by contractor. In case contractor fails to do chase cutting by electrical chisels/cutters and resorts to manual methods, a recovery of Rs.50/- per point shall be made from contractor’s bill.

54. In case cable in the lift shaft is also to be fixed, contractor shall have to liaison with CIVIL/Lift agency to make use of the scaffolding provided by them.

55. Copper wire upto 4 sqmm. may be single stranded or multi stranded whereas wires above 4
sqmm. shall be multi-stranded conductor. Termination of multi-stranded conductors shall be done using crimping type thimbles at both the ends. Nothing extra shall be paid for the same.

56. All metal boxes to be applied primer and painted, then only should be installed else recovery @Rs.20/- per point should be made from contractor’s bill. Boxes shall have socket arrangement for tightening screws, instead of simple holes in M.S.sheet. Boxes shall be again painted at the time of wiring.

57. For Submain Wiring, Colour Code for different phases and Neutral (R.Y.B. black) to be maintained. While circuit wiring, wiring for fan point, wiring for light point shall be done with different colours for easy identification. Wiring for neutral shall be done with black colour and all connections to fans & fittings wherever visible shall be made with white PVC insulated copper wire or wherever cover sleeve may be provided. At Switch board, Switch shall be fixed in a logical manner w.r.t. fittings layout.

58. Unless specifically approved by Executive Engineer (E.), loose wire box, above DB shall be provided and DB’s shall have loose wire box of same make.

59. All connections to MCB’s shall be made using thimble/lugs.

60. All DB’s i/c incoming &outgoing MCB’s shall be suitably numbered with PAINT for location/circuits. DB shall be fixed in recess suitably (30 mm. approx. projected from unplastered wall) to ease opening of door. Top of DB to match with door frame height as per site conditions.

61. All fittings and fans should be properly earthed through the protective conductor.

62. Provision of earth bars in main boards, earth terminal block in DB’s & earth studs in all metal boxes shall be made, connection to this stud shall be crimped.

63. A clamp type termination should be made in the termination of earth strips (where provided) to pipe electrodes to provide surface type contact.

64. The size at switch box for providing Modular Plate type Switch/Sockets shall be properly settled to take care of all necessary switches/screws/fan regulators. Blanking plate if required shall also be provided at no extra cost.

65. For point wiring in steel conduit modular type switches/sockets/telephone outlets/T.V.outlets shall be used of one make only.

66. The contractor shall make his own arrangement at his own cost for electrical/ general tools and plants required for the work.

67. DBs & MCBs, RCCBs shall be used of one make only.

68. The work shall be carried out according to approved drawings/details which shall be subsequently issued to the successful tenderer for execution of work and as per instructions of the Engineer-in-Charge who will have the right to change the layout as per requirement at site and the contractor shall not have any claim due to change in layout.
69. The work shall be carried out in engineering like manner. The bad workmanship will not be accepted and defects shall be rectified at contractor’s cost of the satisfaction of the Engineer-in-Charge. The programme of electrical works are to be co-ordinated in accordance with the building work and no claim for idle labour will stipulated in the tender, electrical work shall have to be completed along with completion of civil work.

70. Watch and ward of the material/equipment shall be the responsibility of the contractor till handing over of installation to the department.

71. The contractor or his representative is bound to sign the site order book as and when required by the Engineer-in-Charge and to comply with the remarks therein.

72. The entire installation shall be at the risk and responsibility of the contractor until these are tested and handed over to the department. However if there is any delay in construction from the department side, the installation may be taken over in parts, but the decision on the same shall rest with Engineer-in-Charge which shall be a binding on the contractor.

73. Some of the items of work, if already executed: on that case the successful tenderer shall have to use these items for completing the work. For wiring, the existing conduit wherever required shall be used by the contractor. The recovery will be made for these items as accepted rate of similar items.

74. Material to be used in the work shall be ISI marked as applicable. The material in required quantity to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.

75. Contractor shall preserve the copies of invoices, test certificates, gate passes etc. to prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.

76. No Form-D, 31/32 (Road Permit) shall be issued by the department. The road permit shall be arranged by the tenderer on his own. Deduction of Income Tax & Contract Tax at source shall be made while releasing payment through running/final bills as applicable. A certificate specifying the rate and amount of deduction shall however be issued.

77. Test Certificate Test certificates including warranty/guaranteecertificates of all the materials supplied for the work carried out shall also be submitted mentioning order date/ no/ lot no etc failing which recovery @1% tendered amount &upto of Rs.1.0 lakh shall be made from final bill.

78. Panels: Drawing of panel/Feeder-pillar shall be submitted for approval along with make/ model/ cat no of switchgears/ accessories to be used and fabrication to be taken up only after approval of such drawing. Before painting proper surface treatment shall be done and than powder coated. These shall be offered for inspection during fabrication.

79. The makes for items shall be strictly as per list of make attached.

80. Storage :- Responsibility for storage space for execution of work shall be of main contractor.
81. Power & Water Supply:- Responsibility for supply of power & water for execution of work shall be of main contractor.

82. Contractor is advised to visit site before quoting rates for determining site conditions. No claim or argument shall be entertained in this regard at later stage.

No inspection out side the country is permissible if required so the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment.

Note: The following information given is indicative only. Execution shall be carried out as per functional requirement and design approved by engineer-in-charge

1. All internal electrical works shall be carried out with FRLS PVC insulated conductor cables (IS:694) in recessed Steel conduit. All switches, sockets, AC Starter, IP Phone socket, Data sockets, stepped type electronic fan regulators, bell push and accessories alongwith matching mounting boxes shall be of modular type.

2. The ceiling fan regulator shall be twin module and step type.

3. The colour and finish of the modular type switch / sockets and its accessories shall be decided by IWD at the time of approval. Nothing extra payable for that.

4. All lighting fixtures should be LED type.

5. Required illumination level for general lighting shall be achieved on the basis of required lux level in various areas, light power density as per CPWD specification.

6. Arrangement of luminaries in various areas of Residential and non – residential buildings shall be done on the basis of Illumination level & light power density as specified in CPWD specification Internal 2013 and National Building Code 2016 and shall be got approved from Engineer-in-charge.

7. Ceiling fans will be provided in building and at each location except toilets / Bath rooms irrespective of provision of air conditioners. Optimum size / number of ceiling fans for room of different sizes shall be as per provision laid down in specifications for internal EI work 2013. Minimum air delivery and service value shall be as per the specification. Exhaust fans of suitable capacity and sweep shall be provided in all the toilets as per standard specifications and as per the approval of Engineer-in-Charge.

8. T.V outlet wiring shall be terminated in suitable size of G.I. box along with splitter. The interconnections of all splitter boxes fixed at all floors shall be done properly to form proper distribution system with the prior approval of Engineer-in-Charge.

9. Floor Panels: In building, the panel boards shall be of modular type and fabricated as per Specifications. The incomers, outgoings, bus bar, indicating instruments etc.
shall be designed as per connected load and shall be got approved from Engineer-in-charge.

10. All types of panel shall be fabricated from CPRI approved firms and strictly as per CPWD specifications. All Panel shall have compatibility with BMS system. The drawing of panel boards must be got approved from Engineer – in – charge before fabrication work. The panel board shall consist of MCCB/ACB as incomer and outgoing, copper / Aluminum bus bar, digital type ammeter, voltmeter OR multifunction meter, selector switches, LED type indication lamps etc as per standard sound engineering practice. Every multi function meter should have RS 485 port.

11. Rising mains: Upward transmission of power inside the buildings shall be done with Sandwich type bus trunking with Aluminum bus bar with all accessories i.e; adapter box, cable end box, tap-off box with MCCB. Rating of rising mains shall be decided as per connected load of the building and future expansion and as approved by Engineer – in – Charge. Rising mains shall be conforming to IS 8623, IEC61439 as amended upto date. Rating of rising mains in various building shall be minimum of 200 amps as per design / connected load and future expansion.

12. Staircase lighting should be twin controlled, lobby and toilet lights shall be group controlled.

13. Minimum size of copper conductor for power wiring shall be 4 Sq mm and that for light and fan points wiring shall be 1.5 sq mm.

14. The wiring and conduit route plan/drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.

15. To facilitate drawing of wires, 18 SWG GI fish wire shall be provided along laying of recessed conduit. Conduits laid for other services, like fire alarm, PA system etc., where wiring is not done along IEI works; fish wire shall be invariably drawn.

16. The connection between incoming switch / isolator and bus bar shall be made of suitable size of thimble and cable.

17. While laying conduits for fire alarm system, sufficient junction outlets are to be provided as per the direction of the Engineer-in-Charge for detectors as required.

18. Lightning arrester shall be provided for all buildings irrespective of height as per IS 2309-1989 as amended up to date and CPWD specifications for internal work – 2013.

19. RCBBO of 300ma sensitivity of suitable rating shall be provided as Incomer of each Distribution boards.

20. Lighting luminaries (LED type) in all buildings shall be decided as per functional requirement, design and drawing approved.

21. In each building, wherever lift is provided, power supply to DBs located in Lift shaft at suitable location as approved by Engineer-in-charge shall be done using suitable XLPE insulated armored cable. Supply of cable shall be in the scope of work.
22. Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at over head, one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq mm FRLS copper conductor cable. 15 amp power plug and 5 amp power plug shall be provided at each floor. Wiring of these power plugs shall be done with 4 sq mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide minimum lux of 110 shall be connected with each point of lift shaft.

23. For accommodating various size of cable incoming to the building, NP2 pipes of suitable size shall be provided.

24. All hardware items such as screws, thimbles, connectors, earth/neutral terminals, wires etc. which are essentially required for completing any item as per specifications will be deemed to have been included in the item even when the same have not been specifically mentioned.

25. All hardware material such as nuts/bolts/screws/washers etc. to be used in the work shall be zinc/cadmium plated iron. The galvanized boxes of modular switch/sockets etc. shall be of the same make as of switch/socket etc.

26. While laying conduit, suitable minimum number of junction boxes shall be left for pulling the wires. These shall be placed in such a way that the same do not remain noticeable.

27. Multi stranded FRLS PVC insulated copper conductors wires are to be used in the work. Termination of multi-stranded conductors shall be done using crimping type copper thimbles at both the ends. Nothing extra shall be paid for the same.

28. The connections of switches, earthing conductors & interconnections cables shall be made by adequate rating thimbles of approved standard makes only and nothing extra on this account shall be paid.

29. Check nuts shall be provided while terminating the M.S. conduits in switch board boxes for which nothing extra shall be paid.

30. All distribution boards shall be marked with circuits controlling the rooms/area/SDB controlled

31. Material to be used in the work shall be ISI marked. The makes of material have been indicated in the list of acceptable makes. No other make will be acceptable. The material to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications

32. While deciding the size of switch boxes for light points/fan point, exhaust fan point items, extra two modules will be provided for each fan point for fixing of regulator(s) (fan regulator is to be provided under different item). Wherever extra modules are available, the same shall be provided with blanking plates without any extra cost.

33. Modular type switches/sockets/telephone outlets/TV sockets are to be provided wherever
indicated in the items. The same shall be of only one make. The modular plates of switches, sockets, telephone & TV sockets etc. shall be in two parts i.e. plates with frames with in quoted rates.

34. The building shall be provided with false ceiling in various areas. In order to avoid maintenance problem the contractor will not provide any ceiling rose/connector/looping box etc. above the false ceiling. The point wiring in that case will be extended up to the fitting/fan etc. directly without provisions of any termination arrangement in between. The wire from the end point up to the fixture shall be considered to be included in the point wiring. Nothing extra shall be paid for the same.

35. Wherever it is not possible to provide rigid conduits, flexible conduit pipe shall be provided for drawing/running the wires. However, such arrangement has to be kept to the barest minimum and only with the prior approval of Engineer-in-charge.

36. Earthing and all hidden items of work shall be carried out in the presence of the Engineer-in-charge or his authorized representative.

37. The fan box cover shall be made from 3mm thick phenolic laminated sheet as per CPWD specification.

38. The firm has to go through the site order book kept with the Assistant Engineer(E) regularly and has to sign the same and carryout the instructions recorded therein by various officers of the department.

39. The quantities of various items may vary from the quantities given in tender drawing / tender document. The agency shall bring the various items & materials as per actual requirement at site at the time of execution of work. Excess quantities shall not be accepted & paid by the department.

40. The ceiling roses wherever required to be provided are included in the scope of work without extra payment and the same shall also be of modular type & of the same make as that of switches & sockets alongwith earthing provision.

41. MCCB should have centrally adjustable overload setting 80% to 100% & short circuit setting adjustable from 500% to 1000% of nominal current for thermal type & overload setting 40% to 100% & short circuit setting adjustable from 150% to 1000% of nominal current for microprocessor type MCCB. All MCCB should be ICS=ICU

42. Size of distribution board shall be as per number of light / power circuits. All distribution board shall be double door type. RCBO of suitable rating shall be provided as main incomer in all DBs.

43. In vertical DBs used for power distribution main incomer shall be MCCB of suitable rating breaking capacity not less than 25KA, Ics=Icu.

44. LT panel shall be cubicle type with IP 54 protection class and fabricated from CPRI approved fabricator and shall be equipped with digital type measuring instruments like ammeter, voltmeter, frequency meter, watt meter, multi-function meter and shall have BMS facility etc. as per drawing approved by Engineer – in – charge.
45. Each floor Panel shall be fabricated from 2 mm thick CRCA powder coated 9 tank process and shall be equipped 4 pole MCCBs, MCBs, Bus bar, digital voltmeter, ammeter, KWH meter, BMS compatible LED indicating lamp extended rotary handle and all accessories as required.

46. If used as incomer then it should have earth fault protection and time delay in addition to above protection. Earth leakage modules are not acceptable.

47. Earthing: Earthing system comprising of earth electrode, earth conductor, earth bus, protective conductor etc. for each building shall be as per provision laid down in CPWD Specifications Part – I 2013. Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked / tested in harsh climatic conditions.

48. All equipments shall be guaranteed for a period of 36 months (except LED fittings which shall be guaranteed for minimum 5 years), from the date of taking over the installation by the department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer -in Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding on the contractor.

49. Two years manufacturers guarantee should be submitted by the contractor for LED fittings on completion of the works. A letter from the original manufacturer of Luminaires shall be submitted along with the supply of item.
Electrical Components

Switch / Sockets and accessories:
All switches 6 Amp to 40 Amp should be latest ISI marked as per IS 3854 : 1997. 6 Amp 3 Pin and 6/16 Amp 3 Pin combined sockets should be latest ISI Marked as per IS 1293 : 1988.

The fan regulator should be capacitor based, Hum Free and ISI marked as per IS 11037:1984.

All the switches, sockets, fan regulator etc should be completely IP 20 protected with no live part directly accessible.

AIR CIRCUIT BREAKERS (ACB)

The ACB shall confirm to IEC/IS – 60947-2. The ACB shall have a rated service short circuit breaking capacity (Ics) as specified in SLD’s .“Technical parameters” at rated operational voltage(Ue) at 415V, frequency at 50 Hz. The ultimate breaking capacity (Icu) shall be equal to Service breaking capacity (Ics) and Short Ckt Withstand capacity (Ics=Icu=Icw for 1 sec) rated Impulse withstand voltage(Uimp) shall be 12kv and rated insulation voltage (Ui) at 1000V. The ACB release should have true RMS sensing. ACB should have single frame size up to 4000A and shall be suitable for “Switch Disconnect” function (AC 23 utilization category). The construction of circuit breakers shall be as per pollution degree.

Circuit breakers shall be three / four pole, air break, horizontal draw out / fixed type as indicated in SLD.

Draw out type Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.

There shall be “SERVICE”, “TEST” and “FULLY WITHDRAWN” positions for the breakers. In “TEST” position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be
provided so as to prevent movement of the circuit breaker from the “SERVICE”, “TEST” or “FULLY WITHDRAWN” position. Safety interlock must be provided to prevent the ACB from falling out in a fully withdrawn position. It shall be possible to close the door in “TEST” position.

Suitable mechanical indications shall be provided on all circuit breakers to show “OPEN”, “CLOSE”, “SERVICE”, “TEST”, and “SPRING CHARGED” positions.

All ACBs should be provided with Microprocessor based release as specified in SLD’s should be provided on circuit breaker for short circuit, over current and earth fault protection with adjustable settings with intentional delay. Specific LED indications should be provided for short circuit, over current and earth fault operation for faster fault diagnosis and reduced down time. All ACBs should be provided with “Auto Protection” facility. Opening and closing time of ACB should be <40 m Sec and <70 m sec respectively. All Incomer ACB Release should be provided with display for current and voltage parameters (for each phase & Ground Fault). Control unit shall have fault history data & store last 10 trip causes.

The Circuit Breaker shall have minimum mechanical life of 10000 operations without maintenance.

The electrical life of circuit breaker upto 2000 Amps shall not be less than 5000 operations and beyond 2000 Amps shall be greater than 1000 operations.

ACB releases shall be EMI/ EMC compatible. In case of Four Pale ACB, Fully rated Neutral with protection against O/L & S/C with settings at 50%-100%- OFF. ACBs should comply with RoHS. Microprocessor releases shall be provided with integral LCD Display of load current and individual loading of all the three phases. Microprocessor release shall also be suitable for zone selective interlocking (ZSI). Microprocessor releases shall also have Ft ON/OFF time delay protection for short circuit and Earth fault.

All ACBs release shall have in-built thermal memory before and after the fault. ACB release should be provided with Rotary Dial for release setting. Separate LEDs should be provided on release itself for fault differentiation.

Relays should be CT operated through shunt trip, under voltage trip for short circuit and earth fault protection.

Wherever microprocessor earth fault release is asked for. Additional CT shall be provided on the neutral bus link. This CT shall have characteristics matching to the CT’s installed in the ACB for the purpose. It should be possible to change the setting of release in “ON” condition.

All circuit breakers shall be provided with “4 NO” and “4NC” potential free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker and should be directly operated from breaker operating mechanism.

All circuit breakers shall be provided with the following interlocks:
Movement of a circuit breaker between “SERVICE” and “TEST” position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In cases the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exist between the fixed and drawout contact at the time of breaker trip, so that no arcing takes place even with the breaker carrying it’s full rated current.

Closing of a circuit breaker shall not be possible unless it is in “SERVICE” position, “TEST” position or in “FULLY WITHDRAWN” position.

All ACB’s shall have door interlock

Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.

ACBs shall be provided with a flexibility to rotate power terminals by 90 degree to suite stringent site requirements.

A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

There should be a provision of positive earth connection between fixed and moving portion of the ACB either through connector plug or sliding solid earth mechanism. Earthing bolts must be provided on the cradle or body of fixed ACB.

It should be possible to bolt the drawout frame not only in CONNECTED position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

Circuit barker shall provide with castle key / electrical interlocking devices

Mechanical tripping shall be possible by means of front mounted Red “trip” push-button.

In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking

Alternatively Means shall be provided to slowly close the circuit breaker in “withdrawn position”, if required, for inspection and setting of contacts. In “service position” slow closing shall not be possible.

All accessories like shunt release, under voltage, motorized mechanism etc. shall be front mounted, requiring no adjustments and can be fitted at site.

The manufacturer shall provide details of opening time and duration with temperature to ensure discrimination and proper selection for feeder protections. All ACB’s of 4000A and above shall be a single ACB unit. The manufacturer shall also indicate the mechanical and electrical life of circuit breaker.
Circuit breaker shall be provided with either of the following mechanisms:

The trip unit shall have following protection settings, based on the type of trip unit.

- Adjustable over load current (Ir) settings from 40% to 100% of rating of ACB (In).
- Over load time setting (tr) from 0.5s, 1s, 2s, 4s……24s as field selectable curves.
- Short circuit setting (Isd) from 1.5 to 10 times of Ir setting.
- Short circuit time delay adjustable from 0 to 400 msec.
- Instantaneous (Ii) protection with an adjustable pick-up and an OFF position.
- Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400 ms.

Manually Operated Mechanism

Manually operated mechanism shall be of manual spring charging stored energy type.

The circuit breaker shall have a spring charging handle and push-button for closing the breaker mechanically after the spring has been charged. However, closing by spring charging handle after the spring has been fully charged shall also be acceptable, provided the movement of contacts does not take place with the movement of handle and the contacts operate only when the spring stored energy is released. Overcharging of spring shall not be possible.

The closing action of the circuit breaker shall charge the tripping spring, thus making it ready for tripping.

The circuit breaker shall be provided with the interlocks so that it shall not close unless the spring is fully charged.

The mechanism shall be suitable for addition of motor mechanism at site if required for future upgrade without the need of any special accessories.

Power Operated Mechanism

Power operated mechanism shall be provided with a universal motor suitable for operation on 240 AC / DC Control supply, with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class “E” or better.

All ACBs should be provided with “Ready to Close” Contact

The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.

Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.
The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operation shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

All circuit breakers shall be provided with closing and trip coils (Shunt release + Under voltage release). The closing coil shall operate correctly at all values of voltage between 85% to 110% of rated control voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% of rated control voltage and shall have continuous rating.

Provision for mechanical closing of the breaker only in “TEST” and “WITHDRAWN” positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.

For all incoming and outgoing feeders rating above 630A, LT ACBs shall be used.

Moulded Case Circuit Breakers (MCCB’s)

The Moulded case circuit Breaker (MCCB) shall confirm to the latest IEC 60947-2 and IEC 947-3-1989. MCCB’s shall be suitable for rated operation voltage upto 415 VAC & rated insulation voltage upto 690 VAC.

MCCB’s in AC circuits shall be of triple pole / four pole construction as per SLD. Operating mechanism shall be quick-make, quick-break and trip-free type (Roto-Active design). The “ON”, “OFF” and “TRIP” positions of the MCCB’s shall be clearly indicated and visible to the operator when mounted as in service. Front of door operating handle shall be provided with pad lock and door interlock. Front of door operating handle shall be provided with door interlock defeat mechanism to facilitate inspection of the MCCB during ‘ON’ position. MCCB shall be suitable for Positive isolation / disconnection according to IEC 60947-1 & 2 for optimum user safety.

The Service short circuit Breaking capacity (Ics at 415 VAC) of all MCCB’s shall be as specified in SLD and shall have (Ics=Icu=100%).

All MCCB should have “Class-II” front facia as per IEC 60664.

Electrical life of MCCB’s shall not be less than 10000 operations and mechanical life shall not be less than 20000 operations.

The MCCB shall be current limiting type. MCCB shall have Arc extinguishing device contained in a compact, high strength, heat resistance, flame retardant, halogen free insulating moulded case with high withstand capability against thermal and mechanical stresses.

MCCB’s shall be either with Thermal-magnetic releases for over load and short circuit or with microprocessor based releases for over load and short circuit as asked for in the SLD.

Load indication LED shall be integral part of electronic releases. All electronic releases shall be EMI / EMC compatible.
Wherever microprocessor earth fault add on earth fault Module is asked for, additional CBCT shall be provided.

It should not be possible to by pass / switch off the S/C, E/F protection in MCCB. The E/F setting should be provided with 10% to 60% with time delay of 0.3 to 3 seconds. LED Indication should be provided in case of earth Fault. E/F Module should have Test Push Button for self diagnostic features without tripping the ckt. breaker. Also Over current and earth fault differentiation should be provided.

The trip command of releases in MCCB shall over ride all the other commands. The MCCB shall employ maintenance free double break contact system to minimize the set through energies and capable of achieving Total Discrimination up to the full short circuit capacity of the downstream MCCB. The MCCB shall not be restricted to line / load connections. MCCB shall be provided with test trip Push Button to check the proper function of tripping mechanism. MCCB shall comply with RoHS & WEEE norms

Where Earth fault protection are indicated in drawings they shall be thru Add on Module MCCB’s and have adjustability from 10% to 60% of rated current with adjustable time delays to aid discrimination on earth faults. The system shall be immunized against nuisance tripping as per IEC 61000-4 standards.

MCCB’s shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short-circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 8 milliseconds.

MCCB terminals shall be shrouded and designed to receive Bus Bar Links /cable lugs for cable sizes relevant to circuit ratings.

The MCCB shall have common field fittable snap-on auxiliaries common for entire range. The remote tripping coil should be of continuous duty cycle.

Where mechanical interlocking is called-for between two Incomer and Bus Coupler or between two Incomers without Bus Couplers, proper arrangement for built-in Ronis/ Coded key interlocking shall be provided.

MOTOR PROTECTION CIRCUIT BREAKER (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947-1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22.2 No.14. The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947-4. MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure
maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the “isolated” position.

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

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

MINIATURE CIRCUIT BREAKER (MCB)


Suitable capacity C curve, 10 KA MCB shall be used. It should have label holder for circuit identification, MCB should be capable of minimum 10000 operation with load. MCB’s shall have a facility to accommodate accessories like auxiliary contacts, trip alarm contact, shunt trip and under voltage add-on blocks.

Miniature Circuit Breaker shall be quick make and break type for 230 / 415 V AC and 50 Hz application. The housing of MCB’s shall be heat resistant and having a high impact strength. MCB’s shall be current limiting type class – 3. The MCB contacts shall be silver nickel alloy and contact tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB’s shall be provided with magnetic coil releases for short circuit protection and thermal release for over load protection. The over load or short circuit devices shall have a common trip bar in the case of DP, TP, TPN and FP Miniature
Circuit Breakers and shall have 10000 electrical operations upto 63A. The terminals shall be protected against finger contact to IP 20 Degree of protection. Impulse withstand capacity should be – 4KV.

RESIDUAL CURRENT CIRCUIT BREAKER CURRENT OPERATED TYPE (RCCB/RCBO)

The RCCB / ELCB should comply with IEC 1008 and shall be suitable for use with pure AC/AC with DC off set, for frequency range of 50 Hz to 400 Hz. The RCCB / ELCB shall be protected against nuisance tripping by a protective device, limiting such tripping to a peak value of 250 A according to the 8/20 wave for instantaneous devices. RCCB’s / ELCB’s shall be suitable for isolation function and line load reversibility.

EL + MCB / RCCB shall have Earth leakage, over load and short circuit protection where as ELCB shall have Earth leakage protection only. RCBO / RCCB wherever provided in Computer systems / IT equipment’s shall be super immunized / equivalent.

EL + MCB / RCCB / ELCB shall be quick make and break type. The housing shall be heat insulated and having a high impact strength. The moving contacts of the Phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism for closing / opening of all the three phases simultaneously. The neutral moving contact shall be so mounted on the common bridge that at the time of closing, the neutral makes contact first before the phases and at the time of opening, the neutral breaks last after allowing the phases to open first.

The core balance transformer ensures positive detection of earth leakage currents. The incoming current shall pass through the torroidal core transformer. As long as the current in the phase and the neutral shall be the same, no electromotive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which will cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. The device shall be current operated independent of the line voltage, current sensitivity of 30mA/100mA/300mA at 240 / 415V AC as called for in the SLD.

EL + MCB / RCCB / ELCB shall have trip free nature of mechanism ensuring that it cannot be closed when an earth leakage fault persists.

Test device shall be there to check the integrity of earth leakage detection system and the tripping mechanism. It shall have box type terminals and capture screws ensuring easy connection of cables and protected against finger contact to IP 20 Degree of Protection.

METERS

All voltmeters / multi-function meters and indicating lamps shall be protected through MCB’s / MPCB’s depending upon fault level.
Meters and indicating instruments shall be flush type.

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

CT ratio and burdens shall be as specified on the Single line diagram/ as required for the application.

CURRENT TRANSFORMERS

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

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and metering CTs shall be of accuracy class I.

Accuracy class and VA burden shall be as per the application as required as per metering / protection needs.

INDICATING LAMPS

This shall be as per CPWD specifications.

SELECTOR SWITCH

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

Contactor shall be built into a high strength thermoplastic body and shall be provided with a shield for quick are extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starter’s contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class “E”.

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply. Contactors shall be of 3P / 4P design as required.

THERMAL OVERLOAD RELAY
Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from –5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensated time logged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacities.

TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

TOGGLE SWITCH

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS codes and shall be of 5 amps rating.

PUSH BUTTON STATIONS

Push button shall be provided for manual starting and stopping of motors / equipment “Green” and “Red” colour push buttons shall be provided for ‘Starting’ and ‘Stopping’ operations. ‘Start’ or ‘Stop’ indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for ‘Stop’ push buttons. The push button contacts shall be suitable for 6 amps current capacity.

Coordination Study In LV Network

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

DLP Trunking:

Shall be made from very high quality of PVC with very good strength.
Shall be Used to distribute power as well as LAN cables.
Shall be installed in combination with the Internal Angles, External Angles, Flat Angles etc in order to suit the application area where we are installing it on.
The different components involved are : DLP Trunking Base, Flexible Cover, Seperation
Partition, Clip On Partition (For creating separate compartments in 150*50 & 195*50 Size Trunking), End Caps, Internal Angle, External Angle, Flat Angle (for any 90 Degree Angle), Flat Junction (T Point), Mosaic Frames (For mounting Switches & sockets etc)

The trunking Base is fixed on to the wall by using the correct fasteners on the pre drilled location. Then the cable is carried into the DLP and wherever required.

M.S. Conduit

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with stowe enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used unless otherwise stated.

Conduit Joints

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipe shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

Wherever conduit passes a building expansion joint, galvanized flexible metallic conduit shall be provided for connecting rigid M.S. Conduit in either slab.

Protection against Condensation

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

Protection of Conduit against Rust

The outer surface of conduit including all bends, unions, tees, junction boxes etc forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

Painting of Conduit and Accessories

After installation, all accessible surface of conduit pipes, fittings, switch and regulator
boxes etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

Fixing of Conduits Surface Conduit

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one meter but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30cm from the centre of such fittings. The saddles should not be less than 24 gauge for conduits up to 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used. All fixing arrangement like saddles, special purpose clamps, nuts, bolts etc. shall deemed to be included in quoted rates of conduit.

For 25mm diameter conduit width of clip shall be 19mm and of 20 SWG. For conduit of 32mm and above, width of clip shall be 25mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-In-Charge at site.

Recess / Concealed Conduit

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and during the conduit in mortar before plastering shall form part of point wiring work. (For chase cutting-chase cutting machine shall be used and no manual cutting shall be allowed).

The conduit pipe shall be fixed by means of stipples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius which shall permit easy drawing in of conductors. All threaded joint of conduit pipe shall treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 metres, then circular junction box shall be provided to facilitate pulling of wires. The chicken wire mesh shall be provided by civil agency.
Outlet Boxes

Switch/outlet boxes shall be made of metal on all sides except on the front. Boxes shall be G.I. Up to 10cmx20cm size Box shall have wall thickness of 16 SWG and above 10cmx20cm shall have 14 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm all fitting shall be fitted in flush pattern. Switch/outlet boxes shall be suitable to house modular type light and power accessories. Earthing stud to be provided for connection of earthing wire in side of box at near any corner.

Fan Box

Fan Box shall be made out of 14 gauge M.S. sheet in hexagonal shape. The dia of box shall be 150 and depth of box shall be 80 mm. A M.S. covers plate size 160 mm x 160mm x 16 gauges to be provided in the back of fan box. 12 mm dia M.S.Rod to be provided for fan hanging arrangement in the box. A 28 mm dia knockout To be made in all six hexagonal vertical part for conduit entry in the box. The box shall be painted with 2 coat of primer. A 180 mm dia, 3 mm thick hylem sheet Cover to be provided. (The sample to be approved before procurement by IWD.)

Telephone Outlet

Each Telephone outlet location shall be provided with 1 No. telephone Jack type outlet (RJ45). The telephone outlet shall be of modular range of plate switch type and shall be mounted on a suitable size G I Box with modular range cover plate.

Wiring

All FRLS insulated copper conductor multi-stranded wires shall conform to relevant IS codes. Cable conductor size and material shall be as required.

All internal wiring shall be carried out with FRLS insulated wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red or yellow or blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS insulated wire for RYB phase wire respectively and black colour FRLS insulated wire for the neutral wires. FRLS insulated green colour wire shall be used as earth continuity conductor and shall be drawn along with other wires. 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 conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

(Maximum Nuer of PVC Insulated 650/1100 V grade Aluminium / Copper Conductor cable confirming to IS 694 : 1990 [Clause 4.2.1 (ii)] in conduits shall be as per CPWD General Specification for Electrical works Part-I Internal 2013 Page no. 47.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

Sub Mains

Sub-main wiring shall be carried out with FRLS Insulated Copper multi-stranded wires/cables.

Sub-main cable where called for shall be of the rated capacity and approved make. Every sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the sub-main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub-main wiring. An independent FRLS insulated copper earth wire of proper rating shall be provided for every sub-main. Single phase sub-main shall have single earth wire whereas three phase sub-main shall be provided with two earth wire.

Where sub-mains cables are connected to the switchgear, sufficient extra lengths of sub-main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.

Load Balancing

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

Conduiting and Wiring for TV System

i) Conduiting

Conduiting for TV system shall be carried out in M.S. Conduit Conduiting shall be carried out as specified in point wiring head.

ii) Outlets

All TV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.

iii) Junction Box

Suitable size of metallic junction box shall be provided for termination of conduit for TV
system. Box shall be made of 16 SWG G.I. sheet and shall be treated before galvanizing. Front of the junction box shall be provided with 3mm thick phenolic laminated sheet cover.

iv) Coaxial Cables
The coaxial cable shall be of wideband type coaxial cables.

v) Tap Off
These shall be of ultra wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.
The Tap offs shall be in one way, two way and four way configurations.

vi) Splitters
These shall be of ultra wide band width and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.
The splitters shall be in 2 way, 3 way & 4 way configurations.

Sub Distribution Panel General
Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

All Panels and outdoor feeder pillars shall have BMS / SCADA Compatibility.

Shop Drawings And Technical Data
The tenderer shall furnish relevant technical data of switchgears and associated equipment along with the offer.
The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

Typical and recommended schematic diagrams and control wiring.

Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.
Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, levelled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access. Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

A base frame made out of 75mm x 40mm x 5.0mm M.S. Channel to be provided.

DIGITAL AMMETERS

Digital Ammeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

DIGITAL VOLTMETERS

Digital Voltmeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for
working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as per CPWD specifications.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Control switches

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Cable Terminations

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one
circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Control Wiring

All control wirings shall be carried out with 1100V grade single core ZHFR cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

Terminal Block

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

Labels

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

Testing at Manufacturing Work

All routine tests specified is IS: 8623-1977 shall be carried out and test certificates submitted to the Engineer – in –Charge.

Testing and Commissioning

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

Operation checks and lubrication of all moving parts.

Interlocking function check

Insulation test: When measured with 500 V meggar, the insulation resistance shall not be

less than 100 mega ohms.

Trip tests & protection gear test.

LT CABLES:

STANDARDS OF CODES:

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

CABLES:

Medium voltage cables shall be aluminum conductor XLPE insulated, PVC sheathed armored conforming to latest IS. Cables shall be rated for a 1100 Volts.

All Conductor cables shall be as per CPWD Specification and IS codes.

Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of un-vulcanized compound. Armoring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer’s name and trade mark at every meter length. Cores shall be provided with following colors scheme of PVC insulation.

<table>
<thead>
<tr>
<th>Core Number</th>
<th>Color Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red/Black/Yellow/Blue</td>
</tr>
<tr>
<td>2</td>
<td>Red and Black</td>
</tr>
<tr>
<td>3</td>
<td>Red, Yellow and Blue</td>
</tr>
<tr>
<td>3 ½/4 Core</td>
<td>Red, Yellow, Blue and Black</td>
</tr>
</tbody>
</table>

LAYING:

Cables shall be laid as per the CPWD specifications (Amended Up to Date) given below

Duct system

Wherever specified such as road crossing, entry to building or in paved area etc. cables shall be laid in under ground ducts. The duct system shall consists of a required number of stone ware pipes, GI, CI or spun reinforced concrete pipe with simplex joints and all the jointing work shall be done according to the CPWD building specifications or as per the instructions of the Engineer-In-Charge as the case may be. The size of the pipe shall not be less than 100mm in diameter for a single cable and shall not be less than 150mm for more than one cable and so on. The pipe shall be laid directly in ground without making any special bed but wherever asbestos cement pipes are used, the pipes shall be encased in concrete of 75mm thick. The ducts shall be properly anchored to prevent any movement. The top surface of the cable ducts shall not be less than 60 cm. below the ground level. The ducts shall be laid a gradient of at least 1:300. The duct shall be provided manholes of adequate size at regular intervals for drawing the cables. The manhole cover and frame shall be of cast iron and machine finished to ensure a perfect joint. The manhole covers...
shall be installed flush with the ground or paved surfaces. The duct entry to the manholes shall be made leak proof with lead-wool joints. The ducts shall be properly plugged at the ends to prevent entry of water, rodents, etc. Suitable duct markers shall be placed along the run of the cable ducts. The duct markers shall at least be 15 cm. square embedded in concrete, indicating duct. Suitable cable supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.

Cables in outdoor trenches

Cable shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cm from the final ground level. The width of the trenches shall not be less than 45 cm. However, where more than one cable is laid, an axial distance of not less than 15 cm. shall be allowed between the cables. The trenches shall be excavated in reasonably straight line with vertical side walls and with uniform depth. Wherever there is a change in direction suitable curvature shall be provided complying with the requirements. Suitable shoring and propping may be done to avoid caving in of trench walls. The bottom of the trench shall be level and free from stone brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm. in depth.

The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be paved of in one stretch. However where this is not possible the remainder of the cable may be removed by "Flaking" i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 mtrs. apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

For short cut runs and sizes upto 50 sq.mm of cables upto 1.1 KV grade any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer-in-charge.

When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable length then measured. The ends of all cables shall be sealed immediately. In case of PVC cables suitable moisture seal tape shall be used for this purpose.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less 17 cms above the base cushion of sand before the protective cover is laid. In the case of vertical multi tier formation after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms as stated above. The top most cable shall have final sand covering not less than 17 cms before the protective cover is laid.
Unless otherwise specified, the cables shall be protected by the second class bricks of not less 20 cms x 10 cms x 10 cms (nominal size) protection covers placed on top of the sand (bricks to be laid breadth wise) for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at 5 cm. over the sides of the end cables. The trenches shall be taken back filled with excavated earth free from stones or other sharp edge debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm, unless otherwise specified.

Route Marker

Cable route marker marked "Cable" shall be provided along with the route of the cable and location of loops. The route markers shall be of tapered concrete slab of 60 x 60cm at bottom and 50 x 50cm at top having a thickness of 10cm. Cable marker shall be mounted parallel to and 50cm away from the edge of the trench.

Cables in indoor trenches

Cables shall be laid in indoor trenches wherever specified. The trench shall be made of brick masonry with smooth cement mortar finish with suitable removable covers (i.e. pre-casted slabs or chequered plates). The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated and can be conveniently laid. Cables shall be arranged in tier formation in trenches and if necessary, cables may be fixed with clamps. Suitable clamps, hooks and saddles shall be used for securing the cables in position.

Spacing between the cables shall not be less than 15 cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC or steel chequered trench covers.

Cable on Trays/Racks

Cable shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of ladder, trough or channel design suitable for the purpose. The nominal depth of the trays/racks shall be 150

The width of the trays shall be made of steel or aluminum. The trays/racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware, entire steel trays/ racks shall be hot dip galvanized including widths & accessories. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles made of aluminum strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements:

The tray shall have suitable strength and rigidity to provide adequate support for all contained cables.

It shall not present sharp edges, burrs or projections injurious to the insulation of wiring/cables.
If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion-resistant material.

It shall have side rails or equivalent structural members.

It shall include fittings or other suitable means for changes in direction and elevation of runs.

Installation

Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.

Each run of the cable tray shall be completed before the installation of cables.

In portions where additional protection is required, non combustible covers/enclosures shall be used.

Cable trays shall be exposed and accessible.

Where cables of different system are installed on the same cable tray, non combustible, solid barriers shall be used for segregating the cables.

Cable trays shall be grounded by two nos, earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

At no place the cable tray/rack/ladder running horizontally should rest on any building partition like Brick wall, RCC beams etc. but instead proper MS supports/hangers to be provided at minimum of 1500 mm intervals and at every Turning Angles.

Jointing and terminations

Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.

All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working. Jointing materials and accessories like conductor, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, confirming to relevant Indian Standards.

Each termination’s shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end termination’s. Cable gland shall be bonded to the earth by using suitable size copper wire/tape.

Cable Tray

All cables trays shall be made of G.I. sheet.

Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays. The bends, Tee joint, Cross joint for all sizes of cable tray shall be factory fabricated.
Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

Perforated Cable Tray

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>100 mm to 1200 mm</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>2500 mm</td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td>2 mm up to 750 mm width and 3 mm from 900 mm to 1200 mm</td>
</tr>
<tr>
<td><strong>Collar height</strong></td>
<td>: 50 mm up to 600 mm and 75 mm from 750 mm to 1200 mm</td>
</tr>
</tbody>
</table>

Ladder Type Cable Tray

Standard dimensions of ladder type cable trays shall be as follows:

**Size of tray**

- **size of main channel**
  - 900 mm to 1200 mm: 25 x 100 x 25 x 3 mm
  - Up to 750 mm: 25 x 75 x 25 x 2 mm

- **size of rung / spacing between rungs**
  - 20 x 50 x 20 x 2 @ 200°C/C

Sizes of angle for cable tray supports shall be minimum 40 x 40 x 5 mm up to 600 mm & 50 x 50 x 5 mm minimum as specified in the drawings/schedule of quantities for sizes above 600 mm. Hangers shall be of minimum 10 mm dia steel round bars up to 600 mm & 12 mm dia steel from 750 mm to 1200 mm as specified in the drawings/schedule of quantities. All the support shall be G.I.

Fixing arrangement shall be as approved by the Consultant.

Hardware to be used in cable tray system shall be galvanized or zinc passivated.

The testing on galvanized material if required shall be carried out as per IS: 2633, amended to date.

**NOTE:** Land escaping works:

**The pole should be B class GI pipe 4mtr long with 40 watt post top lantern LED.**

**The external power cable laying from substation No. 1 approximate length about 300 Mtr. Cable size mentioned in SLD.**
Lightning Protection Devices as per IEC 62305.

IEC 62305 provides the requirements for protection of a structure against physical damage by means of a lightning protection system (LPS), and for protection against injury to living beings due to touch and step voltages in the vicinity of an LPS.

Lightning is one of the most devastating natural phenomena. There are many discharges during lightning storms and some of them can even reach hundreds of kilo amperes. The electrical discharges are a great hazard to people, animal, buildings and electronic equipment’s. Until now, there is no device that can prevent lightning formation or lightning strikes. However, it is possible to create a path (divert) for the lightning discharge to the ground which will minimise the damage to the environment through a well-designed Lightning Protection System (LPS). The purpose of a lightning protection system is to protect buildings from direct lightning strikes and possible fire or from the consequences of lightning currents (non-igniting flash). If national regulations such as building regulations, special regulations or special directives require lightning protection measures, they must be implemented. If these regulations do not specify a class of LPS, a lightning protection system which meets the requirements of class of LPS III according to IEC 62305-3 (EN 62305-3) is recommended as a minimum. In principle, a risk analysis, which is described in the IEC 62305-2 (EN 62305-2) standard (see chapter 3.2.1), should be performed for an overall assessment.

EXTERNAL LIGHTING

TECHNICAL SPECIFICATIONS

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 following CPWD Specifications amended upto date.


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.

The of scope of work is Supplying, fabrication, Installation, testing and commissioning of street light / compound light, landscaping bollards light and feeder pillars at Roads, compound area and landscaped area as per shown in tender drawings. EPC Contractor shall calculate quantity of poles, fittings and cables. The contractor is required to recheck the quantities based on equipment offered by him to achieve required parameters.
FEEDER PILLAR

Outdoor type Feeder Pillars shall be suitable for 3 phase, 50Hz, 415 volts, A.C. system and shall generally conform to IS 5039. Rating and size of Feeder pillar shall be as per designed load and requirement.

The Feeder pillar shall be fabricated out of heavy gauge 2.00 mm thick MS sheet steel with suitable stiffeners. Feeder pillar shall be constructed with slanting roof top/over hang for protection against rain & weather and adequately ventilated by providing louvers with wire mesh from inside. The Feeder pillar shall be provided with degree of protection IP 65 as per IS : 2147.

Feeder pillar shall be double door construction with M.S. hinges and handle for opening the door. Each door shall open to minimum 135 degrees. Locking on both the doors with two keys for each lock shall be provided with each pillar. The Feeder pillar shall be dust, vermin proof and weather proof type.

Neoprene gaskets shall be provided for the doors. The enclosure shall be provided with ventilated louver cover with wire mesh, lifting hooks, supporting legs and double earth terminal with double washer.

Feeder Pillar shall be epoxy painted after metal treatment. Feeder pillar shall be provided with suitable size of aluminium alloy busbars. Moulded case circuit breaker shall be provided for incoming and MCB shall be provided as per IS 8828-1978 for outgoing. Gland plate shall be 3mm thick with suitable number of flanged type brass cable glands of required sizes shall be provided. Provision shall be suitable for lighting the interior when the doors are open. Danger notice board shall be provided on front door of the Feeder Pillar.

All civil work for feeder pillar foundation shall form part of feeder pillar installation work. This shall include excavation, backfilling, brickwork, plastering and providing PVC sleeves. Cost of civil work shall deemed to be included in quoted rates.

Feeder pillar shall fully comply with CPWD General Specification for Electrical works (Part-II External-1994). Erection or installation shall also be carried out as specified in CPWD.

BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-91E of IS : 5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to
provide a through fault withstand capacity. The neutral as well as the earth bar should be capable of withstanding fault withstand capacity. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault. High tensile bolts and spring washers shall be provided at all busbar joints/connections.

The Feeder Pillars shall be designed that the cables are not directly terminated on the terminals of breaker / switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be considered as 1.0 Amp per sq.mm of cross section area of the busbar and also conforming to Table VI of CPWD specification. The main busbars shall have continuous current rating throughout the length of Feeder Pillars. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consists of main horizontal busbar and auxillary vertical busbars run in busbar alley/ chamber on either side in which the circuit could be arranged/ connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

SPECIFICATION FOR L.T CABLES

GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer’s instructions. The cable shall be delivered at site in original drums with manufacturer’s name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum
utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-In-Charge before the cables are cut to lengths.

CABLES TAGS
Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 15 metres.

CONSTRUCTION FEATURES & GENERAL NOTES OF LOW VOLTAGE MAIN AND SUB DISTRIBUTION BOARDS / PANELS/SWITCH BOARDS/ METER BOARDS/ACB ISOLATOR PANELS / MOTOR CONTROLS CENTRES (MCC)

As per CPWD Specifications for Electrical Works Part I Internal Electrical – 2013.

EARTHING
As per CPWD specifications.
GI plate EARTHING:
Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required including suitable GI strip in surface or in pipe. The earth resistance results shall be less than one ohm.

TESTING & COMMISSIONING
As per CPWD Specifications for Electrical Works Part I Internal Electrical– 2013.

Internal and External Electrical installation item details and specification for items to be used in addition to CPWD Specifications
a) FRLS PVC insulated copper conductor, single core cable shall be used for point, circuit, submain, main wiring.
b) Steel conduit along with accessories including painting in case of surface conduit shall be used.
c) UTP 4 pair CAT 6A LAN Cable shall be used.
d) Minimum 2 pair 0.5 mm dia FRLS PVC insulated annealed copper conductor, unarmored telephone cable shall be used or higher pair as required.
e) Co-axial TV cable RG-6 grade,0.7 mm solid copper conductor PE insulated,shielded with fine tinned copper braid and protected with PVC sheath shall be used.
f) suitable size GI box with modular plate and cover in front shall be used for boxes of power point, switch board, LAN, Telephone, TV etc outlet.
g) modular switch/socket shall be used for switch board, power point, LAN, Telephone, TV, USB Socket, Key fob etc.
h) USB charger 1 Module Make- Legrand Cat No. 675971 or equivalent in make list.
i) Key Fob Switch including Key Fob with 2 Module GI box Make- Legrand Cat No. 6755 60 & 673038 or equivalent in make list.
j) AC & Geyser point shall be controlled by 25 A modular socket outlet and 25 A modular SP MCB, "C" curve, MCB should be capable of minimum 10000 operation with load.
k) As per drawing ceiling fan with (with stepped type electronic two module regulator) capacitor type shall be installed complete with 30 cm down rod or more (as required for proper installation, aesthetics design and delivery of air as per available height, Nothing extra to be paid for this), canopies, hanging shackle,
i) i/c pdg & fixing phenolic laminated sheet cover in the fan box, blades, double ball bearing type suitable for use on 220/240 volts, 50Hz single phase A.C. supply i/c wiring the down rod with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable etc.
ii) 1200 mm sweep (Minimum air delivery 200 cum/Minute), (Minimum service value 4 cum/Minute/watt), (Maximum power input 50 watt) or
iii) 1400 mm sweep (Minimum air delivery 245 cum/Minute), (Minimum service value 4.1 cum/Minute/watt), (Maximum power input 60 watt)
l) surface/wall mounted LED Batten (1200mm) with a system lumen output of 2500 lumens and a minimum system efficacy of 110 lumen/watt. The luminaire shall have a CRI of greater than or equal to 80. The luminaire is made of An Extruded Aluminium housing and PC diffuser, input voltage range 140-270V, P.F>0.9, THD <20%, Color temperature 6500K, Burning hour 25000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.
m) Energy Efficiency Recess mounted round LED down light made out pressure die cast Aluminium housing and PC diffuser a system lumen output of 1500 lumens and a minimum system efficacy of 110 lumen/watt. Input voltage range 140-270V, P.F>0.90, THD <10%, CRI>80, Color temperature 6500K, Burning hour 50000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.
n) Energy Efficiency Surface mounted round LED down light made out Polycarbonate housing and PC diffuser a system lumen output of 1200 lumens and a minimum system efficacy of 100 lumen/watt. Input voltage range 140-270V, P.F>0.90, THD <30%, CRI>80, Color temperature 6500K, Burning hour 30000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.
o) Energy Efficiency Recess mounted LED Luminarie CRCA Housing suitable for 2X2 Grid Ceiling having flat diffuser & constant current electronic driver complete with all accessories & lamps, fitting lumen out put >=3000, efficacy of 120 lumen/watt. Input voltage range 140-270V, P.F>0.90, THD <10%, CRI>80, Color temperature 6500K, Burning hour 50000 @ L 70% i/c connection with 1.5
sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.

p) Energy Efficiency Surface mounted LED Luminarie CRCA Housing suitable for 2X2 Grid Ceiling having flat diffuser & constant current electronic driver complete with all accessories & lamps, fitting lumen out put >=3200, efficacy of 80 lumen/watt. Input voltage range 140-270V, P.F>0.90, THD <10%, CRI>70, Color temperature 6500K, Burning hour 50000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.

q) Energy Efficiency surface mounted LED 1’ x 1’ square CRCA Housing with a system lumen out put >=1600, efficacy of 80 lumen/watt. Input voltage range 140-270V, P.F>0.90, THD <10%, CRI>80, Color temperature 6500K, Burning hour 50000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.

r) surface/wall mounted LED Batten (600mm long) with a system lumen output of 1000 lumens and a minimum system efficacy of 110 lumen/watt. The luminaire shall have a CRI of greater than or equal to 80. The luminaire is made of an Extruded Aluminium housing and PC diffuser, input voltage range 140-270V, P.F>0.9, THD <20%, Color temperature 6500K, Burning hour 25000 @ L 70% i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.

s) Decorative wall bracket complete with 7 watt LED Bulb/ Lamp i/c connection etc.

t) Bulkhead with a system lumen output of 600 lumens and a minimum system efficacy of 110 lumen/watt. The luminaire shall have a CRI of greater than or equal to 80. The luminaire is made of Die cast aluminium housing and PC diffuser, input voltage range 140-270V, P.F>0.9, THD <20%, CRI-70, Color temperature 6500K, Burning hour 25000 @ L 70%, IP-66 i/c connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing etc.

u) 4 watt LED bed light

v) Suitable ways mounting, double door, IP43, horizontal/ Vertical type, three pole neutral/ SPN as required, made of CRCA sheet steel of grade D having PU gasketted hinges doors i/c cable end box, testing IK09 as per IEC 62262, powder coated finish, MCB distribution board, 415 V on surface recess complete with tinned copper busbar, neutral bar, earth bar, din bar, interconnection including earthing et as required. (with MCBs and incomer), DB shall be as IEC 61439-3. All MCCB i/c VPTN DB shall be comptible to fit up to 160A 3P/4P MCB.

w) All MCCB's shall be with Ics=Icu, suitable rating and breaking capacity and pole MCCB with thermomagnetic release and terminal spreaders shall be used.

x) Essential and Non-Essential feeder pillar shall be compartment based cubical type 440 V AC L.T.outdoor Feeder pillar with Rainhood canopy, dust vermin proof, IP 42, fabricated with 2 mm thick (14 gauge) CRCA Sheet with both side cable allay having suitable capacity TPN aluminium busbar. All the incoming & outgoing feeder units of feeder pillar shall be 4P MCCB units and Automatic
lighting unit shall comprises of MCB, Triple pole power contactor with 2NO+2NC auxiliary contact & 230V AC coil voltage, photosensitive switch (with required relay/power supply to switch on Lights), and LCD Display time switch 230 V AC, 24 Hour dial, start/stop push button, auto/manual selector switch and indication lamp. The Feeder Pillar shall essentially comprise the required feeders, Digital Voltmeter and Ammeter with CTs and selector switches and shall have two vacant cubicals for future expansion i/c CC foundation and suitable size angle iron leg of minimum 400 mm height. Note- All MCCB’s shall be with Ics=Icu.

y) Suitable capacity Sandwich Type Rising Mains for use on 3 phase 4 wire 415 volts, 50Hz A.C. supply with metal clad enclosure having IP-54 rating after fixing the tap off boxes and all accessories, made of 1.6mm thick steel sheet duly powder coated in convenient sections complete with 4 Nos aluminium bus bars having current density of 130 A/ sq cm at nominal current rating, necessary joints, elbow joints & expansion joints and bends, fire barrier at each floor, provision of tapping at every metre, adopter box and copper flexible for joints, continuous earthing with 2 Nos aluminium strip of suitable size (one on each side) including, G.I. clamping brackets, suspenders, angle iron bracket, steel fasteners, connecting to earthing system etc. shall be used as per drawing.

z) Suitable ratings of tap-off boxes with MCCB for the above mentioned rising mains with indicating lamps etc., earthing, connections, as per specifications complete as required shall be used.

a) Suitable capacity End Feed Unit made of 1.6mm thick sheet steel enclosure duly painted with powder coating to above mentioned rising mains complete with suitable rating MCCB, i/c mounting stands, cable end box, brass compression gland, connections, earthing etc. as required shall be used.

b) Required number of XLPE insulated, PVC outer sheathed, armoured with galvanized round steel wire or steel strip cables with stranded aluminium conductor suitable for rated voltage of 1.1KV grade, ISI marked conforming to IS:7098 / (Pt.I) / 1988 with amendment no. 1 of calculated sizes in required manner shall be laid for service connection/power supply.

c) Suitable dia. G.I. Pipe (medium class) in ground complete with G.I. Fittings i/c trenching (75 cm deep) and refilling etc. shall be used for cable laying at road crossing/under pavement/RCC path.

d) 6.0 m. Galvanised octogonal pole (as per BS EN ISO 1461) with base plate 220 x 220 x 12 mm, top 70 mm and bottom 130 mm made up of 3 mm thick sheet suitable for max. wind speed upto 160 km/hr. including foundation bolts and HDPE pipe for incoming and outgoing cables and making foundation with Gr M20 RCC and Fe 415 grade reinforcement (550 mm x 550 mm x 1500mm), GI base plate, GI anchor plate etc as required. Each pole shall be supplied with a junction/looping box complete with 10 amps, 10 kA DP MCB, Screwless DIN mounting Connectors suitable for 16/25 sq.mm terminations complete with DIN bar, shorting links, end locks etc. as required and 3x2.5 sqmm PVC insulated and PVC sheathed multistrand copper conductor power cable from junction box to the luminarie complete including terminations with copper lugs etc. shall be used.

e) 60 watt LED Street Light/Road light with 4KA & 4KA additional surge arrester Luminarie CRCA Housing complete with all accessories & lamps, fitting lumen out put >=6600, efficacy of 110 lumen/watt. Input voltage range 120-270V, P.F>0.95, THD <15%, CRI>70, Color temperature 5700K, Burning hour 50000, IP-66, IK-08 i/c connection with 3x1.5 sq. mm FRLS PVC insulated, copper
conductor cable etc. shall be used.

f) LED Bollard light fixture Luminarie pressure die cast aluminium Housing complete with all accessories, fitting lumen out put >=500, efficacy of 56 lumen/watt. Input voltage range 140-270V, P.F>0.95, THD <10%, CRI>70, Color temprature 6500K, Burning hour 50000, IP-65, IK-10 on 1: 2: 4 (1 cement : 2 coarse sand and 4 graded stone aggregate of 40 mm monial size) cement concrete foundation 300 mm x 300 mm x 450 mm deep and 200 mm above ground level including testing connection etc. as reqd. shall be used.

g) Lightning Conductor & Earthing shall be done as per CPWD specifications, NBC 2016 and relevant IS code.
Terms & Conditions

The contractor is advised to visit the site of work at his own convenience & cost to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

WORKS TO BE DONE BY THE CONTRACTOR INCLUDES FOLLOWING:
Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

(i) Foundations for equipments and components where required, including foundations bolts. Cutting and making good all damages caused during installation and restoring the same to their original finish.
(ii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.
(iii) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubicle switchboard etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.
Testing and commissioning of completed installation.
Storage space for all equipments, components and materials for the work.
(iv) Cutting of chases shall be done by chase cutting machine and hole through the walls/ slabs if required will be done by core cutting machine.

STORAGE AND CUSTODY OF MATERIALS:
The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra Payment will be made on this account.
The storage space shall however be arranged by the department at site, if available. The main contractor shall arrange for proper storage of the electrical fans and fittings at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

ELECTRIC POWER SUPPLY AND WATER SUPPLY:
Power and water supply will be arranged by the contractor at the site for installation and testing commissioning etc. Contractor will take due care to ensure safety during execution of work.
TOOLS FOR HANDLING AND ERECTING:
All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

CO-ORDINATION WITH OTHER AGENCIES:
The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

CARE OF BUILDINGS:
Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

STRUCTURAL ALTERATIONS TO BUILDINGS
No structural member in the building shall be damaged /altered, without prior approval from the competent authority through the Engineer-in-charge.
Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these required modifications or fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.
All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.
All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings without any extra payment beyond the agreement items.

ADDITION TO AN INSTALLATION:
Any addition, temporary or permanent, to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

WORK IN OCCUPIED BUILDINGS:
When work is executed in occupied buildings, there would be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after the office hours.
The contractor shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.
The contractor shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the Engineer-in-charge.
GFC DRAWINGS:
The work shall prepare all GFC drawings as per the tender drawings and tender document and also in accordance with modification thereto from time to time as approved by the Engineer-in-charge.

All wiring diagrams shall be deemed to be ‘GFC DRAWINGS’. They shall indicate the main switch board, the distribution boards (with circuit numbers controlled by them), the runs of various mains and sub mains and the position of all points with their controls. All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which they are electrically connected.

After award of the work, the firm will be required to submit the GFC drawings and technical data sheets for the proposed work. Work will be carried out as per the approved GFC DRAWINGS.

CONFORMITY TO IE ACT, IE RULES, AND STANDARDS:
All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of submission of online bids of tender unless specified otherwise). List of rules of particular importance to electrical installations under these General Specifications is given in Appendix C for reference.

RATINGS OF COMPONENTS
All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.

All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

CONFORMITY TO STANDARDS:
All components shall conform to relevant Indian Standard Specifications wherever existing.

Materials with ISI certification mark shall be preferred.

Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

INTERCHANGEABILITY:
Similar parts of all switches, lamp holders, distribution fuse boards, Switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.
WORKMANSHIP:
Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.

Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.
1. SCOPE OF WORK
   a. This specification outlines the requirements for an intelligent, addressable fire detection and alarm system.
   b. The work described in this specification consists of all labour, materials, equipment and services necessary and required to complete, test and commission the fire detection and alarm system. Any material not specifically mentioned in this specification or not shown on drawings but required for proper performance and operation shall be provided and installed for a complete and operational system, by the contractor at no extra cost.
   c. The contractor shall furnish, and install complete and ready for intended use and operation, an intelligent, addressable fire detection and alarm system including Fire panel(s), initiating devices (manual pull stations, addressable smoke, heat detectors etc.) indicating devices (hooters, bells, visual warning signals, etc.) and supervisory devices, annunciators, wiring apparatus and accessories.
   d. The installation and locations of equipment and devices in the building shall be governed by the specifications and drawings with due regard to actual site conditions, manufacturers' recommendations, ambient factors affecting the equipment and other operations in the vicinity. If any departure from the specifications or drawings is necessary, approval shall be obtained from the Engineer-in-Charge before work is started thereon.
   e. Materials and equipment shall be new, first grade, standard, current models of the manufacturer and shall be suitable for this system. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by the same manufacturer. All materials, devices, and equipment shall be compatible with the circuits or systems in which they are utilized.
   g. The Contractor shall submit specific catalogue cuts for each of the item specified in BOQ for approval from Engineer in charge before procurement.

3. REQUIREMENTS
   a. This installation shall be made in accordance with the drawings, specification, local codes and local fire authorities having jurisdiction over this project.
   b. Reference Standards
      i) The design, supply, installation, testing and commissioning of the entire fire detection and alarm system shall conform to BS:5839 or NFPA 71 and 72. The Detectors shall conform to relevant codes for Fire Alarm System.
      ii) The system installed shall comply with the following codes/publications:
         a) IS 2175
         b) IS 2189
         c) IS 11360
         d) IS 732
         e) UL "UNDERWRITERS" laboratory/NFPA/FM/VDS/FOC for addressable detector, fire panel.
         f) EN 54
         g) BS 5445
   C. TESTS AT SITE
      i) All commissioning tests at site will be in line with BS : 5839 or NFPA 71 and 72.
      ii) Following tests shall be conducted:
         i) Loop Checking
         ii) Checking of smoke detectors, Heat detectors etc. by simulation.
         iii) Functional tests for fire alarm panel.
         iv) The Mock trial of the complete Fire Detection and Alarm system.
   e. TESTS AT MANUFACTURER'S WORK
      i) Tests certificates will be furnished for approval of all Fire alarm devices and system devices.
      ii) All routine tests as per relevant codes for the Fire Alarm Panel, shall be conducted and results
furnished to the Engineer-in-Charge.

5. **POWER SUPPLY**
   a. The control panel shall derive 230 Volts power from main supply. A standby power supply shall be immediately available in the event of failure of normal supply and shall automatically be connected so as to maintain the equipment in condition such that fire alarm originating from the operation of Detector can be given. The standby battery as secondary supply shall be such that when charged by associated battery charging equipment it can operate independently for a period of 12 hours. It shall have enough power supply to cope with additional load resulting in alarm originated from two separate zones for the one hour. Batteries shall be of Lead Acid type and sealed Maintenance free.
   b. Suitable arrangements shall be incorporated to prevent secondary batteries from discharging through the charging equipment in the event of its breakdown or a failure in the supply.
   c. In addition to the batteries, a battery charger suitable for operation on the auxiliary power available in the plant as specified above shall be supplied. The capacity of the charge shall be such that the same can boost charge the battery (within 8 hrs) while supplying the rated load of the fire detection and annunciation system. Facilities shall be provided to limit the voltage supplied to fire detection and alarm system to their rated values during the time of boost charging. The charger shall normally supply the battery trickle charging current and the DC load of the fire detection and alarm system. In case the AC supply on the input side of the charger fails the necessary power for the complete fire detection and alarm system shall be supplied by the battery.
   d. Visible and audible annunciation for troubles or failure in the power supply system like "charger Failure", "Battery Low Voltage", etc. shall be provided.
   e. Battery earth/fault indication/annunciation shall be included in the panel.

6. **FIRE ALARM SYSTEM DEVICES**

6.1 **General**
   i. Each device shall be assigned a unique address via easily understood decade (01 to 99) switch. Address selection via binary switches or by jumpers is not acceptable. Devices which take their address from their position in the circuit are unacceptable because if devices are later added, existing addresses, descriptors and commands need to be reprogrammed.
   ii. Devices shall receive power and communication from the same pair of conductors. For fault isolating modules a separate power wiring which shall be fault tolerant shall be provided.
   iii. Each device shall contain screw terminals with rising plates for positive termination suitable for 1.5 sq.mm. copper conductor wire.

6.2 **Addressable Manual Stations**
   i. Manual stations shall be of rugged die cast construction designed for semi-flush mounting. Plastic stations will not be acceptable. Stations shall be of the break-glass design and must be opened to be reset. Closing the box after opening it shall automatically perform the reset function. It shall be possible, for testing purposes, to initiate an alarm without breaking the glass. All stations shall be furnished with a spare glass break rod.
   ii. Provisions shall be made such that the address cannot be changed merely from opening the station.

6.3 **Addressable Analog Detectors**
   i. All fire sensors shall mount on a common base to facilitate the changing of sensor type if building conditions change. The base shall be incompatible with conventional detectors to preclude the mounting of a non-intelligent device.
   ii. If the Fire Alarm Panel determines that the sensor is in alarm, the Fire Alarm Panel shall command the sensor LED to remain on to indicate alarm.
   iii. Each sensor shall be capable of being tested for alarm via command from the Fire Alarm Panel.
   iv. Each sensor shall respond to Fire panel scan for information with its type identification to preclude inadvertent substitution of another sensor type. The Fire Alarm panel shall operate with the installed type but shall initiate a mismatch (trouble) condition until the proper type is installed or the programmed sensor type changed.
   Each sensor shall respond to Fire Alarm Panel scan for information with an analog representation of measured fire related phenomena (smoke density, particles of combustion, temperature). Such
response proves end-to-end sensor including the operation of the sensor electronics. Systems which only monitor the presence of a conventional detector in an addressable base shall not be acceptable.

v. The Detector shall meet the requirements of either EN 54 or shall be listed with UL. It shall be possible to test the Detector's working both from the Panel as well as locally by means as designed by the Contractor and approved by the Engineer-in-Charge. The approved coverage per Detector for unhampered areas shall not be less than 50 sq. M. The detector shall be capable of being reset automatically after any alarm condition.

6.4 Addressable Analog Heat Detectors
i. The Detector shall be Analog, Addressable Detector with its own manually set digital code and be able to give a single digitised output to the Fire Alarm Panel regarding its condition. The Detector shall employ the thermistor principle for heat sensing and the fixed temperature setting shall be at 60 degrees Centigrade. It shall be able to communicate with the Fire Alarm Panel by the Pulses emitted from the Panel.
ii. The Base of the Detector shall be interchangeable with other Smoke Detectors and the construction shall be of flame retardant material. LEDs shall be provided to indicate locally alarm condition.
iii. It shall be able to withstand temperature variations from 0o C to 50o C. Further, relative Humidity (non Condensing type) upto 95% shall not hamper its performance.
iv. It shall have in built safety device to monitor the removal and pilferage of the Detector. The Detector also must have facility for remote indication. The quiescent current flow must not exceed 50 milliamps. and alarm condition current shall be maximum 60 milli amps.

6.5 Alarm Hooters
Alarm hooters shall be suitable for indoor, or outdoor, application with the appropriate 4 x 4 in. electrical box. All hooters shall be 24 V DC operated. The minimum sound level shall be 90 db at 10 feet. Hooters shall be surface semi-flush mounted.

6.6 Monitor Module
i. The monitor module shall provide an addressable input for N.O. or N.C. contact devices such as manual stations, waterflow switches, sprinkler supervisory devices, etc.
ii. It shall provide a supervised initiating circuit. An open-circuit fault shall be annunciated at the Fire Alarm panel (Subsequent alarm shall be reported.)
iii. The device shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon determination of an alarm condition of an alarm condition, the LED shall be latched on.

6.7 ADDRESSABLE CONTROL MODULE
a) Addressable Control Module shall be provided to operate dry contacts for switching ON OFF Pressurisation fans, AHU’s etc. in case of fire etc.
b) It shall have a built in type identification to automatically identify this device to the control panel.
c) It shall have internal circuitry & relay powered directly by two-wire loop.

6.8 Fault Isolator Device
i. The Fault Isolator Device shall detect and isolate a short-circuited segment of a fault-tolerant loop.
ii. The device shall automatically determine a return to normal condition of the loop and restore the isolated segment.
The fault isolator device shall be placed every [20] devices to limit the number lost in the event of a short-circuit.

7 FIRE ALARM PANEL
Fire Alarm panel shall be provided with 80 character backlit Liquid Crystal Display (LCD) Annunciator, function key pad, and printer as specified below. Necessary software and hardware shall be furnished at the location shown on the drawings.

7.1 Automatic Functions
The alarm shall be displayed at the FP on an LCD display. The FP printer shall print out the same information displayed on the LCD display.
7.2 Manual Functions
At any time, the operator shall have the following manual capabilities at the FP by means of switches located behind a key locked cover:

a) Initiate an alarm summary display on the FP LCD display. This display shall step through all currently active alarm in the system.

b) Initiate a summary printout of all currently active alarms on the FP printer.

c) Initiate an "all point summary" printout on the FP printer recording the status of each system point (initiating circuits, indicating circuits, etc.)

At any time the operator shall have the following manual capabilities at the FP under password control. Operator privileges and ID numbers of up to four digits shall be assignable only by the main operator or designated alternate. Actions taken by operators shall automatically be printed on the FP printer with operator initials, time and date.

d) Command output points to different mode. Such commands shall be printed with selected descriptors ON/OFF, ON/OFF/AUTO, OPEN/CLOSE, DAY/NIGHT, etc.

e) Modify system parameters. Full alphanumeric key pad shall be provided for operators to modify the following parameters:-
- change sensor alarm and prealarm thresholds
- update date and time
- change point descriptions
- change action messages

f) Select a system status report for printing on the FP printer. The following real time reports shall be provided:-
- all point log
- alarm summary
- trouble summary
- status summary
- sensitivity log
- disabled points log
- isolated points log
- disconnected points log
- logical group points log

The sensitivity log shall print the analog value of each addressable analog sensor.

g) Select printing of a trend log which, when enabled, shall print the last 24 analog values for every addressable analog sensor taken at predetermined intervals selected by operator. Systems which limit the number of addressable analog sensors which can be trended are not acceptable.

h) Select a sequence of preprogrammed commands which shall be automatically executed, in sequence, via a single command. Provide a minimum of 255 commands which can be divide among a minimum of seven sequences.

f. Perform a walktest function such that a single operator can periodically check out all initiating devices on a loop. In walktest mode all initiators on the selected loop shall automatically be isolated. As each device is placed into an alarm or trouble condition the FP shall print the condition and automatically reset the device. No audible signals shall be initiated from the loop to prevent disruption of building occupants. If a loop is inadvertently left in the walktest mode it shall automatically reset to normal after a five minute idle time is exceeded.

7.3 System Supervision

a) In the normal supervisory condition, only the green "POWER" LED, and green "RUN" LED shall be illuminated. The LCD display shall display "System Normal" and the current time and date.

b) The LCD display shall indicate the loss of power condition and the printer shall record same. Following restoration to normal AC power, the trouble indicators shall be automatically reset, and the printer shall record the return to normal condition.

c) The LCD display shall indicate the loop in trouble and the printer shall record same. Operation of a momentary "Silence" switch shall silence the audible trouble signal, but the visual "Trouble" LEDs shall remain on until the malfunction has been corrected and the system reset. The FP printer shall record this action.

The FP shall contain an integral backlit LCD display of two lines of 40 characters each, and a 40
character width printer. Both display and printer shall be viewable through the FP door.

7.4 Programming
The LCD display and printer programming shall be accomplished on-site by means of a lap-top personal computer which shall plug into the FP. Modules requiring off-site programming are not acceptable. Programming functions shall include alarm/trouble type assignment, point descriptor assignment, etc. Data file for the LCD display and printer shall be stored in EEPROM.

7.5 Networking
An additional output drive card must be provided to facilitate networking between two or more panels.

8 Approval of Fire Detection and Alarm System
The Contractor has to get the drawings for Fire Detection and Alarm System approved from the local fire authorities. On completion of the work, the Contractor has get the installation approved and obtain a certificate from the local fire authorities and handover the same to the Construction Manager. The contractor shall be responsible for obtaining the required approval from Tariff advisory committee and other statutory authorities.

9 Testing & Commissioning

9.1 PHOTOTHERMAL SMOKE AND HEAT DETECTOR:
9.1.1 The testing shall be carried out for each loop initially with one detector in a loop and subsequently two or more disassociated detectors in each loop with time gap between the detectors for alarm acknowledge and Reset.
9.1.2 An identified smoke detector will be subjected to smoke aspiration from burning paper or cigarette puffs, held at 0.3 m distance from the detector. The panel should indicate through piezo sounder and hooter that alarm signal has been transmitted throughout the system. This test shall be carried out in different loops as well as two loops simultaneously. This part of the detector test shall be repeated again after 24 hours gap.
9.1.3 The same test in the same sequence shall be carried out for heat detector but with the application of heat from a hair dryer-held at approximately 60 cm distance. Repeat testing of the same detector shall be carried out at 24 hours interval.

9.2 Combined Test :
9.2.1 The panel shall be checked for basic tests, such as, visual checking of input voltage and amperage. All loops one by one, shall be D-wired to check for fault signal indication in the panel.
9.3.2 Subsequently, in every loop of panel, a detector shall be subjected to smoke or heat test and signals shall be checked on the panel.
9.3.1 The hooter shall sound automatically and the piezo sounders shall also sound. It shall also be possible to check that the hooters of all panels sound automatically when the panels are auto moded.
9.3.2 The power source shall be cut off and checked for standby supply from the batteries. After six hours the power source shall be switched on to check for auto switch over to mains mode. The trickle charger shall take over the charging of the battery to its maximum cut off level with auto cut off. A set of discharged batteries shall be connected to the panel in place of the new batteries and the trickle/boost switch checked for charging of the batteries.
9.3.2 Tests shall be conducted for AC failure, charger failure, battery disconnected or battery failure. In all such cases the relevant indication should come and the sounder shall also sound alarm.
9.4 Manual Call Box :
The manual call box glass shall be removed by unscrewing the back. The micro switch shall instantaneously give a fire signal in the panel.
9.5 Random Sample Testing :
About 5% of all fire alarm components shall be subjected to random testing by connecting to the panels. All smoke detectors shall be tested as given above and later cleaned with a vacuum cleaner. Hooters shall also be tested through direct 24V supply. It shall be tested for 10 minutes.
9.6 Testing of Earthing system:
The earth continuity conductor including metallic parts of the equipments shall be tested for earth to electrical continuity. All tests shall be carried out as per IS 3043 and resistance of complete installation shall not be more than one ohm.
9.7 COMMISSIONING AND ACCEPTANCE TESTS
The commissioning and acceptance tests shall be apart from the standard or routine tests prescribed and normally conducted by the manufacturer and will be irrespective of the fact whether the same are covered by such tests or not.
Each sounder circuit shall be energised separately and the sound level reading taken to check for conformity with the minimum standards.

b. Mains failure performance
c. Battery disconnection test.
d. Open circuit of each sounder circuit to be tested.
e. Short circuit of each sounder circuit to be tested.
f. The results of the above tests either by fault warning or fire alarm shall be recorded in the log books which will be signed both by the Consultant and Engineer in charge.

CCTV SYSTEM

Video Management System:-

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Technical Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Video Management System (VMS) software shall be used to view live and recorded video from capture cards and IP devices connected to local and wide area networks. The VMS software shall have a client/server-based architecture that can be configured as a standalone VMS system with the client software running on the server hardware and/or the client running on any network-connected TCP/IP workstation. Multiple client workstations shall be capable of simultaneously viewing live and/or recorded video from one or more servers. Multiple servers shall also be able to simultaneously provide live and/or recorded video to one or more workstations.</td>
</tr>
<tr>
<td>2</td>
<td>The VMS shall be supplied with minimum 100 nos of thick clients and 16 mobile clients</td>
</tr>
<tr>
<td>3</td>
<td>Recording of all video transmitted to the VMS shall be continuous, uninterrupted and unattended</td>
</tr>
<tr>
<td>4.1</td>
<td>The VMS system shall offer the capability of video motion detection recording, such that video is recorded when the NVRMS detects motion within a region of interest of the camera’s view. Video prior to the detection of the motion shall also be stored with recording using the pre-recorded feature.</td>
</tr>
<tr>
<td>4.2</td>
<td>It should also provide following feature:</td>
</tr>
<tr>
<td>a.</td>
<td>Suspect Tracking : Configure camera links between cameras to follow a suspect between different camera scenes</td>
</tr>
<tr>
<td>b.</td>
<td>Archive bookmarks: Specifically archive bookmarked video to create a second copy of important video and avoid using limited WAN bandwidth</td>
</tr>
<tr>
<td>c.</td>
<td>Inactivity timeout : Save bandwidth with blacked out video panels after inactivity</td>
</tr>
<tr>
<td>5</td>
<td>The VMS system shall manage the video it has been configured to monitor. Loss of video signal shall be configured to annunciate on VMS client by an on-screen visual indication alerting operators of video loss.</td>
</tr>
<tr>
<td>6</td>
<td>The VMS software shall have an open architecture supporting IP cameras and encoders from multiple manufacturers providing best-of-breed solutions ranging from low-cost, entry-level features to high-resolution, megapixel features</td>
</tr>
<tr>
<td>7</td>
<td>The VMS client software shall be able to view live video and audio, recorded video and audio and be able to configure the complete system all from a single application</td>
</tr>
<tr>
<td>8</td>
<td>The VMS client software shall have the same functionality when connected remotely as it does when it is run locally on the same computer as the server software</td>
</tr>
<tr>
<td>9</td>
<td>The VMS client software shall operate on all of the following operating systems: Windows, Linux, Mac OSX</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
</tr>
<tr>
<td>10</td>
<td>The VMS software shall allow the user to have any combination of VMS client applications running on any of the supported operating systems and be able to connect to any of the VMS servers running on any of the supported operating systems. For example, a VMS client running on Microsoft Windows 7 shall be able to simultaneously connect to four (4) different VMS servers all running on different operating systems, such as Windows Server 2003, Windows XP, Vista and Linux.</td>
</tr>
<tr>
<td>11</td>
<td>The VMS software shall have the capability to run multiple client applications simultaneously on one workstation with multiple monitors. Up to 12 monitors shall be configured on a single workstation with one (1) client application running on each monitor. Because decompressing video is CPU-intensive, the PC workstation shall have multiple core processors with a recommendation of one core for each VMS client application.</td>
</tr>
<tr>
<td>12</td>
<td>The VMS shall also allow an authorized user to view video through a web client interface. The web client interface shall allow authorized users to view live video, view recorded video, control pan-tilt zoom (PTZ) cameras and activate triggers. The web client interface shall allow connections to multiple VMS servers simultaneously.</td>
</tr>
<tr>
<td>13</td>
<td>The web client interface shall operate without requiring installation of any software.</td>
</tr>
<tr>
<td>14</td>
<td>When using the web client interface, the VMS server shall transcode the video into a JPEG file of the size as the browser screen before sending it to the browser.</td>
</tr>
<tr>
<td>15</td>
<td>The web client interface shall support the following browsers: IE, Firefox, Opera, Safari, Chrome and shall be compliant with HTML 4.</td>
</tr>
<tr>
<td>16</td>
<td>The VMS server software shall record and retrieve video, audio and alarm data and provide it to the VMS clients upon request.</td>
</tr>
<tr>
<td>17</td>
<td>The VMS software shall provide a purpose built mobile application capable of viewing multiple simultaneous live video streams and playing a recorded video stream. Application shall be provided for both iOS and Android operating systems. Min. 5 mobile clients to be supplied at each location.</td>
</tr>
<tr>
<td>18</td>
<td>The VMS server software shall operate on any of the following operating systems: Windows, Linux.</td>
</tr>
<tr>
<td>19</td>
<td>The VMS server software shall record video based on metadata generated by an edge network device. The edge network devices shall generate the metadata and transmit it with the video stream to the VMS server software.</td>
</tr>
<tr>
<td>20</td>
<td>The VMS shall license the total number of cameras on the system. This license shall be based on the MAC address of a single network card that is present on the system. The VMS shall only require that this network card be enabled and does not require that data is actually sent through it.</td>
</tr>
<tr>
<td>21</td>
<td>The VMS shall be able to use the Active Directory or LDAP features of a network to authenticate users and determine which permissions they will have on each server.</td>
</tr>
<tr>
<td>22</td>
<td>The VMS shall allow the use of maps. The maps will be accessible to users with the appropriate permission levels and display video sources and their status.</td>
</tr>
<tr>
<td>23</td>
<td>The VMS shall allow maps to be embedded inside of maps (i.e. hierarchical or nested maps). When an event happens on a map that is embedded inside of a map, it shall transmit the alert to all parent maps and change the color of the icon on the parent map and all subsequent parent maps.</td>
</tr>
<tr>
<td>24</td>
<td>The VMS allows soft triggers to be placed, viewed and triggered from a map.</td>
</tr>
<tr>
<td>25</td>
<td>The VMS shall have a single page that displays the status of all servers and cameras currently connected. This page shall display any alarms, events, MAC addresses, camera configuration, format and frame rate from each individual camera.</td>
</tr>
<tr>
<td>26</td>
<td>When in live display mode, the user shall be able to view live video, live audio, point of sale (POS) data and alarm information.</td>
</tr>
<tr>
<td>27</td>
<td>The VMS shall provide an option to view 16:9 wide video display panels.</td>
</tr>
<tr>
<td>28</td>
<td>The VMS shall allow the customization of the user interface to allow software triggers to be shown. This shall allow them to activate events through the push of a button, which could trigger recording, PTZ presets, output triggers or email.</td>
</tr>
<tr>
<td>Page</td>
<td>Text</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>29</td>
<td>The VMS software shall allow control of PTZ cameras to authorized users and be used to maneuver a PTZ camera. When used on a non-PTZ camera, it shall allow you to digitally pan, tilt and zoom on any video whether in live or recorded mode.</td>
</tr>
</tbody>
</table>
| 30   | The VMS shall allow following methods of controlling a PTZ camera to be available:  
- PTZ graphics control windows  
- Live graphic overlay PTZ control icons  
- Keyboard control (up, down, left, right arrows; page up, page down for zoom)  
- PTZ presets  
- Digital PTZ  
- USB joystick to control PTZ cameras  
- Proportional PTZ control by clicking the mouse in the center and moving it |
| 31   | The VMS software shall allow virtual matrix functionality by designating a cell to do so. This video cell shall automatically show video as it is triggered |
| 32   | The VMS software shall have a feature for viewing logical groups of cameras. This shall allow efficient viewing of cameras in a logical order |
| 33   | The VMS software shall have a feature to organize your cameras into preset views. Views are preconfigured arrangements of the video panels so that they may be easily recalled later. A view can save the location of the video streams, audio streams, maps and event views. These views shall be accessible in both live and recorded video modes |
| 34   | The VMS software shall have the capability to automatically cycle through two or more saved views to create a video tour. The VMS shall allow the configuration of the dwell time and the different views it shall use |
| 35   | The VMS software shall support searching through recorded video based on time, date, video source and image region and have the results displayed as both a clickable timeline and a series of thumbnail images |
| 36   | The VMS software shall have the capability to export video, maps, and audio files |
| 37   | The VMS software shall provide the option of exporting the file in the following formats:  
- Standalone Exe (*.exe) – includes an executable player with the video and audio data  
- AVI File (*.avi) – a multimedia container format  
- PS File (*.ps) – a format for multiplexing video and audio |
<p>| 38   | The VMS standalone player shall package all of the exported video into a single executable. The VMS standalone player shall be able to authenticate that the video has not been tampered with using a keyed Hash Message Authentication Code (HMAC) |
| 39   | The VMS system shall be able to display system information about users that are currently logged into the system, plug-in file version information number and status, and a system log that contains a detailed history of the processes that occur on the system |
| 40   | The VMS system shall have the ability to record an audit trail of when users log in that shows what changes they have made, what video they have viewed and what they have exported |
| 41   | The VMS shall allow monitoring of the inputs on both network devices and on manufacturer provided hardware. The VMS shall also allow triggering of outputs on the network devices and manufacturer provided hardware |
| 42   | The VMS shall allow for the configuration of what drives to use for recording video. Those drives may be local drives, direct attached storage drives or iSCSI drives |
| 43   | The VMS shall not require a database when recording video |
| 44   | The VMS shall have the ability to receive ASCII data through the COM port on the server or over the network |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>The VMS shall have the ability to look for keywords in the ASCII data and use these to execute various events such as PTZ presets, recording video, recording audio and sending email notifications.</td>
</tr>
<tr>
<td>46</td>
<td>The VMS software shall be able to send a predefined email based on an event trigger. The VMS software shall also support SSL and TLS connections for transmissions of the mail.</td>
</tr>
<tr>
<td>47</td>
<td>The VMS software shall have a feature to export a video segment from specific cameras or audio inputs to a CD or DVD upon an input trigger or other event being activated.</td>
</tr>
<tr>
<td>48</td>
<td>The VMS software shall be used to connect different types of events, such as input triggers, to a desired action such as recording video or triggering an alarm. The VMS software shall recognize the following event types: Video Motion, Video Loss, Input Trigger, Health, IP Camera Connection, Software Trigger and Analytics.</td>
</tr>
<tr>
<td>49</td>
<td>The VMS client shall be able to use OpenGL and Direct3D to decompress and render video.</td>
</tr>
<tr>
<td>50</td>
<td>The VMS software shall allow the user to input time-based triggers through event monitoring, including the time of day and day of week.</td>
</tr>
<tr>
<td>51</td>
<td>Camera preview Style e.g Hovering.</td>
</tr>
<tr>
<td>52</td>
<td>Video Pane must be identify by color e.g Motion, Alarm, Free Run, PTZ Focused, Book Marked.</td>
</tr>
<tr>
<td>53</td>
<td>VMS has Video Push feature to another Client desktop simultaneously.</td>
</tr>
<tr>
<td>54</td>
<td>Support mainstreaming to manage all quality stream.</td>
</tr>
<tr>
<td>55</td>
<td>Server and Client must be run on single machine another client machine not Required.</td>
</tr>
<tr>
<td>56</td>
<td>Support configuration of multiple DNS servers.</td>
</tr>
<tr>
<td>57</td>
<td>At least 60 second timeout for out of schedule login failure.</td>
</tr>
<tr>
<td>58</td>
<td>Support analytic metadata in live and search.</td>
</tr>
<tr>
<td>59</td>
<td>Support Video Wall.</td>
</tr>
<tr>
<td>60</td>
<td>Search and display analytic meta data when searching analytic event linkages.</td>
</tr>
<tr>
<td>61</td>
<td>VMS shall support CIFS and NFS network shares for archive target locations.</td>
</tr>
<tr>
<td>62</td>
<td>All streams can be individually configurable for recording schedules and storage rules.</td>
</tr>
<tr>
<td>63</td>
<td>Configurable recording of video prior to the detection of the motion.</td>
</tr>
<tr>
<td>64</td>
<td>The VMS shall support a graphical representation of drive status for associated RAID-based storage.</td>
</tr>
<tr>
<td>65</td>
<td>The VMS shall support local HDD disk storage.</td>
</tr>
<tr>
<td>66</td>
<td>The VMS shall support iSCSI extended storage whereby a remote storage unit can appear as a local drive.</td>
</tr>
<tr>
<td>67</td>
<td>Support Map Functionality and multi-level mapping.</td>
</tr>
<tr>
<td>68</td>
<td>Support bookmarking feature shall allow the tagging, naming, and retention of video clips.</td>
</tr>
</tbody>
</table>

Failover Management:

1. System Manager Minimizes Downtime of Servers.
2. Maximize uptime of servers with constant server health monitoring. Receive email notifications or use browser-based dashboard to receive immediate notification of system errors and warnings.
3. Instant health assessment of all servers from anywhere using the intuitive dashboard to visually confirm the health of all servers from a PC browser, tablet or smartphone.
4. Highly flexible e-mail notifications allow individual users or groups of users to be e-mailed real-time or periodically for over 25 user selectable errors and warnings such as VMS recorder offline, storage warning, drive failure, temperature alarm or camera disconnected.
5. Reduce software maintenance time with scheduled software updates. In a matter of minutes, you can schedule hundreds or thousands of servers to receive the latest features.
6. Monitor camera health and events to confirm camera uptime and proper positioning.
Continually monitors all recorders to immediately detect a failure
Ensures video continues to record and users can utilize live view functions during downtime
Automatically transfers failed recorder duties back to the primary recorder when available
Manually failover recorders at any time for system maintenance
Intuitive dashboard for constant server health monitoring
Receive e-mails for immediate notification of system errors and warnings
Schedule automatic software updates during non-peak hours, Automatically synchronize user permissions across all recorders, Integrated backup and restore of recorder configurations, Plan software updates to hundreds or thousands of servers within minutes.

**Server & Storage to support 64 HD Camera**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Technical Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make &amp; Model No.:</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>It should connect min 64 full HD (1920x1080p) cameras per appliances</td>
</tr>
<tr>
<td>2</td>
<td>It must continuously record up to 550 Mbps of video for high concentration of high definition IP cameras</td>
</tr>
</tbody>
</table>
| 3 | Local client display rate:  
  Windows OS: up to 1800 frames per second  
  Linux OS: up to 1200 frames per second |
| 4 | It should support streaming live/recorded video up to 100 simultaneous PC clients |
| 5 | It should support two-way audio |
| 6 | Processor: Gen 4 Intel Core i7 |
| 7 | It must work on Windows/Linux platform with 2x1 Gbps NIC and 16 GB of RAM |
| 8 | It should support maximum 80 TB of storage (It should be configured as per the storage calculation provided by VMS OEM), and 8 USB slot. |
| 9 | It must support DVI-I, HDMI, 1 display ports, max 2 simultaneous monitors |
| 10 | Operating temperature should be 5 – 35°C |
| 11 | NVR Support Maximum 8 HDD slot support. |
| 12 | Windows, or Linux operating system and factory installed Video Management System (VMS) must be installed in SSD Drive. |
| 13 | minimum capability: 2 GigE Network ports |
| 14 | Operating Temperature 40° - 95°F (4.5° - 35°C) |
| 15 | Operating System must be support Windows/Linux both platform |
| 16 | Requirement is of critical nature and hence offered camera must be of global standards and hence should be CE, FCC and UL certified. |

**Dome Camera**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Image Sensor</td>
<td>1/2.8” Progressive Scan CMOS</td>
</tr>
<tr>
<td>2</td>
<td>Min. Illumination</td>
<td>0.01Lux @ (F1.2, AGC ON), 0 Lux with IR, 0.028 Lux @ (F2.0, AGC ON), 0 Lux with IR</td>
</tr>
<tr>
<td>3</td>
<td>Shutter Speed</td>
<td>1/3 s to 1/100,000 s</td>
</tr>
<tr>
<td>4</td>
<td>Lens</td>
<td>2.8mm @ F2.0, Angle of view: 106°</td>
</tr>
<tr>
<td>5</td>
<td>Lens Mount</td>
<td>M12</td>
</tr>
<tr>
<td></td>
<td>Feature</td>
<td>Specification</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>Day &amp; Night</td>
<td>IR cut filter with auto switch</td>
</tr>
<tr>
<td>7</td>
<td>Digital Noise Reduction</td>
<td>3D DNR</td>
</tr>
<tr>
<td>8</td>
<td>Wide Dynamic Range</td>
<td>Digital WDR</td>
</tr>
<tr>
<td>9</td>
<td>Angle Adjustment</td>
<td>Pan: 0° - 355°, Tilt: 0° - 75°, Rotation: 0-355°</td>
</tr>
<tr>
<td>10</td>
<td>Compression Standard</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Video Compression</td>
<td>H.264/ MJPEG</td>
</tr>
<tr>
<td>12</td>
<td>Video Bit Rate</td>
<td>32 Kbps – 8 Mbps</td>
</tr>
<tr>
<td>13</td>
<td>Dual Stream</td>
<td>Supported</td>
</tr>
<tr>
<td>14</td>
<td>Max. Resolution</td>
<td>1920 x 1080</td>
</tr>
<tr>
<td>15</td>
<td>Frame Rate</td>
<td>25fps(1920 × 1080), 25fps (1280 × 960), 25fps (1280 × 720)</td>
</tr>
<tr>
<td>16</td>
<td>Image Settings</td>
<td>Rotate mode, Saturation, Brightness, Contrast adjustable</td>
</tr>
<tr>
<td>17</td>
<td>Backlight compensation</td>
<td>Required</td>
</tr>
<tr>
<td>18</td>
<td>ROI</td>
<td>Required</td>
</tr>
<tr>
<td>19</td>
<td>Network Storage</td>
<td>Local storage: Built-in Micro SD/SDHC/SDXC card slot, up to 128 GB</td>
</tr>
<tr>
<td>20</td>
<td>Alarm Trigger</td>
<td>Motion detection, Dynamic Analysis, Tampering alarm, Network disconnect, IP address conflict, Storage full, Storage error</td>
</tr>
<tr>
<td>21</td>
<td>Protocols</td>
<td>TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour</td>
</tr>
<tr>
<td>22</td>
<td>Security</td>
<td>User Authentication, Watermark</td>
</tr>
<tr>
<td>23</td>
<td>Standard</td>
<td>ONVIF</td>
</tr>
<tr>
<td>24</td>
<td>Communication Interface</td>
<td>1 RJ45 10M/100M Ethernet interface</td>
</tr>
<tr>
<td>25</td>
<td>Regulatory</td>
<td>CE, FCC, UL</td>
</tr>
<tr>
<td>26</td>
<td>Operating Conditions</td>
<td>-30 °C – 60 °C (-22 °F – 140 °F) Humidity 95% or less (non-condensing)</td>
</tr>
<tr>
<td>27</td>
<td>Power Supply</td>
<td>12 V DC ± 10% PoE (802.3af)</td>
</tr>
</tbody>
</table>
## Bullet Camera

### Camera

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Sensor</td>
<td>1/2.8&quot; Progressive Scan CMOS</td>
</tr>
<tr>
<td>Min. Illumination</td>
<td>Color: 0.005 Lux @ (F1.2, AGC ON), 0 Lux with IR Color: 0.0068 Lux @ (F1.4, AGC ON), 0 Lux with IR</td>
</tr>
<tr>
<td>Shutter Speed</td>
<td>1/3 s to 1/100,000 s, Slow Shutter supported</td>
</tr>
<tr>
<td>Day &amp; Night</td>
<td>IR Cut Filter</td>
</tr>
<tr>
<td>Digital Noise Reduction</td>
<td>3D DNR</td>
</tr>
<tr>
<td>WDR</td>
<td>120dB</td>
</tr>
<tr>
<td>3-Axis Adjustment</td>
<td>Pan: 0° to 360°, tilt: 0° to 90°, rotate: 0° to 360°</td>
</tr>
</tbody>
</table>

### Lens

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focal length</td>
<td>2.8 to 12 mm</td>
</tr>
<tr>
<td>Aperture</td>
<td>F1.4</td>
</tr>
<tr>
<td>Lens Mount</td>
<td>Ø14</td>
</tr>
</tbody>
</table>

### Compression Standard

<table>
<thead>
<tr>
<th>Type</th>
<th>Main Stream: H.265+/H.265/H.264+/H.264</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.265 Type</td>
<td>Main Profile</td>
</tr>
<tr>
<td>H.264 Video Bit Rate</td>
<td>32 Kbps to 16 Mbps</td>
</tr>
<tr>
<td>H.264 Audio Compression</td>
<td>G722.1/G711ulaw/G711alaw/G726/MP2L2</td>
</tr>
<tr>
<td>H.264 Audio Bit Rate</td>
<td>32 to 128kbps</td>
</tr>
</tbody>
</table>

### Intelligence

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavior Analysis</td>
<td>Line crossing detection, intrusion detection, unattended baggage detection, object removal detection</td>
</tr>
<tr>
<td>Face Detection</td>
<td>Support</td>
</tr>
<tr>
<td>Region of Interest</td>
<td>Support 1 ROI per stream</td>
</tr>
</tbody>
</table>

### Image

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Resolution</td>
<td>1920 × 1080</td>
</tr>
<tr>
<td>Main Stream</td>
<td>50Hz: 25fps (1920 × 1080, 1280 × 960, 1280×720)</td>
</tr>
<tr>
<td></td>
<td>60Hz: 30fps (1920 × 1080, 1280 × 960, 1280×720)</td>
</tr>
<tr>
<td>Sub Stream</td>
<td>50Hz: 25fps (640 × 360, 352 × 288)</td>
</tr>
<tr>
<td></td>
<td>60Hz: 30fps (640 × 360, 352 × 240)</td>
</tr>
<tr>
<td>Third Stream</td>
<td>50Hz: 25fps (1920 × 1080, 1280×720, 640 × 360, 352 × 288)</td>
</tr>
<tr>
<td></td>
<td>60Hz: 30fps (1920 × 1080, 1280×720, 640 × 360, 352 × 240)</td>
</tr>
<tr>
<td>Image Enhancement</td>
<td>Back Light Compensation</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Image Setting</td>
<td>Rotate mode, saturation, brightness, contrast, sharpness adjustable by client software or web browser</td>
</tr>
<tr>
<td>Day/Night Switch</td>
<td>Auto/Schedule/Triggered by Alarm</td>
</tr>
</tbody>
</table>

**Network**

<table>
<thead>
<tr>
<th>Alarm Trigger</th>
<th>Motion detection, video tampering, network disconnected, IP address conflict, illegal login, HDD full, HDD error, Alarm input, Alarm output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocols</td>
<td>TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour</td>
</tr>
<tr>
<td>General Function</td>
<td>One-key reset, anti-flicker, password protection, privacy mask, watermark, IP address filter</td>
</tr>
<tr>
<td>ONVIF</td>
<td>Supports PROFILE S, PROFILE G</td>
</tr>
<tr>
<td>Simultaneous Live View</td>
<td>Up to 6 channels</td>
</tr>
<tr>
<td>User/Host</td>
<td>Up to 32 users 3 levels: Administrator, Operator and User</td>
</tr>
</tbody>
</table>

**Interface**

| Audio | 1 input (line in, 3.5 mm), 1 output (3.5 mm) |
| Communication Interface | 1 RJ45 10M/100M self-adaptive Ethernet port |
| Alarm | 1 input, 1 output (max. 12 VDC, 30 mA) |
| Video Output | 1Vp-p composite output (75 Ω/BNC) |
| On-board Storage | Built-in Micro SD/SDHC/SDXC slot, up to 128 GB |
| Reset Button | Support |

**General**

| IR Range | Up to 50m |
| Regulatory | UL, CE, FCC |
| Operating Conditions | Temperature: -30 °C to +60 °C (-22 °F to +140 °F) Humidity: 95% or less (non-condensing) |
| Power Supply | 12 VDC ± 25%, PoE (802.3at) |
| Power | 12 VDC, 1.2A, max. 14.5W |
| Consumption and Current | PoE (802.3at, 42.5V to 57V), 0.5A to 0.1A, max. 16.5W |
| Protection Level | IP67, IK10 TVS 2000V Lightning Protection, Surge Protection and Voltage Transient Protection |

**EPABX SYSTEM:**
Supply Installation, Testing and Commissioning of Server Based EPABX Fully Computerized IP System, SIP Compliant. Multi slot 19: U Rack Mountable 2U Rack Expandable upto 900 Ports Presently Configuration as Below:
- CO Line 16Nos.
- PRI(30 Channel) 1Nos.
- SIP Extension 16 Nos
- Digital Extension Circuits 16 Nos
- Analog Extension Circuits 64 Nos.
- Integrated Voicemail System 4 Level IVR software with 6 different languages and 4 time schedule (As per
OEM).
Digital Phone (24Key+ 60-line DSS Console) Backlit keypad Hands-free, full duplex ,Headset support Easy to use soft keys/LCD prompts, Directory dialling, Navigation wheel, Call history, Backlit LCD screen, Bluetooth support (BCAZ),Security lock key XML open interface
24Key Digital Phone Backlit keypad Hands-free, full duplex ,Headset support Easy to use soft keys/LCD prompts, Directory dialling, Navigation wheel, Call history, Backlit LCD screen, Bluetooth support (BCAZ),Security lock key XML open interface .

12 key display Backlit keypad Hands-free working Easy to use soft keys / LCD prompts on display model Directory dial key 1000 system, 1000 group, 10 personal, 600 phone book Conference key Wall mountable Message waiting indicator.

Digital Phone 6 key display Backlit keypad Hands-free working Easy to use soft keys / LCD prompts on display model Directory dial key 1000 system, 1000 group, 10 personal, 600 phone book Conference key Wall mountable Message waiting indicator Analog CLI Phone with hands free.
Audio –Visual System

Audio –Visual System (Seminar Hall and Meeting room)
100" 4K UHD LED Display on Front wall, 3840x2160 pixels resolution, 700 Nits Brightness, 3000:1 or better contrast Ratio, Viewing Angle: 178 deg (H)/178 deg(V), Response time: 6.5 ms or less, Display Port 1.2 x 2, HDMI 2.0 X 2 (HDCP 2.2) , HDMI 1.4 X2 , VGA X 1, OPS X 1, OPS USB 2.0 X 2, OPS USB 3.0 X 1, Multiple Views: PIP, Dual, Quad complete with installation along with wall mounted frame as per the site complete etc as required.

Projector Single 0.7" DLP Technology by TI Dual-lamp engine design for a brighter image and operational reliability should one lamp go down 6700 ANSI Lumens and 3000:1 contrast ratio Native XGA resolution with a maximum UXGA resolution DLP® and BrilliantColor™ technologies for detailed image quality Variety of connectivity options including: DVI, S-video, composite, component Enhanced color and display adjustments PC 3D compatibility with DLP® Link™ Power lens shift for easy adjustment and movement Seven (7) interchangeable lens options for a variety of projection needs Interchangeable color wheels for diverse applications and installation requirements One touch quick release lens button Built-in 12V trigger for convenient control of projector screen Network-ready for integration and system administration via RJ45. Motorised front Projection Screen, wide(12ft) X height (8ft) with Remote Control with heavy duty projector ceiling mount kit.

Wired Table Top Digital Delegate unit with Gooseneck Microphone with Super Cardiod Capsule. Gooseneck length : 14.20" to 15.47". Gooseneck Microphone : Not detachable. Connection : standard CAT5 cable. Twin Loudspeaker THD : 0,03 % at 50 mW/16ohm. Per Microphone recording option required to of record minute of meeting Digital Signal processor limiter inbuilt Maximum power consumption : 3.8W Homogenius sound level from speaker 3.5mm headphone jack with volume control Operating voltage : 35 V to 52.8 V DC. Push to Talk button.

Wired Table Top Digital Chairman unit with Gooseneck Microphone with Super Cardiod Capsule, Gooseneck length : 14.20" to 15.47" Gooseneck Microphone : Not detachable, Connection : standard CAT5 cable Twin Loudspeaker THD : 0,03 % at 50 mW/16ohm Per Microphone recording option required to of record minute of meeting. Digital Signal processor limiter inbuilt Maximum power consumption : 3.8W, Homogenius sound level from speaker3.5mm headphone jack with volume control Operating voltage : 35 V to 52.8 V DC. Priority and Next-Key for delegate control.

Digital Central Unit to connect 40 participants and with USB Recording Capability. Supplies up to 40 and controls up to 400 discussion units. USB Conference recording. Electronically balanced XLR In&Out. Per Microphone recording option required to of record minute of meeting. Open Media Control Protocol over Ethernet, Permanent malfunction monitoring and error diagnostics. Integrated PC with pre-installed control Software Integrated software package. Conference Manager’ can be used directly on the CU1 by connecting a Screen, Mouse and Keyboard. Frequency response : 100 – 14.000 HzTotal harmonic distortion : 0,01%, Signal-to-noise ratio : >80 dB Audio input and frequency ports : balanced XLR connection.

Wireless digital Handheld Microphone one set with 18 or more channel, RF output 80mW or more, super cardiod pickup pattern, Frequency range : 1880 to 1930 MHz, Connectivity : RJ-45, battery can be chargeable through mini / micro USB as well etc complete required as per specifications.

Wireless digital Lavalier Microphone one set with 18 or more channel, RF output 80mW or more, Omni-directional pickup pattern, Frequency range : 1880 to 1930 MHz, Connectivity : RJ-45, battery can be chargeable through mini / micro USB as well etc complete required as per specifications.

4.25" two-way, thin edge ceiling speaker with back can, Speaker system : 2-way with bass reflex, Woofer Size : 4.25" - 5:25", Woofer cone material : polypropylene, nominal impedance : 16ohm, 100V transfo power taps : 30 - 15, frequency range : 75 - 20,000 Hz, low impedance dynamic power : 80 watts, RMS power : 50watts, max SPL at 1m : 108, dispersion angle (1000 Hz) : 180° etc complete required as per specifications.

12" to 15" two way full range speaker, nominal impedance : 700 or more watts, rotatable constant directivity horn, 80°H x 60°V or more, protection : HF overload protection, SPL 1 watt / 1m : 98 dB or better, SPL peak : 130dB, frequency response (-10 dB) : 40 Hz - 22 Khz etc complete required as per specifications and compliance sheet.

Powerful passive dual 10" to 15" subwoofer, woofer size : 2 X 10" or more, impedance (ohms) : 4 or 16, low impedance RMS power : 300watts or more, max SPL 1m : 140dB, loudspeaker system : dual coil, SPL 1W/1m : 99dB or better, frequency response : 40 - 150 etc complete required as per specifications and compliance sheet.

8" to 10" two-way full range speaker, impedance (ohms) : 8, low impedance RMS power : 200watts or more,
max SPL 1m : 118dB, main construction material : mdf wood, Vertical dispersion angle 1000 Hz : 140° or more, SPL 1W/1m : 90dB or better, frequency response : 40 - 25K Hz, Horizontal dispersion angle 1000 Hz : 120° or more etc complete required as per specifications and compliance sheet.

30watt wall mount speaker (powered / external) with all the required details of all connectivity and specifications (external amp should be class - D), Frequency range : 40 - 20000 Hz, THD : <0.07%, S/N ratio : >90 dB, should have volume operation through wall control panel / IR remote, Stereo inputs on standard 3.2 mm mini stereo jack, • Stereo inputs on standard 3.2 mm mini stereo jack, compatible with headphone outputs and line inputs (Computer, MP3 players) , RS232 control etc complete required as per specification and compliance sheet.

High power Hypex Class-D amplifier, High thermal efficiency, Integrated APC limiter, Transformer : Toroidal, Input connections : 4 x unbalanced on RCA with passthrough + 4 x balanced on euroblock, Input sensitivity : 0 dBV / 1 V or less, Input impedance : 22 kΩ, S/N ratio : >101 dB A weighted or better, THD : < 0.07 %, Frequency response : 50 – 20 kHz, Protection circuits : over current, over temperature, Channel separation : >68 dB @ 1 kHz, Power supply : 2xswitching mode power supply, Cooling : temperature controlled fan, Bridged output power: 2x480W@100V etc complete required as per specifications.

8-channel bridgeable class D power amplifier, Output power RMS at 8 ohms : 500watts, Input sensitivity : 0dB or better, S/N ratio : >100 dB, THD : <0.5%, Frequency response : 20 – 20 kHz, Protection circuits : over current, over temperature, Channel separation : >60 dB @ 1 kHz or better etc complete required as per specifications and compliance sheet.

12 Channels of AEC Processing with Auto Gain Control and Noise Cancellation digital signal processor, 8 Analog Outputs, Configurable Signal Processing, Clear Front Panel LED Indication, Bi-Directional Locate Functionality, 12 Control Inputs and 6 Logic Outputs for GPIO Integration, Soundweb London Interface Kit for Third Party Control System Integration (Documentation), HiQnet Device Configuration, Control and Monitoring from HiQnet complete in all respects.

Cable Manager with 1 no. multiregion AC Power socket, Black anodised/brushed aluminium finish, Tilt up lid with pass through holes for 1 HDMI, 1 VGA with audio, 1x LAN complete with CE, UL certification complete etc. as required.

8x8 HDMI to HDBT Matrix switcher having minimum Inputs of 8Nos.x HDMI (female), 9Nos. infrared on 3.5mm mini jacks, 1No. RS232 on a 9pin D sub connector, 1No. Ethernet on an RJ45 connector or better, Outputs of 8Nos. x HDMI (female), 8 x HDBaseT (RJ45), 9 Nos. infrared on 3.5mm mini jack or better, Max. data rate: 6.75Gbps or better, Audio support: upto 7.1 channels@192GHz or better, Resolution support upto 4K or better, with all built-in features complete as per the site requirement.

FHD Video Conference Systems having 1+5 Party connectivity on FHD Resolution from day 1(Inbuilt/External) i/c wireless remote control, 12x Optical zoom , 10x Digital Zoom Full HD PTZ Camera, having minimum 50 presets, Input for 3 More External cameras, Dual Microphone, 3 Video outputs, Inbuilt SD card/Pen Drive Recording feature, PC connectivity for presentation sharing, necessary hardware, software, license, programming complete etc as required at site.

Digital Podium with Gooseneck microphone, HDMI, VGA, Audio, LAN& Power Input.

2.5 Metres HDMI patch cord with connectors in existing conduit i/c testing etc. as required.

1.5 Metres HDMI patch cord connectors in existing conduit i/c testing etc. as required. 1 6 AWG 2 core speaker cable with connectors in existing conduit i/c testing etc. as required. 24 AWG or better shielded CAT 6 cable with suitable connectors in existing conduit i/c testing etc.

Floor Standing Rack network Rack - 22U / 600w / 800d, with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Two pairs of 19” mounting angles with ‘U’ marking. Depth support channels - 3 pairs. With a Overall Weight Carrying Capacity of 500Kgs. Side Panels - 22U/800d Front MS Door perforated honeycomb 22U/600w Rear MS Door (Fully Perforated - Mesh) 22U/600w Fan 90CFM 230V AC, 4” dia Castors with Brake (set of 4) Cable manager 1U MS with Loops Shelf, Stationery 475mm N/W PDU 7Sockets 5Amps with MCB Mounting Hardware (Pkt. Of 20) Vertical Cable Channel 50mmW 22U.

LAN & TELEPHONE NETWORK
### 4-PAIR CAT-6 COPPER UTP CABLE COLORED (305 METER)

<table>
<thead>
<tr>
<th>Detail</th>
<th>Technical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor</td>
<td>23 AWG solid bare copper with a Diameter $\geq 0.56$ mm</td>
</tr>
<tr>
<td>Separator</td>
<td>Cross-member (+) fluted Spine/isolator for uniform separation for all pairs.</td>
</tr>
<tr>
<td>Cable Diameter</td>
<td>$6.1 \pm 0.3$</td>
</tr>
<tr>
<td>Maximum Attenuation</td>
<td>32.8 dB per 100m</td>
</tr>
<tr>
<td>Min Next (dB)</td>
<td>30.2</td>
</tr>
<tr>
<td>ACRF (dB/100m)</td>
<td>20.7</td>
</tr>
<tr>
<td>Return Loss (dB)</td>
<td>24.6</td>
</tr>
<tr>
<td>PSACRF-F</td>
<td>20.4</td>
</tr>
<tr>
<td>TCL</td>
<td>36.1</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>54.9</td>
</tr>
<tr>
<td>Standards</td>
<td>ROHS complied and U/L listed EC Verified to ISO 11801 IEC 60332-1 EN 50173-1 TIA/EIA 568A in accordance with NFC 32062 with flame retardant effect &amp; NFC 32070. The cable NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT test result should meet &amp; exceed the performance requirement as per ANSI/TIA 568C.2.</td>
</tr>
</tbody>
</table>

All UTP Components should be from the same OEM.

The OEM should be ISO 9001:2000 Certified.

In the changing needs of the global resources if the company has environmental management systems in place like ISO 14001 accreditation the same shall be added advantage.

| Certification           | 3P, UL, ETL and RoHS                                                                 |
| Copper Gauge            | 23AWG                                                                                  |
| Frequency               | Minimum 700Mhz                                                                         |
| Characteristic Impedance from 1 to 100 MHz | 100 Ohm $\pm$ 15%                                                                |
| Sheath                  | PVC                                                                                    |
| Colour                  | Blue box of 305 Mtrs.                                                                   |

### CAT6 UTP INFORMATION OUTLET

<table>
<thead>
<tr>
<th>Detail</th>
<th>Technical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards and Approvals</td>
<td>The electrical performance of installation outlet shall meet or exceed requirement as per</td>
</tr>
<tr>
<td></td>
<td>- ISO/IEC 11801 Edition 2</td>
</tr>
<tr>
<td></td>
<td>- CENELEC EN 50173-1 2007</td>
</tr>
<tr>
<td></td>
<td>- ANSI/EIA/TIA 568-C.2</td>
</tr>
<tr>
<td></td>
<td>- IEC series 60603-7</td>
</tr>
<tr>
<td>Certifications</td>
<td>3P, UL, ETL and RoHS</td>
</tr>
<tr>
<td>Connection of RJ</td>
<td>Should accept RJ11 (4 contacts), RJ12 (6 contacts), RJ45 (9 contacts).</td>
</tr>
</tbody>
</table>
### Conductors Supported
- 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

### Shutter
Information outlet should have transparent shutter for protection against dust when not used.

### Tool Less Crimping
The information outlet termination should be of built-in self-crimping type without use of 110 punching tool requirement.

### Body
- Contacts: gold/nickel, minimum thickness of gold > 0.8 μm
- Metal parts: bronze, nickel, platinum, gold
- The information outlet shall be made of high impact PBT Polycarbonate plastic material

### Break Down Voltage
Greater than or equal to 1000V

### Contact Resistance
Less than or equal to 20mOhms

### Insulation Resistance
Greater than or equal to 500 M Ohm at 100 V DC

### Load Testing
Connector should be tested and guaranteed under PoE restrictions, IEEE 802.3af standard and PoE+, standard 802.3at, up to 2500 on-load connections / disconnections.
- Tested with 2 simultaneous PoE+ circuits for a minimum total power of 50W

### Endurance
2500 mating cycles (plug insertion/withdrawal). IK03

### Performance Warranty
25 years warranty

### Make
Systimax/Legrand/Panduit

### FACE PLATE-SINGLE/DUAL/QUAD

<table>
<thead>
<tr>
<th>Detail</th>
<th>Technical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Polycarbonate Hi-Grade Plastic FR Grade &amp; UV Resistant 850 degree C / Glow Wire Test</td>
</tr>
<tr>
<td>No. of Ports</td>
<td>1 Module to 4 Module</td>
</tr>
<tr>
<td>Size</td>
<td>Single/Dual – 86mmx86mm</td>
</tr>
<tr>
<td></td>
<td>Quad – 86mmx146mm</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Should be Modular and compatible to Cat5e, Cat6 and Cat6A range of UTP, STP I/O modules and AV connectors, HDMI connectors, BNC connectors</td>
</tr>
</tbody>
</table>

### 32. 24 PORT CAT 6 PATCH PANEL

<table>
<thead>
<tr>
<th>Detail</th>
<th>Technical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>24-port, Unshielded Twisted Pair, Category 6, TIA / EIA 568-6.2</td>
</tr>
<tr>
<td>Ports</td>
<td>24</td>
</tr>
<tr>
<td>Port arrangement</td>
<td>Each port to be modular and be able to remove &amp; plug in from front.</td>
</tr>
<tr>
<td>Configuration</td>
<td>The panel configuration shall be of minimum 6 connectors in 19” &amp; maximum 24 connectors in 1U design with rear cable manager design.</td>
</tr>
<tr>
<td><strong>Earthing</strong></td>
<td>The patch panel connector of 6 port shall be of back removable type for ease of maintenance.</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Height</strong></td>
<td>1 U (1.75 inches)</td>
</tr>
<tr>
<td><strong>Port Identification</strong></td>
<td>Labelling provision to be on blank port inbuilt in the jack panel</td>
</tr>
<tr>
<td><strong>Number of plug insertion cycles (Endurance)</strong></td>
<td>2500</td>
</tr>
<tr>
<td><strong>Max. number of connections and disconnections</strong></td>
<td>5 without refreshing the wiring.</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
<td>Integrated bend-limiting strain-relief unit for cable entry or other mechanism to reduce the strain and bends at cable entry</td>
</tr>
<tr>
<td><strong>Material Housing</strong></td>
<td>Polyphenylene oxide, 94V-0 rated</td>
</tr>
<tr>
<td><strong>Wiring blocks</strong></td>
<td>RAL 9005 polycarbonate</td>
</tr>
<tr>
<td><strong>Jack contacts</strong></td>
<td>Gold/nickel, thickness of gold &gt; 0.8 μm</td>
</tr>
<tr>
<td><strong>Panel</strong></td>
<td>DC01 galvanised steel sheet</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>UL / ETL / 3P Certified</td>
</tr>
<tr>
<td><strong>Termination Pattern</strong></td>
<td>Tool less - TIA / EIA 568 A and B</td>
</tr>
<tr>
<td><strong>ROHS Compliant</strong></td>
<td>ROHS/ELV Compliant</td>
</tr>
</tbody>
</table>

### CAT6 UTP PATCH CORD COLOURED-1/2/3/5MTRS

<table>
<thead>
<tr>
<th><strong>Detail</strong></th>
<th><strong>Technical Specification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>The patch cord shall provide air-tight connection for cross-connection and shall meet or exceed Unshielded Twisted pair, Category6, TIA/EIA 568.B.2-1, EN 50173-1,</td>
</tr>
<tr>
<td><strong>Conductors</strong></td>
<td>24 AWG 7/32, multi stranded copper conductors 100 Ω</td>
</tr>
<tr>
<td><strong>Plug Protection</strong></td>
<td>Over-molded boot at each end maintains minimum bend radius of the cable</td>
</tr>
<tr>
<td><strong>Jacket</strong></td>
<td>PVC / LSZH</td>
</tr>
<tr>
<td><strong>Insulation</strong></td>
<td>Polyethylene</td>
</tr>
<tr>
<td><strong>Construction of Patch cords</strong></td>
<td>Assembled with RJ45 50μ” gold plated contacts.</td>
</tr>
<tr>
<td><strong>Operating temperature range:</strong></td>
<td>-10°C to +60°C</td>
</tr>
<tr>
<td><strong>Separator</strong></td>
<td>Cross separator within patch cord</td>
</tr>
<tr>
<td><strong>Copper</strong></td>
<td>Multistranded copper in conductor</td>
</tr>
<tr>
<td><strong>colour</strong></td>
<td>blue, Green, Red, Yellow</td>
</tr>
<tr>
<td><strong>Performance Warranty</strong></td>
<td>25 years warranty</td>
</tr>
<tr>
<td><strong>Approvals</strong></td>
<td>UL listed / ETL Verified</td>
</tr>
</tbody>
</table>

### SC/LC Couplers/Adapter – Multimode Mode - 12 Port

<table>
<thead>
<tr>
<th><strong>Detail</strong></th>
<th><strong>Technical Specification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Should be able to house Single</strong></td>
<td></td>
</tr>
<tr>
<td>mode Fiber connectors</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>---</td>
</tr>
<tr>
<td>Should have option of 3/6 Duplex SC/LC adaptor</td>
<td></td>
</tr>
<tr>
<td>Should have transparent label holders with 6 different coloured labels</td>
<td></td>
</tr>
<tr>
<td>Should be compatible with ST, SC, LC, SC / APC Connector</td>
<td></td>
</tr>
<tr>
<td>Base should be of Polycarbonate RAL 9005</td>
<td></td>
</tr>
<tr>
<td>Should have rugged ceramic (Ziconia) Sleeve for fibre ferrule alignment</td>
<td>0.5dB 0.2dB</td>
</tr>
<tr>
<td>Service life (Cycles):</td>
<td>500 cycles</td>
</tr>
<tr>
<td>Operating temperature:</td>
<td>-40°C to +70°C</td>
</tr>
<tr>
<td>Storage temperature:</td>
<td>-55°C to +85°C</td>
</tr>
<tr>
<td>Make</td>
<td>Systimax/Legrand/Panduit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Service life (Cycles):</td>
<td>500 cycles</td>
</tr>
<tr>
<td>Operating temperature:</td>
<td>-40°C to +70°C</td>
</tr>
<tr>
<td>Storage temperature:</td>
<td>-55°C to +85°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi mode OM3 pigtails – 50/125 μm:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTOR SPECIFICATION</td>
<td></td>
</tr>
<tr>
<td>OPTICAL PERFORMANCE</td>
<td>Multi mode</td>
</tr>
<tr>
<td>IL MAX/Master (Acceptance)</td>
<td>0.25dB</td>
</tr>
<tr>
<td>IL Average/Master</td>
<td>0.15dB</td>
</tr>
<tr>
<td>IL Average/Random</td>
<td>0.20dB</td>
</tr>
<tr>
<td>CHARACTERISTIC</td>
<td>SIMPLEX</td>
</tr>
<tr>
<td>SC/LC connectors</td>
<td></td>
</tr>
<tr>
<td>Low smoke zero halogen (LSZH) sheath</td>
<td></td>
</tr>
<tr>
<td>900 μm tight buffer or easy strip</td>
<td></td>
</tr>
<tr>
<td>The multimode fibre conforms to ITU-G651 and TIA/EIA 492AAAA standards.</td>
<td></td>
</tr>
<tr>
<td>CABLE SPECIFICATION</td>
<td></td>
</tr>
<tr>
<td>CHARACTERISTICS</td>
<td>SIMPLEX</td>
</tr>
<tr>
<td>Crush resistance</td>
<td>500 (N/100 mm)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>- 20 to + 60 °C</td>
</tr>
<tr>
<td>Normal sheath Diameter (2mm,2.4mm &amp; 900 ± 50 μm)</td>
<td></td>
</tr>
</tbody>
</table>
### Maximum Tensile Load

| Maximum Tensile Load | 6N |

### Attenuation (dB)/km

| Attenuation (dB)/km | 2.8 @ 850 nm / 0.8 @ 1300 nm |

### OFL bandwidth (MHz x km)

| OFL bandwidth (MHz x km) | 3500 50 nm / 500 @ 1300 nm / 4700 @ 850 nm |

---

### Multimode Fiber Optic Patch Cords

**OM 3 (PC) Multimode optical duplex cords (50/125 µm) – SC/SC, SC/LC, LC/LC**

<table>
<thead>
<tr>
<th>Detail</th>
<th>Technical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards &amp; Approvals :</td>
<td>Conform to IEC, ANSI-TIA, and Telecordia performances requirements</td>
</tr>
<tr>
<td>RoHS, REACH &amp; SvHC compliant</td>
<td></td>
</tr>
</tbody>
</table>

**CONNECTOR SPECIFICATION :**

<table>
<thead>
<tr>
<th>OPTICAL PERFORMANCE</th>
<th>OM3</th>
<th>CONFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL MAX/Master (Acceptance)</td>
<td>0.3dB</td>
<td>IEC 61300-3-4</td>
</tr>
<tr>
<td>MAX IL/Random</td>
<td>0.4dB</td>
<td>IEC 61300-3-34</td>
</tr>
<tr>
<td>Ave/Master *</td>
<td>0.15dB</td>
<td>IEC 61300-3-4</td>
</tr>
<tr>
<td>Ave/Random *</td>
<td>0.20dB</td>
<td>IEC 61300-3-34</td>
</tr>
<tr>
<td>Return Loss</td>
<td>NA</td>
<td>IEC 61300-3-6</td>
</tr>
</tbody>
</table>

*The change in attenuation for all the above listed criteria shall be a maximum of 0.2dB.

**MECHANICAL PROPERTIES CONFORMANCE :**

| Mechanical endurance | 500 matings | IEC 61300-2-2 |
| Vibration | 10-55 Hz, 0.75 amplitude | IEC 61300-2-1 |
| Cable retention | Magnitude 90 N | IEC 61300-2-4 |
| Cable torsion | 1.5 kg – 2.5 kg for 2 mm - 3 mm cable dia.. | IEC 613000-2-5 |

**CONNECTOR TYPE**

| SC | IEC 61754-4 |
| LC | IEC 61754-20 |

**CABLE SPECIFICATION :**

**CHARACTERISTICS**

<p>| Cable Material | LSZH or PVC |
| Strength Member | Aramid |
| Crush | 1000 N |
| Operating Temperature | -20 to +60 °C |</p>
<table>
<thead>
<tr>
<th>Secondary Buffer Diameter (2mm,2.4mm &amp; 3mm)</th>
<th>900 ± 50 μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Bending Radius (mm)</td>
<td>10 D (installed)  20 D (loaded)</td>
</tr>
</tbody>
</table>

50 Pair annealed tinned copper conductor PVC insulated and sheathed armoured copper telephone cables with suitable clamps, saddles and including making terminal joints complete as required.

100 Pair annealed tinned copper conductor PVC insulated and sheathed armoured copper telephone cables with suitable clamps, saddles and including making terminal joints complete as required.

Network/Server Rack - 42U / 800w / 800d, with Heavy Duty Extruded Aluminium Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Two pairs of 19” mounting angles with ‘U’ marking. Depth support channels - 3 pairs. With a Overall Weight Carrying Capacity of 500Kgs. Side Panels - 42U/800d Front MS Door Perforated honeycomb 42U/800w Rear MS Door Split Perforated honeycomb 42U/800w Fan 90CFM 230V AC, 4” dia Castors with Brake (set of 4) Vertical Cable manager 80mmW 42U Shelf, Stationery 700mm N/W PDU 12Sockets 5/15Amps with MCB Mounting Hardware (Pkt. Of 20) earthing Kit 150mmH Cable manager 1U MS with Loops complete in all respect.

PA SYSTEM

ceiling mount speaker, speaker system : dual cone, Woofer size : 6.5" - 8", 100V power tap : 6watt or more, SPL 1W/1m : 91dB or better, max SPL 1m : 99dB or better, frequency response : 60Hz to 20KHz, IP rating : 50 or more, Grill main material : steel, Dispersion angle : 180° etc complete required as per specifications.Make: APART-AUDIO / AIM-LINE / MARTIN AUDIO Audio Control matrix Balanced inputs 1 – 6, Unbalanced outputs 1 – 8, SPDIF in to analog output : 97 dB @ 1 kHz, 75 dB @ 20 kHz @ nominal output level, Unbalanced inputs to analog output : 92 dB @ 1 kHz, 82 dB @ 20 kHz, Balanced inputs to analog output : 95 dB @ 1 kHz, 82 dB @ 20 kHz, Input : SPDIF 2 channel. 8 – 24 bit, 32 – 96 kHz sampling rate with sampling rate converter, Output : SPDIF 2 channel. 24 bit, 48 kHz fixed sampling rate, RS232A port settings : 19200 Baud, 8 databits, no parity and 1 stop bit, RS232 B and C settings : selectable via GII: baudrate: 600, 1200, 2400, 4800, 9600, 19200, 38400 8 databits, no parity and 1 stop bit, 8 wall panel connections : euroblock 2 wire, DSP and AD/DA specifications : 48 kHz sampling rate, 1.2 ms latency from analog input to analog output, Frequency response: 20Hz to 20 kHz +/- 1dB, serial port on front panel for configuration using the GII (graphic installer interface) etc complete required as per specifications. Paging station, with uni directional / cardioid / omni-directional microphone, 12 keys for different required zone, 1 ky for all call zone etc complete required as per specifications.

High power Hypex Class-D amplifier, High thermal efficiency, Integrated APC limiter, Transformer : Toroidal, Input connections : 4 x unbalanced on RCA with pass through + 4 x balanced on euro block, Input sensitivity : 0 dBV / 1 V or less, Input impedance : 22 kΩ, S/N ratio : >101 dB A weighted or better, THD : < 0.07 %, Frequency response : 50 – 20 kHz, Protection circuits : over current, over temperature, Channel separation : >68 dB @ 1 kHz, Power supply : 2Xswitching mode power supply, Cooling : temperature controlled fan, Bridged output power: 2x480W@100V etc complete required as per specifications. Professional CD/DVD player with USB flash port & 19” Rack mount arrangement.

19-inch Equipment Rack with standardized frame or enclosure for mounting multiple PA controllers, CD player, Amplifiers etc modules. Size 24U.
ACCESS CONTROL SYSTEM

1. Multi Door Networked Intelligent Access Controller

General Specifications & Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Bidder shall propose IP Enabled Access Controllers for the project. The Access controller shall be completely field upgradeable or by remote access on IP Network without changing the software or effecting any database information.</td>
</tr>
<tr>
<td>The same shall be true for remote diagnostics purposes, wherein the service provider shall render services for monitoring / improvement / up gradation / trouble shooting.</td>
</tr>
<tr>
<td>The Networked Intelligent Controller shall utilize true distributed processing technology with the capability of local processing based on the local storage of Cardholders, all system access groups and time schedules, and input and output information shall be maintained in the controller’s RAM memory.</td>
</tr>
<tr>
<td>The Intelligent Access Controller modules shall be support the monitoring and control of four (4) reader, with either or combination of various types of readers, keypads and Biometric Readers in any types and combinations.</td>
</tr>
<tr>
<td>Each Networked Intelligent Controller shall utilize on-board self -diagnostic LEDs, and a connection diagram overlay for ease of installation and service.</td>
</tr>
<tr>
<td>The controller shall also support technology feature which shall retain the last complete panel database as a default until the update has been confirmed, ensuring the integrity of the database in the field panel. The technology shall ensure corruptions due to hang-ups during downloads are accommodated and the field panel always has a complete and fully functional database.</td>
</tr>
<tr>
<td>Each Networked Intelligent Controller shall be supplied with an enclosure with an enclosure tamper switch.</td>
</tr>
<tr>
<td>The controller should be network intelligent with the following specifications:</td>
</tr>
<tr>
<td>No. of readers per Controller (Max.)</td>
</tr>
<tr>
<td>No. of door locks / Controller (Max.)</td>
</tr>
<tr>
<td>Access decisions shall be made at each door controller</td>
</tr>
<tr>
<td>Communications links</td>
</tr>
<tr>
<td>Cable type</td>
</tr>
<tr>
<td>Data transfer between each equipment</td>
</tr>
<tr>
<td>Error Checking, parity checking &amp; message</td>
</tr>
<tr>
<td>Communication through</td>
</tr>
</tbody>
</table>
Facility for accepting Fire alarm input as Hardware input
Facility for opening the all doors and Pedestrian barrier in case of Fire
Minimum card handling capacity in each control Panel
Minimum No. of Transaction records at each control panel
The communications links shall be on-line at all times
Communications link failure
Number of holidays definable
On Board RTC
Multi Reader Technology:
Watch dog
Output relays (freely Programmable)
Input on Controller (Supervised)
Dedicated Technical Input to Monitor:
Max number of controller on RS485
Battery Backup:
Power Supply
Operating Temperature:
Operational Humidity:
Certification:
Compliance:
Enclosure

**ACCESS CONTROL SOFTWARE**

The basic components of the Security Access Control and Alarm Monitoring System shall include:

Data Management System Complete with Specified Servers and Client hardware and Software all required database management Modules, configuration software, database storage system software and hardware, as well as complete browser based Access Control and Alarm Monitoring software package including a dynamic and interactive graphical user interface.

The ACCESS CONTROL APPLICATION system shall also support a fully integrated Visitor Management System, CCTV System Interface, Time & Attendance, Intrusion Detection Functionality and other System functions as defined in the specifications and contract documents. ACCESS CONTROL APPLICATION File Server shall communicate with ACCESS CONTROL APPLICATION Client Workstations over an industry standard Ethernet Local Area Network (LAN).

ACCESS CONTROL APPLICATION Client workstation shall be color monitor and keyboard for database entry, operator requested reports and alarm/event reporting. ACCESS CONTROL

Operator interface at the ACCESS CONTROL APPLICATION client shall be easy to understand screens with point and click buttons.

Access control Integration with BMS shall allow for Dynamic and Interactive Color Graphics user interface with full graphic map/floor plan import and display capability. The interfaced GUI system shall have the capability to simultaneously display floor plan maps or photos with coded interactive alarm, reader, and relay icons and indications, together with audible alarm, descriptive text and operator instructions.
Intelligent Access controllers shall be capable of utilizing both central processing and true distributed processing technology.

Local processing shall be based on the full local storage of cardholders, access groups, time zones, input and output information in controller RAM. In the event that database information has not been downloaded, is corrupted or is insufficient to make necessary local transaction decisions, the controllers shall access the Main ACCESS CONTROL APPLICATION server.

The Controllers shall be a microprocessor-based device, with 32-bit processor.

The controller shall feature a direct Ethernet connection to the controller bus structure in addition to an RS-232 and an RS-485 connection, all of which may be designed for use in communication with the ACCESS CONTROL APPLICATION server.

The Access controller shall be capable of supporting directly connected readers as well as combined reader/keypads, and or Biometric Readers, and Biometric-cum-keypad-cum Proximity Readers.

The Access Controller shall be capable of dynamically allocating its memory between database information and transaction history, which shall be stored if the controller has lost communication with the ACCESS CONTROL APPLICATION server(s).

Such transaction history shall be automatically uploaded to the ACCESS CONTROL APPLICATION server(s) once communication has been restored in the event of link failure.

Alternately, the Access controller may have Input and output Module cards directly sitting on the controllers Motherboard. Quantity and location of Access Controllers shall be as specified in contract documents and drawings.

Card Readers, Keypads and Access Control Cards shall be provided as per quantities specified in the Tender BOQ documents and drawings. Door contacts switches, request-to-exit devices, electric locks, local alarm horns, status indicators and other devices shall also be provided as shown on Tender BOQ documents and drawings.

SYSTEM COMPONENTS

SYSTEM IT HARDWARE
ACCESS CONTROL APPLICATION Servers
The basic minimum Configuration of the Main Server shall be as under:
For ACCESS CONTROL Server(s):-
SITC of Server Hardware for Application & Data Base Management.
19” rack mount with a minimum of Quad Core Xeon Processor at 2.00GHz, 1333MHz FSB
with 16 GB of RAM,
500GB SAS HDDs for Application Server & 2TB SAS HDDs for Database Server
1 Gigabit Network Controller , DVD Combo Drive, Monitor and Keyboard
Windows Server 2008 or higher which ever is latest for both Application server and database server
Microsoft SQL Server 2008 or Higher, standard edition License for Database server
The Main server shall be provided with 19-inch color monitor, standard 101-key keyboard and Scroll mouse, and DVD Combo Drive. The server computer system shall be of accepted make as given in the tender.

The Servers shall be supplied with Ethernet Network Interface Card supporting both 10BaseT and 10base2 topologies.

ACCESS CONTROL APPLICATION Client Workstation:
The Client workstation requirement shall be as follows:
Intel Dual core 2GHz Processor with minimum 2GB RAM, min 250 GB HDD, Graphics Card, DVD Combo Drive, 19” Monitor and Keyboard. Complete with Windows 7 premium license.
The client workstation shall be provided with 19 -inch color monitor, standard 101-key keyboard and Scroll mouse. The computer system shall be as per approved makes.
Each client workstation shall be capable of supporting the Client Software installed on it for Access / Visitor / and Vehicle Management as described above.

On-Line Event & Report Printers

On-line Alarm Reports and Event Transactions shall be printed on the On-Line Events Printer. The printer shall be a Laser printer utilizing tray feed A4 paper and capable of a print speed of at least 18 PPS.

SYSTEM SOFTWARE

The software system design shall be object oriented, and shall support Server-Client Architecture.

The Access Control Software shall be a native 32-bit application running under the Windows Server Environment. All client workstations and the Server(s) shall have full system functionality and shall not be segregated in any way by function, except as defined by the user authentications of sign on and password.

The system shall have a simple, easy to use graphical user interface, browser based. Help text shall be provided for each screen function, and shall be sufficiently interactive that a user may access page help directly and be provided with explicit information relevant to the particular screen being displayed.

The system shall have a distributed architecture; however the central server(s) shall have the capability to make transaction decisions for access requests, alarm handling and output control. The software shall be provided with a high-speed real time functionality, which allows the server to take over the transaction handling function of Access Controllers, which are being downloaded, or whose database is incomplete or corrupted, and thus maintain the fully functional access and security response of the Access controllers under these circumstances.

It is vitally important that the access and alarm functionality of the system shall in no way be impaired during periods when database information is being downloaded to Access Controllers or other field devices, or when these Access Controllers or other field devices have insufficient information to make necessary transaction decisions. Thus, it is unacceptable for the performance of Access Controllers to be degraded in any way. Access decisions based solely on company codes or facility codes or even a combination of the two are not acceptable.

Functional Features of ACS software:

The ACS software system shall have the modules that connect the controllers on TCP/IP or RS-485, scans all the units defined for any events/alarms, and downloads any settings configured by the operator.

The ACS shall be designed and configured in such a way so that single point failure shall have no degradation in overall functionality.

It shall be the responsibility of the installer to ensure that the hardware and software solution using the PC specified meets the standards and performance criteria as set down in this bid.

The system software architecture shall be designed not only to provide a high speed open architecture platform for individual single server applications, but also be specifically designed to insure high speed and high integrity partitioning.

The ACS architecture should store its data in MS – SQL Database

Access Control system software shall, as a minimum, support the following features:

Integration with a wide range of data collection devices such as biometric, smart card (iClass&Mifare), PIN and Proximity.

User defined role and operations

255 time zones for multi-shift operation support.

180 Holidays

Configure up to 8 digit Pin for Keypad

Global and local, hard, soft and timed anti-pass back/anti-tailgate capability.

Bulk addition of cards
Navigation window to facilitate easily access to employee details, remote controlling of controller operations & operating modes etc.
Configurable alarm-to-relay linking downloaded to field controllers for local operation
Configurable automatic, time controlled report generation and/or disk backup commands.
Communication monitoring
Address book of Employees at security station
History/audit trail.
Ability to respond to access requests/alarm conditions before and during download
Automatic card activation and deactivation
Global and local alarm masking by operator or cardholder
Access activity analysis by card reader
English language software, user friendly and menu driven operator screens
On screen help and/or manual
Support for different category like employee/contract employee/visitors etc.
Login and authority rights to the software for each operator
cardholder fields updating, deletion & addition
User defined database fields per card user.
Data searching parameters as and where require
anti-pass back/anti-tailgate feature definition
Access card enable and disable, Expired card deletion
Database backup, restore, export, import, archival, validation
Access group definition, assignment, activation, deactivation
It should define different transaction status like access denied, access granted, Egress pressed, invalid enable or expiry date for card user, anti-pass back violation etc.
Windows options like tile horizontal/vertical or cascade open form windows
Generation of various reports for Admin evaluation.
Ability to Customise the Report
Export of report to text, PDF, excel, CSV, Tif, XML format
Should be capable of integrating with following as a part of this Tender, and/or in Future as per the directive of the Consultant/Client:
- ERP, HR and legacy Systems
- Time attendance
- Basic Visitor management
- Vehicle Management Systems
- Asset tracking system
- Canteen management system
- IP Modbus integration with BMS
- IP CCTV integration

The access control system software shall, as a minimum, support the following features:
Cardholder records – 2,000 expandable up to 250,000 as per user requirement.
Escort Functionality for any specified Zone/Reader Set/Access controller defined to the directives of the client/consultant.
Alarm input points – 1,024 minimum
Relay outputs - 1,024 minimum
Client workstations - 32 minimum
255 time schedules and multiple Shift Capability.
User-defined alarm categories.
Local, hard and soft anti-pass back / anti-tailgate Configurable alarm-to-relay linking, downloaded to field controllers for local operation.
Configurable automatic time zone controlled commands, downloaded to the field controller for automatic local operation.
History/audit trail.
Alarm masking by operator
Capability to define within the system variable card formats.
Optional elevator control functions
Capability to support multiple site and facility codes at card readers
Capability to support biometric access control and verification readers.
On-Line System Management & Reporting
The system shall maintain, on disk, an Event Transaction Log File, and be capable of Historical Data Reports as well as Cardholder Report Listings in a variety of formats
System Event Transaction Log File.
The system shall maintain an Event Transaction Log File on hard disk for the recording of all historical event log data.
The historical data file shall maintain the most recent 120,000 log file physical records without having to resort to archived media.

The system shall warn the user of the need to archive historical data before data is over-written.
The system shall provide the utilities by which the historical event log file may be backed up to a removable disk cartridge of not less than 100-Mbyte capacity, which may be accessed on-line, without the need to copy the archived data back to hard disk. The system shall be capable of recalling historical events directly from the backup magnetic media without the need to interrupt normal on-line activity of the ACCESS CONTROL APPLICATION system.

Historical Reports.
The system shall be capable of producing the following reports, based on logged historical events over a specified date and time period, both individually and in any combination.
Report of valid accesses for a selected cardholder, selected card reader, on selected area.
Report of rejected access attempts for a selected cardholder, selected card reader, and selected alarm activation’s for a selected alarm point, on selected area.
Report of alarm acknowledgments for a selected alarm or group of alarms.
In addition, the system shall offer the user the option of directing the historical reports to a client workstation color monitor for display or to the report printer.
The system shall have the flexibility to customize Report which are not easily available in the standard report with MDB/SQL Query.

Cardholder Reports.
The system shall be capable of producing lists of selected cardholder data records on a client workstation color monitor and/or a report printer. The system shall allow the user to select sorting by card number, cardholder name or other fields.

Standard Cardholder Record Reports may be requested by an operator, with the data records sorted numerically by encoded card number, alphabetically by cardholder name, numerically by employee number, and numerically by the embossed card serial number. Such listings may also be requested to include only those cardholders who are authorized access to a specified area (list by security area).

Special Employee Report Generator reports may be created by the operator to provide cardholder record listings that include only operator specified data fields. Each report may include conditional testing on up to two (2) data fields in order to include data for only those cardholders that comply with those conditions specified. Each report shall be capable of being sorted in alphabetical or numeric order.
OPERATIONAL OBJECTIVES

Card Access Control
The Security Access Control System shall provide the following card access control operational objectives:
Controlled entry, via access card readers, of only authorized personnel to secured areas based on cardholder information entered and stored in the system database.

The access request response time from card presentation, database verification, to electric lock unlock shall be no more than one second in normal operating mode on a fully loaded system.

All access requests, both authorized and denied, shall be sent to the host for storage and annunciation, as required, with the cardholder number, name, and access point/area where access was attempted or gained.

The software package shall provide for Local Anti-Pass back, and also provide a facility for “soft” Anti-Pass back (i.e. allowing entry following an Anti-Pass back violation but still report and log the violation.) The system shall also be capable of providing timed Local Anti-Pass back for security areas.

The system shall provide for automatic lock/unlock of access-controlled doors on a scheduled basis using time schedule.

Each card and cardholder shall be entered into the database prior to their use. Each card can be manually disabled at any time without the requirement to delete the card. Each card can then be subsequently re-enabled at a later time.

Card records shall include the entry of activation and deactivation dates to provide for the automatic enabling and expiring of the card record.

The operating mode of access controlled doors shall be indicated as locked, unlocked, or controlled. The door status shall be indicated as open or closed.

The system shall provide for the monitoring of the reader controlled door position in order to detect and report Door Forced Open and Door Held Open alarm conditions. Door Held Open condition shall be based on a user-adjustable time period. The act of opening the door shall initiate the door timer, and also cause the immediate reset of the door lock. Shall be able to activate the In-Built Buzzer on the Reader during the said Conditions

The system shall provide for the designation of certain calendar days to be holidays, with special access privileges and system activity to be specified for those days.

The system shall provide the capability to unlock the door and/or mask (shunt) the door alarm, as user-configured, via a request-to-exit door motion sensor device or exit push-button. The capability shall be software programmable to allow selectable exit reporting.

All system controlled electric locks shall be capable of being unlocked via a client workstation color monitor/keyboard and request-to-exit devices.

The system shall provide for a completely downloaded and distributed database such that access control decision are made locally at the access controller and, in the event of the failure of the host computer or loss of communication to the host computer, the access control system shall continue to operate using full database information for all cardholders including security areas authorizations, time schedules, expiration dates of cards, holidays, etc. At no time after a card has been entered into the database of the file server and validated, shall the system fail to respond to an access request by a valid cardholder. (Restricted subsets of access control privileges and time schedule facilities in the distributed database shall not be accepted).

Alarm Monitor Points
The Security Access Control System shall provide the following alarm monitoring and reporting functions:

All door contacts and request-to-exit devices shall be connected in such a manner to provide supervised alarm monitoring. They shall be terminated at the remote reader module local to the door, and shall not be required to be routed back to the networked intelligent controller, unless it is more advantageous to do so. The input points used for door contact and request-to-exit device shall be user-configurable.
The system shall provide for special purpose alarm monitoring and/or transaction reporting for specific events, such as, but not limited to the following:
Duress condition at a card reader
Anti-Pass back
Rejected access request
Controller Cabinet Tampered
Commercial AC Power Failure
Controller Failure
Low battery at UPS power supply

RELAY OUTPUT Points
The Security Access Control System shall provide the following relay output control and operational functions:
Each security system output point (door lock, gate controller and other associated relay outputs) shall have a user-specified 16 character, minimum, text identifier. Each point shall be software programmable for activation and deactivation.
The system shall allow activation and deactivation of output points manually by the operator, automatically by time schedule, automatically by the activation of an alarm point.

DataBASE
The system shall provide for the following Database Management capabilities:
The software shall be capable of providing for the recall of system historical transactions with a minimum of 6,000 transactions recallable by operator command from the main event transaction file on the file server hard disk. Additional events may be recalled directly from an archived history log file on a removable hard disk cartridge.
Data searching parameters shall be provided in the ACCESS CONTROL APPLICATION system software. The search capability shall include, but is not limited to the following:
Card Number, Serial Number, Employee Number or Name.
Card readers.
Security Areas.
Alarm Points.
Alarm Categories.
Date and time periods.
The software shall provide report creation capabilities which offer search, organize and sorting according to the operator instructions, and have the ability to print, spool, or display a full report at a printer or client workstation.
All operator commands and database entry functions shall be Internet Browser driven with plain English text and prompts, and the system shall provide on-screen ‘Help’ information by one click of a button. It shall also include multi-media help for certain critical functions.
All access to the operator system functions shall require the entry of a valid password. A password shall be used by the operator, manager, or administrator to access the system, with each password access authority being completely user-selectable by individual menu selection.
Key Points for all bidders to follow:
API should be provided along with the software for integration with 3rd party software’s.

22. Contractor shall preserve the copies of invoices, test certificates, gate passes etc. to prove the genuineness of material/purchases. The responsibility of procurement, genuine material of specialized works shall rest with the contractor.
23. No inspection outside the country is permissible if required so the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment.

**INTERNAL ELECTRICAL SPECIFICATION**

1.00.00 Cable Trays, Racks, perforated and associated Material

1.01.00 Cable Trays / Support

1.01.01 All cable trays shall be ladder type and shall be supported and laid in accordance with the ‘layout drawings’.

1.01.02 Cable trays shall be ladder type and dip galvanized after fabrication.

1.01.03 Cable tray supports shall be cantilever type for easy installation. All supports and hardware shall be hot dip galvanized.

1.01.04 Standard cable tray width shall be 600 mm. However reduced width of 300 mm shall be used in some place where specifically required.

1.01.05 Trays in general shall be supported at a distance of 1.5 m horizontal run.

1.01.06 All welds for cable trays shall have a minimum throat thickness of 60 mm.

1.01.07 Jointing of cable trays shall be done by welding only.

1.01.08 Damaged galvanized surfaces shall be cleaned and coated with two (2) coats of red oxide primer followed by two (2) coats of cold galvanized paint.

1.02.00 Earthing of cable Trays.

1.02.01 Cable trays shall be electrically continuous and grounded. Earthing of cable trays shall be ensured by separate connection with the weld.

1.03.00 Cable Tray Installation

1.03.01 All relevant layout drawings enclosed shall be followed except shaft obvious interference occurs. In such case the coating shall be damaged as directed and approved by the owner. Twenty (20%) spare space shall be provided in cable tray.

2.00.00 Cabling

2.01.01 Adequate space will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

2.01.02 Different voltage grade cable shall be laid in separate trays when the tray are run in tier formation. Generally power cable will be on bottom trays and control cables system with non-inflammable materials.

2.01.03 Cables for redundant equipment / system shall be run in separate trays.

2.01.04 All opening in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials.
3.00.00 Grounding

3.01.00 All grounding work shall be carried out as per guidelines specified in ‘Grounding notes and details along with the typical grounding drawings enclosed with this specification.

3.02.00 Main grounding grid shall be laid 1 M below ground level. This shall be comprising of 40mm dia MS rod and earth pit. This earthing system will also be interconnected to the existing system.

3.03.00 Tapped riser of 50 x 6 mm 6.5 mtr from main grounding grid running along tray, building structural steel shall be used as ground continuity conductor.

3.04.00 Building structural steel wherever available shall be directly connected with main ground grid. In no case runner angle of cable tray, building structural steel shall be used as ground continuity conductor.

3.05.00 All equipment under this package shall be directly connected to main grounding grid/ ground continuity conductor running along cable tray.

3.06.00 The riser shall be bolt connection at equipment end. In case the rise length is not adequate, separate equipment ground conductor shall be used which will be welded to the riser at one end and bolt connector to the equipment at other end.

3.07.00 All ground conductor shall be painted black after connection to guard against weathering and easy identification.

Equipment ground connection after checked and tested by the Authority shall be coated with anti-corrosive paint/ old compound.

3.08.00 All ground connection shall be made by electric arc welding unless otherwise specified.

3.09.00 Electrical equipment shall be provided with two separate and all sealed grounding pads, each complete with tapped hole galvanizing spring washer for connection to main ground grid.

4.00.00 Tests

4.01.00 Upon completion system and equipment shall be subjected to standard tests for checking the acceptability of the system with reference to relevant IS and IE rules.

4.02.00 Six (6) copies of Routine tests Certificate shall be submitted for approval prior to the dispatch of the concerned equipment from works.
1. Grounding work shall conform to the requirements of the following latest standard, statutory provision is amended upto date:

Indian Electricity act, 1910
Indian Electricity Rules – 1956
Contract Specifications
Enclosed grounding drawings

2. The ground shall be connected with main grid available in the yard.

3. The earth pit shall be as per enclosed drawing and connected to the ground grid conductor.

4. Riser / pig tail from the ground grid conductor shall be as per typical details shown in the enclosed drawing.

5. All ground connection below the grade shall be made by Electric arc welding with low hydrogen content electrode Bonding of the conductor where necessary shall be done by gas heating.

6. The ground conductors shall be interconnected between them and top the main ground grids through risers.

7. All electrical equipments and associated non-current carrying metal works, supporting structures, building columns, fence, and system neutrals lightening mast / arrestors shall be connected to the ground grid system.

8. Two separate and distinct ground connections shall be provided for earthing of electrical equipment frame work in compliance with I.E. rules.

9. Misc. devices such as push button stations, lockout switches and cable end boxes etc. shall be grounded effectively whether specifically shown or not.

10. For ground connections, the conductor sizes shall be as listed below:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>G.I. Steel flats / wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 33 / 11 KV equipments</td>
<td>1 No. 50 x 6mm</td>
</tr>
<tr>
<td>b. Structures, cable trays etc</td>
<td>1 No. 50 x 6mm</td>
</tr>
<tr>
<td>c. LT/HT panels</td>
<td>1 No. 50 x 6 mm</td>
</tr>
</tbody>
</table>

11. Ground conductor connection above the grade shall be generally made by electric arc welding.

12. Bolted connections shall be made only for grouting equipment devices and removable structures. The contact surface shall be thoroughly cleaned before connection to ensure good electrical contact.

13. A continuous 50x6mm GI flats ground c conductor shall be installed on one bank of vertical/horizontal trays and securely attached to such tray section, forming a solidly grounded trays system.

Before installing 50x6mm GI flats ground conductor along the cable tray run the cable trays welding joints in cable to ground tray supports shall be painted as specified.

14. Where two or more trays run together in one bank either vertically/ horizontally provide a continuous conductor on the top tray only on taps to each section of to other tray at 10M interval.
15. Fence within the ground grid shall be bounded the palimony at regular interval not exceeding ten (10) meters. Fence generally separately grounded with flexible connection before type.

16. Earth pit shall be provided at connection.

17. All welding joints in ground conductor above the ground shall be coated with two coats of cold galvanizing anti-cursive paint after welding.

18. For typical detail of grounding refer drawing enclosed.

SPECIFICATION FOR LT PANEL/ SWITCHGEAR

2.01.00 CONSTRUCTION:-

2.01.01 Switchgear enclosure shall conform to the degree of protection IP4x minimum thickness of sheet metal used shall be 2 mm.

2.01.02 The switchgear shall comprise a continuous line up of single / Multi-tire cubicles. The installations of circuit breakers however shall be limited to the bottom two tires only.

2.01.03 The design shall be of fully compartmentalized execution with metal/ insulating portions. Working height shall be limited between 750 mm to 1800 mm from the floor level.

2.01.04 Each breaker shall be housed in a separate cubicle, complete with an individual front access door; each vertical section shall have a removable back cover. All doors & covers shall be gasketed.

2.01.05 Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position.

2.01.06 All switchgear, lamps & indicating instruments shall be flush mounted on the respective cubicle door whereas relays & other auxiliary devices of any may be mounted on a separate cubical.

2.02.00 BUS AND BUS TAPS

2.02.01 The main buses & connections shall be of high conductivity aluminium alloy, as per IS : 5082 sized for specification current rating with maximum temperature limited to 85 degree C ( i.e., 35 degree C rise over 50 degree C ambient). Bus bars shall be designed for a maximum current density of 0.8A/sqmm.

2.02.02 All bus connections shall have adequate contact pressure which should be ensure by means of two bolt connections with plain & spring washers locknuts. Bimetallic connections between dissimilar metals.

2.02.03 Bus connections shall be fully insulated for working voltage with adequate phase / ground clearances.

Insulating sleeves for bus bars & surrounds for joints shall be provided.

*Bus insulator shall be flame-retardant, track resistant type with high creep age surface.*

2.02.04 All buses & connections shall be supported & braced to with stand the stresses due to maximum short circuit current & also to take care of any thermal expansion.
2.02.05 Bus-bars shall be sleeved in colour coded manner for easy identification & so located that the sequence RYB shall be from left to right, top to bottom of front to rear, when viewed from the front of switchgear assembly.

2.02.06 Bolted disconnected links shall be provided from all incoming & outgoing feeders for isolation of neutral, if necessary.

2.03.00 CIRCUIT BREAKER

2.03.01 Circuit breaker shall be three poles, single throw, air breaker type with stored energy, trip free mechanism & shunt trip. The circuit breaker of the outgoing feeder shall have an in built microprocessor base release, short circuit, over current & earth fault protection release.

2.03.02 Circuit breakers shall be draw out type, having SERVICE, TEST & ISOLATED position with positive indication for each position along with in built relay unit.

2.03.03 Circuit breaker of identical rating shall be physically & electrically interchangeable.

2.03.04 Circuit breaker shall be motor wound spring charged mechanism, motor voltage should be 240 V AC. For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. Power supply for this motor shall be taken from the output of auto changeover.

2.03.05 Mechanical safety interlocking shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

2.03.06 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

2.03.07 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter & mechanism charge/discharge indicator.

2.03.08 In addition to the auxiliary contacts required for normal breaker operation & indication, each breaker shall be provided with following for interlocking purpose:-

a) Position/ cell switch with 4 NO. + 4 NC contacts. These shall be available as spare for automation work.
   Control Supply :- 230V AC for closing, Tripping & indication lamps.

b) Auxiliary switch, with 6 NO+ NC contact, mounted on the stationary portion of the switchgear & operated mechanically by a sliding level from the breaker, in SERVICE position. These shall be available as spare for automation work.

2.03.09 Limit / auxiliary switches shall be convertible type, that is, suitable for changing NO contact to NC & Vice-Versa.

2.04.00 MOULDED CASE CIRCUIT BREAKERS

2.04.01 Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall
have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of microprocessor based electronic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Electronic tripping device shall have IDMT characteristics for sustained over loads and short circuits. Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances. MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities:

- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

2.04.02 MCCB shall be triple pole air break.

2.04.03 The MCCB shall have a quick - make, quick - break mechanism operated by a suitable external rotary handle, complete with position indicator this handle shall have provision for pad locking in ON & OFF position.

2.04.04 MCCB should have microprocessor base electronic release with over current, earth fault & short circuit protection equivalent to L&T 'D' since with RC-10 release.

2.05.00 CONTROL & INDICATION :-

The circuit breaker shall be wired up wired up for both local & remote operation. A local- remote selector switch shall be provided for this purpose. Each breaking cubicle shall be equipped with following:

2.05.01. One (1) Test- neutral - service selector switch stay put type with test/ service position pistol grip handle & key interlock for breaker marked 'E'.

2.05.02. Two (2) heavy duty, oil tight push buttons for TRIP & CLOSE.

2.05.03. Three (7) LED indicating lights on front of compartment :-
- GREEN : breaker open & spring charged
- RED : Breaker close
- AMBER : Trip / circuit healthy condition
- WHITE : Control supply failure

Phase indication : One Red, One Blue & One Yellow
1 NO & 1 NC should be provided for status monitoring of the remote / local position.

2.05.04 Lamps shall be low watt, LED type lamp & lens shall be replaceable from the front.

2.05.05 The general scheme of connections for control, interlock & protection shall got approved before fabrication of panel.

2.06.00 FUSES :-

Fuses shall be HRC, preferably link type with a minimum interrupting capacity equal to the short
2.06.01 Fuses shall be furnished complete with fuse base & fittings of such as to permit easy & safe replacement of fuse element. Visible indicated indication shall be provided on blowing of the fuse.

2.07.00 CURRENT TRANSFORMER :-

2.07.01 Current transformer shall be cast- resin type. All secondary connections shall be brought out to terminal blocks where or delta connection will be made.

2.07.02 Ratings :
- for incomers and buscoupler As per rating of incomer
- For out goings :As per ratings of outgoing feeders

2.07.03 Accuracy class of the current transformers shall be :-
   a.) Class 5P10 for other relaying (protection).
   b.) Class 1.0, ISF < 5 for metering.

2.08.00 RELAYS :-

2.08.01 Relays shall be of drawout design with built in testing facilities. Small auxiliary relays may be in non drawout execution.

2.08.02 Relay shall be rated for operation on 5 Amp secondary current & 110 / 220 V secondary voltage ; number & rating of relay contacts shall suit the job requirements.

2.08.03 The contractor shall furnish, install & co-ordinate all relays to suit the requirements of protection & interlock & as broadly indicated in the annexure & drawings.

2.09.00 METERS (DIGITAL DISPLAY):-

2.09.01 Indicating instruments shall be switch board type & accuracy class of 2% .

2.09.02 All Digital Watt-hour meter shall be provided , Alternatively, they may have test block to facilitate testing of meter without disturbing C.T. or V.T. secondary connections.

2.09.03 Each breaker shall be with volt meter, amp meter with selector switches & KWH meters. Only out going feeders will be relaxed from voltmeters.

2.10.00 SECONDARY WIRING :-

2.10.01 The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, & interlocking schemes.

2.10.02 Fuses & links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches & other devices shall be wired upto terminal blocks.

2.10.03 Wiring shall be done with FRLS PVC flexible, 650V grade, PVC insulated switchboard wires with solid copper conductors of 2.5 sq.mm for voltage circuits alongwith numbered ferrules.

2.10.04 Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per contractors wiring diagrams.

2.10.05 Wire terminations shall be made with crimping type connectors with insulating sleeves. Wire shall not be spliced between terminals.
2.11.00 **TERMINAL BLOCKS**

2.11.01 Terminal blocks shall be 660V grade box clamp type with marking strips, similar to ELMEX 10 sqmm of equal. Terminals for C.T. secondary leads shall have provision for shorting.

2.11.02 Not more than two wires shall be connected to any terminals equal in number to 20% active terminals shall be furnished.

2.11.03 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

2.12.00 **CABLE TERMINATION** :-

2.12.01 Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for each of termination & connection.

2.12.02 All provision & accessories shall be furnished for termination & connection of cables, including removable gland plates, cable supports, crimp type tinned copper/ aluminium lugs, brass compression gland with tapered washer (power cable only) & terminal block.

2.12.03 Gland plate shall be minimum 4 mm thick.

2.13.00 **BUS DUCT CONNECTION** :-

2.13.01 Bus duct connections, where specified shall be furnished along with transportation of panel. Bus duct connections shall be generally from the top.

2.13.02 All connecting bus work shall have the same continuous rating as associated switchgear bus & shall be fully braced for the listed short circuit current.

2.13.03 All provision such as matching flange & other accessories shall be furnished for connection to bus duct if any, being supplied by this purpose will be furnished by contractor.

2.14.00 **GROUND BUS** :-

2.14.01 A ground bus, rated to carry maximum fault current, shall external full length of the switchgear.

2.14.02 The ground bus shall be provided with two bolt drilling with GI bolts & nuts at each to receive 50 x 6mm GI flat.

2.14.03 Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker &drawout VT unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

2.14.04 Whenever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus & connected thereto.

2.14.05 C.T. & V.T. secondary neutrals shall be earthed through removable links so removed without disturbing others.

2.15.00 **NAMEPLATES** :-

2.15.01 Nameplates of approved design shall be furnished at each cubicle & at each instrument & device mounted on or inside the cubicle.
2.15.02 The material shall be lamicoid or approved equal, 3mm thick with white letter on block background.

2.15.03 The name plate shall be held self-tapping screws. Nameplate size shall be minimum 20 x 75 mm for instrument device & 40 x 150 mm for panels.

2.15.04 Caution notice suitable metal plate shall be affixed at the back of each vertical panel.

2.16.00 **SPACE HEATERS PLUG SOCKETS :-**

2.16.01 Each vertical section shall be provided with thermostat controlled space heater & 5A, 3 pin plug socket.

2.16.02 Cubical heater, plug-socket circuit shall have individual switch fuse units.

2.17.00 **A.C. / D.C. POWER SUPPLY :-**

2.17.01 The following power supplied will be made available to the switchgear:

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C. Supply</td>
<td>Two Feeders</td>
</tr>
<tr>
<td>DC Supply for control</td>
<td>Rectifier arrangement to convert 250V AC to 24V DC</td>
</tr>
</tbody>
</table>

2.17.02 Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 2-pole, single throw for A.C. & 2-pole, double throw for D.C. Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch-fuse units shall be provided at each cubicle for AC/DC supplies.

2.17.03 AC load shall be so distributed as to present a balance loading on three-phase supply system.

2.18.00 **PAINTING :-**

2.18.01 All surface shall be sand blasted, pickled & grounded as required to produce a smooth, clean surface free of scale, grease & rust.

2.18.02 After cleaning, the surface shall be given a phosphate coating followed by 2 coats of high quality prime & stove after each coat.

2.18.03 The switchgear shall be finished in light gray (IS shade # 631) with two coats of synthetic enamel paint.

2.18.04 Sufficient quantity of touch-up paint shall be furnished for application at site.

3.00.00 **SPECIAL TOOLS & TACKLES :-**

3.00.01 A set of special tools & tackle (manual charging handle & operating handle trolley for lifting outside breaker for maintenance) which are necessary or convenient for erection, commissioning, maintenance & overhauling of the equipment shall be supplied.

3.00.02 The tools shall be shipped in separate containers (Tool Box) clearly marked with the name of the equipment for which they are intended.

4.00.0 **SPARES :-**

4.00.01 The bidder shall submit list of recommended spare parts for three (3) years satisfactory & trouble free operation indicating the itemized price of each item of the spares.

5.00.00 **DRAWINGS, DATA & MANUALS :-**

5.01.00 To be furnished for approval after award of work.
a.) General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.
b.) Details of materials with specifications.
c.) Typical foundation plan & loading.
d.) Typical breaker control schematic.
e.) Matching flanges & terminals for the bus termination.
f.) Type test reports on circuit breaker.
g.) Technical leaflet on
   i. Circuit breaker
   ii. Instrument transformers
   iii. Relays, meters, switches etc.
h.) Single line diagram
i.) Control schematics
j.) Wiring diagram

5.02.00 Instruction manuals of switchgear & individual equipment :-
The manual shall clearly indicate the installation method, checkup & tests to carried out before commissioning of the equipment.

5.03.00 The bidder may note that the drawings, data & manuals listed here in are minimum requirements only the bidder shall ensure that the other necessary write-ups, curves & information required to fully describe the equipment are submitted with his bid.

CIRCUIT BREAKER
Make - As per approved make.  
Type - Microprocessor release air circuit breaker 
Rated voltage - 415 Volts  
Rated frequency - 50 Hz  
Rated current - As per BOQ  
No. of pole - 3  
Aux. Voltage for trip/close coil - 24 V DC 
Motor for spring charging Voltage - 240 V AC 
Protection unit - Equivalent to L&T,SR-18Gi+D or ABB, PR122/P-LSIG 
with fault indication & thermal masonry. 

Interlocking arrangement electrically & mechanically with bus coupler & incomer.

PROTECTION (FOR LT SUPPLY 415V PANEL)
The minimum protection to provided for different type of circuit are listed below :-
INCOMING FEEDER :-
(i) 2 over current +E/F relay microprocessor based alongwith the element of instantaneous o/c & E/F protection.
SPECIFICATION FOR LT BUS DUCT

1.00.00 Design Criteria

1.01.00 The LT non phase segregated bus duct serve as a interconnection between the LT switchgear and outdoor LT transformer.

1.02.00 The LT bus ducts will be installed partially indoor and partially outdoor in a hot, humid and tropical atmosphere. All panels associated.

1.03.00 Bus duct associated equipment and wiring shall be provided with tropical finish to prevent fungus growth. All ventilation openings shall be screened and drains shall be filtered to prevent entrance of dust and insects.

1.04.00 For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the site permissible values stipulated in relevant standards and / or this specification.

1.05.00 Bus duct and auxiliary equipment shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit currents listed in the annexure without any damage or deterioration of material.

1.06.00 The bus ducts shall be self cooled and shall not be equipped with blower or any other type of forced ventilation.

1.07.00 Bus duct enclosure shall be of sheet steel.

2.00.00 Specific Requirements.

2.01.00 General

2.00.01 The LT bus duct shall be non phase segregated enclosure type.

2.00.02 The layout of the bus ducts shall be generally in accordance with enclosed drawings. The details shown however are only typical. Bidder may propose changes to suit his particular design.

2.00.03 All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

2.02.00 Enclosure

2.02.01 Phase shall be enclosed in weather proof, dust-tight, enclosure of sheet steel fabricated type conforming to degree of protection of IP 65.

2.02.02 Circumferential neoprene rubber gaskets shall be provided for dust tight joints with adjacent enclosure section.

2.02.03 The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/ construction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stress in the supporting structures.

2.02.04 All outdoor bus enclosures shall be so designed & constructed as to prevent accumulation of rain water on top sheet. Similarly all gasketed flanged joints shall be suitably protected against direct splashing of rain water in case of outdoor runs.
2.02.05 Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switchgear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.

2.02.06 Seal-off bushings complete with wall frame and support plates shall be provided where the bus duct penetrates the building wall. The seal is to prevent free exchange of air between indoor and outdoor portions of the bus duct.

2.02.07 Silica-gel breather shall be provided on both indoor and outdoor portions of the bus duct.

2.02.08 Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.

2.02.09 Shipping length of the bus duct shall be not more than three (3) meters in length.

2.03.00 Bus Conductor

2.03.01 The bus conductor shall be of high conductivity, aluminium alloy, supported on wet process porcelain insulators.

2.03.02 The bus conductor shall be designed for bolted connections throughout the run.

2.03.03 Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connections shall also be provide at all equipment terminations.

2.03.04 All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non-magnetic and shall have high corrosion resistance.

2.04.00 Disconnect Link

2.04.01 Removable bolted disconnect link shall be provided in the bus where shown on the drawing for the purpose of isolation.

2.04.02 Disconnect link shall consist of a removable section of conductor and shall be so constructed as to permit easy removal or reinsertion without alignment difficulties.

2.04.03 The bus on both sides of the link shall be rigidly supported so that the disconnect link is equal in mechanical strength to any other section of the bus.

A minimum clearance of 300mm (12”) shall be provided between the disconnected bus sections with the link removed.

2.05.00 Insulators

2.05.01 Bus support insulators shall be interchangeable, high creep, high strength, wet process, fine glazed porcelain. Alternatively good quality cast resin insulators.

2.05.02 Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit.

2.05.03 The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.

2.05.04 Space heater shall be provided preferably located near to each insulator to avoid moisture condensation within bus-duct. No and wattage rating of space heater shall be decided by the tenderer.
2.06.00 Connections & Terminations

2.06.01 All matching flanges, seal off bushings, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers shall be furnished.

2.06.02 In this connection the contractor is required to coordinate through the engineer with the suppliers of the switchgear, transformers with regard to connection details, mechanical and thermal stresses.

2.06.03 Flexible connections both for conductor and enclosure shall be furnished.

   a) At all equipment termination to provide for misalignment upto 25mm (1”) in all directions.
   b) Between bus duct supported from building steel to prevent transmission of vibration.

2.06.04 The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.

2.06.05 If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

2.07.00 Grounding

2.07.01 A separately run 50x6mm GI flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure supporting structures and equipment frames shall be bonded to above ground bus.

2.07.02 Ground pad shall be bolted type to accommodate 50x6mm galvanized steel flats. Complete with suitable tapped holes, bolts and washers.

2.08.00 Supporting Structures

2.08.01 All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plate, beams, hangers, brackets, bracings and hardware.

2.08.02 All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.

2.08.03 Supports shall be designed to provide tolerance of ± 12mm (1/2”) in the horizontal and vertical directions.

2.08.04 All steel members shall be hot dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.

2.08.05 Concrete foundation, building steel, concrete, inserts/plates will be provided by the owner.

   The contractor shall co-ordinate with the owner for this purpose giving well in advance the details of his requirements so as to enable the owner to arrange for the same in time.

2.09.00 Wiring

2.09.01 All wiring for space heaters shall be done with insulated stranded copper conductor of not less than 2.5 sqmm cross section. Each wire shall be identified at both ends with wire designation as per contractor’s wiring diagram and shall be brought out to a terminal box outside the bus duct.

2.09.02 Terminal blocks shall be box-clamp type Elemex 10 sqmm with marking strips or approved equal.
2.09.03  At least 20% spare terminals shall be furnished in the terminal block.

2.10.00  Name Plate

2.10.01  Suitable name plate shall be furnished with each piece of equipment.

2.10.02  Materials for name plate shall be plastic/lamicoid, 3mm thick, using white letters on black background.

2.11.00  Finish

2.11.01  Except for supporting steel structures which shall be galvanized, all equipment shall be finished with a undercoat of high quality primer followed by two coats of synthetic enamel paints.

2.11.02  The interior surface finish shall be as per manufacturer’s standard. The shade of exterior surface finish will be battle ship gray shade 632 as per IS-5.

2.11.03  Pretreatment consisting of degreasing, derusting etc. shall be done on all fabricated parts before painting or galvanizing.

2.11.04  Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkle or get removed by abrasion due to normal handling.

2.11.05  Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.
SPECIFICATION FOR POWER AND CONTROL CABLES

1.00.00 DESIGN CRITERIA

1.01.00 The cable will be used for connection of power and control circuits of the owner’s electrical system.

1.02.00 Cable will be either laid on ladder type trays or directly buried in ground.

1.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.

1.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be enough to withstand mechanical stresses during handling.

1.05.00 Armoring shall be single round wire of galvanized steel for multicore cables and aluminium for single core cable.

1.06.00 Core identification for multicore cable shall be provided by colour coding.

2.01.00 SPECIFIC REQUIREMENTS

2.02.00 L.V. Power cables

1100 Volt grade, heavy duty armoured power cables with stranded aluminium conductors, XLPE insulation and extruded PVC overall sheath.

2.03.00 Control Cables

1100 Volt grade, 70°C rating, control cables with standard copper conductor, PVC insulation, round wire armour and extruded PVC overall sheath.

2.03.00 Drum Length & Tolerance.

Each size of the control cable shall be supplied in one length.

2.05.00 Cable Identification

Cable identification shall be provided by embossing on the outer sheath the following:

a. Manufacture’s name or trade mark
b. Voltage grade
c. Year of manufacture
d. Type of insulation e.g. PVC etc.

3.00.00 Joints and Termination

Material of construction for joints / termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concept shall incorporate a high degree of operating compatibility between the cable and the joints. The protective outer covering (jacket) used on the joints / terminations shall have the same qualities as that of the cable oversheath in terms of ambient / operating temperature and fire retardant properties withstand capability and resistance of hazardous environment and corrosive elements.

4.00.00 TESTS

4.01.00 Shop tests

The cables shall be subject to shop tests in accordance relevant standards to prove the design and general qualities of the cables as below:

4.01.01 Routine tests on each drum of cables
4.01.02 Acceptance tests on each drum s chosen at random for acceptance of the lot.

4.01.03 Type tests on each type of cable, inclusive of measurement of armour D.C resistance of power cables.

4.02.00 Test witness

Tests shall be performed in presence of engineer-in-charge if so desired by the Institute. The contractor shall give at least thirty (30) days advance notice of the date when the tests are to be carried out.

4.03.00 Test Certificates

4.03.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the owner

4.03.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable to facilities review.

4.03.03 The cable shall be dispatched from works only after receipt of owner’s written approval of the test reports.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools and tackles which are necessary or convenient for splicing, jointing and termination of different types of cables.

5.02.00 These special tools and tackles shall includes but not limited to:-
   a. Splice-cum-insulation remover for control cable 1 No
   b. Hand operated compression tools with a set of dies for different cable sizes 1 No
   c. Hydraulically operated compression tools with a set of dies for different cable sizes 1 No

5.03.00 The tools shall be shipped in separate containers, clearly marked with the service for which they are intended.

6.00.00 SPARES

The bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble free operation, indicating the itemized price of each item of the spare.

7.00.00 DRAWING, DATA & MANUALS

7.01.00 Drawing data manuals shall be submitted and in quantities and procedures as specified in general conditions of contract and / or else where in this specification on approval & subsequent distribution after the issue of letter of intent.

7.02.00 To be submitted with the bid:
   a. Manufacturer’s catalogues giving cable construction details and characteristics.
   b. Cable current rating for different type of installation inclusive of operating factors for ambient temperature, grouping etc.
   c. Write-up on manufacturer’s recommended method of splicing, jointing, termination etc. of the cables.
   d. Type test report on H.V power cable.
7.03.00 To be furnished for Approval and distribution:

a. Confirmed cable data.
b. Shop test reports.
SPECIFICATION FOR ELECTRICAL ERECTION

1.00.00 GENERAL

1.01.00 The tenderer shall furnish & install all materials & equipment which are obviously a part of the completed installation but have not been specifically mentioned in this specification without any additional charge to the Authority.

1.02.00 All ladders, platforms, scaffolding, temporary supports, any other facility required for erection at site shall also be provided.

1.03.00 The tenderer shall at all times work in close coordination with Engineer-in-charge supervisory personnel & afford them every facility to become familiar with the erection & maintenance of the equipment.

1.04.00 The tenderer shall arrange his schedule of work & method of operation to minimize inconvenience to other contractors at the project site. In case of any difference between contractors. The decision of the Owner shall be final & binding on all parties concerned.

1.05.00 In case of any hold up due to fault of other contractors or for any other reason, the tenderer shall bring it to the notice of the engineering-in-charge in writing without any delay. Otherwise any delay in completion of his work will be accounted for.

1.06.00 In case of any contradiction/ confusion with any other section/ sub-section of this specification, the same shall be referred to the Engineer-in-charge in this respect shall be final & binding.

2.00.00 REGULATIONS

The complete installation shall meet the requirements of the latest edition of the relevant Indian Standard & I.E. Rules.

3.00.00 DRAWINGS

The tenderer shall inform himself fully with the relevant Electrical layout single line diagram & schematic drawings enclosed with the package specification.

The tenderer shall furnish all erection drawings, catalogue data sheets, etc as required to cover specific information for all items.

4.00.00 TRANSPORATION

The contractor shall be responsible for the transportation to the site of all equipment, materials & supplies to be provided by him according to terms of the contract. The contractor shall be responsible for arranging transportation as advised by Owner depending on requirement & to meet the completion schedule. In the event of the schedule requiring change in the mode of transportation the same shall be arranged by the contractor without any extra cost.

5.00.00 UNLOADING

The contractor shall arrange to unload equipment received at site & also arrange to transport the material from the unloading point to site.

The contractor shall make all necessary arrangement for tools & tackles, men & machinery for unloading of equipment at site & its transportation to site or storage. It is clearly understood that demurrage, whereas & other expenses incurred by the contractor due to delayed clearance of the material or for any other reason,
shall be to the contractor's account.

6.00.00 STORAGE AT SITE
The contractor shall provide coverage of the equipment & material, security arrangement & all other facilities required for proper & safe storage till completion of the work.

7.00.00 PROTECTION OF WORK
7.01.00 The contractor shall effectively protect his work at his own expense, equipment & material under his custody from theft, damage or tampering.

7.02.00 Finished work where required shall be suitably covered to keep it clean & free from defacement or injury.

7.03.00 For protection of his work contractor shall provide fencing & lighting arrangement connect up space heaters & provide heating arrangement as necessary or directed by Engineer-in-charge.

7.04.00 Contractor shall be responsible for any loss or damage to equipment & material until his work is fully & finally accepted.

8.00.00 OPENING OF CASE, CHECKING AND CLEANING OF PART

8.01.00 All packing cases or package shall be opened in presence of Owner's reprehensive.

8.02.00 All equipment, accessories & materials i.e. Switchgear, transformer, bus duct, power & control cables etc after receipt at site shall be jointly inspected & checked with packing list & identified with erection drawings.

8.03.00 All claims against loss or damage in transit shall be lodged by the contractor under intimation to Owner. The contractor shall be responsible for processing and settlement of claim including furnishing any information that may be required in this connection.

8.04.00 The contractor shall ensure that insurance formalities are observed & any loss of claim due to the fault of the contractor shall be to the contractor's account.

8.05.00 All parts shall be thoroughly cleaned all rust removed & surface polished as required.

8.06.00 Cleaned & polished parts shall be coated with anti-corrosive paints where necessary & stored with care, ready for erection.

9.00.00 TESTING EQUIPMENT
The major testing equipment that are required to be arranged by the contractor are listed below:

a.) Insulation Tests:
i) Power operated Meggar - 1 kV & 2.5 kV grade
ii) Hand operated Meggar - 500 Volt/ 1100 Volt grade
b.) Hand driven earth Resistance Meggar, range 0-1/3/30 Ohms.
c.) High potential testing set- roller mounted type
d.) Tong testers of suitable ranges
e.) Contact resistance measuring set for micro-ohms
f.) Torque wrench of various sizes.
g.) Multimeters, test lamp, field telephone with buzzer set, different gauges etc.

10.00.00 PAINTING
After completion of the erection, all equipment & materials supplied under this specification shall be given necessary protective painting. The colour of the final coat shall be approved by the Owner.

11.00.00 ERECTION
11.01.00 Method & materials
11.01.01 All work shall be installed in a first class, neat & workman like manner by mechanics skilled in the trade involve. All details on the installation shall be mechanically & electrically correct.
11.01.02 All materials shall be brand new & of best available quality without having imperfections & blemishes. Where two or more units of the same manufacture.

11.01.03 All conduits & equipment shall be installed in such a manner as to preserve access to any other equipment installed.

12.00.00 DETAILED REQUIREMENT OF INSTALLATION:

12.01.01 All alignment, leveling, grouting, base channel fixing & anchoring adjustments shall be carried out in accordance with manufacturer's instructions and install necessary floor steel for supporting the panels.

12.01.02 All connections, in switchgear shall be completed, checked and adjusted to ensure safety & satisfactory operation of the equipment.

12.01.03 In some cases minor modifications may have to be carried out at site in the wiring & mounting of the equipment to meet the requirement of desired control scheme & the contractor shall have to do the same at no extra cost.

12.02.00 Transformer

12.02.01 The contractor shall place the transformer on its foundation, assemble parts, fabricate & erect & supporting structure for detachable type cable chamber.

12.02.02 H.V. test of transformer oil shall be carried out taking a sample from individual transformer. If the result is not in satisfaction of the purchaser, oil conditioning of that particular transformer shall have to be carried out.

12.03.00 L.T. Bus duct shall be erected duly supported on the soffit on the building by structural member supplied along with the bus duct. The bus duct will pass through separate wall between transformer & switchgear & will reset on two flanges one each at the switchgear & The transformer end. The grounding of the bus duct shall be carried as per the relevant stranded. The flanges supplied along with the bus duct shall be erected & terminals end equipment namely transformer & switchgear will be connected to the bus duct. The bus duct shall be erected in straight, vertical or horizontal formation as per the site requirement. The test like mili volt drop on the contacts, insulation resistance value & proper tightness shall be ensured by the contractor.

12.03.01 For draining out of oil a oil soak pit for transformer is to be erected of the suitable capacity.

12.04.00 Miscellaneous items:

12.04.01 The tenderer shall install miscellaneous minor items to complete the installation of equipment.

12.04.02 These equipment will be generally floor or wall mounted. The exact location will be as decided by the Owner at site or as shown in Final drawings.

12.04.03 All support & bracket needed for installation shall be fabricated & painted by the tenderer.

12.04.04 All welding, cutting, chipping & grouting as & when necessary shall be carried out by the contractor.

12.05.00 Handling of cable drum and cable

12.05.01 Rolling of drum shall be avoided as far practicable. For short distance, the drums may be rolled they are rolled slowly and in proper direction as marked on the drum. In absence of any identification, the drums may be rolled in the same direction as it was rolled during taking up the cable.
12.05.02 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly, so that cable should come out over the drum & not below the drum.

12.05.03 While laying cable, cable shall be used at an interval of 2 meters. The cable shall be pushed over the roller by a gang of people positioned in between rollers. The cable shall not be pulled from the end without laying intermediate pushing arrangement. Bending radius shall not be less than what is specified by manufacturer.

12.06.00 Cable laying:
Cables shall generally be installed in cable trays except for some short runs in buried formation or in conduit / pipe for protection or crossing. Multi core power cables laid on trays & riser shall be neatly dressed & clamped with fabricated 25 x 3 mm G.S. flat or cable tray at an interval of maximum 1 meter for vertical / inclined run & 1.50 meter for horizontal run. Control cables may be laid in single layer with touching formation. Power & control cables shall be claimed in separate group. Power & control cables shall not be laid in a common tray excepting in very special case where a gap of 150 mm shall be maintained between power & control cables.

12.06.01 H.T. & L.T. power cables shall be laid in cable tray in single layer & with spacing equal to the diameter of cable.

12.06.02 Control cables can be laid upto a maximum of three layers in each tray.

12.06.03 Both power & control cables shall be clamped to the tray rungs by means of clamp made up of 25 x 3 mm fabricated G.S. flat at an interval of 1500 mm for horizontal run & 1000 mm for vertical / inclined cable run.

12.06.04 The cable trays shall be run with a vertical spacing of 300 mm cable trenches. A minimum of 300 mm clearance shall be provided between the top of tray & beams, cold piping. 500 mm clearance for hot piping/ object to facilitate installation of cables in tray.

12.06.05 Adequate pull boxes shall be provided in conduit run to facilitate. Cable pulling in long runs & also to ensure that there will be no more than 270 degree bend between the pull points.

12.06.06 Cable tray shall be installed to accommodate cable manufacturer's recommended maximum pulling tension & minimum bending radius.

12.06.07 All openings in the floor & wall for cable access shall be sealed after installation of the cable system with non-inflammable materials.

12.06.08 All floor / wall openings for cable entry to the electrical equipment & accessories shall be sealed with non-inflammable material, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor / wall.

12.07.00 Cables-power & control:
12.07.01 The tenderer shall install & connect all power & control cable required for complete installation within his scope of work. Type & size of power & control cable shall be as specified & as supplied under a separate sub section for power & control cable.

12.07.02 In general all power & control cable shall be run in cable trays in cable trenches. Isolated runs of control cables shall be run in rigid conduit.

12.07.03 Jointing of power cable should be avoided as far as possible. However, if any splicing of control cable is required to carry out interlock it will be done in junction boxes not in the conduit or in the trays. Such junction boxes shall be in the scope of tenderer.

12.07.04 The contractor shall not install cables with different voltage grade in the same cable tray.

12.07.05 During cable installation care shall be taken so that the actual bending radius of each cable is not
less than the one recommended by the cable manufacturer.

12.07.06 For cables buried directly underground there shall be a stone free sand cushion both above & below the cable run being held by brick wall supports on two (2) sides. The excavated portion above the top sand cushion shall be covered by concrete precast slab supported on the side walls & finally filled up with standard back fill.

12.07.07 Cables shall be pulled into the trenches in strict accordance with the cable manufacturer’s instruction.

12.07.08 Tenderer shall furnish & install suitable solderless crimping type cable lugs at the termination of all wires & cables if not already furnished with the equipment.

12.07.09 All exposed conduits & armoured cables shall be tagged with the numbers that appear in the conduit & cable schedules as prepared by the tenderer. All conduits & armoured cables shall be tagged at their entrance and/or exist from any piece of apparatus, junction box or pull box. Aluminium tags shall be used with the number engraved/punched on the tag. Tag shall be suitable secured to the conduit or armoured cable.

The cable tags shall also be provided at all bends and at interval of 30 M on straight run of cable in order to facilitate the identification.

12.07.00 Laying termination & connection of all control cables for interlock, protection, indication & annunciation.

The tenderer shall prepare cable schedule & interconnection diagram & submit the same for approval of the Authority. Cable laying shall be started with the approval cable schedule & interconnection diagrams. Separate cables for each type of following services/functions as applicable shall be used & laid along the run for each feeder.

a.) Power - designate as ‘P’

b.) Control protection interlock, metering, indication & annunciation designate as ‘C’.

13.00.00 FIELD TESTING :

13.01.00 Field Testing shall be required for all the equipment & accessories furnished, installed or connected by the tenderer to ensure proper installation, setting, connection & in accordance with the plans, specifications & manufacturer's recommendations. Testing shall be conducted in presence of Owner’s engineers with prior notice at least 2 weeks before commencement of any test.

13.02.00 Field testing work shall be done as per the latest edition of the relevant standards. All tests recommended by the equipment manufacturer shall be conducted. The tenderer shall submit the list of all field tests to be conducted for all equipment & accessories for review/approval by the Owner.

13.03.00 Testing shall include any additional tests suggested by the Owner that he deems necessary because of field conditions to determine that equipment, materials & system meet requirements of the specification.

13.04.00 The tenderer shall depute qualified personal to conduct all testing & shall provide all labour & testing equipment required for & incidental to testing.

13.05.00 The tenderer shall be responsible for any damage to equipment & material due to improper test procedure or test apparatus & shall replace or restore to original condition of any damaged equipment or material.

13.06.00 The tenderer shall maintain in quadruplicate a written record of all tests showing date, personal making the tests, equipment or material tested, test performed & result. Two copies of test records shall be given to the Authority.

14.00.00 COMMISSIONING :

After the satisfactory test are performed the equipment & material shall be put on trial operation by the tenderer. After successful trial operation, the equipment shall be put on performance tests. Initially at no load condition & finally with different loading conditions.

SPECIFICATION FOR THE ELECTRICAL INSTALLATION WORK
The following specifications will apply under all circumstances to the equipment to be installed against this contract and it is to be ensured that the contractor shall obtain for himself at his own expense and on his own responsibility all the information which may be necessary for purpose of making the tender and for entering into a contract keeping in view the specification and inspection of site etc.

The tendered rates shall include for the cost of material erection, connection, commissioning, labour, supervision, tools, transport all taxes, contingencies, breakage, wastage, sundries, scaffolding, maintenance of installations for defect liability period i.e. they should be for an item complete in all respects.

The general specifications of electrical works for internal-2005 and general specifications for Sub-station works-2007 of CPWD shall be followed.

1. SITE CONDITIONS:
   The equipment to be erected and commissioned should be suitable for the site conditions, it is estimated that the maximum temperature as site will be 50°C.

2. L.S.SPECIFICATIONS:
The following Indians standard specifications will apply to the equipment and the contract unless specified otherwise.

   a) Transformer IS 2026-1977 & 1981
   b) Low tension air-circuit breakers and MCCB IS 2516-1965
   c) Switch fuse unit on cubicle switch boards etc. IS 4047-1967
   d) Switch fuse unit on industrial boards etc IS 4064-1967
   e) Switch gear bus bars IS 375-1963
   f) HRC fuse links IS 2208-1962
   g) Distribution fuse boards IS 2675-1966
   h) Degree of protection provided by enclosure
      For low voltage switchgear IS 2147-1962
   i) PVC cables. IS 1954-1962
   j) 11,000 volt paper insulated lead sheathed cables IS 692-1965
   k) Tubular fluorescent lamps for general lighting
      Service. IS 2418-1965
   l) Tungsten filament lamps for general service. IS 418-1963
   m) Ceiling fans IS 374-1966
   n) Flood light IS 1947-1961
   o) Well glass flame proof electric light fitting IS 2206-1962 Part-I
   p) XLPE cables IS 7098-Part-II
   q) Industrial light fittings with metal reflectors. IS 1971-1961
   r) Water tight electric light fittings IS 3533-1966
   s) Fittings for rigid steel conduits IS 2667-1964
   t) Rigid steel conduits for electrical wiring IS 1958-1964
   u) Accessories for rigid steel conduit for electrical wiring.
      IS 3873-1966
   v) Switch socket outlets. IS 4615-1963
   w) Three pin pug and socket outlets’ IS 1233-1967
   x) Switches for domestic and similar purpose IS 3858-1966
   y) AC electricity meters IS 722-1977/1980+86
## CODE FOR PRACTICE

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<tr>
<td>Lighting protection</td>
<td>IS 2309-1969</td>
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COMMERCIAL AND ADDITIONAL CONDITIONS

1. General

1.1 The work shall be executed as per CPWD General Specifications for Electrical Works (Part-III Lifts & Escalators – 2003), NBC 2016, as per relevant IS and as per directions of Engineer-in-Charge. These additional specifications are to be read in conjunction with above and in case of variations, specifications given in this additional conditions shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions as the same are to be read alongwith schedule of quantities for the work.

2. Completeness of tender:

All sundry equipment, fittings, unit assemblies, hardware items, foundation bolts, termination lugs for electrical connections, and all other items which are useful and necessary for efficient assembly and installation of equipment and components of the work shall be deemed to have been included in the tender irrespectively of the fact whether such items are specifically mentioned in the tender documents or not.

3. For item/ equipment requiring initial inspection at manufacturer’s works’ the contractor will intimate the date of testing of equipments at the manufacturer’s works before dispatch. The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make the arrangement for the same. The successful tenderer shall give sufficient advance notice regarding the dates proposed for such tests/inspection to the department’s representative(s) to facilities his presence during testing/fabrication. The Engineer-in-charge at his discretion may witness such testing/fabrication. The cost of the Engineers visit to the factory will be borne by the Department. Also equipment may be inspected at the Manufacturer’s premises, before dispatch to the site by the contractor.

4. Care of Building:

Care shall be taken by the contractor while handling and installing the various equipments and components of the work to avoid damage to the building. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove at his cost all unwanted and waste materials arising out of the installation from the site of work.

5. Completion Period:

The completion period indicated in the tender documents is for the entire work of planning, designing, supplying, installation, testing, commissioning and handing over of the entire system to the satisfaction of the Engineer-in-Charge.

6. Warranty:

Guarantee

All equipments shall be guaranteed for a period of 36 months from the date of taking over the installation by the department against unsatisfactory performance and/ or break down due to defective design, workmanship of material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of Engineer-in-Charge in this regard shall be final.

7. Storage and Water Supply:

Storage :- Responsibility for storage space for execution of work shall be of main contractor.

8. Power & Water Supply:

Responsibility for supply of power & water for execution of work shall be of main contractor.

9. Data Manual and Drawings to be furnished by the tenderers:

(i) The successful tenderer would be required to submit the following drawings within a month of award of work for approval before commencement of installation.

(a) All general arrangement drawings.

(b) Details of foundations for the equipment, load data, location etc. of various assembled equipment as may be needed generally by other agencies for purpose of their work. The data will include breaking load on guides, reaction of buffers on lift pits reaction on support points in machine room, lift well etc.

(c) Complete lay out dimensions for every unit/group of units with dimensions required for erection purposes.

(d) Any other drawing/information not specifically mentioned above but deemed to be necessary for the job by the contractor.
13. The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance i/c preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue and workshop procedure for repairs, assembly and adjustment etc. all in triplicate.

14. Extent of work

14.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract.

14.2 Minor building works necessary for installation of equipment, foundation, making of opening in walls or in floors and restoring to their original condition, finish and necessary grouting etc. as required.

14.3 Maintenance (Routine & preventive) for one year from date of completion and handing over.

14.4 The work is turn key project. Any item required for completion of the project but left in-advertantly shall be executed with- in the quoted rates.

15. Inspection and testing:

15.1 Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in-charge and consignee.

15.2 After completion of the work in all respect the contractor shall offer the installation for testing and operation.

16. Compliance with Regulations and Indian Standards

16.1 All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specifications. In particular, the equipment and installation will comply with the following:
   (i) Factories Act.
   (ii) Indian Electricity Rules
   (iii) I.S.& BS Standards as applicable
   (iv) Workmen’s compensation Act.
   (v) Statutory norms prescribed by local bodies like CEA etc.

16.2 Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

16.3 Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs. 50/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recove the cost thereof from him.

17. Indemnity

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the department shall not be responsible for any accident or damage incurred or claims arising there from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer due to the above.

18. Erection Tools

No tools and tackles either for unloading or for shifting the equipments for erection purposes would be made available by the department. The successful tenderer shall make his own arrangement for all these facilities.

19. Cooperation with other agencies

The successful tenderer shall co-ordinate with other contractors and agencies engaged in the construction of
building, if any, and exchange freely all technical information so as to make the execution of this works contract smooth. No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the work has to be dismantled and re-done for want of cooperation and coordination by the successful tenderer during the course of work, such expenditure incurred will be recovered from the successful tenderer if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by the successful tenderer himself.

20- Insurance and Storage
All consignments are to be duly insured upto the destination from warehouse at the cost of the supplier. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

21- Painting
This shall include cost of painting of entire exposed iron work complete in the installation. All equipments works shall be painted at the works before despatch to the site.

22- Training
The scope of works includes on job technical training of two persons at site. Nothing extra shall be payable on this account.

23- Maintenance
23.1 Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of one year from the handing over of the installation.
23.2 The maintenance, routine as well as preventive for one year from the date of taking over the installation as per manufacturers recommendation shall be carried out and record of the same shall have to be maintained.

24- Interpreting Specifications
In interpreting the specifications, the following order of decreasing importance shall be followed in case of contradictions:
(a) Schedule of quantities.
(b) Technical specifications
(c) Drawing (if any)
(d) General specifications
(e) Relevant IS or other international code in case IS code is not available.

25- The of procurement, genuine material of specialized works shall rest with the contractor. material in required quantity to be used in the work shall be got approved from the Engineer-in-charge before its use at site. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications.

26- Contractor shall preserve the copies of invoices, test certificates, gate passes etc. to prove the genuineness of material/purchases. The responsibility

27- No inspection outside the country is permissible if required so the same will be deemed to be waived off and necessary test reports shall be submitted before the dispatch of equipment.

Lift work item details and specification for items to be used in addition to CPWD Specifications
1. Supplying, installation, testing and commissioning of MR Gearless Lift having contract speed & serving different floors in the lift shaft as per detailed specifications enclosed and as under:-

i) Controller: A.C. variable voltage and variable frequency.
ii) Operation: Microprocessor based Simplex selective control with/without attendant.
iii) Power: 415 V ± 10%, 3 phase, 50 Hz, 4 wire system.
iv) Auxiliary power Supply: 230 V ± 10%, 50 Hz single phase supply.
v) Type of doors
   (a) Car: Power operated automatic horizontal sliding center opening SS hairline finish with Multi-beam infrared / ultrasonic door detector.
   (b) Landing doors: SS hairline finish in all floors.
vi) Voice announcement system with music in the car to announce the position of the elevator as the car stops at a floor served by the elevator.

vii) Automatic rescue device complete with dry maintenance free batteries as required.

viii) Control panel in the car and hall button panel at each landing.

ix) Braille buttons inside the car and at all landings.

x) A handrail at a height of 900 mm above floor level to be fixed as per specifications.

a) 13 Passenger
   Suitable for minimum 13 persons (884 Kgs) having contract speed of 1.0 MPS Floors to be Served: G + 5 (6 Floors) Hoistway size: As per specifications attached.
   Number of stops and openings: 6 Nos.
   Travel: 22 metres approximately

b) 2000 Kg Freight Elevator Suitable for minimum 2000 Kg having contract speed of 0.5 MPS Floors to be Served: G + 5 (6 Floors) Hoistway size: As per specifications attached.
   Number of stops and openings: 6 Nos.
   Travel: 14 metres approximately

2. Comprehensive maintenance of all (03 Nos.) installed lifts which include routine, preventive and break down maintenance for period of four years including repair/replacement of worn out items with minimum down time and warranty & guarantee or repaired/replaced items after completion of one year guarantee period (The AMC shall include lift car lights, cabin/cross flow fan, intercom system and ARD system with steel rope batteries etc) for Four Years after completion of Defect Liability Period.
### 13 Passenger Lift Additional Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Lift</strong></td>
<td>PASSENGER</td>
</tr>
<tr>
<td><strong>Load / Speed</strong></td>
<td>13 Persons (884Kgs.) / 1.0 Mtr. Per Second</td>
</tr>
<tr>
<td><strong>Drive</strong></td>
<td>MICRO PROCESSOR BASED VVVF</td>
</tr>
<tr>
<td><strong>Travel / PIT / HEADROOM</strong></td>
<td>28 METER/ PIT 1800mm/ HEADROOM 4800 mm</td>
</tr>
<tr>
<td><strong>Number of Floors</strong></td>
<td>(G+5) 6 floors</td>
</tr>
<tr>
<td><strong>Floor Display Char</strong></td>
<td>0,1,2,3,4,5</td>
</tr>
<tr>
<td><strong>Number of Landing Entrances</strong></td>
<td>6 (G+5)</td>
</tr>
<tr>
<td><strong>Number and Position of Car Entrances</strong></td>
<td>1 (ONE), IN FRONT ONLY</td>
</tr>
<tr>
<td><strong>Position of Machinery</strong></td>
<td>Directly Above the Lift Well- Gearless</td>
</tr>
<tr>
<td><strong>Size of Lift Well</strong></td>
<td>2500 X 1900 X (MM Wide * MM Depth * MM Height * MM E-Value)</td>
</tr>
<tr>
<td><strong>Lift Car Inside Size</strong></td>
<td>2000 X 1100 X 2200 (MM Wide * MM Depth * MM Height * MM C-Value)</td>
</tr>
<tr>
<td><strong>Clear opening of Gates / Doors / Lintel</strong></td>
<td>900 X 2000 (MM Wide * MM Height) Lintel - 2200 mm</td>
</tr>
<tr>
<td><strong>Type or Design of Lift Car</strong></td>
<td>STAINLESS STEEL (1.5 mm) - HAIRLINE FINISH -</td>
</tr>
<tr>
<td><strong>Additional Specification</strong></td>
<td>As per CPWD specification and relevant IS code</td>
</tr>
<tr>
<td><strong>Car Ceiling - Car Floor</strong></td>
<td>SLEEK (SMALL CIRCULAR LIGHTS) - SS HAIRLINE FINISH – PVC</td>
</tr>
<tr>
<td><strong>Car Fittings</strong></td>
<td>LED LIGHTS &amp; CROSS FLOW - FAN</td>
</tr>
<tr>
<td><strong>Type of Car Front Entrance Protection</strong></td>
<td>POWER OPERATED CENTRE OPENING SLIDING DOOR - STAINLESS STEEL</td>
</tr>
<tr>
<td></td>
<td>(1.5 mm) - HAIRLINE FINISH</td>
</tr>
<tr>
<td><strong>Land Entrance Protection (0,1,2,3,4,5)</strong></td>
<td>SIDE/ CENTRE OPENING SLIDING DOOR - STAINLESS STEEL (1.5 mm) – HAIRLINE FINISH</td>
</tr>
<tr>
<td><strong>Landing Door Frame (0,1,2,3,4,5)</strong></td>
<td>STAINLESS STEEL (1.5 mm) - HAIRLINE FINISH</td>
</tr>
<tr>
<td><strong>Type of Control System</strong></td>
<td>MICROPROCESSOR BASED SIMPLEX SELECTIVE COLLECTIVE CONTROL WITH / WITHOUT ATTEND</td>
</tr>
<tr>
<td><strong>Electric Supply</strong></td>
<td>AC 3 PHASE, 50 CYCLES, 415 VOLTS +10%</td>
</tr>
<tr>
<td><strong>Brail button</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Automatic rescue device</strong></td>
<td>Yes</td>
</tr>
</tbody>
</table>
2000 KG FRIGHT LIFT ADDITIONAL SPECIFICATIONS

LOAD & SPEED
ABOUT 2000 KGS @ 0.5 METRES PER SECOND

TRAVEL
Ground+ 5 ABOUT 14 Meter

STOPS & OPENINGS
6 STOPS WITH (All Opening on Same Site)

POWER SUPPLY
400 VOLTS, 3 PHASE, 50 CYCLES, ALTERNATING CURRENT

CONTROL
A C VARIABLE VOLTAGE VARIABLE FREQUENCY

OPERATION
SIMPLEX FULL COLLECTIVE (WITH/ WITHOUT ATTENDANT)

MACHINE
GEARED PLACED DIRECTLY ABOVE THE HOISTWAY

CAR SIZE
ABOUT 1700MM WIDE X 2500MM DEEP - INSIDE DIMENSIONS

HOISTWAY REQUIRED
ABOUT 2620MM WIDE X 3050MM DEEP-FINISHED DIMENSIONS

PIT DEPTH
1600 MM

OVER-HEAD
4800 MM

CAR ENCLOSURE
SS HAIRELINE FINISH

CAR PANELS
SS HAIRELINE FINISH
FALSE CEILING
SS HAIRELINE FINISH
FLOORING
20 MM Recess will be provided, Flooring by Client
CAR ENTRANCE
CLEAR OPENING ABOUT 1200 MM WIDTH X 2000 MM HEIGHT in SS HAIRELINE FINISH
HOISTWAY ENTRANCE
PROTECTED BY POWER OPERATED CLEAR OPENING ABOUT 1200 MM WIDTH X 2000 MM HEIGHT IN SS HAIRELINE FINISH
DOOR OPERATION
AUTOMATIC
SIGNS

1. COMBINED LUMINOUS HALL BUTTON WITH SIXTEEN SEGMENT DIGITAL HALL POSITION INDICATOR AT ALL FLOORS.
2. CAR OPERATING PANEL WITH LUMINOUS BUTTONS AND DIGITAL CAR POSITION INDICATOR IN CAR.
3. BATTERY OPERATED ALARM BELL & EMERGENCY LIGHT.
4. FIREMAN’S SWITCH AT MAIN LOBBY
5. ALL SIGNAL FIXTURES IN STAINLESS STEEL FACE PLATES
6. AUTOMATIC RESCUE OPERATION
7. INTERCOM
ADDITIONAL TERMS & CONDITIONS

1. LOCATION
The System will be installed at IIT, Kanpur will be required to operate under the Climatic conditions as prevailing.

2. SITE INFORMATION
The tenderer should, in his own interest, visit the site and familiarizes himself with the site conditions before tendering. For any clarification, tenderer may discuss with the Engineer-in-Charge.

3. CONFORMITY WITH STATUTORY ACTS, RULES, STANDARDS AND CODES
i) The work shall be executed as per Tender Specifications, IS Codes, standards of practice and as per directions of Engineer-in-Charge. These additional specifications are to be read in conjunction with above and in case of variations; specifications given in this Additional conditions shall apply. However, nothing extra shall be paid on account of these additional specifications & conditions as the same are to be read along with schedule of quantities for the work.

The additional specifications are to be read with above and in case of any variations; specifications given along with the tender shall apply.

4. ACCEPTANCE OF TENDER
The department reserves the right to reject any or all the tenders without assigning any reasons. The department may call for fresh tenders with or without modification in the tender from the same firms whose applications are already approved by the competent authority.

5. RATES
5.1 The rates quoted by the tenderer, shall be firm and inclusive of all taxes (excluding GST) and labour cess, duties levies, octroi etc and all charges for packing forwarding, insurance, freight and loading, unloading, delivery, installation, testing, commissioning etc. at site including temporary construction of storage, risks, over head charges, general liabilities/ obligations, clearance from Chief Fire Officer and other statutory bodies if any.

5.2 The department will not issue octroi exemption certificate.

5.3. The contractor has to carry out maintenance as per manufacturer’s standards for a period of 36 months from the date of handing over. Nothing extra shall be paid on this account.

6. SECURITY DEPOSIT
Security deposit shall be deducted from each running bill and the final bill to the extent of 5% of the gross amount payable subject to a maximum amount of 5% of the tenderer value. The earnest money deposited shall be adjusted against this security deposit. The security deposit shall be released on the expiry of guarantee period stipulated in the contract.

7. PERFORMANCE GUARANTEE
The successful tenderer shall submit an irrevocable performance guarantee of 5% of the tenderer amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement within 15 days of issued of letter of acceptance of tender, expendable upto 7 days. This guarantee shall be in the form of Demand Draft/ Pay Order or irrevocable bank guarantee bond of any scheduled bank or the State Bank of India in the specified format or in the form of Government security, fixed deposit receipt pledged in favour of Executive Engineer or as specified in the letter of acceptance of tender. The performance guarantee shall be initially valid up to the stipulated date of completion plus 60 days beyond. This bank guarantee shall be kept valid till the recording of completion certificate for the work by the competent authority.

8.1 Labour cess & other statutory deductions etc. shall be made at source as per the prevalent laws.

8. Completeness of tender, Submission of Execution Programme, Approval of Drawings, and Commencement of Work:

9. Completeness of tender - All sundry equipment, fittings, assemblies, accessories, hardware items, bolts, supports, termination lugs for electrical connection, cable glands, junction box and all other sundry items for proper assembly and efficient working of the various equipment and components of the work shall be deemed to
have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the
tender or not.

9.2 Submission of programme - within fifteen days from the date of receipt of the letter of acceptance, the
successful tenderer shall submit his programme for submission of drawings, supply of equipment, installation,
testing, commissioning and handing over of the installation to the Engineer-in-Charge. This programme shall be
framed keeping in view the building progress.

9.3 Submission of Drawings - The contractor shall submit the design calculations and drawings to the Engineer-in-
Charge for approval before start of work.

9.4 Commencement of Work - The contractor shall commence work as soon as the drawings submitted by him are
approved.

10. Dispatch of Materials to Site and Safe Custody thereof:
10.1 The contractor shall dispatch materials to site in consultation with the Engineer-in-Charge.
10.2 Suitable lockable storage accommodation shall be made available free of charge temporarily if available
otherwise contractor has to arrange storage accommodation on his own. Watch & Ward however, shall be the
responsibility of contractor.
10.3 Programme of dispatch of material shall be framed keeping in view the building progress.
10.4 Safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the
contractor till final taking over by the department.

11. Co-ordination with Other Agencies:
11.1 The contractor shall co-ordinate with all other agencies involved in the work so that the work of other agencies is
not hampered due to delay in his work.
11.2 Piping, cabling or any other work, which directly affect the progress of building work, shall be given priority.

12. Quality of Materials and Workmanship:
12.1 The components of the installation shall be of such design so as to satisfactorily Function under all conditions of
operation.
12.2 The entire work of supplying and installation shall confirm to sound engineering practice.
12.3 All equipment and materials to be used in work shall be manufactured in factories of good repute having
excellent track record of quality manufacturing, performance and proper after sales service.

13. Care of the Building:
13.1 Care shall be taken by the contractor during execution of the work to avoid damage to the building.
13.2 They shall also be responsible for repairing all such damages and restoring the same to the original finish at their
cost.
13.3 They shall also remove all unwanted and waste materials arising out of the installation from the site of work
from time to time.

14. STORAGE & CUSTODY OF MATERIALS
Temporary storage space at site will be provided by the deptt. However Watch and Ward responsibility of the
material of the contractor.

15. COMPLETION PERIOD
The completion period will be as indicated in the tender documents is for the entire work of planning, designing,
supplying, installation, testing, commissioning and handing over of the entire system to the satisfaction of the
Engineer-in-Charge.

16. GUARANTEE:
16.1 All equipment shall be guaranteed for a period of 36 months from the date of acceptance and taking over of the
installation by the Department against unsatisfactory performance and/or breakdown due to defective design,
material, manufacture, workmanship or installation. The equipment or component or any part thereof so found
defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-
in-charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the
same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-charge
in this regard shall be final & binding on the contractor.
16.2 The tender shall guarantee among other things, the following:-
   a) Quality, strength and performance of the materials used as per manufacturers standards.
   b) Safe mechanical & electrical stress on all parts under all specified conditions of operation.

17. POWER SUPPLY
17.1 The power supply for testing and commissioning of the complete installation shall be made available by the Department free of charge to the contractor. For this purpose, the power supply shall be given at one point through U.G. cable or as specified in the contract. The termination of the feeder in the unit shall be the responsibility of the contractor and nothing extra shall be paid on this account.

17.2 Unless otherwise specified in the contract, further power distribution to the various equipment shall be done by the contractor.

17.3 The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power shall be used only for welding / cutting works. The power supply shall be disconnected in case of such default and the contractor shall then have to arrange the required power supply at his cost.

18. ACCEPTABLE MAKES OF VARIOUS EQUIPMENTS.

The acceptable makes of various equipment's/components/accessories have been indicated in "Acceptable Makes". The tenderer shall work out the post of the offer on this basis. Alternate makes are not acceptable.

19. DRAWINGS FOR APPROVAL AND COMPLETION

19.1 Drawings for approval on award of the work - The contractor shall prepare & submit three sets of following drawings and get them approved from the Engineer-in-charge before the start of the work. The approval of drawings however does not absolve the contractor not to supply the equipment/ materials as per agreement, if there is any contradiction between the approved drawings and agreement. The decision of the Engineer-in-Charge shall be final & binding on the contractor.

   a) Lay out drawings of core switches, layer 2 switches, cabling route etc.
   b) Any other drawings relevant to the work.

19.2 Completion Drawings

   On the successful completion of work, tenderer would be required to submit the following drawings.
   i. Completion plan showing location of various switches, cable route and LAN nodes
   ii. Panta scanning report of entire installation
   iii. Any other drawings relevant to the work.

20. EXTENT OF WORK

20.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract as this is a turnkey job.

21. INDEMNITY:

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer on account of the above.

22. WORKS TO BE ARRANGED BY THE DEPARTMENT:

   Unless otherwise specified in the tender documents, the following works shall be arranged by the Department:

   i) Space for accommodating all the equipment and components involved in the work.
23. WORKS TO BE DONE BY THE CONTRACTOR:

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost- whether specifically indicated in the schedule of work or not.

- Making openings in the walls/ floors/ slabs or modification in the existing openings wherever provided for carrying pipe line, cables etc.
- Making good all damages caused to the structure during installation and restoring the same to their original finish.

24. INSURANCE AND STORAGE:

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

25. VERIFICATION OF CORRECTNESS OF EQUIPMENT AT DESTINATION:

The contractor shall have to produce all the relevant records to certify that the genuine equipment’s from the manufacturers are used.

26. MACHINERY FOR INSTALLATION:

All tools and tackles required for unloading/ handling of equipment and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

27. SAFETY MEASURES:

All equipment shall incorporate suitable safety provisions to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated for all equipment.

28. After Sales Service:

The contractor shall ensure adequate and prompt after sales service in the form of maintenance, spares and personnel as and when required and shall minimize the breakdown period. In case of equipment supplied by other manufacturers the firm shall furnish a guarantee from the manufacturer for the same before the installation is taken over.

29. Documents to be provided on Completion of Work:

Three sets of following documents shall be furnished to the department by the contractor on completion of work.

a) Completion drawings
b) Three sets of manufacturer’s technical catalogues of all equipment and accessories.
c) Operation and maintenance manual of all major equipment.

30. INTERPRETING SPECIFICATIONS:

In interpreting the specifications, the following order of decreasing importance shall be followed in case of contradictions:

(a) Schedule of quantities
(b) Technical specification
(c) Drawing (if any)
(d) General specifications
(e) Relevant BIS or other international code in case BIS code is not available.
TECHNICAL SPECIFICATIONS

1. All the switching components as like Core Switch, Distribution Switches, Access Switches and transceiver modules should be from single OEM.

2. Operating System Software (OS) of all active switches should be same for ease of management and upgrades.

3. All active switches and their OS should be EAL 2/3/4 /common criteria NDPP/ FIPS certified

4. Any non-compliance to above clauses & technical specifications will not be acceptable.

5. All the switching components should be from Leaders, Challengers and Visionaries Gartner magic quadrant for "Wired and Wireless LAN Access" or "Data Center Networking" 2014 or later reports

6. Warranty - Tender must be quoted with the three years comprehensive NBD support.

   Indoor/ Outdoor Dome Camera –
   • 1/3-inch CMOS Sensor Progressive scan,
   • 2304x1296 (4MP);
   • Varifocal 2.7 – 12 mm , ESS 1/3(4)~1/100000 s,
   • min Illumination 0.1 lux, F1.4 (Color), 0 lux (IR LEDs on),
   • DC Iris F1.4, IR corrected; H.264 High or Main profiles; and MJPEG,
   • RJ-45 connector for 100Base-TX,
   • ONVIF Profile, PoE (IEEE 802.3af) or Power-over-Ethernet,
   • Operating Temperature -30° to 60°C.

PTZ Camera
   • IP 66 - 1/2.8-inch Type Exmor CMOS Sensor ;
   • 1920 x 1080, 1080p, 1/1.6 ~ 1/4.7, focal length 4.3 mm (wide) ~ 129.0 mm (tele),
   • 30X optical, 12X digital, 256 Presets,
   • RJ-45 Data Port for Software Update and Setup,
   • 360° continuous pan rotation,
   • Operating Temperature 0° to 50°C (32° to 122°F).

Layer 2 PoE Switch :
   • Minimum of 24 Port 10/100/1000 Base-T
   • with 2 x 10G SFP+ Uplinks Support Stacking Bandwidth 215 Gbps,
   • 16 port PoE with 16 ports PoE (IEEE802.3af/at),
   • BIT Rate 16 kbps ~ 20 Mbps per channel,
   • Network Throughput Input 320 Mbps; Output 320 Mbps,
   • Motion Detection, Internal storage supports 8 HDDs expandable up to 64 TB (8 TB each),
   • RAID 0/1/5/6/10 external storage compatibility supports a wide range of high capacity storage

Storage :
   • Surveillance 8TB Internal SATA 6Gb/s 256MB
   • Cache 3.5-Inch Internal Hard Drive

5" TFT touch LCD Network cameras / SSM control
   • User-friendly design and easy-to-use keypad
   • 3 Axis joystick to control PTZ function
   • Detachable joystick / jogshuttle for universe use and
   • 255 Camera Supported control equipment

UTP 4 pair CAT 6 LAN Cable
   • conforming to the standards like ANSI/TIA 568 C.2, EN50173, IEC 11801 2nd ED,
   • Cat 6 U/UTP LCS2 cable 23AWG.

Cat 6 UTP , Tool less Information outlet
   • CAT6 U/UTP built in crimping hands-free,
   • Minimum 5 times reconnection possibilities.
   • LCS2 Toolless RJ45 Information outlet where insertion test (in & out) must be 2500 times (I/O)
- White in colour, including front plate and anodised GI box in concealed manner of adequate sizes, including all fixing accessories.

24 port Cat 6 patch panels
- With block of four equipped with tool less IO.
- Rack Mountable.
- 19" Modular Patch Panel, loaded CAT6 U/UTP 24 port LCS2
- compatible in 4nos of 6 X RJ 45 Tool less connector U/UTP unit in a block.

CAT6 UTP 23 AWG PVC Patch Cord –
- 1 mtr & 2 mtr - Rack End for CCTV Points.
- Factory crimped LCS2 Patch cord.

Layer 3 Switch : Minimum of 24 Port 10G Fiber Switch IP Base with 4 x 10GE Extra Network Module ; 1 x Out of Band IP based management Port ; 1 Console Port, USB Port / External Flash ; Support Switching Capacity 92Gbps, Stacking Bandwidth 480 Gbps, MAC Addresses 32000, DRAM 4GB, Flash Memory 2GB.; Have Redundant Power Supply support and variable speed fan to adjust to varying weather conditions in campus

<table>
<thead>
<tr>
<th>Ports</th>
<th>Switching capacity</th>
<th>Stacking bandwidth</th>
<th>Total number of MAC addresses</th>
<th>Total number of IPv4 routes (ARP plus learned routes)</th>
<th>FNF entries</th>
<th>DRAM</th>
<th>Flash</th>
<th>VLAN IDs</th>
<th>Total switched virtual interfaces (SVIs)</th>
<th>Jumbo frame</th>
<th>Total routed ports per stack</th>
<th>Wireless</th>
<th>Number of access points per switch/stack</th>
<th>Number of wireless clients per switch/stack</th>
<th>Total number of WLANs per switch</th>
<th>Wireless bandwidth per switch</th>
<th>Network Module</th>
<th>Forwarding Rate</th>
<th>Standards</th>
</tr>
</thead>
</table>
| 24 10G Ports-X | 92 Gbps | 480 Gbps | 32,000 | 24,000 | 48,000 flows | 4 GB | 2 GB | 4,000 | 1,000 | 9198 bytes | 208 | 100 | 2000 | 64 | Up to 20 Gbps on 24-port Gigabit Ethernet model | 4 x 10GE Network Module | 454.55 Mpps | IEEE 802.1as IEEE 802.1s IEEE 802.1w IEEE 802.11 IEEE 802.1x IEEE 802.1x-Rev IEEE 802.3ad IEEE 802.3af IEEE 802.3at IEEE 802.3bz IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports IEEE 802.1D Spanning Tree Protocol IEEE 802.1p CoS prioritization IEEE 802.1Qat Stream Reservation Protocol IEEE 802.1Qav IEEE 802.1Q VLAN IEEE 802.3 10BASE-T specification IEEE 802.3u 100BASE-TX specification
IEEE 802.3ab 1000BASE-T specification
IEEE 802.3z 1000BASE-X specification

Power supply rated maximum
715W
Total output BTU (Note: 1000 BTU/hr = 293W)
2465 BTU/hr, 715W
Input-voltage range and frequency
100-240VAC, 50-60 Hz
Input current
10-5A
Output ratings
-56V at 12.8A
Output holdup time
16.7 ms minimum at 100VAC
Power-supply input receptacles
IEC 320-C16 (IEC60320-C16)
Power cord rating
13A

Layer 2 Switch: Minimum of 48 Port 10/100/1000 Base-T with 10G SFP+ Uplinks Support Stacking Bandwidth 215 Gbps, Unicast MAC Addresses 16K, DRAM 512 MB, Flash Memory 128 MB.; Have Redundant Power Supply support and variable speed fan to adjust to varying weather conditions in campus

Ports
48 Port 10/100/1000 Base-T with 2 x 10G SFP+ Uplinks

Switching Bandwidth
215 Gbps

Forwarding bandwidth
108 Gbps

DRAM
512 MB

Flash
128 MB

VLAN IDs
4,096

Jumbo frame
9216 bytes

Unicast MAC Addresses
16K

IPv4 Unicast Direct Routes
2K

IPv4 Unicast Indirect Routes
1K

IPv6 Unicast Direct Routes
2K

IPv6 Unicast Indirect Routes
1K

IPv4 Multicast Routes and IGMP Groups
1K

IPv6 Multicast Groups
1K

IPv4 QoS ACEs
500

IPv6 QoS ACEs
500

IPv4 Security ACEs
625

IPv6 Security ACEs
625

Standards
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1s
- IEEE 802.1w
- IEEE 802.1X
- IEEE 802.1ab (LLDP)
- IEEE 802.3ad
- IEEE 802.3af and IEEE 802.3at
- IEEE 802.3ah (100BASE-X single/multimode fiber only)
- IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
- IEEE 802.3 10BASE-T
- IEEE 802.3u 100BASE-TX
- IEEE 802.3ab 1000BASE-T
- IEEE 802.3z 1000BASE-X
- RMON I and II standards

- SNMP v1, v2c, and v3
- IEEE 802.3az
- IEEE 802.3ae 10Gigabit Ethernet

IEEE 802.1ax
RFC 768 - UDP
SFP 10G Base Module supports a link length of 26m on standard Fiber Distributed Data Interface (FDDI)-grade Wavelength 840 to 860 nm Multimode Fiber (MMF). T.P. Minimum -7.3 & Maximum -1.2 dBm. R.P. Minimum -9.9 & Maximum -1.0 dBm. Using 2000MHz km MMF (OM3), up to 300m link lengths are possible. Using 4700MHz km MMF (OM4), up to 400m link lengths are possible.

Layer 2 PoE Switch : Minimum of 24 Port 10/100/1000 Base-T with 2 x 10G SFP+ Uplinks Support Stacking Bandwidth 215 Gbps, Unicast MAC Addresses 16K, DRAM 512 MB, Flash Memory 128 MB 350W IEEE 802.3af Power over Ethernet (PoE) and IEEE 802.3at PoE+. Have Redundant Power Supply support and variable speed fan to adjust to varying weather conditions in campus.

<table>
<thead>
<tr>
<th>Ports</th>
<th>24 Port 10/100/1000 Base-T with 2 x 10G SFP+ Uplinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Bandwidth</td>
<td>215 Gbps</td>
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<td>Forwarding bandwidth</td>
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<td>DRAM</td>
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<td>Flash</td>
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<td>VLAN IDs</td>
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<td>Jumbo frame</td>
<td>9216 bytes</td>
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<tr>
<td>Unicast MAC Addresses</td>
<td>16K</td>
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<tr>
<td>IPv4 Unicast Direct Routes</td>
<td>2K</td>
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<tr>
<td>IPv4 Unicast Indirect Routes</td>
<td>1K</td>
</tr>
<tr>
<td>IPv6 Unicast Direct Routes</td>
<td>2K</td>
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<tr>
<td>IPv6 Unicast Indirect Routes</td>
<td>1K</td>
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</tbody>
</table>
IPv4 Multicast Routes and IGMP Groups: 1K
IPv6 Multicast Groups: 1K
IPv4 QoS ACEs: 500
IPv6 QoS ACEs: 500
IPv4 Security ACEs: 625
IPv6 Security ACEs: 625

Standards:
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1s
- IEEE 802.1w
- IEEE 802.1x
- IEEE 802.1ab (LLDP)
- IEEE 802.3ad
- IEEE 802.3af and IEEE 802.3at
- IEEE 802.3ah (100BASE-X single/multimode fiber only)
- IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T port
- IEEE 802.3 10BASE-T
- IEEE 802.3u 100BASE-TX
- IEEE 802.3ab 1000BASE-T
- IEEE 802.3z 1000BASE-X
- RMON I and II standards
- SNMP v1, v2c, and v3
- IEEE 802.3ae 10Gigabit Ethernet
- IEEE 802.1ax

RFC compliance:
- RFC 768 – UDP
- RFC 783 - TFTP
- RFC 791 - IP
- RFC 792 - ICMP
- RFC 793 - TCP
- RFC 826 - ARP
- RFC 854 - Telnet
- RFC 951 - Bootstrap Protocol (BOOTP)
- RFC 959 - FTP
- RFC 1112 - IP Multicast and IGMP
- RFC 1157 - SNMP v1
- RFC 1166 - IP Addresses
- RFC 1256 - Internet Control Message Protocol (ICMP) Router Discovery
- RFC 1305 - NTP
- RFC 1492 - TACACS+
- RFC 1493 - Bridge MIB
- RFC 1542 - BOOTP extensions
- RFC 1643 - Ethernet Interface MIB
- RFC 1757 - RMON
- RFC 1901 - SNMP v2c
- RFC 1902-1907 - SNMP v2
- RFC 1981 - Maximum Transmission Unit (MTU) Path Discovery IPv6
- RFC 2068 - HTTP
- RFC 2131 - DHCP
- RFC 2138 - RADIUS
- RFC 2233 - IF MIB v3
- RFC 2373 - IPv6 Aggregatable Addrs
- RFC 2460 - IPv6
- RFC 2461 - IPv6 Neighbor Discovery
- RFC 2462 - IPv6 Autoconfiguration
- RFC 2463 - ICMP IPv6
- RFC 2474 - Differentiated Services (DiffServ) Precedence
- RFC 2597 - Assured Forwarding
- RFC 2598 - Expedited Forwarding
- RFC 2571 - SNMP Management
- RFC 2865 - RADIUS
- RFC 3046 - DHCP Relay Agent Information Option
- RFC 3376 - IGMP v3
- RFC 3580 - 802.1X RADIUS

Wireless Controller: 802.11n, 802.11r, 802.11u, 802.11w, 802.11ac.
<table>
<thead>
<tr>
<th>Wired/Switching/Routing</th>
<th>IEEE 802.3 10BASE-T, IEEE 802.3u 100BASE-TX specification, 1000BASE-T: 1000BASE-SX, 1000-BASE-LH, IEEE 802.1Q Vtagging, and IEEE 802.1AX Link Aggregation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>● RFC 768 UDP</td>
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<tr>
<td>● RFC 791 IP</td>
<td></td>
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<tr>
<td>● RFC 2460 IPv6 (pass through Bridging mode only)</td>
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<tr>
<td>● RFC 792 ICMP</td>
<td></td>
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<tr>
<td>● RFC 793 TCP</td>
<td></td>
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<tr>
<td>● RFC 826 ARP</td>
<td></td>
</tr>
<tr>
<td>● RFC 1122 Requirements for Internet Hosts</td>
<td></td>
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<tr>
<td>● RFC 1519 CIDR</td>
<td></td>
</tr>
<tr>
<td>● RFC 1542 BOOTP</td>
<td></td>
</tr>
<tr>
<td>● RFC 2131 DHCP</td>
<td></td>
</tr>
<tr>
<td>● RFC 5415 CAPWAP Protocol Specification</td>
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<tr>
<td>● RFC 5416 CAPWAP Binding for 802.11</td>
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<tr>
<td>● WPA</td>
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<tr>
<td>● IEEE 802.11i (WPA2, RSN)</td>
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<tr>
<td>● RFC 1321 MD5 Message-Digest Algorithm</td>
<td></td>
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<tr>
<td>● RFC 1851 The ESP Triple DES Transform</td>
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<tr>
<td>● RFC 2104 HMAC: Keyed Hashing for Message Authentication</td>
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<tr>
<td>● RFC 2246 TLS Protocol Version 1.0</td>
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<tr>
<td>● RFC 2401 Security Architecture for the Internet Protocol</td>
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<tr>
<td>● RFC 2403 HMAC-MD5-96 within ESP and AH</td>
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<tr>
<td>● RFC 2404 HMAC-SHA-1-96 within ESP and AH</td>
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<tr>
<td>● RFC 2405 ESP DES-CBC Cipher Algorithm with Explicit IV</td>
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<tr>
<td>● RFC 2406 IPsec</td>
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<tr>
<td>● RFC 2407 Interpretation for ISAKMP</td>
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<tr>
<td>● RFC 2408 ISAKMP</td>
<td></td>
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<tr>
<td>● RFC 2409 IKE</td>
<td></td>
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<tr>
<td>● RFC 2451 ESP CBC-Mode Cipher Algorithms</td>
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<tr>
<td>● RFC 3280 Internet X.509 PKI Certificate and CRL Profile</td>
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<tr>
<td>● RFC 3602 The AES-CBC Cipher Algorithm and Its Use with IPsec</td>
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<tr>
<td>● RFC 3686 Using AES Counter Mode with IPsec ESP</td>
<td></td>
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<tr>
<td>● RFC 4347 Datagram Transport Layer Security</td>
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<tr>
<td>● RFC 4346 TLS Protocol Version 1.1</td>
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<tr>
<td>● WEP and TKIP-MIC: RC4 40, 104 and 128 bits (both static and shared keys)</td>
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<tr>
<td>● AES: CBC, CCM, CCMP</td>
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<tr>
<td>● DES: DES-CBC, 3DES</td>
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<tr>
<td>● SSL and TLS: RC4 128-bit and RSA 1024- and 2048-bit</td>
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<tr>
<td>● DTLS: AES-CBC</td>
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<td>● IPsec: DES-CBC, 3DES, AES-CBC</td>
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<tr>
<td>Security Standards</td>
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<tr>
<td>● IEEE 802.1X</td>
<td></td>
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<tr>
<td>● RFC 2548 Microsoft Vendor-Specific RADIUS Attributes</td>
<td></td>
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<tr>
<td>● RFC 2716 PPP EAP-TLS</td>
<td></td>
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<tr>
<td>● RFC 2865 RADIUS Authentication</td>
<td></td>
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<tr>
<td>● RFC 2866 RADIUS Accounting</td>
<td></td>
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<tr>
<td>● RFC 2867 RADIUS Tunnel Accounting</td>
<td></td>
</tr>
<tr>
<td>● RFC 2869 RADIUS Extensions</td>
<td></td>
</tr>
<tr>
<td>● RFC 3576 Dynamic Authorization Extensions to RADIUS</td>
<td></td>
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<tr>
<td>● RFC 5176 Dynamic Authorization Extensions to RADIUS</td>
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<tr>
<td>● RFC 3579 RADIUS Support for EAP</td>
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<tr>
<td>Encryption</td>
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<tr>
<td>● IEEE 802.1X</td>
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<tr>
<td>● RFC 2548 Microsoft Vendor-Specific RADIUS Attributes</td>
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<tr>
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<tr>
<td>● RFC 2869 RADIUS Extensions</td>
<td></td>
</tr>
<tr>
<td>● RFC 3576 Dynamic Authorization Extensions to RADIUS</td>
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</tr>
<tr>
<td>● RFC 5176 Dynamic Authorization Extensions to RADIUS</td>
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<td>● RFC 3579 RADIUS Support for EAP</td>
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<tr>
<td>Authentication, Authorization, and Accounting (AAA)</td>
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<tr>
<td>● RFC 3580 IEEE 802.1X RADIUS Guidelines</td>
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<tr>
<td>● RFC 3748 Extensible Authentication Protocol</td>
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<tr>
<td>● Web-based authentication</td>
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<tr>
<td>● TACACS support for management users</td>
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<tr>
<td>● SNMP v1, v2c, v3</td>
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<tr>
<td>● RFC 854 Telnet</td>
<td></td>
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<tr>
<td>● RFC 1155 Management Information for TCP/IP-Based Internets</td>
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<tr>
<td>● RFC 1156 MIB</td>
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<tr>
<td>● RFC 1157 SNMP</td>
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<td>● RFC 1213 SNMP MIB II</td>
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<tr>
<td>● RFC 1350 TFTP</td>
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<tr>
<td>● RFC 1643 Ethernet MIB</td>
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</tbody>
</table>
Management

- RFC 2030 SNTP
- RFC 2616 HTTP
- RFC 2665 Ethernet-Like Interface types MIB
- RFC 2674 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual Extensions
- RFC 2819 RMON MIB
- RFC 2863 Interfaces Group MIB
- RFC 3164 Syslog
- RFC 3414 User-Based Security Model (USM) for SNMPv3
- RFC 3418 MIB for SNMP
- RFC 3636 Definitions of Managed Objects for IEEE 802.3 MAUs
- Management Interface
- Regulatory management interfaces
- Command-line interface: Telnet, Secure Shell (SSH) Protocol, serial port Wired Control System (WCS)
- Uplink: 8 (5508) 1000BaseT, 1000Base-SX and 1000Base-LH transceiver slots
- Small Form-Factor Pluggable (SFP) options (only Cisco SFPs supported): GLC-T, GLC-SX-MM, GLC-LH-SM
- LED indicators: link
- Service Port: 10/100/1000
- Service Port: 10/100/1000 Mbps Ethernet (RJ45) For High Availability for future use
- LED indicators: link Mbps Ethernet (RJ45)
- Utility Port: 10/100/1000 Mbps Ethernet (RJ45)
- LED indicators: link
- Expansion Slots: 1 (5508)
- Console Port: RS232 (DB-9 male/RJ-45 connector included), mini-USB
- Other Indicators: Sys, ACT, Power Supply 1, Power Supply 2
- CE Mark Safety:
  - UL 60950-1:2003
  - EN 60950:2000
- Regulatory Compliance
  - EMI and susceptibility (Class A)
  - Canada: ICES-003
  - Japan: VCCI
  - Europe: EN 55022, EN 55024

Access Point: Access Point (AP) PoE with two integrated, independant radio units 802.11 a/b/g/n/ac and Integrated or External Antenna Include Wall mounting and Ceiling mounting Bracket as per requirement

4x4 MIMO with three spatial streams
Maximal ratio combining (MRC)
802.11n and 802.11a/g beamforming on 802.11n
802.11ac beamforming on 802.11ac w1-w2
20- and 40-MHz channels on 802.11n
802.11n, 802.11ac Wave 1, 802.11ac Wave 2 capabilities
20-, 40-, and 80-MHz channels on 802.11ac w1
20-, 40-, 80, 160-MHz channels on 802.11ac w2
PHY data rates up to 450 Mbps (40 MHz with 5 GHz) on 802.11n
PHY data rates up to 1.3 Gbps (80 MHz in 5 GHz) on 802.11ac w1
PHY data rates up to 5.2 Gbps on 802.11ac w2
Packet aggregation: A-MPDU (Tx/Rx), A-MSDU (Tx/Rx) 802.11 dynamic frequency selection (DFS)
Cyclic shift diversity (CSD) support

Integrated antenna
Flexible radio 2.4 GHz gain 4 dBi or 5 GHz gain 5 dBi
- 256 MB flash
- 2802/E

Interfaces
- 2x100/1000BASE-T autosensing (RJ-45)
- Management console port (RJ-45)
- USB 2.0 (enabled via future software)

boot loader warnings, boot loader errors

Input power requirements
- 802.3at PoE+, Power injector
  - UL 60950-1
  - CAN/CSA-C22.2 No. 60950-1

Compliance standards
- Radio approvals:
IEEE standards:
- IEEE 802.11a/b/g, 802.11n, 802.11h, 802.11d
- UL 2043
- IEC 60950-1
- EN 60950-1
- EN 50155
- FCC Part 15.107, 15.109, 15.247, 15.407, 14-30
- RSS-247 (Canada)
- EN 300.328, EN 301.893 (Europe)
- ARIB-STD 66 (Japan)
- VCCI (Japan)
- ARIB-STD T71 (Japan)
- EMI and susceptibility (Class B)
- ICES-003 (Canada)
- EN 301.489-1 and -17 (Europe)
- EN 60601-1-2 EMC requirements for the Medical Directive 93/42/EEC
- IEEE 802.11ac
- 802.11i, Wi-Fi Protected Access 2 (WPA2), WPA
- 802.1X
- Advanced Encryption Standards (AES)
- EAP-Transport Layer Security (TLS)
- EAP-Tunneled TLS (TTLS) or Microsoft Challenge Handshake Authentication Protocol Version 2 (MC5HAPv2)
- Protected EAP (PEAP) v0 or EAP-MSCAPv2
- EAP-Flexible Authentication Protocol (EAP) types:
  - EAP Flexible Authentication via Secure Tunneling (FAST)
  - PEAP v1 or EAP-Generic Token Card (GTC)
  - EAP-Subscriber Identity Module (SIM)
  - Multimedia: Wi-Fi Multimedia (WMM)
- FCC Bulletin OET-65C
- RSS-102
- 802.11b: 1, 2, 5.5, and 11 Mbps
- 802.11a/g: 6, 9, 12, 18, 24, 36, 48, and 54 Mbps
- IEEE standards:
- 802.11n HT20: 6.5 to 450 Mbps (MCS0 to MCS23)
- 802.11n HT40: 13.5 to 450 Mbps (MCS0 to MCS23)
- 802.11ac VHT20: 6.5 to 288.9 Mbps (MCS8 to 8 – SS 1, MCS8 to 9 – SS 2 and 3)
- 802.11ac VHT40: 13.5 to 600 Mbps (MCS0 to 8 – SS 1, MCS0 to 9 – SS 1 to 3)
- 802.11ac VHT80: 29.3 to 1300 Mbps (MCS0 to 9 – SS 1 to 3)
- 802.11ac VHT160: 58.5 to 2304 Mbps (MCS0 to 9 – SS 1 to 2, MCS0 to 8 – SS 3)
IP Communications Server PBX 100% Non-Blocking System with 02 ISDN PRI Trunk, 16 Analogue Trunk with Caller ID, 08 Digital Extensions with Caller ID, 500 Analogue Extensions with Caller ID, 60 VoIP Extension with Wireless Cell on Mobile and One Time Activation Key, 02 Channel Simplified Voice Mail/Auto Attendent, 8 GSM 2G SIM Supporting Card, T1E1 Dual PRI Card

- System should be scalable to Minimum 1300 ports/Channel
- Details of Incoming/ missed & outgoing calls- Buffer Capacity-10,000 Calls
- System should be Pure IP PBX which can accommodate traditional Trunks & Extensions also without any third party hardware or software
- System should have Desktop, Network & Application Integration
- System should have Business Productivity with Mobility Solution (DECT, IP-DECT, Wi-Fi and GSM Integration)
- DECT Cell station to have direct connectivity on extension port, without any need for interface card to save on free slot. Each cell station should support at least 8 simultaneous calls
- System should Leveraging Open Standard Communications
- System should be 19” Rack mountable
- System should support full feature transparency same as controlled by single CPU when networked in case of multi-system/location installation with least 16 systems/locations i.e. Server – Gateway Architecture
- System should support Network Survivability/Resiliency, in Server – Gateway Architecture
- Server & Gateways, other Accessories should be the same make
- Gateways should work stand alone in case of connectivity failure between Server & Gateway and should provide the same feature as Gateway
- System should support Q-Sig Networking up to 999 systems/locations
- System should have Built-In 32 party Group Conference Call in both way(Dial-In & Dial-out)
- System should have Built-In 32 party conference bridge
- System should support 3 party to 8 party conference
- System should support Conference Management through Graphical User Interfaces(GUI) screen(Laptop/Desktop)
# ANNEXURE: LIST OF APPROVED MAKES - ELECTRICAL

## IIT KANPUR

<table>
<thead>
<tr>
<th>S. No.</th>
<th>ITEM DESCRIPTION</th>
<th>PROPOSED MAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UPS</td>
<td>Numeric Eaton Emerson</td>
</tr>
<tr>
<td>2</td>
<td>Batteries</td>
<td>Amron Exide AMCO</td>
</tr>
<tr>
<td>3</td>
<td>Lighting Control</td>
<td>Honeywell Lutron Leviton</td>
</tr>
</tbody>
</table>

## EXTRA LOW VOLTAGE SYSTEM

<table>
<thead>
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<th>ITEM DESCRIPTION</th>
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<tbody>
<tr>
<td>1</td>
<td>CCTV Camera</td>
<td>Tyco Pelco Axis</td>
</tr>
<tr>
<td>2</td>
<td>NVR</td>
<td>Tyco Pelco Axis</td>
</tr>
<tr>
<td>3</td>
<td>Video Management Software</td>
<td>Tyco Axis Pelco</td>
</tr>
<tr>
<td>4</td>
<td>EPABX system</td>
<td>NEC Avaya Cisco</td>
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<tr>
<td>5</td>
<td>Hard Disk</td>
<td>WD seagate Toshiba</td>
</tr>
<tr>
<td>6</td>
<td>LED Display</td>
<td>Panasonic Sony Samsung</td>
</tr>
<tr>
<td>7</td>
<td>Workstation</td>
<td>Dell HP IBM</td>
</tr>
<tr>
<td>8</td>
<td>Fire Alarm System</td>
<td>Notifier Edward Simplex</td>
</tr>
<tr>
<td>9</td>
<td>Fire Survival Cable</td>
<td>Bonton KEI Polycab</td>
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<tr>
<td>10</td>
<td>PA System</td>
<td>Honeywell Actis Bosch</td>
</tr>
<tr>
<td>11</td>
<td>100&quot; 4K UHD LED Display</td>
<td>Sony Planner Sharp</td>
</tr>
<tr>
<td>12</td>
<td>Projector</td>
<td>Delta Barco Christie</td>
</tr>
<tr>
<td>13</td>
<td>Wired Table Top Digital Delegate unit</td>
<td>Sennheiser Symmatrix Xylica</td>
</tr>
<tr>
<td>14</td>
<td>Wired Table Top Digital Chairman unit</td>
<td>Sennheiser Symmatrix Xylica</td>
</tr>
<tr>
<td>15</td>
<td>Digital Central Unit to connect 40 participants</td>
<td>Sennheiser Symmatrix Xylica</td>
</tr>
<tr>
<td>16</td>
<td>Wireless digital Handheld Microphone</td>
<td>Sennheiser NEUMAN REVOLAB</td>
</tr>
<tr>
<td>17</td>
<td>4.25&quot; two-way, thin edge ceiling speaker</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>18</td>
<td>12&quot; to 15&quot; two way full range speaker</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>19</td>
<td>Powerful passive dual 10&quot; to 15&quot;</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>20</td>
<td>8&quot; to 10&quot; two-way full range speaker,</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>21</td>
<td>High power HypeX Class-D amplifier</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>22</td>
<td>8-channel bridgeable class D power amplifier</td>
<td>APART-AUDIO AIM-Line Mayer Sound.</td>
</tr>
<tr>
<td>23</td>
<td>12 Channels of AEC Processing</td>
<td>Sennheiser Symmatrix Xylica</td>
</tr>
<tr>
<td>24</td>
<td>Cable Manager</td>
<td>AMX Extron Crestron</td>
</tr>
<tr>
<td>25</td>
<td>8x8 HDMI to HDBT Matrix switcher</td>
<td>AMX Extron Crestron</td>
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<tr>
<td>26</td>
<td>FHD Video Conference Systems</td>
<td>Polycom Lifesize Sony</td>
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<tr>
<td>27</td>
<td>Digital Podium</td>
<td>AHA</td>
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<tr>
<td>28</td>
<td>HDMI patch cord</td>
<td>AMX Extron Crestron</td>
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<tr>
<td>29</td>
<td>AWG</td>
<td>AMX Extron Crestron</td>
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<tr>
<td>30</td>
<td>Floor Standing Rack network Rack - 22U</td>
<td>Rittal APW VALRACK</td>
</tr>
<tr>
<td>31</td>
<td>CAT-6 COPPER UTP</td>
<td>Systimax Legrand Panduit</td>
</tr>
</tbody>
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<tbody>
<tr>
<td>32</td>
<td>FACE PLATE-SINGLE/DUAL/QUAD</td>
<td>Systimax</td>
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<tr>
<td></td>
<td></td>
<td>Legrand</td>
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<td></td>
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<td>Panduit</td>
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<tr>
<td>33</td>
<td>CAT6 UTP PATCH CORD</td>
<td>Systimax</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legrand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panduit</td>
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<tr>
<td>34</td>
<td>SC/LC Couplers/Adapter – Multimode Mode</td>
<td>Systimax</td>
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<td>Legrand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panduit</td>
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<tr>
<td>35</td>
<td>Multi mode OM3 pigtails</td>
<td>Systimax</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legrand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panduit</td>
</tr>
<tr>
<td>36</td>
<td>Multimode Fiber Optic Patch Cords</td>
<td>Systimax</td>
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<tr>
<td></td>
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<td>Legrand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panduit</td>
</tr>
<tr>
<td>37</td>
<td>24 Port Switch</td>
<td>Juniper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alcatel-Lucent</td>
</tr>
<tr>
<td>38</td>
<td>Network/Server Rack</td>
<td>Rittal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>APW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VALRACK</td>
</tr>
<tr>
<td>39</td>
<td>Ceiling mount speaker</td>
<td>APART-AUDIO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AIM-LINE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MARTIN AUDIO</td>
</tr>
<tr>
<td>40</td>
<td>Paging station</td>
<td>APART-AUDIO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AIM-LINE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MARTIN AUDIO</td>
</tr>
<tr>
<td>41</td>
<td>High power Hypex Class-D amplifier</td>
<td>APART-AUDIO</td>
</tr>
<tr>
<td></td>
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<td>AIM-LINE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MARTIN AUDIO</td>
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<tr>
<td>42</td>
<td>19-inch Equipment Rack</td>
<td>Rittal</td>
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<tr>
<td></td>
<td></td>
<td>APW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VALRACK</td>
</tr>
</tbody>
</table>

### Notes:

a. For any other item sample to be approved by Engineer incharge/client/consultant.

b. The list of approved materials is only for the guideline. However the Client reserves the right to choose any of the indicated makes.
# Approved Make List

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Items</th>
<th>Makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MS Conduit (ISI marked)</td>
<td>BEC/AKG/NIC/Steel craft/ M-Key, SK (E.R.W)</td>
</tr>
<tr>
<td>2</td>
<td>PVC Conduit and accessories</td>
<td>Polycleab/AKG/Asian</td>
</tr>
<tr>
<td>3</td>
<td>PVC/XLPE insulated aluminium/Copper conductor armoured/Unarmoured MV Cable upto 1100 V</td>
<td>Havells/Finolex/KEI/Grandlay/ Gloster</td>
</tr>
<tr>
<td>4</td>
<td>FRLS PVC insulated copper conductor stranded flexible wire i/c control cables</td>
<td>Havells/Finolex/KEI/Grandlay/RR Kabel/ Gloster</td>
</tr>
<tr>
<td>5</td>
<td>Cable Raceway floor/wall mounted and accessories</td>
<td>Schenider/Legrand/Cooper</td>
</tr>
<tr>
<td>6</td>
<td>Modular Switch &amp; Socket</td>
<td>Legrand (Myrus)/M.K. (Element)/Schneider (Zencelo India)/Havells/ ABB</td>
</tr>
<tr>
<td>7</td>
<td>Metal clad Industrial Socket</td>
<td>Legrand/Siemens/Schneider/ABB</td>
</tr>
<tr>
<td>8</td>
<td>Cat-6 Cable</td>
<td>Beldon/Siemon/Legrand/Penduit (Pannet)</td>
</tr>
<tr>
<td>9</td>
<td>Cable Glands</td>
<td>Dowells/Commet/Gripwell/Raychem</td>
</tr>
<tr>
<td>10</td>
<td>Crimp Patch Cord</td>
<td>Beldon/Siemon/Legrand/Penuit (Pannet)</td>
</tr>
<tr>
<td>11</td>
<td>Protection Device (MCB/RCCB/DB/ELCB)</td>
<td>Siemens (Betagard),/Hager/Schneider / Legrand / ABB</td>
</tr>
<tr>
<td>12</td>
<td>MCCBs</td>
<td>Siemens (3VA)/L&amp;T /Schneider/ Legrand / ABB</td>
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<tr>
<td>13</td>
<td>Power contactor</td>
<td>Siemens /L&amp;T / Schneider / Legrand / ABB</td>
</tr>
<tr>
<td>14</td>
<td>Surge Protection Devices</td>
<td>Siemens/L&amp;T/Schneider / Legrand</td>
</tr>
<tr>
<td>15</td>
<td>Panel Accessories</td>
<td>Siemens /L&amp;T/Schneider / Legrand/Tecnic / ABB/Neptune</td>
</tr>
<tr>
<td>16</td>
<td>Selector Switch</td>
<td>Salzer/Seimens /BCH/ Kacee</td>
</tr>
<tr>
<td>17</td>
<td>Auxiliary Relays</td>
<td>Siemens/L&amp;T/Schneider/Legrand/ABB</td>
</tr>
<tr>
<td>18</td>
<td>LED/Metal Halide/Fluorescent Internal Lighting Fixture</td>
<td>Philips/ Vipro/Havells/Crompton/Decon</td>
</tr>
<tr>
<td>19</td>
<td>External Lighting Fixture</td>
<td>Philips/ Wipro/Havells/Crompton</td>
</tr>
<tr>
<td>20</td>
<td>Emergency Lighting/ Exit Sign boards</td>
<td>Philips/Havells/Lighting Technologies/Trilux/Prolite</td>
</tr>
<tr>
<td>21</td>
<td>Ceiling Fan (ISI marked &amp; BEE rated 5 star)</td>
<td>Havells/Almonard/Orient/Usha/Bajaj</td>
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<tr>
<td>22</td>
<td>Paint</td>
<td>Nerolac/Asian/Berger</td>
</tr>
<tr>
<td>23</td>
<td>Advance Lighting Protection System (Early Streamer Emission Type)</td>
<td>LPI (Australia)-by allied power/SGI (Duval Messien/satellite (France)- by SGI/Bradlay (USA)- by JMV/Erico (USA)-by security shoppe/ABB</td>
</tr>
<tr>
<td>24</td>
<td>GI Pipe</td>
<td>Tata/Jindal/SAIL</td>
</tr>
<tr>
<td>25</td>
<td>Main LT Panels/ MCC Panel</td>
<td>(Main LT panel / MCC Panel board should be IEC 61439 part-1 and II manufacturer has to produces the relevant test certificate as per IEC code for the same failing which panel shall be rejected). Tricolite, Delhi /Siemens / Schneider/ Milestone/ Neptune</td>
</tr>
<tr>
<td>26</td>
<td>Air Circuit Breaker</td>
<td>Siemens / Schneider /L&amp;T /Legrand/ABB</td>
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<tr>
<td>27</td>
<td>Surge Voltage Protection</td>
<td>Siemens /Schneider/L&amp;T/Legrand/ABB</td>
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<tr>
<td>28</td>
<td>Earth fault module</td>
<td>Siemens/Schneider/L&amp;T/Legrand</td>
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<tr>
<td>29</td>
<td>Protection relays</td>
<td>Siemens/Areva/L&amp;T/Legrand</td>
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<tr>
<td>30</td>
<td>C.Ts and PTs</td>
<td>Kappa/AE/Matrix</td>
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<tr>
<td>No.</td>
<td>Item Description</td>
<td>Brand(s)</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>-----------------------------------------------</td>
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<tr>
<td>31</td>
<td>Digital Meters</td>
<td>Siemens (PAC)/ Schneider/ (conzerv) / Secure Enersol / L&amp;T/ Neptune</td>
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<tr>
<td>32</td>
<td>Change Over Switch</td>
<td>L&amp;T/Havells /Socomec/ABB</td>
</tr>
<tr>
<td>33</td>
<td>Indicating lamps</td>
<td>ESBEE/Schneider/Siemens/Vaishno/Neptune</td>
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<tr>
<td>34</td>
<td>Power capacitors</td>
<td>Epcos/ Neptun / Legrand /ABB/ L&amp;T</td>
</tr>
<tr>
<td>35</td>
<td>Automatic Power factor correction relay/controller</td>
<td>Epcos/Siemens (PAC)/Schneider (Conzerv)/L&amp;T/Neptune</td>
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<tr>
<td>36</td>
<td>Sealed Maintenance Free Batteries</td>
<td>Exide/Panasonic/Hitachi/Shinkobe</td>
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<tr>
<td>37</td>
<td>Battery charger</td>
<td>Caldyne/Chhabi Electricals/Statcon/Max Power</td>
</tr>
<tr>
<td>38</td>
<td>Cable Trays (Factory Fabricated/Overhead &amp; Floor Raceways)</td>
<td>Legrand/MEM/OBO/ Milestone/ Neptune</td>
</tr>
<tr>
<td>39</td>
<td>HDPE underground cable duct</td>
<td>Rex Polyextrusion/Tirpura/Plasomatics/Duraline</td>
</tr>
<tr>
<td>40</td>
<td>Insulation Mats</td>
<td>DL Miller &amp; Co. Ltd.?PremierPolyfilm Ltd./RMG Polyvinyl India Ltd/Jyoti</td>
</tr>
<tr>
<td>41</td>
<td>Smoke/Heat detectors</td>
<td>Apollo/ System Sensor/ Agni</td>
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<tr>
<td>42</td>
<td>Manual Call point</td>
<td>PRD/System-Tek/ Simplex/ System Sensor/Agni</td>
</tr>
<tr>
<td>43</td>
<td>Response indicators</td>
<td>PRD/System-Tek/ Simplex/ System Sensor/Agni</td>
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<tr>
<td>44</td>
<td>Fire Exit Signs</td>
<td>System-Tek/ Simplex/ Agni</td>
</tr>
<tr>
<td>45</td>
<td>Fire Control Panel</td>
<td>System-Tek/ Morley/ Agni</td>
</tr>
<tr>
<td>46</td>
<td>Speaker / Hooter</td>
<td>System-Tek/ Philips/ Agni</td>
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<td>47</td>
<td>Occupancy Sensors/ Movement Sensor</td>
<td>Legrand/ Philips/ Wipro</td>
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<tr>
<td>48</td>
<td>Flush type switch /socket</td>
<td>Anchor/ Kinjal/ SSK/ Havells Reo</td>
</tr>
<tr>
<td>49</td>
<td>Fuse switches unit / switch fuse unit /HRC fuse</td>
<td>L&amp;T / Siemens/ Havells</td>
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<tr>
<td>50</td>
<td>Exhaust fan</td>
<td>Almonard/ Alstom/ Crompton/ Havells</td>
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<td>51</td>
<td>XLPE insulated HT cables</td>
<td>Gloster /KEI/Havells</td>
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<td>52</td>
<td>Cable lug</td>
<td>Ascon (Heavy gauge) JainsonDowells</td>
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<td>53</td>
<td>Lamp Holder (Brass)</td>
<td>Kay/SSK/Kinjal</td>
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<tr>
<td>54</td>
<td>Telephone wires/Telephone Cable / jelly filled telephone cables</td>
<td>Finolex /Delton/Havell’s /R.R. Kabel</td>
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<tr>
<td>55</td>
<td>Telephone tag blocks</td>
<td>Krone/ Pouyet</td>
</tr>
<tr>
<td>56</td>
<td>Telephone outlet</td>
<td>MK Electric /Legrand (Mosaic)/Crabtree (Piccadilly)</td>
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<tr>
<td>57</td>
<td>GI raceways</td>
<td>Milestone Engineering /Legrand/MDS/Neptune Systems Pvt. Ltd./MK</td>
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<tr>
<td>58</td>
<td>PVC raceways</td>
<td>Legrand/ MK</td>
</tr>
<tr>
<td>59</td>
<td>Electronic ballast</td>
<td>Philips /Wipro/Bajaj/Decon/Crompton/Havells</td>
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<tr>
<td>60</td>
<td>DLP plastic trunking</td>
<td>Legrand/MK</td>
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<tr>
<td>61</td>
<td>Geysers</td>
<td>Recold /Venus /Usha Lexus /Sphere hot</td>
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<tr>
<td>62</td>
<td>Tower Light</td>
<td>Ligman/Simes/Bega</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Makes</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>63</td>
<td>HT/LT transformers</td>
<td>ABB/Schneider/CGL</td>
</tr>
<tr>
<td>64</td>
<td>HT SF-6 circuit breakers/VCB</td>
<td>Siemens/ABB/CGL/Schneider</td>
</tr>
<tr>
<td>65</td>
<td>Programmable Logic Controller(PLC)</td>
<td>Siemens/Allen-Bradley/Schneider</td>
</tr>
<tr>
<td>66</td>
<td>Earthing (Chemical Earthing) Plate Earthing</td>
<td>JMV/As per CPWD Norms</td>
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<tr>
<td>67</td>
<td>Octagonal Pole</td>
<td>Bajaj/Crompton/Phillips</td>
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<tr>
<td>68</td>
<td>11 kV HT panel Incoming relay</td>
<td>CGL/Schneider/ABB/Siemens</td>
</tr>
<tr>
<td>69</td>
<td>Control Relay Panel</td>
<td>CGL/Schneider/ABB</td>
</tr>
<tr>
<td>70</td>
<td>Lightning Arrestor</td>
<td>ABB/Alltec/JMV</td>
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<td>71</td>
<td>Temp. Gauge</td>
<td>Guru</td>
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<td>72</td>
<td>Gate Valve</td>
<td>Leader/Sant</td>
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<tr>
<td>73</td>
<td>Electrical Backup</td>
<td>Spare hot/Racold</td>
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<td>74</td>
<td>PVC Tank</td>
<td>Syntex/Polycon</td>
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<td>75</td>
<td>Thermostat</td>
<td>ISI Marked</td>
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<tr>
<td>76</td>
<td>Flat Collector Plate</td>
<td>Solocrome/Tata BP/Racold</td>
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<tr>
<td>77</td>
<td>S.S Sheet</td>
<td>Jindal/National</td>
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<tr>
<td>78</td>
<td>HT/LT cable joints (Straight through/outdoor/indoor)</td>
<td>3M/Denson/M Seal/Raychem/Cabseal</td>
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<tr>
<td>79</td>
<td>Alternator</td>
<td>STAMFORD/Crompton Greaves</td>
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<tr>
<td>80</td>
<td>DG Set</td>
<td>Sterling &amp; Wilson/Commins Power/Kirlosker</td>
</tr>
<tr>
<td>81</td>
<td>Makes of accessories of HT / LT Panel / Transformers</td>
<td>As per standard practice of manufacturer.</td>
</tr>
<tr>
<td>82</td>
<td>Bus Trunking</td>
<td>L&amp;T/Schneider as per standard practice of OEM manufacturer/channel partner</td>
</tr>
<tr>
<td>83</td>
<td>HT Panel 11 KV</td>
<td>ABB/Schneider/CGL (Crompton Greaves Ltd.)</td>
</tr>
<tr>
<td>84</td>
<td>Bus Duct</td>
<td>Neptune/Milestone/Tricolite</td>
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</tbody>
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## PART C-II
### HVAC COMPONENT

<table>
<thead>
<tr>
<th>Part</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HVAC- AHUs and accessories (Ducting, Piping, Valves, Grills/Diffusers, Fitting)</td>
</tr>
<tr>
<td>2</td>
<td>Misc. Ventilation system</td>
</tr>
<tr>
<td>3</td>
<td>Ventilation- LAB, Autoclave, Central Instrumentation</td>
</tr>
</tbody>
</table>
PART- A: GENERAL TERMS AND CONDITIONS

1. SCOPE OF WORK

Scope of work covers planning, designing, supply, installation, testing & commissioning of HVAC services required to be provided in the said scheme. The scope of work to be carried out under the contract is illustrated in DBR, Drawings, Specifications and Schedule. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Executive Engineer (Air-conditioning). The contractor shall furnish all labour, materials and equipment as listed under Schedule and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete HVAC system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

The system includes:

a) All refrigerant, Chilled water piping works including insulation, pressure testing, protection, hanging and support works.

b) Supply, Installation, Testing and Commissioning of air distribution system comprising of factory fabricated GSS Rectangular/round duct work complete with acoustic lining and thermal insulation by XLPE type..

c) Supply and installation of BMS compatible electrical panel for HVAC equipments.

d) Supply and installation of BMS Related work.

e) Electrical and control wiring from panel to HVAC equipment.

f) Electrical wiring from panel to Outdoor and control cabling from outdoor to indoor units. Electrical wiring of indoor units.

g) Earthing (Grounding) System.

h) Supply, installation and commissioning of AHUs, FCUs, Ventilation Fans, condensing units and any other HVAC equipment/ accessories mentioned in schedule or necessary to successfully complete the project as per client’s requirements

i) Foundations for equipments including foundation bolts and vibration isolation spring/pads,

j) Suspenders, brackets and floor/wall supports for suspending/supporting ducts and pipes.

k) Suspenders and/or cable trays for laying the cables,

l) Opening and Sealing of all floor slab/ wall openings for pipes and cables, from fire safety point of view, after laying of the same.

m) Painting of all exposed metal surfaces of equipments and components with appropriate color.

n) Making openings in the Walls/Floors/Slabs or modification in the existing openings wherever provided for carrying pipe line, ducts, cables etc.

o) Providing wooden/ metallic frames for fixing grills/diffusers.

p) Making good all damages caused to the structure during installation and restoring the same to their original finish.

q) All electrical associated works as per the schedule and drawings, specifications.
r) Supply, Installation, Testing and Commissioning of Dx split Packages complete with all accessories for control rooms.
s) Supply, installation, testing & commissioning of Variable frequency drives for air handling units and its integration with BMS on Bacnet protocol, extruded aluminum powder coated grilles & diffusers, volume control dampers, new generation fire dampers etc. as required.
t) Supply & Installation of condensate drain piping complete with insulation.
u) Supply, Installation, Testing & Commissioning of Variable frequency drives for air handling units and its integration with BMS on Bacnet protocol, extruded aluminum powder coated grilles & diffusers, volume control dampers, new generation fire dampers etc. as required.
v) Supply & Installation of automatic controls and instrumentation required for efficient functioning of the HVAC system.
w) Supply, installation, testing & commissioning of variable frequency drives and integration with valve actuator, fire damper, thermostats and BMS controller.
x) Supply, installation, T& C of BMS software and its integration with AHU, VFD, existing fire alarm panels, access control system CCTV and VAV system of offices.
y) Balancing, Testing and commissioning of the entire installation under scope.
z) Arrangement of scaffolding in case of working height more than 3.5 mtr.

2. The above scheme of all the E & M work shall have to meet all the requirements of local bodies/ CEA/NBC norms as applicable and meet the technical specifications of various relevant CPWD specifications for E & M works.

3.0 Technical Submittals
The successful tenderer after award of work shall furnish technical submittals for various items incorporating complete technical details prior to procurement of equipment/materials, for the approval of the Engineer-in-charge. The submittals for items mentioned in the tender document but not restricted to the following:

| a.  | Air Handling Units. |
| b.  | Fan coil units |
| c.  | Axial Flow fans |
| d.  | Pre insulated pipes |
| e.  | Factory fabricated ducting, GS Sheet, dampers, grilles & diffusers and actuators, sensors etc. |
| f.  | Insulation material. |
| g.  | Variable frequency drive, variable air volume boxes |
| h.  | Field devices and DDC controllers |
| i.  | BMS software and hardware components |
| j.  | Electrical Panels & components. |

Test certificates for various items shall also be submitted by the contractor.

10.0 Performance Guarantee
The Contractor shall guarantee uninterrupted service and stipulated quality of performance of the installed HVAC system. The guarantee shall be furnished in the Proforma indicated in the Appendix-I. It is to be clearly understood that the specifications indicated represent minimum performance requirements for the tenderers guidance.

11.0 Fees and Permits
The Contractor shall obtain all permits/licenses and pay for any and all fees required for the installation, inspection and commissioning of the work.

12.0 Liability to Govt. Regulations:

a. The Contractor shall be responsible and shall abide by all the Government rules and
regulations pertaining to erection, testing and commissioning of complete HVAC system at site.

b. Any compensation towards damage/loss of property/material/ equipment or to any person working at site shall be borne by the Contractor as per standard terms of Contract.

c. No escalation/ change of prices would be admissible under any circumstances.

**No Limit to Liability**

In addition to the liability imposed by law upon the Contractor for injury (including death) to persons or damage to property by reason of the negligence of the Contractor or his agents, which liability is not impaired or otherwise affected hereby, the Contractor hereby assumes liability for and agrees to save the Engineer-in-charge harmless and indemnifies him from every expense, liability or payment by reason of any injury (including death) to persons or damage, to property suffered through any act of omission of the Contractor, or any of his sub-Contractors, or any person directly or indirectly employed by any of them or from the conditions of the premises or any part of the premises which is in the control of the Contractor or any of his sub-contractors, or any one directly or indirectly employed by either of them, or arising in any way from the work called for by this contract.

**15.0 Partial Ordering:**

Engineer-in-charge reserve the right to order equipment & material from any and all the alternates and/or low side equipment and materials or parts thereof from one or more tenderers.

**16.0 Engineering Responsibility of the system**

a. The responsibility of system design, manufacturing, erection, working and safety will solely be responsibility of the Contractor for the parameters as mentioned in the tender documents prepared by the Engineer-in-charge.

b. The system after commissioning shall be handed over to the Engineer-in-charges and thereafter they will monitor the performance for standard designed (without operation of any other equipment) parameters for 30 days continuously. In case during this period the performance is not found satisfactory and rectification/ replacement, design improvement or any other change as felt necessary, will be made by the Contractor at no extra cost. Though these improvements can only be done after getting the approval from the Engineer-in-charges.

**17.0 Schedule and Manner of Operations**

Time being the essence of this Contract, the Contractor will be expected to furnish all labour and materials in sufficient quantities and at appropriate times, expedite and schedule the work as required and so manage the operation that the work will be completed within the time stated in the Contract. In addition to providing a detailed time and progress schedule, the Contractor shall submit an outlined and graphic schedule of proposed procedures to the Engineer-in-charge within two days of issue of work order.

**18.0 Bye Laws & Regulations**

The installation shall be in conformity with the bye-laws, regulations and standards of the concerned local authorities so far as these become applicable to the installation. However, if these specifications call for a higher standard of materials and /or workmanship than those required by the regulations and standards then these specifications shall take precedence over the said regulations and standards then these specifications shall take precedence over the said regulations and standards. If the specifications call for requirements which violate the bye-laws and regulations, the bye-laws and regulations shall govern the requirements of these installations.

**19.0 Erection and Supervision :**

a. The Contractor shall depute engineers from time to time of commencement of assembly and installation work to inspect all relevant civil construction/ fabrication and other necessary facilities to make improved action if felt necessary. However, a site
engineer preferably a graduate in mechanical or electrical discipline shall be deputed at site permanently till completion of the work and shall be identified to the Client at the time of appointment at site.

b. All the ducting installation work shall be carried out in conformity with approved reflected ceiling plans well in advance to ensure uninterrupted working of other agencies.

20.0 Electrical Power

The tenderer shall submit with their quotation the break up of electrical power requirement for all the HVAC equipment.

21.0 Design Drawings

The drawings prepared by the Consultant/Engineer-in-charge as listed under HVAC LAYOUT DRGS are indicative only of the general arrangement of the entire installation. The Contractor shall follow these drawings and specifications in preparation of his shop drawings and subsequent installation. He shall check the drawings of other trades to verify space for his installation. The Contractor shall thoroughly examine all relevant architectural, structural, plumbing, electrical and other services layout drawings before preparing the shop drawings for this installation and report to the Engineer-in-charge any discrepancy and obtain clarifications. Any changes found necessary for coordination and installation of this work with other services and trades shall be made with prior approval of the Engineer-in-charge without any additional cost to the Engineer-in-charge.

22.0 Technical Data

The tenderer shall submit a comprehensive schedule of technical data and complete manufacturer’s specifications for all items of equipment and material including the manufacturer’s name. The technical data shall be furnished in the proforma indicated in Appendix B.

23.0 Shop Drawings

a. Within 45 days after the award of the Contract, the contractor shall furnish for the approval of the /engineer in charge, three sets of detailed shop drawings of all equipment and materials including plant room, ducting, piping, ventilation system electrical work associated with the HVAC system required to complete the project as per Specifications and as required by the engineer in charge. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics, and capacity of all items of equipment, as also the details of all related items of work by other Contractors. Each item of equipment proposed shall be a standard catalogue product of an established manufacturer as per specifications. If the Engineer-in-charge makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated, along with the drawings on which corrections were made. After final approval has been obtained from the engineer in charge, the Contractor shall submit a further six sets of shop drawings for the exclusive use of and retention by the Engineer-in-charge. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawings for the particular material or equipment.

b. The shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Engineer-in-charge ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved CPM charts.

c. Samples, drawings, specifications, catalogues, pamphlets and other documents submitted for approval shall be in quarduplicate, each item in each set shall be properly labeled, indicating the specific service for which material or equipment is to be used, giving reference to the governing section and clause number of Specifications clearly
identifying in ink the items and the operating characteristics data of a general nature shall not be accepted.

d. Approval rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are approved said approval does not mean that drawings have been checked in detail nor does it way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract.

e. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required thereof, shall be prepared by the Contractor at his own cost and approved by the Architect/Consultant.

f. Where the work of the Contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustments. If so directed by the engineer in charge, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Engineer-in-charge.

24.0 Co-operation /Co-ordination with other agencies

During the currency of the Contract, a number of Contractors will be at site to execute works under their respective contracts viz. structure, finishing works, electrical, lifts and other services. All these agencies will be at site at the same time. The Contractor shall offer full co-operation to all these agencies with regard to use of materials etc. and co-ordinate the work in such a manner that the time schedules of all agencies are not adversely affected. The work shall be executed as per program approved by the engineer in charge. If part of site is not available, for any reason, or if there is some unavoidable delay in supply of materials stipulated by the Engineer-in-charge, the program of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

No claim shall be entertained from the Contractor on the plea that the work has been executed in the above circumstances or under difficult conditions. It shall be the responsibility of the Contractor to enforce necessary discipline among his workers and staff to ensure smooth working at the site in spirit of co-operation and amity with all other agencies.

25.0 Construction Program & Schedule Of Operations:

A tentative construction program indicating the scheduling of various activities forms an annexure to this document. The Contractor should examine this program with respect to construction logic, scheduling and duration of various activities etc. in relation to the resources available at his disposal, and suitably modify the program without extending the total duration of the job as also the completion targets for major milestones of the job and submit a modified construction program along with a firm commitment to adhere to the dates of completion of various activities. This construction program shall after scrutiny and approval of the engineer in charge form part of the agreement and shall be treated as a baseline schedule to monitor, determine delays in individual activities, work milestones or the overall duration of the work.

In the event of the Contractor, not submitting any modified construction program, the tentative construction program shall remain binding on the Contractor.

The Contractor shall mobilize equipment, tools, plant, scaffolding, shuttering, material, labour etc. in sufficient quantities so as to complete the work to meet the above agreed construction
program. In the event of delays in the construction activities, the Contractor shall mobilize additional resources to complete the job in the specified time period and at no extra cost to the Engineer-in-charge. The Engineer-in-charge may suggest an alternative scheduling of operations, should they find it necessary to accomplish the targets and the Contractor shall accordingly mobilize additional resources at no extra cost to the Engineer-in-charge.

26.0 Electrical Installation and Cabling
The electrical works related to the HVAC system shall be carried out in full knowledge and with complete co-ordination of the Contractor. It is to be clearly understood that the final responsibility for sufficiency, adequacy, and conformity to the performance of the HVAC system shall be with the Contractor.

27.0 Testing and Commissioning
On completion, the installation shall be tested for conformity with the stipulated performance specifications. Any defect, shortcoming detected in the system/ material/workmanship shall be rectified by the Contractor to the entire satisfaction of the and without any extra cost to the Engineer-in-charge. The installation shall be tested again after the removal of the defects and shall be commissioned only after approval by the Engineer-in-charge. All tests shall be carried out in the presence of the Engineer-in-charge or his representative.

28.0 Completion Certificate
On successful completion of the installation, a certificate in the approved format shall be furnished by the Contractor. The Contractor shall be responsible for getting the entire installation duly approved by the Electrical Inspector or concerned authority, if any, and shall bear the all expenses in connection with the same.

29.0 Completion Documents
a. 5 copies of operation manuals/catalogues of all standard equipment to be furnished by the contractor immediately after commissioning of HVAC system.

b. 5 copies of write up on preventive maintenance, trouble shooting and operating instructions of the system alongwith as-built drawings to be supplied by the Contractor at time of commissioning.

c. 5 sets of catalogues of all accessories such as dampers, valves, strainers, gauges, electrical components etc.

30.0 Completion Drawings
On completion of the work in all respects, the Contractor shall supply five port folios (300 x 450mm) each containing a complete set of drawings at approved scale clearly indicating complete AHU layouts, ducting and piping layouts, location wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, dampers, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The Contractor shall frame under glass, in the BMS control room ac schematic with BMS controls, one set of these consolidated control diagrams.

31.0 Training of Engineer-in-charge’s representative
Upon completion of work and conclusion of all tests, the Contractor shall furnish necessary skilled labour and helpers for operating the entire installation for a period of thirty working days of eight hours each, to enable the Engineer-in-charge’s representative to get acquainted with the operation of the system. During this period, the Contractor shall train the Engineer-in-charge’s representatives in the operation, adjustments and maintenance of all equipment installed.

32.0 Correction of Work before Final Payment
The Engineer-in-charge shall conduct a final inspection just before the virtual completion of the work and prepare a final list of materials, equipment and item of work which fail to conform to the contract specifications. The Contractor shall promptly replace or re-execute such items in accordance with the contract and shall bear all expenses of making good all work and the cost of all work of the other Contractor, destroyed or damaged by such replacement or removal.

If the Contractor fails to remove and replace above rejected materials, equipment or workmanship within a reasonable time, fixed by written notice, the Engineer-in-charge may employ and pay other persons to amend and make good such defects at the expense of the Contractor. All expenses incurred by the Engineer-in-charge in rectifying the defects including all damages, loss and expense consequent on the defects shall be recoverable from any amount due or which may become due to the Contractor.

33.0 Virtual Completion

The work shall be considered virtually complete only upon fulfillment of the procedure laid down in the preceding clause and when the Consultants and the Engineer-in-charge has certified in writing that the work has been virtually completed. The defect liability period shall commence from the date of such certificate.

34.0 Maintenance of Liability Period

Defects liability period shall commence from the date of virtual completion upon fulfillment of the procedure laid down. The complete HVAC system shall be under warrantee of 36 months from the date of completion of the system. Contractor shall include incidental expenses towards necessary maintenance during defects liability period.

35.0 Force majeure

The right of the contractor to proceed with the work shall not be terminated because of any delay in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not limited to acts of God, or of public enemy, restraints of a sovereign state, floods, unusually severe weather.

36.0 Use and Care of Site

Contractor will be permitted to use without charge, the site and the areas shown in the contracts drawing for execution of work and for related activities. The contractor shall not commence any operation on such and except with the approval of the Engineer-in-charge. All rubbish shall be burnt or removed from the site as it accumulates. All surface and soil drains shall be kept in a clean sound and workman-like state. All the areas of contractor's operation shall be cleared before returning them to the Engineer-in-charge. The contractor shall make good any damages or alternations made to areas, properly or land handed over to him before these are returned.

37.0 Safety Provisions

The contractor shall take full responsibility for the adequate stability and safety of all site operations and methods of construction, subject to provisions of excepted risks and special risks.

The contractor shall at his own expense arrange for the safety in his operations as required. Safety provisions shall be as per the latest safety manuals published by Indian Standard Institution, Statutory Rules, Regulations and Provisions of contract conditions.

38.0 Clearance of Site

The Contractor shall have to remove all malba and other unwanted materials from site of work, before handing over HVAC installation to the Engineer-in-charge. The work shall not be treated as complete in all respects unless these requirements are fulfilled by him. In the event
of the Contractor failing to do so, the Engineer-in-charge shall have the right to get the site cleared at his expenses.

39.0 **After Sales Services:**

The HVAC Contractor shall ensure adequate and prompt after sales service in the form of maintenance personnel and spares as and when required with a view to minimizing the breakdown period. Particular attention shall be given to ensure that all spares are easily available during the normal life of the installation.

40. **Works Inspection and Testing of Equipment:**

Prior to dispatch of the AHU’s, factory fabricated ducting, pre insulated pipes, valves and other equipment’s the Institute reserves the right to inspect the same at the manufacturer’s works and the contractor shall provide and secure every reasonable access and facility at the manufacturers works for inspection, for witness of all acceptance and routine tests as per relevant Indian Standards. Contractor shall give a reasonable notice of about 15 days for the purpose of test, and witness of all major equipment’s. For this inspection the visiting expenses shall be borne by the Institute and not to be uploaded in to the contract except the testing charges. The contractor shall only facilitate the inspection, testing at manufacturer works. **The Pre insulated chilled water pipe shall be tested at the manufacturing location as per the specification.**

41.0 The work shall be executed on the basis of the following CPWD specifications:

i) **Electrical & HVAC Works:**
- General specifications for Electrical Works Part-1 (Internal) 2013 with up to date corrections.
- General specifications for electrical works (external) 2013 with uptodate corrections.
- General specifications for electrical works Part-VII (DG set) 2013 with up to date corrections.
- General specifications for electrical works Part-IV Sub-station- 2013 with up to date corrections.
- General specifications of HVAC works 2017 with up to date corrections.

1. **RELATED DOCUMENTS**

These Specifications shall be read in conjunction with the General conditions of contract, schedule of work, drawings and other documents connected with the work.

2. **TERMINOLOGY**

The definition of terms used in these specifications shall be in accordance with IS: 3615-"Glossary of terms used in refrigeration and air-conditioning". Some of the commonly used terms are defined in last chapter of the specification.

3. Eligibility condition for Associate agency for execution of HVAC works.
4. The associate agency (Non CPWD) having valid electrical license.
5. They should have successfully completed works, as mentioned under during last 7 year ending previous day of last date of submission of tender.
   i) Three similar works each of value not less than Rs. 90,04,000/-
      OR
   ii) Two similar works each of value not less than Rs. 1,35,06,000/-
      OR
   iii) One similar work each of value not less than Rs. 1,80,08,000/-
Out of the above at least one work must be in the Central Govt. /Central autonomous bodies/central PSU/State PSU/State Govt.

iv) Similar nature of work means: Execution of central air-conditioning low side works with integrated building management system work (both mandatory) i.e. supply, installation, testing & commissioning of chilled water based AHU, CSU, and FCU, ducting, piping, insulation and its controls etc, along with integrated building management system (BMS) project with its integration with variable frequency drives/AHU's/fire alarm system/access control/CCTV etc.

v) Having GST, ESI & EPF registration No. of government authorities.

vi) Details of average annual financial turnover of air-conditioning works should be at least 100% of the estimated cost during the last 3 consecutive financial years.

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 the previous day of last date of submission of tenders.

6. The main contractor / agency has to submit detail of such associate agency to Engineer-In charge (HVAC) within 45 days of issue of award of letter. (The associate agency shall be approved by Executive Engineer (AC). In case the main contractor intends to change any of the above agency / agencies during the operation of the contract; he shall obtain prior approval of Executive Engineer (AC).

7. The new agency shall also have to satisfy the laid down eligibility criteria. In case Executive Engineer (AC) is not satisfied with the performance of any agency, he can direct the main contractor to change the agency executing such items of work and this shall be binding on the contractor.

8. The eligible tenderer for major component (i.e. civil) will quote rates for various items of minor components (i.e. HVAC) of work also. It will be obligatory on the part of the tenderer to sign the tender document for all the components. (After acceptance of the tender by competent authority, the SE, IWD shall issue letter of award on behalf of the Board of Governors.

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

10. The tenderer has to enter into agreement with the contractor(s) associated by him for execution of minor component(s). Copy of such agreement shall be submitted to EE in-charge of minor component as well as to EE in-charge of major component. In case of change of associate contractor, the main contractor has to enter into agreement with the new contractor associated by him. The Memorandum of Understanding between Main Contractor & the HVAC contractor & the certificate of willingness by the HVAC contractor shall be as per Proforma A & B respectively.

11. In case, the bidder is not having desired experience for execution of similar HVAC works, he shall associate air-conditioning contractor with adequate experience for the execution of similar nature of air-conditioning works. The bidder shall indicate minimum three agencies, to which he would like to associate for the execution of HVAC works. The proposed HVAC agencies shall be evaluated on the basis of eligibility criterion for the estimated value of HVAC component. The credentials of HVAC agency have to be submitted along with the technical bid.
12. The tenderer shall, within fifteen days of issue of award of letter, submit details of the agency which he proposes to associate with him for execution of HVAC items of work along with consent letter of HVAC Contractor. The details shall be submitted in the per the required eligibility criteria of HVAC Contractor attached with the tender documents to the Engineer-in-charge of HVAC item of work. The eligibility of the agency proposed to be associated for HVAC items of work shall be governed by the provisions contained in paras 5.

13. The main contractor shall be responsible for execution the HVAC work as per the detailed specification and as per requirement at the site. The contractor shall get approved the final execution drawing and specification before start of the work.

PERFORMA-A
MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN

1] M/S [ Name of firm with full address]
   Enlistment Status
   Valid Upto :
   [Henceforth called the main contractor]  
And

2] M/S [ Name of firm with full address]
   Enlistment Status
   Valid Upto :
   [Henceforth called the main contractor]

Name of work :- Centre for Engineering in Medicine (CEM) at IIT Kanpur
[ HVAC component only ] as per schedule, specification, terms and conditions of the tender.

We state that M.O.U between us will be treated as an agreement and has legality as per Indian Contract Act (amended upto date ) and the department (IIT Kanpur) can enforce all the terms and conditions of the agreement for execution of the work. Both of us shall be responsible for execution of the work as per the agreement to the extent this MOU permits.

We have agreed as under :
1- The associated contractor shall be liable for disciplinary action if he failed to discharge the action(s) and other legal action as per agreement beside forfeiture of the security deposit.
2- All the material, machinery, equipments, tools and tackles required for the execution of HVAC works as per agreement shall be the responsibility of the associated contractor.
3- The site staff required for HVAC work shall be arranged be the associated contractor as per terms and conditions of the agreement.

SIGNATURE OF SUB CONTRACTOR SIGNATURE OF MAIN CONTRACTOR
DATE DATE
PLACE PLACE

COUNTER SIGNED
EXECUTIVE ENGINEER (AC)

PERFORMA-B

WILLINGNESS CERTIFICATE

Name of work :- Centre for Engineering in Medicine (CEM) at IIT Kanpur

I will execute the work as per specification and terms and conditions of the agreement and as per direction of the Engineer-in-Charge. Also I will employ full time technically qualified supervisor for the work. I will attend inspection of officers of the department as when required.

"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 notice of the Department, then I/We shall be debarred for tendering in IIT Kanpur contract in future forever."

"I have also read the complete tender conditions and I am aware that complete tender condition of this tender document is applicable to me also"

Date : Signature of Contractor
PART B: DESIGN BASIS REPORT (DBR)

BASIS OF DESIGN FOR MEP SERVICES
FOR
CENTRE FOR ENGINEERING IN MEDICINE

A. INTRODUCTION:

A.1 Purpose: The primary purpose of this report is to provide and describe a permanent record of the building systems. In addition to describing the systems, the fundamental assumption used for design is also outlined. This includes water demand usage, power demand and usage, occupancy and lighting level. This information is critical to ensure the contractor, other disciplines operator, and future designers understand the assumptions made and the limitations of the systems. Without this information, one has to guess at the designer’s line of reasoning during their design process. Throughout the design process, the basis of design needs to be consistent with the project intent. This report is based on the schematic design assumptions and will be modified as the project progress to the detailed levels of design. The project intent is shown in the basis of design; the designer transformed the project intent and challenges into reality.

A.2 Project Description: The proposed Center for Engineering in Medicine is at campus of IIT Kanpur, which has total six floors including Ground floor. The complete description of the building is given below:

<table>
<thead>
<tr>
<th>Building Type</th>
<th>No. of Floors</th>
<th>Total Built up Area Sq.m. (Aprox.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTRE FOR ENGINEERING IN MEDICINE</td>
<td>G+5</td>
<td>7800</td>
</tr>
</tbody>
</table>

The building is proposed in existing campus of IIT Kanpur.
- Site Location: Kanpur, Uttar Pradesh
- Geographic Location: Latitude 26.44° N and Longitude 80.33° E
Altitude: 126 m above mean sea level

The proposed development includes labs, Autoclave, Central instrumentation lab on each floor. On Level -01, seminar Hall, some office spaces meeting rooms are also proposed.

**Climatic Study to design services:**

A detailed climatically study is done to utilize the systems in best possible and energy efficient manner.

The hot season lasts for 2.7 months, from April 8 to June 28, with an average daily high temperature above 97°F. The hottest day of the year is May 24, with an average high of 110°F and low of 80°F.

The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.
The muggier period of the year lasts for 5.5 months, from May 13 to October 30, during which time the comfort level is muggy, oppressive, or miserable at least 25% of the time. The muggiest day of the year is August 17, with muggy conditions 100% of the time.

The percentage of time spent at various humidity comfort levels, categorized by dew point.

The percentage of time spent in various temperature bands. The black line is the percentage chance that a given day is within the growing season.
The wetter season lasts 3.0 months, from June 19 to September 20, with a greater than 31% chance of a given day being a wet day. The chance of a wet day peaks at 60% on July 21.

**HVAC SYSTEM**

**B.1 Intent**

Objective of HVAC is to provide thermal comfort, provide sufficient ventilation and to improve Indoor air Conditions to all areas of the buildings for all occupants in an efficient and cost-effective manner. Temperatures and Indoor air quality shall be maintained in accordance with parameters as specified in the following section of Basis of Design.

The design approach shall be sensitive to environmental issues. The main thrust shall be laid on energy conservation, safety and ease of maintenance and current progressive technological developments. Building will be designed after understanding minute level of detailing and requirements of thermal comfort.

**B.2 Salient Features Of Design**

a) All motors, fans shall be as per ECBC 2017 plus to be adopted.

b) Smoke Evacuation for all common areas, wherever applicable.

c) Pressurization of Labs, Central Instrumentations, Chemical Store, and Autoclaves.

d) High level of IAQ to be maintained in Labs, Autoclave and Central Instrumentation areas.

e) The AHUs or duct shall be provided with a provisional strip heater for the dehumidification purpose.

f) HEPA filter shall be provided for Clean Room to achieve Class-100,000 cleanliness.
B.3 Energy Conservation Measures

Following measures can be taken to reduce the heat load for HVAC system

a) Wall: It is recommended to have Walls constructed with lower overall U-value to reduce heat gain through walls.

b) Roof: It is recommended to insulate Roof to increase thermal resistance and lower U-value to reduce heat gain. It is recommended to have insulation on roof with 50mm PU.

c) Glass: Low emissivity Glass of lower U-value shall be used to reduce heat gain through glass. It is proposed to considered Double Glass unit of U Value of 0.6 Btu/h. ft².°F

d) Fans and motors shall be ECBC 2017 plus complaint equipment.

B.4 Assumption

This section of the basis of design documents specifies numbers used in the design of the proposed Building of IIT Kanpur. These assumptions are an essential part of making the transition from the project intent to installed equipment and the codes are guidelines for the designer and contractor which are to be followed during the different stages of project. Following assumption are considered for the design of air conditioning. During design it is important to evaluate year round building performance for equipment selection and also study the influence of other natural parameters like temperature, Relative humidity, wind speed and solar orientation etc.

Table-1 Design Assumptions:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude/Longitude</td>
<td>26.44 ° N, 80.33 ° E</td>
</tr>
<tr>
<td>Summer outdoor air DB/WB temperature</td>
<td>43.8°C (111 °F) / 25 (77 °F)</td>
</tr>
<tr>
<td>Winter outdoor air DB/WB temperature</td>
<td>7.22 °C (45 °F) / 5.55°C(42°F)</td>
</tr>
<tr>
<td>Insulated Roof with 50 mm PUF U-value</td>
<td>0.08 Btu/h. ft².°F</td>
</tr>
<tr>
<td>Overall Wall U-value</td>
<td>0.16 Btu/h. ft².°F</td>
</tr>
<tr>
<td>Glass U-value(DGU)</td>
<td>0.6 Btu/h. ft².°F</td>
</tr>
<tr>
<td>Glass shading coefficient</td>
<td>0.56</td>
</tr>
<tr>
<td>Infiltration /Ex-filtration</td>
<td>As per ASHRAE 90.1</td>
</tr>
<tr>
<td>Cooling load design calculation program</td>
<td>HAP</td>
</tr>
<tr>
<td>Ductwork sizing program</td>
<td>Trane Ductulator</td>
</tr>
<tr>
<td>Cooling Safety factor</td>
<td>10%</td>
</tr>
</tbody>
</table>
Fan heat gain safety factor | 5%

**a. Inside Design Conditions:**
The room inside set points is considered on the basis of ASHRAE -55, Thermal Comfort charts. The tables below shows temperature profile of all the buildings:

**Table-2 Inside Condition:-**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Area Description</th>
<th>Inside Temp.</th>
<th>Inside Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corridors/ Lobbies/ Foyer/ Entrance Hall/ Seminar Hall</td>
<td>24 ± 2 °C</td>
<td>55 ± 5 %</td>
</tr>
<tr>
<td>2</td>
<td>Record/ Special Facility/Rooms</td>
<td>22 ± 2 °C</td>
<td>55 ± 5 %</td>
</tr>
<tr>
<td>3</td>
<td>Labs/Autoclave</td>
<td>23 ± 2 °C</td>
<td>55 ± 5 %</td>
</tr>
<tr>
<td>4</td>
<td>Server room</td>
<td>20 ± 1 °C</td>
<td>55 ± 5 %</td>
</tr>
<tr>
<td>5</td>
<td>Central Instrumentation/ Labs(Level-6)</td>
<td>21 ± 2 °C</td>
<td>55 ± 5 %</td>
</tr>
<tr>
<td>6</td>
<td>Faculty Office/ Department Office/ Staff Room/ Offices</td>
<td>23 ± 2 °C</td>
<td>55 ± 5 %</td>
</tr>
</tbody>
</table>

- Inside temperature of both Labs of Level-6 should be maintained at 21 ± 2°C.

**b. Lighting Load**
Following is the assumptions made for the purpose of considering heat Generation from lighting load for air conditioning and is as per the ECBC standards:

- 0.9W/SFT for Seminar Hall/ Corridor/ Foyer/ Coffee Lounge/ Rooms
- 1.4 W/SFT for Labs/ Central Instrumentation/ Autoclave/ Virus room
- 1.4 W/SFT for Clean room/ Special Facility
- 1.1 W/SFT for Meeting Rooms/ Reception/ Office/ Faculty/ Waiting Lounge
- 1.1 W/SFT for Faculty Office/Chemical Storage/ BMS Tech Staff/ Faculty

**c. Fresh Air**
Adequate fresh air quantity shall be provided to air-conditioned spaces to maintain Indoor air quality (IAQ) generally as per ASHRAE standard 62.1-2013.

- 7.5 CFM /person + 0.06 CFM/Sq.ft. for Seminar Hall.
- 7.5 CFM /person + 0.18 CFM/Sq.ft. for Central Instrumentation/ Autoclave
- 7.5 CFM /person + 0.18 CFM/Sq.ft. for Coffee Lounge
- 5 CFM /person + 0.18 CFM/Sq.ft. for Chemical Store/ Staff Room
- 10 CFM /person + 0.18 CFM/Sq.ft. for Labs.
- 5 CFM /person + 0.06 CFM/Sq.ft. for Office/Meeting room/Dept. Office/Teaching Lab
- 5 CFM /person + 0.06 CFM/Sq.ft. for Faculty/ Special Facility/ Faculty Office
- 5 CFM /person + 0.06 CFM/Sq.ft. for Lobby/ Foyer/ Corridor
- 5 CFM /person + 0.06 CFM/Sq.ft. for Rooms
d. **Equipment Loads**  
Following is the assumptions made for the purpose of considering Equipment load and will be according to electrical equipment used:

- 3 W/Sq.ft. for Seminar Hall
- 6 W/Sq.ft. for Central Instrumentation
- 10 W/Sq.ft. for Autoclave
- 7 W/Sq.ft. for Labs
- 5 W/Sq.ft. for Chemical Storage
- 1 W/Sq.ft. for Corridors/Lobby
- 2 W/Sq.ft. for Foyer
- 500 W for Faculty/Faculty Office/Chemical Store
- 300 W for Lobby
- 600 W for Foyer/ Entrance Hall/ Offices/ Rooms/ Coffee Lounge
- 1200 W for Special Facility
- 1500 W for Teaching Lab/Reception
- 1000 W for Technical Staff/ Offices/ Rooms
- 800 W for Faculty
- 2000 W for Meeting Room/ Waiting Lounge/Departmental Office


e. **Occupancy**  
Occupancy as per furniture layout of rooms as mentioned on the architectural plans. For areas where capacity is not mentioned, ASHRAE 62.1-2013 table 6-1 referred.

f. **Noise Criteria**  
Noise levels to be maintained inside the respective spaces as mentioned below as per NBC-2016:

<table>
<thead>
<tr>
<th>Type of Space</th>
<th>Sound Level-dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs/Autoclave/Central Instrumentation/ Chemical Store</td>
<td>40-45</td>
</tr>
<tr>
<td>Corridors/ Lobbies</td>
<td>35-40</td>
</tr>
<tr>
<td>Foyer/ Entrance Hall/ Record/ Special Facility</td>
<td>35-40</td>
</tr>
<tr>
<td>Faculty Office/ Department Office/ Staff Room/ Offices</td>
<td>35-40</td>
</tr>
</tbody>
</table>


g. **Mechanical Ventilation System:**  
The following areas shall be provided with dedicated ventilation system with the number of air changes, or CFM per Sq.ft, for each space as identified herewith:

a) Toilets : 10 ACPH  
b) Electrical Room : 20 ACPH  
c) Chemical store Room : 15 ACPH  
d) Virus room : 20 ACPH  
e) Pantry : 15 ACPH
f) Smoke exhaust : 12 ACPH

h. Relative Pressure:
- Toilet Rooms : Negative inside pressure
- Chemical Store Rom : Negative inside pressure
- Virus Room : Negative inside pressure
- Clean Room : Positive inside pressure
- Lift well : Positive inside pressure
- All other areas : As per codes and standards

i. Clean Room:
Clean room shall be designed as per Class-100,000 Standard, in which the air cleanliness shall be maintained in a way where, 0.5 micron & 5 micron of particles should not be more than 1Lakh & 70 particles per cubic foot respectively.

To achieve such condition following parameters are considered during design:
- Air Change per Hour : 60 ACPH
- Filter : HEPA filter of 99.997 %
- Pressurization : Positive inside pressure
- Air Return : Low Wall
- Filter Coverage : 7-15 %

B.5 Reference Standards
The applicable Standards/Codes are:
(a) American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE).
- ASHRAE-55, Thermal Comfort
- ASHRAE 90.1-2013
- ASHRAE 62.1-2013
- Fundamentals-2009
- HVAC Application - 2007
- HVAC System & Equipment - 2008
- Refrigeration -2006
- ASHRAE Standard 170-2008
(b) Duct construction standards as per relevant BIS Codes & SMACNA standards
(c) Motor, Cabling Wiring, and accessories as per BIS codes
(d) Air Filter as per ASHRAE-52.1-1992 and 52.2-2007
(e) National Electric code
(f) National Fire code
(g) National building Code-2016
(h) NFPA Standards
(i) ECBC-2017
The following IS codes shall be applicable:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Material/item of Work</th>
<th>Standard/Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ducting Fabrication</td>
<td>IS: 655 (Latest Rev.)/ SMACNA</td>
</tr>
<tr>
<td>3.</td>
<td>Aluminum Sheets/Wires</td>
<td>IS: 737</td>
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<tr>
<td>4.</td>
<td>Mild Steel, ERW Pipes</td>
<td>IS: 1239, IS: 3589</td>
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<td>5.</td>
<td>Pipe Fittings</td>
<td>IS: 1239</td>
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<tr>
<td>6.</td>
<td>Steel Pipe Flanges</td>
<td>IS: 6392</td>
</tr>
<tr>
<td>7.</td>
<td>Gate, Globe &amp; Check Valves</td>
<td>IS: 778</td>
</tr>
<tr>
<td></td>
<td>• Upto 40 mm Gun metal</td>
<td>IS: 778</td>
</tr>
<tr>
<td></td>
<td>• Butterfly valve of 50 mm and Above(Cast Iron)</td>
<td>IS: 780, IS: 2906</td>
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<tr>
<td></td>
<td>• Balancing valve</td>
<td>IS: 778</td>
</tr>
<tr>
<td></td>
<td>• Non Return valve</td>
<td>IS: 5312</td>
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<tr>
<td>9.</td>
<td>3 Phase induction motors</td>
<td>IS: 325</td>
</tr>
<tr>
<td>10.</td>
<td>Burden type pressure gauges</td>
<td>IS: 3624</td>
</tr>
<tr>
<td>11.</td>
<td>PVC insulated electric cables</td>
<td>IS: 1554</td>
</tr>
<tr>
<td>12.</td>
<td>Starters sheets/wires</td>
<td>IS: 8555</td>
</tr>
<tr>
<td>13.</td>
<td>Specific requirements for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct switching of motors</td>
<td>IS: 4064 (Part II)</td>
</tr>
<tr>
<td>14.</td>
<td>Inspection and testing of Installation</td>
<td>IS: 732 (Part III)</td>
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<td>15.</td>
<td>Glossary of terms used in refrigeration and</td>
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<tr>
<td></td>
<td>Air-conditioning</td>
<td>IS: 3615</td>
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<tr>
<td>16.</td>
<td>Hot die zinc coated steel pipes</td>
<td>IS: 4736-1968</td>
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<td>17.</td>
<td>Expanded polystyrene</td>
<td>IS: 4671</td>
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</table>

**Safety codes**

The following safety codes as laid down by ISI shall be followed:

1. Safety code for mechanical refrigeration  IS: 660
2. Safety code for air-conditioning         IS: 659
3. Safety code for scaffolding and ladders IS: 3696
4. Welding & cutting operations            IS: 3696
5. Code of safety procedures and practices in electrical works IS: 5216

**B.6 Mechanical System Design Parameters:**

This section describes the assumptions, parameters considered for sizing and designing of various Mechanical equipments and its components. Below is the detailed description.

- **Air Handling Units:**
  - Maximum face velocity across pre-filters and filters (350 fpm): 1.78 m/sec
  - Maximum face velocity across cooling coils (500 fpm): 2.54 m/sec
  - Maximum fan outlet velocity (1800): 9.14 m/sec
  - Maximum fan speed:
    - Fan above 450 mm dia: 1000 RPM
    - Fan up to 450 mm dia: 1450 RPM
• **Piping:**
Piping shall be sized for the following design parameters:
  - Maximum velocity : 1.2 m/sec (4 FPS)
    (For piping 50 mm and under)
    : 2.5 m/sec (8.2 FPS)
    (For piping over 50 mm)
  - Maximum Friction : 15 KPa for 30 m run (5'/100’)

• **Ventilation Fans:**
  - Maximum fan outlet velocity for fan upto 450 mm dia : 9.14 m/s (1800 FPM)
  - Maximum fan outlet velocity for fan above 450 mm dia : 12 m/s (2400 FPM)
  - Maximum fan speed for fan upto 450 mm : 1440 RPM

• **Filtration:**
  - Re-circulated air (mixed outdoor & return air) at Air handling unit: Washable synthetic type air filter having 90% efficiency down to 10 micron MERV 8 and filter having 99% efficiency down to 3 microns MERV 13).
  - Re-circulated air (mixed outdoor & return air) at Ductable and Fan coil units: Washable synthetic type air filter having 90% efficiency down to 10 microns (MERV-8).

• **Duct Design Criteria:**
The following maximum duct design velocities will be used in the design of ductwork systems. Where a range is indicated, it is intended to represent velocities over a range of flow volume.

**Table-4:-**

<table>
<thead>
<tr>
<th>Low Pressure Systems</th>
<th>Meters/Second</th>
</tr>
</thead>
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<td>- Main Duct</td>
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<tr>
<td>- Primary Branch</td>
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<td>- Secondary Branch</td>
<td>2.0-3.5</td>
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</table>

<table>
<thead>
<tr>
<th>Medium Pressure Systems</th>
<th>Meters/Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Coils</td>
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</tr>
<tr>
<td>Heating Coil</td>
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<tr>
<td>Filters</td>
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</tbody>
</table>

The following maximum friction losses are to be used in conjunction with the velocities noted above.

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<th>Pascal’s/meter</th>
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</thead>
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<tr>
<td>Medium pressure systems</td>
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</table>
**B.7 Building Cooling Requirements**

This section of the report describes the Cooling (TR) requirement for the various spaces of the Research building. The total Cooling load is based on standard practice for various particular areas to figure out the overall tonnage capacity of the Buildings. Later at detailed building design, each building is simulated and modeled in the HAP to calculate 8760 hours loads estimations. Table below shows the space wise preliminary requirements:

**Table-5 Cooling Load Summary:-**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>S.N No.</th>
<th>Description</th>
<th>Area (Sq.ft)</th>
<th>Occupancy</th>
<th>Light load (Watts/Sqft)</th>
<th>Eq. Load (Watts/Sqft)</th>
<th>Lump Equip load (Watt)</th>
<th>Fresh Air (CFM)</th>
<th>Dehumidified CFM (Summer)</th>
<th>Tonnage Summer</th>
<th>Selected TR</th>
<th>Selected CFM</th>
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<tbody>
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<td>Equip load (kW)</td>
<td>Fresh Air (CFM)</td>
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| 104     | 502 FACULTY-2 | 150  | 2   | 1.1  | 500 | 19   | 352  | 0.74  |       |        |
| 105     | 503 SPECIAL FACILITY-2 | 130  | 3   | 1.4  | 120 | 0    | 53   | 344   | 0.91  |       |        |
| 106     | 504 LAB-3   | 750  | 20  | 1.4  | 7   | 335  | 2039 | 5.35  | 7.0   | 2700.0 |
| 107     | 505 FACULTY-3 | 150  | 2   | 1.1  | 500 | 19   | 352  | 0.74  |       |        |
| 108     | 506 SPECIAL FACILITY-4 | 130  | 3   | 1.4  | 120 | 0    | 53   | 344   | 0.91  |       |        |
| 109     | 507 LAB-4   | 750  | 20  | 1.4  | 7   | 335  | 1940 | 5.35  | 7.0   | 2700.0 |
| 110     | 508 FACULTY-4 | 150  | 2   | 1.1  | 0   | 500  | 19   | 320   | 0.69  |       |        |
| 111     | 509 SPECIAL FACILITY-4 | 130  | 3   | 1.4  | 0   | 120  | 0    | 53    | 325   | 0.88  |       |        |
| 112     | 510 AUTOCLAVE | 677  | 20  | 1.4  | 10  | 0    | 322  | 1983  | 5.19  | 5     | 2000    |</p>
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- Total calculated cooling load requirement for the Research Lab is **339.2TR.**
- Total selected cooling load for Research Lab is **346 TR.**
- 1 Nos. of 1.6 TR split AC unit shall be installed in UPS room at Level-1.
- 1 Nos. of 1.0 TR split AC unit shall be installed in BMS room at Level-1.
- 1 Nos. of 8.0TR VRV unit shall be installed in Central instrumentation at Level-4.

### B.8 Proposed Air Conditioning System

#### A. HIGH SIDE: Chilled Water System
Chilled water supply & Return pipe shall be connected to existing Chiller supply and return pipe as per the cooling requirement of the research building. The tap off shall be taken as per the existing line and the site condition.

#### B. LOW SIDE SYSTEMS: Air Distribution Systems
Various Options has to be explored, evaluated and opted for air distribution and low side system.
- Variable volume air distribution shall be used for faculty rooms
- Constant volume air distribution system shall be used for rest spaces

Double skin air handling units (for noise control) each consisting of centrifugal fan, cooling coil and filter section shall be provided. Supply air ducts shall be installed in ceiling spaces. Conditioned supply air shall be discharged through supply air Grills/Diffusers/Duct. Return air shall be taken back to the air handling unit room through return air Grills/Diffusers/Duct. Smoke dampers shall be provided in accordance with ASHRAE / NFPA within supply air ducts and return air ducts at AHU room wall crossings and at fire rated wall crossings to prevent spread of smoke/fire to the adjoining areas. Smoke dampers shall be motorized and actuated by smoke sensor. All AHU rooms shall also be acoustically/thermally insulated to minimize noise transmission to adjoining areas and at the same time offset unwanted return air heat gain.

#### BTU Metering System
Metered chilled water will be provided to the building. This will help to keep a check on energy usage.

#### Duct Construction and Fire Safety
All ducts shall be fabricated out of galvanized sheet steel (GSS) as per SMACNA standard for long life and as per fire norms. Motorized smoke dampers shall be installed within supply air ducts and return air ducts at AHU room wall crossings, to prevent spread of smoke / fire to the adjoining areas. Air handling unit fan motor shall also be tripped when smoke is sensed in the conditioned area served by the air handling unit.

**B.9 Mechanical Ventilation System**

Mechanical ventilation system shall be considered for Toilets, Utility, Pantry, and Electrical room using combination of Inline, Propeller, and Cabinet& Tube axial flow fans.

**UTILITY VENTILATION**

Utility Room like Electrical room, Chemical store, Pantry, etc shall be negatively pressurized so as to avoid any escaping of foul air from Utility area to other conditioned space. Exhaust air shall be removed with the use of exhaust fans.

**Table-6: Utility Ventilation:-**

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</table>

**VENTILATION FOR OTHER AREAS:**

Toilet exhaust shall be provided as required for removing foul air and maintaining good air quality. Toilet doors shall have an undercut (or an air transfer grill) so that
some conditioned air from the surrounding spaces shall pass through this undercut /air transfer grill and exhausted out. Toilets and store are exhausted using the individual/combined ducted inline fan.

**Table -7: Toilet Ventilation requirement:**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>LEVEL</th>
<th>SPACE NAME</th>
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<th>AREA IN SF</th>
<th>HEIGHT IN FT</th>
<th>ACP H</th>
<th>CF M</th>
<th>SELECTED EXHAUST FAN (CFM)</th>
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</table>

**SMOKE EXTRACTION:**
Smoke extraction hall be provided for large spaces, passages, labs and corridors.
The scheme shall be as per NBC guidelines / local fire authority bye laws whichever stringent to ensure the evacuation of smoke in case of fire. Each space shall be provided with exhaust fans suitable to run in fire mode and shall meet a min of 12 air changes. Below is the table that states the CFM required for smoke evacuation in particular zones.

**Table -8: Smoke Extraction:-**

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<th>S. NO.</th>
<th>LEVEL</th>
<th>SPACE NAME</th>
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<th>AREA IN SF</th>
<th>HEIGHT IN FT</th>
<th>ACP H</th>
<th>CFM SELECTED FAN (CFM)</th>
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## SMOKE EXTRACTION

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<th>AREA IN SF</th>
<th>HEIGHT IN FT</th>
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<th>CFM SELECTED FAN (CFM)</th>
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<td>538</td>
<td>12</td>
<td>12</td>
<td>129</td>
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### Lift well Pressurization:
Lift well pressurization shall be provided for all the lifts, as per the local norms and standards for safe evacuation in case of fire. The below calculations show the required CFM for different lift:

**Table-9 Lift well pressurization**:

<table>
<thead>
<tr>
<th>Calculation of air quantity leakage through open lift well door</th>
<th>Calculation of air quantity leakage through lift well doors and cracks on other floors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of door</td>
<td>5</td>
</tr>
<tr>
<td>Door Area(mXm)</td>
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</tr>
<tr>
<td>Area of each door</td>
<td>2.2</td>
</tr>
<tr>
<td>Air velocity(m/s)</td>
<td>1</td>
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<tr>
<td>Q(Flow)</td>
<td>4659</td>
</tr>
<tr>
<td>Perimeter of Door(m)</td>
<td>6.4</td>
</tr>
<tr>
<td>Assumed Gap(m)</td>
<td>0.001</td>
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<td>Total no. of leakaged door</td>
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<tr>
<td>Total Leakage area(sqft)</td>
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<tr>
<td>Differential pressure(Pa)</td>
<td>50</td>
</tr>
<tr>
<td>Q (Flow)</td>
<td>(2610X Total Leakage areaX (Differential pressure)^.5)</td>
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<tr>
<td>CFM required for Lift well Pressurization(CFM) of a lift</td>
<td>4978</td>
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CALCULATION FOR CFM:

<table>
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<tr>
<th>Total No.of lift in a sequence</th>
<th>1</th>
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<tr>
<td>Total cfm required for lift pressurization</td>
<td>4978</td>
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<tr>
<td>Considering 5% Safety Factor</td>
<td>5227</td>
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<tr>
<td>SELECTED FAN (CFM)-TUBE AXIAL FAN @30 mm static</td>
<td>5000</td>
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**Pressurization of Lift well(Ground + 5 floors) for Lift-2**

<p>| Calculation of air quantity leakage through open lift well door | |
|----------------------------------------------------------------| |
| Total No. of door | 6 |
| Door Area(mXm) | 1 | 2.2 |</p>
<table>
<thead>
<tr>
<th>Area of each door</th>
<th>2.2</th>
<th>m²</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>23.7</td>
<td>sqft</td>
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<td>Air velocity(m/s)</td>
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<td>m/s</td>
</tr>
<tr>
<td></td>
<td>196.8</td>
<td>fpm</td>
</tr>
<tr>
<td>Q(Flow)</td>
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<td>cfm</td>
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2 **Calculation of air quantity leakage through lift well doors and cracks on other floors**

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<th>Perimeter of Door(m)</th>
<th>6.4</th>
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</thead>
<tbody>
<tr>
<td>Assumed Gap(m)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Total no. of leakaged door</td>
<td>5</td>
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</tr>
<tr>
<td>Total Leakage area(sqft)</td>
<td>0.34432</td>
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</tr>
<tr>
<td>Differential pressure(Pa)</td>
<td>50</td>
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</table>

\[
Q \text{ (Flow)} = (2610 \times \text{Total Leakage area} \times (\text{Differential pressure})^{.5})
\]

\[
= 399 \, \text{CFM required for Lift well Pressurization (CFM) of a lift}
\]

<table>
<thead>
<tr>
<th>CFM required for Lift well Pressurization(CFM) of a lift</th>
<th>5057</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of lift in a sequence</td>
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</tr>
<tr>
<td>Total cfm required for lift pressurization</td>
<td>5057</td>
</tr>
<tr>
<td>Considering 5% Safety Factor</td>
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</tr>
<tr>
<td><strong>SELECTED FAN (CFM)-TUBE AXIAL FAN @30 mm static</strong></td>
<td>5000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pressurization of Lift well (Ground + 5 floor) for Service Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 <strong>Calculation of air quantity leakage through open lift well door</strong></td>
</tr>
<tr>
<td>Total No. of door</td>
</tr>
<tr>
<td>Door Area(mXm)</td>
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<tr>
<td>Area of each door</td>
</tr>
<tr>
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<td>Air velocity(m/s)</td>
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<tr>
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</tr>
<tr>
<td>Q(Flow)</td>
</tr>
</tbody>
</table>

2 **Calculation of air quantity leakage through lift well doors and cracks on other floors**

<table>
<thead>
<tr>
<th>Perimeter of Door(m)</th>
<th>8</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumed Gap(m)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Total no. of leakaged door</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Total Leakage area(sqft)</td>
<td>0.4304</td>
<td></td>
</tr>
<tr>
<td>Differential pressure(Pa)</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

\[
Q \text{ (Flow)} = (2610 \times \text{Total Leakage area} \times (\text{Differential pressure})^{.5})
\]

\[
= 498 \, \text{CFM required for Lift well Pressurization (CFM) of a lift}
\]

<table>
<thead>
<tr>
<th>CFM required for Lift well Pressurization(CFM) of a lift</th>
<th>8884</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No.of lift in a sequence</td>
<td>2</td>
</tr>
<tr>
<td>Total cfm required for lift pressurization</td>
<td>17768</td>
</tr>
<tr>
<td>Considering 5% Safety Factor</td>
<td>18656</td>
</tr>
<tr>
<td><strong>SELECTED FAN (CFM)-TUBE AXIAL FAN @30 mm static</strong></td>
<td>19000</td>
</tr>
</tbody>
</table>
4.0 **AHU (Air Handling Units Horizontal Type)**

Each of the units should be constructed as a double skinned unit comprising of 25mm thick foam filled panels of extruded aluminum in a pent post framework arrangement with the corners connected with glass reinforced nylon moldings or similar.

Each unit should include centrifugal DIDW forward curved G.I construction fan and components such as filter section, coiling coil, drain pan. These individual components much comply with specifications.

The double skin panels should consist of an approved expanded polyurethane foam insulation sandwiched between two galvanized sheet steel panels. The insulation should not be less than 23mm thick and have a mean density of 32 kg/m³. The two steel skins should be 0.6 mm thick.

The panels should be fixed to the frame with stainless steel screws using a nylon bush to bridge the panel sandwich. Each panel to framework joint should be sealed with low density PVC foam gasket. The panel/gasket/framework assembly should give an air tight seal. The air leakage from the unit should not be greater than that specified for the distribution ductwork.

The unit should be complete with a base frame fabricated from 2 mm galvanized G.I. sheet with cast aluminum corners. The base frame corners should incorporate a flange and hold to provide the unit with a bolt down position in each corner.

The AHU room shall be provided with drainage system and shall have proper arrangement for filter cleaning or maintenance purpose.

Chilled water coil shall be of copper having 12.5 mm to 15 mm dia tubes minimum 26 G thick with Aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across coil shall not exceed 450 FPM. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg/cm² air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. The coils shall have 10 to 12 fins per inch. Coils shall be provided with copper header to connect all the tubes. The headers shall be complete with water in/out connections, vent plug on top and drain at the bottom, and designed to provide water velocity between 0.6 to 1.8 m/s (2 to 6 fps).

For GRIHA/LEED Rating MERV 8 filters are to be used for the project.

5.0 **AHU (Air Handling Units Vertical Type)**

The unit shall be double-skinned central station air handling units. Each unit shall be in Thermo-Acoustic construction, draw-thru type, Highly Compact with lowest Foot-Print area, Ultra Quiet Performance with Factory fitted inbuilt Electrical Panel with VFD (IP-55), modular type with field assembled casing sections, complete with fans, motors wire guard, cooling coils, valves chamber, drain section, structural mountings, vibration isolators and all other related accessories as required. The unit shall be Vertical Draw-thru to suit AHU room size.

The unit shall be of the type and size suitable for ensuring a performance and capacity not less than the minimum required for the design when operating under the specified conditions. The physical size of the selected unit shall be suitable for the space allocated on the drawings and in Equipment schedule.

Thermo-acoustic panels shall be 46+2mm thick made of 0.8mm Pre-coated GSS on outside and 0.8mm GI intermediate sheet. There should not be any metal to metal contact between inner and outer skins of AHU casing to ensure thermal bridging. AHU shall be with thermal break casing.
**Thermo-acoustic Double Skin panels shall be 46±2 mm thick:**

(a) **23±2 mm thick Thermal insulation**- CFC free injected PUF of density not less than 40±2 kg/cu. m. sandwiched between Outer sheet of the panel made out of 0.80 mm pre-coated galvanized sheet with PVC guard on outside.

(b) **Acoustic insulation**- 23±2mm thick Glass wool with FRP tissue of density not less than 32±2 kg/cu.m. and 0.80mm Perforated G.I. sheet inside These panels shall be screwed from outside to the framework with gasket system to make the joints airtight. Suitable doors with nylon handles, aluminum die cast hinges & hatches shall be provided for access to various panels for maintenance. Units shall be required with access door(s) for maintenance purpose. The entire frame shall be mounted on rolled / formed GSS heavy gauge galvanized steel

The cooling coil Drain pan shall be made out of minimum 22G stainless steel sheet externally insulated with 13mm thick closed cell Nitrile rubber insulation (For coastal area insulation thickness 19 mm) with multiple slope to facilitate fast removal of condensate

**Chilled Coils:**

The coil shall have 12.7mm dia (OD) & made from seamless solid drawn copper tubes. The minimum thickness of tube shall be 0.41mm for cooling/heating coils. The coil shall be split into 2/3 coils depending upon the capacity. The split coils shall be placed on 2/3 sides of the lower section of the Vertical AHU with suitable size header having chilled water supply & return connections all inter-connected to the single header inside the casing of AHU and vertically lifted out of the casing by minimum 150mm. The necessary valves sets should be factory fitted and placed within the coil section. Single Condensate Drain Pan shall be large enough to accommodate all the split coils along with headers & valve assembly.

Computerized cooling coil selection output shall be submitted. Coils shall be AHRI 410 certified.

The coil shall be designed to provide water velocity between 0.6 to 1.8 m/s in the tubes.

The fins shall be of aluminum. The minimum thickness of the fins shall be 0.15 mm. Fin spacing shall be 11-12 fins per inch (4-5fins per cm). Fins may be sine wave/corrugated type fins. The tubes shall be mechanically expanded for minimum thermal contact between fins and tubes. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. The Coil Casing shall be of SS. Each coil shall be factory tested at 21Kg/Sqcm air pressure under water. Coils shall be designed for a maximum working pressure of 10Kg/Sq.cm. Face velocity across coil shall not exceed 2.54m/ s.

The motor shall be of high efficiency (IE-3) Totally enclosed fan cooled squirrel cage induction motor with IP-55 protection, class F insulation & selected for quiet running. The motor shall be suitable for operation on 415 ± 10%V., 3phase, 50Hz. A.C supply. The fan-motor combination shall be optimum so that power consumption and noise level may be minimized.

Each AHU shall have its own Factory fitted inbuilt electric panel within the AHU housing consisting of VFD model FC 102 of Danfoss make or equivalent (IP-55), MCB/Fuse switch unit, starter, indication Lamps, incoming out going internal & external wiring including earthing.

**Filters:**

**Pre – filters (MERV-8/ G-4):**

Cleanable filter made out of dry cleanable synthetic type minimum 50mm thick, shall be provided on the suction side of AHU as a standard equipment with the unit. These filters shall have the efficiency of 90% down to 10 micron particle size. When these
filters become loaded or full of dirt, it is removed from service and replaced by another filter. Face velocity across these filters shall not exceed 155 MPM.

**HEPA (High Efficiency Particulate Air) Filter:**

Institute of Environment Sciences And Technology dictates that a HEPA filter must trap 99.97% of particulates 0.3 micron or larger, HEPA purifies re-circulated air to achieve cleanliness.

**Dry Fabric Fine Filters (MERV-13/ F-7):**

These filters shall have efficiency of 99% down to 3micron particle size as per EU 7/ MERV-13 standard. AHUs for comfort application shall be provided with these filters on the suction side along with MERV-8 filters. Face velocity across these filters shall not exceed 155 MPM.

6.0 FCU

The fan coil unit should be of the blow through type. The fans should be centrifugal, forward curved, double width, galvanized housed, directly connected to extended motor shaft. The motor should be permanent capacitor type, and sealed lubrication. The motor wiring should include a quick disconnect for easy fan board removal. Water coils should be four-row split types. The required cooling capacity of the fan coil shall be achieved at medium speed. Setting the fan coil to high speed allows quick cool down or heat-up.

Double construction Nitrile rubber insulated drain pan should be included with each fan coil. The fan coil unit valve package must be also installed above an appropriate drain pan.

The sound transmission form the FCU at distance of one meter form the grill should be less than 37 NC.

7.0 Piping

Chilled water system shall be designed for self balancing of water flows, Therefore, 2-way automatic balancing cum control valve shall be designed in major branch pipes and at each AHU for the fine tuning balancing of the chilled water system.

The material of the piping shall be Mild Steel “C” class (heavy duty) for chilled water pipes and “B” Class GI for condensate drain pipes.

Condensate drain piping would be GI ‘B’ Class conforming to relevant BIS codes whereas in shafts PVC pipe has been considered.

Chilled water piping buried underground shall be pre-insulated HDPE SDR 11 pipe.

8.0 Centrifugal Fans

Fans shall be of the non-overloading centrifugal fan type. Impellers should have backward curved blades. Fans should have direction of rotation, discharge direction, and arrangement to suit space conditions.

Fan housing should be rigidly built and braced. Where fan scroll is 475mm or more, an access door with frame and gasket should be provided. All access doors should be so fabricated that the inner surface is flush with the inside of the scroll.

Impellers should have ample strength. They should be statically and dynamically balanced to avoid vibration and should have blades to secure quiet efficient operation.

All fans should be factory-coated with one coat of primer and one coat of machine enamel. The interior of all fans and all fan wheels should be painted as per manufacturer’s standards. All fans should be provided with galvanized steel inlet guard screens. Inlet guard screens should be of such design that they will not reduce the inlet area of fan beyond the maximum reduction permitted by the fan
manufacturer to guarantee the fan performance.

9.0 Axial Fans
The fan casing and Motor mounting plates should be manufactured from mild steel. The fan casing and flanges should have a minimum thickness of 3.0mm for fans up to and including 1000mm diameter, with thickness of 5mm for larger diameters. Flanges should be integral with casing and should be provided with bolt holes for connection. The casing assembly, complete with flanges, should be hot dip/spray galvanized after manufacture.
An external terminal box should be provided, as standard, on long case fans. Short case fans will have a terminal box on the motor only.
The fan blades should be aerofoil section, high-pressure die cast from aluminum alloy. Al blades will be examined by x-ray before machining. The fan impeller hub and clamp-plate should be cast in aluminum alloy and should be examined by x-ray before machining to ensure sound casting.
The pitch angle of the fan should be individually adjustable. The fan should be of the variable pitch angle or controllable pitch angle design. The supplier should be able to provide evidence that the impeller has been adequately stressed for running at the highest speed. The impeller should be balanced to G3.6 or better as defined in ISO 1940/1:1986 (6.3 mm/s peak to peak or 4.5mm/s rms).
The aerodynamic design of the fan should be such that the maximum power required by the fan occurs within the normal working ranges, i.e., it has a non-overloading characteristic.
The fan should be suitable for frequent starting applications and for continuous operation in ambient temperatures ranging from -43°C up to +63°C.
Fan motors should be at the totally enclosed, squirrel cage induction, continuous duty, and variable torque type.
Flexible connectors should be provided where indicted by design engineer and should be fabricate from neoprene coated fiberglass type NCA/S.

10.0 Motors
All Motors use in air conditioning system shall be suitable for 415±10% Volts 3 phase 50 cycles/second incoming power supply and shall be high efficiency and shall meet performance as per ASHRAE standard 90.1-2010 and shall be IE-03 efficiency.

11.0 Sound & Vibration Isolator:
Mechanical services shall generally be designed and installed with provision to contain noise and transmission of vibration, generated by moving plant and equipment or source to achieve acceptable Noise rating for NC levels for occupied space. Vibration isolator shall be designed for minimum isolation efficiency of 90%.
All items of rotating/reciprocating plant and equipment shall be isolated from the foundation/structure by the use of anti-vibration material, mounting or spring loaded support fixed to either concrete bases, inertia blocks or support steels as indicated.

12.0 SHEET METAL DUCT (FACTORY FABRICATED):
I. GENERAL:
Supply, fabrication, installation and testing of all sheet metal ducts & supply, installation, testing and balancing of all grilles, registers and diffusers, in accordance with these specifications and the general arrangement shown on the drawings Duct work shall mean all ducts, casings, dampers, access doors, joints, vanes, stiffeners, hangers and supports etc. All ducts shall be fabricated according to SMACNA & IS277 & 655 from galvanized steel sheets of zinc grade G27 or Z90 of the following thickness as indicated in schedule of quantities & as described in
the relevant latest IS codes.

II. RECTANGULAR DUCT:

<table>
<thead>
<tr>
<th>Dimensions of Ducts</th>
<th>GI Sheet</th>
<th>Type of Joints</th>
<th>Type of Bracing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thickness (mm)</td>
<td>Gauge</td>
<td></td>
</tr>
<tr>
<td>Upto 600</td>
<td>0.63</td>
<td>24</td>
<td>G.I. Flange at 2.5 Centre</td>
</tr>
<tr>
<td>601 to 750</td>
<td>0.63</td>
<td>24</td>
<td>-------</td>
</tr>
<tr>
<td>751 to 1000</td>
<td>0.63</td>
<td>24</td>
<td>25x25x3mm angle iron frame with 6mm dia nuts and bolts.</td>
</tr>
<tr>
<td>1000 to 1500</td>
<td>0.8</td>
<td>22</td>
<td>25x25x3mm angle iron frame with 8mm dia nuts and bolts.</td>
</tr>
</tbody>
</table>

Sheet metal ducts shall be fabricated out of galvanized steel sheets conforming to BIS 655, BIS 277, BIS 737. Sheets used shall be produced by Hot dip process and galvanizing shall be Class VIII.

III. HANGERS FOR DUCT:

<table>
<thead>
<tr>
<th>Duct Size (mm)</th>
<th>Spacing (M)</th>
<th>Size of MS Angle (mm x mm)</th>
<th>Size of Rod Dia (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 750</td>
<td>2.4</td>
<td>25 x 3</td>
<td>8</td>
</tr>
<tr>
<td>751 to 1500</td>
<td>2.4</td>
<td>40 x 5</td>
<td>10</td>
</tr>
<tr>
<td>1501 to 2250</td>
<td>2.4</td>
<td>50 x 5</td>
<td>12</td>
</tr>
</tbody>
</table>

13.0 TOILET AND PANTRY EXHAUST:
Toilet exhaust fans will be provided in spaces as required removing foul air and maintaining air quality. Toilets, Pantry etc. will also have exhaust system installed. Toilet doors shall have an undercut (or an air transfer grill) so that some air from the surrounding spaces shall pass through this undercut/air transfer grill and exhausted out, using duct mounted fans. Toilets are ventilated through the Propeller/Inline fans but it is a localized and air is exhausted at the same floors.

PART- II: APPLICABLE CODES AND STANDARDS

1. APPLICATION CODES AND STANDARDS
Supply, erection, testing and commissioning of all equipment’s shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of relevant standard and codes.

   i) General

ASHRAE-2008 | Systems and Equipment’s
### ii) PIPES AND FITTINGS:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS: 1239, IS: 3589</td>
<td>Mild Steel, ERW Pipes</td>
</tr>
<tr>
<td>IS: 6392</td>
<td>Steel Pipe Flanges</td>
</tr>
<tr>
<td>IS: 4736-1968</td>
<td>Hot die zinc coated steel pipes</td>
</tr>
<tr>
<td>IS: 1239</td>
<td>Pipe Fittings</td>
</tr>
</tbody>
</table>

### iii) SHEET METAL WORK:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS: 737</td>
<td>Aluminum Sheets/Wires</td>
</tr>
<tr>
<td>IS: 277-1977</td>
<td>Galvanized Sheets/Wires</td>
</tr>
<tr>
<td>IS: 655 (Latest Rev.)/ BIS Code</td>
<td>Ducting Fabrication</td>
</tr>
</tbody>
</table>

### iv) VALVES:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS: 778</td>
<td>Balancing Valves</td>
</tr>
<tr>
<td>IS: 13095</td>
<td>Butterfly valves for general purposes.</td>
</tr>
<tr>
<td>IS: 5312</td>
<td>Non return valve</td>
</tr>
<tr>
<td>IS: 3950</td>
<td>Specification for surface boxes for sluice valves.</td>
</tr>
<tr>
<td>IS: 12992 (part - 1)</td>
<td>Safety relief valves, spring loaded design.</td>
</tr>
</tbody>
</table>

**v) NOISE & VIBRATION:**

| IS: 2264 | Preferred frequencies for acoustical measurement. |

**vi) EARTHING:**

| IS: 3043 : 1966 | Code of practice for earthing |
| IS : 3151 : 1965 | Earthing transformer |
| IS: 12776 : 1989 | Galvanized stand for earthing |

**vii) FUSES:**

| IS: 2208 : 1966 | HRC fuses links up to 650 V |
| IS : 2086 : 1963 | Carrier and bases used in rewire able type electric fuses up to 650 V |
| IS: 3106 : 1966 | Code of practice for maintenance of Fuses |

**viii) MOTOR :**

| IS: 325 | 3 Phase induction motor |
| IS : 996 | Specs for single phase small AC and universal motor |
| IS: 3106 : 1966 | Code of practice for maintenance of Fuses |

**ix) SAFETY CODES :**

| IS: 660 | Safety code for mechanical refrigeration |
| IS : 659 | Safety code for air conditioning |
| IS: 3016 | Safety code for precaution for precaution in welding and cutting operation |
| IS: 5216 | Code for safety procedure and practice in electrical work |
In addition below codes shall also be referred:
1. NBC-2016
2. ECBC+Building-2017
3. ANSI/ASHRAE/IESNA-90.1-2013
   3.1. AHRI 410-2001 WITH ADDENDA 1,2 AND 3: Forced circulation Air-Cooling and Air-heating coils
   3.2. ANSI/AHRI 430-2009: Central Air Handling Units
   3.3. ANSI/AHRI 440-2008: Performance Rating of room fan coil units
   3.4. AHRI 575: Standard for method of measuring machinery sound within equipment room

Note: All codes/ Standards with latest amendments/ Issues shall be referred.

All codes mentioned in the DBR documents shall be referred.
TECHNICAL SPECIFICATIONS

PART-III: FACTORY BUILT AIR HANDLING UNITS (AHU), FAN COIL UNITS (FCU), air cooled split unit & AIR COOLED VRV SYSTEM

1. SCOPE
This chapter covers the detailed requirements of factory built double skin air handling unit (AHU) and single skin fan coil unit (FCU) for central air-conditioning system. The configuration and details of each AHU shall be verify and co-related with individual building schedule.

2. FACTORY BUILT AIR HANDLING UNIT (AHU)

2.1. TYPE
The air-handling unit shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, humidification section (where specified), filter section and drain pan. The unit shall be with In built electrical panel with VFD (FC-102/Equivalent) (IP-55). Unless otherwise specified, the unit shall be horizontal type. The Vertical AHUs shall be provided with wall mounted electrical panel with VFD (FC-102/Equivalent) (IP-55).

2.2. RATING
i) The capacity of the cooling coil, the air quantity from the blower fan and static pressure of blower fan shall be as laid down in the tender documents. Where these parameters as calculated by the tenderer exceed the specified values, the coils and the blower fan shall satisfy these calculated values.

ii) The coil shall be designed for a face velocity of air not exceeding 450 ft/min.

2.3. MATERIAL AND CONSTRUCTION

a) HOUSING / CASING (Horizontal AHU)

i) The housing/ casing of the air handling unit shall be of double skin construction. The housing shall be so made that it can be delivered at site in total semi knocked down conditions depending upon the requirements. The main framework shall be of suitable structural sections. The entire framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Framework of all air handling units shall be made of thermal break hollow extruded aluminum profile. In case of AHU casing design with no contact between inner and outer surface, thermal break profiles can be avoided.

ii) Double skin panels shall be minimum 46mm thick made of 0.8mm pre-plasticized and pre-painted with PVC guard, GSS sheet on outside and 0.8mm galvanized sheet inside with polyurethane foam insulation of density not less than 38 kg/cum injected in between by injection moulding machine. It shall also be provided with internal acoustic insulation for AHU internal noise suppression. These panels shall be joined and connected to the framework/ supports with soft rubber gasket in between (if necessary) to make the joints airtight and low air leakage potential. The gaskets shall be inserted within groove in extruded aluminum profile of the framework.
iii) Frame work for each section shall also be joined together to make the joints air tight. Suitable doors with nylon handles and all access panels should be operable with allen key/ suitable locking arrangement. Aluminium die-cast powder coated/ Nylon hinges &latches shall be provided for access to various panels for maintenance. However, AHU in the form of complete single unit shall also be acceptable with access door(s) for maintenance to various sections. The entire housing shall be mounted on galvanized steel channel frame work made out of G.I. sheet of thickness not less than 2mm. For higher capacity AHUs hot dip galvanized steel channel framework made of minimum 3 mm thick G.S. sheet shall be used.

b) HOUSING / CASING (Vertical AHU)

iv) **23+2 mm thick Thermal insulation** - CFC free injected PUF of density not less than 40+2 kg/cu. m. sandwiched between Outer sheet of the panel made out of 0.80 mm pre-coated galvanized sheet with PVC guard on outside.

v) **Acoustic insulation** - 23+2mm thick Glass wool with FRP tissue of density not less than 32+2 kg/cu.m. inside of the AHU.

c) DRAIN PAN

Drain pan shall be made out of minimum 1.25 mm stainless steel sheet externally insulated (If Drain pan is outside the unit), with 10mm thick closed cell Polyethylene foam/ equivalent suitable insulation with necessary dual slope to facilitate fast removal of condensate. Necessary supports shall be provided to slide the coil in the drain pan.

d) COOLING COIL

i) The coil shall be made from seamless solid drawn copper tubes. The minimum thickness of tube shall be 0.35 mm for cooling coils.

ii) The depth of the coil shall be such as to suit the requirements, viz. re-circulated air applications, or 100 % fresh air applications and the bypass factor required shall be specified in the tender specifications. The coil shall be 4 or 6 rows deep for normal re-circulated air application and 8rows deep for all outdoor air application, unless otherwise specified in the tender specifications. In case of 8 rows deep coils, it shall be made of 2x4 rows deep coils with a spacing of 200mm between the two coils, access door and independent drain pan.

iii) U bends shall be of copper, jointed to the tubes by brazing, soft soldering shall not be used.

iv) Each section of the coil shall be fitted with flow and return headers to feed all the passes of the coil properly. The headers shall be of copper and shall be complete with water in/out connections, vent plug on top and drain at the bottom. The coil shall be designed to provide water velocity between 0.6 to 1.8m/s in the tubes.

v) The fins shall be of aluminum. The minimum thickness of the fins shall be 0.15 mm nominal. The no. of fins shall not be less than 4-5 per cm length of coil. Fins may be of either spiral or plate type. The tubes shall be mechanically expanded to ensure proper thermal contact between fins and tubes. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. For coastal areas fins shall be phenolic coated and for 100% FA application fins shall be hydrophilic type.

vi) The coil shall be suitable for use with the refrigerant specified or with water as the case may be. Refrigerating coils shall be designed for the maximum working pressure under the operating conditions. Water coils shall be designed for a maximum working pressure of 10 kg./sq.cm.
vii) Shut off and regulating valves at the inlet and outlet of water shall be provided. In the case of Direct Expansion (DX) coils, solenoid valve and expansion valves shall be provided at the inlet of coil.

2.4. **SUPPLY AIR FAN AND DRIVE**

i) The supply air fan shall be AMCA certified Screw type with forward/ backward curved blades double inlet double width type or Plug type direct driven aerofoil backward curved fans. For static pressure upto 65mm forward curved blades shall be used and for higher sizes backward curved blades shall be used in case of Double Inlet Double Width (DIDW) fans.

ii) The fan housing of Galvanized sheet steel and the impellers shall be fabricated from heavy gauge steel sheet as per approved manufacturer's standard. The side plates shall be die-formed for efficient, smooth airflow and minimum losses. Fan impeller shall be mounted on solid shaft supported to housing using heavy duty ball bearings. Fan housing and motor shall be mounted on a common extruded aluminum base mounted inside the fan section on anti-vibration spring mounts or cushy-foot mount. The fan outlet shall be connected to casing with the help of fire retardant fabric.

iii) The fan impeller assembly shall be statically and dynamically balanced.

iv) If belt drive is applicable, the fan shall be fitted with V belt drive arrangement consisting of not less than two evenly matched belts. Belts shall be of oil resistant type. Adequate adjustments shall be provided to facilitate belt installation and subsequent belt tensioning by movement of the motor on the slide rails. A readily removable door guard shall be provided.

v) The fan motor shall be totally enclosed fan cooled squirrel cage induction motor with IP-54 protection & selected for quiet running. The motor shall be suitable for operation on 415 ± 10%V, 3phase, 50 Hz, A.C. supply. The motor shall conform to IS: 325. "Three phase induction motors" having class F insulation. The motor shall have efficiency class IE-3.

2.5. **FILTERS**

The air used in an air-conditioning system must be filtered to maintain a clean atmosphere in the conditioned space. The concentration of contaminants in the air and the degree of cleanliness required in the conditioned space shall determine the type of filter or filters that must be used.

a) **TYPE OF FILTERS**

i) **Pre-filters:** Cleanable metallic viscous type filter made out of aluminum wire mesh or of dry cleanable synthetic type minimum 50mm thick, shall be provided on the suction side of AHU as standard equipment with the unit. These filters shall have the efficiency of 90% down to 10 micron particle size. When these filters become loaded or full of dirt, it is removed from service and replaced by another filter. The dirty filter can then be washed in a cleaning solution in a tank, dried and then given a bath of viscous oil. Face velocity across these filters shall not exceed 155 MPM.

ii) **Dry Fabric Fine-filters:** These filters shall have efficiency of 99% down to 5 micron particle size as per EU 7 standard. These filters are provided only where special cleanliness standard is required such as for labs, clean rooms etc. these are provided on the discharge side of AHU after fan section and are always backed by pre-filters provided on the suction side of AHU. Face velocity across these filters shall not exceed 155 MPM.
III) ESP Filter: This filter section of the specification covers the supply of Micro Electrostatic Technology (ESP Filter) with Ultra High One – time purification efficiency and substantial reduction in the pollutants inside the premises: The technology is based on a simple phenomena of charging the particles and collecting the same in the collector area. The system is effective for re circulated space to filter out the particulate matter, the efficiency of the system is 90 percent per pass for PM 2.5 micron sized particles. The Initial Pressure Drop (IPD) of 5 mm which gets added to the system. The system has significant advantages such as having a Filtration efficiency of MERV 13/14 at 5 mm IPD, washable filters, life of at least 5-7 years or greater if maintained properly. The system functionality along with the filtration efficiency details is enclosed for your reference.

<table>
<thead>
<tr>
<th>SNo.</th>
<th>Particulars</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Micro – Electrostatic Unit</td>
<td>AHU Type</td>
</tr>
<tr>
<td>2</td>
<td>Input Power</td>
<td>220 – 240V</td>
</tr>
<tr>
<td>3</td>
<td>Pressure Drop</td>
<td>&lt;50 Pa @2.5m/s</td>
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<tr>
<td>4</td>
<td>Efficiency (PM2.5)</td>
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<tr>
<td>5</td>
<td>Status Indication</td>
<td>Running and Cleaning</td>
</tr>
<tr>
<td>6</td>
<td>Components</td>
<td>Micro Static Filter and Particulate Filter</td>
</tr>
<tr>
<td>7</td>
<td>Net Weight (kg)</td>
<td>5kg to 12kg</td>
</tr>
</tbody>
</table>

b) GENERAL CONSTRUCTION OF FILTERS
i) Each AHU shall be provided with a factory assembled filter section containing pre-filters made of cleanable metal viscous filters made of corrugated aluminum wire mesh, or dry cleanable synthetic filters. These shall be minimum 50 mm thick with a frame work of aluminum/GI.

ii) The filter area shall be made up of panels of size convenient for handling. The filter panels shall be held snugly within suitable aluminum framework made out of minimum 1.6 mm GI/ aluminum sheet with sponge neoprene gaskets by sliding the panels between the sliding channels so as to avoid air leakage.

iii) In order to indicate the condition of these filters while in operation, a manometer shall be provided to indicate the pressure drop across the fine filters and absolute filters.

iv) Special filters, if any specified in the tender specifications shall be provided in addition to the above filters. In that event, the latter shall function as pre-filters.

v) Each filter shall carry test certificate from manufacturer.

2.6. INSTRUMENTS AND VALVES
The following instruments shall be provided at the specified locations in the AHUs for the chilled water/ hot water system:

i) Pressure gauges at the inlet and outlet of the coil with tubing and gauge cock

ii) Stem type thermometers at the inlet & outlet of coil with tubing & gauge cock

iii) Butterfly valve at the inlet and outlet of coil

iv) Balancing valve at the outlet of coil

v) Y-strainer at the inlet of coil

vi) Motorized 2-way diverting/ mixing valve along with proportionate thermostat
2.7. **MIXING BOX**
   The mixing box section shall be equipped with opposed action dampers of various sizes for the fresh air, return air and exhaust air, that can be linked together or operate independently. The damper system permits the use of 100% fresh air with 100% exhaust air or, any other percentage combination of fresh / exhaust air.
   Mixing boxes shall be fabricated from 18 gauge galvanized steel.

2.8. **INSTALLATION**
   The air handling unit shall be so installed as to transmit minimum amount of vibration to the building structure. Adequate vibration isolation shall be provided by use of rubber/ neoprene pads and/or vibration isolation spring mountings.

3. **FAN COIL UNITS**

3.1. **GENERAL**
   The fan coil units shall be floor/ wall/ ceiling mounted draw through type complete with finned coil, fan with motor, insulated drain pan, cleanable air filters and fan speed regulator and other controls as described.

3.2. **CASING**
   The casing shall be fabricated out of minimum 1.25mm thick GSS.

3.3. **COOLING COIL**
   The coil shall be of seamless copper tubes with aluminum fins. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes. The coil circuit should be sized for adequate water velocity but not exceeding 1.8 m/s. The air velocity across the coil shall not exceed 155 m/min.

3.4. **FAN**
   This shall consist of two lightweight aluminum impellers of forward curved type, both statically and dynamically balanced, along with properly designed GI sheet casings. The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running-at three speeds.

3.5. **DRAIN PAN**
   Drain pan shall be fabricated out of minimum 1.00 mm thick stainless steel sheet covering the whole of coil section and extended on one side for accommodating coil connection valve etc. and complete with a 25mm drain connection. The drain pan shall be insulated with 10mm thick closed cell polyethylene foam insulation and jacketed from outside with single piece moulded Fiberglass Reinforced Polyester (FRP) tray.

3.6. **AIR FILTER**
   The filter shall be cleanable type 15 mm thick with 90% efficiency down to 10 micron of dry cleanable synthetic type to be mounted behind the return air grill in the Unit casing.

3.7. **SPEED CONTROL**
   A sturdy switch shall be provided with the unit complete with wiring, for ON/OFF operation and with minimum three speed control of the fan.

3.8. **AUTOMATIC CONTROLS**
   Each unit shall have a room type thermostat and a solenoid valve. The valve shall be fixed at a convenient location. The thermostat shall be mounted along with the speed control switch.
on a common plate. The plate shall clearly indicate the fan positions. The water valves on inlet line shall be of gun metal ball type with internal water strainers, having Stainless Steel Pipe (SSP) female pipe thread inlet and flare type male pipe thread outlet connection. The valves on return line shall be as above, but without the water strainer.

3.9. **WATER CONNECTIONS**
The water lines shall be finally connected to the coil of the fan coil unit, by at least 300mm long, Type 'L' seamless solid drawn copper tubing, with flare fittings and connections.

3.10. **PAINTING**
All equipment shall be supplied as per manufacturer's standard finish painting.

4. **DX TYPE AIR COOLED SPLIT UNIT**

a. **General**
The units shall be wall-mounted, ductable unit type. The units include pre-filter, fan section and Direct Expansion (DX) coil section. The housing of units shall be light weight powder coated galvanized steel. Units shall have an attractive external casing for supply and return air. The air cooled DX units shall match with the capacities given in schedules and drawings. The approval shall be taken before order placement from Engineer in charge.

b. **INSTALLATION:**
The indoor units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment.

All the equipment shall be thoroughly tested and checked for leaks. All safety controls shall be suitably set and a record of all setting shall be furnished to the project supervisor.

Providing and fixing M.S. structural support for condensing unit with vibration isolator pad in-between support and structure and vibration isolation suspender and pads for evaporating units.

c. **DIMENSIONS:**
Dimensions given in figures shall be taken in preference to scaled dimensions in all cases. Before commencing any work the sub-contractor shall get clarifications wherever necessary from engineer-in-charge.

d. **PAINTING:**
Shop coats of paint that have become marred during transportation or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

e. **CONDENSATE DRAIN PIPING:**
All pipes to be used for condensate drain shall be Insulated medium class GI pipe & all joints should be Gluing or solvent cementing as per manufacturer recommendation.

f. **REFRIGERANT PIPING:**
i) All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder.

ii) All joints in copper piping shall be swaged joints using low temperature brazing and/or silver solder. Before jointing any copper pipe or fittings, its interior shall be thoroughly
cleaned be passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

iii) Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg per Sq.cm.

iv) After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side) pressure shall be maintained on 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, during which time change in vacuum shall not exceed 12 cm of mercury. Vacuum shall be checked with vacuum gauge. Vacuum to be achieved using a vacuum pump. Use of compressor for vacuuming is not permitted. All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.

v) The copper thickness of pipe shall be 20G/22G (0.7 to 1 mm)

vi) Sleeves shall be provided around refrigerant pipes crossing the wall and wooden partition.

vii) Refrigerant pipes should be supported on grooved wooden (teak wood only) strips suitable to accommodate insulated refrigerant pipes. The piping should be clamped to these wooden strips using a ‘C’ clamps. The distance between two supports should not be more than 5 ft.

viii) Wherever the pipes are running on the floor or exposed to view they should be covered from both side with 18 G GI tray. The tray should be supported at every 8 ft. distance using clamp supports which are painted as approved by The Engineer in charge.

ix) Refrigerant piping design for VRV system shall be submitted by the vendor for final approval.

x) Insulation should be of approved or equivalent make and of closed cell tubing type of specifications give in Duct insulation section.

xi) Clean the outer surface of refrigerant copper piping. Insert the pipes in tubular insulation using suitable adhesive. Tape the joints with masking tapes of the same material. All outdoor piping to be protected with (For ref. Piping,) Woven Fiberglass cloth, 7 mil thickness and 200 gsm weight, with factory laminated, self-adhesive backing should be used. This needs to be finished with 2 coats of UV painting.

g. POWER SUPPLY:

Power supply near the indoor unit will be provided from the Socket/Main LT panel using Distribution Boards (DBs) by lead contractor with suitable MCBs.

Power supply from MCB to indoor unit and from outdoor unit to Indoor unit to be provided by the sub-contractor along with earthing.

5. AIR-COOLED VARIABLE REFRIGERANT FLOW (VRF/VRV) SYSTEM

I. SCOPE

The scope of this section comprises the supply, erection testing and commissioning of inverter based Variable Refrigerant Volume System (heat pump type) with Scroll Compressor conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities. The VRV shall be strictly verified and co-relate with schedules. The efficiency shall be not less than specified in the ECBC+ Building-2017.

II. TYPE
Units shall be air cooled heat pump type, variable refrigerant volume air conditioner of R410A gas based consisting of outdoor unit and multiple indoor units. Each indoor units having capability to cool or heat independently for the requirement of the rooms.

It shall be possible to connect several indoor units on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually. Compressor installed in each modular outdoor unit shall be equipped with Scroll / rotary compressors for higher reliability, improved life, better backup and duty cycling purpose. Outdoor unit shall be suitable for mix match connection of all type of indoor units.

Following type of indoor units shall be connected to the system:
- Ductable unit
- Wall Hung Units

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site.

The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to a minimum of 165m with maximum 50m level difference without any oil traps.

III. OUTDOOR UNIT

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired tested with all necessary controls and switch gears:
- The outdoor unit shall be modular in design and should be allowed for side by side installation.
- The outdoor unit shall be provided with welded steel support with two coats of paint for erection purpose.
  - All outdoor units above 8 HP shall have minimum two scroll compressors and be able to operate even in case one of compressor is out of order.
  - In case of outdoor units above 14HP, the outdoor unit shall have at least 2 inverter compressors and inverter motor of brushless DC Type so that the operation is not disrupted with failure of any compressor.
  - It should also be provided with duty cycling for switching starting sequence of multiple outdoor units.
  - The noise level shall not be more than 68 dB (A) at anechoic chamber conversion value, measured horizontally 1m away and 1.5m above ground level.
  - The outdoor unit shall be modular in design and should be allowed for side by side installation
  - The unit shall be provided with its own microprocessor control panel.

The outdoor unit should be fitted with low noise, aero spiral design fan with large airflow and should be designed to operate compressor-linking technology. The unit should also be capable to deliver 78 Pa external static pressure to meet long exhaust duct connection requirement wherever applicable and per drawings and schedules.
- The condensing unit shall be designed to operate safely when connected to multiple fan coil units, which have a combined operating nominal capacity up to 160% of indoor units for outdoor units up to 40 HP.
  a. COMPRESSOR
The compressor shall be highly efficient scroll type and capable of inverter control. It shall change the speed in accordance to the variation in cooling or heating load requirement. The inverter shall be IGBT type for efficient and quiet operation.

All outdoor units shall have at least 10 to 30 steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed. Oil heater shall be provided in the compressor casing.

b. HEAT EXCHANGER
The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coal.

The aluminum fins shall be covered by anti-corrosion resin film. The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

c. REFRIGERANT CIRCUIT
The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end.
All necessary safety devices shall be provided to ensure the safely operation of the system.

d. SAFETY DEVICES
All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit; high pressure switch, fuse, crankcase heater, fusible plug, over load relay, protection for inverter, and short recycling guard timer.

e. OIL RECOVERY SYSTEM
Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

IV. INDOOR UNIT

a. GENERAL
This section deals with supply, installation, testing, commissioning of various type of indoor units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in schedule or drawing.

b. Indoor units shall be High static Ductable, Low Static Ductable, Wall mounted type as specified in the schedule. These units shall have electronic control valve to control refrigerant flow rate respond to lead variations of the room.
   i) The address of the indoor unit shall be set automatically in case of individual and group control
   ii) There shall be localized control only.

c. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

d. The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for
minimum thermal contact resistance with fins. Each coil shall be factory tested at 21kg/sq.m air pressure under water.

e. Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.

f. Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling and heating.

g. The outdoor unit shall be pre-charged with first charge of R 410A refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 380 - 415 V 50 Hz + 3%, 3 Phase supply for outdoor units & 220 – 240 V/380 - 415 V 50 Hz + 3%, 1/3 Phase supply for indoor units.

h. The units shall be integrated with Fire Alarm system and in case of fire all units shall be switched off.

i. The aluminum fins of Condenser Coils shall be provided with suitable factory installed protective for corrosion prevention.

j. The outdoor units must be suitable for up to 150m (straight length) refrigerant piping between outdoor unit & the farthest indoor units, total piping of 500m for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50m in case of outdoor unit on top & 40 m in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one outdoor unit shall be up to 15m.

k. The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each outdoor unit – Single Module or Multi Module.

l. The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg C to 48Deg C, in cooling mode & -20 Deg C to 15 Deg C in heating mode.

m. Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors with minimum IP 55 protection. The outdoor unit condenser fan shall be able to develop external static pressure up to 6 mm of H2O.

n. The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.

o. Starter for the Outdoor Unit compressor shall “Direct on Line” type. Inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

p. Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

q. Outdoor units shall be complete with following safety devices:
   a) High pressure switch
   b) Fan driver overload protector
   c) Over current relay
   d) Inverter Overload Protector
e) Fusible Plug
PART IV - DUCTING

1. SHEET METAL WORK

i. FACTORY FABRICATED (As per SMACNA):
   This section deals with supply, erection, testing & balancing of GI sheet metal duct work and air registers conforming to specifications as given below:

   **Material for Ducting:**
   All the ducts shall of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates. Galvanizing shall be 120gms/sq.m. (total coating on both sides).
   In addition, if deemed necessary, sample of raw material, selected at random by owner’s site representative shall be subject to approval and tested for thickness and zinc coating at contractor’s expense.
   The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only, irrespective of cross-section dimensions.

   **Governing Standards:**
   Unless otherwise specified here, the construction, erections, testing and performance of the ducting system shall conform to the SMACNA standards and Addendum of SMACNA

   **Duct connectors and Accessories:**
   All the transverse duct connectors (Flanges\Cleats) and accessories related hardware such as support system shall be zinc coated (galvanized).

   **Fabrication standards:**
   All the ductwork including straight sections, tapers, elbows, branches, shoe pieces, collars, terminal boxes and other transformation pieces shall be factory-fabricated. Equivalency shall require fabrication by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply.
   Coil lines to ensure location of longitudinal seams at corners\folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any side of the ducts.
   All ducts, transformation pieces and fittings shall be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.
   All edges shall be machines treated using lock-formers and rollers for furning up edges.

   **Selection of G.I. and Transverse Connectors:**
   Duct construction shall be in compliance with 1” (250 Pa) w.g. static norms as per SMACNA.All transverse connectors shall be 4-bolt system.To avoid any leakage additional sealant shall be used.The specified class of transverse connectors and duct gauge for a given duct dimensions shall be 1” (250 Pa) pressure class.Non-toxic, AC-application grade P.E. or PVC gasketing shall be provided between all mating flanged joints. Gasket sizes shall conform to flange manufacturer’s specification.

   **Duct construction:**
   The fabricated duct dimensions shall be as per approved drawings and all connecting sections shall be dimensionally matched to avoid any gaps.
   Dimensional Tolerances: All fabricated dimensions shall be within + 1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerance shall be +1.0mm per meters.Each duct pieces hall be identified by coded sticker, which shall indicate specific part number, job name, drawing number, duct sizes and gauge.
shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at
corners, which shall be either Pittsburgh or snap button punch as per SMACNA
practice, to ensure air tightness. Changes in dimensions and shape of ducts shall be
gradual (between 1:4 and 1:7) turning vanes or air splitters shall be installed in all
bends and duct collars designed to permit the air to make the turn without
appreciable turbulence. Plenum shall be factory fabricated panel type and assembled at
site. Factory fabricated ducts shall have the thickness of the sheet as follows and
length of the piece not more than 1200mm and should have beading at every
300mm. Recommended SMACNA standard at 4 feet Transverse Joint Reinforcement

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<thead>
<tr>
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<th>1”</th>
<th>2”</th>
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</table>

Note: SMACNA- sheet Metal & Air Conditioning Contractor National Association Inc.

In 1” static pressure i.e. comfort cooling application optional “C&S and C&SS cleats joints
can be used Upto 450mm duct size use C&SS cleats. Over 750 mm duct size use TDF/TDC flanges with respective gauges as mentioned above. Alphabets
B,C,D,E,F,G,H,I and j per SMACNA 2005, transverse joint reinforcement table 1-12m
(T-25b flanged) and TDC addendum. The gauges, joints and bracing for sheet metal
ductwork shall further conform to the provisions as shown on the drawings. Ducts
larger than 600 mm shall be cross broken, duct sections up to 1200 mm length may
be used with bracing angles omitted. Changes in section of duct work shall be affected
by tapering the ducts with as long a taper as possible. All the branches shall be taken
off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise
approved by the Engineer-in-charge.

* Ducts 2250 mm and larger require special field study for hanging and supporting
methods.
In addition to above the following points should be also taken into account while fabrication of ducts.

I. All ducts of size larger than 450mm shall be cross broken.
II. All ducts shall be supported from the ceiling / slab by means of MS rods of dia 9mm with MS angle of size 40 x 40 x 5 mm at the bottom with neoprene pad in between the duct & MS angle. The ducts shall be suspended from the ceiling with the help of dash fasteners. Provision for necessary ancillary materials required for hanging the ducts shall be arranged by the contractor.
III. The vanes shall be provided wherever required and shall be securely fastened to prevent noise & vibration.
IV. The rubber gasket shall be installed between duct flanges in all connections and joints.
V. All flanges and supports should be primer coated.
VI. The flexible joints shall be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300 mm between faces.
VII. The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.
VIII. Box Type Dampers & Splitters

These dampers shall be provided in the ducting work for proper control and balancing of air distribution. All dampers shall be louver type robust construction. These dampers shall be fitted with easily accessible operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct. All dampers, splitters shall be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers shall be installed in duct at all required locations. No extra payment shall be made separately since these form part of Air Circulation System.
NOTE: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

ii. SHEET METAL DUCT (SITE FABRICATED):

GENERAL:
Supply, fabrication, installation and testing of all sheet metal ducts & supply, installation, testing and balancing of all grilles, registers and diffusers, in accordance with these specifications and the general arrangement shown on the drawings.
Duct work shall mean all ducts, casings, dampers, access doors, joints, vanes, stiffeners, hangers and supports etc.
All ducts shall be fabricated according to ASTM 525A from galvanized steel sheets of zinc grade G27 or Z90 of the following thickness as indicated in schedule & as described in the relevant latest IS code.
RECTANGULAR DUCT:

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<th>Dimensions of Ducts</th>
<th>GI Sheet</th>
<th>Type of Joints</th>
<th>Type of Bracing</th>
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</thead>
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<tr>
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<tr>
<td>Upto 600</td>
<td>0.63</td>
<td>24</td>
<td>G.I. Flange at 2.5 Centre</td>
</tr>
<tr>
<td>601 to 750</td>
<td>0.63</td>
<td>24</td>
<td>-------</td>
</tr>
<tr>
<td>751 to 1000</td>
<td>0.63</td>
<td>24</td>
<td>25x25x3mm angle iron frame with 6mm dia nuts and bolts.</td>
</tr>
<tr>
<td>1000 to 1500</td>
<td>0.80</td>
<td>22</td>
<td>25x25x3mm angle iron frame with 8mm dia nuts and bolts.</td>
</tr>
<tr>
<td>1501 to 2250</td>
<td>1.0</td>
<td>20</td>
<td>40x40x5mm angle iron be cross braced diagonally with 10mm dia nuts &amp; bolts at 125 centre.</td>
</tr>
<tr>
<td>2250 and above</td>
<td>1.25</td>
<td>18</td>
<td>50x50x6mm angle iron frame with 10mm dia nuts &amp; bolts at 125 centre.</td>
</tr>
</tbody>
</table>

THICKNESS OF SHEET FOR ROUND DUCTS (FROM ISS: 655):

| Diameter of Duct (mm) | Thickness of Sheet (mm) | |
|-----------------------|-------------------------| |
|                       | G.I. Sheets | Aluminium Sheets |
| 150 to 500            | 0.63 | 0.80 |
| 501 to 750            | 0.80 | 0.80 |
| 751 to 1000           | 0.80 | 1.00 |
| 1001 to 1250          | 1.00 | 1.50 |
| 1251 and above        | 1.25 | 1.80 |

Sheet metal ducts shall be fabricated out of galvanized steel sheets conforming to BIS 655, BIS 277, BIS 737. Sheets used shall be produced by Hot dip process and galvanizing shall be Class VIII.

HANGERS FOR DUCT:

<table>
<thead>
<tr>
<th>Duct Size (mm)</th>
<th>Spacing (M)</th>
<th>Size of MS Angle (mm x mm)</th>
<th>Size of Rod Dia (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 750</td>
<td>2.4</td>
<td>25 x 3</td>
<td>8</td>
</tr>
<tr>
<td>751 to 1500</td>
<td>2.4</td>
<td>40 x 5</td>
<td>10</td>
</tr>
<tr>
<td>1501 to 2250</td>
<td>2.4</td>
<td>50 x 5</td>
<td>12</td>
</tr>
<tr>
<td>2251 to above</td>
<td>2.4</td>
<td>50 x 5</td>
<td>12</td>
</tr>
</tbody>
</table>

FABRICATION:

All ducts irrespective of size shall be fabricated and installed in workman like manner,
generally conforming to relevant latest IS code.

a. Ducts so identified on the drawings shall be acoustically lined with thermal insulation as described in the section 'Insulation' and as indicated in schedule or shown in the drawing. Duct dimensions shown on drawings are inner clear dimensions.

b. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

c. Changes in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise indicated, shall have a centre line radius equal to one and a half times the width of the duct. Air turns shall be installed in all vanes, arranged to permit the air to make the turn without appreciable turbulence. Suitable vanes shall be provided in duct collar to have uniform/ proper air distribution.

d. Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles of sample size to keep the ducts true to shape and to prevent bulking, vibration, breathing or oil canning.

e. All sheet metal connections, partitions and plenums required to confine the flow of air to and through 18g GI/16 gauge aluminium, thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary doors as required to give access to all parts of the apparatus. Access Doors shall be not less than 45cm x 45cm in size.

vi) INSTALLATION:
All ducts shall be installed generally as per the drawings and in strict accordance with approved shop drawings to be prepared by the Contractor.

1. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent, of these specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

2. All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and/or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained, all as per the site requirements.

3. If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available, in accordance with other services and as per approval of Owners site representatives.

4. All duct work shall be independently supported from building structure. Duct shall be supported to the ceiling with the help of anchor fasteners by drilling holes in concrete slab and inserting anchor fasteners and bolts. All horizontal ducts shall be rigidly and securely supported, in approved manner with trapeze hangers formed of MS rods and angle iron under ducts at not greater than 2.4 meter centers. All vertical duct work shall be supported By structural members at each floor.
   If duct is passing through in such areas where space between ceiling slab to false ceiling is more than 1500 mm than duct should be supported by wall mounted brackets of 40x40x3mm angle.

5. Ducting over furred ceiling shall be supported from the slab above, or from beams, after obtaining approval of Owner's site representative. In no case shall any duct by supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead
or furred down spaces shall be erected in time to occasion no delay to other contractors on the building.

6. Where metal ducts or sleeves terminate in wood work, tight joints shall be made by means of closely fitted heavy flanged collars. Where ducts pass through brick or masonry opening and wooden frame work shall be provided within the opening and crossing ducts provided with heavy flanged collars on each side of wooden frame work, so that duct crossing is made leak-proof.

7. All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blower coil units that may cause vibrations in the ducts, ducts shall be provided of closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass fire resistant flexible connection. The flexible connections located close to the unit, in mutually perpendicular directions. The flexible sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation and shall be class 'O' smoke rated.

8. Air conditioning unit and exhaust fans shall be connected to duct work by inserting at air inlet and air outlet a double canvass sleeve. Each sleeve shall minimum 150mm securely bolted to duct and the connecting duct work rigidly held in line with unit inlet or outlet and shall be class 'O' smoke rated.

9. All ducts above 450 mm are to be cross broken to provide rigidity to the ducts.

2. VOLUME CONTROL DAMPERS

i) At the junction of each branch duct with main duct and split of main duct, splitter dampers must be provided. Dampers shall be two gauges heavier than gauge of the large duct, and shall be rigid in construction to the passage of air.

ii) The volume control dampers shall be of opposed blade type, lever operated and complete with locking devices, which shall permit the dampers to be adjusted and locked in any positions.

iii) Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.6 mm steel and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh specking.

iv) Wherever required for system balancing, provide a volume balancing opposed blade damper with quadrant and thumb Scroll lock. Provide damper rod and damper block with upset screws.

v) After completion of the duct work, dampers are to be adjusted and set to deliver the required amounts of air as specified on the drawings.

vi) A hinged and gasketed access panel shall be provided on duct work at each control device that may be located inside the duct work.

**Actuator for Motorized Volume Control Damper:**
Electronic actuation shall be provided. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.
The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable.

All actuators shall provide a 2 to 10 VDC position feedback signal. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose. The rated torque of the actuator shall be 10 N.m/m². All proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections. Actuators shall be CE certified as meeting correct safety requirements and recognized industry standards.

Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator’s rated torque and shall have a 2-year manufacturer’s warranty, starting from the date of installation.

3. FIRE DAMPERS
i) Fire dampers shall be provided in all the supply air ducts and return air ducts (where ever provided in the drawings), return air passage in the air-handling unit room and at all floor crossings. Access door shall be provided in the duct before each set of fire dampers.

ii) Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in Open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator & control panel.

iii) Fire dampers shall be motorized smoke & fire dampers type. It shall be supplied with spring loaded UL(Underwriters Laboratories) stamped motorized link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire alarm signal to cut off air supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor as well as strip heaters.

iv) Fire dampers shall be CBRI tested & certified for 90 minutes rating against collapse & name penetration as per UL 555-1995(Underwriters laboratories)

v) Fire dampers shall be compatible with the fire detection system of building & shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.

vi) Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the lead contractor & further from AHU electric panel to fire damper shall be provided by sub-contractor.
Actuator for Motorized Fire/Smoke Damper:
Electronic actuation shall be provided. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a "V" bolt design with associated "V" shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a "V" clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or set screw type fasteners are not acceptable.
The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable.
All actuators shall provide a 2 to 10 VDC position feedback signal. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose. The rated torque of the actuator shall be 10 N.m/m². All proportional actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections. Actuators shall be CE certified as meeting correct safety requirements and recognized industry standards.
Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation.

4. ACCESS PANELS:
A hinged and gasket access panel shall be provided on duct work at each control device that may be located inside the duct work.

5. MISCELLANEOUS:

i) All ducts above 450 mm are to be cross broken to provide rigidity to the ducts.
ii) All duct work joints are to be true right angle or approaching with all sharp edges removed.
iii) Smoke rated sponge rubber gaskets also to be provided behind the flange of all grilles.
iv) Each branch from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the branch.
v) Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Project Manager/Engineer-in-charge.
vi) Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
vii) Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Project Manager/Engineer in-charge.
viii) The ducts should be routed directly with a minimum of directional change.
.ix) The duct work shall be provided with additional supports/hangers, wherever required or as directed by the Project Manager/Engineer in-charge at no extra cost.
x) All duct supports, flanges, hangers and damper boxes etc. shall be either zinc coated or given 2 coats of anti-corrosion red oxide paint before installation and one coat of aluminum paint after the erection, at no extra cost.
xi) All angle iron flanges to be welded electrically and holes to be drilled.
.xii) All the angle iron flanges to be connected to the GSS ducts by rivets at 100 mm centers.
.xiii) All the flanged joints, to have a 3 mm neoprene rubber gasket to the flanges with Adhesive.
xiv) The G.S.S. Ducts should be lapped 6 mm across the flanges.
xv) The ducts should be supported by approved type supports at a distance not exceeding 2.4 meters and at every vertical floor penetration.
xvi) Sheet metal connection pieces, partitions and plenums required shall be constructed of 1.25 (18 gauge) sheet thoroughly stiffened with 25 mm x 25 mm angle iron braces and fitted with access doors.
xvii) Ready made (factory fabricated) flanges shall be used for all ducting.
xviii) All duct joints shall be filled up by silicon.
xix) All duct penetrations in fire rated walls and slabs shall be filled up by fire resistant materials of fire rating not less than fire rating of wall / slab.
.xx) All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish unless noted otherwise.
.xxi) Wherever ducts are acoustically lined the duct size shall be increased by the thickness of the duct lining.
.xxii) Wherever MVCDs are provided, an access door shall be provided for the maintenance.

6. AIR OUTLET AND INLETS (SUPPLY AND RETURN)
   a) All air outlets and intakes shall be made of extruded aluminum sections &shall present a neat appearance and shall be rigid with mechanical joints.
b) Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminum sheet. The louvers shall be of aero foil design of extruded aluminum section with minimum thickness of 0.8 mm at front and shall be made of 0.8 mm thick aluminum sheet. Louvers may be spaced 18 mm apart.
c) Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti-smudge type. The outlets shall comprise an outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6 mm thick extruded section aluminum sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminum section.
d) Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it
is fitted. Anti-smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.

e) Linear diffusers shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.

f) Grilles and diffusers constructed of extruded aluminum sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grilles and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purposes.

g) All supply air outlets shall be fitted with a VOLUME CONTROL DEVICE, made of extruded aluminum gate section. The blades of the device shall be mill finish/ block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied space without removing any access panel. The volume control device for circular cutlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/ wall outlets and intakes.

h) All the products supplied by contractor should supplement 'in performance by selection curves of product ratings from the manufacturer.

i) Laminar supply air diffusers shall be made of 2mm thick powder coated aluminum sheet duly insulated with 5mm thick dosed cell polyethylene foam insulation having factory laminated aluminum foil and joints covered with self-adhesive aluminum tape and having holes 2/3 mm dia. including frame work.

7. FRESH AIR INTAKES

I. Fresh air intake grills/Louvers shall be made of extruded aluminum sections.

II. A flanged frame using RS sections shall be provided on front face to conceal the gap between the louvers and the adjoining wall face. Corners of frame shall be welded. The frame shall be made structurally rigid.

III. Louvers made from extruded aluminum section shall be in modular panel form for ease of handling. These shall be free from waves and buckles. Vertical blades shall be truly vertical and horizontal blades shall be truly horizontal. Butt joints in blades shall not be accepted.

IV. Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/vibrating of the louvers, at not more than 750mm centers where the louver's length is longer than 750mm.

V. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

8. VARIABLE AIR VOLUME (VAV) BOXES

i) The scope is to provide Variable Air volume cooling only Boxes.

ii) These shall be low velocity variable air volume boxes without re-heat coils, and shall be of open protocol as marketed by a firm specializing in this field. The sub-contractor shall supply and install units to the quantity and locations as specified in the documents, schedules and drawings.

iii) The unit shall be complete with damper, airflow ring, and solid-state electronic controls to provide accurate room temperature control. The damper shall be aero foil type construction with bearings.

iv) Boxes shall be supplied with all internal attenuation treatment and acoustical damped casing necessary to achieve the required noise criteria. Shall be made out of heavy gauge
extruded aluminium of 1.5 mm nominal thickness consists of low leakage extruded aluminium volume control damper; Rapid Average Pitot tube; Air Flow Straightener (Honey-Comb patterned) with feather touch display thermostat. Dynamic factory calibrated and adjustable flow

v) The actuator shall be of 24V AC Bi-directional, direct coupled to the damper shaft. The required transformer to step down of the voltage range from 230V to 24V shall be part of the unit.

vi) The noise level shall be less than 30 NC.

vii) Boxes shall be able to reset any air flow between 10% and the maximum air quantity that the boxes can handle without changing orifices or other parts. Air quantity limiters shall not be accepted.

viii) A suitable device shall be provided for the field adjustment of minimum airflow. All boxes shall be initially factory set at minimum air quantity of 10% and maximum quantity of 110% of the design requirements.

ix) Under shut-off conditions, all boxes shall not have air leakage more than 2% of the maximum air quantity at 75mm static pressure.

x) The VAVs shall be used in standalone mode complete with its own temperature sensor and controller and shall perform the function of maintaining the temperature and airflow. However, the VAVs shall be BMS compatible to enable to network the VAVs to a Network Control Unit and onto BMS. In this mode all VAV data shall be available at the BMS workstation and it shall be possible to change set points and flow settings from the BMS workstation.

xi) The boxes shall be pressure independent. All controllers used for the control of VAV boxes shall be compliant with BACnet/ MODBUS protocol and be freely communicable to third party BACnet/ MODBUS IP controllers.

xii) VAV Box shall have provision to support from floor/ wall/ ceiling and in vertical/ horizontal condition.

9. BACK DRAFT DAMPERS
The dampers shall be installed at the outlet of the unit. The damper should be air-tight and should be in a position to prevent back flow. Dampers shall be opposed blade in 18G and 20G blades in G.I construction. Damper shall be operated manually through lever and constructed with suitable links and levers.

10. TESTING:
The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final balancing of air quantities thorough each air outlet shall be recorded and submitted to Client for approval.
All ducts shall be pressure tested for leakage. The entire ducting shall be tested for leakage with help of soap solution if required. The Contractor shall arrange, on his own, duct leakage system required for pressure testing of duct.
The ducting work shall be completed with inspected chamber as per US standard for taking out samples and inside duct cleaning shall be provided at required length.
Test and Balance report shall be submitted after proper testing and balancing of the system.

11. INSTALLATION PRACTICE:
SUPPORT HANGERS:
i. The flexible duct must be installed fully extended to produce optimum results.
ii. The maximum allowable sag, between any two adjacent suspension points, should not exceed 50mm per meter.
iii. The distance between any two adjacent suspension points may vary from 1.50 to 3.00 meter, depending upon the type of flexible duct in use.

iv. Flexible ducts above suspended ceiling should always be independently supported. Ducts mounted in these locations are susceptible to damage whenever ceilings panels need to be periodically interchanged, unless they are separately supported.

BENDING RADIUS:
All bends should be made as large as possible and should have a radius of not less than the diameter of the duct in use. This reduces un-favorable pressure losses and is particularly important for metal based products which are more susceptible to stress rupturing. Double bends should be avoided, however if un-avoidable, ensure that each radius is not less than \( R = 2 \times D \).

STRAPS:
The hanging straps should support the flexible duct with a minimum of half the circumference surface in contact, and without reducing the effective inside diameter of the duct. It is also recommended that the minimum width of material to be used for the hanging straps should be at least 25mm.

FLEXIBLE DUCT TO CONVENTIONAL DUCT CONNECTION:
Extra care should be taken when making flexible connection to fix conventional ducts, etc., and ensure that they do not become too stressed. An additional support is recommended to obviate this potential problem.

Metal based flexible duct products are particularly prone to fracturing due to stress caused as a result of sharp connections.

12. **Steel Wire Rope Hangers & Supports:**

Wire Hangers shall be used to suspend all static HVAC Air Distribution services. Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip (double channel lock) at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

i. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002.

ii. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.
Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer’s handbook.

The contractor shall select the correct length of wire rope required to support the service. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. Comply with manufacturer's load ratings and recommended installation procedures. Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5: 1.

HVAC Supports – Hanger Supports are suitable for: Rectangular duct, Spiral Duct, Oval Duct, Fabric Duct, Desertification fans, Air Conditioning Units, Plenum Boxes, Fan Coil Units, Diffusers.

Ducting Supports:
All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners. In case of PEB structure Loop and Catenary system can be used based on the site conditions as per approved suspension system drawings. All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method (refer to typical drawings) under ducts at no greater than 3000mmcentre, for 3001mm-above appropriate size angle along with neoprene pad in between the duct & MS angles should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger wires shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection or as per approved drawings. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided, refer to manufacturer’s recommendations.

Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/Engineer in charge. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor’s work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.
PART-V: MECHANICAL VENTILATION SYSTEM

1. SCOPE
This chapter includes supply air fans, exhaust air fans and fans used in any equipment like AHUs, FCUs etc.

2. CENTRIFUGAL FANS
i) Centrifugal fans shall be of double-width, double-inlet construction, with bearing on both sides, complete with access door, squirrel-cage induction motor, V-belt drive, belt guard etc.
ii) Housing shall be of heavy gauge sheet steel in 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 shall be provided throughout split joints to make it airtight. 1.2 mm galvanized wire mesh inlet guard, of 5cms sleeves shall be provided on both inlets. Housing shall be provided with access door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.
iii) Fan wheel shall be backward curved non-overloading type unless otherwise specified. Fan wheel and housing shall be statically and dynamically balanced. Fan outlet velocity shall not exceed 610 meters per minute.
iv) Shaft shall be constructed of steel, turned, ground and polished.
v) Bearings shall be of the sleeve/ball bearing type mounted directly on the fan housing. Bearing shall be self-aligned, oil grease packed, pillow block type.
vii) Drive to fan shall be provided from 3 phase electric motor through belt with adjustable motor sheave and belt guard. Belt shall be of the oil resistant type. The number of belts shall be not less than two.
vii) The fan motor shall have efficiency class IE-3 or EFF-1, whichever is more efficient.

3. AXIAL FLOW FANS
i) Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.
ii) Casing shall be constructed of heavy gauge sheet steel. Casing shall be provided with hinged door enabling easy replacement of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de-rusted, cleaned, primed and finish coated with enamel paint.
iii) Rotor hub and blades shall be of cast aluminum, or cast steel construction. Blades shall be die-formed aero foil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blade mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually read just able at site, upon installation, for obtaining actual airflow values, as specified.
iv) Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with Part VIII Para 1.9 respectively. The speed of fan shall not exceed 1000 RPM for fans with impeller diameter above 450mm, and 1450RPM for fans.
with impeller diameter of 450mm and less. The fan motor shall have efficiency class IE-3 or EFF-1, whichever is more efficient.

v) DRIVE:
For Duct/Wall Mounted Fan:
For duct/wall mounted fans the impeller shall be mounted directly on the motor. Drive unit and impeller shall be totally enclosed inside the duct.

For Floor/Ceiling Mounted Fan:
The fan shall be provided with belt drive and adjustable motor sheave, standard sheet steel belt guard with vented front for heat dissipation. Belt shall be of the oil resistant type.

vi) Vibration Isolation:
Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through cushion foot vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.

Types of Vibration Isolators:

i) Free Spring Floor Mounted Isolators:
Vibration isolators shall be free standing, un-housed, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 6 mm (0.25") thick, bonded to the base plate. Springs shall be selected to provide operating static deflections as required. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with a steel leveling bolt lock nut and washer for attachment to the supported equipment.

ii) Restrained Spring Floor Mounted Isolators:
Vibration isolators for equipment which is subject to load variations and large external or torquing forces shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment. Springs shall be supported either with a neoprene cup of a metal base plate complete with a ribbed neoprene pad, minimum 6 mm (0.25") thick, bonded to the base plate. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, vertical restraints, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure. Housing shall be hot dipped galvanized.

iii) Vibration Modular Restrained Spring Isolator:
Spring isolators shall be comprised of two interfacing but independent elements; a coil spring element and a seismically rated housing. The spring coil element shall be comprised of one or more coil assemblies having all of the characteristics of freestanding coil spring
isolators as specified in the vibration isolation portion of the specification. The seismically rated housing shall be sized to meet or exceed the force requirements applicable to the project and have the capability of accepting coils of various sizes, capacities, and deflections as required to meet the desired isolation criteria. All spring forces shall be contained within the coil/housing assembly and under no seismic load condition shall the restraint anchoring hardware be exposed to spring-generated forces. The restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. The restraint shall allow a maximum of 1/4 in. (25 mm) motion in any direction from the neutral position. All elastomeric elements shall be replaceable. To ensure the optimum anchorage capacity, the restraint shall have an overturning factor (the ratio of the effective lateral snubber height to the short axis anchor spacing) of 0.33 or less.

iv) Vibration/Seismic Modular Restrained Spring Isolator:
Vibration isolators shall be seismically rated, restrained spring isolators for equipment which is subject to load variations and large external forces. Spring isolators shall be comprised of two interfacing but independent elements; a coil spring element and a seismically rated housing. The spring coil element shall be comprised of two or more coil assemblies having all of the characteristics of freestanding coil spring isolators as specified in the vibration isolation portion of the specification. The seismically rated housing shall be sized to meet or exceed the force requirements applicable to the project and have the capability of accepting coils of various sizes, capacities, and deflections as required to meet the desired isolation criteria. The housing shall be hot dipped galvanized for corrosion resistance. All spring forces shall be contained within the coil/housing assembly and under no seismic load condition shall the restraint anchoring hardware be exposed to spring-generated forces. The single restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. The single restraint shall allow 1/4 in. (25mm) motion in any direction from the neutral position. All elastomeric elements shall be replaceable in the field after an event without lifting the unit.

4. CABINET FANS
The construction of the cabinet fans shall be identical with that of the air washer unit except that the cabinet fans shall not have humidifiers and filters only for fresh air fans.

5. PROPELLER FAN
a) Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.
b) Mounting Plate shall be of steel construction, square with streamlined venturi inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.
c) Fan Blades shall be constructed of aluminum or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.
d) Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.
e) Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycle’s 3 phase power supply, and for smaller fans shall be
suitable for 220±6% volts, 50 cycle’s single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated on drawings and system design requirements. The motor shall be rated for IP-55.

f) Accessories:
The following accessories shall be provided with propeller fans:
I. Wire guard on inlet side and bird screen at the outlet.
II. Fixed or gravity louvers built into an aluminum steel frame at the outlet.
III. Electronic speed controller for controlling fan speed for single phase fan motor and variable speed drives for three phase motors.
IV. Single phase preventers for 3 phase fans.

6. INLINE FANS

a) SCOPE
The scope of comprises of supply, erection, testing and commissioning of inline fans conforming to these specifications and in accordance with the Schedule of Quantities and drawings.

b) TYPE
Fans shall be single inlet single width (SISW) type / Double Inlet Double Width (DIDW). Fan shall have directly driven forward curved centrifugal impeller, running in a metal scroll balanced to give quiet and vibration free operation. Fan motor assembly shall be statically and dynamically balanced.

The fan shall be assembled in such a manner that the motor and impeller can be easily removed and reinstalled after servicing.

The air handling capacities, maximum motor H.P., Static pressure shall be as shown on Drawing and in Schedule of Quantities.

c) MATERIAL
I. Fans casing shall be manufactured from galvanized steel sheets.
II. All other metal parts shall be hot dip galvanized.

d) MOTOR
i) The fan motor shall be equipped with motor with speed regulator giving volume control from 0 to 100% of output.
ii) Motors shall be with class ‘F’ insulation wired to an externally mounted weather proofed terminal box.
iii) Motor name plate horsepower shall exceed brake horsepower by minimum of 10%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1500 RPM.

e) INSTALLATION
i) Fan shall have rigid supports and fitted to both ends of the casing.
ii) Wherever the fans are to be suspended from ceiling or mounted on the wall, the contractor shall include supply and fixing of all the material that may be required to complete the installation in all respect.
iii) Fan inlet and outlet connections shall be by means of flexible canvas connections.

f) TESTING
Fan after installation shall be tested for capacities, power consumption, noise level and vibration and results shall confirm to the approved data furnished by the contractor.
7. **Air Curtain Unit:**

i) **Scope:**
   The scope of this section comprises the supply, erection, testing and commissioning of Air Curtains units conforming these Specifications and in accordance with the requirements of the Drawings and of Schedule of Quantities.

ii) **Type:**
   The Air Curtain units shall be Centrifugal Type Non-Recirculating, preferably installed horizontal to the ground. Installed with anchor fasteners to the wall or mounted to the Ceiling or frame with proper supports. The discharge nozzle shall be uniform all through, and the Air curtain shall fully cover the Door opening.

iii) **Capacity:**
   The Air Curtain shall be sized according to the width of the Door, and Air throw shall be selected as per the height of the Door, the Selection should be such that throw at the outlet of the Air Curtain is approx 21 m/s.

iv) **Outer Body:**
   Outer Body shall be constructed in Aluminum Extruded Sections and powder coated. The cabinets shall have good finish and the access panels and the mounting shall be so provided for easy removal. The side Covers should made in Plastic. There should be no visible nuts and bolts.

v) **Suction Grills:**
   The Machine should have Plastic Suction Grills, and grill should be so placed that the suction should be from the Top of the Machine.

vi) **Nozzle:**
   The Nozzle should have a uniform opening for a Laminar flow and Should have a Diverter which can Tilt the Angle of throw both inside and outside by at least 30 degree.

vii) **Blower Housing:**
   The Housing shall be engineered in vortex design to provide the required outlet velocity with minimum noise level. The housing should be preferably constructed in two parts and should be made in Plastic with Lockable points to avoid Air Leakage.

viii) **Fans:**
   Fans shall be centrifugal, forward curved double inlet, lightweight Dynamically balanced made in Plastic ABS 300 by the process of Injection Molding. Blades shall be made in Aerodynamic Design. Performance of Impeller shall be tested as per AMCA Standards and Guaranteed.

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**PART-VI: CONTROLS**
1. **SCOPE**  
This chapter covers the requirements of equipment safety controls, refrigerant flow controls, system controls, and variable speed drive (VSD). For chilling units all the controls shall be microprocessor based.

2. **SYSTEM CONTROLS**  
i) The requirements for maintaining the inside design conditions as specified in the tender specifications for the work shall be met by appropriate system controls and control elements. The system shall satisfy the requirements of both full load and partial load conditions. Details of complete control elements shall be indicated by the tendered in the tender.

ii) Control shall be affected by 2 way diverting valve in chilled water coil. For heating using hot water coils, now control through them shall also be achieved by using 2 way valves.

iii) The size of 2 way diverting valves shall be selected so as to match the coil where in the flow is to be regulated. The make and size shall be indicated in the Technical particulars in the tender.

iv) Operation of the modulating proportional motor of 2 way diverting valve shall be controlled by proportional type thermostat.

3. **REQUIREMENTS OF CONTROL ELEMENTS**  
The system control elements comprise controlling elements such as thermostats, three way valves etc. as required for individual applications.

4. **THERMOSTATS**  
Thermostats shall be electric fixed differential type as indicated below, with sensing element located in the return air stream. All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer. The profile, mounting arrangement and exact location of the thermostat shall be such as to suit the site.

i) Proportional control thermostats shall be provided for actuating the three way modulating valve at each air handling unit. Thermostat shall provide manual switching (heat-off-cool-in heating-cooling system).

ii) Snap-acting fixed differential type thermostat for actuating the three-way diverting valve at each fan coil unit.

iii) Thermostat shall have temperature adjustments WARM-NORMAL-COOL settings and fan switch. Switching off must break fan circuit.

iv) Snap-acting fixed differential heating thermostat for electric winter heating and reheat applications for putting on/off power supply to electric heating or reheat coils in air handling units.

v) Safety thermostat shall be provided for electric winter heating and reheat application for cutting off power supply to strip heaters in case air flow across strip heater is not established.

vi) Air-stat shall be provided within air handling unit containing electric heating or reheat coils to prevent heaters from energizing unless the air flow is established.

5. **PRESSURE INDEPENDENT/BALANCED/HIGH-RANGEABILITY CONTROL VALVES (PICV) – AHU**  
The Self-balancing flow control valves that are pressure independent, 2-way, modulating to accept Input signals from the control system.  
Each Air Handling Unit / Fan Coil Unit shall be provided with a Two Way Pressure Independent Balancing and Control Valve integrated in a single Body.
i) EPIV shall be rotary type with a characterizing disc to provide an equal percentage flow and mounted in return water line of AHU.

ii) Electronic Pressure Independent Characterized Control Valve with built in ultrasonic flow-meter upto 50mm size and electromagnetic flow-meter for higher sizes. The flow sensing mechanism shall have no moving parts.

iii) Valves shall be with screwed ends upto 50mm and with flanged ends as per ISO7005-2 for higher sizes.

iv) The valve should be able to operate with Hot/Cold normal water and 50% Glycol-water mix media between -10/2...120 ℃.

v) The nominal pressure of the valve shall be 1600 kPa (pressure rating PN16)

vi) The flow rangeability should be atleast 40:1 for the entire range of operation.

vii) Balancing valves and associated balancing should not be required on devices where EPIV are installed.

viii) The valve should give a pressure independent flow volume with minimum differential pressure in the range of 7 to 35 kPa based on the flow requirement to the maximum differential pressure of 350 kPa for sizes upto 50mm and 340 kPa for higher sizes. Minimum close-off shall be 1400 kPa for sizes upto 50mm and 690 kPa for higher sizes. Valves should be maintenance free and should not include replaceable cartridges.

ix) The accuracy of the flow sensor should be +/-2% at inlet length of 5 times the nominal diameter.

tax) The control valves shall be available with proportional actuators. Multi-turn actuators are not acceptable.

xi) The rotary actuator shall be thermally decoupled with the control device.

xii) The control valve should be operated by rotary electric actuator for maintenance free application.

xiii) The actuator should control by modulating or open close control system and drive the ball of the valve, the throttling device to the opening position dictated by the control signal.

xiv) The degree of protection of actuator shall be IP 54.

xv) In IP 54 actuators the push button shall be there for manual operation of the actuator by disengaging the gears.

xvi) The material of construction for valve body shall be nickel plated brass upto 50mm size and for higher sizes body should be Ductile Iron; ball shall be of Stainless Steel.

xvii) The supply voltage for the actuator should be 24 V AC/DC.

xviii) Actuator shall accept 0-10V signal from controller and provide position feedback signal of 0-10V too.

xix) Actuator shall have provision for PC connection via protocol converter for monitoring and controlling flow and valve position

6. TWO-WAY DIVERTING VALVES FOR FCUS

This shall be provided as 2 position diverting valves in chilled water lines at each fan coil unit and shall be actuated by space thermostat. Space conditions shall be maintained by allowing all of chilled water to either pass through the coil or bypass the coil and mix with the chilled water return. The valves shall revert to fully bypass position when fan is shut off. Pressure drop across the valve shall not exceed 0.14 kg/ sq.cm. Valve shall have the facility to replace motor actuator without removing the valve body.

7. Btu METER

The Btu meter shall provide the following information via both an integral LCD, and via serial network communications (protocol conforming to BACnet MS/TP, BACnet/IP, LONWORKS®, JCI-N2, MODBUS RTU RS485, MODBUS RTU TCP/IP ): Energy Total, Energy Rate, Flow Total, Flow Rate, Supply Temperature and Return Temperature. Each Btu meter shall be factory
programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).

8. **VARIABLE SPEED DRIVE (VSD)**

**AIR QUANTITY FLOW CONTROL**

The VSD System shall function to supply variable air quantity in the air-conditioned area in response to the load variations including that due to variations in ambient conditions and filter cleanliness conditions, to maintain the inside designed temperature, RH and pressure conditions in conjunction with the humidifier and re-heaters. During the day hours, as per the time interval selected, the VSD System shall regulate the speed of the AHU to maintain the temperature within maximum designed temperature and positive air pressure inside the air-conditioned area. The positive air pressure shall be maintained by keeping a difference of minimum 15% in the airflow between the supply and exhaust air. However, under any circumstances during the day hours, the airflow rate shall not fall below the 60% of the rated CFM of the AHU or 15 air changes, whichever is higher. During the rest of the night hours, the Programmable timer shall give a signal to the VSD to run the AHU at a pre-determined reduced speed so as to provide only 25% of the normal CFM or the minimum CFM achievable closest to 25% but not below 25% of the normal CFM. Due to the clogging of the air filter if the inside temperature conditions are not achieved even at 100% AHU speed then the VSD shall close an N.D. contacts to activate an alarm. The VSD shall have the provision to switch over to the manual mode as and when required. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept 2 feedback signals (from temperature sensor installed in the AC area and programmable timer controller) and have 2 programmable set points (inside temperature conditions, and 60% of the normal CFM condition as stated above) using HVAC terminology, to regulate the speed of the AHU motors in response to the variations in load and filter cleanliness conditions to maintain temperature and Air flow differential in supply and exhaust conditions. In case, any additional sensor (s) including wiring etc are required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD control shall have:

- a) RFI (Radio frequency interference) filters for EMC (Electromagnetic compatibility) compliance.
- b) Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-ration and keep motor temperature limits within permissible class B limits.
- c) Displays in user’s friendly Alpha Numeric Characters for all operating parameters, programming parameters and faults.
- d) Built in energy meter
- e) Built in run time counter
- f) Local control panel (key pad)

The system shall also comprise a suitable programmable timer & PLC with required electronic components, to allow 2 feedback signals (Temperature & Minimum CFM) to be passed on to the VSD during the day hours. In the night hours only one signal from the programmable timer shall go to the VSD to run it at pre-determined reduced speed. The room space air temperature and air flow shall be sensed by a temperature and air flow transmitters, which shall generate suitable DC signal to provide feedback to the VSD, which in turn shall regulate the speed of the AHU fan to maintain the designed conditions as described above. VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal fans. The VSDs should not cause any de-ration of...
the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded. The display should be in alpha-numeric characters and programming facility should be in user-friendly HVAC terminology. The VSDs should be able to accept up to 2 feedback signal from temperature & air flow transmitter simultaneously and to program 2 set points in it.

The system shall also have following features incorporated

a) Heat sink over temperature protection
b) Under voltage protection
c) Over voltage protection
d) Alpha-numeric display facilities
e) On indication Trip indication
f) Selectable display of various parameters line voltage, frequency, speed, power, torque, motor temperature percentage, VSD temperature percentage, KWH.
g) Raise and lower speed push button in local mode
h) Frequency range variation from 0 to 50 Hz.
i) Remote start and stop facility including indications thereof with necessary hardware and terminal blocks, including toggle switch etc. to over ride remote start & stop at the time of maintenance/repairs.
j) Off delay facility through timer or PLC with 30 sec to 120 sec. time delay, to be connected to air flow switch.
k) Safeguard facility against single phasing.
l) Tripping of AHU blower motors in response to the fire alarm Signal from AFAS.
m) Inter locking of Exhaust and AHU blowers such that power supply gets fed to exhaust blower only when the supply air flow is there.

Note: All starters and VSDs shall have inbuilt MCCB/ MPCBs in accordance with Type 2 Coordination.

3.3 PRE INSULATED CHILLED WATER PIPES

All piping system for service reaching a maximum temperature of 254°F installed above ground shall be with Aluminum or GI jacketing and underground with HDPE jacketing.
i) The pipe shall be MS ERW as specified in the Piping Section.

ii) The pipe insulation shall be rigid polyurethane foam with excellent heat-insulating properties, good mechanical properties and good resistance against aging with minimum density of 48 kg/cu m, 90% minimum closed cell content, minimum compressive strength of 2.7kg/cm2, and initial thermal conductivity of 0.026W/mK and the insulation fulfills all technical requirements according to EN 253. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both, the service pipe & jacket. Polyurethane foam made from Polyol and Isocyanate with 48 kg/ m3 density. Minimum thickness of insulation shall be 30mm.

Protective Jacket Material shall be as specified and shall be sufficiently sized to allow for desired insulation thickness for optimum performance of the system.

iii) The cladding shall be spirally wounded of G.I. or Aluminium as specified in tender documents for pipes installed on surface.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Dia. Of MS Pipe</th>
<th>Minimum Thickness of PUF in (mm)</th>
<th>Minimum Thickness of G.I. Cladding</th>
<th>Minimum Thickness of Al. Cladding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
</tbody>
</table>
v) Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable.

vi) Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

vii) For pipes buried in ground outer protective insulation jacket shall be seamless, extruded, black, UV resistant, high-density polyethylene (HDPE). HDPE Jacket shall be of High-density polyethylene (HDPE) with > 944 kg/ m³ density Diameter from 90 to 1000mm with minimum 3 to 28mm wall thickness and compressive strength is 40 PSI as specified.

i) All straight pipe lengths will have water tight end seal. All fittings will have square cut insulation cutback.

viii) For leak identification purpose 2 wire diagnostic wiring shall also be provided.

ix) Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

ii) Field joints insulation shall consist of PUF poured manually in a site-fabricated GI cladding fixed around the joint

x) For pipes buried in ground minimum thickness of the HDPE jacket and PUF shall be as follows:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Dia. Of MS Pipe</th>
<th>PUF Thickness (mm)</th>
<th>Thickness of HDPE Cladding (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20mm</td>
<td>30</td>
<td>2.5</td>
</tr>
<tr>
<td>2.</td>
<td>25mm</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>3.</td>
<td>32mm</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>4.</td>
<td>40mm</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>5.</td>
<td>50mm</td>
<td>37</td>
<td>3.0</td>
</tr>
<tr>
<td>6.</td>
<td>65mm</td>
<td>39</td>
<td>3.0</td>
</tr>
<tr>
<td>7.</td>
<td>80mm</td>
<td>43</td>
<td>3.0</td>
</tr>
<tr>
<td>8.</td>
<td>100mm</td>
<td>43</td>
<td>3.2</td>
</tr>
<tr>
<td>9.</td>
<td>125mm</td>
<td>43</td>
<td>3.5</td>
</tr>
<tr>
<td>10.</td>
<td>150mm</td>
<td>53</td>
<td>4.4</td>
</tr>
<tr>
<td>11.</td>
<td>200mm</td>
<td>63</td>
<td>5.0</td>
</tr>
<tr>
<td>12.</td>
<td>250mm</td>
<td>63</td>
<td>6.3</td>
</tr>
<tr>
<td>13.</td>
<td>300mm</td>
<td>63</td>
<td>7.0</td>
</tr>
</tbody>
</table>
The pre insulated pipe shall be manufactured at factory. The insulation shall completely fill the annular space between the carrier pipe & jacket and shall be bonded to both, carrier & jacket. The preinsulated pipes must be manufactured using High pressure PUF injection machines. The outer jacket & the carrier pipe must be held concentric using special chucks. Vent holes must be drilled to ensure expiration of air. The necessary quantity of Polyol & ISO must be mixed at high speed & injected into the void. The quantity of PUF injected for each pipe must be kept as a verifiable record to ensure that the required Density & thickness of insulation is maintained.

3.4 Leak Detection System

1 General

Leak Detection monitor can detect 1500 meter sensing cable. Once if water leaks on the cable alarm will start by flash and sound, and the leakage point will display on the LCD screen and the relays will ON automatically. Combined with MOD BUS RTU protocol & easy to integrate with monitoring system. This can be used as independent alarm, also can be connected to other monitoring system.

2 Performance

The Leak detection system shall locate the point of origin of first liquid or fault within +- 1% of sensor string length. The system shall identify the type of alarm leak / break /fault of prob as the location. The system shall be able to monitor (detect and locate) up to 1500 meter long string of sensor cable.

The system shall provide Modbus 485 output and dry contact relay for remote indication of the alarm condition.

3 Monitoring Unit (Model no LDS485L1500)

The monitoring unit shall be microprocessor based and capable of monitoring up to 1500 meter of sensing string per device including sensing cable, end cable and leading cable. The monitoring unit shall indicate when any liquid or growing liquid contacts the sensor cable by sounding an alarm, actuating relay and displaying message the states a leak has been detected as shown the location of leak on sensing string.

The monitoring unit power requirement shall be AC/DC 9 to 24, 3 watt and also equipped with RS 485 communication ports and dry relay 125VAC and 24DC NO/NC contacts can be choose.

<table>
<thead>
<tr>
<th>Basic characteristics</th>
<th>Sensor compatibility</th>
<th>Maximum length of the cable</th>
<th>1500m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>Sensor cable’s length of 0.5%±0.5m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 °C<del>60 °C (0 °F</del>140 °F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working temperature</td>
<td>-20 °C<del>50 °C (22 °F</del>122 °F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>5% - 95% (no condensation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Sensor compatibility</td>
<td>AC/DC 9~24V, 3W</td>
<td></td>
</tr>
<tr>
<td>Serial interface</td>
<td>Network configuration</td>
<td>RS-485 double wire net work, the baud rate can be set, the factory default value is 9600, choose-able address is from 0 to 255, default address is 0</td>
<td></td>
</tr>
<tr>
<td>Communication protocol</td>
<td>MODBUS RTU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay contactor</td>
<td>Function</td>
<td>NO, NC can be choose; leakage alarm or sensor error alarm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rating</td>
<td>AC125V, 0.5A, DC24V, 1A</td>
<td></td>
</tr>
</tbody>
</table>

4. Sensor cable Model no LDSSC6000
The conductive-polymer technology and fluoropolymer construction make sensing cable mechanically strong and resistant to corrosion and abrasion. The cable is constructed of two sensing wires, an alarm signal wire, and a continuity wire embedded in a fluoropolymer carrier rod. The alarm module constantly monitors the sensing cable for continuity. The rugged cable construction exposes no metal, and enables the cable to be reused even in corrosive environments.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable diameter</td>
<td>0.24 in (6.0mm) nominal</td>
</tr>
<tr>
<td>Continuity and signal wires</td>
<td>26 AWG with insulation of fluoropolymer</td>
</tr>
<tr>
<td>Sensing wires</td>
<td>30 AWG with jacket of conductive fluoropolymer</td>
</tr>
<tr>
<td>Carrier</td>
<td>Fluoropolymer</td>
</tr>
<tr>
<td>Cable weight (50 ft/15m length)</td>
<td>2.3 lb (1kg)</td>
</tr>
<tr>
<td>Cable color</td>
<td>High-visibility yellow</td>
</tr>
<tr>
<td>Breaking strength</td>
<td>Cable only: 160 lb (72KG) Including connectors: 70 lb (32kg)</td>
</tr>
<tr>
<td>Cut-through force</td>
<td>&gt;50lb with 0.005 (~22kg with 0.13mm) in blade; crosshead speed 0.2in/min</td>
</tr>
<tr>
<td>Abrasion resistance</td>
<td>&gt;65 cycles per UL719</td>
</tr>
<tr>
<td>Maximum continuous operating temperature</td>
<td>70 degree</td>
</tr>
<tr>
<td>Leak size to alarm (tap water)</td>
<td>2 in (50mm) maximum at any point along sensing cable, up to 5000 ft maximum system length</td>
</tr>
<tr>
<td>Drying time</td>
<td>Cable dries and resets within 15 seconds; removal from standing water</td>
</tr>
<tr>
<td>Standard cleaning method</td>
<td>Wipe with clean damp cloth</td>
</tr>
</tbody>
</table>

5 Installation of Sensor Cable

Sensor cable shall be installed in polyurethane foam insulation during puff injection in factory fabricated pipes and each cable must be suitable for to join with adjacent cable with plug and play type connector for easy installation at site.

Sensing cable shall be supplied with factory-installed plastic connectors that plug together. The cable is designed of a range of applications, including data center subfloors, telecommunication rooms, HVAC equipment locations, pipes, storage areas, tanks and roofs. The cable is small, lightweight and flexible, allowing easy installation. The smooth design allows for quick drying.

3.5 VALVES

i) The material of butterfly valves shall be as under: Body- Cast iron; Disc- Stainless Steel; Seat- Either integral or Nitrile rubber O-ring; Nitrile/ Silicon

ii) Balancing valve shall be of cast iron flanged construction with EPDM/ SG iron with epoxy coated disc with built in pressure drop measuring facility (pressure test cocks) to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation.

iii) Non return valves shall be of gun metal construction up to 65 mm, the metal conforming to class 2 of IS: 778. For 75 mm and above, the valve shall be of bronze or gun metal, body being of cast iron. While screwed or flanged ends may be provided up to 65 mm, flanged ends shall be provided for larger sizes.

iv) Air valves shall be of gunmetal body.

10.7 STRainers

i) Strainers shall be of "Y" type or pot type as specified.

ii) "Y" strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit.

iii) Pot strainers, where specified, shall be provided in return water headers, for chilled water and condenser water if enough floor area is available in the refrigeration plant room, as an alternate to individual Y type strainers with pumps.

iv) The strainers shall be designed to the test pressure specified for the gate valves.

v) Filtration area of Y-strainer shall be minimum four times the connecting pipe size.

vi) Strainers shall have a removable bronze/ stainless steel minimum 1mm thick screen with 3 mm perforations and permanent magnet.

vii) Strainers shall be provided with flanges or threaded sockets as required. They shall be designed
so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

(viii) Strainers shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.

(i) Pot strainer shall be fabricated out of MS sheet and the sizes shall be as under:

<table>
<thead>
<tr>
<th>Pipe sizes (mm)</th>
<th>Pot dia (mm)</th>
<th>Pot Height (mm)</th>
<th>Basket dia (mm)</th>
<th>Basket Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>300</td>
<td>400</td>
<td>200</td>
<td>240</td>
</tr>
<tr>
<td>80</td>
<td>350</td>
<td>450</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>100</td>
<td>450</td>
<td>500</td>
<td>300</td>
<td>280</td>
</tr>
<tr>
<td>125</td>
<td>500</td>
<td>600</td>
<td>330</td>
<td>340</td>
</tr>
<tr>
<td>150</td>
<td>540</td>
<td>700</td>
<td>360</td>
<td>390</td>
</tr>
<tr>
<td>200</td>
<td>610</td>
<td>815</td>
<td>400</td>
<td>470</td>
</tr>
<tr>
<td>250</td>
<td>800</td>
<td>955</td>
<td>550</td>
<td>510</td>
</tr>
<tr>
<td>300</td>
<td>1000</td>
<td>1105</td>
<td>750</td>
<td>580</td>
</tr>
<tr>
<td>350</td>
<td>1190</td>
<td>1300</td>
<td>895</td>
<td>678</td>
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<tr>
<td>400</td>
<td>1350</td>
<td>1500</td>
<td>1020</td>
<td>785</td>
</tr>
<tr>
<td>450</td>
<td>1518</td>
<td>1700</td>
<td>1060</td>
<td>890</td>
</tr>
<tr>
<td>500</td>
<td>1690</td>
<td>1800</td>
<td>1100</td>
<td>900</td>
</tr>
</tbody>
</table>

3.6 INSTRUMENTS
i) Pressure gauge of appropriate range and 150 mm. dial size shall be provided at the following locations.
   a) Supply and return of all heat exchange equipments. b) Suction and discharge of all pump sets. The pressure gauge shall be duly calibrated before installation and shall be complete with shut off cocks.
   ii) Direct reading industrial type thermometer of appropriate range shall be provided at the inlet and outlet of all heat exchange equipments. The thermometers shall be installed in separate wells.
   iii) Appropriate number of additional sockets shall be provided for the installation of pressure & temperature transducers for BMS.

PART-VII: BUILDING AUTOMATION SYSTEM
1.0 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES:
1.1 SPECIFICATION NOMENCLATURE
   A. Acronyms used in this specification are as follows:
      BMS Building Management System
      GUI Graphical User Interface
      POT Portable Operator’s Terminal
      DDC Direct Digital Controls
      LAN Local Area Network
      PICS Product Interoperability Compliance Statement

1.2 ARCHITECTURE:
   A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet, and Modbus technology communication protocols in an interoperable system.
B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet TCP to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device’s compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet at all levels.

C. All components and controllers supplied under this contract shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a Master / Global / Host to pass data shall not be acceptable.

D. Structured Query Language (SQL) or Java Database Connectivity (JDBC) or ORACLE compliant server database is required for all system database parameter storage. This data shall reside on a server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. Two (2) level hierarchical topology is required to assure fast system response times and to manage the flow and sharing of data. Systems Requiring Router, Gateways are not acceptable.

1.3 WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of users using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware.

The Web page shall get automatically refreshed without any user intervention.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator and set holidays.

View logs and charts.

View and acknowledge alarms.
The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to adjust their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.4 SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

The proposed system shall be a Direct Distributed Digital Control (DDC) system. It shall be a PC based system and shall combine latest state of the art technology with simple operating techniques. The entire Monitoring of Building Management System (BMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the Internet to a host computer in a remote location. The BMS shall communicate to third party systems such as VAVs, Energy meters, UPS, DG, Lifts, VFDs & HT/LT circuit breakers, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.

The BMS framework shall utilize built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the ongoing computerization of control applications under single integrated system architecture.

The features shall be distributed both physically and functionally over the field controllers. Microprocessor based Direct Digital Distributed Controllers (DDC) shall interface with sensors, actuators and environmental control systems (i.e. HVAC units, fans, lighting etc.) and carry out followings functions:

a. Individual input/output point scanning, processing and control.

b. Centralized operation of the plant (remote control).

c. Static / Dynamic graphic details of plant and building.

d. Energy Management through optimization of all connected electrical and mechanical plants.

e. Alarm Detection and early recognition of faults.

f. Time, event and holiday scheduling as well as temporary scheduling.

g. Prevention of unauthorized or unwanted access.

h. Communication interface and control.

i. Suggestive preventive maintenance for all equipment as well as own error diagnosis.


k. Optimum support of personnel.

l. Data Visualization Tool

These Controllers shall be capable of functioning on a stand-alone mode i.e. in case of loss of
communication with the central control station / Server, these shall function independently.

DDC shall have microprocessors built-in as standard, which control the respective operation centers based on the required logic and also offer fast communication of data via the network communication system. The local access to these shall be either through an in-built display with keypad for each outstation or through a portable operator’s terminal. The controllers shall be capable of executing advanced control algorithms like Optimum Start stop, PID control, auto PID tuning and schedule management. They shall also execute logic functions based on time and/or event. Totalization and averaging functions shall be an inherent feature of the controller.

Each stand-alone intelligent DDC Controller shall have a dual 32 bit processor, on board Ethernet connectivity. These shall also control any other operations on the floor and shall be sized to suit the operation centres or system requirement. This shall help in reducing the site electrical installation.

The number of controllers for central plant room equipments shall be decided by the contractor. Overall, the system shall be provided with 15% spare capacity, with spare of at least 15% points on each controller.

There shall be one BMS control station located in Control Room. The Operator Station should use a simple Web Browser in conjunction with the BMS Server software. The Computer shall be sized to cover the graphic display memory, planning information, software & data storage requirement. The display shall be in the form of dynamic color graphics and text format with menu driven pop-up windows and help facility.

The following software packages shall be loaded into the system as minimum standard:-

a. Complete system operational software
b. Site specific data manipulation software
c. Graphics software
d. Alarm indication software
e. Internet Enabled Remote Monitoring Package.
   • DI=DIGITAL INPUT
   • AI=ANALOG INPUT
   • DO=DIGITAL OUTPUT
   • AO=ANALOG OUTPUT
d. Refer Annexure-B for IO summary

2.0 CENTRAL STATIONS SOFTWARE AND HARDWARE
2.1 CENTRAL STATION SOFTWARE
A. A central server, located at Control Room, shall be provided. The server shall support all DDC’s connected to the customer’s network whether local or remote.
B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, PSTN or dial-up connection.
C. It shall be possible to provide access to all DDC & 3rd party integration units via a single connection to the server. In this configuration, each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the Local Area network.
D. The server software shall provide the following functions, at a minimum:
   • Complete control and monitoring of IBMS system from colour graphics pages on the machine, or from a remote web browser.
- Full client-server operation.
- SQL / JDBC / ORACLE Database.
- Comprehensive alarm handling with alarm retransmission and logging.
- Scheduled recording of logged data from DDC.
- Management of multiple controller occupation times.
- Multilevel security system.
- International language support
- Display of HTML pages from company Intranet, or Internet.
- Display of live, logged, or recorded data in multi-trace graphs.
- Simple engineering path using drag and drop operations.
- Self-learning of all local networks.
- Help file in PDF format for viewing or printing.
- Access to the configuration mode of devices.
- Display all devices on the system connected via LANs, internet works, autodialed links and Ethernet Network connections.
- Customised program creation environment.

The BMS software shall be simple, flexible and convenient to use such that an operator with minimal programming knowledge can use it to perform control / monitoring and to build programs for control applications, graphics to generate management information systems (MIS) reports. As well, on higher end it shall be possible to create customized programs to suite the site requirement by a software programmer. All necessary documents required to make customization possible should be available along with the software without any additional charge. The operating system shall be the Microsoft Windows XP / Windows 7 / Windows 2008 Server / Enterprise /Professional 32 / 64 bit multitasking environment. The networking software shall use the TCP / IP LAN protocol. The system shall be capable of supporting unlimited users. The BMS software shall be upgradable up to 10 years without any cost by the provider. The system shall be provided with 5 years comprehensive maintenance after first year of DLP. The bidder shall quote as a item for this scope of work as separate item. The bidder shall provide undertaking by the OEM for providing comprehensive AMC to the IIT Kanpur at the quoted rate including upgradation of software for 10 years.

2.2 Energy Management Software
The Energy Management Dashboard & Report shall be done from the BMS graphics software, The Data into Separate Application Database (SQL Server) for Analysis shall be created, System Should Have The Following Key Features:

Energy Management -

1. Data monitoring and reporting in real time no delay with 2min.
2. Energy Dash-Board shall be Customizable.
3. Energy Report Generation and all kind of report of meters Against Selection of Time And Frequency.
4. Energy breakdown and consumption patterns for DG & grid supply
5. Should have the compatibility to set energy consumption targets, alarm and pricing.
6. Should have the compatibility to compare historical trends, benchmark data
7. Web Enabled.
8. Email / mobile SMS Option Available
9. Multiple Database Sources / Site Can Be Integrated.
10. Trends and previous History can be generated

2.3 Monitoring and control functions
Monitoring:

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The system shall support data acquisition using periodic scanning, exception reporting or on operator request. The system shall support a range of scan intervals, ranging from less than 5 seconds up to several minutes as desired / required. The system shall allow certain selected points to be scanned more often / faster than other points.

The communication techniques shall be optimized to minimize network traffic while providing good system response and reliability. The system shall also provide utilities to compile aggregate statistics on communication link usage.

**Control:**

Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user.

### 2.4 System Database

The system shall provide a real-time database incorporating data from analogue, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to modify on-line without interrupting operation of the system. In addition to point based information, the database shall also provide historization capabilities for analogue, digital, pulse; event based information and calculated values. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written application, etc.,

The real-time database shall use suitable data structures to collect and store the following categories of data, as minimum.

- Access points
- Analogue points
- Status points
- Accumulator points
- Historical data
- Event data

The facility shall also exist to accommodate user defined data structures.

Each of the point database structures shall be comprised as a composite point with a number of associated parameters that may be referenced relative to a single tag name. Specifically, each of these parameters shall be accessible by various sub-systems such as the graphical operator interface, report generation system and application program interface in a simple format without the need to know any internal storage mechanism.

The system shall maintain portions of the data base requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data.

Database backup shall be possible with the system on-line including backup of historical based data. The database backup shall be part of GUI software & shall be possible to configure automatic backup at regular interval without any user interference / attention. All other backup such as graphic pages / drawing etc can be windows based where simple copy & paste should be enough for taking backup other than database. Long term storage of this data shall be possible using the zip drive. The system shall have the provisions for importing this data at later date for analysis and long terms MIS reports.

Point data shall be stored in a composite point database structure that provides a wide range of configurable information including but not limited to:

- Point name and description
- Multiple locations for data storage and device scanning addresses.
- Scan period
Multiple dead-band or hysteresis settings
Monitoring and control access restriction information.
Location of operator alarm handling instructions
Location of ancillary information associated with the point.

2.5 Historical data storage

Collection of historical point data shall be configurable as part of the point definition. Once configured, this data shall be collected automatically. Historical data collection shall be provided for both snapshots and averages with intervals ranging from 5 seconds to several hours.

The system shall provide the necessary means to easily locate the particular value of interest for any of the historical points. The graphical operator interface, trend, report generation and application interfaces shall be able to access historical data.

2.6 Trending

The system shall provide flexible trending allowing real-time, historical or achieved data to be trended in a variety of formats. In addition, trend data types shall be able to combine to allow for comparisons between data e.g. current real-time data versus archived data. The system shall provide trending capability with following functions.

- Real time trending
- Historical trending
- Archived history trending
- Trend scrolling
- Trend zoom
- Export option / Copying of currently displayed trend data to the clipboard for pasting into spreadsheet or document.

The system shall allow the trending of a minimum of 5 points in a single trend display set. For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with the mouse or other pointing devices. From such a selection, it shall be possible to copy the underlying data to the windows clipboard for subsequent pasting into spreadsheet application such as Microsoft excel.

2.7 Alarm Management

The software shall include a well organized alarm management facility to enable the operator to react quickly and efficiently to alarm conditions. Apart from the specific points identified for alarm annunciation in the I/O points schedule, the alarm types supported shall included:

- Very high value alarm
- Very low value alarm
- Large deviation alarm
- Rate of change alarm
- Unreasonable value alarm
- Delay to avoid nuisance alarm / short time change in value

The system shall permit any of these alarm types to be applied to the analog and accumulated points.
The software shall permit at least 90 levels of alarm priorities to be assigned to each alarm ranging from the lowest to the highest. These levels shall be easily distinguished by the manner in which they are presented such as the color of the alarm message, blinking of the alarm message, varying audible alarms, etc. All alarm shall be logged in the event / alarm file and / or on the alarm printer. On acknowledgement of an alarm, it shall be possible to automatically issue a reset command to the controller so as to attempt to reset the alarm point.

2.8 Reporting
The system shall support a flexible reporting package to allow easy generation of report data. The reports provided shall include pre-configured standard reports for common requirements such as alarm / event reports and custom report generation facilities that are configurable by the user.

The following pre-formatted reports shall be available on the system:
- Alarm / event report
- Operator trail report
- Point trail report
- Alarm duration report
- All point report
- Point attribute report
- Lockout summary
- Over-ride summary

Configuration of these reports shall only require entry of the schedule information, and other parameters such as point name or wildcard, filter information, time interval for search and destination printer to fully configure the report. No programming shall be required.

The requirement of the above mentioned reports shall be as follows:

**Alarm/Event Report**
This report shall be summary of all events of a specified type for nominated points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period to the current time.

**Operator trail report**
This report shall be a summary of all operator actions relating to a specific operator in a specified period.

**Point trail report**
This report shall be provided to produce a summary of all events of a specified type occurring in a period on nominated points.

**Alarm duration report**
This report shall be provided to calculate the total amount of time a nominated point or group of points has been in an alarm condition over a given time period.

**All point report**
A report shall be provided to produce a list of point information, including point name, description, point type, engineering units, and current values.

**Point attributes report**
A report shall be provided for summaries of the points selected as per the following criteria:
- Out of service
- Alarm suppressed
- Abnormal input levels
- In manual mode.
Over-ride summary
This report shall be used to provide the summary of all points / commands that have been over-ridden by the operator.

2.9 Time Schedules:

The system shall include the facility for time scheduling activities on both a periodic and one-off basis. All time schedules shall be configurable via the Operator workstation. Each time schedule entry shall consist of:

♦ Date
♦ Time
♦ Point name
♦ Point Parameter
♦ Target Value
♦ Type of scheduling

♦ The available time schedule type shall include:
  Daily – to be executed everyday
  Workday – to be executed on the week days
  Holidays – to be executed on holidays
  Individual days – to be executed on a particular day

The system shall also have the provision for programming temporary schedules that over-ride the normal schedule.

2.10 Energy Monitoring & Analysis:

Energy Monitoring & Analysis should be integral part of GUI. It shall support minimum of 50 Energy points for analysis purpose. The software shall provide the following feature but are not limited to,

a) It shall be possible to generate & view detailed Daily, Weekly & monthly graphs of the energy meter / point identified.
b) It shall be possible to see and analyze the total energy usage in a building and also shall be possible to identify by which system is major user of the energy.
c) It shall be possible to compare the energy points week against week, day against day in a month, identify Maximum, Minimum & average daily values & Energy usage for different periods of time of the day.
d) It shall be possible to make cost and consumption analysis or CO2 reports on consumption.
e) Based on the energy consumed it shall be possible to rank the systems or building (in case of multi location buildings)
f) Software shall allow the user to compare the predicted / forecasted energy or based on historic performance with current performance.
g) It shall be possible to create energy signature with respect to ambient / outside temperature of the day
h) Software shall allow the user to identify the exceptions happened in the system due to which energy consumption was increased.
i) It shall be possible to compare the energy consumption after introducing a energy saving strategy for further fine tuning or to visualize the savings achieved.

2.11 Operator Interface:

The operator interface provided by the system shall through an intuitive graphical user interface and shall allow for efficient communication of operational data and abnormal
conditions. It shall provide a consistent framework for viewing of information. Critical areas (such as alarm icons) shall be visible all the times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times.

The operator interface shall be interactive and based on graphics and / or icons. Standard tool bar icons and drop-down menus shall be available on all standard and custom display to allow easy access to common functions.

The system shall provide an operator interface with the following minimum capabilities:

- Window re-size, zoom in, zoom out.
- Dedicated icons and pull down menus to perform the following:
  - Associated display
  - Alarm summary
  - Alarm acknowledgement
  - Previous display recall
  - Graphic call-up
  - Trend call-up
  - Point detail
  - Current security level
  - Alarm annunciation
  - Communication fail annunciation
  - Operator message zone.

2.12 **Area assignment / area profile**

Each operator shall be assigned one or more specific areas / functions of the facility with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the facility or a particular utility or a particular equipment.

The system shall provide the facility to create area profiles, which combine areas and time periods, and which can be assigned to operators with the same area access requirements. By using area profiles in this way, area access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

2.13 **Command partitioning**

It shall be possible to assign to each operator a set of allowed commands / operating for each assigned area. With this feature, it shall for example be possible to configure an operator to set a digital point to On, but to disallow the same operator from setting the same digital point to OFF.

2.14 **Standard system displays**

The following displays shall be included as part of the system:

- Alarm summary display
- Event summary display
- Point detail template displays
- Trend set template displays
- Communication status displays
- System status displays
- Operator scratch-pad display.
2.15 **System Status Displays**

These shall display the following information:
- Points in alarm condition pending acknowledgement
- Points which remain in an alarm condition state but which have been acknowledged.
- Communication failure
- Printer Status
- Operator workstation status
- Controller status

2.16 **Administrative Displays**

The system shall provide the following full screen display:
- Master system menu
- Report summary
- Alarm summary
- Event summary
- Display summary.
- Area assignment
- Holiday assignment
- History assignment
- Push-button assignment
- Operator definition
- Operator message board
- Events archive and retrieval
- Time period summary

2.17 **Other requirements**

It shall be possible to launch any windows based applications, such as Microsoft word or Microsoft excel, from within the operator interface.

2.18 **Help Facility**

Software shall be provided to facilitate programming and storage of the system operation manuals in the hard-disk. The operation manual shall be retrieved by On Line Help mode so as to enable the operator to self learn the system operation, command, or function as and when needed.

This `help` facility shall be made available to the operator by use of a dedicated key or a single key click on the mouse. A minimum help shall be available for every menu item and dialogue box.

The facility shall contain both text and graphics to provide information about the selected function directly.

The information provided shall be in simple clear language and shall be possible to search the help based on typical word included in the process.

When a point is overridden by operator command from an operator workstation or a local workstation, an alarm message shall be output to the appropriate alarm printer and to respective operator workstation. Alarm messages shall require operator acknowledgement.

When a point returns to normal, the event shall be recorded in control stations as 'Return to Normal'.

The Operator workstations shall be capable of displaying a list of all points in alarm for
the building in a single summary. Systems which require the operator to make a separate summary for alarms shall not be acceptable. The software shall also provide details of particular alarm occurred on a point.
Contractor shall strictly follow the procedures as laid down in the necessary guidelines.

3.0 3RD PARTY SYSTEM INTEGRATOR UNITS:
A. The 3rd party Integration unit shall provide the interface between Ethernet LAN and the 3rd party field control devices such as DDC or PLC or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others.
B. The Unit must provide the following hardware features as a minimum:
   a. One no. on board RS-232 port
   b. One No. on Board RS-485 port
   c. Provision to include / add additional communication card
   d. Battery Backup
   e. Minimum RAM of 128 MB & Flash of 64MB
C. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.
D. The Integration unit shall have built in drivers for open protocol such as
   a. Bacnet over MSTP
   b. Bacnet over IP
   c. Modbus over MSTP
   d. Modbus over IP
   e. Lon FTT
   f. Lon IP
   g. Mbus over TCP
   h. Mbus Serial
   i. SNMP
   If the above drivers are add-on products, it shall be made available / considered while selecting the unit & the same to be confirmed in writing.
E. The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself.
F. The Integration unit shall have inbuilt JAVA engine and it shall be possible to configure the IO, if required, of the 3rd party devices.
G. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol.
H. The Integration unit should have inbuilt memory for program storage.
I. The Integration unit should automatically backup its database for the user defined interval.
   j. User authentication should be integral part of the unit.
K. All vendors are required to provide the documentation highlighting the capabilities mentioned above.
L. All units shall have LEDs for fault / status identification such as
   a. LAN active (one per port in case of multiport units)
   b. LED to display proper functionality / Status of the unit.
   c. LED to display healthiness of CPU of the unit.

4.0 DIRECT DIGITAL CONTROLLER

4.1 DIRECT DIGITAL CONTROLLER (DDC) HARDWARE REQUIREMENT:
1) DDC controllers shall be capable of fully “stand- alone” operation i.e. In the event of loss of communication with other DDC’s or Control Station, they shall be able to function on their own.

2) The controllers shall consist of single 32 bit microprocessors for reliable throughput, with EEPROM based operating system on BACNET

3) The memory available to the controller board should serve as working space and there should not be any limitation of using particular function block other than the memory.

4) The controllers shall be UL listed and conforming to CE.

5) The controller shall have support programs built in RAM for minimum of 120 hours in the event of a power failure and it shall be possible to fit any battery thus expanding the time limit to 5 years. An alarm shall be generated on low battery voltage. The battery shall not be required to supply power to actuators, valves, dampers etc.

6) DDC shall have embedded TCP/IP connectivity so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

7) Controller shall have capability to communicate with other controllers for any interlock or data sharing using peer to peer technology. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable.
Vendor to demonstrate this capability during the commissioning time and the same shall be verified at the time of handing over.

8) Each controller shall have RS232 port built on to it so that any trouble shooting required at field level can be carried out without removing the controller from the network (LAN).

9) All controllers shall accept 230V, 50Hz Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided.

10) Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user.

11) All controllers shall have capability to provide 24V DC auxiliary power supply for the sensor which requires power, however the same shall not be required to high power consuming devices / equipments such as actuators, dampers etc.

12) The Controllers shall have proportional control, Proportional + Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control, Two Position Control and Time Proportioning Control and algorithms etc, all in its memory and all available for use by the user, i.e. all the control modes shall be software selectable at any time and in any combination. The analog output of Proportional Control, PI Control, and PID Control shall continuously be updated and output by the program shall be provided. Between cycles the analog output shall retain its last value. Enhanced integral action in lieu of Derivative function shall not be acceptable.

Automatic loop tuning facility should be available to tune the loop at regular interval and adjust the gain or the integral / derivative time.

13) The controllers shall have a resident real time clock for providing time of day, day of week, date, month and year. These shall be capable of being synchronized with system / time master clocks in the network.

Upon power restoration all clocks shall be automatically synchronized to the time master controller which will be set during the commissioning phase.

14) The microprocessor based DDC’s shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 128 input/output (I/O)
hardware points (with or without an expansion board).

15) If the controllers provided by the contractor have the configurable plug in function cards, then the following minimum specifications shall have to be met:
   i) The cards shall provide for analog or digital, input or output, hardwired connections to the installed plant.
   ii) The quantity and combination of these cards shall be determined by the requirements of the plant in that location with the concurrence of the Owner.

16) The DDC’s shall have 15% spare capacity for each type of point (digital/analog input/output) to give flexibility for future expansion.

17) All DDC controllers shall have 10 / 12 bit A/D resolution and be capable of handling voltage, milli-ampere, resistance or open and closed contacts inputs in any mix, if required.
   Analog inputs/outputs of the following minimum types shall be supported:
   a. 4-20 mA.
   b. 0-10 volts.
   c. 2-10 volts.
   d. Resistance Signals (either PTC or NTC such as PT 100, PT 1000, PT 3000, NTC20K)

   Digital input/output types to be supported shall be, but not limited to the following:
   i) Normally-open contacts.
   ii) Normally-closed contacts.
   iii) Pulse inputs

   **Modulating outputs shall be true proportional outputs and not floating control type.**

18) It shall be possible to change the analog inputs to accept any of the above depending upon the site condition or system requirement using a jumper. **The DDC which is configured using software trigger / switch shall not be acceptable.**

19) Controller’s packaging shall be such that, complete installation and check out of field wiring can be done prior to the installation of electronic boards.

20) All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.

21) Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for Power up Test OK, Watch dog and Bus Error. All LED’s shall be visible without opening the DDC cover.

22) It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.

23) Controllers requiring fan cooling are not acceptable.

24) There shall be the facility for accessing controller data information locally, via a portable plug-in color LCD display which will be common to all controllers and normally removed to prevent unauthorized tampering. In either case, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.

25) In case the Portable operator Terminals (POT) are required to programmed the controllers,
sockets shall be provided for same. Attachment of POT shall not interrupt or disable normal panel operation or bus connection in any way.

26) The controllers shall be housed in vandal proof boxes to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external application shall be housed IP66/IP54 rating enclosures.

27) It shall be possible to add new controllers to the system without taking any part of the system off-line.

28) All DDC should have XML web service option which can be enabled in later stage for any higher interface with IT infrastructure or any other service.

29) Individual DDC should be BTL (Bacnet Testing Lab) tested.

4.2 DIRECT DIGITAL CONTROLLERS CAPABILITIES:

1) The Controllers shall have a self analysis feature and shall transmit any malfunction messages to the Control Station. For any failed chip the diagnostic tests, printout shall include identification of each and every chip on the board with the chip number/location and whether the chip “Passed” or “Failed” the diagnostic test. This is a desired requirement as it would facilitate trouble-shooting and ensure the shortest possible down time of any failed controller. Controllers without such safety feature shall be provided with custom software diagnostic resident in the EEPROM. The tenderer shall confirm in writing that all controllers are provided with this diagnostic requirement.

2) Operating system (O.S.) software for controllers shall be EPROM resident. Controllers shall have resident in its memory and available to the programs, a relevant library of algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences.

3) In the event of failure of communication between the controllers and/or Control Station terminal, alarms, reports and logs shall be stored at the controllers and transmitted to the terminal on restoration of communication.

4) In the event of memory loss of a Controller or the expiration of back-up power, on start-up of the unit the necessary data-base shall be downloaded manually so that the logic built are verified by the user. However, controllers requiring a manual intervention for the re-boot of software are not desired.

5) Where information is required to be transmitted between controllers for the sharing of data such as outside air temperature, it shall be possible for global points to be allocated such that information may be transmitted either on change of incremental value or at specific time intervals.

6) Controllers must be able to perform the following energy management functions as a minimum, Time & Event programs
   a. Holiday Scheduling
   b. Maximum and Distributed power demand
   c. Optimum start and stop program
   d. Night purge
   e. Load reset
   f. Zero energy band
   g. Duty cycle
   h. Enthalpy analysis and control
   i. Run Time Totalization
j. Sequencing and Optimization
k. Exception scheduling

Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the Engineer in charge.

7) The DDC Controllers shall have Adaptive Control capability whereby the control software measures response time and adjusts control parameters accordingly to provide optimum control. The software shall allow self-tuning of the variable control loops (all or any of P, P+I, P+I+D) of the AHU’s system so as to provide the most efficient and optimized controls at different load conditions. The energy management programs shall update their parameters based on past experience & current operating conditions.

8) Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a “timed lockout” period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic.
   Tenderers shall indicate their proposed system alarm handling capability & features.

9) Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time. Run time counts shall be resident in non-volatile memory.

10) It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.

11) All DDC shall have trend / log storing capacity in built into it. It shall be possible to have stored the data for at least 40 days @ 1 hour sampling time for all the points of the DDC (used or unused).

12) Minimum communication should be 10MBPS for each of the controller.

13) DDC should be forward compatible type so that any expansion or upgrade of the system required in the future is easily taken care off without scrapping / removing / disturbing the existing working system.

14) DDC Should allow user to include graphics, if required, however it shall be of static in nature.

15) All DDC Should be capable of sending email to specific user in the event of alarm, identified by end user.

5.0 PORTABLE OPERATORS TERMINAL (POT)

1) POT shall be provided to allow operator readout of system variables, override control and adjustment of control parameters. The POT shall be portable and plug directly into individual controllers for power and data.

2) The minimum functionality of POT shall include:
   - Set points to a fixed value or state.
   - Display diagnostic results.
   - Display sequentially all point summary and sequentially alarm summary.
   - Display/change digital point state, analog point value.
   - Display/change time and date.
   - Display/change analog limits.
   - Display/change time schedule.
• Display/change run time counts and run time limits.
• Display/change time and/or event initiation.
• Display/change programmable offset values.
• Access DDC initialization routines and diagnostics.
• Enable/disable points, initiators and programs.
• Display/change minimum ON/OFF and maximum OFF times.

3) The POT shall be complete with command keys, data entry keys, cursor control keys or liquid crystal display (LCD). Access shall be via self prompting menu selection with arrow key control of next menu/previous menu and step forward/backward within a given menu.

4) Connection of a POT to a controller shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or interfere with Control Station commands and system modifications.

5) Connection of POT at any controller shall provide display access to all controllers on that bus. In case the controller has a fixed LCD display and entry keyboard, then the display access shall be available on each screen.

6) It should be possible to override the commands given through POT by the Operator Control Station.

7) POT shall have touch screen color display and it shall possible to hook this to Local area Network so that the entire system data can be visualized.

8) POT shall have self learning capability so that it can recognize the DDCs on the network and update all points without any manual programming.

6.0 DATA COMMUNICATION

The communication between controllers shall be via a dedicated or customer provided Ethernet communication network as per standards. Controller's microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.

Each controller shall have equal rights for data transfer. There shall be no separate device designated as the communication's master. Those systems using dependent controllers shall be pointed out by the contractor and a dual Hot redundant transmission media with automatic switching and reporting in the event of line faults will have to be provided.

The communication network shall be such that:

1) Every DDC must be capable of communicating with all DDC’s on its own.

2) Network connected devices shall be capable of sending message after successive retries shall constitute a communication or device failure.

3) Each controller is to be provided with a communication watchdog to assure that the failure is reported to central station.

4) Error recovery and communication initialization routines are to be resident in each network connected device.

5) The communication protocol shall incorporate CRC (Cyclic Redundancy Check) to detect transmission errors.

Single or multiple standalone controller failures shall not cause loss of communication between active DDCs connected on the communication network. Full communication shall be sustained as long as there are at least two operational stand alone control panels active on the communication network.

All the System Integration Units shall be linked together on a Local Area Network.

The communication network shall include provision for automatically reconfiguring itself to
allow all operational equipment to perform as efficiently as possible in the event of single or multiple failures.
The BAS supplier shall be required to provide details of standards to which their system conforms.

7.0 FIELD DEVICES

7.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements:
All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.
All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items
When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items:

(i) Weather Protection
All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment are mentioned in the respective section.

(ii) Pipe work Immersion
Corrosion resistant pockets of a length suitable for the complete active length of the device, screwed ½” (13 mm) or ¾” (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)
Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

7.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications:

1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be at least ± 1.33 deg C.
2) Immersion sensors shall be provided with separate Brass thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of at least 10 kgf/cm².
3) The connection to the pipe shall be screwed type. An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.
4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.
5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.
6) Outdoor air temperature sensor shall be provided with a sun shield.
7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.
The temperature sensors may be of any of the following types:

1) PT 100, PT 1000, PT 3000
2) Thermistor

7.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be ± 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat
source such as windows, electrical appliances etc.

7.4 FLOW METER

Water flow meters shall be either Electro magnetic or ultra sonic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Engineer in charge, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to ‘zero’ the flow meter without any external instruments, with the overall accuracy of at least ± 1% full scale.

7.5 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer’s standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10 °C to 60° C with ambient ranging between 0 °C to 55 °C.

7.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1A rating.

The switch shall be supplied suitable for wall mounting on ducts. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and has differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.8 AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 1 NO/NC potential free. Site adjustable scale shall also be provided.

7.9 AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

7.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 1NO/1NC potential free.

7.11 CO SENSOR
CO Sensor shall be integrated Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0-10 Volts etc. Response time of the detector shall be <10 minutes.

7.12 AIR VELOCITY SENSOR
Air Velocity Sensor shall be integrated Surface / Duct mounted type on the field. These shall work on 24V AC/DC supply with +/-10% variation the output being standard type i.e. 4-20 mA / 0-10 Volts etc with an accuracy of +/-3%. It shall be possible to select the different ranges by changing the jumpers on the sensor. At least 3 selection ranges on the sensors are required.

7.13 CO2 SENSOR – Space Type
CO2 Sensor shall be wall / Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0-10 Volts etc. The sensing range required shall be 0-2000 PPM with good resolution. The preferred type of sensing element / method is NDIR type with accuracy of +/-30PPM or +/-5% of measured value. Warm up time of sensor shall be <2 minutes & response time is better than 150 seconds. Sensor shall be suitable to fix & operate at 1500 to 1750mm above the finished floor level.

7.14 LEVEL SWITCH
The level switches shall have to meet the following requirement:

<table>
<thead>
<tr>
<th>Type</th>
<th>Float Type/Capacitance type/Conductivity type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>To suit application.</td>
</tr>
<tr>
<td>Connection</td>
<td>Flanged ANSI 150 lbs RF Carbon steel</td>
</tr>
<tr>
<td>Float material</td>
<td>316 SS</td>
</tr>
<tr>
<td>Stem Material</td>
<td>316 SS</td>
</tr>
<tr>
<td>Output</td>
<td>1 NO, 1 NC potential free</td>
</tr>
<tr>
<td>Switch Enclosure</td>
<td>IP 55</td>
</tr>
</tbody>
</table>

8.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions. The panel shall be metal enclosed 18 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag ground off and welding pits wiped smooth with plumber metal. All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Engineer in charge. Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection).

9.0 CONDUITS AND WIRING
Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the
drawings shall be brought to the notice of Engineer or any modifications suggested by the Contractor shall be got approved by the Engineers before the actual laying of conduits is commenced.

9.1 **CONDUITS/TRUNKER**
Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.
The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

9.2 **CONNECTIONS**
All jointing methods shall be subject to the approval of the Engineer in charge. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

9.3 **BENDS IN CONDUIT**
Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

9.4 **FIXING CONDUITS**
The conduits, junction boxes, outlet boxes and controller boxes once installed in position, shall have their outlets properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of spacer bar saddles at intervals not more than 500 mm.
The saddles shall be 2 mm x 19 mm galvanized steel flat, properly treated, primer coated & painted, securely fixed to supports by means of nuts and bolts/rawl bolts and brass machines screws.

9.5 **DRAWING OF CONDUCTORS**
While drawing insulated wires/cable into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. No joint shall be allowed in case of breakage of any conductor. No joint shall be shaved off like length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material. Strands of wires shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.
No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance.
Only licensed supervisors/wiremen shall be employed for cabling and other connected work. Only approved make of cables shall be used. The cables shall be brought to the site in original packing.

9.6 **MODE OF MEASUREMENT**
**Signal Cable**
The cabling running between DDC controllers to the field devices shall be termed as signal cabling. This cabling along with conduits shall be payable on per I/O point basis.
LAN Cable
The cable connecting various system integration units to the control station shall be termed as LAN cable. These cables along with conduits shall be measurable on unit length basis.

10.0 SIGNAL CABLING & COMMUNICATION CABLING
The signal cable shall be of the following specifications:
- Wire : Annealed Tinned Copper
- Size : 1.0 sq. mm, stranded type
- No. of conductors : Two (One pair)
- Shielding : Overall beld foil aluminium polyester shield.
- Jacket : Chrome PVC
- Nominal DCR : 17.6 ohm/km for conductor
- 57.0 ohm/km for shield
- Nominal capacitance : 130 pF/m between conductors
  at 1 KHz
- 180 pF/m between one conductor and other
  Conductors connected to shield.

11.0 LOCAL AREA NETWORK CABLE
Depending on the type of LAN system being used by the contractor, standard, manufacturer’s specification shall apply.

12.0 BMS DELIVERABLES-
The deliverables expected from the BMS in broadly defined here under. However it is understood that the I / O summary detailed in this specifications will be reckoned while designing the system.

Ventilation:
1. Timed scheduled operation ventilation fans.
2. Facility to bring into any of the additional fans into operation in the event of maintenance on any of the main in-line fans.
3. Status of fans
4. Status of Generator room, STP room, and toilet ventilation fans
5. Status of staircase pressurization and kitchen exhaust fans
6. Run Time Reports for above equipment
7. Trending of CO concentration levels.

Air handling units (Standard AHU’s)
1. Space Temperature Set point control
2. Actual space / RA Temperature
3. Filter status
4. Fan status
5. Auto/Manual operation status
6. Fan on/off status
7. Control valve status
8. Run Time for the Fan/Motors
9. PID Control for Valves

Electrical monitoring and data logging:
Parameters relevant to Automatic Transfer Switches (ATS) at the origin of utility supply and standby sources and Multi Data Meters (MDM) in outgoing feeders as per following.
(Through integration as all MDMs shall be provided with communication ports)
Data Points to be monitored & trended for MDMs: kW, kWh, kV Ar.p.f, V, A, Power outages, DG run
Data Points to be monitored & trended for KWH Meters: kW, kWh
PART-VIII: HYDRONIC AND REFRIGERANT PIPING WORK

1. SCOPE
This chapter covers the requirements of piping work in chilled water, water in condenser circuit, Refrigerant and drains, to be executed as part of heating, ventilating and air conditioning.

2. PIPING DESIGN
Pipe sizes shown in tender documents are purely for sub-contractor’s guidance. The sub-contractor shall be responsible for selection of sizes as per detailed engineering to be done by him. Plumbing design to be done by the Air-conditioning contractor shall conform to the following:

i) Water velocity in pipes shall not exceed 2.5 m/sec.
ii) Butterfly/Ball valves shall be provided at
   a. All drain connections from equipments
   b. Inlet & outlet of every heat exchanger coil, namely for AHU’s, FCU’s, convector etc.
iii) Balancing valves shall be provided, where specified, for AHU’s to regulate the maximum flow rate upto a value preset as desired. A mercury manometer shall be supplied with every 10 nos. or part thereof of balancing valves, whether or not specifically indicated in the tender specifications.
iv) Air vent valves shall be provided at all high points in the piping system for venting with a size of 25 mm for pipes up to 100 mm and 40 mm for larger pipes.
v) Plumbing drawings showing the sizes of valves, layout and other details shall be prepared and shall be got approved from the Engineer-in-Charge before the execution of the plumbing work.

3. PIPE MATERIALS
Pipes shall be of the following materials.

i) Mild steel medium class (Black steel) tube conforming to IS: 1239 for sizes upto 150mm.
ii) Welded black steel pipe, class 2, conforming to IS: 3589, for sizes greater than 150mm. These pipes shall be factory rolled & fabricated from minimum 6mm thick M.S. Sheet for pipes upto 350mm dia. & from minimum 7mm thick M.S. sheet for pipes of 400mm dia. & above.

4. PIPE JOINTS
Joints in black steel pipes shall be of any of the following types.

i) Screwed joints and union joints screwed to pipes, upto 25 mm size.
ii) Butt welded joints for pipe sizes above 25mm. electric welding shall be used for sizes 100mm and above.
iii) Flanges joints with flanges as per IS: 6392 for all sizes. Flanges may be steel welded neck type or slip on type welded to pipe, or alternatively screwed type.

5. VALVES
a) The material of butterfly valves shall be as under:
   Body - Cast iron
   Disc - Cast Bronze or Stainless Steel
   Seat - Either integral or Nitrile rubber
   O-ring – Nitrile/Silicon

b) Balancing valve shall be of cast iron flanged construction with Ethylene propylene diene monomer(EPDM)/ Spheroidal Graphite(SG) iron with epoxy coated disc with built in
pressure drop measuring facility (pressure test cocks) to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation.

c) Non return valves shall be of gun metal construction upto 65 mm, the metal conforming to class 2 of IS: 778. For 75 mm and above, the valve shall be of bronze or gun metal, body being of cast iron. While screwed or flanged ends may be provided upto 65 mm, flanged ends shall be provided for larger sizes.

d) Air vent valves shall be of gunmetal body.

6. STRAINERS
i) Strainers shall be of 'Y' type or pot type as specified. 'Y' strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit. Pot strainers, where specified, shall be provided in return water headers, for chilled water and condenser water if enough floor area is available in the refrigeration plant room, as an alternate to individual Y type strainers with pumps. The strainers shall be designed to the test pressure specified for the gate valves. Filtration area of Y-strainer shall be minimum our times the connecting pipe size.

ii) They shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.

iii) Pot strainer shall be fabricated out of MS sheet and the sizes shall be as under:

<table>
<thead>
<tr>
<th>Pipe sizes (mm)</th>
<th>Pot dia (mm)</th>
<th>Pot Height (mm)</th>
<th>Basket dia (mm)</th>
<th>Basket Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>300</td>
<td>400</td>
<td>200</td>
<td>240</td>
</tr>
<tr>
<td>80</td>
<td>350</td>
<td>450</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>100</td>
<td>450</td>
<td>500</td>
<td>300</td>
<td>280</td>
</tr>
<tr>
<td>125</td>
<td>500</td>
<td>600</td>
<td>330</td>
<td>340</td>
</tr>
<tr>
<td>150</td>
<td>540</td>
<td>700</td>
<td>360</td>
<td>390</td>
</tr>
<tr>
<td>200</td>
<td>610</td>
<td>815</td>
<td>400</td>
<td>470</td>
</tr>
<tr>
<td>250</td>
<td>800</td>
<td>955</td>
<td>550</td>
<td>510</td>
</tr>
<tr>
<td>300</td>
<td>1000</td>
<td>1105</td>
<td>750</td>
<td>580</td>
</tr>
<tr>
<td>350</td>
<td>1190</td>
<td>1300</td>
<td>895</td>
<td>678</td>
</tr>
<tr>
<td>400</td>
<td>1350</td>
<td>1500</td>
<td>1020</td>
<td>785</td>
</tr>
<tr>
<td>450</td>
<td>1518</td>
<td>1700</td>
<td>1060</td>
<td>890</td>
</tr>
<tr>
<td>500</td>
<td>1690</td>
<td>1800</td>
<td>1100</td>
<td>900</td>
</tr>
</tbody>
</table>

Strainers shall have a removable bronze/stainless steel minimum 1mm thick screen with 3 mm perforations and permanent magnet. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

7. INSTRUMENTS
i) Pressure gauge of appropriate range and 150 mm. dial size shall be provided at the following locations.
   a. Supply and return of all heat exchange equipments.
   b. Suction and discharge of all pump sets.

ii) The pressure gauge shall be duly calibrated before installation and shall be complete with shut off cocks.
iii) Direct reading industrial type thermometer of appropriate range shall be provided at the inlet and outlet of all heat exchange equipments. The thermometers shall be installed in separate wells.

iv) Flow meter of orifice type shall be provided for measuring the flow through each condenser and chiller.

8. CONDENSATE DRAIN PIPING:
   All pipes to be used for condensate drain shall be Insulated medium class GI pipe & all joints should be Gluing or solvent cementing as per manufacturer recommendation.

9. FLEXIBLE CONNECTIONS
   i) The Flexible connections shall be flanged type expansion joint. Flanges shall be non-compressible and mechanically strong type and the Neoprene rubber shall be provided in between the flange ends.
   ii) The connections shall work for a temperature range of minus 10°C to 70°C.
   iii) The length and working pressure of bellows shall be as follows:

<table>
<thead>
<tr>
<th>Nominal Bore (mm)</th>
<th>Length (mm)</th>
<th>Pressure (Bars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-25</td>
<td>125</td>
<td>15</td>
</tr>
<tr>
<td>32-200</td>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>250-350</td>
<td>200</td>
<td>10</td>
</tr>
</tbody>
</table>

   iv) Connections shall be provided with control roads to control the excessive elongation or compression of piping systems.
   v) It shall have torsional movement upto 3° without damage.
   vi) The drain piping shall be medium class galvanized steel as per relevant latest IS code.
   vii) The fittings shall be of ‘R’ brand or equal forged with screwed connections.
   viii) The gate valves shall be of gun metal as described earlier.
   ix) Pipe crosses shall be provided at bends, to permit easy cleaning of drain line or plugged tees.
   x) The drain line shall be provided upto the nearest drain trap and pitched towards the trap.
   xi) Drain lines shall be provided at all the lowest points in the system, as well as at equipment, or to remove condensate and water from pump glands.

10. INSTALLATION
   i) The installation work shall be carried out in accordance with the detailed drawings prepared by the sub-Contractor and approved by the Engineer-in-charge.
   ii) Sub-contractor shall utilize the structural provisions for Air-conditioning services wherever provided by the lead contractor in the building and make his own arrangements for additional changes.
   iii) Expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.
   iv) Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.
   v) Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.
   vi) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.
   vii) All pipes using screwed fittings shall be accurately cut to the required size and threaded in accordance with IS: 554 and burs removed before laying.
viii) Piping installation shall be supported on or suspended from structure adequately. The sub-contractor shall design all brackets, saddles, clamps, hangers etc. and shall be responsible for their structure integrity.

ix) Pipe supports, preferably floor mounted shall be of steel, adjustable for height and prime coated with zinc chromate paint and finish-coated gray. Spacing of pipe supports shall not be more than that specified below:

<table>
<thead>
<tr>
<th>Nominal Pipe size (mm)</th>
<th>Spacing (Meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 and 15</td>
<td>1.25</td>
</tr>
<tr>
<td>20 and 25</td>
<td>2.00</td>
</tr>
<tr>
<td>32, 40, 50 and 65</td>
<td>2.50</td>
</tr>
<tr>
<td>80, 100 and 125</td>
<td>2.50</td>
</tr>
<tr>
<td>150 and above</td>
<td>3.00</td>
</tr>
</tbody>
</table>

x) Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic or rawl plugs or approved shear fasteners.

xi) Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation.

xii) Anti-vibration pads, springs or liners of resilient and non-deteriorating, material shall be provided at each support, so as to prevent transmission of vibration through the supports.

xiii) Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.

xiv) 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 by clamps or collars attached to pipe with a 12 mm thick rubber pad or any other resilient material as approved by the Engineer-in-charge.

xv) The space in the floor cut outs around the pipe work (after insulation work where applicable) shall be closed using cement concrete (1:2:4 mix) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the structure.

xvi) Riser shall have suitable supports at the lowest point.

xvii) Where pipes are to be buried under ground, the top of the pipes shall be not less than 75cms from the ground level. Where this is not practicable, permission of the Engineer-in-charge shall be obtained for burying the pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15cms. After the pipes have been laid and top sand cushion provided, the trench shall be refilled with the excavated soil and any extra soil shall be removed from the site of work by the sub-contractors.

xviii) All pipes and their steel supports shall be thoroughly cleaned and given one primer coat of Zinc chromate before being installed.

xix) After all the water piping has been installed, pressure tested in accordance with clause 8.13, all exposed piping in the plant room shall be given two finish coats of paint, approved by the Engineer-in-Charge. Similar painting work shall be done over insulated pipe work, valves etc. The direction of flow of fluid in the pipes shall be indicated with identifying arrows.

xx) 3mm gasket shall be used for flanged joints.

xxi) Cut-outs in floor slabs shall be sealed with cement concrete or steel plate after the plumbing work is done, from the fire safety point of view.
PART-IX: INSULATION WORK

1. SCOPE
This chapter covers the requirements of thermal insulation for chilled water piping and tanks, duct work and acoustic lining in duct work and weather maker rooms. This also covers exposed roof insulation and under deck insulation work.

3 PRE INSULATED CHILLED WATER PIPES
All piping systems for service reaching a maximum temperature of 254°F installed above ground with Aluminum or GI jacketing and underground with HDPE jacketing.

i) The pipe shall be MS ERW as specified in the Piping Section.

ii) The pipe insulation shall be rigid polyurethane foam with excellent heat-insulating properties, good mechanical properties and good resistance against aging with minimum density of 48 kg/cu m, 90% minimum closed cell content, minimum compressive strength of 2.7kg/cm2, and initial thermal conductivity of 0.026W/mK and the insulation fulfills all technical requirements according to EN 253. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both, the service pipe & jacket. Polyurethane foam made from Polyol and Isocyanate with 48 kg/m3 density. Minimum thickness of insulation shall be 30mm.

iii) The cladding shall be spirally wound of G.I. or Aluminium as specified in tender documents for pipes installed on surface.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Dia. Of MS Pipe</th>
<th>Minimum Thickness of PUF in (mm)</th>
<th>Minimum Thickness of G.I. Cladding</th>
<th>Minimum Thickness of Al. Cladding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>2</td>
<td>25mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>3</td>
<td>32mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>4</td>
<td>40mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>5</td>
<td>50mm</td>
<td>33</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>6</td>
<td>65mm</td>
<td>36</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>7</td>
<td>80mm</td>
<td>42</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>8</td>
<td>100mm</td>
<td>42</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>9</td>
<td>125mm</td>
<td>42</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>10</td>
<td>150mm</td>
<td>42</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>11</td>
<td>200mm</td>
<td>52</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>12</td>
<td>250mm</td>
<td>62</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>13</td>
<td>300mm</td>
<td>62</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>14</td>
<td>350mm</td>
<td>62</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
</tbody>
</table>

v) Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable.

vi) Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

vii) For pipes buried in ground outer protective insulation jacket shall be seamless, extruded, black, UV resistant, high-density polyethylene (HDPE). HDPE Jacket shall be of High-density polyethylene
(HDPE) with > 944 kg/m³ density Diameter from 90 to 1000mm with minimum 3 to 28mm wall thickness and compressive strength is 40 PSI as specified.

iii) All straight pipe lengths will have water tight end seal. All fittings will have square cut insulation cutback.

viii) For leak identification purpose 2 wire diagnostic wiring shall also be provided.

ix) Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

iv) Field joints insulation shall consist of PUF poured manually in a site-fabricated GI cladding fixed around the joint

xi) For pipes buried in ground minimum thickness of the HDPE jacket and PUF shall be as follows:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Dia. Of MS Pipe (mm)</th>
<th>PUF Thickness (mm)</th>
<th>Thickness of HDPE Cladding (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20</td>
<td>30</td>
<td>2.5</td>
</tr>
<tr>
<td>2.</td>
<td>25</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>3.</td>
<td>32</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>4.</td>
<td>40</td>
<td>36</td>
<td>2.5</td>
</tr>
<tr>
<td>5.</td>
<td>50</td>
<td>37</td>
<td>3.0</td>
</tr>
<tr>
<td>6.</td>
<td>65</td>
<td>39</td>
<td>3.0</td>
</tr>
<tr>
<td>7.</td>
<td>80</td>
<td>43</td>
<td>3.0</td>
</tr>
<tr>
<td>8.</td>
<td>100</td>
<td>43</td>
<td>3.2</td>
</tr>
<tr>
<td>9.</td>
<td>125</td>
<td>43</td>
<td>3.5</td>
</tr>
<tr>
<td>10.</td>
<td>150</td>
<td>53</td>
<td>4.4</td>
</tr>
<tr>
<td>11.</td>
<td>200</td>
<td>63</td>
<td>5.0</td>
</tr>
<tr>
<td>12.</td>
<td>250</td>
<td>63</td>
<td>6.3</td>
</tr>
<tr>
<td>13.</td>
<td>300</td>
<td>63</td>
<td>7.0</td>
</tr>
<tr>
<td>14.</td>
<td>350</td>
<td>64</td>
<td>7.8</td>
</tr>
</tbody>
</table>

The pre insulated pipe shall be manufactured at factory. The insulation shall completely fill the annular space between the carrier pipe & jacket and shall be bonded to both, carrier & jacket. The preinsulated pipes must be manufactured using High pressure PUF injection machines. The outer jacket & the carrier pipe must be held concentric using special chucks. Vent holes must be drilled to ensure expiration of air. The necessary quantity of Polyol & ISO must be mixed at high speed & injected into the void. The quantity of PUF injected for each pipe must be kept as a verifiable record to ensure that the required Density & thickness of insulation is maintained.

3.4 Leak Detection System

1 General

Leak Detection monitor can detect 1500 meter sensing cable. Once if water leaks on the cable alarm will start by flash and sound, and the leakage point will display on the LCD screen and the relays will ON automatically. Combined with MOD BUS RTU protocol & easy to integrate with monitoring system. This can be used as independent alarm, also can be connected to other monitoring system.

2 Performance

The Leak detection system shall locate the point of origin of first liquid or fault within +/- 1% of sensor string length. The system shall identify the type of alarm leak / break /fault of prob as the location. The system shall be able to monitor (detect and locate) up to 1500 meter long string of sensor cable. The system shall provide Modbus 485 output and dry contact relay for remote indication of the alarm condition.
3 Monitoring Unit (Model no LDS485L1500)
The monitoring unit shall be microprocessor based and capable of monitoring up to 1500 meter of sensing string per device including sensing cable, end cable and leading cable. The monitoring unit shall indicate when any liquid or growing liquid contacts the sensor cable by sounding an alarm, actuating relay and displaying message the states a leak has been detected as shown the location of leak on sensing string.
The monitoring unit power requirement shall be AC/DC 9 to 24, 3 watt and also equipped with RS 485 communication ports and dry relay 125VAC and 24DC NO/NC contacts can be choose.

<table>
<thead>
<tr>
<th>Basic characteristics</th>
<th>Sensor compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum length of the cable</td>
<td>1500m</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Sensor cable’s length of 0.5% ± 0.5m</td>
</tr>
<tr>
<td>Environmental rating</td>
<td>Storage temperature: -40 °C to 60 °C (0 °F to 140 °F)</td>
</tr>
<tr>
<td>Working temperature: -20 °C to 50 °C (32 °F to 122 °F)</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>5% - 95% (no condensation)</td>
</tr>
<tr>
<td>Power supply</td>
<td>Sensor compatibility</td>
</tr>
<tr>
<td>Serial interface</td>
<td>Network configuration: RS-485 double wire will work; the baud rate can be set, the factory default value is 9600, chooseable address is from 0 to 255, default address is 0</td>
</tr>
<tr>
<td>Communication protocol</td>
<td>MODBUS RTU</td>
</tr>
<tr>
<td>Relay contactor</td>
<td>Function: NO, NC can be choose; leakage alarm or sensor error alarm</td>
</tr>
<tr>
<td>Rating</td>
<td>AC125V, 0.5A, DC24V, 1A</td>
</tr>
</tbody>
</table>

4. Sensor cable Model no LDSSC6000
The conductive-polymer technology and fluoropolymer construction make sensing cable mechanically strong and resistant to corrosion and abrasion. The cable is constructed of two sensing wires, an alarm signal wire, and a continuity wire embedded in a fluoropolymer carrier rod. The alarm module constantly monitors the sensing cable for continuity. The rugged cable construction exposes no metal, and enables the cable to be reused even in corrosive environments.

| Cable diameter | 0.24 in (6.0mm) nominal |
| Continuity and signal wires | 22/4 AWG with insulation of fluoropolymer |
| Sensing wires | 22/2 AWG with jacket of conductive fluoropolymer |
| Carrier | Fluoropolymer |
| Cable weight (50 ft/15m length) | 2.3 lb (1kg) |
| Cable color | High-visibility yellow |
| Breaking strength | Cable only: 160 lb (72kg) including connectors: 70 lb (32kg) |
| Cut-through force | > 500 lb with 0.005 in (2.2kg with with 0.13mm) in blade; crosshead speed 0.2 in/min |
| Abrasion resistance | > 65 cycles per UL719 |
| Maximum continuous operating temperature | 70 degree |
| Leak size to alarm (tap water) | 2 in (5mm) maximum at any point along sensing cable, up to 5000 ft maximum system length |
| Drying time | Cable dries and resets within 15 seconds for removal from standing water |
| Standard cleaning method | Wipe with clean damp cloth |

5 Installation of Sensor Cable
Sensor cable shall be installed in polyurethane foam insulation during puff injection in factory fabricated pipes and each cable must be suitable for to join with adjacent cable with plug and play type connector for easy installation at site.
Sensing cable shall be supplied with factory-installed plastic connectors that plug together. The cable is designed of a range of applications, including data center subfloors, telecommunication rooms HVAC equipment locations, pipes, storage areas, tanks and roofs. The cable is small, lightweight and flexible, allowing easy installation. The smooth design allows for quick drying.
a) Duct Insulation

i) For Insulation of ductwork Thermal insulation material for Duct insulation shall be anti-microbial closed cell cross linked polyethylene foam (XLPE) with aluminum foil. Thermal conductivity of the insulation material shall not exceed 0.032 W/mK at an average temperature of 25°C. Density of the material shall be 25-30 Kg/m³. The product shall have temperature range of −40°C to 105°C.

The insulation material shall be fire rated for Class 0 as per surface spread of flame test. Water vapor permeability shall not exceed 0.15ng/Pa.Sec.m.

Thermal conductivity of the material shall not be affected by ageing, as per DIN 52616. The material must be tested for ageing effect in an accredited laboratory for a minimum period of five years to satisfy the ageing criteria.

There shall be no toxicity in the emitted smoke, both under flaming and non-flaming conditions.

The insulation shall comprise of a single layer upto 18 mm thickness.

* All the piping and ductwork in the mechanical rooms, AHU rooms or spaces which are not air conditioned shall have cladding over the insulation to protect piping/ductwork from condensation and temperature loss. All outside exposed duct shall be insulated with XLPE and one layer of glass clothe with weather proof coating and aluminum cladding.

ii) Insulation material for Duct Acoustic Lining shall be board of resin bounded fiberglass wool with one side factory laminated Black Glass Tissue and one side aluminium facing. The Thermal conductivity of the fiberglass for air-conditioning application shall not exceed 0.0316 W/m K at 25 deg C mean temperature and average Noise Reduction Coefficient (NRC=0.65-0.75 frequency range from100 Hz to 8000Hz ).The density of insulation material shall be either 70-80 Kg./m³ and thickness of insulation material shall not less 25mm.

iii) For acoustic lining of Ducting and AHU rooms: -Rigid board of glass wool.

iv) For double skin AHUs: -Polyurethane foam (PUF Insulation)

2. MATERIAL SPECIFICATIONS

The insulation material shall satisfy the following requirements:

iv) For thermal application on Chilled water pipes.

<table>
<thead>
<tr>
<th>Material</th>
<th>Min. Density (Kg/cu.m)</th>
<th>Max. Thermal conductivity (W/mK at 30 deg C mean temp.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>polyurethane foam (PUF)</td>
<td>36</td>
<td>0.02</td>
</tr>
</tbody>
</table>

v) For acoustic lining:

<table>
<thead>
<tr>
<th>Application</th>
<th>Material</th>
<th>Minimum Density (Kg./Cu.M)</th>
</tr>
</thead>
</table>
vi) The specification for resin bonded glass wool insulation & resin bonded mineral wool insulation shall conform to IS 8183 as amended upto date. The specification for expanded polystyrene shall conform to IS-4671 as amended upto date

3. INSULATION THICKNESS

The thickness of insulation shall be as indicated below unless specified otherwise in the tender specifications.

i) For Condensate water pipe insulation

<table>
<thead>
<tr>
<th>Pipe Size (mm)</th>
<th>Nitrile rubber (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sizes</td>
<td>9</td>
</tr>
</tbody>
</table>

ii) For Duct insulation

<table>
<thead>
<tr>
<th>Application</th>
<th>Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Insulation</td>
<td>13 mm thick</td>
</tr>
<tr>
<td>Acoustic</td>
<td>25 mm thick</td>
</tr>
</tbody>
</table>

iii) Acoustic lining For AHU room

Open Cell Melamine Foam 35 mm

iv) For Under deck Insulation

XLPE 32 mm

Tender Specification:

Acoustic Board should be applied on AHU room walls and ceiling to provide superior acoustic absorption.

The insulation should conform to non-combustibility, Class-P (not easily ignitable), Class I(surface spread of flame NIL), and Class ‘O’ rating as per BS 476 standards.

Installation guideline:

ix) The surface shall be cleaned and friction fixed in 610mm X 610 mm frame of 25X25X18 mm made out of 22 G thick GI sheet U shaped channel or else it can be installed on the wall with screw bit.

x) If wall surface is smooth it is prefer to install acoustic board with screw bit.

3 The Acoustic board should be placed in such a way that black glass cloth is visible from inside the AHU room. Complete as required and as per specifications.

4. APPLICATION OF INSULATION ON PIPES (including suction line insulation)

i) The surface to be insulated shall be first cleaned and a coat of zinc chromate ‘primer shah be given. The insulation shall be fixed tightly to the surface with hot bitumen/ cold setting adhesive CPRX compound as recommended by the insulation manufacturer. All joints shall be staggered and sealed. The second layer of insulation shall be similarly applied over the first layer.
ii) The insulation shall be finished as under:
   a) For pipes laid inside the building, the pre-insulated pipes shall be used as per the specification. The joints shall be insulated with PUF injection machine after the testing of the pipeline. The other pipe insulation after approval of the Engineer In charge shall be with 36kg/m3 thermocole, covered with polythene of 120gm/sqm for water vapor barrier, covered with hessian cloth and wrapped with wire mesh and finally cement plastered and aluminum sheet cladded on the top layer have to execute as per the requirement in case of non pre insulated chilled water pipeline.
   iii) All valves, fittings, strainers etc. shall be insulated to the same thickness and in the same manner as for the respective piping, taking care to allow operation of valves without damaging the insulation.

5. APPLICATION OF INSULATION (THERMAL) ON DUCT
   i) Surface of duct on which the external thermal insulation is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
   ii) Two coats of cold compound adhesive (CPRX compound) shall be applied over the duct. (Any other adhesive recommended by the manufacturers may also be used with the approval of the Engineer-in-charge).
   iii) The aluminum faced insulation shall then be wrapped to the duct with aluminum facing on the outer side. The joints shall then be sealed with BOPP tape.
   iv) Additional treatment on Exposed duct insulation
      a. Apply tack coat of insulation protective coating Starbond(SB 30-36) evenly by brush @ 2 to 2.5 m²/liter (Min 0.4mm thick)
      b. After applying tack coat embed the glass fiber or canvas cloth immediately and make it wrinkle free.
      c. Apply first coat of Starbond(SB 30-36) on prepared surface evenly @ 2.5 to 3 m²/liter (Min. 0.4 mm thick).
      d. Apply finish coat of Starbond(SB 30-36) @ 2.5 to 3 m²/liter (Min. 0.4 mm thick) once first coat is fully cured.

6. APPLICATION OF DUCT LINING (ACOUSTIC INSULATION)
Where specified in the tender specifications, ducts shall be lined internally with acoustic insulation as detailed below:
   i) The inside duct surface should be cleaned with suitable solvents and rendered free from all physical and chemical impurities.
   ii) The Acoustic board should be placed in such a way that black glass cloth is visible from inside the duct and its aluminium faced should be pasted on GI duct with suitable adhesive.
   iii) Fix 22 gauge G.I. channels & angle frame work 25mm x 25 at mouth of GI duct to provide strength to acoustic board.

7. APPLICATION OF ACOUSTIC LINING IN AHU ROOMS
   i) The wall/ roof surface should be thoroughly cleaned with wire brush.
   ii) A 610 x 610 mm frame work of 25mm x 5 0mm x 50mm x 50mm x 25mm shape channel made of 0.6mm thick G.S.S. shall be fixed to walls leaving 610mm from floor by means of raw plugs in walls and dash fasteners in ceiling. Similar frame work shall also be fixed on ceiling by means of dash fasteners.
   iii) Resin bonded glass wool/ mineral wool as specified cut to size shall be friction fitted in the frame work and covered with tissue paper.
   iv) Aluminum perforated sheet having perforation between 20-40%of thickness not less than 0.8mm shall be fixed over the entire surface neatly without causing sag/ depression in between and held with screws. Sheet joints should overlap minimum 10mm.
v) Aluminum beading of 25mm wide and thickness not less than 1.00 mm shall be fixed on all horizontal/vertical joints by means of screws.
PART-X: INSPECTION, TESTING AND COMMISSIONING

1. SCOPE

This chapter covers initial inspection and testing of AHUs, FCUs at manufacturer’s works, initial inspection of other equipments/ materials on receipt at site, final inspection testing & commissioning of all equipment at site & description of testing requirements & procedure.

2. INITIAL INSPECTION AT MANUFACTURER’S WORKS

AIR HANDLING UNITS
i) Salient features such as model, size, physical dimensions, and other details of various sections, fan motor details, fan dia, static pressure etc. shall be verified against the contract requirements.
ii) Manufacturer’s internal test certificates for the motor and air handling unit shall be furnished and scrutinized as per contract requirements.
iii) Test certificate for static and dynamic balancing of the fan/ blower should be furnished. Fan balancing may be witnessed by Engineer-in-Charge or his authorized representative.
iv) Salient features like type, material, no. and gauge of fins and tubes and no. of rows of cooling coil shall be furnished and verified with reference to contract requirements during stage inspection.
v) Hydraulic pressure to the extent of 10 Kgf/sq.cm or pneumatic pressure of 21kgf/ sq.cm shall be applied to cooling coil and this pressure should be maintained for 1 hour and no drop should be observed indicating any leaks.

3. INITIAL INSPECTION AT SITE

FOR ASSOCIATED WORKS AT SITE:
i) Inspection of raw materials to be used for fabrication and assembly and inspection of Manufacturer’s Certificates.
ii) Inspection of welding including welders qualification as desired by inspection Engineers. Inspection of fabricated items.
iii) Pressure testing of pipe fittings used for the refrigerant and water services.
iv) Pressure testing, leak testing of complete piping network for chilled water and condenser water.
v) Vacuum missing and gas/oil charging for refrigeration system.
vi) Checking of electrical circuits (power & controls) and checking functioning of controls of refrigerant systems and other circuits of air conditioning plant.
vii) Checking of calibration of controls and instrumentation
viii) Performances testing of complete
ix) The above inspection procedure is given for general guidance and information of vendors and inspection of Purchaser is strictly not limited to these and Inspection Engineer of Purchaser shall have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by Inspection Engineer, Coordination of Inspection Agency of Purchaser with his Factory/Sub-vendor’s Factory/Erection Site shall be the sole responsibility of successful vendor after placement of order for complete

DUCTING
i) The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.
ii) Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

**SWITCH GEAR, CONTROL GEAR, AND MEASURING INSTRUMENTS**
These should be of specified make. For air circuit breaker manufacturers test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

Electric Motors Electric motors should be of specified make, manufacturer's test certificate for electric motor shall be furnished.

**PIPES AND VALVES**
i) It should be checked that the same is as per makes specified in contract
ii) Dimensions including weight shall be checked for pipes against the requirements contract.

**INSULATION AND ACOUSTIC LINING**
a) Physical verification for thickness and make should be made as per contract before application of insulation.
b) Manufacturer’s test certificate for density should be furnished. Note: Accuracy of testing instruments shall be as mentioned in the final inspection procedure.

4. **FINAL INSPECTION**
i) After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running.
ii) After the trial run, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier.
iii) The equipment capacity computations shall be carried out.
iv) All instruments for testing shall be provided by the AC contractor. The accuracy of the instruments shall be as follows:
   a) Temperature: Liquid in glass thermometer having accuracy ±1deg. C as per IS: 4825.
   b) Wet bulb Temperature: Sling psychomotor conforming to IS:6017,
   c) Scale Error: For less than 0 deg.-C.0.3°C ±0.2 deg. C. For over 0°C 0.2°C±0.1 deg.
   d) Pressure Gauge: With the accuracy of ±1% for maximum scale value from 10 to 90%, and +1.9% for maximum scale value for rest of the scale conforming to IS: 3695.
   e) Water flow meter: Water flow shall be measured using the arrangement installed as per schedule of work,

In case the tendering firms do not have testing instruments of the accuracy mentioned above, they should specify the accuracy of the instrument available with them for testing at the tender stage.

5. **TESTING REQUIREMENTS AND PROCEDURES**

Balancing of all air and water systems and all tests as called for in the specification shall be earned out by the HVAC contractor in accordance with the specifications and relevant local codes if any. Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative.
The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy ± 0.5%. The instrument shall be capable of storing data and then downloading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments:

i) Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point
ii) Velo meter to measure air volume and air velocity
iii) Pitot tube -Electronic rotary vane Anemometer
iv) Accubalance flow measuring hood

The contractor shall be responsible to provide necessary sockets and connections for fixing of the testing instruments, probes etc.

AIR SYSTEMS
Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers. Balancing of the air system shall be accomplished without causing objectionable air noise. Baffles and orifice plates required for proper air balance shall be furnished and installed by the contractor. Basically, the following tests and adjustments are required.
1. Test and balance all fan systems to provide proper cfm/ cmh.
2. Adjust fresh air return air and exhaust dampers to provide proper air quantities in all modes of control.
3. Test and record fresh air, return air and mixed air temperature at all air handling units. Test and record data at all coils after air and hydronic systems are balanced. Measure wet and dry bulb temperature on cooling coils.
4. Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper cfm/cmh.
5. Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size manufacturer’s model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.
6. Test and record static pressure drop across all filters and major coils.
7. High velocity duct systems shall be tested for leakages. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.
8. Test and balance VAV boxes per design document to meet minimum and maximum airflows.

WATER SYSTEM
Systems are to be balanced by opening all valves, closing all by-pass and setting all mixing valves to full coil flow. Water systems shall be cleared of Verify that the system has been properly cleaned, flushed and treated before testing. Basically, the following tests and adjustments are required.

i) Check the operation of all automatic valves.
ii) Test and adjust correct water flow through chiller, major items of equipment and main water circuits. The balancing valves, provided on the equipment shall be used for adjustment.
iii) Check capacity output of chillers and set water flow rate for proper data.
iv) Check and adjust each coil to provide proper rpm. Record water and air temperature changes and water pressure drop.

v) Set pressure drops across coil by-pass to match coil full-flow pressure drop.

Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water/brine flow measurements. Flow measurements shall be preferably through flow meters. Pumps shall be tested for the discharge head, flow and BHP. Where it is not possible to measure the flow, at least the discharge head and BHP (on the input side) shall be field tested.

Balancing Tolerance: Systems shall be balanced within the following tolerances

1. Duct leakage Rates (at operating pressures)
   - Low pressure ducts (0 to 0.5kPa) 5% of full flow
   - Medium Pressure Ducts (0.5 to 3kPa) 1% of full flow
   - High Pressure Ducts (Greater than 3kPa) 1% of full flow

2. Air flow rates
   - Under 70 L/S 10% of flow
   - Over/ at 70 L/S 5% of flow

3. Water flow rates
   - Chilled Water 2% of flow
   - Other 5% of flow

Procedure:

i) Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

ii) Furnish equipment and instruct sheet metal trade on proper use for conducting duct leakage tests. Conduct first test as a way of instructing the above trades in the presence of the Department's representative.

iii) Test relative barometric pressures in various building areas, as deemed necessary by the Department's representative and at least in an areas served by different systems.

iv) Test performance and continuously record on a 24 hour basis, temperature and humidity levels where control equipment is provided for that purpose in certain critical areas.

v) Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report shall be furnished by a qualified and authorized person.

REPORTS

Provide 3 copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided.

FINAL DOCUMENTATION

a) The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges. Proper damper positions shall be marked on ducts with permanent indication. Notify the department of any areas marginal or unacceptable system performance.

b) The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/performance criteria.
Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer-in-charge department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300 x 450 mm) in addition to the completion drawings.

1. Comprehensive operation and maintenance manual
2. Test certificates, consolidated control diagram and technical literature on all controls.
3. Equipment warranties from manufacturers.
4. Commissioning and testing reports
5. Rating charts for all equipment
6. Log books as per equipment manufacturers standard format
7. List of recommended spares and consumables
8. Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.
9. At the close of the work and before issue of final certificate of completion by the Engineer-in-charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for the Defects liability period. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.
10. Any defective material or equipment supplied by the contractor
11. Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

**SUBMITTALS:**

**SUBMITTALS SHALL BE SUBMITTED FOR THE FOLLOWING EQUIPMENTS:**

i) Fan coil units
ii) Air Handling Units
iii) Air cooled DX type split unit
iv) VRV indoor/Outdoor unit
v) Fans
vi) Motorized Dampers
vii) Control valves
viii) Controls
ix) Valves
x) Panels
xi) Pre Insulated Chilled water pipes

**REQUIRED SUBMITTAL SHOULD CONTAIN THE FOLLOWING INFORMATION ALSO.**

i) System summary sheet
ii) Sequence of operation
iii) Shop drawing indicating dimensions, required clearances and location and size of each field connection
iv) Power and control wiring diagrams
v) System profile analysis including variable speed pump curves and system curve. The analysis shall also include pump, motor and AFD efficiencies, job specific load profile, staging points, horsepower and kilowatt/hour consumption.
vi) Equipment data sheets

**MISCELLANEOUS:**

i) The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of Contract and Specification.
ii) The date of commencement of all tests listed above shall be subject to the approval of the Engineer in charge and in accordance with the requirements of this specification.
iii) The contractor shall supply the Commissioning Engineer and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the Engineer in charge requests such a test for determining specified or guaranteed data as given in the Specification or on the Drawings.

iv) Any damage resulting from the tests shall be repaired and/or damaged material replaced to the satisfaction of the Engineer in charge.

v) In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.

vi) The Contractor must inform the Engineer in charge when such tests are to be made, giving sufficient notice, in order that the Engineer in charge or his nominated representative may be present.

vii) Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the Engineer in charge.

viii) The Contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the Engineer in charge, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.
GUARANTEE PROFORMA FOR HVAC INSTALLATION

Owner : IIT KANPUR
Location : IITK Campus

1. The Contractor shall furnish the following guarantee:

   “We warrant that everything supplied by us including all components fitted into the equipment manufactured by others also, shall be in all respects free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and quality to acceptable standards for all materials of the type ordered and shall be in full conformity with all the specifications, drawings or samples if any and we shall be fully responsible for its efficient performance. This guarantee shall survive inspection for acceptance and payment for the equipment and installation, but shall expire (except in respect of the complaints notified to us) 36 months from the date of issue of completion certificate by the Engineer In Charge. The complaints, workmanship, manufacturer, or performance of any of the equipment or part/parts thereof shall be notified by e-mail/letter within 36 months from the date of issue of such completion certificate.”

2. The Contractor shall replace such of these parts which require replacement under these conditions free of cost, charge and expenses to the purchaser. In addition, the Contractor shall be responsible for a period of 36 months from the date of issue of completion certificate for any defect that may develop or appear under the conditions provided by the Contractor or use thereof arising from faulty material design or workmanship in the equivalent or any part thereof or faulty installation of the equipment by the Contractor but not otherwise and shall correct such defects within one week from the date of notification at his own cost when called upon to do so by the purchaser who shall state in writing in what respect the portion is faulty.

3. Any faulty component replaced or renewed under the clause shall also be guaranteed for a period of six months from the date of such replacement or removal of until the end of the above mentioned period whichever is later.

4. If defects are not rectified within a reasonable time as mentioned in the written notice, the Engineer In-Charge shall proceed to do so at the Contractor’s risk and cost without prejudice to any other right thereof.

SIGNATURE AND STAMP OF THE CONTRACTOR

DATE :
APPENDIX-A(TERMINOLOGY)

a. **AIR CONDITIONING**  
The process of treating air so as to control simultaneously its temperature, humidity, purity, distribution and air movement and pressure to meet the requirements of the conditioned space.

b. **DRY-BULB TEMPERATURE**  
The temperature of air as registered by an ordinary thermometer.

c. **WET-BULB TEMPERATURE**  
The temperature registered by a thermometer whose bulb is covered by a wetted wick and exposed to a current of rapidly moving air.

d. **DEW POINT TEMPERATURE**  
The temperature at which condensation of moisture begins when the air is cooled at same pressure.

e. **HUMIDITY**  
It is the amount of water vapor present in a certain volume of air.

f. **RELATIVE HUMIDITY**  
Ratio of the actual water vapor in the air as compared to the maximum amount of water that may be contained at its dry bulb temperature. When the air is saturated, dry bulb, wet bulb and dewpoint temperatures are all equal.

g. **ENTHALPY**  
A thermal property indicating the quantity of heat in the air above an arbitrary datum in kilo joules per kg of dry air (or in Btu per pound of dry air).

h. **PSYCHROMETRY**  
Psychometry is the science involving thermo dynamic properties of moist air and the effect of atmospheric moisture on materials and human comfort. It also includes methods of controlling thermal properties of moist air.

i. **PSYCHROMETRIC CHART**  
A Psychometric chart graphically represents the thermodynamic properties of moist air. If two properties are known, all the other properties can be determined with the help of psychometric chart.

j. **EVAPORATIVE AIR COOLING**  
The evaporative air-cooling application is the simultaneous removal of sensible heat and the addition of moisture to the air. The water temperature remains essentially constant at the wet-bulb temperature of the air. This is a process in which heat is not added or removed from the air.

k. **POSITIVE VENTILATION**  
The supply of outside air by means of a mechanical device, such as a fan.
I. **ATMOSPHERIC PRESSURE**
   The pressure of air exerted on the surface of earth by the atmospheric column is called atmospheric pressure. At sea level, the atmospheric or barometric pressure is 760mm column of mercury (29.92 in Hg/406.8 inch water column/101.325 Kpa).

   Generally atmospheric pressure is used as a datum for indicating the system pressures in air-conditioning and accordingly, pressures are mentioned above the atmospheric pressure or below the atmospheric pressure considering the atmospheric pressure to be zero. A 'U' tube manometer shall indicate zero pressure when atmospheric pressure is measured.

m. **INDOOR AIR QUALITY (IAQ)**
   Indoor air quality refers to the nature of conditioned air that circulates throughout the space/area where one works or lives, i.e. the air we breathe when we are indoor. IAQ refers not only to comfort which is affected by temperature, humidity and odours but also to harmful biological contaminants and chemicals present in the conditioned space.

   Bad Indoor Air Quality can be a serious health hazard. Carbon dioxide (C02) has been recognized by ASHRAE as the surrogate ventilation index or the only measurable variable for the indoor air contaminants.

n. **BUILDINGS RELATED ILLNESSES (BRI)**
   BRI are attributed directly to the specific air-borne building contaminants like the outbreak of the legionnaire's disease after a convention and sensitivity pneumonitis with prolonged exposure to the indoor environment of the building.

o. **SICK BUILDING SYNDROME (SBS)**
   SBS is a term, which is used to describe the presence of acute non-specific symptoms in the majority of people caused by working in buildings with an adverse indoor environment. It could be a cluster of complex irritative symptoms like irritation of the eyes, blackened nose and throat, headaches, dizziness, lethargy, fatigue irritation, wheezing, sinus, congestion, skin rash, sensory discomfort from odours, nausea, etc. These symptoms are usually short-termed and experienced immediately after exposure, and may disappear when one leaves the building.

p. **HYDRONIC SYSTEMS**
   Water systems that convey heat to or from a conditioned space or process with hot or chilled water are frequently called hydronic systems. The water flows through piping that connects a chiller or the water heater to suitable terminal heat transfer units located at the space or process.

q. **WATER CONDITIONING**
   Water circulating in a hydronic system may require to be treated to make it suitable for air-conditioning system due to effect on the economics of air-conditioning plant. Unconditioned water used in air-conditioning system may create problems with equipments such as scale formation, corrosion and organic growth.

r. **WATER HARDNESS**
   Hardness in water is represented by the sum of calcium and magnesium in water and may also include aluminium, iron, manganese, zinc, etc. A chemical analysis of water sample should provide number of total dissolved solids (TDS) in a water sample in parts per million (ppm) as also composition of each of the salts in parts per million.
Temporary hardness is attributed to carbonates and bi-carbonates of calcium and/or magnesium expressed in parts per million (ppm) as CaCO\(_3\). The remainder of the hardness is known as permanent hardness, which is due to sulfates, chloride, nitrites of calcium and/or magnesium expressed in ppm as CaCO\(_3\).

Temporary hardness is primarily responsible for scale formation, which results in poor heat transfer resulting in increased cost of energy for refrigeration and air-conditioning. Permanent hardness (non-carbonate) is not a serious a factor in water conditioning because it has a solubility which is approximately 70 times greater than the carbonate hardness. In many cases, water may contain as much as 1200 ppm of non-carbonate hardness and not deposit a calcium sulfate scale.

The treated water where hardness as ppm of CaCO\(_3\) is reduced to 50 ppm or below, is recommended for air-conditioning applications.

d. **THERMAL TRANSMITTANCE**
   Thermal transmission through unit area of the given building unit divided by the temperature difference between the air or some other fluid on either side of the building unit in 'steady state' conditions.

e. **THERMAL ENERGY STORAGE**
   Storage of 'Cold Energy' sensible, latent or combination for use in central system for air-conditioning or refrigeration is called thermal energy storage. It uses a primary source of refrigeration for cooling and storing 'Cold Energy' for reuse at peak demand or for backup as planned.

f. **SHADE FACTOR**
   The ratio of instantaneous heat gain through the shading device to that through a plain glass sheet of 3mm thickness.

g. **SENSIBLE HEAT FACTOR (SHF)**
   Sensible heat factor is the ratio of sensible heat to total heat, where total heat is the sum of sensible and latent heat.

h. **SUPPLY AIR**
   The air that has been passed through the conditioning apparatus and taken through the duct system and distributed in the conditioned space is termed as supply air.

i. **RETURN AIR**
   The air that is collected from the conditioned space and returned to the conditioning equipment is termed as return air.

j. **RE-CIRCULATED AIR**
   The return air that has been passed through the conditioning apparatus before being re-supplied to the space is called re-circulated air.

k. **DUCT SYSTEM**
   A continuous passageway for the transmission of air which in addition to the ducts may include duct fittings, dampers, plenums and grilles &diffusers.

l. **PLENUM**
An air compartment or chamber to which one or more ducts are connected and which forms part of an distribution system.

**bb. SUPPLY AND RETURN AIR GRILLES & DIFFUSERS**
Grilles and diffusers are the devices fixed in the air-conditioned space for distribution of conditioned supply air and return of air collected from the conditioned space for recirculation.

**cc. FIRE DAMPER**
A closure which consists of a normally held open damper installed in an air distribution system or in a wall or floor assembly and designed to close automatically in the event of a fire in order to maintain the integrity of the fire separation.

**dd. SMOKE DAMPER**
A smoke damper is similar to fire damper. However, it closes automatically on sensing presence of smoke in air distribution system or in conditioned space.

**ee. FIRE SEPARATION WALL**
The wall provides complete separation of one building from another or part of a building from another part of the same building to prevent any communication of fire of any access or heat transmission to wall itself which may cause or assist in the combustion of materials of the side opposite to that portion which may be on fire.

**ff. REFRIGERANT**
The fluid used for heat transfer in a refrigerating system, which absorbs heat at a low temperature and low pressure of the fluid and rejects heat at a higher temperature and higher pressure of the fluid, usually involving changes of state of the fluid.

**gg. GLOBAL WARMING POTENTIAL (GWP)**
Global Warming can make our planet and its climate less hospitable and more hostile to human life. It is, therefore, necessary to reduce emission of green house gases such as Co2, Sox, Nox and refrigerants. The potential of are refrigerant to contribute to Global Warming is called its GWP. Long atmospheric life time of refrigerants results in Global Warming unless the emissions are controlled.

**hh. OZONE DEPLETION POTENTIAL (ODP)**
The potential of refrigerant or gasses to deplete the Ozone in the atmosphere is called ODP. The ODP values for various refrigerants are as under:

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ODP Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-11</td>
<td>1.000</td>
</tr>
<tr>
<td>R-12</td>
<td>0.820</td>
</tr>
<tr>
<td>R-22</td>
<td>0.034</td>
</tr>
<tr>
<td>R-123</td>
<td>0.012</td>
</tr>
<tr>
<td>R-134a</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Due to high OPD of 1, R-22 & R-123 their use in the air conditioning and refrigeration is being phased-out.
APPENDIX-B(SCHEDULE OF TECHNICAL DATA)

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment.

(B) WATER PIPING:

a) Material for pipes
b) Material for fittings
c) Pipe wall thickness
d) Material for valves
e) Pressure gauges:
   (i) Make
   (ii) Range
   (iii) Dial
f) Flow meter type and make
g) Size of flow meter

(C) ELECTRICAL

- Motors (Give separate particulars for each application)
f) Manufacturer
g) Type and frame reference
h) Rated output (KW)
i) Range of working voltage (V)
j) No. of phases
k) Rated frequency
l) Rated speed (RPM)
m) Full load current (amps)
n) Class of insulation
o) Efficiency and power factor at the following loadings 100%, 75%, 50% 25% of Rated full load.
p) Type of bearings
q) Noise Level at 1 m distance:

- Motor starters (Give separate particulars for each application):
  (i) Manufacturer
  (ii) Type
  (iii) Rating
  (iv) Whether the following protections are provided
    (a) Over load
    (b) Under voltage
    (c) Single phase prevention (for 3phase motor starters)

- Switch board
  (i) Manufacturer
  (ii) Type

- Circuit Breaker
(i) Manufacturer
(ii) Type
(iii) Rated normal current (amps)
(iv) Short circuit ratting (MVA)
(v) Whether following are provided
   (a) OIL trip
   (b) ELF trip
   (c) Under voltage trip

- Measuring Instruments:
  (i) Manufacturer
  (ii) Range
  (iii) Dial size
  (iv) Glass Index

- Iron clad switch gears:
  (i) Manufacturer
  (ii) Make of HRC fuse provided

(D) CONTROLS
i) Make and type of thermostats
ii) Make and type of humidistats
iii) Make and type of damper motor
iv) Make and type of other control components

(E) INSULATION (For each application)
   i) Manufacturer
   ii) Material and density
   iii) ‘K’ value at 10 deg C mean temperature
   iv) Thickness.

(F) FANS (For each Type and application)
1. Manufacturer
2. Type
3. CFM
4. Static Pressure MM WG
5. Motor H.P.
6. Insulation Class
7. Outlet Vel. FPM
8. R.P.M
9. Type of Drive
10. Noise Level DB

(G) M.S. PIPE:
1. Make
2. Class
3. Wall Thickness of Pipes
(H) **VALVES & GAUGES:**
1. Butterfly Valve Make
2. Balancing Valve Make
3. Check Valve Make
4. Y-strainer Make
5. Pressure Gauge Make
6. Flow Switch Make
7. Thermometer Make

(I) **GRILLES/DIFFUSERS/DAMPERS:**
- Fire Dampers - UL Listed
- Grilles
- Louvers
- Diffusers
- Duct Dampers

(J) **Duct Insulation Material**
- Thermal Conductivity
- Duct Insulation

(K) **Air Handling Units/ Fan Coil Units:**
1.0 Make
1.1 Casing
1.2 Coil
2.0 Type: horizontal/ vertical
3.0 Dimension MxMxH (M)
4.0 Cooling coil
4.1 Coil area Sq.M
4.2 No. of rows Nos.
4.3 No. of fins/cm
4.4 Tube dia (Outer dia) mm
4.5 Thickness of tube mm
5.0 Material of casing: CRCA/GI
6.0 Air quantity at max. Speed
   And 1 m long duct collar CMH
7.0 Air quantity at min. Speed
   And 1.0 m. Long duct collar CMH
8.0 Whether auxiliary drain pan Provided: Yes/No.
9.0 Make & model of room thermostat.
10.0 Water valves.
10.1 Type 2 way/ 3 way
10.2 Motorized/solenoid.
10.3 Make/dia.
11.0 Type of shut off valves
12.0 Whether acoustic lined duct collar included in Unit price.
13.0 Does FCU/ AHU have return air plenum. Yes/No.
14.0 Noise Level at 1 m distance:
### L) Split Air Conditioning System/VRV System:

#### INDOOR

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>1.0</strong> Make</td>
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</tr>
<tr>
<td><strong>2.0</strong> Casing</td>
<td></td>
</tr>
<tr>
<td><strong>3.0</strong> Type:</td>
<td><strong>Ductable/ Cassete/ High wall</strong></td>
</tr>
<tr>
<td><strong>4.0</strong> Dimension</td>
<td><strong>MxMxH (M)</strong></td>
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<tr>
<td><strong>5.0</strong> Cooling Capacity</td>
<td></td>
</tr>
<tr>
<td><strong>6.0</strong> Air quantity at max. Speed</td>
<td><strong>CMH</strong></td>
</tr>
<tr>
<td><strong>7.0</strong> Air quantity at min. Speed</td>
<td><strong>CMH</strong></td>
</tr>
<tr>
<td><strong>8.0</strong> Whether auxiliary drain pan Provided:</td>
<td><strong>Yes/No.</strong></td>
</tr>
<tr>
<td><strong>9.0</strong> Make &amp; model of room thermostat.</td>
<td></td>
</tr>
<tr>
<td><strong>10.0</strong> Whether acoustic lined duct collar included in Unit price.</td>
<td></td>
</tr>
<tr>
<td><strong>11.0</strong> Does Indoor Unit have return air plenum.</td>
<td><strong>Yes/No.</strong></td>
</tr>
<tr>
<td><strong>12.0</strong> Noise Level at 1 m distance:</td>
<td></td>
</tr>
</tbody>
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#### OUTDOOR

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<td><strong>b)</strong> Type</td>
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<tr>
<td><strong>c)</strong> Model</td>
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</tr>
<tr>
<td><strong>d)</strong> Overall dimensions (mm)</td>
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</tr>
<tr>
<td><strong>e)</strong> Operating Weight (kg.)</td>
<td></td>
</tr>
<tr>
<td><strong>f)</strong> No. of fans</td>
<td></td>
</tr>
<tr>
<td><strong>g)</strong> CMH per fan</td>
<td></td>
</tr>
<tr>
<td><strong>h)</strong> Outlet velocity (Mts. Per min)</td>
<td></td>
</tr>
<tr>
<td><strong>i)</strong> Tip speed (Mts per min)</td>
<td></td>
</tr>
<tr>
<td><strong>j)</strong> Compressor Type</td>
<td></td>
</tr>
<tr>
<td><strong>k)</strong> Vibration isolator</td>
<td></td>
</tr>
<tr>
<td><strong>l)</strong> Noise Level at 1 m distance:</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX-C (TESTING AND MEASUREMENT NOTES)

A. TEST INSTRUMENTS
   i) All instruments for testing shall be provided by the air conditioning contractor.
   ii) Thermometers used for measurement of temperature of water, refrigerant shall have
       graduation of 0.1 deg C and shall be got calibrated from N.P.L. or any recognized test
       house before hand.
   iii) Thermometers used in the psychrometers shall have graduations of 0.2 deg C and shall be
       calibrated as at (2) above.
   iv) Pressure gauges shall also be got calibrated before hand from a recognized test house.
   v) Orifice type of flow meters shall be used for measuring flow rate through the condensers
       and chillers.

B. CAPACITY COMPUTATIONS
   1. Air handling unit (chilled water type):
      The capacity shall be computed from the water temperature and water flow measurement
      A tolerance of + 5% from the tender documents value shall be acceptable in the capacity so
      computed. Air quantity shall be measured in the supply duct and checked with the quantity
      specified in the tender documents. a tolerance of ±10% in the air quantity shall be
      acceptable. The enthalpy difference of air entering and leaving the coil shall be computed
      from air temperature and recorded.

   2. Air handling unit (Dx type):
      The capacity shall be computed from the air quantity measured in the supply air duct and the
      enthalpy difference between the air entering leaving coil. Air quantity measured shall be
      checked with that recorded in the tender documents. A tolerance of ±10% from tender
      documents value shall be acceptable.

   3. For the purpose of system capacity, the refrigeration tonnage obtained from the main
      refrigeration plant shall be accepted.

   4. If due to any reason, internal load mentioned in the tender specifications is not available
      psychometric computations for actual load conditions shall, be done and the plant, if found
      satisfactory shall be accepted.
**APPENDIX-D (MAINTENANCE)**

This section covers the maintenance schedule during 3 year free warranty period.

The maintenance provided during the warranty period shall be fully comprehensive and shall include but not limited to all equipment’s, labour part and emergency calls providing and site response within 24 hours. However, during the maintenance the department shall arrange period after the warranty is over, the materials if any replacement is warranted. However consumable materials shall be arranged by the department during 3 yrs period including that of warranty period.

The maintenance shall also include a minimum of 36-month preventive maintenance visits by qualified personnel who are thoroughly familiar with the type of equipment and system provided for this project.

<table>
<thead>
<tr>
<th>AIR HANDLING UNITS, AND FAN COIL UNITS</th>
<th>MONTHLY INSPECTION</th>
<th>ANNUAL INSPECTION PRIOR TO EXPIRY OF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1) Inspect all air handling and fan coil units.</td>
<td>1) Perform all functions for monthly check.</td>
</tr>
<tr>
<td></td>
<td>2) Check all air filters and clean or change filters as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Check all water coils, seals and pipelines for leaks and rectify as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Check and re-calibrate modulating valves and control. Adjust and rectify as necessary to ensure compliance with the original specifications.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) Purge air from all water coils.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6) Check all fan bearings and lubricate with grease as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7) Check the tension of belt drives and adjust as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8) Check and clean all condensate pans, trays and drains.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9) Check, measure and recalibrate all sensors if necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10) Check, clean and service all smoke detectors. Carry out a system test to ensure that the smoke detector shall trip the AHU’s.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11) Check all spring vibration isolators for abnormal vibration. Rectify as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12) Coil to be cleaned by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Spray of high press clean water(not exceeding 30 psi)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) With chemical spray, if necessary.</td>
<td></td>
</tr>
</tbody>
</table>
| **COIL UNITS** | **WARRANTY PERIOD** | 2) Tighten motor terminals.  
3) Check starter contacts.  
4) Test and calibrate over-load settings. |
| **AIR DISTRIBUTION SYSTEM** | **MONTHLY AND ANNUAL INSPECTION PRIOR TO EXPIRY OF WARRANTY PERIOD** | 1) Check operations of all modulating and fixed dampers controlling air flow through unit. Lubricate all damper bearing and linkages as necessary.  
2) Carry out space temperature checks on air conditioned areas with thermo hydrographs. Balance air flow as necessary to compliance with requirement of original specifications. These checks include the calibration of sensors, thermostat, etc.  
3) Check noise level of discharged air from diffusers. |
| **VENTILATION** | **MONTHLY CHECK AND ANNUAL INSPECTION PRIOR TO EXPIRY OF WARRANTY PERIOD** | 1) Check, adjust as necessary the air flow of all fans are in compliance with the original specification.  
2) Check the tension of all belt drives and adjust as necessary.  
3) Check and lubricate all fan bearings.  
4) Tighten motor terminals.  
5) Check starter contacts.  
6) Test and calibrate over-load settings.  
7) A system check shall be carried out for all mechanical ventilation (MV), pressurization and exhaust system to verify the performance of the system. |
| **SWITCH BOARD** | **SIX-MONTHLY AND ANNUAL INSPECTION PRIOR TO EXPIRY OF WARRANTY PERIOD** | 1) Clean and adjust all switch gear, contactors, relays and associated electrical equipments at intervals not exceeding six months.  
2) Check and prove operation of thermal over-load and protection devices. |
<table>
<thead>
<tr>
<th>PIPINGSYSTEM</th>
<th>MONTHLY AND ANNUAL INSPECTION PRIOR TO EXPIRY OF WARRANTY PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>3) Check and ensure tightness of all equipment fastenings and cable terminations within switch boards.</td>
<td></td>
</tr>
<tr>
<td>4) Vacuum clean all switch board cubicles.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONSUMABLE MATERIALS</th>
<th>The department shall supply the following consumable materials as and when required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) The oils and grease required for lubrication of compressors, fan bearings, motors bearings, pivots and other moving parts.</td>
<td></td>
</tr>
<tr>
<td>2) All refrigerant required for topping up. Refrigerant loss if due to manufacturing defect or due to negligence shall be made good by the contractor.</td>
<td></td>
</tr>
<tr>
<td>3) All consumable filter elements/rolls.</td>
<td></td>
</tr>
<tr>
<td>4) All chemical for the correct chemical treatment of the cooling tower and chilled water system.</td>
<td></td>
</tr>
<tr>
<td>5) All carbon brushes required to replace worn brushes in electric motors.</td>
<td></td>
</tr>
<tr>
<td>6) All electric contact points required to replace worn electric contact points in switchgears, motor starter gears, electronic control gears and electric relays.</td>
<td></td>
</tr>
<tr>
<td>7) All electric fuses required to replace blown fuses.</td>
<td></td>
</tr>
</tbody>
</table>

Just before the expiry of the warranty of the contact, the contractor shall carry out a complete system operability test on all the system or sub systems as called for in the contract.
The purpose of the test is to verify that the performance of all the systems or sub-systems in the contract is in accordance to the specifications.

All test shall be carried out in the presence of the Engineer-in-charge or his representative.

The warranty period is deemed to be over if the department or his representative is completely satisfied with the system performance during the test.

<table>
<thead>
<tr>
<th>BMS WORK</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The BMS software shall be upgradable up to 10 years without any cost by the provider.</td>
<td></td>
</tr>
<tr>
<td>The BMS system shall be provided with 5 years comprehensive maintenance after first year of DLP</td>
<td></td>
</tr>
<tr>
<td>The bidder shall quote as a item for this scope of work as separate item.</td>
<td></td>
</tr>
<tr>
<td>The bidder shall provide undertaking by the OEM for providing comprehensive AMC to the IIT Kanpur at the quoted rate including upgradation of software for 10 years.</td>
<td></td>
</tr>
</tbody>
</table>
# ANNEXURE-A: SCHEDULE OF EQUIPMENTS

## A. FLOORMOUNTED / CEILING SUSPENDED AHU:

### AIR HANDLING UNIT-SCHEDULE

<table>
<thead>
<tr>
<th>SR NO</th>
<th>LEVEL</th>
<th>EQUIPMENT TAG</th>
<th>Location</th>
<th>SERVICE AREA</th>
<th>CFM</th>
<th>TR</th>
<th>FRESH AIR CFM</th>
<th>Cooling Coil</th>
<th>Pre Filter</th>
<th>ESP Filter</th>
<th>Hepa Filter</th>
<th>Total Static Pressure (mm of WC)</th>
<th>VFD FC-102 Or Equivalent</th>
<th>Volt/Phase</th>
<th>Power Consumption (KW)</th>
<th>Casing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>AHU-01-01</td>
<td>LAB-2</td>
<td>LAB-2</td>
<td>2,700</td>
<td>7.0</td>
<td>400</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.4</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>AHU-01-02</td>
<td>LAB-1</td>
<td>LAB-1</td>
<td>2,700</td>
<td>7.0</td>
<td>400</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.4</td>
</tr>
<tr>
<td>3</td>
<td>LEVEL-1</td>
<td>AHU-01-03</td>
<td>AHU ROOM - CENTRAL INSTRU.</td>
<td>CENTRAL INSTRUMENTAT.</td>
<td>2,700</td>
<td>7.0</td>
<td>200</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.4</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>AHU-01-04</td>
<td>AHU ROOM - AUTOCLAVE</td>
<td>CORRIDOR/LOBBY</td>
<td>3,000</td>
<td>8.0</td>
<td>300</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.5</td>
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<tr>
<td>5</td>
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<td>AHU-01-05</td>
<td>AHU ROOM - AUTOCLAVE</td>
<td>AUTOCLAVE</td>
<td>2,000</td>
<td>5.0</td>
<td>200</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.0</td>
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<tr>
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<td>AHU-01-06</td>
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<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES 415-3Ø</td>
<td>1.35</td>
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</tbody>
</table>
## AIR HANDLING UNIT-SCHEDULE

<p>| SR. NO. | LEVEL | EQUIPMENT TAG | Location | SERVICE AREA | CFM | TR | FRESH AIR CFM | Cooling Coil | Pre-filter | ESP Filter | Hepa Filter | Total Static Pressure | VFD FC-102 Or | Volt/Phase | Power Consumption (KW) | Casing |  |
|---------|-------|---------------|----------|--------------|-----|----|---------------|--------------|------------|------------|-------------|--------------|----------------------|--------------|------------|----------------------|--------|---|
| 7       |       | AHU-01-07     | AHU ROOM | SEMINAR HALL | 4,000 | 10.0 | 400 44 54 6 | YES          | YES        | NO         | 50 YES     | 415-3Ø     | 2.00                  | Double Skin Floor Mounted Horizontal Type |
| 8       |       | AHU-01-08     | AHU ROOM | SEMINAR HALL | 4,000 | 10.0 | 400 44 54 6 | YES          | YES        | NO         | 50 YES     | 415-3Ø     | 2.00                  | Double Skin Floor Mounted Horizontal Type |
| 9       |       | AHU-01-09     | AHU ROOM | ENTRANCE/FOYER | 3,200 | 8.0  | 44 54 6 | YES          | YES        | NO         | 40 YES     | 415-3Ø     | 1.60                  | Double Skin Floor Mounted Horizontal Type |
| 10      |       | AHU-02-01     | LAB-5    |              | 2,700 | 7.0  | 400 44 54 6 | YES          | NO         | NO         | 40 YES     | 415-3Ø     | 1.35                  | Double Skin Floor Mounted Vertical Type |
| 11      | LEVEL-2| CAHU-02-01    | ENTRANCE HALL | ENTRANCE HALL LEVEL-2 | 2200 | 6.0  | 150 44 54 6 | YES          | NO         | NO         | 40 YES     | 415-3Ø     | 1.00                  | Double Skin Ceiling suspended Type |
| 12      | LEVEL-2| AHU-02-02     | LAB-4    |              | 2,700 | 7.0  | 400 44 54 6 | YES          | NO         | NO         | 40 YES     | 415-3Ø     | 1.35                  | Double Skin Floor Mounted Vertical Type |
| 13      |       | AHU-02-03     | AHU ROOM | CENTRAL INSTRU. | 2,700 | 7.0  | 200 44 54 6 | YES          | YES        | NO         | 40 YES     | 415-3Ø     | 1.35                  | Double Skin Floor Mounted Horizontal Type |</p>
<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>LEVEL</th>
<th>EQUIPMENT TAG</th>
<th>Location</th>
<th>SERVICE AREA</th>
<th>CFM</th>
<th>TR</th>
<th>FRESH AIR CFM</th>
<th>Cooling Coil</th>
<th>Pre-Filte r</th>
<th>ESP Filter</th>
<th>Hepa Filter</th>
<th>Total Static Pressure</th>
<th>VFD FC-102 Or</th>
<th>Volt/Phase</th>
<th>Power Consumption (KW)</th>
<th>Casing</th>
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<td>AHU-02-04</td>
<td>AHU ROOM- AUTOCLAVE</td>
<td>CORRIDOR/LOB BY</td>
<td>3,000</td>
<td>8.0</td>
<td>300</td>
<td>44</td>
<td>54</td>
<td>6</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES</td>
<td>415-3Ø</td>
</tr>
<tr>
<td>15</td>
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<td>AHU-02-05</td>
<td>AHU ROOM - AUTOCLAVE</td>
<td>AUTOCLAVE</td>
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<td>6</td>
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<td>6</td>
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<td>54</td>
<td>6</td>
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<td>NO</td>
<td>NO</td>
<td>40</td>
<td>YES</td>
<td>415-3Ø</td>
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<td>400</td>
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<td>54</td>
<td>6</td>
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<td>NO</td>
<td>NO</td>
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<td>YES</td>
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<td>19</td>
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<td>AHU-03-02</td>
<td>LAB-8</td>
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### B. FAN COIL UNITS:

#### FAN COIL SCHEDULE

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| 2     | LEVEL-1 | FCU-01-02 | FACULTY OFFICE    | 1.00     | 400    | 44            | 54          | 4                               | 20          | 240-1Ø               | 0.24           | DUCTABLE INIT
| 3     | LEVEL-1 | FCU-01-03 | CHEM.STORE        | 2.00     | 400    | 44            | 54          | 4                               | 20          | 240-1Ø               | 0.24           | DUCTABLE INIT
| 4     | LEVEL-1 | FCU-01-04 | DEPT.OFFICE       | 2.00     | 800    | 44            | 54          | 4                               | 20          | 240-1Ø               | 0.48           | DUCTABLE INIT
| 5     | LEVEL-1 | FCU-01-05 | OFFICE            | 1.00     | 400    | 44            | 54          | 4                               | 20          | 240-1Ø               | 0.24           | DUCTABLE INIT
| 6     | LEVEL-1 | FCU-01-06 | RECEPTION         | 1.50     | 600    | 44            | 54          | 4                               | 20          | 240-1Ø               | 0.36           | DUCTABLE INIT
| 7     | LEVEL-1 | FCU-01-07 | UPS ROOM          | 2.00     | 800    | 44            | 54          | 4                               | 240-1Ø     |                      | 0.48           | HI-WALL UNIT
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| 11    | LEVEL-2 | FCU-02-04 | FOYER             | 4.00     | 1600   | 54            | 150         | 4                               | 30          | 240-1Ø               | 0.96           | DUCTABLE INIT
| 12    | LEVEL-2 | FCU-02-05 | MEETING ROOM      | 3.00     | 1200   | 44            | 54          | 4                               | 30          | 240-1Ø               | 0.72           | DUCTABLE INIT
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### ANNEXURE-B: IO SUMMARY

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# IO SUMMARY

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<th>DP switch Air/Blower</th>
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<th>Pressure sensor</th>
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## ANNEXURE-C: LIST OF APPROVED MAKE

### PROJECT - IIT KANPUR, UP

### PACKAGE - MECHANICAL

### LIST OF APPROVED MAKES

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<td>Split AC unit</td>
<td>Mitsubishi/Hitachi/ Daikin/Carrier/Panasonic, Toshiba/Blue star/Voltas</td>
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<td>AHU</td>
<td>Zeco/systemair/Edgetech/Flaktwood/Nutech</td>
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<td>4</td>
<td>Motors</td>
<td>Siemens/Crompton</td>
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<td>VFD</td>
<td>Siemens/ Danfoss</td>
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<td>Filters</td>
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<td>Trocellen/Aerolam/Thermaflex/Supreme</td>
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</table>

**BUILDING MANAGEMENT SYSTEM**

<table>
<thead>
<tr>
<th></th>
<th>Central control station</th>
<th>Compaq</th>
<th>IBM</th>
<th>DELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Building management system web-based server software</td>
<td>Johnson Controls</td>
<td>Schneider/Siemens</td>
<td>Honeywell</td>
</tr>
<tr>
<td>41</td>
<td>Energy management software</td>
<td>Johnson Controls</td>
<td>Schneider/Siemens</td>
<td>Honeywell</td>
</tr>
<tr>
<td>42</td>
<td>Programmable &amp; application specific controller (ddc)</td>
<td>Johnson Controls</td>
<td>Schneider/Siemens</td>
<td>Honeywell</td>
</tr>
<tr>
<td>43</td>
<td>Web server engines (network / supervisory controllers)</td>
<td>Johnson Controls</td>
<td>Schneider/Siemens</td>
<td>Honeywell</td>
</tr>
<tr>
<td>44</td>
<td>Integrators</td>
<td>Johnson Controls</td>
<td>Schneider/Siemens</td>
<td>Honeywell</td>
</tr>
<tr>
<td>45</td>
<td>SENSORS AND FIELD DEVICES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>a</td>
<td>Immersion type temperature sensors</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>47</td>
<td>b</td>
<td>Differential Pressure Switch (blowers &amp; Filters &amp; Pump)</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>48</td>
<td>c</td>
<td>Duct mount temperature &amp; RH sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>49</td>
<td>d</td>
<td>Damper Actuator</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>50</td>
<td>e</td>
<td>CO Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>51</td>
<td>f</td>
<td>CO2 Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>52</td>
<td>g</td>
<td>Current Relay</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>53</td>
<td>h</td>
<td>Water level Switch</td>
<td>Johnson Controls</td>
<td>Greystone</td>
</tr>
<tr>
<td>i</td>
<td>Network Temp, RH &amp; PIR Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
<td>Honeywell</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------</td>
<td>------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>j</td>
<td>Water Pressure Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
<td>Honeywell</td>
</tr>
<tr>
<td>k</td>
<td>Duct Static Pressure Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
<td>Honeywell</td>
</tr>
<tr>
<td>l</td>
<td>Ultrasonic Flow Meters</td>
<td>Greystone</td>
<td>Honeywell</td>
<td>Sontay</td>
</tr>
<tr>
<td>m</td>
<td>Ultrasonic BTU Meters</td>
<td>Kamstrup</td>
<td>Sontay</td>
<td>Schenitech</td>
</tr>
<tr>
<td>n</td>
<td>Ultrasonic water flow Meters</td>
<td>Kamstrup</td>
<td>Sontay</td>
<td>Schenitech</td>
</tr>
<tr>
<td>o</td>
<td>Flameproof Level Switch</td>
<td>Kele</td>
<td>Vekeselor</td>
<td>Filpro</td>
</tr>
<tr>
<td>p</td>
<td>Outside Air Temperature/ RH Sensor</td>
<td>Schneider</td>
<td>Greystone</td>
<td>Johnson Controls</td>
</tr>
<tr>
<td>q</td>
<td>Voltage / Current / Power Factor Transducer</td>
<td>L&amp;t</td>
<td>ABB</td>
<td>Honeywell</td>
</tr>
<tr>
<td>r</td>
<td>Room Temp. Sensor</td>
<td>Johnson Controls</td>
<td>Greystone</td>
<td>Honeywell</td>
</tr>
</tbody>
</table>

### Panels, WIRING & CONDUITING

<table>
<thead>
<tr>
<th>a</th>
<th>Communication Cables / Signal Cable/ Control Cable</th>
<th>RR Cable</th>
<th>Havells/CCI/KEI</th>
<th>Skytone</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>MS/GI/ PVC conduits</td>
<td>BEC</td>
<td>AKG</td>
<td>Precision</td>
</tr>
<tr>
<td>c</td>
<td>CAT 6 cable</td>
<td>Leviton</td>
<td>Amp</td>
<td>Panduit</td>
</tr>
<tr>
<td>d</td>
<td>HVAC Electrical Panel</td>
<td>Milestone/Neptune</td>
<td>Tricolite</td>
<td>Adlec</td>
</tr>
</tbody>
</table>
## SCHEDULE OF STAGE PAYMENT (IN PERCENTAGE OF TOTAL COST)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Activities</th>
<th>Percentage of total building cost</th>
<th>Break-up</th>
<th>Total Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upon completion all works upto plinth level (all earth work, PCC work, sand filling, Anti-termite treatment, RCC work, DPC, brick work, etc.)</td>
<td></td>
<td></td>
<td>10.88</td>
</tr>
<tr>
<td></td>
<td>a Earth work</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b PCC work</td>
<td>0.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c RCC work (raft foundation)</td>
<td>6.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d RCC work (column, plinth beams,)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e RCC work (Grade slab)</td>
<td>1.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f Sand filling, Anti-termite treatment, DPC, brick work, etc.</td>
<td>0.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>10.88</td>
</tr>
<tr>
<td>2</td>
<td>Upon completion of all RCC structural works for the building above plinth level, including mumties, overhead water tanks, RCC parapets, etc.</td>
<td></td>
<td></td>
<td>19.78</td>
</tr>
<tr>
<td></td>
<td>a Upon completion of Level-1</td>
<td>4.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b Upon completion of Level-2</td>
<td>3.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c Upon completion of Level-3</td>
<td>3.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d Upon completion of Level-4</td>
<td>3.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e Upon completion of Level-5</td>
<td>2.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f Upon completion of Level-6, including mumties &amp; water tanks</td>
<td>2.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>19.78</td>
</tr>
<tr>
<td>3</td>
<td>Upon completion of all AAC block work above plinth level</td>
<td></td>
<td></td>
<td>9.00</td>
</tr>
<tr>
<td></td>
<td>a Upon completion of Level-1</td>
<td>1.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b Upon completion of Level-2</td>
<td>1.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c Upon completion of Level-3</td>
<td>1.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d Upon completion of Level-4</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e Upon completion of Level-5</td>
<td>1.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f Upon completion of Level-6, including mumties &amp; water tanks</td>
<td>1.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>9.00</td>
</tr>
<tr>
<td>4</td>
<td>Upon completion of door &amp; windows shutters (wood, mild steel &amp; fire-rated) including glazing, hardware fittings, and cupboard &amp; loft door etc.</td>
<td></td>
<td></td>
<td>2.37</td>
</tr>
<tr>
<td>5</td>
<td>Upon completion of all SS staircase railing and steel works (gratings, MS ladders, etc.)</td>
<td></td>
<td></td>
<td>0.44</td>
</tr>
<tr>
<td>6</td>
<td>Upon completion of all water proofing works at roofs, sunken areas, balconies, usable terraces, including laying of glazed broken tiles in roof and sunken filling</td>
<td></td>
<td></td>
<td>1.46</td>
</tr>
<tr>
<td>7</td>
<td>Upon completion of all flooring works including skirting/ dado, copings, OH water tank tile works, etc.</td>
<td></td>
<td></td>
<td>9.29</td>
</tr>
<tr>
<td></td>
<td>a Upon completion of Level-1</td>
<td>1.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b Upon completion of Level-2</td>
<td>1.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c Upon completion of Level-3</td>
<td>1.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d Upon completion of Level-4</td>
<td>1.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e Upon completion of Level-5</td>
<td>1.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Upon completion of Level-6, including mumties &amp; water tanks</td>
<td>1.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>9.29</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Upon completion of all plastering works (internal &amp; external)</td>
<td><strong>1.69</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Upon completion of false ceiling (Aluminium, Al wood, calcium silicate, stretch ceiling, mineral fiber, etc.) except seminar hall</td>
<td><strong>3.72</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Upon completion of all internal &amp; external painting works (excluding SKK texture paint) including wood polishing</td>
<td><strong>1.06</strong></td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>Upon completion of external SKK texture paint</td>
<td><strong>5.00</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Upon completion of Aluminium doors &amp; windows works including Aluminium louvers &amp; Alwood louvers</td>
<td><strong>3.43</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Upon completion of Fire curtains installation</td>
<td><strong>3.33</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Upon completion of false ceiling &amp; wall paneling in seminar hall</td>
<td><strong>1.05</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Upon completion of space-frame including polycarbonate sheet</td>
<td><strong>0.89</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Upon completion of internal water supply pipes &amp; fittings, soil and waste pipes &amp; fittings upto 1st manhole, rainwater pipes &amp; fittings upto 1st manhole</td>
<td><strong>1.07</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Upon installation of complete sanitary fittings and fixtures including RO system</td>
<td><strong>0.80</strong></td>
<td></td>
<td></td>
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<tr>
<td>18</td>
<td>Upon completion of external sewage, storm water drainage &amp; rain water harvesting</td>
<td><strong>0.23</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Upon installation and commissioning of fire-fighting works (pumps, piping, equipment’s &amp; fittings, etc.)</td>
<td><strong>0.35</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Upon completion of electrical wiring, DB’s with MCCB’s &amp; RCCB’s etc., cable tray &amp; raceway, etc., earthing &amp; lightning protection</td>
<td><strong>3.14</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Supplying and laying of conduit and boxes of all floors</td>
<td><strong>0.37</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Supplying and drawing of wires for all floors</td>
<td><strong>0.49</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Supply of DBs MCBs rising mains alongwith accessories</td>
<td><strong>0.49</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Supply street light poles, bollard, landscape lighting, cabling, panels etc.</td>
<td><strong>0.41</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Supply of corridor light fittings, street lights, cabling, panels etc.</td>
<td><strong>0.60</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Installation of above equipment’s</td>
<td><strong>0.52</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>Testing and commissioning of all equipment’s</td>
<td><strong>0.26</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3.14</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Upon installation and commissioning of UPS, LT panels &amp; cables</td>
<td><strong>2.58</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Supplying and installation of UPS</td>
<td><strong>0.98</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Supplying and installation of LT main panel &amp; supplying and laying of external cables</td>
<td><strong>0.98</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Testing and commissioning of all equipments</td>
<td><strong>0.62</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>2.58</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Upon completion and commissioning of light fixtures, data &amp;</td>
<td><strong>4.91</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Amount</td>
<td></td>
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<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>telephone network, EPABX system, IP CCTV system, Access control system, Audio visual system, Fire Alarm system &amp; digital voice evacuation system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Supply and installation of electrical indoor light fittings, fan, Ex / fresh air fans sensors, lighting controls, raceways etc.</td>
<td>2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Supplying and installation of data network / telephone system</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Supplying installation testing and commissioning of CCTV, Access control and Audio Visual System.</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Supplying and installation of fire alarm system &amp; digital voice evacuation system</td>
<td>0.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Upon installation and commissioning of HVAC works</td>
<td>8.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Upon installation of complete AHU, VFD, TFA, Axial fans, VRF &amp; others associated accessories</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Upon installation of ducting, duct insulation, duct/room acoustic insulation and under deck insulation</td>
<td>1.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Upon installation of grills, diffusers, VCD's &amp; VAV's etc.</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Upon installation testing &amp; commissioning of chilled water pipeline, valves, strainers, gauges and pipe insulation etc.</td>
<td>1.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Upon installation of complete ventilation system</td>
<td>0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Upon testing &amp; commissioning of entire HVAC &amp; BMS system</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Upon completion of path, plinth protection, etc., works</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Upon completion of road/parking works including kerbstones</td>
<td>1.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Upon completion of Lift work including commissioning</td>
<td>2.74</td>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>100.00</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: On-account payments on pro-rata basis of above percentages can be re-worked during construction, on completion of respective works for each floor.