

**INDIAN INSTITUTE OF TECHNOLOGY KANPUR
INSTITUTE WORKS DEPARTMENT**

**TENDER FOR
CONSTRUCTION OF KOTAK SCHOOL OF SUSTAINABILITY**

including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016



**INDIAN INSTITUTE OF TECHNOLOGY KANPUR
G.T. ROAD, KALYANPUR, KANPUR-208016
UTTAR PRADESH, INDIA**

NIT No.: 06/Composite/CO/2025-26

DATE:24.04.2025

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 24 on pages- 16 & 17** 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 **02/05/2025 at 11:00 AM** as detailed in this document

Note-7:- The construction work is to be carried out at IIT Kanpur campus

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INDIAN INSTITUTE OF TECHNOLOGY, KANPUR
INSTITUTE WORKS DEPARTMENT
CENTRAL OFFICE

Notice Inviting e-Tender -06/Composite/CO/2025-26

The Superintending Engineer, IWD, IIT Kanpur on behalf of the Board of Governors of IIT Kanpur invites online percentage rate open bids on two envelope system from eligible firms/contractors of repute in two bid system (Eligible cum Technical & Financial Bid) for the following work:

Sl. No.	Name of work	Estimated cost in Rs.	Earnest Money in Rs.	Period of completion
1.	Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur- 208016	Rs. 70,92,00,263/- i/c Civil works: Rs. 52,11,76,908/- Electrical & Lift works: Rs. 12,23,66,463/- HVAC works: Rs. 6,56,56,892/-	Rs. 80,92,003/- (Rs. 20 Lacs in the form of FDR & balance amount in the form BG/eBG / FDR)	18 (eighteen) months

Last date & time of submission of bid on **16.05.2025 upto 5.00 PM**. All details are available on website, <https://eprocure.gov.in/eprocure/app>,. The bids can only be submitted online at <https://eprocure.gov.in/eprocure/app>. Any corrigendum regarding this tender will be published only on above mentioned websites.

-Sd-

No. IWD/CO/2025-26/26 Dated: 24.04.2025

Superintending Engineer

Phone No-0512-259-7604

Section-

A

Technical BID

(Eligibility Bid)

Name of work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.

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

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

1. TENDER DETAILS:

The Superintending Engineer Institute Works Department), on behalf of the Board of Governors invites online Percentage Rate composite bids on basis from CPWD enlisted contractors of appropriate class in Composite category as well as from eligible firms / agencies satisfying the eligibility criteria, in two bid system for the following work:

Sr. No.	Particulars	Schedule
1.	NIT No.:	6/Composite/D2/2025-26
2.	Location	Indian Institute of Technology, Kanpur
3.	Tender / Quotation type (open/ limited /EOI / Auction / Single	Open
4.	Tender / Quotation category (services / works	Works
5.	Type of Contract (work / supply / auction/ service / buy/ empanelment / sell	Works
6.	Form of contract (CPWD-7/8)	CPWD-7
7.	Work Category (civil / electrical / fleet / management / computer system	Composite (Civil , E&M & HVAC works)
8.	Is multi-currency allowed?	No
9.	Name of works	Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.
10.	Estimated cost put to Tender	Rs. 70,92,00,263/- i/c Civil works: Rs. 52,11,76,908/- Electrical works: Rs. 12,23,66,463/- HVAC works: Rs. 6,56,56,892/- Estimate cost put to Tender= <u>70,92,00,263/-</u>
11.	Earnest money	Rs. 80,92,003/-
12.	Performance Guarantee	5% of estimated cost put to tender
13.	No. of Bids / Covers (1 / 2 / 3/ 4)	2
14.	Value of Security Deposit	2.5% of tendered amount to be deducted from each invoice.
15.	Period of Completion	18 (eighteen) months
16.	Date of publishing / issue / Start	As per CPP portal at https://eprocure.gov.in/eprocure/app
17.	Document download start date	As per CPP portal at https://eprocure.gov.in/eprocure/app
18.	Document download end date	As per CPP portal at https://eprocure.gov.in/eprocure/app

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

Sr. No.	Particulars	Schedule
19.	Date & time of pre-bid meeting	As per CPP portal at https://eprocure.gov.in/eprocure/app
20.	Venue of pre-bid meeting	Office of Superintending Engineer, IWD, IIT Kanpur
21.	Last date & time of uploading of bids	As per CPP portal at https://eprocure.gov.in/eprocure/app
22.	Date & time of opening of Technical bids	As per CPP portal at https://eprocure.gov.in/eprocure/app
23.	Bid validity Days	90 Days after opening of technical bid
24.	Address for communication	Office of Superintending Engineer, IWD, IIT Kanpur-208016 Contact no. 0512-259-7604
25.	Email address	seiwd@iitk.ac.in

The bid forms and other details can be obtained from the website www.eprocure.gov.in. All corrigendum / addendum shall only be available on this website and shall not be published anywhere else.

Superintending Engineer
IWD, IIT Kanpur

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 allow to participate.**

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 2836.80** lacs

OR

- (ii) Two similar works each costing not less than **Rs.4255.20** lacs

OR

- (iii) One similar work costing not less than Rs. **5673.60** lacs.

Similar work shall mean works of "Construction of building in RCC framed structure having minimum one building of five storied 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 HVAC works (Centralized Air Conditioning system) all executed under single agreement. The five storied building should have firefighting system or lift or Fire alarm system 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. 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. **2127.60 lacs** on construction works during the last three years

ending 31st March 2024.

- (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, 2024
 - (d) Should have net worth certificate of minimum 10% of the estimated cost put to tender issued by a certified chartered Accountant with UDIN.
- Or
- Should have banker's certificate of the amount equal to 40% of the estimated cost put to tender.
- (e) Should have the calculated bidding capacity equal to or more than the estimated cost of the work.
 - (f) 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 Executive Engineer 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 <https://eprocure.gov.in/eprocure/app>.
6. Applicant has to deposit earnest money of rupees **Rs.80,92,003** 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 in envelop mentioning "EMD for the work" on 19.05.2025 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, hard 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 all bidders on 00.00.2025 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 **at 11.00 AM on 02-05-2025** 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 Superintending Engineer on email id seiwd@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.***
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.
19. Online technical bid documents submitted by intending bidders shall be opened only of those bidders who have deposited Earnest Money and duly signed Integrity pact with date and seal.
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 to the office of the***

Superintending Engineer, IWD IIT Kanpur.

- (iii) The bidder does not upload scanned copies of all the documents stipulated in the bid document.
 - (iv) 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. 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.
21. 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.
22. 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.
23. 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.

24. 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:

1	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 (scan copy of the EMD is to be uploaded and original copy of EMD shall be deposited to the office of SE, IWD before the last date & time of opening of technical bid as specified in the bid document)
2	Proof of deposition of processing fee (Form '1')
3	The scanned copy of duly signed Integrity Pact with date and seal
4	Letter of transmittal
5	Certificate of Financial Turnover for the last five years from Chartered Accountant (Form 'A') .
6	Bank Solvency Certificate from a Scheduled Bank (Form 'B') .
7	Networth certificate of minimum Rs. 0000 lacs issued by a certified Chartered Accountant. (Form 'B1') .
8	Details of eligible similar nature of works completed during the last seven years ending previous day of last date of submission of tenders (Form 'C')
9	Details of Projects under execution (Form 'C-1') .
10	Performance report of works referred to in Form 'C' (Form 'D') .
11	Performance report of works referred to in Form 'C-1' (Form 'D1') .
12	Structure & Organisation (Form 'E') .
13	Details of works in progress or works awarded as on the last date of submission of tenders (Form 'F') .
14	Affidavit as per provision of CPWD-6 (Form 'G') .
15	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 Form-'H'
16	Permanent Account Number (PAN) as issued by the Income Tax Department
17	Copy of Registration of the concern department.
18	Copy of EPF & ESIC registration.

Superintending Engineer

SECTION -I

BRIEF PARTICULARS OF THE WORK:

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

SCOPE OF WORK:

The scope of work includes Civil, Public Health Engineering (PHE) works, Internal Electrical works Fire Fighting and HVAC works including Finishing Works, internal water supply, sanitary and electrical Installations, fire protection, fire Alarm & ELV systems, Lifts, air-conditioning, external development, furniture fixture and equipment as follows: -

- A. ARCHITECTURAL SCHEME:** Kotak School of Sustainability has an approx. area of 18446.93 sqm with **Basement + Ground + 5 storey building.**

Sl. No	Description	Area (Sq.m)
1	Basement	670.33
2	Ground Floor	2934
3	Ground Floor Porch	140.9
4	First Floor	2934
5	Second Floor	2904
6	Third Floor	2904
7	Fourth Floor	2904
8	Fifth Floor	2904
9	Mumty	151.70
10	Total Area	18446.93

- The building is designed to achieve a **LEED Platinum** rating.
- Project site situated at North side of the IIT Kanpur Campus (herein after referred to as “Campus”) is approached by 6m wide access road on West side and North side, respectively.
- Lower ground, Podium and part of podium top is utilised as parking for 4w and 2w parking with E.V. changing facility. Laundromat for users is located at parking podium level.
- Building essentially comprises of Offices and Labs on a Built-up area of 18447sqm
- All rooms in built form are well lit and with useful daylight.
- Aluminium windows are with multitrack to accommodate mosquito net and high-performance glass.
- Roof tops are provided with semi shade area covered with solar panels.
- Accessibility to the building is proposed considering the differently abled via adequate ramps and elevators. The main access to the building is from the Ground floor connected via a stair and ramp.

- Building is serviced by four staircases.
- Staircases accessible from Basement to Ground to 5th floor & Terrace opening out to the exterior at the Ground level.
- **There are 02 elevators for passengers (13 PAX) and 1 No. elevator for Services (2 Ton capacity).**
- Dedicated restrooms have been provided as per the statutory by-laws for Male & Female.
- The Underground water tank along with the pump room is located in the Basement.
- Terrace floor comprises of Overhead water tanks for Fire, Flushing & Domestic water supply, Lift machine rooms with required access and Solar Panels shall also be provided on the terrace.
- Internal electrification of the building is with Bus bar in the shaft and Distribution cable for the floor levels, panels, Distribution Boards etc.
- The Other services include Firefighting system, Lifts, Sprinkler system, Public Address system and Fire Alarm system as per Fire NoC.
- All Doors Powder coated Hollow metal fire rated doors insulated/ un-insulated as per respective IS for 60/120min integrity as required by code. With all accessories.
- Windows and Window shutters Colour anodized Aluminium extruded sections. Multi track sections to host Shutters with performance glass and one shutter with Aluminium insect wire mesh. As per design.
- Toilets and Lift Walls will be in Red Brick Masonry.

B. CIVIL WORKS:

The scope of work is as follows:

- i. Design, procurement, supply, preparation of shop drawings, fabrication, installation, and construction of architectural, civil, and structural works for school of sustainability.
 - Sub-structure (comprising of footing, raft) as per available Geotech report data and GFC drawings. Superstructure (comprising the beam, Slab, Column, and shear wall).
 - Underground Basement, water tank.
 - Road works and other miscellaneous (equipment foundations) structures.
 - Structural Steel works.
 - Other facilities as shown in the drawings.
 - The designs and drawings as formulated by the Contractor shall be subjected to the approval by consultant.
- ii. Site development works includes:
 - Site clearance works including removal of vegetations and trees etc.
 - Demolition of existing structure (artificial pond) at the location where new structures are proposed.
 - Site grading
 - Temporary fencing for storage and safe working

- Civil works for temporary barricades and scaffolding around existing buildings of required height as per Client before starting construction activity and removing it after completion of construction.
 - Temporary roads.
 - Excavation, soil and sand filling, compaction, backfilling, dewatering, shoring, pipe bedding, disposal of surplus excavated soil and constructing of other civil works as per specifications.
 - The maintenance and repair of damaged Road, landscape, and green area due to vehicle movement and construction activity.
- iii. Construction enabling works includes supply and erection of:
- Plant and machinery
 - Site office
 - Site store complex
 - Temporary workshop and garage
 - Fabrication yard
 - Quality control laboratory
 - Fuel storage area
 - Staff welfare facilities
 - Central documentation facility
- iv. Excavating the areas to the required formation levels and disposing the excavated materials as directed by the Engineer In-Charge/PMC.
- v. Filling the excavated areas with good quality excavated earth or earth brought from outside as directed by the Engineer In-Charge/PMC.
- vi. All tools & tackles, manpower, transportation, and other resources required for executing the job shall be in the scope of the contractor. No extra charges will be paid to the contractor for any tools & tackles, manpower, transportation etc.
- vii. Entire materials intended for use shall be approved by the Engineer-in-charge before its actual use. The rejected material shall be removed immediately from the site of work.
- viii. Before conducting any replacement, renovation, breakdown work, Contractor shall take the prior permission from Engineer-in-charge.
- ix. Contractor must maintain their working area clean and after any maintenance or repair work, garbage / scrap (packing material etc.) disposal shall be the responsibility of contractor only. The Engineer-in-charge has right to stop the work if the contractor fails to improve upon the cleanliness after having been notified.
- x. The Contractor's personnel shall not disclose any information or drawings furnished to him by the client. Any drawings, records and other information's prepared by the Contractor or by the

Client or jointly by both for the execution of the works shall not be disclosed without the prior approval of the Client.

- xi. Timely completion of all the jobs and works shall be the essence of this contract. Contractor should closely monitor each activity and complete the jobs as per the time given by and under the supervision of the Engineer-In-Charge and shall ensure that sufficient manpower is deployed for the same.
- xii. Engineer in charge or his authorized representative can do the inspection of work at any time. If the work is not found satisfactory, Engineer-in-charge reserves the right to take suitable action.
- xiii. The Contractor shall perform all necessary checks, approvals on associated work if required and shall claim no additional payment for the same.
- xiv. In case of unavailability of item mentioned in BOQ, the contractor shall use the item equivalent to specifications mentioned in tender document and shall take prior approval from Engineer-in- Charge before execution.
- xv. Handing over of complete facilities to the satisfaction of Engineer In-charge.

C. PUBLIC HEALTH ENGINEERING WORKS:

General

- The contractor shall execute all Public Health Engineering (PHE) and specialized services per drawings, specifications, and system requirements, ensuring completion to the satisfaction of the Engineer-in-Charge.
- Designs and drawings require consultant approval. The contractor shall provide all necessary manpower, materials, equipment, and incidental works.
- The contractor is responsible for arranging imported equipment and spares.
- The work must meet high engineering standards, ensuring reliability, ease of operation, and maintenance. All necessary accessories for normal operation are included in the scope.
- In case of conflicting requirements, the more stringent standard shall apply.
- Cleanliness, fire safety, and accident prevention must be maintained.
- The contractor must comply with all tender documents, perform necessary checks without extra claims, and seek prior approval for BOQ item substitutions.
- All works must adhere applicable Uttar Pradesh Byelaws and NBC 2016.
- Water supply connection from the campus network with a flushing UGT in the STP area.
- SITC of domestic & flushing water systems, including pumps, panels, piping, and concealed piping restoration.
- Sanitary fixtures to be procured with prior approval based on aesthetics and specifications.
- SITC of soil, waste, and vent pipes, including shaft routing and drainage connectivity.
- SITC of geysers in theme labs and water dispensers in common toilets.
- STP-treated water to flushing tank system, including pumps, panels, piping, and cabling.

- Design & SITC of domestic & flushing transfer pumps, piping up to OHT level, isolation valves, and OHT filling system.
- Excavation, backfilling, pipe protection, supports, and sealing wall openings.
- SITC of drainage chambers, roof rainwater collection, and recharge pit connectivity, with provision for using rainwater in flushing tanks.
- Post-handover, the contractor shall operate and maintain the system as per the tender, including the Defect Liability Period (DLP)

D. ELECTRICAL WORKS:

The scope of electrical works consists of supply, installation, testing & commissioning of: -

- LT Electrical Panels
- LT Power & Control cables & Terminations
- Cable Trays and cable containment system
- Distribution boards with MCB, RCBO etc
- Indoor & outdoor / façade / Landscape Lighting system
- Internal Point Wiring
- Modular Switches and Sockets
- UPS and Batteries
- Earthing system.
- Lightning Protection System
- Elevators
- Roof Top Solar PV System
- EV Charging Stations

E. FIRE FIGHTING WORKS:

The scope of firefighting works consists of supply, installation, testing & commissioning of: -

- Fire Fighting pumps & Booster pumps
- GI piping
- Valves and associated accessories
- Siamese Connection
- Miscellaneous items like Pressure Gauges, air release valves etc.

A detailed Scope of Work is outlined in the Technical Specification document.

F. HVAC Works:

- HVAC System for Staff Area, Lecture Rooms, Laboratories & kitchen area as shown in Tender drawings.
- Fire tower & fire lift well pressurisation

1.1. Definitions

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

- (a) Engineer In-Charge Means the Executive Engineer Institute Works Department (IWD) acting through the Superintending Engineer IWD.

- (b) Bidder Means the individual proprietary firm, firm in partnership, limited company private or public or corporation.
- (c) Year means "Financial Year" unless stated otherwise.
- (d) Composite Work means work includes, in addition to building work, all other construction works and services such as sanitary and water supply, drainage, electrical, mechanical, development works like retaining walls, horticulture, roads and paths, etc.
- (e) Major Works means the construction scope of Civil, Structural, and High Side MEP Works.
- (f) Minor Works means the construction scope of Low Side Mechanical, Electrical, Air-conditioning and Mechanical ventilation works.
- (g) Composite Tender means the Tender for Composite Work which includes the construction scope of Major and Minor Works including any specialised works.

SECTION- II
INFORMATION & INSTRUCTIONS FOR BIDDERS

1.0 General:

The Indian Institute of Technology, Kanpur, is an institution of premier repute, decided to construct "**Construction of building in RCC framed structure having minimum one building of five storied 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 HVAC works (Centralized Air Conditioning system) all executed under single agreement. The five storied building should have firefighting system or lift or Fire alarm system under the said agreement.**

- 1.1** It is a very prestigious and 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.
- 1.2** Letter of transmittal and forms for deciding eligibility are given in Section III.
- 1.3** 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.
- 1.4** The bid should be type- written. The bidder should sign each page of the application.
- 1.5** 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.
- 1.6** 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.

- 1.7** 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.

(i) Three similar works each costing not less than Rs. **2836.80** lacs

OR

(ii) Two similar works each costing not less than
Rs. **4255.20** lacs

OR

(iii) One similar work costing not less than Rs. **5673.60** lacs.

Similar work shall mean works of "Construction of building in RCC framed structure having minimum one building of five storied 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 HVAC works (Centralized Air Conditioning system) all executed under single agreement. The five storied building should have firefighting system or lift or Fire alarm system 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.
3. The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to previous day of last day of submission of tenders.
4. Bidders are advised to submit copy of Agreement / final bill or any other relevant document in support of their proposed completed work (s) which conforms to the definition of similar work.
5. In case of private works, the same shall be supported by TDS certificate (Form 16 and 26AS) for the work(s) under consideration. The executed value of private works shall be supported by corresponding TDS certificates. Bidder has to submit the complete set of As Built drawings and other relevant documents to substantiate the scope and scale of such works certified by the architect.

- (g) Should have had average annual financial turnover of Rs. **2127.60 lacs** on construction works during the last three years ending 31st March 2024.
- (h) 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, 2024
- (i) Should have net worth certificate of minimum 10% of the estimated cost put to tender issued by a certified chartered Accountant with UDIN.

Or

Should have banker's certificate of the amount equal to 40% of the estimated cost put to tender.

7.2 The bidder should have had average annual financial turn Rs. over(gross) of Rs. 2127.60 lacs on Civil/Electrical construction work during the last three consecutive years **balance sheets duly audited by Chartered 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 The bidder should have a Banker's certificate from a commercial Bank for Rs _____ certified by his bankers. (Not required if applicant is a CPWD registered contractor of appropriate class) or the bidder should submit Net worth certificate of minimum 10% of ECPT issued by the certified chartered Accountant (on the format prescribed in form B-1)

- 7.5** Should have the calculated bidding capacity equal to or more than the estimated cost of the work and shall provide the data required in soft copy for calculating the bidding capacity.

The bidding capacity shall be $= (1.5 \times N \times A - B)$, 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.

- 7.6** 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 Bankers certificate in (**Form "B"**) or 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 — Construction of building in RCC framed structure having minimum one building of five storied 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 HVAC works (Centralized Air Conditioning system) all executed under single agreement. The five storied building should have firefighting system or lift or Fire alarm system under the said 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

To:

The SE IWD

Indian Institute of Technology, Kanpur

Sub: Construction of _____ at IIT Kanpur.

Dear Sir,

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

1. I / We, hereby certify that all the statements made, and information supplied in the enclosed form A to I accompanying statements are true and correct.
2. I/We have furnished all information and details necessary for pre-qualification and have no further pertinent information to supply.
3. In case, I / We submit the requisite Banker's certificate, I / We authorize the SE IWD to approach the issued Bank to confirm the correctness thereof.
4. I/We, also authorize SE IWD to approach individuals, employers, firms and corporation to verify our competence and general reputation.
5. I/We, submit the following certificates in support of our suitability, technical knowhow and capability for having successfully completed the following eligible similar works:

Name of work:	Certificate from:

Certificate:

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

Enclosures:

Form A

FINANCIAL INFORMATION AND PROFIT & LOSS STATEMENT

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

Year	2019-20	2020-21	2021-22	2022-23	2023-24	Average annual financial turnover of any best performed 3 years out of the immediate last 5 consecutive financial years
Gross Annual Turnover on Construction works						
Profit/loss						

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(S) Of Bidder(s)

Signature of Chartered Accountant

with Seal

with Seal
Membership No. ICAI

FORM B

FORM OF BANKER'S 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 up to a limit of Rs.....(Rupee -----only).

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

Address and (Signature) for the Bank

NOTE:

1. Banker's certificates should be on letter head of the Bank addressed to tendering authority.
2. In case of partnership firm, certificate should include names of all partners as recorded with the Bank.
3. Solvency certificate should not be more than 6 months old.

FORM B-1

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 01/04/2024 (the relevant date) is Rs 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 (01/04/2024). Unique Document Identification Number (UDIN)"

Signature of Chartered Accountant

Name of Chartered Accountant

Membership No. of ICAI

Date and Seal

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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

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

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

Signature(s) of Bidder(s)

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

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FORM C-2

Calculation of bidding capacity Details of existing commitments and ongoing works.

Sl. No	Name of work / Project and location	Owner/ Sponsoring organization	Contract value (in Cr.)	Date of commencement as per Contract	Stipulated date of completion	Up to date % progress of work	Remaining work in % (100- column 7)	Existing commitment column 4 x column 8/ 100	Name & address/ telephone no. of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10	11

Total (B) =		
Maximum turnover in last seven years	=	Rs.
Updated value of turnover (A) No. of years	=	Rs.
(N)	=	
Bidding Capacity= {[AxNx1.5]-B}	=	

Certificate:

I certify that all the awarded and ongoing works have been included in the above list and that the information given is correct to my / our knowledge and belief.

Signature(s) of Bidder(s)

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FORM D

PERFORMANCE REPORT OF WORKS REFERRED IN FORM 'C'

Sr. No.	Particulars	Details Filled by Bidder
1	Name of Work/Project and Location	
2	Agreement No.	
3	Estimated Cost	
4	Cost of the project done	
i	Tendered Cost:	
ii	Value of work done	
5	Date of start	
6	Date of completion	
i	Stipulated date of completion	
ii	Actual date of completion:	
7.1	Whether case of levy of compensation for delay has been decided or not: Yes/No	
7.2	If decided, amount of compensation levied for delayed completion if any	
8	Amount of reduced rate items, if any	
9	Performance Report:	
i	Quality of Work	Outstanding/ Very Good/ Good / Poor
ii	Financial Soundness	Outstanding/ Very Good/ Good / Poor
iii	Technical Proficiency	Outstanding/ Very Good/ Good / Poor
iv	Resourcefulness	Outstanding/ Very Good/ Good / Poor
v	General behaviour	Outstanding/ Very Good/ Good / Poor

Signature:

(Executive Engineer or Equivalent)

Date:

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

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FORM D1 (FOR INFORMATION)

ASSESSMENT OF QUALITY FOR COMPLETED AS WELL AS ONGOING WORKS

Name of work: -

Date of Inspection: -

Date of submission of the report: -

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

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A. General Observations and Operational Aspects		Yes / No
5	Quality of steel work / aluminium work	
6	Quality of plumbing and sanitary installation	
7	Quality of workmanship	
8	Quality of water proofing	
9	If cladding done, observation on efficiency/ quality of cladding / brick work	
10	Quality of internal electrification work	
11	Quality of DBs, EBDs and panels?	
12	Quality of E&M equipment, panels and feeder pillar.	
13	Quality of fire alarm system/ fire-fighting system	
14	Quality of Air conditioning work.	
15	Quality of Sub-Station based on complete live diagram, capacitor panel, power factor, insulating materials, cleanliness, cable termination, earthing pits, earthing of transformer /DG sets.	
16	Any other aspect (To be elaborated)	

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.

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 AND ORGANISATION

1. Name and address of the bidder:
2. Telephone No./Telex No./Fax No.
3. Legal status of the bidder (Attach copies of original document defining the legal status) i. An individual
ii. A proprietary Firm
iii. Affirm in Partnership
iv. A limited company or Corporation
4. Particulars of registration with various Government bodies (Attach Attested Photocopy) Organisation /Place of Registration no. i. ii.
5. Names and Titles of Directors and Officers with designation to be concerned with this work.
6. Designation of individuals authorized to act for the organization.
7. Has the bidder, or any constituent partner in case of partnership firm, Limited company/joint venture, ever has been convicted by the court of Law? If so, give details.
8. In which field of Civil Engineering Construction and MEP Works the bidder has specialization and interest?
9. Any other information considered necessary, but not included above.

Signature(s) of Bidder(s)

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FORM F PROJECTS UNDER EXECUTION

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

Signature(s) of Bidder(s)

FORM G

PROFORMA OF AFFIDAVIT FOR NOT BLACKLISTING

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.

Signature(s) of Bidder(s)

NOTE:

Affidavit to be furnished on a 'non-Judicial' stamp paper worth Rs 100/- or an authorized Officer of the firm with stamp
Signature of Notary with seal

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

FORM I

Declaration about site Inspection

(By Bidder)

To
The Executive Engineer
IWD,IIT,
Kanpur

Subject:

Dear Sir/Madam,

It is hereby declared that as per terms and conditions of this tender document, I/we the bidder inspected and examined the subject site and its surrounding and satisfy myself / ourselves as to the nature of the ground and sub -soil (so far as is practicable), the forms and the nature of the site. Ourselves before submitting the bid, the accommodation which may require and all necessary information as to risks, contingencies and other circumstances which may influence or affect our bid have been obtained. I/we the bidder shall have full knowledge of the site and no extra charge consequent upon any misunderstanding or otherwise shall be claimed in later date. I/We bidder shall be responsible for arranging and maintaining at own cost all materials, tool & 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 me/ us implies that I/ We have read this notice and all other contract documents and has made myself/ ourselves aware of the scope and specifications of the work to be done and local conditions and other factors having a bearing on the execution of the work.

Sincerely

(Duly authorized signatory of the Bidder)

ANNEXURE- 1

CRITERIA FOR EVALUATION OF THE PERFORMANCE OF CONTRACTORS FOR PRE-ELIGIBILITY

	Attributes		Evaluation				
(a)	Financial strength	(20 marks)					
	(i) Average annual	16 marks		(i) 60% marks for minimum eligibility criteria			
	Turnover			(ii)100% marks for twice the minimum eligibility			
	(In case of Private/Public limited			criteria or more			
	company, the lower of the value			In between (i) & (ii) – on pro-rata basis			
	calculated based on standalone finance						
	statement and consolidated		financial				
	statement value shall be considered.)						
	(ii) Bankers Certificate or 4 marks						
	(iii) Networth Certificate						
(b)	Experience in similar	(20 marks)		(i) 60% marks for minimum eligibility criteria			
	Class of works			(ii) 100% marks for twice the minimum			
				eligibility criteria or more			
				In between (i) & (ii) – on pro-rata basis			
(c)	Performance on works	(20 marks)					
	(Time over run)						
	Parameter Calculation For points			Score		Maximum Marks	
						20	
	If TOR =			1.00	2.00	3.00	>3 .50
	(i) Without levy of compensation			20	15	10	1 0
	(ii) With levy of Compensation			20	5	0	- 5
	(iii) Levy of compensation not decided			20	10	0	0

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.

(d)	Performance of works (quality) as per assessment in Form D-1:		
	Completed works	Ongoing works	Maximum 40 Marks
	(max. 25 marks)	(max. 15 marks)	Total marks assessed

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 from eligible firms/contractors of repute in two bid system (Eligibility cum Technical bid & Financial Bid) for the work of - **Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur**.

1. The work is estimated to cost **Rs. 70,92,00263/-**. 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. **2836.80** lacs
OR
- (ii) Two similar works each costing not less than Rs. **4255.20** lacs
OR
- (iii) One similar work costing not less than Rs. **5673.60** lacs.

Similar work shall mean works of "Construction of building in RCC framed structure having minimum one building of five storied 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 HVAC works (Centralized Air Conditioning system) all executed under single agreement. The five storied building should have firefighting system or lift or Fire alarm system 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.
3. The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated

- from the date of completion to previous day of last day of submission of tenders.
4. Bidders are advised to submit copy of Agreement / final bill or any other relevant document in support of their proposed completed work (s) which conforms to the definition of similar work.
 5. In case of private works, the same shall be supported by TDS certificate (Form 16 and 26AS) for the work(s) under consideration. The executed value of private works shall be supported by corresponding TDS certificates. Bidder has to submit the complete set of As Built drawings and other relevant documents to substantiate the scope and scale of such works duly certified by the architect.
- (b) Should have had average annual financial turnover of **Rs. 2127.6 lacs** on construction works during the last three years ending 31st March 2024.
 - (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, 2024
 - (d) Should have net worth certificate of minimum 10% of the estimated cost put to tender issued by a certified chartered Accountant with UDIN.
- Or
- Should have banker's certificate of the amount equal to 40% of the estimated cost put to tender.
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> & 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 **18 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 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> & 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 before last time and date of submission of bid as notified.

8. This bid is invited in two bid system.

a) Applicant has to deposit earnest money of Rs. 0000000.00 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 shall be submitted in the hard copy to the office of the Superintending Engineer upto 3.00 PM on 19.05.2025.

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.

Online qualification bid documents submitted by intending bidders shall be opened only of those bidders who have deposited Earnest Money, processing fee & Integrity pact.

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 05:00 PM on 19.05.2025.**

8. The bid submitted shall become invalid if:
 - (i) The bidder is found ineligible.
 - (ii) ***The bidder does not deposit original EMD to the office of the Superintending Engineer, IWD IIT Kanpur.***
 - (iii) The bidder does not upload scanned copies of all the documents stipulated in the bid document.
 - (iv) 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
9. 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 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. 0000/-) 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. 0000/-) 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 be 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. 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 Percentage rate contract 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 PERCENTAGE RATE CONTRACT bid.

18.1.2 The financial bid document will include the 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 2023 for PERCENTAGE RATE CONTRACT 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:- Schedule of financial quote

Volume-II – Details of Part C

Volume- III – Drawings for Execution Architectural

- 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 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 Superintending 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.

18.1.13 A. ***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

CPWD-7

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR
INSTITUTE WORKS DEPARTMENT
CENTRAL OFFICE

***Percentage Rate Composite Tender &
Contract for Works***

Tender for the work of: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.

- a. Last date and time of technical and financial bid for online submission of e-tenders is up to **5.00 PM on 16.05.2025**
- b. Time and Date of opening of technical bid in presence of tenders who may be present on **3.30 PM on 19.05.2025** in the office of the Superintending Engineer, IWD, IIT Kanpur.
- c. 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.

2. Percentage Tender and Contract for Works:

I/We have read and examined the notice inviting tender, schedule A, B, C, D, E & F, Specifications applicable, Drawings & Designs, General Conditions of Contract with pre-Bid Clarifications and Amendments up to the last date of submission of tenders, Technical Specifications as per CPWD, General Conditions of the Contract, Special conditions of the Contract, Schedule of Rate & other documents and Rules referred to in the Conditions of the Contract and all other contents in the Tender document for the work “Construction Of Kotak School Of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, HVAC, Development and Landscape Works at IIT Kanpur Campus, Kanpur– 208016”.

- a. I/We hereby tender for the execution of the work specified for the IITK within the time specified in Schedule ‘F’ in accordance in all respect with the specifications, designs, schedule of quantities, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of Contract with amendments up to the last date of submission of tenders and with such materials as are provided for ,by, and in respect of accordance with, such conditions so far as applicable.
- b. We agree to keep the tender open for Ninety (90) days from the date of /extended bid submission and not to make any modification in its terms and conditions.
- c. A sum **of Rs 80,92,003/-** 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.

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- d. If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the said IITK, 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 IITK shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the General Conditions of the Contract.
- e. Further, I/We agree that in case of forfeiture of Performance Guarantee or committing such breach as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.
- f. 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 IITK, then I/We shall be debarred for tendering in IITK in future forever. Also, if such a violation comes to the notice of IITK before date of start of work, SW IWD shall be free to forfeit the entire amount of Performance Guarantee.
- g. I/We hereby declare that I/We shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information /derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

Dated:.....

Signature with stamp of the Bidder:.....

Address:

Postal Address:.....

Position:

Witness Signature:

Witness name and address:

(Blanks to be filled by the Bidder)

Acceptance

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

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

(a)

(b)

For & on behalf of

Signature.....

Dated:

Designation.....

(Blanks to be filled by SE IWD)

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

2.1. Check list:

Bidder shall follow and submit their Bid, indexed, page numbered and checked in the order as per the below Check List indicating the submission (Yes / No, by striking the not applicable). Bidder shall also submit any other specific instructions in the NIT as part of the Bid which shall also be included in the Check List.

Sr. No.	Eligibility and Technical Documents	Submittal status		Page No.
1	Letter of Transmittal (as per Article 4.31.1)	Yes	No	
2	Certified copy of the partnership deed & current address of all the partners of the firm and certified copy of the power of attorney for signing the application/copy of memorandum of Articles of Association duly attested by a Public Notary and certified copy of the power of attorney for signing the application (If applicable) (as per Article 3.43)	Yes	No	
3	Copy of memorandum of Articles of Association duly attested by a public Notary for Limited Company or Corporation (If applicable) (as per Article 5.7.d).			
4	Certificate of Registration for GST and acknowledgement of up-to-date filed return	Yes	No	
5	PAN (Permanent Account Number) Registration	Yes	No	
6	List of Construction Plants and Machinery	Yes	No	
7	List of Technical Staff	Yes	No	
8	Balance sheet for the last three years	Yes	No	
9	Financial Information and Profit & Loss statement certified by CA for the last 5 consecutive balance sheet (as per Article 4.31.2) duly audited and certified by CA (in the Form 'A')	Yes	No	
10	Bank Solvency Certificate (in the Form 'B') or Net Worth Certificate (in the Form 'B-1')	Yes	No	
11	Eligible 'Similar Works' completed during last 7 years (in the Form 'C')	Yes	No	
12	Projects under execution (in the Form 'C-1')	Yes	No	
13	Calculation of bidding capacity with details of existing commitments and ongoing works (in the Form 'C-3')	Yes	No	

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Sr. No.	Eligibility and Technical Documents	Submittal status		Page No.
		Yes	No	
14	Performance Report of Works referred in Form C (in the Form 'D')	Yes	No	
15	Structure & Organisation (in the Form 'E')	Yes	No	
16	Affidavit of 'not blacklisting' (in the Form 'F') on non-judicial stamp paper	Yes	No	
17	Undertaking that the eligible Similar Work(s) have not been executed through another contractor on back-to-back basis(as per Article 4.17) duly signed and stamped	Yes	No	
18	Undertaking for Percentage Tender and Contract for Works(as per Article 5) duly signed and stamped	Yes	No	
19	Submission of signed and stamped all the components of the Tender document (NIT, Schedule of Quantities, General Terms & conditions, Special Terms & Conditions, Additional / Particular Specifications, Approved / Recommended manufacturers and specialised agencies, Performa Schedules including additions, changes, modifications, Record notes of Pre-Bid meeting, addendums and amendments to the Tender, mandatory approvals, Geotechnical, Field and Topographic Survey reports etc) (as per Article 4.30)	Yes	No	
20	Government project supporting documents fulfilling the eligibility criteria (as per Article 4.3d)	Yes	No	
21	HVAC system supporting documents fulfilling the eligibility criteria (as per Article 4.3e)	Yes	No	
22	Integrity Pact duly signed by Bidder	Yes	No	
23	EMD Hardcopy submission	Yes	No	
24	As mentioned in the Similar Works GRIHA / LEED Certificate attached	Yes	No	
25	Any other information necessary to establish contractor's capabilities to complete the envisaged work	Yes	No	

Dated:.....

Signature with stamp of the Bidder:.....

6. CONDITIONS OF THE CONTRACT:

6.1 GENERAL CONDITIONS OF CONTRACT:

The General Conditions of Contract shall be as per the Central Public Works Department (CPWD)- 2023 Construction Works published under the authority of Director General, CPWD, Nirman Bhawan, New Delhi vide Office Memorandum No. DG/ CON / MISC / 30 dated 22-09-2023.

6.2 SPECIAL CLAUSES OF CONTRACT

Definitions

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

1. In the Contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them: -
 - a. The expression works **or work** shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the Contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.
 - b. The **Site** shall mean the land, places on, into or where work is to be executed under the Contract or any adjacent land, path or street or where work is to be executed under the Contract or any adjacent land, path or street which may be temporally allotted or used for the purpose of carrying out the Contract.
 - c. The **Contractor** shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, for the successors of such firm or company and the permitted assignees of such individual, firm or company.
 - d. The **Institute/IITK** means Indian Institute of Technology Kanpur an Autonomous institute of Government of India
 - e. The **Director** means Director of Indian Institute of Technology Kanpur and his successors.
 - f. The **Engineer-in-charge** means the Executive Engineer IWD who shall supervise and be in charge of the work and who shall sign the Contract on behalf of Director IITK as mentioned in Schedule 'F' hereunder.
 - g. Deleted
 - h. The **Architect/ Architectural consultant** means the consulting agency appointed by Institute for comprehensive architectural design of the building.

- i. **Program Management Consultancy (PMC)** means the Agency appointed by IITK to assist him in Pre and Post Award of the Contracts, project Management and day-to-day quality assurance/quality control and supervision of the construction works.
- j. Accepting Authority shall mean the authority mentioned in Schedule 'F' for acceptance of the Tender.
- k. **Excepted Risk** are risks due to riots (other than those on account of Contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the Contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by IITK of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to IITK faulty design of works.
- l. **Market Rate** shall be the rate as decided by the Engineer-in-Charge on the basis of the cost of materials and labour at the site where the work is to be executed plus the percentage mentioned in Schedule 'F' to cover, all overheads and profits, provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the Contractor as per terms of the Contract.
- m. **Schedule(s)** referred to in these conditions shall mean the relevant schedule(s) annexed to the tender documents or the standard Schedule of Rates of the government mentioned in Schedule "F" hereunder, with the amendments thereto issued up to the date of receipt of the tender.
- n. **Institute** means IITK which invites tenders on behalf of Director of Indian Institute of Technology Kanpur as specified in schedule 'F'.
- o. Tendered value means the value of the entire work inclusive of GST component as stipulated in the letter of award.
- p. Date of commencement of work: The date of commencement of work shall be the date of start as specified in schedule 'F' or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document.
- q. GST shall mean Goods and Service Tax Central, State and Inter State

2. Scope and Performance

- a. Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.
- b. Headings and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.
- c. The Contractor shall be furnished, free of cost one certified copy of the Contract documents except standard specifications, Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the tender documents. None of these documents shall be used for any purpose other than that of this Contract.

3. Works to be carried out

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

4. Sufficiency of Tender

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

5. Discrepancies and Adjustment of Errors

The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.

i. In the case of discrepancy between the schedule of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed: -

- a. Description of Schedule of Quantities.
- b. Particular Specifications and Special Conditions, if any.
- c. Drawings.
- d. Specifications of Contracts / CPWD specifications
- e. Indian Standard Specifications of B.I.S.

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

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

6. Signing of the Contract

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

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

- ii. Standard Form as mentioned in Schedule 'F' consisting of:
 - a. Various standard clauses with corrections up to the date stipulated in Schedule 'F' along with annexures thereto.
 - b. C.P.W.D. Safety Code/ Contract Safety Code.
 - c. Model Rules for the protection of health, sanitary arrangements for workers employed by CPWD or its contractors.
 - d. CPWD Contractor's Labour Regulations.
 - e. List of Acts and omissions for which fines can be imposed.

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

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

Note: Construction of Kotak school of sustainability shall be monitored by PMC group, duly appointed by IIT Kanpur.

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PROFORMA OF SCHEDULES (COMBINED FOR MAJOR AND MINOR COMPONENTS) SCHEDULE “A” to “F”

SCHEDULE “A”

Schedule of financial quote in Part D of NIT

SCHEDULE “B”

Schedule of materials to be issued to the Contractor: NIL

SCHEDULE “C”

Tools and Plants to be hired to the Contractor: NIL

SCHEDULE “D”

Extra Schedule for specific requirements/ documents for the work, if any: NIL

SCHEDULE “E”

Reference to General Conditions of Contract: General condition of contract for CPWD-23 for Construction works (with amendments up to previous date of last date of receipt of tender including extension, if any) .

Name of Work:	Construction Of Kotak School Of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.
Estimated Amount:	GRAND Total = <u>70,92,00,263/-</u> (Estimate cost put to Tender)
Earnest Money:	Rs. 80,92,003/-
Performance Guarantee:	5% of estimated cost put to tender
Security Deposit:	2.5% of tendered amount to be deducted from each invoice.

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SCHEDULE “F”

GENERAL RULES & DIRECTIONS

Officer inviting Tender:	Superintending Engineer, IWD, IIT Kanpur (SE IWD)

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. see below:

Definitions:

1.f. Engineer-in-charge:	
For Civil Items of work	Executive Engineer (Civil) , IWD, IIT Kanpur
For Electrical items & Lift items of work	Executive Engineer (Electrical), IWD, IIT Kanpur
For HVAC works	Executive Engineer (HVAC), IWD, IIT Kanpur
1.. Accepting Authority:	SE IWD on behalf of the Board of Governors
1.i Percentage on cost of materials and labour to cover all overheads and profits:	15%
1.m. Standard Schedule of Rates:	Generally, as per Delhi Schedule Rates (DSR) 2023 published by CPWD for Civil and market rate for non-schedule items. Generally, as per Delhi Schedule Rates (DSR), Analysis of Rates and specification published by CPWD. Generally, as per Delhi Schedule Rates (DSR) 2022 published by CPWD for E&M Works and market rate for non-schedule items.
All the above with correction slips upto the last date of submission of tender including extension, if any.	
1.n. Department	Institute works Department, IIT Kanpur
6.ii. Standard CPWD contract Form:	CPWD Form 7 of GCC for CPWD -2023 for construction works(with amendments upto previous date of last date of receipt of tender, including extension, if any) The following condition pertains to GST of clause 33 and 34 of general condition of contracts and corresponding amendments should be read as follows: a) The quoted rates should be exclusive of GST b) The GST as applicable shall be paid extra.
Building Information Modelling (BIM)	The bidder to demonstrate Building Information Modelling (BIM) capabilities. The successful contractor shall submit the Shop Drawings and As Built Drawings as directed by Engineer-in-charge.
3.45 Special Note:	The NIT along with associated documents will be simultaneously uploaded in CPPP portal along with the Prebid queries and responses.
	Contractors and bidders shall make special note of this and ensure that their final bid submission is based on the BOQ and Prebid response on CPP portal only

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CLAUSE 1	
i. Time allowed for submission of Performance Guarantee, Programme Chart (Time and Progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance by IITK:	10 days
ii. Maximum allowable extension with late fee @0.1% per day of the Performance Guarantee amount. beyond the period provided in (i) above:	5 days
CLAUSE 2:	
Authority for fixing compensation under Clause 2:	SE IWD
CLAUSE 2A:	
Incentive for early completion:	Not Applicable

CLAUSE 5:	
Milestones / Bar chart (s) -	As per construction programme on ANNEXURE- II

Schedule of handing over of site reckoned from date of issue of work order	15 Days
Schedule of issue of designs:	7 days after W.O.
Submission of Programme Chart (Time and Progress using PRIMAVERA within a period from the date of start	7 days
Number of days from the date of issue of letter of acceptance / Work Order for reckoning date of start of the work	15 days or date of handing over of the site whichever is later
Clause 5.2	
Nature of hindrance register (either Physical or Electronic)	Physical
Clause 5.4	
Schedule of rate of recovery for delay in submission of the modified programme in terms of the delay days	
Contract Value, more than Rs. 20 Crore	Rs. 50,000/-

Time allowed for execution of work – 18 months

AUTHORITY TO DECIDE:

Extension of time:	DOIP
Rescheduling of Milestones:	SE IWD
Shifting of date of start in case of delay in handing over of site:	SE IWD

CLAUSE 6, 6A:	
Clause applicable (6 or 6A)	6A (only computerized MB)

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CLAUSE 7:	
Gross work to be done together with net payment / adjustment of advances for material collected, if any, since the last such payment for being eligible to Interim payment (As per discretion of Engineer-In-Charge)	Rs. 350 lakhs

CLAUSE 7A
Applicable licenses/ registrations or proof of applying for obtaining labour licenses, registration with EPFO, ESIC and BOCW Welfare Board including Provident Fund Code No. If applicable shall be submitted within a period of 15 days from issue of work order.

CLAUSE 8A	
Authority to decide compensation on account if Contractor fails to submit completion plans: Compensation for failure in submission of completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work is limited to 0.1% of the Tendered Price.	SE IWD

CLAUSE 10A
a. List of minimum testing equipment to be provided by the Contractor at site lab for Civil Works

CLAUSE 10B	
Whether clause 10B (i) shall be applicable:	YES
Whether clause 10B (ii) shall be applicable:	YES

CLAUSE 10C:	Not Applicable
Component of labour expressed as percent of value of work:	Not Applicable

CLAUSE 10CA:	
Whether clause 10CA shall be applicable:	Clause 10CA shall not be applicable and stands deleted

CLAUSE 10CC:	
Clause 10CC to be applicable in the Contract with stipulated period of completion exceeding the period shown in next Column:	Applicable

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

Schedule of component of cement, labour, steel reinforcement bar, fuel and lubricant and other inputs materials etc. for price escalation as under vide CPWD OM no. DG/Construction-2022/336 dated 22.12.2022	
For Civil Component	
Cement component *	10%
Reinforcement steel bars / TMT bars / Structural steel** (including strands and cables) component	20%
Labour component	20%
Civil components of other construction materials	50%
POL (Diesel) component	NIL
Bitumen component	Nil
TOTAL	100%
For E&M Component	
Component of Labour	15%
E&M Component of Construction Materials	85%
Total	100%
* Includes Cement component used in RMC brought at site from outside approved RMC plants, if any	
** Structural steel doesn't include stainless steel.	

CLAUSE 11:	
Specifications to be followed for execution of work: (Enclosed as an Attachment separately for Civil and E&M Works)	As per CPWD Specifications for Civil and MEP works with up-to-date correction slips (Hereinafter termed as CPWD specifications). i. For Civil, Plumbing Works Horticulture & Landscaping: CPWD Specifications- 2019_VOL 01 (July 2019) and updates if any till submission of the Bid and CPWD Specifications- 2019_VOL 02 (July 2019) and updates if any till submission of the Bid. Particular Specifications / Manufacturer specifications and IS Standards for non-scheduled items of CPWD. ii. Electrical works (Part – 1); internal – 2023 & External (Part-II)- 2023, iii. Lift & Escalators (Part – III)- 2003, Amendment No. 1 iv. iv. Wet Riser & Sprinkler System - (Part V) - 2020. v. Substation (Part IV) - 2013, vi. DG Sets (Part VII) - 2013, vii. Fire Detection & Alarm System (Part VI) – 2018 And viii. Relevant IS codes of latest revisions

CLAUSE 12:	
12.2, 12.3 & 12.5	Deviation Limit beyond which clauses 100% 12.2, 12.3 & 12.5 of GCC shall apply (One Hundred percent) for all Sub-Structure Superstructure and E&M Works.

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CLAUSE 16:	
Competent Authority for deciding reduced rates.	SE IWD

CLAUSE 17:	
Defect liability period:	36 months (From the date of certificate or otherwise of completion of work).

Clause 18		
Sl. No.	list of required Mandatory machinery, tools & plants to be deployed by the contractor at site	APPENDIX -III

CLAUSE 19:	
Clause 19 C	
Non- Compliance against deployment of safety Officer by contractor on month-wise basis	
(a) Daily absenteeism of one safety officer upto a maximum of 3 days in a month	Rs 800 per day
(b) For 4 to 7 days absenteeism of one safety Officer in a month	Rs 1200 per day
(c) More than 7 days absenteeism of one safety Officer in a month	Rs 2000 per day

CLAUSE 25:	
Constitution of Dispute Redressal Committee (DRC)	Competent Authority to appoint DRC
DRC shall constitute one Chairman and two members	Director, IIT Kanpur

Place of Arbitration : Kanpur

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 arrenment from the Engineer –in -charge).

CLAUSE 32 (ii):

Requirement of Technical Representative(s) and recovery Rate: -

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Sl. No.	Minimum Qualification of Technical staff	Discipline	Designation of Technical Staff	Minimum Experience (years)	No. Of major & Minor Components	Rate at which recovery shall be made from the Contractor in the event of not fulfilling provision of clause 32 (ii)	
						Figures (in Rs.)	Words
1	Graduate Engineer (Major component)	Civil	Project Manager with degree in major discipline of Engineering	20 years (and having experience of one similar nature of work)	1 no.		
2	Graduate Engineer	Civil, Electrical & Mechanical	Deputy Project Manager	12 Years (and having experience of one similar nature of work)	2+1 No.		
3	Graduate Engineer Or Diploma Engineer	Civil, Electrical & Mechanical	Project / Site Engineer	5 Years OR 10 Years (respectively)	1+1 Nos		
4	Graduate Engineer	QA/ QC	Project Planning/Billing	6 Years	1 No.		
5	Degree in any discipline with Certificate in Safety	Safety	Safety Cum Labour Officer	NA	2 no.		

Note:

Assistant Engineers retired from Government services who are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10-year relevant experience with a reputed company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

Clause 38		
(i)	a. Schedule/statement for determining theoretical quantity of cement, bitumen etc on the basis of Schedule of Rates	Delhi Schedule of Rates 2023 with correction slips up to the last date of receipt of tenders
(ii)	Variations permissible on theoretical quantities:	
	a. Cement	±(plus/minus) 2% (Two percent)
	b. Bitumen for all works	+ (plus) 2.5% (Two-point five percent) only and nil on – (minus) side.
	c. Steel Reinforcement and structural steel sections for each diameter, section and category	+ (plus) 2.0% (Two percent) only and nil on – (minus) side.

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e	d. Paint	As per co-efficient of standard Delhi Analysis of Rate 2023.
	e. Any other item viz fire rated paint etc.	As per manufacturer specification

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ANNEXURE -II

Milestone Chart

Sl. No.	Description of mile stone	Period for completion from date of start	Withheld amount for non-achievement of mile stone.
1	A-Activity Completion of Civil Work: (a)RCC of Foundation upto plinth level B- Activity completion of E&M work: a) Submission of eligibility documents of associate agencies for E&M works as per eligibility condition. (b)Submission of shop / layout drawings for conduits/ equipment's of EI,Fire fighting, Lift, CCTV etc. as required for all E&M services. or Grossvalueofworkdone not less than 5% of the accepted tendered value.	2.5 months	0.5 % of the accepted tendered value.
2	A-Activity completion of Civil Work: (a) RCCslab upto floor level 3 (b) Brickwork upto floor level 1 B-Activity completion of E&M work: (a) Slab conduiting upto floor level 3 (b) Wall conduiting upto floor level 1 (c) Sample lab, toilet and approval other samples of civil ,electrical and HVAC. or Gross value of work done not less than 30 % of the accepted tendered value.	06 months	0.5 % of the accepted tendered value.
3	A-Activity completion of Civil Work: (c) RCCslab upto floor level 6 (d) Brickwork upto floor level 4 B-Activity completion of E&M work: (c) Slab conduiting upto floor level 6 (d) Wall conduiting upto floor level 4 including plastering work. or Grossvalueofworkdone not less than 60% of the accepted tendered value.	09 months	0.5 % of the accepted tendered value.

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4	A-ActivitycompletionofCivilWork: (a) RCCslabuptofloorlevel7, overhead tank machine room complete (b) Brickworkuptofloorlevel7 (c) Internalworki/cflooringuptofloorlevel3 (d) Waterproofingoftoilets,internalplumbing work, upto floor level 6 B-ActivitycompletionofE&M work: (a) Slabconduitinguptolevel 6 (b) Wallconduiting,socketboxesandDBsuptolevel6 (c) Making of holes in toilets, labs/rooms, lift lobby, liftshaft, etc. pressurization, fire fighting andexhaustetc.uptolevel 6 or Grossvalueofworkdonenotlessthan75%of the accepted tendered value.	12 months	0.5 % of the accepted tendered value.
5	A-ActivitycompletionofCivilWork: (a) Internalworki/cflooringuptofloorlevel7 (b) Waterproofingoftoilets,internalplumbing work, upto floor level 7. (c) Brickcobacomplete (d) CompletionofBrickwork (e) Toiletworkincludinginternalplumbingwork,wall tiling work upto level 7 (f) completionofallFlooringwork and finishing up to level 6 B-ActivitycompletionofE&M work: Submission of inspection call at OEM premises for all major materials such as panels, lift, UPS, equipments, cables etc. and any othermaterials as required. (a) Wallconduiting,socketboxesandDBsofallfloors (b) Makingofholesintoilets, labs/rooms,lift lobby,liftshaft,etc.pressurization,fire fighting andexhaustetc.uptoallfloors (c) Wiring,layingofracewayworkcompleted. Or Grossvalueofworkdonenotlessthan 85 %ofthe accepted tendered value.	15 months	0.5 % of the accepted tendered value.
6	Completionofallworksinallrespectincluding testing and commissioning obtaining fire NOC from authorities.	18 months	0.5 % of the accepted tendered value.

Appendix-III

**LIST OF BASIC MINIMUM REQUIRED MACHINERY, TOOLS & PLANTS TO BE
DEPLOYED BY THE CONTRACTOR AT SITE**

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

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24	Vernier Callipers	1 No.
25	Weighing Machine	1No.
26	Earth Compactor	1No.

Superintending Engineer

Appendix -IV SPECIFICATIONS

Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016. 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.

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

Sl. No.	Department	Registered Yes/No	Registration No.	Tendering limits Rs. Lacs	Validity of Registration	Debarred from Tendering Yes/No
1	2	3	4	5	6	7
1.						
2.						
3.						

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

INTEGRITY PACT

The contractor shall download the Integrity Pact, which is a part of tender documents, affix his signature & seal in the presence of a witness and upload the same while submitting the online bids. In absence of duly signed integrity pact the bids shall not be considered for technical evaluation.

Superintending Engineer

PART -B

**GENERAL CONDITIONS AND
MATERIAL AND QUALITY
ASSURANCE**

GENERAL REQUIREMENTS FOR THE TENDER

Name of Work: **"Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016"**

- 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 **18 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 arrange 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.**
- 11 **Steel Reinforcement shall be arranged by the contractor himself.**
- 12 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 evoked as water proofing treatment, plumbing/sanitary work, Aluminium works etc.

- 13 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.
- 14 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.
- 15 The contractor shall submit the running bills in the shape of the computerized 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.
- 16 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

MATERIAL AND QUALITY ASSURANCE

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 elsewhere 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. **Incase of delay in establishment of Lab at site, nonrefundable 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 equipment's specified in the tender.

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 authorized 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.
 - 10 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 2019 Vol. 1 & 2 the higher of the two frequencies of testing shall be adopted.

11 Maintenance of Registers:

- (i) All the register 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.
- 17 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.
- 18 Third party quality control/assurance: Third part 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 timeframe.

ADDITIONAL CONDITIONS FOR CEMENT

- 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.

ADDITIONAL CONDITIONS FOR STEEL REINFORCEMENT

1. 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:

Size of bar	For consignment below 100 tonnes	For consignment over 100 tonnes
Under 10 mm dia bars	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes or part thereof
10 mm to 16 mm dia bars	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16 mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

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 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.
11. If the quantity of steel actually used in the work is found to be more than the theoretical quantity of steel including authorized 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 authorized 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 unauthorized 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:-

Sl. No.	Nominal size mm	Tolerances on the Nominal Mass, percentage
1	Upto and including 10	-8%
2	Over 10 upto& including 16	-6%
3	Over 16	-4%

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, aluminum, glazing, stainless steel, & plumbing work and other specialized 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:

S.No	Description	Defect Liability
(i)	Concrete work	(a) Rectification of structural /superficial/non-structural cracks. (b) Rectification of dampness/leakages/seepage in roof slab/junctions & sunken portion, depressed portion, through RCC slab, vertical ties, bands, walls, base slab, junction of RCC walls with base slab and construction joints of RCC water tanks. (c) Rectification of cracks in girders, beam, slab, column, lintels, vertical ties, plinth bands, lintel bands etc.
(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 bolts, 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 24 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. 000 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. 2000 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 mile stones 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/collected 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 directed.

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-

inCharge.

- 39 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.
- 40 The Contractor shall take all precautions to abide by the environmental related restrictions imposed by any statutory body having jurisdiction in the area as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Contractor, entirely to the satisfaction of the Engineer- in-Charge and disposed at designated places only. No claim what so ever on account of site constraints mentioned above or any other site constraints, lack of public transport, inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of construction machinery spare parts and any other constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Tenderers are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. Nothing extra shall be payable on this account.
- 41 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 co-ordination 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 alongwith 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 an 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.
- (ix) Overhead lifting of heavy materials should be avoided. Barrow wheel and hand-lift boxes should be used to transport materials onsite.
- (x) Tobacco and cigarette smoking should be prohibited onsite.
- (xi) All dangerous parts of machinery are well guarded and all precautions for working

on machinery are taken.

- (xii) 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.
- (xiii) Use of durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
- (xiv) 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.
- (xv) Provide measure to prevent fire. Fire extinguisher and buckets of sand to be provided in fireprone area and elsewhere.
- (xvi) Provide sufficient and suitable light for working during night.
- (xvii) Ensure that measures to protect workers from materials of construction, transportation, storage and other dangers and health hazards are taken.
- (xviii) Ensure that the construction firm/division/company have sound safety policies.
- (xix) 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.
- (xx) 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 $94 + 10 \log_{10} (\text{KVA})$. 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.

- (iii) 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 relating 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 large 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 SI 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 upto 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 percentage rate contract 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 7.00 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.

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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 borne 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.

S.No.	Articles	Quantity
1.	Office Tables	2 Nos.
2.	Office Chairs	2 Nos.
3.	Steel Almirah (Big)	2 Nos.
4.	Visitor chairs	6 Nos.

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 bye-laws 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 Provisional Fire NOC from Fire department is the responsibility of the Architect. The Architect shall obtain approvals relating to building.

Approvals of Final Fire NOC/permission from the fire department shall be obtained by the contractor at his own level.

No.	Details	Remarks
1	Department of Fire services (DFS)	Case is being submitted to DFS. Contractor has to pursue and obtain provisional and final approval from the fire department.

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 casualties. 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
 - iv. 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.

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- 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/agrofibre 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 SI. 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 establishment, 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 by necessary improvement, rectification, replacement up to the complete satisfaction of Engineer-in-charge.

- (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:

- (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

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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.

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

- (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.

	Agenda	a) Progress Status/Statistics v/s program in target.
b)	Completion Outlook.	
c)	Major hold ups/slippages and remedial action.	
d)	Assistance required.	

- e) Critical issues.
 - f) Any decision on queries raised either by Contractor/PMC.
 - g) Anticipated cash flow, financial progress and monthly requirement for next three months.
- (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. 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 may be added by the contractor in the concrete to increase the workability, but the design mix of concrete shall be done, taking into account the admixture proposed. Quality control shall be considered “good” while making design mix for standard deviation. Under no circumstances shall the water cement ratio be increased beyond the permissible limit. The cement content considered for RCC work of grade M-25 is 330kg/cum. If required, extra cement may be used by the contractor to get the desired quality of concrete, which shall be paid extra. But, if the cement consumption increases beyond 360kg/cum of concrete, for M-25 grade concrete, the payment for extra cement shall be restricted as concrete with cement content of 360kg/cum of concrete.

Similarly, the cement content considered for RCC work of grade M-30 and M-35 is 340kg/cum and 350kg/cum respectively. If required, extra cement may be used by the contractor to get the desired quality of concrete of M-30 and M-35 grade, which shall be paid extra. But, if the cement consumption increases beyond 375kg/cum of concrete for M-30 grade concrete, the payment for extra cement shall be restricted as concrete with cement content of 375kg/cum of concrete for M30 grade and similarly if cement consumption increases beyond 395kg/cum of concrete for M-35 grade concrete the payment for extra cement shall be restricted as concrete with cement content of 395kg/cum of concrete.

2. The maximum permitted water cement ratio is 0.50.
3. 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.
4. Steel reinforcement for R.C.C. work shall be Thermo-Mechanically Treated bars of grade Fe500D or higher confirming.
5. 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.

6. 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 borne by the contractor.
7. 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.
8. 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.
9. The standard deviation to be adapted for design mix shall be for "Good" quality control as per IS code 456.
10. 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 along with 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,
6. 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.
 7. Barricading shall be provided as detailed in this tender document.
 8. 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.

Compliances to be made by the agency for obtaining the leed platinum rating of the proposed building.

PART -B2

List of Preferred Makes for Civil Works

The Following Brand Makes/ Manufacturer's Makes Listed Below May Be Used With Prior Approval of the Architect. In Case it is established that any material as listed below is not available in the market, approved equivalent materials and finishes of any other specialized Brand Names/ Manufacture Makes may be used as per approval of the BIPARD Design Consultant. The items are categorized under respective sub head to make it easy to search.		
CIVIL WORKS		
S.No.	Item Description	Make/Brand
A	Cement & Steel	
1	Cement (OPC/PPC/ Portland Slag)	ACC/Ambuja/Ultra Tech/JK/ BIRLA CHETAK, BIRLA UTTAM/ JP
2	Batch Mix Concrete (BMC) / Ready Mix Concrete (RMC)	Ultratech, Lafarge, ACC, RMC India Or The contractor to install his own computerized batching plant of suitable capacity and arrange for Transit Mixers, pumps etc. as per approval of Engineer – In-Charge. Or The RMC shall be procured from the source as approved by Engineer – in Charge. RMC Producing plants of the main Cement producers shall be preferred
3	Reinforcement Steel (TMT Fe 500d/550/550d)	Sail/Tata Steel/Jindal Steel/ RINL/ IISCO
4	Structural Hollow Steels sections/ Tubular section	Tata Steel/JSW/SAIL
5	Rolled Steel sections - beams, Channels, tee, flats, angles, bars(Round, square, hexagonal, bright), etc.	TISCO, SAIL, RINL, IISCO, JSW, JSPL
6	Stone Rubbles & Gravels Approved quarry from(Hard black trap stone)	As approved by EIC
7	Cover /Spacer Block	Conbextra as manufactured by M/s Fosroc Chemicals India Ltd. or equivalent
B	Wall	
1	Exposed Brick Wall	Jay Jalaram Bricks/Pioneer Bricks/Jindal Mechano Bricks
2	AAC Block	Ambuja Cements AAC, Renacon AAC Block, Magicrete AAC Block, Biltech AAC Block, JK Lakshmi AAC Block, Finecrete AAC Block

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C	Paint, Primer, Putty & POP	
1	White Cement/Putty	JK White / Birla /Asian/ Walplast
2	Cement Primer	Nerolac/Bp White (Berger)/Decoprime-Wt (Asian)/White Primer (ICI)
3	P.O.P	Gyproc/USG Boral/SHERA/Trimurti Sundarta Ki Pehchan/as approved by EIC
4	Steel Primer (Red Oxide Zinc Chromate Primer& Pink Primers)	Asian Paints, Nerolac, Berger, ICI
5	1st Quality Paint 1. Acrylic Distemper, 2. Acrylic/ Plastic Emulsion , 3. Synthetic Enamel Paint, 4. Acrylic Exterior Paint, 5. Anti-bacterial Paint	Asian Paints/ Dulux / Nerolac/Berger
6	Anti-Fungal paint (For Operation theatre)	Sika by Liquid Plastic/ Viesmann/ SSK/ TRILUX
7	Anti-Carbonation Paints	SIKA, FOSROC, Pidilite Industries Ltd., BASF, Sunanda Specialty Coating Pvt. Ltd./ MAPEI
8	Water proof Cement paints	Snowcem India Ltd., ICI, Asian
9	Textured Paints -Exterior	Acro Paints/ Unistone/ Spectrum/Heritage, Berger/ Unilite Heritage /Asian Paints
10	Fire Retardant Paint	Nippon Paint/Berger/Asian Paints/Shalimar Paints, Viper FRS 881/ Nullifire/ Berger
11	Epoxy Paint or PU paint	Asian Paints/Berger Paints/IWL india Pvt Ltd./ Nerolac
12	Wall Rendering	MAPEI
D	Floor Finish	
1	Ceramic Tiles: Ceramic /Glazed ceramic/Antiskid ceramic Tiles/Rectified tiles	Nitco/Kajaria / Somany/RAK/Johnson/Vermora/RAK
2	Vitrified Tiles: Vitrified /Glazed Vitrified/Double Charged/ Full body/Antiskid tiles/Rectified tiles	Nitco/Kajaria /Somany/RAK/ Johnson/Vermora/RAK
3	Heat Resistant Tiles	Thermatek or equivalent/ Johnson/Vermora/RAK

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4	Vinyl	Tarkett Floors / LG Floors / Gerflor / Premier Vinyl flooring / Regent / Armstrong
5	Epoxy Flooring	FOSROC, SIKA, Pidilite Industries Ltd., Dr. Beck/Flamafloor, CIBA, HindCon Chemicals Ltd., ICI Dulux/Nerolac / Cico / Sikka / BASF / Berger / MAPEI
6	Exposed brick/Brick Pavers	Jay Jalaram Bricks/Pioneer Bricks/Jindal Mechano Bricks
7	Precast cement concrete Paver blocks / Tiles (All Types)	KK / Uni Stone Products (India) Pvt. Ltd/ Hindustan Tiles/ NITCO/Dura Crete/Basant Beton/Astana
8	Epoxy Terrazo Flooring	MAPEI, NITCO tile
9	Self Levelling Compound	MAPEI
10	Wooden Flooring (Laminates/Engineered wood etc.)	Merino/Pergo/Floor Pan/Wood Brew
E	Roof	
1	Sandwich Puff Panel	JSW/SINTEX or equivalent
2	Pre-coated Galvanized Steel Sheet	Tata Steel/ JSW/Tata Bluescope
F	Ceiling & Panelling	
1	Gypsum board/tile	USG Boral/Shera/Gyproc/India Gypsum/Saint Gobain/Lafarge
2	Calcium Silicate Boards/Tiles	Usg Boral/Shera/Gyproc/ Hilux (Ramco Industries Ltd.)/Aerolite
3	Metal Ceiling (Clip-In and Lay-In)	Armstrong/ Ecotone/Usg Boral
4	Open Cell Ceiling-Metal	Armstrong/Usg Boral/Hunter Douglas
5	Acoustic False Ceiling	Armstrong/ Ecophon/ Top acoustic/ Knauf/Anutone
6	Acoustic Wall Panel	Hera design/ Anutone/ Knauf/Tectum/Ferrari/Barisol/wall track
7	Extruded Polystyrene Board	Styrofoam by DOW Chemicals / Insuboard by Supreme Industries
8	Sound Isolation for roof	Magnum/Anutone/Win Win
G	Wood Work	
1	Block Board & Plywood	Duroply Industries Ltd., Green Ply, Century ply, Merinolam
2	MDF	Duro, Green ply, Century Ply
3	Decorative Laminate	Formica/ Greenlam/ Merinolam/Duro/ Ventura/Century ply
4	Natural Wood Veener	Century ply, Ventura, Greenlam, Duro, Green ply
5	Flush Door	Centuryply, Duro, Archid, Greenply, Greenlam

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H	Doors/Windows (Metal & Misc.)	
a	Aluminium	
1	Aluminium Extruded Profiles	Hindalco/ Jindal/Indal
2	Aluminium Fabricator	AGV fenestration pvt. Ltd., Alufit, Windroz, CEC, Fenesta
b	Miscellaneous Doors	
1	Fire Doors	Navair International Pvt. Ltd./ Godrej/Kutty/Shakti Hormann
2	Lead lined door	Navair International Pvt. Ltd./Leadlined toughwood/ Weatherline
3	RF Shielded Door	ETS Lindgern/ Synchrony Agency/ Huaming EMC India
c	Accessories	
1	Window Turn Handles, Friction Hinges	Ipsa, Dorma, Ebco, Dorma, Hettich, Geze, Kich
2	1. SS Handles, 2. Tower Bolts, 3. Hinges, Aldrop, 4. Floor Stopper, 5. Casement Stay, 6. Safety Chain, 7. Magnetic Door Catcher, 8. Magic Eye, 9. Drawer Glides, 10. Panic Bar/ Push Bar, etc.	Hafele/ Dorma/ Geze/ Hettich/ Kich/Dorset
3	Floor Spring, Patch Fittings For Frameless Doors	Dorma/Hettich/Dorset/Geze/Kich/Hafele
4	Stainless Steel Fire Rated Hardware	Dorma,Geze,Hafele
5	SS Railing/ SS Glass Railing (SS AISI 304 Grade/ SS AISI 316 Grade)	Kich/Ozone
6	Fire door accessories	Briton, Hettich, Geze
7	Door closer	Hardwyn/Godrej/ Dorma/Doorking/Everite/Kitch
8	Neutron Shielded Door	Ray-Ban Engg corp/A-Fabco In/A7L shielding INC/Accurate Radiation Shielding
9	Modular Grab bars and Disabled Hardware	Dorma /D-line/Kich
I	Glass/Mirror	

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1	Hermetically-Sealed Double Insulated Glass	Saint Gobain/Ais Asahi India Glass Ltd./Gsc Trutuf
2	Clear Float Glass/ Toughened Glass/ Frosted Glass	Saintgobain /Ais Asahi India Glass Ltd/ Modiguard
3	Structural Glazing/ Spider Glazing	Dorma/Kalco/Consolidated Group/Alumax India/Domal
4	Glass Film	3M, Llumar
5	Mirror	Saintgobain /Ais Asahi India Glass Ltd/ Modiguard
J	Elevation/External Facade Work	
1	ACP Panels	Alucobong/Alstrong/Aludecor/Alstone
2	GRC Jali	Unistone/ Kuber Fibrostone/Everest Composites/ Birla white
K.1	Adhesive/release agent etc	
1	AAC Block Adhesive	Pidilite/Ferrouscrite/Laticrete/Kerakoll
2	Glue/ Adhesives for Woodwork	Fevicol/Dunlop/Vemicol/ Araldite
3	Release Agent	FOSROC, Pidilite Industries Ltd., BASF, Sunanda Specialty Coating Pvt. Ltd., M/s Adoadditives Technologies Pvt. Ltd.
2	Tile Adhesives	Laticrete/Roffe/Pidilite/Kitcol/Araldite/ MAPEI/Kerakoll
K.2	Sealants	
1	Silicon sealants /Weather Sealant / Structural Glazing Sealant	GE- Silicon / Pidilite / Forsoc / Cico /Dow Corning /Sika/ Wacker/ Becker/ MAPEI
2	Epoxy Grout	Laticrete/Roffe/Pidilite/Kitcol/Araldite/ MAPEI/Kerakoll
3	Silicone Spray	GE- Silicon / Pidilite / Forsoc / Cico /Dow Corning /Sika/ Wacker/ Becker
5	Polysulphide Sealant	Pidilite/Fosroc/Basf/IWL india Pvt Ltd./ Sika/ STP/ MAPEI
6	Fire Seal	Sealz, Alstroflam/ Abacus
7	Fire: Sealant	Birla/ 3M/ Hilti
8	Non-Shrink Grout: /Micro concrete	Fosroc / Sikka/Pidilite or equivalent/ MAPEI
9	Grouting Compound	Bal Endura/ Pidilite/ Laticrete/ Unitile
10	PVC Water Stop Bars	Fixopan, BASF, Fosroc, Syntex
K.3	Waterproofing	
1	Cement Admixture & Curing Compound/ Plasticizer	Pidilite/Fosroc/Basf/IWL india Pvt Ltd./ Sika/ Cico/MAPEI/Kerakoll
2	Waterproofing membranes	Pidilite/Fosroc/Basf/IWL india Pvt Ltd./ Sika/ Cico/MAPEI
3	Damp Proof Material	Ardex Endura, Impermo, Duraseal, STP Ltd.
4	Tarfelt	MAK, Bengal Bitumen, Rishub Petrochemical

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K.4	Anti-termite	
1	Anti-termite Paint	Nocil/Pyramid/Trisul/Montari Industries
2	Anti-Termite Chemical & Wood Preservatives	Thiodon, De-nocil, Bayer, Vam Organic, NOCIL, Hindustan Insecticides, Roffe Construction Chemicals/ Gibraltor/Basf. It should be done by permanent members of IPCA as approved by Engineer-in-Charge.
K.5	Additives	
1	Floor Hardener	Fosroc/Pidilite / SIKA/ Fairmate / BASF/Ardex Endura
K.6	Steel Accessories	
1	Fasteners	Fischer/Hilti/Bosch/Canon
2	HSFG Bolts	Unbrako Precision, Panchsheel Fasteners, Laxmi Precision Fasteners
3	Stainless Steel Clamps	Hilti /Bosch/Fischer/Intellotech Konzept or equivalent
4	Self-Taping Screws	Hilti, Landmark
5	Welding Rod/ Electrodes	ESAB Ferro Speed plus, D&H Norma , Advani-Orlikon, Weld Alloy, Lincoln Industries Ltd., BASF.
K.7	Insulation	
1	Thermal Insulation/ Rockwool / Glass Wool/ Mineral Wool/ Puf	Twiga/Polyglass/Owens Corning
K.8	Expansion Joint	
1	Expansion Joint Board/Shalitex Board	Supreme Industries, SIL FILL or Equivalent/ MAPEI
L	Road Works	
1	Stone Rubbles & Gravels Approved quarry from (Hard black trap stone)	As approved by EIC
2	Bitumen	IOC, HPCL, BPCL, Tiki Tar Industries/ Juno Bitumix Pvt. Ltd
M	Misc	
1	Crash Guard/ Corner Guard	MDD/TSI/LSR/Radius
2	Blinds	Vista/Decorex/Elegant Décor
3	SFRC / RCC Manhole Covers/ Perfect RCC Grating	KK Manholes / SK Precast Concrete/ Advent concreteovision / Daya concrete
4	Terracotta Jaali	Jindal/Nuvcotto/Mahaluxmi BMF Industries Pvt. Ltd.
5	Mud Bricks	Hanuman Contractor/Awdhesh Singh Civil Contractor/Mahendra Singh Civil Contractor
6	False Floor	Pallium Marketing Pvt. Ltd/Hewetson/Tate

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7	Automatic Sliding door	Dormakaba/Ozone
8	Polycarbonate sheet	DPI

PART–B3

1. Proforma (Water Proofing, Aluminium & Bank Guarantee)

**T O BE EXECUTED BY CONTRACTOR FOR REMOVAL OF DEFECTS AFTER
C OMPLETION IN RESPECT OF WATER PROOFING WORKS**

**G UARANTEE BOND FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT
O F WATER PROOFING WORKS**

(TOILETS & BATHROOMS/HAND WASH AREA/UNDER GROUND TANK/OVERHEAD
TANKS/ROOF)

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-

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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 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 work in the said contract recited structurally stable, leak proof and sound material, workmanship, anodizing, colouring, sealing.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect 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 (Three) 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 _____ and _____ by _____ for and on

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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

_____ (Indicate the name of the Bank) (hereinafter referred to as "the Bank") hereby undertake to pay to the

Government an amount not exceeding ₹ _____ on demand by the Government. _____ (only)

2. We _____ do hereby undertake to pay the amounts due and payable

(Indicate the name of the Bank)

under this Guarantee without any demure, 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 (Rupees
not exceeding _____

_____.
_____. 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 shall

(Indicate the name of the Bank)

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. We _____ lastly 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

**The tender drawings uploaded
separately page no from 01 to
124 is part of contract
agreement**

IITK-Kotak School of Sustainability		
Drawing List		
Architectural drawings		
I.	Architecture drawings	
S.no.	Name	Drawing No.
A.1.	Site plan Superimposed	SA-IITK-KSS-AR/01
A.2.	Site plan	SA-IITK-KSS-AR/02
B	Architectural Floor plan	
1	Basement	SA-IITK-KSS-AR/03
2	Ground floor plan	SA-IITK-KSS-AR/04
3	First floor plan	SA-IITK-KSS-AR/05
4	Second floor plan	SA-IITK-KSS-AR/06
5	Third floor plan	SA-IITK-KSS-AR/07
6	Fourth floor plan	SA-IITK-KSS-AR/08
7	Fifth floor plan	SA-IITK-KSS-AR/09
8	Terrace	SA-IITK-KSS-AR/10
9	Mumty terrace	SA-IITK-KSS-AR/11
C	Elevation	
		SA-IITK-KSS-AR/12
		SA-IITK-KSS-AR/13
		SA-IITK-KSS-AR/14
		SA-IITK-KSS-AR/15
		SA-IITK-KSS-AR/16
D	Sectional Elevation	
		SA-IITK-KSS-AR/17
		SA-IITK-KSS-AR/18
		SA-IITK-KSS-AR/19
E	Section	
		SA-IITK-KSS-AR/20
		SA-IITK-KSS-AR/21
		SA-IITK-KSS-AR/22
Structural drawings		
I.	Structural Plans	
S.no.	Name	Drawing No.

A	Plan	
1	Foundation Plan & Detail	SA-IITK-KSS-ST/01
2	Plinth Level Beam Framing Plan	SA-IITK-KSS-ST/02
3	1st Floor Beam Framing Plan	SA-IITK-KSS-ST/03
4	2nd Floor Beam Framing Plan	SA-IITK-KSS-ST/04
5	3rd Floor Beam Framing Plan	SA-IITK-KSS-ST/05
6	4th Floor Beam Framing Plan	SA-IITK-KSS-ST/06
7	5th Floor Beam Framing Plan	SA-IITK-KSS-ST/07
8	Terrace Floor Beam Framing Plan	SA-IITK-KSS-ST/08
Plumbing drawings		
	SERVICE DRAWINGS	
S.no.	Name	Drawing No.
A	WATER SUPPLY PLAN	
1	GROUND FLOOR	SA-IITK-KSS-WS/01
2	FIRST FLOOR	SA-IITK-KSS-WS/02
3	SECOND FLOOR	SA-IITK-KSS-WS/03
4	THIRD FLOOR	SA-IITK-KSS-WS/04
5	FOURTH FLOOR	SA-IITK-KSS-WS/05
6	FIFTH FLOOR	SA-IITK-KSS-WS/06
7	SCHEMATIC DIAGRAM	SA-IITK-KSS-WS/07
B	DRAINAGE	
1	GROUND FLOOR COMBINE LAYOUT	SA-IITK-KSS-DR/01
2	BASEMENT	SA-IITK-KSS-DR/02
3	GROUND FLOOR	SA-IITK-KSS-DR/03
4	FIRST FLOOR	SA-IITK-KSS-DR/04
5	SECOND FLOOR	SA-IITK-KSS-DR/05
6	THIRD FLOOR	SA-IITK-KSS-DR/06
7	FOURTH FLOOR	SA-IITK-KSS-DR/07
8	FIFTH FLOOR	SA-IITK-KSS-DR/08
9	TERRACE	SA-IITK-KSS-DR/09
10	MUMTY TERRACE	SA-IITK-KSS-DR/10
11	TYPICAL DETAIL	SA-IITK-KSS-DR/11
Firefighting drawings		
	SERVICE DRAWINGS	
S.no.	Name	Drawing No.
B	FIRE FIGHTING DRAWINGS	
1	GROUND FLOOR LAYOUT	SA-IITK-KSS-FF/01
2	BASEMENT	SA-IITK-KSS-FF/02
3	GROUND FLOOR	SA-IITK-KSS-FF/03
4	FIRST FLOOR	SA-IITK-KSS-FF/04
5	SECOND FLOOR	SA-IITK-KSS-FF/05
6	THIRD FLOOR	SA-IITK-KSS-FF/06
7	FOURTH FLOOR	SA-IITK-KSS-FF/07

8	FIFTH FLOOR	SA-IITK-KSS-FF/08
9	TERRACE PLAN	
10	SCHEMATIC DIAGRAM	SA-IITK-KSS-FF/09
Electrical drawings		
S.no.	Name	Drawing No.
A	LIGHT LAYOUT (EL- LIGHTING LOOPING & CIRCUITING LAYOUT)	
1	BASEMENT PLAN	SA/IITK/KSS/EL-01
2	GROUND FLOOR	SA/IITK/KSS/EL-02
3	FIRST FLOOR	SA/IITK/KSS/EL-03
4	SECOND FLOOR	SA/IITK/KSS/EL-04
5	THIRD FLOOR	SA/IITK/KSS/EL-05
6	FOURTH FLOOR	SA/IITK/KSS/EL-06
7	FIFTH FLOOR	SA/IITK/KSS/EL-07
8	TERRACE FLOOR	SA/IITK/KSS/EL-08
B	POWER LAYOUT (EL-POWER,UPS LOOPING & CKT LAYOUT)	
1	BASEMENT PLAN	SA/IITK/KSS/EL-09
2	GROUND FLOOR	SA/IITK/KSS/EL-10
3	FIRST FLOOR	SA/IITK/KSS/EL-11
4	SECOND FLOOR	SA/IITK/KSS/EL-12
5	THIRD FLOOR	SA/IITK/KSS/EL-13
6	FOURTH FLOOR	SA/IITK/KSS/EL-14
7	FIFTH FLOOR	SA/IITK/KSS/EL-15
8	TERRACE FLOOR	SA/IITK/KSS/EL-16
C	POWER RACEWAY LAYOUT (EL- POWER RACEWAY LAYOUT)	
1	BASEMENT PLAN	SA/IITK/KSS/EL-17
2	GROUND FLOOR	SA/IITK/KSS/EL-18
3	FIRST FLOOR	SA/IITK/KSS/EL-19
4	SECOND FLOOR	SA/IITK/KSS/EL-20
5	THIRD FLOOR	SA/IITK/KSS/EL-21
6	FOURTH FLOOR	SA/IITK/KSS/EL-22
7	FIFTH FLOOR	SA/IITK/KSS/EL-23
D	CABLE TRAY LAYOUT (EL- CABLE TRAY LAYOUT)	
1	BASEMENT PLAN	SA/IITK/KSS/EL-24
1	GROUND FLOOR	SA/IITK/KSS/EL-25
2	FIRST FLOOR	SA/IITK/KSS/EL-26
3	SECOND FLOOR	SA/IITK/KSS/EL-27
4	THIRD FLOOR	SA/IITK/KSS/EL-28
5	FOURTH FLOOR	SA/IITK/KSS/EL-29
6	FIFTH FLOOR	SA/IITK/KSS/EL-30

E	CCTV TRAY LAYOUT (EL- CCTV & ACS LAYOUT)	
1	BASEMENT PLAN	SA/IITK/KSS/EL-31
2	GROUND FLOOR	SA/IITK/KSS/EL-32
3	FIRST FLOOR	SA/IITK/KSS/EL-33
4	SECOND FLOOR	SA/IITK/KSS/EL-34
5	THIRD FLOOR	SA/IITK/KSS/EL-35
6	FOURTH FLOOR	SA/IITK/KSS/EL-36
7	FIFTH FLOOR	SA/IITK/KSS/EL-37
F	FIRE ALARM LAYOUT (EL- FIRE ALARM, PA & TBS LAYOUT)	
1	BASEMENT FLOOR PLAN	SA/IITK/KSS/EL-38
2	GROUND FLOOR	SA/IITK/KSS/EL-39
3	FIRST FLOOR	SA/IITK/KSS/EL-40
4	SECOND FLOOR	SA/IITK/KSS/EL-41
5	THIRD FLOOR	SA/IITK/KSS/EL-42
6	FOURTH FLOOR	SA/IITK/KSS/EL-43
7	FIFTH FLOOR	SA/IITK/KSS/EL-44
G	ELECTRICAL EL-LIGHTNING ARRESTOR LAYOUT)	
	TERRACE FLOOR	SA/IITK/KSS/EL-45
H	ELECTRICAL POWER SLD LAYOUT FOR ALL FLOORS	SA/IITK/KSS/EL-46
I	ELECTRICAL CCTV SLD LAYOUT FOR ALL FLOORS	SA/IITK/KSS/EL-47
J	DATA SYSTEM SLD LAYOUT FOR ALL FLOORS	SA/IITK/KSS/EL-48
K	EPBAX SYSTEM SLD LAYOUT FOR ALL FLOORS	SA/IITK/KSS/EL-49
L	ELECTRICAL ACCESS CONTROL SLD LAYOUT FOR ALL FLOORS	SA/IITK/KSS/EL-50
M	ELECTRICAL EARTHING SLD LAYOUT	
1	EL-EARTHING SLD LAYOUT PART-1	SA/IITK/KSS/EL-51
2	EL-EARTHING SLD LAYOUT PART-2	SA/IITK/KSS/EL-52
HVAC drawings		
	SERVICE DRAWINGS	
S.no.	Name	Drawing No.
A	HVAC DRAWINGS	

1	BASEMENT	SA-IITK-KSS-AC/01
2	GROUND FLOOR	SA-IITK-KSS-AC/02
3	FIRST FLOOR	SA-IITK-KSS-AC/03
4	SECOND FLOOR	SA-IITK-KSS-AC/04
5	THIRD FLOOR	SA-IITK-KSS-AC/05
6	FOURTH FLOOR	SA-IITK-KSS-AC/06
7	FIFTH FLOOR	SA-IITK-KSS-AC/07
8	FIFTH FLOOR	SA-IITK-KSS-AC/08
9	TERRACE	
10	PIPING SUPPORTING DETAILS	SA-IITK-KSS-AC/09
11	DUCT SUPPORT DETAILS	SA-IITK-KSS-AC/10
12	EQUIPMENT INSTALLATION DETAILS	SA-IITK-KSS-AC/11

PART-B5

**The bill of quantity for civil
work uploaded separately page
no from 01 to 52 is part of
contract agreement**

PART–B6

TECHNICAL SPECIFICATION

TENDER FOR STRUCTURAL & ARCHITECTURAL WORK

TECHNICAL SPECIFICATIONS

1.1 GENERAL:

These specification shall be read in conjunction with the latest, IS specifications In case these specifications are found wanting in any way the relevant C.P.W.D. Specifications shall apply.

1.2 MATERIALS TO BE APPROVED/BEST QUALITY:

All the materials employed in connection with the permanent work, shall be new and the best of its kind. All materials shall be in accordance with these specifications and shall be as approved by the ENGINEER-IN-CHARGE.

1.3 STANDARDS:

Except where otherwise specified and permitted by the Architect, all materials shall conform to the latest edition of Indian standard specification.

1.4 Indian Standards

All relevant Standards as specified elsewhere in this Volume are applicable. Frequency of testing of various materials shall be strictly as per IS codes.

Indian Standards to be followed are:

(1)	IS 269	Specification for Ordinary and low heat, Portland cement.
(2)	IS 383	Specification for Coarse and fine aggregates from natural sources for concrete.
(3)	IS 456	Code of practice for plain and reinforced concrete.
(4)	IS 460 (Part I, II & III)	Specification for test sieves: i) Wire cloth test sieve ii) Perforated plate test sieve iii) Method of examination of test sieve
(5)	IS 516	Method of test for strength of concrete
(6)	IS 1199	Method of Sampling and analysis of concrete.
(7)	IS 1489	Specification for Portland pozzolana cement

(8)	IS 1542	Specification for Sand for plaster
(9)	IS 2116	Specification for Sand for masonry mortars
(10)	IS 2386	Method of test for aggregate concrete. (Part I, II, & III)
		i) Particle size and shape
		ii) Estimation of deleterious materials and organic impurities
		iii) Specific gravity, density, voids, absorption and bulking
(11)	IS 2646	Specification for Integral cement water proofing compound.
(12)	IS 3025	Methods of Sampling and test (Physical and Chemical for Water used in construction
(13)	IS 3068	Specification for Broken brick (burnt clay) coarse Aggregate for use in lime concrete
(14)	IS 4031	Method of Physical test for hydraulic cement (Part i to xii)
(15)	IS 4032	Method of chemical analysis for hydraulic cement.
(16)	IS 6452	Specification for high Alumina cement for structure use
(17)	IS 6909	Specification for super sulphated weather
(18)	IS 7861	Code of practice for extreme weather concreting
		i) Recommended practice for hot weather concreting
		ii) Recommended practice for cold weather concreting
(19)	IS 8041	Specification for Rapid hardening Portland cement.
(20)	IS 8112	Specification for high strength ordinary port land cement.
(21)	IS 9103	Specification for admixture for concrete.
(22)	IS 11433	Specification for one part gun grade
		i) Poly sulphate based joint sealant: general requirements.
(23)	IS 12118 (part I)	Specification for two parts poly sulphate based sealant:
		i) General requirements.
(24)	SP 23	Handbook on concrete mix
(25)	SP 24	Explanatory handbook on Indian Standards code for plain and reinforced concrete (IS 456)
(26)	SP 27	Handbook of method of measurement of building works.
(27)	IS -1200	Mode of Measurement

1.5.1 CEMENT

- 1.5.1.1 Cement shall be ordinary Portland cement/PPC conforming to IS 269 for all purpose. It shall be received in Paper bags of 50 kg and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In no case cement which has been stored over 4 weeks, shall not be used unless tested as per the direction of the
- 1.5.1.2 ENGINEER-IN-CHARGE prior to use in the works.
- 1.5.1.3 Cement shall be stored in such locations so as to prevent deterioration due to moisture dampness. A dry and waterproof shed shall be best suited for this. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 12 bags is permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) & that they permit easy access for inspection and handling.
- 1.5.1.4 The following other types of cement may be used in works if specified or with prior approval of the ENGINEER-IN-CHARGE in writing. Specialist literature shall be consulted for guidance regarding use of these types of cement.
 - 11.5.1.3.1 Rapid hardening Portland cements conforming to IS 8041.
 - 11.5.1.3.2 Portland pozzolana cement conforming to IS 1489.
 - 11.5.1.3.3 High strength ordinary Portland cement conforming to IS 8112.
 - 11.5.1.3.4 High Alumina cements conforming to IS 6452.
 - 11.5.1.3.5 Super sulphated cement conforming to IS 6909.

1.5.2 COARSE AGGREGATE

- 1.5.2.1 Coarse aggregate shall be obtained from natural sources such as stone, gravel etc. crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coating. It shall be free from soft, feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material most of which is retained on 4.75 mm IS sieve.
- 1.5.2.2 Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica shale or similar laminated material neither shall it contain clay, alkali, soft fragments, seashells, organic impurities etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material, which might attack the reinforcement. The maximum quantities of deleterious materials in the coarse aggregate when determined in accordance with IS 2386 Part I and Part II "Method of test for aggregates for concrete" shall not exceed the limits laid down in table 1 of Annexure.
- 1.5.2.3 Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with Para 3.3, 3.4, 3.5 and 3.6 of IS 383.
- 1.5.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS 383. See Table 2 and Table 3 of Annexure.
- 1.5.2.5 Source of aggregate shall be from a Government approved location. It shall be tested prior to the approval of the ENGINEER-IN-CHARGE from an approved testing laboratory. In case available aggregates do not meet certain requirements of IS 383 or any other specification, required processing shall be carried out by the contractor at his cost. No extra cost towards these processes, treatment or combination of both shall be paid. It shall be the duty of the contractor to make sure that aggregate material received by him/her is from Government approved quarries and with fully paid royalties, taxes, duties etc. as may be in force from time to time for respective locations.
- 1.5.2.6 Aggregates shall be stored in such a way that it does not get mixed with mud, grass vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the ENGINEER-IN-CHARGE.
- 1.5.2.7 Coarse aggregate shall have a minimum specific gravity of 2.6 (Saturated surface dry basis). Aggregate below this specific gravity shall not be used without the special permission of the ENGINEER-IN-CHARGE.
- 1.5.2.8 Once a specific source of supply of coarse aggregate is approved; the source shall not be changed without the prior approval of the ENGINEER-IN-CHARGE.

1.5.3 FINE AGGREGATE

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- 1.5.3.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of fine aggregate. The fine aggregate shall conform to following standards.
- I. For plain and reinforced concrete: IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
 - II. Mortar and grout : IS 2116 Specification for sand for masonry mortars.
 - III. For plastering : IS 1542 Specification for sand for plaster (Class A grading)
- 1.5.3.2 Sometimes it is obtained from crushed stone screening but often contains a high percentage of dust and clay. It tends to be flaky and angular. This type produces harsh concrete and should be avoided. Sea sand should not be used unless approved by the ENGINEER-IN-CHARGE. If approved, the required treatment shall be done at the contractor's cost.
- 1.5.3.3 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength of durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.
- i) When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of Annexure.
 - ii) Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious materials is within the permissible limits laid down.
- 1.5.3.4 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS 383 and of Annexure.
- 1.5.3.5 Damp and moist sand increases the volume and is called bulking. Due allowance is to be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III Appendix A. For rough guidance table 5 of Annexure gives the relation between moisture content and percentage of bulking.
- 1.5.3.6 Storing of aggregate shall be as given in Clause 11.5.2.6.

1.5.4 WATER

Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalize, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attach the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements, which produce objectionable stains or deposits. Potable water is generally satisfactory but it shall be tested prior to use in the works.

Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456 are reproduced for ready reference in table 6 of Annexure.

Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under:

- i) Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. Preparation and testing in accordance of IS 516.
- ii) The initial setting time of tests blocks made with proposed cement and water to be used shall not be less than 30 minutes and shall not differ by ± 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water.
- iii) Preparation and testing of block shall be in accordance with IS 4031
- iv) The PH value of water shall not be less than 6 and more than 9.
- v) Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.

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- vi) Water shall be tested and approved in writing by the ENGINEER-IN-CHARGE prior to use in the works.
 - vii) Sea water in concrete shall not be permitted unless specifically approved in writing by the ENGINEER-IN-CHARGE for purpose stated. The ENGINEER-IN-CHARGE under unavoidable circumstances may allow mixing or curing of seawater in concrete construction, which are permanently under seawater.

1.5.5 ADMIXTURE

These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.

Admixtures should be free from chlorides and sulphate, which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it should have no effect on the reinforcement in case of Reinforced Cement Concrete.

Admixtures generally in use are classified as under:

- a) Accelerators
- b) Retarders
- c) Workability agents
- d) Water -repelling agents
- e) Air-entraining agents
- f) Gas-forming agents.

These are manufactured and sold by various companies under brand names. The contractor proposing to use any of them shall submit to the ENGINEER-IN-CHARGE technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

- i) The contractor's proposal shall accompany the following with his request to use admixture.
- ii) The trade name of the admixture, its source and the manufacturer's recommended method of use.
- iii) Typical dosage rates and the possible detrimental effects of under and over dosage.
- iv) Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient, which is a likely cause of corrosion of reinforcement or deterioration of concrete.
- v) The average expected air content of freshly mixed concrete containing an admixture, which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

1.6 CONCRETE

Concrete is prepared by mixing graded aggregate stone along with cement, in a specified proportion. Mixing shall be done by a mechanical mixer. Manual hand mixing shall be permitted in specific cases with the written permission of the ENGINEER-IN-CHARGE on account of small quantity or location or any other reason acceptable.

1.6.1 CEMENT CONCRETE

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be in levelling course under foundations, floors, copings etc. and shall include form work as part of the work.

Reinforced cement concrete shall be at all locations and comprise of form work, reinforcement and concrete.

Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 and are given as ready reference in table 7 of Annexure.

- 1.6.1.1 It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the ENGINEER-IN-CHARGE at least 35 days in advance from the actual pouring of concrete at site in the permanent works. The basic aim of mix design shall be to find the most economic proportion of cement, aggregates and water which will give the desired strength of concrete, proper workability and durability. Also it is important that the mix should be easily worked with the help of equipment available at site. The operations involved at site are, measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS specifications and IS code practice 456, SP 23 and SP 24. Further the contractor should ensure that the minimum cement content per cubic meter of reinforced concrete should not be less than that stipulated in table 23, 24, 25 and 26 of SP 23. For ready reference refer table 8 and 9 of Annexure, but the BOQ shall specify minimum cement content for each item.
- 1.6.1.2 For expected strength of cubes tested on the 28th day the design mix at preliminary test and work site shall be as per table 10 of Annexure. The water cement ratio shall be 0.50 to 0.52. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall be 25 mm to 35 mm depending upon the location and type of work. Higher slump with use of plasticizers shall be permitted.
- 1.6.1.3 Design mix and trial mixes
- 1.6.1.4.1 As stated above in clause 11.6.1.2 the contractor shall submit, at least 5 weeks in advance, to the ENGINEER-IN-CHARGE the mix design that he proposes to use at site. The mix design shall also give basic details (when tested according to IS 1199 and IS 2386 – Part III, 1963) such as.
 - a. Slump
 - b. Bleeding
 - c. Compacting factor
 - d. Vee-Bee time
 - e. Cement required for one cubic meter of concrete.
- 1.6.1.4.2 On receipt of this, the ENGINEER-IN-CHARGE may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site. This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him/her will be fully satisfactory with regards to slump, segregation, bleeding, water –cement ratio and workability. 5 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the ENGINEER-IN-CHARGE. Trial mixes shall be approved provided that average strength of 3 consecutive cubes is not less than that specified and that one out of three may give a value less than specified but limited to a maximum of 90% of the specified strength.

In case the trial mix falls below the above criteria, the ENGINEER-IN-CHARGE shall order fresh trial mixes to be made as before, until the desired strength is arrived at.

This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the ENGINEER-IN-CHARGE may order fresh design mix and trial mixes to be carried out before the same is used at site.

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the contract.

- i. Slump
- ii. Grading of coarse and fine aggregates.
- iii. Silt content of sand.
- iv. Moisture content of coarse and fine aggregates.
- v. Slump test of concrete.
- vi. Concrete cube test.

The contractor shall maintain full records of all above tests in a register.

The format of records shall be prepared in consultation with the ENGINEER-IN-CHARGE and either he or his representative shall have full access to the contractor's laboratory.

The contractor shall include charges for the above work in his rates and no extr whatsoever shall be admissible on this account of designing, testing maintaining laboratory etc.

1.6.2 READY MIX CONCRETE (RMC) will be used for mass concreting work as per the structure design and drawings. However, for small concreting such as individual column, beam, etc, will be cast in situ.

a. CEMENT

- i) The type of cement used for this work shall be **ordinary Portland cement. PPC** may also be used with approval of ENGINEER-IN-CHARGE/Bank if OPC is not available in market and work is suffering due to non-availability of OPC based on approval of ENGINEER-IN-CHARGE.
- ii) Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be re-tested before use.

b. AGGREGATES: Used for concrete shall be in accordance with the requirements of IS 456.Ref. IS 4926:2003 RMC code of practice Clause 4.4

TESTING: A sample taken once for every 2500 bags shall be tested. Tests shall be carried out for Fineness, initial and final setting time, compressive strength (IS: 4031) and the results approved by the Engineer, before use of the cement in permanent works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be in accordance with IS: 35555

The Engineer may specify other forms of sampling and tests including chemical analysis (IS: 4032). If in his opinion the cement is of doubtful quality, the costs of such additional tests shall be borne by the contractors.

In addition to above, the cement shall confirm to standard specifications of Government of M.P & CG PWD/CPWD

c. MIXERS AND VIBRATORS:

- i) For all structural concrete work, the contractor shall provide platform types of weighing machinery of a capacity not less than 200 kg.
- ii) The contractor shall provide concrete mixers (IS:1791)
- iii) Batch type concrete mixers (IS: -2439)-roller APN mixer and vibrators (IS:2505)

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- iv) Concrete vibrators Immersion type (IS:20506)
 - v) Screed-board concrete-vibrators (IS:250)
 - vi) Screed board concrete vibrators (IS:4656)
 - vii) Form-vibrators for concrete supplied by recognized manufacturers.

1.6.3 CONVEYING:

Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation and/or loss of ingredients. In case such segregation occurs invade concrete shall be remarked before being placed in final position. It shall be deposited in final position as early as practicable, but always within a period of 30 minutes after mixing. When initial set has taken place in Concrete before it is placed in final position, such concrete shall be rejected and taken away from the site to a distance and disposed off as ordered by the Engineer's Representative.

1.6.4 GRADE OF CONCRETE:

The Concrete is designated as M-15, M-20, M-25, and M-30 etc. The letter M refers to the Mix and the number represents the characteristic compressive strength in Mpa (Mega Pascal's). Maximum content of cement as per table 5 of IS 456.

TRIAL MIXES:

- a. The Contractor is entirely responsible for the design of Concrete mixes. The design however to be approved by the ENGINEER-IN-CHARGE at least 7 weeks before commencing an concreting in the works and which have been tested in an approved laboratory. A clean dry mixer shall be used and the first batch discarded.
- b. The required average strengths of different grades of concrete at 28 days, for which the mixes shall be designed are specified below:

Grade of Concrete	Characteristic strength at 28 days (MPs)	Target Mean Strength at 7th day (MP)	F'cm (Mpa) at 28 days
M15	15	18	24
M25	20	21	29
M25	25	23	24
M30	30	26	39
M35	35	31	44
M40	40	36	49
M45	45	40	54
M50	50	45	60

The mixes are designed to yield mean strengths (F'cm) greater than the corresponding specified characteristic strengths (F'ck) as indicated in above table. The difference between F'cm and is called the current Margin. The value of the current margin has been set at 9 Mpa for all grades of

concrete. The concrete mixes shall be designed on the basis of required strength, desired workability, the maximum size of aggregate and also upon the various grades of cements as specified in IS 10262-1982. Accordingly the required cement content shall be ascertained. The Contractor may be allowed to use either approved plasticizers or increased cement content to achieve the required strengths at his own cost.

- c. For each grade a total of 18 cubes shall be made. Of these 18 cubes made, not more than 6 may be made on any day and further of the 6 cubes made in one day, not more than 2 cubes, each representing a different batch of concrete shall be tested at the age of 7 & 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with Indian Standards IS: 516. The test shall be carried out in a laboratory approved by the ENGINEER-IN-CHARGE.
- d. If the average strength of the concrete cubes falls below the required strength, fresh preliminary mixes for that grade shall be made as before, until the trial mixes yield cubes of compressive strength at 28 days greater than the required average strength at that age.
- e. Whenever there is a significant change in the quality of any of the ingredients for concrete, the ENGINEER-IN-CHARGE may at his discretion, order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Contractor's account and held to be included in the contract rates,
- f. Before commencing the work, the contractor shall submit to the ENGINEER-IN-CHARGE for approval full details of all preliminary trial mixes and tests.
- g. When the proportions of a concrete mix have been approved by the ENGINEER-IN-CHARGE, the Contractor shall not vary the quality or source of the material or the mix without written approval of the ENGINEER-IN-CHARGE.

1.6.5. CONCRETE CUBE TEST:

Quality of hardened concrete will be certified by the following procedures

- a. The Engineer or his representative shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at point of discharge from the mixer.
- b. From the batches thus selected, 6 concrete cubes shall be made from any single batch, of these 6 cubes may be made from any single batch. Of these 6 cubes thus made, 3 cubes (each cube representing Concrete of different batches) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.
- c. All cubes shall be made, cured, stored, transported and tested in accordance with Indian standards. The tests shall be carried out in a laboratory approved by the Engineer.
- d. At least 6 cubes shall be made on each days concreting until 60 cubes have been made for each grade of concrete. This is in initial period.
- e. After the initial period, subject to the acceptance of the Engineer, the frequency at which the cubes shall be made may be reduced as follows: 1 set of 6 cubes, on each day's Concreting consisting of:
 - i) 1 set for every 10 Cum. or part thereof of concrete for critical structural elements like columns, large cantilevers, plus:
 - ii) 1 set for every 40 Cum. or part thereof for all other elements. If concrete is latched at more than one point simultaneously, the above frequency of making cubes shall be followed at each point of batching.
 - iii) Of the cubes if each set shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days from the day of casting the cubes.

1.6.6 ACCEPTABILITY CRITERIA:

The strength requirement of any particular grade of concrete will be considered satisfactory if the 28 days compressive strengths of individual sets (each set consists of 3 cubes) and of individual cubes satisfy the following requirements:

FOR THE FIRST FIVE SETS:

- a. The average strength determined from any group of three consecutive test cubes exceeds the specified characteristic strength (F'_{ck}) by not less than 0.8.
- b. Only one individual cube test result in any set may fall below the specified characteristic strength provided that this value is not less than 95% of the specified characteristic strength.
- c. Provided that the average strength of any fifteen consecutive cubes exceeds the specified characteristic cube strength by at least 0.9 times the current margin. All the subsequent test results may be considered acceptable if:
 - i) The average strength as determined from any group of three consecutive test cubes exceeds the specified characteristic strength (F'_{ck}) by not less than 0.6 times the current margin.
 - ii) Only one individual cube test result in any set may fall below the specified characteristic strength provided this value is not less than 90 % of the specified characteristic strength.
- d. Whenever a mix is redesigned due to a change in the quality of Aggregate or of cement or for any other reason, it shall be considered a new mix and initially be subject to the acceptability criteria as stated above.. The above specification is based on an assumed standard deviation of 5.5 Mps, and a probability of concrete strengths failing below the desired minimum strength of 1 to 20. In case quality control is very good at site and the cube test results consistently show a standard deviation better than the standard deviation assumed here, the Engineer may in his discretion reduce the required target strength F'_{cm} for any particular grade of concrete, and in the current margin.
- e. If the concrete produced at site does not satisfy the above strength requirements, the ENGINEER-IN-CHARGE will reserve the right to require the Contractor to improve the methods of batching, the quality of the ingredients and redesign the mix with increased cement content if necessary. The Contractor shall not be claimed any extra cost for the extra cement used for the modifications stipulated by the Engineer for fulfilling the strength requirements specified.
- f. It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods and to produce the required concrete conforming to specifications and the strength requirements approved by the Engineer. It is expected that the contractor will have competent staff to carry out this work.
- g. As frequently as the ENGINEER-IN-CHARGE may require, testing shall be carried out in the field for:
 - i) Moisture content of sand
 - ii) Moisture content of Aggregates
 - iii) Silt content of sand.

1.6.7 FAILURE TO MEET SPECIFIED REQUIREMENTS:

- a. If from the cube-test results it appears that some portion of the works has not attained the required strength, the ENGINEER-IN-CHARGE may order that portion of the structure be subjected to further testing of any kind whatsoever as desired by the ENGINEER-IN-CHARGE including, if so desired by him/her, full load testing of the suspected as well as adjacent portions of the structure as specified in the Conditions of contract. Such testing shall be at the contractor's cost. If the strength of concrete in any portion of the structure is lower than the required strength but is considered nevertheless adequate by the ENGINEER-IN-CHARGE so that demolition is not necessary, the Contractor shall be paid a lower rate such lower strength concrete as determined by the ENGINEER-IN-CHARGE.
- b. As frequently as the Engineer's Representative may require, testing shall be carried out in the field for:
 - i) Moisture content of sand
 - ii) Moisture content of Aggregates

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- iii) Silt content of sand
 - iv) Grading of sand
 - v) Slump test of concrete
 - vi) Grading of Aggregates
 - vii) Concrete cube test
- c. The Contractor shall provide and maintain at all times, until the works are completed, equipment and staff required for carrying out these tests at his own cost. The Contractor shall grant the ENGINEER-IN-CHARGE or his representative full access to this laboratory at all times and shall produce on demand complete records of all tests carried out on site. Before concreting commences on any section of the works the contractor shall obtain approval of the ENGINEER-IN-CHARGE or his Representative as regards the form and reinforcement confirming with the drawings. He shall also indicate to ENGINEER-IN-CHARGE in writing and obtain his approval for position of construction joints the ENGINEER-IN-CHARGE or his representative's approval shall not relieve the Contractor of any of his obligations to comply with the provisions of this Specification or contract.

1.6.8 ADMIXTURES:

Approved admixtures and air entraining may be permitted by the Engineer at his discretion provided that the strength requirements are not affected by their use. Any cement saving due to their use will be to the benefit of the EMPLOYER. The admixture will not be paid for separately. (IS 4926: 2003 Ready mix concrete code of practice clause 4.50)

1.6.9 VOLUME, BATCHING WITH WEIGHT CONTROL:

Where volume batching with weight control is specified by the Architect /PMC all measurements of coarse aggregates and water shall be by volume and of cement by the bag, controlled by regular periodic weightings. In order to ensure correct proportioning the following precautions shall be taken.

- a. The contractor shall maintain at site suitable number of platform balances similar to the balance used for weighing luggage at railway platforms, capable of weighing upto 200 kg. To the nearest 100 grams; the balance shall be used for weighing cement bags and occasional boxes of sand and coarse aggregate as specified below.
- b. The Contractor shall provide the mixer operator with standard measures for measuring the water to be used in the mix.
- c. The quantity of water to be added to the mix shall be approved by the ENGINEER-IN-CHARGE or his representative and may be adjusted by him/her as frequently as necessary in order to allow for the moisture content of the sand or coarse aggregate and workability desired. On no account shall the Contractor allow more water to be added to the mix. Concrete containing water in excess of that specified shall be rejected and not allowed for use in the works.
- d. Sand and coarse aggregates shall be measured by volume. The size of measuring boxes or the depth to which they are filled or both shall be adjusted to obtain the correct weight of each material specified by the Engineer for that mix.
- e. Every fifth or tenth measuring box of sand or of coarse aggregate shall be weighed on the balance to ensure that filling of boxes is being uniformly done. Adjustments shall be made from time to time in the amount of each box filled to take into account variations in moisture content and consequent bulking of sand. More frequent weighing of boxes, particularly of sand if found to vary considerably in moisture content and building may be required by the Engineer's representative and shall be done by the Contractor without additional cost.

1.6.9.1. WEIGH BATCHING:

All structural concrete shall be weigh batched. All concrete ingredients except shall be batched by weight using a weigh batcher of an approved make (15:2722 Portable swing weigh batchers for concrete). Batching shall be to an accuracy of not less than 1/2 kg and the batcher shall be test for accuracy of calibration before commencement of the works and at least once a week thereafter or more

frequently if so required by the ENGINEER-IN-CHARGE. For calibration & weighing equipment refer to Annexure of IS 4926: 2003 RMC code of practice.

Water shall be batched by weight or by volume measures as approved by the ENGINEER-IN-CHARGE. The method of batching shall be such as will ensure in accuracy to 0.5 litres or better.

1.6.9.2. PLACING TEMPERATURES:

During extreme hot or cold weather, the concreting shall be done as per procedures set out in IS: 7861, Parts I & II. Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the ENGINEER-IN-CHARGE may in his discretion specify the use of ice must either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case, the Contractor shall not be paid any extra on account of ice and additional labour involved in weighing and mixing etc.

1.6.9.3. TRANSPORTING, PLACING, COMPACTING AND CURING:

- a. Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456. For workability refer to clause 6.2 of IS 4926:2003 RMC code of practice.
- b. All rubbish etc. inside the shuttering and curing of concrete shall be washed out immediately prior to placing of concrete. A layer is placed and separate batches shall follow each other so closely that the succeeding layer shall immediately below have taken initial set. The method of segregation, concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer or his representative. It should be held in position until air bubbles cease to come to the surface and then slowly withdrawn so that the concrete can flow into the space previously occupied by the vibrator. The vibrator shall not be dragged through the concrete nor used to help heaps of concrete to spread out. It may be used vertically, horizontally or at an angle depending on the nature of the work.
- c. To secure even and dense surfaces free from aggregate pocket, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.
- d. A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.
- e. Form vibrators when used shall be clamped to the sides of formwork and shall not be fixed more than 450 mm. above the base of the new formwork and concrete shall be filled not higher than 230 mm. above the vibrator. The formwork must be made serially strong and watertight where this type of vibrator is used. Care must be taken to guard against over vibration especially where the workability or the concrete mix is high since this will encourage segregation of the concrete. All concrete shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground and with water draining there from during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials and other influences that may impair the strength and durability of the concrete.

1.7. CONCRETE AT SITE

- a. Weight batching shall be preferred at site but the ENGINEER-IN-CHARGE may permit designed mix to be converted to volumetric if requested by the contractor on specific grounds. The contractor shall provide required boxes to measure the ingredients of concrete.

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- b. The contractor shall provide concrete batch mixes, vibrators, weigh batches conforming to relevant IS specification. The capacity and number of mixers and vibrators required at site from time to time shall be to the approval of the ENGINEER-IN-CHARGE. No equipment from site shall be removed without the prior written approval of the ENGINEER-IN-CHARGE. The contractor shall also maintain a platform weighing scale of capacity 300 kg with fraction upto 100 Gms at the site.

As directed by the ENGINEER-IN-CHARGE, a weekly or periodic calibration of all machines shall be done and records of these calibrations shall be maintained in a register. Regular maintenance of machinery shall also be carried out on a weekly basis or as directed by the manufacturer of machines.

- c. The mixer shall be run for a minimum period of 2 minutes after all materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency.
- d. The placing temperature of concrete shall not be more than 34° C. If it is more, the ENGINEER-IN-CHARGE may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions:
 - e. Mixers and weight batches shall be painted with white colour
 - f. Aggregate storing bins shall not be exposed to the Sun.
 - g. Water shall be sprinkled on aggregates well before concreting to keep the temperature low.

1.7.1. SHRINKAGE CRACKS

Concreting shall be avoided in very warm weather, if necessary; it shall be covered with damped Hessian within 2 hours of placing of concrete. To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks.

1.7.2. LAYING OF CONCRETE

Concreting shall commence only after form work is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the ENGINEER-IN-CHARGE.

Formwork should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete.

Concrete shall be as gently deposited as is practically possible. In its final position to avoid re-handling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footing, if may be done with the help of a chute Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 meter unless consented to by the ENGINEER-IN-CHARGE. Concrete from wheel barrows shall not be dumped away from the face concrete already in place. It shall be dumped into the face of concrete already in place.

Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.

Columns and walls shall be concreted in the operation to their full height to avoid any horizontal construction joints as far as possible. All slabs, beams, wooden planks and cat-walk shall be provided clear of reinforcement.

Concrete shall be placed in position within 30 minutes from the time it is produced.

Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the ENGINEER-IN-CHARGE.

1.7.3. COMPACTION OF CONCRETE

Concrete shall be thoroughly compacted, as depositing shall proceed by means of suitable vibrators. The vibrators shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over-vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compacting shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

It shall be ensured that the needle vibrators are not applied on reinforcement, which may destroy the bond between concrete and reinforcement. When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

1.7.4. CONSTRUCTION JOINTS

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the ENGINEER-IN-CHARGE. Such joints shall be kept to a minimum. The joints shall be at places where shear forces nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber. It shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

1.7.5. EXPANSION JOINTS

Expansion joints shall be formed and located as detailed in the drawing.

1.7.6. CURING

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the ENGINEER-IN-CHARGE. As said above in Clause 11.7.3, after concrete has begun to harden i.e. about 1 to 2 hours after laying. It shall be protected from quick drying with moist or damped Hessian cloth or any other material approved by the ENGINEER-IN-CHARGE. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp Hessian cloth

for a period of 7 days to keep it moist. For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP 24 shall be followed.

1.7.7. FINISHING

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the ENGINEER-IN-CHARGE shall be consulted prior to start of concreting and his decision in this regard shall be final.

- i) Roof slab shall be troweled even and smooth with a wooden float.
- ii) The surface that will receive plaster shall be roughened immediately.
- iii) Surfaces that will be in contact with any masonry work shall be roughened immediately.
- iv) The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.

1.7.8. INSPECTION AND CORRECTIVE MEASURES

On removal of form work, the surface shall be examined by the ENGINEER-IN-CHARGE. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the ENGINEER-IN-CHARGE's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the ENGINEER-IN-CHARGE in this regard shall be final and binding on all parties. Sagged, bulged, patched, honeycombed work shall stand to be rejected for surface that are exposed, or required fair face finish or decorative textured finish. The ENGINEER-IN-CHARGE may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the ENGINEER-IN-CHARGE these works shall be retained and the cost of repair shall be at the contractor's account.

Cracks observed shall be brought to the notice of the ENGINEER-IN-CHARGE who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Structural Engineer and the following procedure shall be followed:

- i) Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non shrinking cement slurry or as directed by the ENGINEER-IN-CHARGE.
- ii) Cracks developing further and in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian Standard.
- iii) Based on result of the test, the ENGINEER-IN-CHARGE in consultation with the structural engineer shall order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.
- iv) Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.
- v) The decision of the ENGINEER-IN-CHARGE in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

1.7.9. QUANTUM OF CUBES AND TESTING

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes. As per relevant IS code:

Concrete quantity	Number of Samples
Upto 5 Cu.m in a day	1

5 cu.m.to 15 cu.m.	2
15 cu.m.to 30 cu.m.	3
30 cu.m.to 50 cu.m.	4
More than 50 cu.m.	4 + one additional cube per each 50 cu m. or part thereof.

Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

1.7.10. ACCEPTANCE OF WORK

It shall be as given in IS 456, SP 23 and SP 24. The guidance brief is as under Part or element of work shall be deemed to be accepted, provided the results of the 28th day cube testing conform to the stated as under

- a) The average of the three consecutive cube's strength shall not be less than the specified strength.
- b) No individual cube strength shall be less than 90% of the specified strength.
- c) If the individual cube strength exhibits more than 33% of the specified strength, such a cube shall be classified as freak and the criteria in (a) and (b) shall be applied to the remaining two cubes and their acceptability determined.
- d) If the concrete tests fail to meet the acceptance criteria of the minimum strength required for respective grades of concrete, the ENGINEER-IN-CHARGE may take one of the following decisions:
 - i. Instruct the contractor to carry out such additional tests (e.g. core tests, load tests etc) and / or remedial measures to ensure the soundness of the structure at the contractor's expense.
 - ii. Any decision to accept the work shall be entirely at the discretion of the engineer who may a reduction in the rate of the appropriate item.
 - iii. The work will be rejected and any consequential action as needed shall be taken at the contractor's expense including cutting out and replacing a part or whole of the work.

CONCRETING UNDER SPECIAL CONDITIONS

1.8.1. WORK IN EXTREME WEATHER CONDITIONS

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the ENGINEER-IN-CHARGE.

1.8.2. UNDERWATER CONCRETING

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the ENGINEER-IN-CHARGE

1.8.3. CONCRETING IN SEAWATER

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the ENGINEER-IN-CHARGE

1.8.4. CONCRETING IN AGGRESSIVE SOILS AND WATER

Guidelines laid down in 13.4 of IS 456 shall be followed together with the instruction of the ENGINEER-IN-CHARGE

1.8.5. MEASUREMENTS

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- a. All works shall be measured in the decimal system.
- i) Dimensions shall be measured to the nearest 0.01 metre except for thickness of slab which shall be measured to the nearest 0.005 metre.
 - ii) Areas shall be worked out to the nearest 0.01 sq. m.
 - iii) Cubic contents shall be worked out to the nearest 0.01 cu. m.
- All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.
- b. Cement concrete work shall be classified as under:
- i. Concrete cast-in-situ Plain and reinforced
 - ii. Precast concrete Plain and reinforced
 - iii. Pre stressed concrete Cast-in-situ or pre-cast
- c. All concrete, except as hereinafter provided, shall be measured in cubic meters.
- d. The price of concrete shall include ingredient material, mixing, transporting, hoisting to any height and lowering to any depth, pouring or laying, consolidating, leaving pockets, holes and protecting them till the next operation or completion of work, hacking the surface to provide key for further work including cleaning, wetting surface etc. and preparing construction joints as described in Clause 11.7.4 of this section.
- e. Concrete processed in a special manner for any specific purpose, such as cooled, heated, water-proofed, acid-proofed, heat-resistant shall be measured separately.
- f. Admixtures shall be used if necessary at the request of the contractor for workability and the price for that shall deemed to be included in the contractor's quoted price o concrete.
- g. No reductions shall be made for :
- i) Ends of dissimilar materials (for example beams, posts, girders, purlins, corbels and steps) upto 500 sq. cm in section.
 - ii) Opening upto 0.1 Sq.mt.
 - iii) Volume occupied by reinforcement.
 - iv) Volume occupied by drainage, water pipes, conduits, etc. not exceeding 100 sq.cm in cross sectional area.
 - v) Small voids each not exceeding 40 Sq.mt. in section.
 - vi) Small moulds, drip moulds, chamfers, splays, rounded or covered angles, beads,
 - vii) Grooves and rebates upto 10 cm in depth and width.
- h. Expansion joints shall be measured in running metre or sq. m. as the case may be. Price shall include required shuttering, special treatment if any, filler and finishing material as detailed in drawing or the BOQ.
- i. Water proofing of concrete shall be measured separately as an extra over ordinary concrete stating the quantity of water proofing material inliers or kilograms.
- j. Surface treatment shall be measured in square metres stating number of coats and proportioning of water proofing liquid to water.
- k. Cement grouting shall be measured in square metres and the mix specified.
- l. Grouting of holding-down bolts and providing temporary boxing or wedges to form holes shall be enumerated. The mix shall be specified. The price shall include required shuttering, grouting etc.
- m. To keep surface dry while concreting, dewatering due to rains and seepage shall be included in the price of concrete.

Plum Concrete:

Providing and laying plum concrete 1:2:4 with 40% boulders with necessary compaction, vibration, formwork, scaffolding & curing etc. at all levels complete (cement content not less than 185 per Cum and boulder of uniform avg. size 150mm)

1.9. MORTARS

- 1.9.1. Mortars shall be prepared by mixing fine graded aggregate with cement, in the proportion specified for respective items of work as detailed in the BOQ. Mixing of mortars shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the ENGINEER-IN-CHARGE.
- 1.9.2. Mortars shall be specified by proportion only and not by strength, volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 Cu.mt. Boxes shall be of size of 40 x 35 x 25 cm. These shall be marked as mortar mixing boxes by red pain and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.
- 1.9.3. Sand for plaster, masonry, PCC, RCC work at site should be used from Palar (River Sand). However the sand quality must be got approved from ENGINEER-IN-CHARGE for RMC purpose.

1.10. BRICK WORK

1.10.1. MATERIAL

- a) **Sand for Masonry mortars:** Unless otherwise indicated, sand for masonry mortars shall consist of natural sand (generally termed as coarse sand) crushed stone sand or crushed sand or a combination of any of these conforming to IS 2116-1965 specifications for sand for masonry mortars. Sand shall be hard durable, clean and free from adherent coatings and impurities such as iron particles, alkalis, salts, coal, mica shale or similar laminated or other materials exceeding the specified limit. Grading of sand shall be as under

IS Sieve	Percentage passing by weight	
	Unreinforced masonry	Reinforced masonry
4.75 mm	100	100
2.36 mm	90-100	90-100
1.18 mm	70-100	70-100
600micron	40-100	40-100
300 micron	5-70	5-70
150 micron	0.75	0-10

- b) The maximum quantities of clay, fine silt and fine dust in sand shall not be more than 4%. Organic impurities shall be below that obtained by comparison with the standard solution specified in 6-2-2 of IS-2386 (Part II 1983). The coarse / fine sand shall be from approved sources.
- c) Common Burnt clay building bricks (hereinafter termed as bricks shall conform to the requirements laid down in IS-1077-1976 for common burnt clay building bricks. (Average compressive strength not less than 35 Kg/sq.cm.), sub Class-A as per parameters given in the IS regarding edges, dimensions etc. The overall dimensions shall however be as per local practice of moulds. Water absorption after immersion in cold water for 24 hours shall not exceed 20% and grading for efflorescence shall be less than moderate. Bricks shall be free from cracks, flaws and nodules of free lime. Dimension shall be all within tolerance. Under / over burnt bricks and warped bricks shall be totally rejected.
- d) Test check on random samples from each lot of bricks brought at site shall be carried out for compressive strength and water absorption test. Results of these tests duly signed and dated by Contractor; Architect and Project Manager shall be recorded in a separate register which shall be kept with the Project Manager.

1.10.2. Workmanship – Masonry Mortars

a) Preparation of cement mortars:

Mortars shall be of mix as indicated. The mixing specified is by volume. Mixing shall be done in a mechanical mixer. The mortar shall be mixed for at least three minutes after adding of water. Cement mortar shall be freshly mixed for immediate use. Any mortar which has commenced to set shall be discarded and removed from the site.

b) Bond: All brick works shall be built in English bond, unless otherwise indicated. Half brick walls shall be built in stretcher bond. Header bond shall be used for walls curved on plan for better alignment, header bond shall also be used in foundation, and stretchers may be used when the thickness of wall renders use of header impracticable. Where the thickness of footings is uniform or a number of courses, the top course of the footings shall be of headers. For load bearing walls brick courses at DPC level and at all slab levels below the bearings of slab shall be as bricks on edges.

Half or cut brick shall not be used except where it is necessary to complete the bond

Overlap in stretcher bond is usually half brick and is obtained by commencing each alternate course with a half brick. The overlap in header bond which is equally half the width of the brick is obtained by introducing a three quarter brick in each alternate course at quoins. In general, the cross joints in any course of brick work shall not be nearer than a quarter of brick length from those in the course below or above it.

c) Curing: The bricks shall be adequately wet before use and brick work shall be constantly kept wet for at least seven days.

1.10.3. Half brick walls:

- a) The bricks shall be laid in stretcher bond in cement and sand mortar 1:4 (1 cement: 4 coarse sand) or as indicated. The reinforcement shall be 2 Nos. MS round bars or as indicated and as described in section VII steel and iron work. The diameters of bars shall be 6 mm. The first layer of reinforcement shall be used at second course and then at every third course of brick work. The bars shall be properly anchored (minimum 150 mm) at their ends where the portions end or where these walls join with other walls. The inlaid steel reinforcement shall be completely embedded in mortar. Overlap in reinforcement if any, shall not be less than 30 cm. The cover, i.e. the mortar interposed between the reinforcement bars and brick shall not be less than 6 mm. The mortar covering in the direction of joints shall be not less than 15 mm.
- b) 43 Grade/Blended cement may be used for brick masonry and plaster as directed by ENGINEER-IN-CHARGE.

1.11. SOLID BLOCK MASONRY

The blocks of concrete shall be of approved mix to satisfy the crushing strength and water absorption test as per IS: 2185 Part/1979

- i) Crushing strength not less than 50kg/sq cm.
- ii) Water absorption shall not be more than 10%. The finish of blocks shall be fairly good with sharp edges. The mode of measurement shall be as per IS: 2195-Part/1979.
- iii) Size of concrete block shall be 140mmx190mmx390mm for 390mm thick masonry and 90mmx140mmx390mm for 90mm thick masonry.

SECTION – II

1.12. REINFORCEMENT AND FORM WORK

1.12.1. INDIAN STANDARDS

All relevant Standards as specified elsewhere in this Volume are applicable.

Indian Standards to be followed are:

1. IS 226 Specification for structural steel standard quality
2. IS 228 Methods for chemical analysis of steels
3. IS 280 Specification for mild steel wire for general engineering purpose
4. IS 303 Specification for plywood for general purpose.
5. IS 432 Specification for mild steel and medium tensile steel bars and hard drawn
Steel wires for concrete reinforcement.
Part – 1 Mild steel and Medium tensile steel bars
Part – 2 Hard drawn steel wire.
6. IS 456 Code of practice for construction and design of reinforced concrete
7. IS 723 Specification for steel counter sunk head wire nails.
8. IS 808 Dimensions for hot rolled steel beams, channels and angle section
9. IS 814 Covered electrodes for metal arc welding of structural steel.
10. IS 961 Specification for structural steel: high tensile steel bars.
11. IS 1139 Hot rolled M.S. medium tensile steel and high field strength
deformed bars for concrete reinforcement.
12. IS 1387 General requirements for supply of metallurgical materials.
13. IS 1599 Method for bend test for steel products other than sheets, strip, wire and
tube.
14. IS 1608 Method of tensile testing: steel products
15. IS 1730 Dimensions for steel plates, sheets and strip for structural and general
engineering purpose.
Part 1 Plates
Part 2 Sheets
Part 3 Strips
16. IS 1786 Specification for cold worked steel high strength deformed steel bars for
concrete reinforcement (Superseding IS 1139)
17. IS 1977 Specifications for structural steel: ordinary quality.

18.	IS 2062	Specification for structural steel: fusion welding quality.
19.	IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement
20.	IS 3696	Safety Code of scaffolds and ladders: Part 1 Scaffolds Part 2 Ladders
21.	IS 4014	Code of practice for steel tubular scaffolding. (Part 1 & 2)
22.	IS 4082	Recommendation on stacking and storage of construction materials at site.
23.	IS 8989	Safety code for erection of concrete framed structures
24.	IS 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.

1.12.2. REINFORCEMENT

Reinforcement bars used in construction shall be mild steel or medium tensile round bars and high strength deformed bars.

1.12.2.1. M.S. Plain

- a) Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part-I. Steel received shall conform to the following IS with regards to manufacturing and chemical composition.

i) M.S. bar Grade I Steel designation Fe 410-S of IS 226

ii) M.S. bar Grade II Steel designation Fe 410-O of IS 1977

Medium Tensile Steel designation Fe 540 W-HT IS 961 Steel bars

- b) National sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For ready reference of minimum requirements, properties are tabulated in table 11 of the Annexure.

1.12.2.2. Tor Steel

- a) High strength deformed bars for use as reinforced in concrete shall be of grade Fe 415, Fe 500 and Fe 550 conforming to IS 1786.
- b) Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228. Permissible limits shall be as shown in table 12 of the Annexure.
- c) Welding of cold work steel bars in reinforcement shall be permitted as per IS 9417. (Recommendation for welding cold worked steel bars for RCC)
- d) Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerance specified therein.

e) Physical properties

- i. It shall satisfy IS 1599 test for bend and re-bend test in conjunction with IS 226.
- ii. Bond requirements shall be deemed to have been satisfied if it meets clause 4.0 of IS 1786.
- iii. Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786 and reproduced as table 13 of Annexure for ready reference.

1.12.2.3. Quality of Material

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- a) Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387.
 - b) In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacturer, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production / cast to which it applied. Corresponding number or identification mark should be found on the material.
 - c) All reinforcement material shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any foreign deleterious material present on the surface. Cleaning shall be done to the satisfaction of the ENGINEER-IN-CHARGE.
 - d) Each batch brought at site shall be tested prior to use for respective specification / Physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not done, the ENGINEER-IN-CHARGE shall impose a penalty of Rs. 500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.
 - e) Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid corrosion and other contamination. It is advised to follow storage methods as described in IS 4082.

1.12.2.4. Miscellaneous

- a) Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Specially PVC made cover spacers shall be used in the Works. Concrete cover spaces may be permitted by the ENGINEER-IN-CHARGE. Such concrete spaces shall be cast from concrete and not cement mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.
- b) Binding wire shall be 18 gauge annealed wire conforming to IS 280. Binding shall be done as per direction of structural consultant with double wire. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.
- c) Deformed bars for concrete reinforcement and rolled mild steel and medium tensile steel conforming to IS 1139 shall be allowed in construction provided they are approved by the ENGINEER-IN-CHARGE.
- d) Weight of reinforcement per meter shall be as follows:

1	6 mm	0.222 kg/Rmt
2	8 mm	0.395 kg/Rmt
3	10 mm	0.617 kg/Rmt
4	12 mm	0.888 kg/Rmt
5	16 mm	1.578 kg/Rmt
6	18 mm	1.998 kg/Rmt
7	20 mm	2.467 kg/Rmt
8	22 mm	2.984 kg/Rmt
9	25 mm	3.853 kg/Rmt
10	28 mm	4.834 kg/Rmt
11	32 mm	6.313 kg/Rmt
12	36 mm	7.990 kg/Rmt

13	40 mm	9.865 kg/Rmt

1.12.2.5. Fabrication of reinforcement

- a) Reinforcement shall be fabricated as per the drawing. Bending shall be done mechanically with use of machine or if approved with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting. It is important that bending, straightening, cutting etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.
- b) Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the ENGINEER-IN-CHARGE.

1.12.2.5.1. Lapping of bar:

Laps shall be strictly as per the drawing or as directed by the Structural Engineer for general guidance, the following principles shall be followed as given in IS 456.

- a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.
- b) Not more than half of the total bars shall be spliced at a section.
- c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and / or using spirals or closely spaced stirrups around the length of the splice.
- d) Lap splices shall not be used for bars larger than 36 mm diameter, for larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.
- e) Lap length including anchorage value of hooks in flexural tension shall be LD (as defined in 25.2.1 of IS 456) or 30 dia whichever is greater and for direct tension 2 LD or 30 dia whichever is greater. The straight length of lap shall not be less than 15 dia or 20 cm. Where LD is the development length as described in 25.2.1 of IS 456.
- f) When splicing of welded wire fabric is to be carried out, lap splices or wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.
- g) The lap length in compression shall be equal to the development length in compression, calculated as described in 25.2.1 of IS 456 or as specified in drawing but not less than 24 dia.

1.12.2.5.2. Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the ENGINEER-IN-CHARGE.

- a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following.
- b) The diameter of the bars, if the diameters are equal.
- c) The diameter or larger bar, if the diameters are unequal and 5mm more than the nominal maximum size of coarse aggregate (by using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome)
- d) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-third of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.
- e) Where there are two or more rows, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm two third the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

1.12.2.5.3. Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the ENGINEER-IN-CHARGE. The following guidelines are to be observed in the absence of the above.

- a) At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar.
- b) For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.
- c) For longitudinal reinforcing bar in beam, not less than 25 mm, nor less than the diameter of such bar.
- d) For tensile, compressive, shear or other reinforcement, in slab not less than 15 mm, nor less than the diameter of such bar and
- e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.
- f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals; saline atmosphere etc. and the cover shall be 50 mm or more as directed by the ENGINEER-IN-CHARGE.
- g) For concrete members totally immersed in seawater, the cover shall be 40 mm more than specified above (a) to (f). This shall be 50 mm more for periodical immersion in sea water.
- h) Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the ENGINEER-IN-CHARGE. Details given in sub Para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

1.12.2.5.4. Fixing in position

Correctly cut and bent bars shall be accurately placed in position as detailed in the drawing. Unless otherwise specified by the ENGINEER-IN-CHARGE, reinforcement shall be positioned within the tolerance as under:

- a) for effective depth 200 mm or less ± 10 mm
- b) for effective depth more than 200 mm ± 15 mm

But in no case shall the cover be reduced by more than 5 mm of that specified.

There shall be no compromise on cover for foundation work. Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal / of higher grade strength of well cured concrete in use) steel chair spacers, steel hangers, supporting wires, etc. and secured by tying with an annealed binding wire of 16 gauge as approved by the ENGINEER-IN-CHARGE.

Layer of bars shall be separated by precast concrete spacer blocks or spacer bars. Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken to maintain reinforcement in position and keep it clean, throughout the period till it is embedded in the concrete. For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage. Binding wire used shall conform to IS 280.

1.12.2.5.4.1. Welded joints or mechanical connections

- a) Welded joints or mechanical connections in reinforcement may be used but, in all cases, or important connections, tests shall be made to prove that the joints are of the full strength of the connected bars. Welding of reinforcement shall be done in accordance with IS recommendation.

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- b) Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged / disturbed.
 - c) Welding rods used shall conform to IS 814: covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from Work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the ENGINEER-IN-CHARGE.

1.12.2.5.5. Measurements

Reinforcement shall be measured as follows:

- a) Lengths of different diameters of bars actually used included authorized overlaps shall be measured nearest to a centimetre and their weight calculated as given in table 11.12.2.4. shall be used.
- b) Chairs and spacer bars shall not be measured and paid. The contractor shall account for all these in his quoted price.
- c) In case of welded coupled joints, measurement for payment shall be equivalent to the length of overlap, as per design
- d) Price build-up shall include, in addition to cost of material.
- e) Cover blocks of PVC or concrete.
- f) Spacer bars, chairs and unauthorized overlaps (Allowed for convenience)
- g) Cutting, bending, placing and fixing in position.
- h) Binding wire as approved.
- i) Wastage / Rolling margin.
- j) Cleaning of bars.
- k) For purpose of reconciliation, maximum wastage permitted shall be 5% of the actual material used. Balance amount shall be borne by the Contractors.

1.12.3. OPENING/ INSERTS

- a) All required openings and pockets should be provided as detailed in the drawing with Hilti core cutter or sanitary pipes, fire pipes, rainwater pipe and pipes for other services as per project requirement. The contractor shall provide for the required materials, labour, for fixing and supporting during concreting. In his quoted price. It is imperative that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved. All openings/pocket shall be in a correct line and level. After concreting, the openings shall be secured against any accident by proper covering and guardrail and warning notice, if any.
- b) The contractor shall clean and grout the pocket at a later date with a non-shrinking compound added to the grout mix or non-shrinking cement shall be used. It shall be well-cured and protected to correct line and level till handing over.
- c) Inserts are material such as timber, steel, plastic, and dowels. Bolts, locks, brackets, pipes, etc. left in concrete partly or fully embedded to receive connection with foreign member at a later date. These may be fabricated by the contractor or provided by the EMPLOYER as received from specialist, manufacturer, etc. These shall be protected from weathering and damage in course of the construction. The cleaning required after concreting and any treatment such as oiling, greasing or covering with paint etc. shall be carried out by the contractor at his cost.

TECHNICAL SPECIFICATIONS - CIVIL

1.12.4. General:

1.12.4.2 These specifications shall be read in conjunction with the latest, specifications. In case these specifications are found wanting in any way the relevant C.P.W.D. specifications shall apply.

1.12.4.3 Materials to be approved/Best Quality: The whole of the materials, employed in connection with the permanent work, shall be new and of the best of its kind. All materials shall be in accordance with these specifications and shall be as approved by the Architect.

1.12.4.4 Standards:

Except where otherwise specified and permitted by the Architect, all materials shall conform to the latest edition of Indian Standard Specifications.

1.12.4.5 All Specialized work such as Termite treatment, Metal doors and windows, tiling, roof insulation, water and damp proofing, structural steel work, glazing, dropped ceiling, painting, and rendering, road work, all plumbing, sanitary and electrical work, fittings and fixtures and horticulture work etc. shall be got done/fabricated erected/installed by approved specialized agencies.

1.12.6 EARTH WORK

General:

Excavation, Backfilling and Levelling: Excavation shall conform to the limits indicated on the drawings and shall not be made below the levels fixed by the Architects or Consulting Engineer except where rock is encountered or for removal of unstable materials is required and any additional cost for additional offset shall be borne by the contractor. Unless otherwise specified provision for shoring / structuring / packing, pumping, dredging and bailing out water whether subsoil or rain water shall be at the contractors own expense. Rock excavation shall include removal of ledge rock, concrete or masonry structures which required drilling or controlled blasting and boulders larger than half cubic yard in volume where trenches are in deep or bad grounds, the sides of the trenches shall be supported with suitable timbering. Trenches shall be backfilled in selected excavated materials in 200mm layer and carefully rammed and consolidated with addition of water if required, and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement.

1.12.5.1. INDIAN STANDARDS

All relevant Standards as specified elsewhere in this Volume are applicable.

Indian Standards to be followed are:

- a) IS 1498 Classification and identification of soils for general Engineering purpose.
- b) IS 3764 Safety code for excavation Work.
- c) IS 4081 Safety code for blasting and related drilling Operation.
- d) IS 6313 Part –1 Code of practice for anti-termite measures in buildings: constructional measures.
 Part –2 Code of practice for anti-termite measures in buildings: Pre constructional chemical treatment measures.
- e) SP 27 Hand book of method of measurement of buildings works.

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- f) Explosive Rules 1940.

1.12.5.2 SITE CLEARANCE

- a) Prior to the start of any activity of earth work the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of 1 meter above ground level. All rubbish must be removed and stacked at distance of 50 cm outside the periphery of the area clearance or location as decided by the ENGINEER-IN-CHARGE.
- b) The rate of such clearance is to be included in the rate of other earth-work items.

1.12.5.3. SETTING OUT

- a) Bench Marks and Reference Lines shall be finalized by the ENGINEER-IN-CHARGE. The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the ENGINEER-IN-CHARGE prior to commencement of work.
- b) The contractor shall do the setting out with the use of Theodolite or like instruments at site, based on details given to him/her. He shall erect timber profiles, masonry pillars, burjis etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the ENGINEER-IN-CHARGE before the commencement of any work.
- c) The rate for the earth work items shall include expenses for all such work including labour, material and equipment / instruments etc.

1.12.5.4. EXCAVATION IN SOILS

- a) Surface dressing
Trimming of natural ground, excavated surfaces and filled up areas to remove vegetation and / or small inequality not exceeding 15 cm in depth shall be described as surface dressing.
- b) Rough excavation
Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.
- c) Trenches for pipes / cables
It shall be detailed with nominal dia of pipe / cable. Required bottom width allowance for concrete foundation for laying pipes, working area, grip require for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in running meter unless otherwise noted in the BOQ.
- d) Post holes
Independent post holes (or similar holes) each exceeding 0.5 cu m shall generally be enumerated. Rate shall include return fill, ramming and removal of surplus soil.
- e) General
 - i. The excavated earth shall be thrown or disposed off beyond 50 m periphery of the building. Earth suitable for backfilling shall be stacked separately Subsequent disposal of the surplus and unsuitable material shall be as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawing or as directed by the ENGINEER-IN-CHARGE.
 - ii. In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of steps of 50 cm, at every 2 m depth. This shall be suitably increased or decreased as per site conditions and type of soil met with. This shall be to the approval of the ENGINEER-IN-CHARGE. Sloping of sides also may be adopted.

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- iii. The bed of trenches shall be firmly consolidated and levelled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the ENGINEER-IN-CHARGE. Cost of digging and filling with concrete shall be paid extra if excavation and PCC is measured separately.
 - iv. If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account.
 - v. Excavated trenches shall have to be approved by the ENGINEER-IN-CHARGE prior to laying of PCC or any other Permanent Work.
 - vi. Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and gradient. Filling for excess excavation shall be done at the contractor's cost in consultation with the ENGINEER-IN-CHARGE.
 - vii. Excavated materials shall not be placed within 1 m of the edge of the trench or half the depth of the trench, whichever is more.
 - viii. Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the ENGINEER-IN-CHARGE, appropriate tests shall be carried out by the contractor.

f) Protection

- i. Fencing and / or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.
- ii. Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc must be taken. No excavation should start till such measures are taken to the satisfaction of the ENGINEER-IN-CHARGE. Payments for such work shall not be made separately unless specified otherwise.

1.12.5.5. EXCAVATION SOFT ROCK

- a) This shall be carried out by crowbars, pickaxes or pneumatic drills or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting. Measurement shall be in cubic meter.
- b) Other general details same as clause (g) and its sub clauses.

1.12.5.6 EXCAVATION IN HARD ROCK (rock is also anticipated as per soil report)

a) General

On meeting hard rock that requires blasting, the contractor shall inform the ENGINEER-IN-CHARGE.

On approval in writing, blasting operation shall start if the contractor feels it necessary and so desires.

- i. The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosive Rules 1940, and as updated. Explosive shall only be procured from an authorized dealer. He shall be responsible for the safe custody and proper accounting of explosives. The ENGINEER-IN-CHARGE shall have access to the store.
- ii. The contractor shall be responsible for any accident to those working on the site, to the public or to property due to blasting operations.

b) Precautions

- i. Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No. 37 of C.R.C. and I.R.C.A. Road tariff No. 18 shall be adhered to.
- ii. Blasting operation shall be carried out under the supervision of a responsible authorized agent of the contractor. Timings shall be as approved by the ENGINEER-IN-CHARGE in writing. Lunch break will be preferred. The authorized agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall be employing licensed blasters for actual operation.
- iii. All proper precaution for safety shall be taken. All persons shall be moved away to a distance not less than 200m. All entries shall be sealed and red flags displayed at prominent places.

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- iv. Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only with written permission of the ENGINEER-IN-CHARGE.
 - v. The number of charges to be fired and the actual number of shots heard shall be counted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall workmen be allowed to start work. Unexploded charges shall be flooded with water, a new hole drilled and exploded again.
 - vi. The ENGINEER-IN-CHARGE shall be informed about all misfires, their causes and the remedial steps taken.

CLASSIFICATION

1.12.5.7.1 All soils comprising any of the following:

- a) Vegetable or organic soil, turf, sand, silt, loam clay, mud, peat, black cotton soil, soft shale or loose murum.
- b) Any mixture of soils (a)
- c) Mud concrete below ground level.
- d) Generally any material which yields to the ordinary application of pickaxe and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c)
- e) Stiff heavy clay, hard shale, or compacted murrum requiring close application or a grafting tool or pick or both and shovel.
- f) Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300mm.

Soft rock comprising any of the following:

- a) Soling of roads, paths etc and hard core.
- b) Macadam surfaces of any description, (water bound, grouted, tarmac, etc)
- c) Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.
- d) Soft conglomerate, where the stones may be detached from the matrix with picks, crow which may be quarried or split with a crowbar.
- e) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.
- f) Unreinforced cement concrete as well as reinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.
- g) Boulders not requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded etc.
- h) Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

Hard rock comprising any of the following

- a) Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.
- b) Reinforced cement concrete.
- c) Boulders bigger than ½ cubic meter requiring blasting.
- d) Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

1.12.5.9 FILLING

- a) Filling shall be done where required with approved quality of earth. It may be from excavation and where possible, cutting and filling shall be done simultaneously to avoid double handling.

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- b) Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 90% consolidation. Consolidation shall be by mechanical rammers or roller of minimum half-ton weight. Where the roller cannot work, wooden or steel rammers of seven to ten kg weight with flat base of 20 sq.cm or 20 cm dia should be used. Labour for ramming shall be at least 1 for every 6 diggers. In embankment or banking, every third layer of earth shall be rolled and consolidated with power roller of minimum eight ton weight.

1.12.5.10 PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking / strutting as required shall be carried out. It shall be the responsibility of the contractor to take steps to prevent slide / collapse. Method of planking / strutting will be largely influenced by the type of soil encountered and as approved by the ENGINEER-IN-CHARGE.

1.12.5.11 DISPOSAL OF SURPLUS EARTH

- a) Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the ENGINEER-IN-CHARGE from time to time. Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the ENGINEER-IN-CHARGE.
- b) Rate for excavation shall include sorting out of useful materials.
- c) All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and confirming to their specification. The constructor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

1.12.5.12 DEWATERING

Bailing or pumping out of water that may have accumulated due to rains, subsoil seepage, tidal waves, or any other means shall be carried on continuously and the area shall be kept dry for the following operations.

- a) Measurements
- b) Concreting or masonry work
- c) Shuttering and reinforcement
- d) Backfilling
- e) Line out
- f) Any other reason deemed fit by the ENGINEER-IN-CHARGE.

1.12.5.13 SAND FILLING

The sand shall be free from any organic and deleterious materials as detailed in I.S. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm. Watered with optimum moisture content and mechanical rammers. Measurement shall be for compacted volume in cubic meters.

1.12.5.14 MEASUREMENT

The following shall not be measured separately and allowance for the same shall be deemed to have been made in description of the main item.

- a) Setting out works, erecting profiles, etc.
- b) Site clearance such as clearing of shrubs, brushwood, small trees not exceeding 30cm in girth measured at one meter above ground.
- c) Unauthorized battering or benching of excavation.
- d) Forming (or leaving) DEAD MEN or TELL-TALES in borrow pits and their removal after measurements.

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- e) Forming or leaving steps in the sides of deep excavation and their removal after measurements.
 - f) Excavations for insertion of planking and strutting.
 - g) Removing slips or falls in excavations.
 - h) Dewatering by bailing or pumping out of water in excavations from rains, sub-soil water, tides undercurrents etc.
 - i) Slings or supporting pipes electric, cables etc met during excavation or while carrying out any other item of work.
 - j) Dressing, trimming of sides, leveling or grading and ramming of bottoms. Soils, soft rocks, hard rocks shall be measured as per SP 27 Part I except for the followings:
 - i. Filling shall be in cubic meter for consolidated volume. The lift shall be considered from made up ground level.
 - ii. Planking and strutting required to be left in position shall be measured separately.
 - iii. The ENGINEER-IN-CHARGE's permission in writing shall have to be obtained for this. In no other case shall payment be made for planning and strutting, if carried out.
 - iv. Lead and lifts shall be as per the BOQ. Post holes, trenches for cables and pipes shall be measured as detailed in clause 5 and clause 4.6 and shall be part of the respective piping, cabling item.
 - v. Excavation shall be paid for in the PCC area, and level shown in drawings or as approved by the ENGINEER-IN-CHARGE. Working space shall not be considered.
 - vi. Back filling of foundation is part of excavation and not paid separately.
 - k) Void percentage considered for computing net quantities shall be
 - i. - Loose Earth 20%
 - ii. - Hard Rock 40%

RUBBLE: The rubble shall be trap, granite, or any other approved stone and shall be sound, hard, tough, durable, dense, clean and free from laminations, soft spots, cracks, decay, weathering and other defects. The stones shall be broken rubble with water absorption as low as possible but not more than 5%.

The shape of the stones shall be regular as can be obtained by quarrying without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stones shall be broken with the smallest dimensions equal to the specified thickness of soling. The length and breadth shall not generally exceed twice its thickness & each stone shall be in one piece for the full depth of soling.

Preparation of sub-grade: All the fillings shall be watered and compacted to get maximum consolidation. All the necessary trimming or filling for the laying of the soling inline and required grade shall be done. The sub grade shall be marked by stakes and strings for the required depth for laying of the soling.

Laying soling: Unless otherwise specified the thickness of the rubble soling shall be 23cm. The stones shall be closely hand packed on the prepared bed with the largest face downwards and in contact with each other. The stones shall break joints as far as possible. The full thickness of soling shall generally be made with one stone only. As the laying of rubble advances, the soling shall be hand packed by wedging and packing with stones of smaller size in the joints of the soling and driving them by crow bars and hammers, etc. so as to fill the voids as completely as possible. Such filling of the interstices shall be carried out simultaneously with the placing in position of the large stones and shall in no case be permitted to lag behind. The soling shall be laid and hand packed true to grade and level. The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the required level.

Consolidating: The soling shall be watered and rammed with wooden rammers of approved weight. Hollows, which appear during ramming, shall be made good with smalls. Ramming and making good shall continue till a closely knit compacted surface conforming to the required levels is obtained. Earth on no account shall be used for making good or blinding purposes and it approved by Executive Engineer, sand or gravel as directed shall be used for blinding purposes. Water shall be lightly sprinkled if required and directed by the Executive Engineer.

Rate to include: apart from others factors mentioned elsewhere in this contract, the contractor's rate quoted shall include for the following:

1.12.6.1 Preparing the sub grade

1.12.6.2 Providing and laying rubble soling, including hand packing

1.12.6.3 Consolidating, watering, ramming and blinding with approved sand gravel as directed.

1.12.6.4 All labour, materials and use of equipments and tools required for carrying out the work, satisfactorily and lead and disposal of material and payment of royalty etc. ensuring complete work being Item rate tender, quoted amount by the Tenderer will be treated as final cost for the project.

1.12.6.5 Anti-Termite Treatment

General:

Anti-Termite Treatment shall be as per ISI-6313 (Part II)-1971 and latest revisions AND shall be carried out by an approved specialist agency as approved and directed by the Architect to the following general specifications:

1.12.6.1 Materials:

'CHLOROPYRIPHOS' mollifiable concentrate conforming to IS: 6439-1978 in approved concentration in water emulsion shall be used. Chemicals shall be brought to site of work in sealed original containers. The material shall be brought in at a time in adequate quantity to suffice for Hand operated pressure pump shall be used for uniform spraying of the chemical. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

1.12.6.2 Time of Application:

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor.

1.12.6.3 Treatment of Junction of Wall and Floor:

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, small channel 30 * 30 mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel up to ground level 150 mm apart and the chemical emulsion poured along the channel @ 7.5 liters / Sq.mt of the vertical wall or column surface so as to soak the soil right to bottom. The soil shall be tamped back into place after this operation.

1.12.6.4 Treatment of Soil along External Perimeter of Building:

After the building is complete, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and depth 300 mm and filling these holes with chemical emulsion at the rate of 7.5 liters per Sqmt of vertical surface.

1.12.6.5 Vertical Surface:

In the event of the depth of the wall filling being more than 300 mm, the external perimeter treatment shall be extended to the full depth of filling up to the G.L. so as to ensure continuity of the chemical barrier.

1.12.6.6 Horizontal Surface along Perimeter:

Treatment of soil under apron (Plinth Protection) along external perimeter of building, top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion at the rate of 5 liters per Sqmt. Of the vertical surface before the apron is laid. If consolidated earth does not allow the emulsion to soak through, holes up to 50 to 75 mm center both ways may be made with 12 mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

1.12.6.7 Treatment for Expansion Joints:

Anti-termite treatment shall be supplemented by treated through the expansion joint after sub grade has been laid 2 liters per linear meter of expansion joint.

1.12.6.8 Treatment of Soil Surrounding Pipes and Conduits:

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe or conduit for a distance of 150 mm and to a depth of 75 mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 75 mm for distance of over 300 mm from Ground level.

1.12.7.1 Wooden Door Frames

a) Wood :

Wood/Second Class Teak Wood Wherever specified, best quality Wood shall be used for frame work, as approved. Wherever specified, second class teak wood shall be with individual hard and sound knot and shall not be more than 25mm in diameter and the aggregate area of all the knots shall not exceed one percent of the area of the piece. It shall be free from Spongy, brittle, flaky, brashly condition sapwood and borer holes.

b) Steel frames:

As specified in detailed bill of quantities and in conformity with relevant IS code.

c) Joints:

These shall be of mortise and tendon type, simple, neat and strong. Mortise and tendon joints shall fit in fully and accurately without wedging or filling. The joints shall be glued with approved adhesive, framed, put together and pinned with hardwood or bamboo pins not less than 10 mm dia. After the frames are put together press in position by means of a press.

d) Surface Treatment:

Wood work shall not be painted, oiled or otherwise treated before it has been approved by Engineer. All portions of timber abutting against masonry or concrete or bedded in ground shall be painted with approved bit mastic paint or with boiling coal tar.

e) Fixing in position:

Before the frames are fixed in position these shall be inspected and passed by Engineer. The frame shall be placed in proper position, and secured to walls or columns as the case may be with metallic fastener; iron hold fasts as shown in drawing or as directed by Engineer. These sills shall be embedded sunk in the floor to its full depth. The doorframes without sills, while being placed in position, shall be suitably strutted and wedged in order to prevent warping during construction. The frames shall also be protected from damage, during construction.

1.12.7.2 JOINERY

- a) **Timber:** Timber shall be first class hard wood. The timber shall be of good quality conforming to IS 4021 – 1963, seasoning and treatment shall be done as per IS 1141-1973 and IS 402-1962.
- b) **Plywood:** Shall be BWP grade conforming to IS 710 – 1975.
- c) **Block boards:** Shall conform to IS 1659 – 1969 BWP grade and shall be with 6 mm thick hardwood lipping.
- d) Adhesive used for wood work and joinery work shall conform to IS – 849 – 1957.

1.12.7.2.1 Timber :

Timber for use in unframed clean sawn wood work for wooden plugs, rough grounds fillets or the like shall be first class hard wood.

The surface of wood sections, boards, ply cutting if touching or embedded in walls etc. shall be treated with colourless wood preservative on all surfaces of a approved quality and make. Nails and spikes shall not be used in joinery works, but instead bamboo wood pins of proper size shall be used.

Where length of any member exceeds 3.00 meters, approved type of joint shall be provided without any extra cost.

Timber surface of all carpentry and joinery work shall be wrought and prepared smooth.

Wooden plugs for fixing timber fixture and fittings and the like shall be built into walls. Alternatively fill plugs made out of asbestos cement powder or PVC plugs sleeves shall be used wherever specified.

- 1.12.7.2.2** Vertical members of timber door (cupboard/ cabinets) frames shall be embedded at floor level if indicated. The bottom of shutters shall be 5 mm above the finished floor level.

- 1.12.7.2.3 Door shutters:** All door shutters (internal or external except steel shutters) for al blocks shall be factory made flush door shutters confirming to IS specifications unless otherwise mentioned in the nomenclature of the respective item. Door shutters shall be of the following specifications.

- a) Phenol formaldehyde synthetic resin conforming to BWP types specified in IS- 848-1974.
- b) Contractor shall obtain the approval for the name of the manufacturer of the flush door shutters from the Project Manager / Architect before placing the supply order. While asking for the approval, copy of the "Bureau of Indian Standard" letter under which manufacturer has been authorized to mark the product with ISI marking should be attached. Project Manager and Architect before giving the approval shall ensure that the validity date of license has not expired.
- c) **Testing of flush door shutters:** On receipt of the shutters at site the Project Manager or the Architect shall be entitled to get the samples of door shutters tested in any approved laboratory. From each lot

of approximately 500 shutters, one shutter shall be selected at random by the Project Manager / Architect. The balance shutters from the lot shall not be installed until the lab report is received confirming that the sample complies with the requirement of IS. The cost of replacement of the door shutters selected as samples, their transportation to the laboratory and cost of testing by the laboratory shall be borne by the contractor, and shall be deemed to be included in the Item rate rates quoted in Schedule 'A' Part I.

- d) **MS sheet door shutters:** These shall be of size as shown in drawing. These shall be fabricated out of MS tube of 35 x 35, 1.25 mm thick and MS sheet, 16 gauge etc. as per details given in section VII and as shown in drawings.
- e) **Window shutters:** These shall be of standard hollow steel reinforced PVC extruded profile sections with 5.5mm plain float glass, with EPDM gaskets and matching special hardware and fittings as per the manufacturer/fabricator specifications. The shop drawing shall be prepared and submitted by the contractor based on schematic design by the Architect. Unless otherwise mentioned in the nomenclature of the respective item
- f) The bottom of door shutters shall be 5 mm above the finished floor level.
- g) The contractor shall provide one sample piece of each type of shutter for approval and comments of the architect and Project Manager before mass production.

1.12.8.1 Flush Door

1.12.8.1 General:

All flush doors shall be of approved make external quality, laminated full solid core block board construction as per IS:2202 to IS:1959. They shall be faced on each face as required and shall have approved teakwood edge lipping. Block board core stock shall be of approved species of timber, well seasoned and proofed against termites by preservative chemical treatment. Approved laminate of decorative flush doors and block boards adjacent to one another shall be selected so that they match, to the satisfaction of the Architect. Other doors shall be as mentioned in the nomenclature of the respective items

a) Size and Thickness:

Flush door and block boards shall be of the required size and thickness. Flush doors shall be ordered to a size little more in width than shown on the schedule so that after trimming it fits the opening between rebates perfectly.

b) Louvers and Vision Panels:

Where shown in the drawing and schedule flush doors shall be provided with kiln seasoned hardwood louvers to match face laminate or glazed vision panels as per standard manufacturer's details. Size of openings shall be as shown in drawings.

c) Rebating:

In case of double leaves shutters, the meeting of the styles shall be rebated by one third of the thickness of shutter. The rebating shall be either splayed or square type. Where lipping is provided, the depth of lipping at the meeting of styles shall not be less than 35 mm.

1.12.8.2 Fittings

Details of fittings to be provided shall be as per the schedule of fittings shown in the drawings. All fittings shall be heavy duty of approved make.

1.12.8.2.1 Fixing in Masonry Openings:

a) Fixing with Lugs:

- I. Doors, windows and ventilators unit shall not be 'built in' as the work proceeds but opening shall be left out and frames fitted afterwards so that the minimum specified clearance between opening and unit frame is left around. The size of the opening shall first be checked and cleared of obstruction, if any. The position of the unit and fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs not less than 10 cm long 15 x 3 mm size fixed in cement concrete blocks 15 x 10 x 10 cm size of 1:3:6 mix (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size). The frames of units shall be set in the opening by using wooden wedges at the jamb, head and sill, (wedges shall preferably be placed near the points where a glazing bar meets the frames and be plumbed in position)
- II. After it, the frame shall be fixed with the lugs with 20 mm, long and 6.3 mm dia G.I. Counter sunk machine screws and nuts. In case of flush opening which are rendered smooth, wedges shall be removed and gap between unit and jambs shall be filled with cement mortar.
- III. In case of flush jamb with external 'fair faced' finished the gap between the opening and frame shall be filled with mastic from inside till it oozes out on external face. The oozing mastic shall be cleaned and flush pointed. The internal gap shall be filled with mastic to about 1/3 rd depth and the rest with cement mortar.
- IV. In case of rebated and jambs finished 'fair faced' externally the mastic shall be freely applied to the inside channel of frame, jamb and sill, so as to ensure a watertight joint. After the unit is firmly fixed in position surplus mastic shall be cleaned and flush pointed, as shown in drawing.

b) Fixing with Screws and Plugs:

In RCC work where lugs cannot be embedded due to reinforcement bars etc. rawl plugs or other approved of metallic fasteners such as Dash Fasteners of the required size and type as approved shall be used.

1.12.8.3 Rolling Shutters

a) General:

Rolling shutters shall be of best quality and obtained from approved make. These shall include necessary looking arrangement and handles etc. These shall be suitable for fixing in position as specified i.e. outside or below lintel or between jambs of the opening. The door shall be push and pull type and also operated with chain crank as required.

b) Springs:

The springs shall be, preferably of coiled type. The spring shall be manufactured from high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions; the spring pipe shaft etc. shall be supported on strong mild steel brackets.

c) Guide Channels:

The guide channels shall be of mild steel deep channel section and or rolled pressed or built-up construction. The thickness of the sheet used shall not be less than 3.15 mm. The minimum depth of guide channels shall be 60 mm for clear width of shutters up to 3.5m and 75 mm for 3.5 m and above. The gap between the two legs of the guide channel shall be sufficient to allow the free movement of the curtain and at the same time closes enough to prevent the rattling of the curtain due to wind. Each guide channel shall be provided with a minimum of three fixing cleats to the walls or columns by means of bolts or screws.

d) Fixing:

Brackets shall be fixed on the lintel or under the lintel as shown with raw plugs, screws, bolts, etc. The shaft along with the spring shall then be fixed to the brackets. The shutters shall be laid on the ground and the side guide channels shall be bound with it with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and the cover frame/shall then are fixed to the walls through the plate welded to the guides. Fixing shall be done accurately in workmen like manner so that the operation of the shutter is easy and smooth.

e) Grilled Curtain:

Wherever specified, rolling shutter shall be provided with rolling grill curtain.

f) Finishing:

The rolling shutter together with guide channel, cover and accessories shall be supplied with two coats of approved primer and shall be painted finally with two coats of approved paint at site after installation, as specified.

g) Fire doors:

Providing and fixing in position 45mm thick single / double leaf one hour fire rated door made with 0.80mm thick Galvanised steel sheet fully flush double skin door shell with seam joints at stile edges and internal reinforcement provided at top, bottom, and stile edges for fire rating. The internal construction of door shutter shall be specially designed Honeycomb structure with reinforcement. *The door leading on each floor to the fire escape staircase shall be Fire Door with 2 hours fire rating and shall be as per NBC/ I S code. The door shall have a panic bar and the entire arrangement is covered in the job.*

1.12.8.4 Metal Inserts in RCC & Block Work

1.12.8.1 General:

Anchor bolts, rolled steel sections sleeves, pipes, inserts, etc. shall be galvanized and shall be fixed or inserted as shown or directed. The Contractor shall supply and place in the shuttering all such inserts as may be required for sanitary, electric or work of any other trade. Work shall be done exactly as required for the purpose, to the satisfaction of the Architect. (For canopy and ducts)

1.12.8.5 Miscellaneous M.S. Works

a) Quality of Steel :

All mild steel used in this work shall be tough with even surface and shall cleanly rolled, sound and free from flaws, cracks, crop ends and other defects.

b) Workmanship :

All work shall be carried out as per drawing in a neat and good craftsman like manner by specially skilled men known for good quality work.

c) Assembly:

Work carried out in sections shall be carefully assembled. All members shall be secured together or to the anchors by welding or as shown in the details. All welds shall be ground smooth and made to match surrounding surfaces and finished to the satisfaction of the ENGINEER-IN-CHARGE.

d) Setting in Lead:

Where the work is fixed to concrete it shall be set in lead. In exterior locations, the end of the main structural support near the point of embedding shall be cleaned and covered with a solar and a bronze sleeve or umbrella shall be set on the steel upright to cover the joint and sealed by blow lamp.

1.12.8.6 Powder coated Steel Doors and Frames with louvered/glass panels as per the drawings for Electrical Rising Main Shaft, Wet Riser Shaft, Fire/Telephone Shaft having all hardware fittings and locking arrangement

1.12.8.6.1 General:

Aluminum doors, windows, etc. shall be electro treated natural anodized free of scratches and any other blemishes or any other approved colour and shall be of sizes as shown on drawings. The details shown on the drawings indicate generally the sizes of the component parts and the general standards. These may be varied slightly on approval to suit the standards adopted by the manufacturers of the aluminum work. Before proceeding with any manufacture, the contractor shall prepare and submit. Complete manufacturing and installation drawings for approval of the ENGINEER-IN-CHARGE and no work shall be performed until the approval of these drawings are obtained. All requisite materials and labors as specified here under shall be fully covered under the rates prices for proper execution and completion of the work. Weather-strip, gaskets and sealants shall be of high quality material capable of resisting local environment exposure and performance requirements. Interior primary seal be a compression type weather seal.

1.12.8.6.2 Shop Drawings & Samples:

The contractor shall submit shop drawings and samples of each type of windows, ventilators and other aluminum work, glass doors, pumps and connecting pipelines for firefighting and water supply, foundation detailing for transformer, generator, solar water heater, solar PV panel, GA drawing of distribution panel, distribution boxes, pump panels, electrical panels and controls for air-conditioning work, lift well detailing for coordination with the lift supplier, detailed room-wise flooring pattern and stone cladding pattern as per general pattern advised by the architect, floor-wise reinforcement bar-bending schedule, structural glazing, glass canopy and layout cum shop drawing of the car parking (two tire stack system) to the ENGINEER-IN-CHARGE for his approval. The shop drawings shall show full size sections of doors, windows etc. thickness of metal, details of construction, anchoring details, hardware as well as connection of windows, doors and other metal work to adjacent work. Samples of all joints and methods of fastening and joining shall be submitted to the Architect for approval well in advance of commencing the work. Samples of all sanitary fittings, wall tiles, floor tiles, granites, kota stone, marble, vitrified tiles, glass and glazing samples duly fixed on site, hardware fittings, balusters and railings, door frame and moulding, wall finishing with cement putty, shades of paints and coating, external inter-locking blocks, road kerbs, cement concrete tiles (duracrete), nosing of marble/stone, fixing of stone dado with approved quality of adhesive (exclusion of pure cement slurry) will be presented for approval well in advance.

1.12.8.6.3 Sections:

White PVC sections to be used for windows, ventilators and fixed glazing etc. shall be fabricated from approved extruded sections. The sections shall be extruded Built up standard tubular and other sections conforming to the prevailing standard of Fenesta (brand) or approved equivalent and free from all defects impairing appearance, strength and durability. The permissible dimensional tolerances of the extruded sections shall be such as not to impair the proper and smooth function/operation and appearance of doors and windows. For any excess weight of section used nothing extra shall be paid.

1.12.8.6.4 Fabrication:

Doors, windows, ventilators, etc. shall be fabricated by an approved specialist firm. All doors and windows shall have mechanical joints. The aluminum sections joints shall be designed to withstand a minimum wind load of 175 kg. perSqmt. The designed sections shall also ensure that the maximum deflection of any framing shall not exceed $L/175$ of the span of the member. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The jointing accessories such as cleats, brackets etc. shall be of such material as not to cause any bimetallic action. The design of the joint and accessories shall be such that the accessories are fully concealed. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to supports and fixing of hardware and other fixtures as approved by the ENGINEER-IN-CHARGE. The aluminum sections shall conform to the following parameters also:

- a) The minimum tensile strength shall be 19 kgf / mm².
- b) The maximum allowable deviation in length from a straight line shall be 0.5mm/metre.
- c) The maximum allowable deviation from straight shall be 1 degree.
- d) The maximum permissible twist shall be 0.5mm/metre.
- e) The maximum variation in flatness shall be not more than $0.125 * \text{Width}/25$.

1.12.8.6.5 Anodizing:

All surfaces of windows, ventilators & fixed glazing etc. shall be natural anodized or dyed to approved in approved shade to conform BIS: 1868-1968 Grading-8. Anodic coating shall be of a minimum thickness of 15 Micron . The testing shall be done by Eddy current method as per IS: 6012 for thickness and relevant test for sealing and colour variation measurements shall also be carried out. Sulphuric acid shall be used as the electrolyte for the anodic process. The anodizing shall be carried out in an approved manner to achieve the desired colour. Prior to anodizing all aluminum shall be rendered uniform in Appearance free from disfiguring scratches, stains or other blemishes and etched in a caustic soda solution.

1.12.8.6.6 Protection of Anodized Finish :

Requisite tests shall also be required to be carried out at site as instructed by the Architect and contractor shall arrange all assistance and equipments required for these tests at site for which no extra payment shall be made to the contractor. All aluminum members shall be wrapped with self adhesive non staining PVC tapes, approved by the ENGINEER-IN-CHARGE.

1.12.8.6.7 Handling:

Fabricated materials shall be crated in an approved manner to protect the material against any damage during transportation. The loading and unloading shall be carried out with utmost care.

1.12.8.6.8 Installation:

Just prior to installation, the doors, windows etc. shall be stacked on edge on level bearers and supported evenly. If so specified or directed by the Architect, window/door frames shall be fixed to 25mm thick 2nd class hard wood rough ground. Width of rough ground shall be exactly the same width of the frames. Wooden rough grounds shall be fixed to masonry surrounds with approved fasteners. The face of rough ground to receive frames shall be in true line, level and plumb. When the rough ground is properly secured and all major internal and external finishing works are over, the assembled doors/windows shall be placed in correct final position in the opening and fixed to rough block through cadmium plated machine screws of required size and spacing. Then all joints shall be sealed with approved silicon sealants. Sizes, details, spacing, etc. given above are approximate and indicative only. They can be varied at the option of Architect to suit particular sizes and situations and the contractor shall carry out the instructions of the ENGINEER-IN-CHARGE in this regard at no extra cost to the owner. The contractor may suggest alternative methods of fixing and anchoring for consideration of the ENGINEER-IN-CHARGE, while the decision of the ENGINEER-IN-CHARGE in this regard shall be final and binding.

In the case of composite windows the different units are to be assembled first. The assembled composite units should be checked for line, level and plumb before final fixing is done. Units may have to be assembled in their final location if the situation so warrants. Where aluminum comes into contact with masonry, brickwork, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that is trimmed off to a clean line on completion. The contractor shall be responsible for assembling composite units, bedding and pointing with mastic inside and outside, at the transoms and mullions, placing the doors windows, etc. in their respective openings. After the doors/windows have been fixed in their correct assigned position, the open hollow sections abutting masonry/concrete shall be filled with cement grout (1 cement :3 coarse sand) densely packed and finished neat without causing any scratch/damage to Aluminum sections. Final packing grout shall be of the expanding type made by approved additive. The contractor shall be responsible for the doors, windows etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

1.12.8.6.9 Epdm Gaskets:

EPDM gaskets of approved size and profile shall be provided and installed at all locations as shown and as called for to tender the doors windows etc. Absolutely air tight and weather tight. Samples of the gaskets shall be produced for approval and procure after approval only.

1.12.8.6.10 Sealant:

The gaps between frames and supports and also any gaps in the window sections shall be raked out as directed and filled with approved silicon sealant of approved colour and make to ensure complete water-tightness. The silicon sealant shall be of such colour, and composition that it would not stain the masonry/concrete work, shall receive paint without bleeding, will not sag, or run and shall not set hard or dry out under any conditions of weather. Silicon sealant shall be applied with special gun as per manufacturer's recommendation by a specialist firm approved by ENGINEER-IN-CHARGE.

1.12.8.6.11 Fittings:

Nylon rollers, Stainless Steel frictional hinges, shutter end lift curbs, buffers, handles, locks and other fittings shall conform to the relevant I.S. specifications and quality and manufacture as approved by the ENGINEER-IN-CHARGE. Fittings shall retain the casements rigidly in both the open and closed position; hinges shall be wrapped and protected until after the completion of the building. Hinges shall be close-up type and shall be opening as shown. These hinges shall work in conjunction with friction adjusters as a hold open device or additional friction for controlled operation. Rollers shall be heavy duty type and allow free sliding movements without any friction.

1.12.8.6.12 Final Cleaning:

The PVC wrapping, protecting and anodized finish shall be retained till the glazing work is commenced. After the glazing and all work connected with installation of windows is complete all aluminum work shall be washed with a suitable thinner and left in a finished condition, in approved uniform appearance and free from all marks and blemishes.

1.12.8.6.13 Glass Doors and glass fixed shutters as per Door Window Schedule with 12mm thick toughened glass and spider and other patch fittings, SS handles 1ft long (u-shaped) as per the drawing with locking arrangement in all the entry point of halls at all the floors and reception area as shown in the layout drawings.

1.12.9.1.1 Tiles:

The tiles shall be of approved make/manufacturer. They shall be flat, and true to shape and free from cracks, crazing, spots, chipped edges and corners. The surface shall be of uniform shade except for patterned tile. The sizes of tiles shall be as directed. The thickness of the tiles min 5 mm unless otherwise required or shown

1.12.9.1.2 Colour and Pattern:

The tiles shall be (rectified type with straight edge cutting to obtain paper thick joint) white, coloured or patterned as specified.

1.12.9.1.3 Preparation of surfaces:

The joints shall be raked out to a depth of at least 12 mm in masonry walls, while the masonry is being laid. In case of concrete walls, the surfaces shall be hacked and roughened with the wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting /dado is commenced.

1.12.9.1.4 Mortar:

12 mm thick plaster of cement mortar 1:3 shall be applied and allowed slightly to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at close intervals.

1.12.9.1.5 Laying of Tiles:

The tiles shall be soaked in water, adequately washed clean, and a coat of neat cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and butt jointed. The joints shall be as fine as possible and uniform. Top of dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Where full size tiles cannot be fixed these shall be cut to the required size and their edges rubbed smooth. Care shall be taken to ensure that as far as possible cut tile are in non-

exposed locations. Works shall be carried out in all areas only after a sample panel has been approved by the ENGINEER-IN-CHARGE.

1.12.9.1.6 Pointing:

After lying is complete, the joints shall be cleaned off the grey cement grout with wire brush and all dust and loose mortar removed. The joints shall then be flush pointed with white cement slurry added with approved pigments to match the colour of tiles.

1.12.9.1.7 Curing and Finishing:

The surface shall be cleaned and kept wet by sprinkling water for seven days. The finished surface shall be clear, free of patches and glossy and shall not sound hollow finished dry surfaces shall be washed with mild organic acid, if so required. The finished surface shall meet the approval of the Architect.

1.12.9.2 FLOOR FINISHING, SKIRTING, DADO AND PAVING:

- a) **Flooring:** Floors shall be provided inside the rooms, corridors, connecting corridors, passages, lobbies, Pantrys, toilets, baths WC's stairs, landings, verandahs, balconies and open terraces, ramps etc. Floor shall be laid to level and or to slope as shown on drawings and as required and directed by ENGINEER-IN-CHARGE / Architect. Floor shall be carried through all the doors and other openings and over dwarf walls. Exposed edge of floors shall be finished in the same manner as for top surface. Skirting shall match with the floor finish unless otherwise specified.
- b) Finishes of the floors at various locations shall be as shown on various drawings / schedule of finishes.
- c) The specifications of various types of floors shall be as specified here-in-after.

1.12.9.2.1) Sub flooring/ base concrete under floor finishes of ground floor and platform

a) For ground floor areas:

Sub floors (base concrete under floor finish) **100** mm thick cement concrete in 1:4:8 (1 cement : 4 coarse sand : 8 stone aggregate 40 mm nominal size for all locations) shall be laid over a layer of fine sand 100 mm thick over rammed earth at ground floor only.

The floor shall be laid in level on the RCC slab of the main building on cement concrete 1:4:8 sub-base average (50 mm thick and necessary raceways shall be embedded as per detailed layout on each floor

b) For upper floors

- I. **Sunken / lower portion of slabs:** Sub base shall be in lean concrete in 1:5:10 (1 cement: 5 coarse sand: 10 brick ballast 40 mm nominal size)
- II. **Other floors:** 60 to 80 mm (avg.) thick as applicable lean concrete 1:5:10 (1 cement: 5 coarse sand: 10 brick aggregate 40 mm nominal size) laid over RCC slabs for building.

1.12.9.3. Plain cements concrete flooring:

- (a) For floors of electric niches, cupboards, cabinets, counters, shelf etc. 40 mm / 50 mm thick concrete floor 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size). The top surface shall be finished with floating coat of neat cement using steel float while the concrete is green.
- (b) Skirting: To match PCC floors 18 mm thick plaster in cement mortar of mix 1:3 (1cement: 3 coarse sand) finished with a floating coat of neat cement shall be applied to skirting. The skirting shall be 125 mm high as shown on drawing.

1.12.9.4. Polished kota stone in flooring and landing and treads/step in staircases:

The kota stone slabs shall be machine polished and of selected quality, hard, sound, dense and homogeneous texture, free from cracks decay weathering and flaws. They shall be machine cut to the requisite thickness. The edges shall be truly vertical the colour of the slabs will be approved by the ENGINEER-IN-CHARGE, before starting of work. The slabs shall have the top (exposed) face polished

before being brought to site. The slabs shall conform to the size required. The thickness of the Kota stone slabs shall be as specified in the nomenclature of the respective items.

- (a) Dressing: Every slab shall be cut to the required size and shape and fine chisel dressed in the edges to the full depth. The edges shall be rubbed with coarse sand or machine rubbed before paving. all angles and edges shall be true and square and the surface be true and plane.
- (b) Preparation of surface and laying: The sub grade concrete or lean concrete filling over RCC slab on which the kota stone stone slabs are to be laid shall be cleaned, wetted and mopped. The bedding shall be with cement mortar of an average thickness of 25mm and mix 1:4 (1cement:4 coarse sand), over this bedding, neat gray cement slurry of honey like consistency shall be spread. The edges shall be pasted with pigment to match the shade of slabs. The joints shall be kept as thin as possible.
- (c) Polishing and finishing: The floor shall then be kept wet a minimum period of seven days. The surface thereafter shall be grounded with machine fitted with grit block No.60, then No.120 and finally with No.320. between every two successive grindings the surface shall be washed, cleaned and covered with a thin coat of cement in order to fill any pin hole that appear. After the final polish oxalic acid shall be dusted over the surface at the rate of 33 gm per square meter sprinkled with water and rubbed hard with mamdah block (pad with woolen rags). The following day the floor shall wiped with a moist rag and dried with a soft cloth and finished clean.

1.12.9.5. Skirting:

- (a) Preparation of surface and laying: the surface shall be chipped off the projections if any cleaned and wetted and 12 mm thick plaster of cement mortar 1:3 (1cement : 3 coarse sand) shall be applied and allowed to harden .The plaster shall be roughened with wire brushed or by scratching diagonal lines 2 mm deep at approximately 7.5 cms center both ways. The back and edges of the stone slabs shall be buttered with coat grey cement slurry and set in the bedding mortar.
- (b) Cutting polishing and finishing: Cutting, grinding and polishing of skirting shall be done in the same manner as of flooring but by hand grinder.

Full size stone shall be used in treads and risers of steps.

1.12.9.6. Glazed tiles in Dado for Toilets and pantry etc.:(Size 8' X 12")

- (a) Glazed tiles of first quality shall be provided in dado of Pantry and toilets of all locations as per drawing. The tiles shall be set over screed / plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) to all surface, set and jointed with neat white cement slurry. The joints shall be neat and fine.

Size of glazed tiles both for toilets, Baths, WC and Pantry shall be as shown on drawings

Height of glazed tiles dado shall be for 2150mm for all toilets in all flats except for guest house where it will be laid up to ceiling as shown in drawing / schedule of finishes. In Pantry glazed tiles shall be done above Pantry platform upto 600 mm high on the entire wall perimeter covered by the platform, sink and drain board. The height of the glazed tile dado in these locations shall be as shown above platform. The glazed tile dado shall also be provided below sink and drain board on the perimeter walls covered by drainage board and sink.

The glazed tiles shall be first quality vitreous china and of the approved makes

1.12.9.7. Working platform in pantry/vanity counter for toilets, etc:

Finish of working platforms in pantry: Finish of the working platform in Pantry shall be with 20mm thick black granite stone diamond cut. Granite slabs shall not be in more than two pieces for each side straight length of working plate from. Granite shall be jointed with white cement slurry pigmented to the same colour as that of the granite stone including grinding smooth and polishing complete. The front fascia of the Pantry platform shall be provided with granite stone of same shade as that of platform. The granite stone slab shall confirm to the samples kept in site Office the exposed edges of the granite stone shall be half rounded and as shown on drawing.

1.12.9.8. VITRIFIED TILES:

Providing and fixing of full body vitrified homogeneous tiles (Acid & Alkali Resistance) of size 600 X 600 mm of approved shade, with cement, slurry @ 2 kg per sq m over the bed of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) with the gap of 3-4 mm between tiles on either side using 3mm thick PVC spacers, to be filled up with epoxy base. Grouting material manufactured by Roffe Construction Chemical or Ball Adhesive or Dr. Back shall be filled up to depth of the tiles. All the work shall be finished & completed as per the manufacturer specifications as directed by the Architect/ Project Manager. These shall be of approved equivalent make.

The vitrified floor tiles shall be fixed with high polymer modified quickset tile adhesive by approved manufacturer and conforming to IS: 15477, using 5 kg adhesive per sq m of tile area, in average 3 mm thickness.

1.12.9.9. VITRIFIED CERAMIC TILES SKIRTING: Where shown/ indicated in the drawing/schedule of finishes provide 100 mm high vitrified ceramic tile & skirting over 12 mm thick cement mortar 1:3(1 cement : 3 coarse sand) and jointed with grouting material as specified above.

1.12.9.10. Paving with interlocking block: Interlocking blocks paving / flooring shall be laid over 100 thick PCC over 50 thick sand, including vibrating the sand layer for compaction.

1.12.9.11. False Ceiling Work: The false ceiling work shall be as per specifications and shall be co-ordinate with the air-conditioning installation and allied piping for the split unit VRV system. The outdoor units shall be placed on terrace and insulated refer grant piping shall be routed by making suitable diameter punctures in the RCC slab with electrical concrete core cutters of M/s Hilti or M/s Bosch. There shall be at least three trap doors per floor plate.

1.12.9.12. Partitions and Furniture Some additional internal partitions and furniture shall be supplied, executed by other agencies and contractor shall progress the work in such a manner that the lower floor is finished so that the building can be ferreted and put to use at the earliest. The work shall be coordinated with ENGINEER-IN-CHARGE

1.12.9.13. Sub-Station Equipment The erection of equipment in sub-station shall need careful pre-construction stage planning by contractor.

1.12.9.14. Fixing Detail for Plumbing and Sprinklers All sewerage/ wastewater/ vent/ water pipelines shall be of cast iron as per specifications. Suitable diameter holes shall be made in floor slabs with concrete core cutters and the pipes shall be routed by suspending with suitable split pipe support clamping system of M/s Intello Industries or equivalent having EPDM rubber lining with zinc-coated suspension rod of 10mm/8mm dia for roof hanging and work shall be as per recommendations of the manufacturer. For cast iron pipes, CI collar clamps or and TOR CI collar clamp shall be used when the pipe is in vertical position.

1.12.10. WATERPROOFING

1.12.10.1. WCs SANITARY BLOCKS, PANTRYs, NAHNI BELOW SINK WASHING PLACES, Etc.

1.12.10.1.1. BY SURFACE METHOD

Before the work is started, all cutting or chasing in the floor and / or walls and all the plumbing work should be completed and the normal plaster to the ceiling and upper part of walls should be provided. The treatment shall starts with filling in the depressed or sunken portions of the WCs and bathrooms, etc. with waterproof brickbat coba in cement with necessary gradient for easy flow away of water towards the Nahani trap or soil pan. The brickbat coba with covered with 18 mm thick approved waterproof layer which shall be continued on the walls above the floor level up to a height of 1 m . In the shower area of the bathrooms, the treatment shall be of full heights of the walls.

1.12.10.1.2. WATERPROOFING WITH CEMENT QUARTZ SAND & CHEMICAL INGREDIENTS

a) General

Cementitious, two-component waterproofing membrane. It comprises a mixture of cement quartz sand and a special blend of chemical ingredients of an inorganic nature. 100% compatible with all masonry structures. It is seamless, liquid-applied, efflorescence free and is used against active water pressure. Due to its excellent adhesion and tensile strength, it can be easily applied to both horizontal and vertical surfaces.

b) Surface Preparation

- a. All new concrete plaster or screed surfaces shall be cured for a minimum of 28 days before doing waterproofing/chemical treatment. All concrete, plaster or screed surfaces shall have a wood float finish.
- b. All surfaces to be applied with the waterproofing compound and shall be cleaned by water blasting, sandblasting, wire brushing, scraping or any other suitable means to remove dirt, grease, moss, moulds, etc. Where necessary, detergent shall be used to remove oil stains and similar. A suitable algacide / fungicide solution shall be used to remove algae/ fungus.
 - i. Other cracks that are subjected to only minimal movement shall be raked out where necessary. These cracks shall be repaired with waterproofing/chemical treatment or a similar epoxy repair mortar.
 - ii. Where cracks are found to be structural, a structural engineer shall be consulted and the structure assessed.
- c. Large holes and defects shall be repaired by plastering or screening or using approved epoxy repair mortar
- d. All protuberances shall be rubbed down or ground flat.
- e. Patch work – All loose and flaky paint shall be removed. All sound smooth paint shall be lightly abraded to provide a key for adherence to the system.
- f. All spalled concrete and plaster must be repaired by appropriate methods prior to the installation of the Waterproofing System.

c) Waterproofing System Application

- i. Priming – Not required.
- ii. Mixing – Add Component A (powder), to Component B (liquid) in the correct mixing ratio and thoroughly mix with a mechanical mixer for at least 3 minutes. Mix only sufficient material that can be used up within its pot life (60 minutes).

Mix ratio: $A / B = 2.5 / 1$ by weight

$A / B = 2.5 / 1$ by volume
- iii. Application – To a properly prepared damp surface, apply by brush, trowel, roller or spray equipment. Apply two coats of at $1.0 - 1.2 \text{ kg/m}^2/\text{coat}$, giving an approximate thickness of 0.95 to 1.20 mm. Allow 3 hours drying time between coatings.
- iv. On the very next day after the System is completed, the entire surface shall be checked for pinholes and holidays (areas not covered properly). Immediately, reapply the undiluted on pinholes and holidays areas.
- v. Allow at 24 hours before carrying out ponding test and or screening and tiling over.
- vi. If to be left exposed for a short time, the treated surface must be protected from direct sunlight frost, wind and rain. Canvas or wet Hessian bags may be used to protect surfaces. Curing can also be done by covering the hardened surface with plastic sheets canvas. The total curing time takes 7 days. Back-filling can normally be carried out careful after 24 hours. Water retaining structures can normally be filled with water after three day ventilation should be provided in enclosed or humid areas.

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- vii. Detailing - This shall be applied with. It is very important to pay special attention to corners, edges, and down-pipes, etc. as it will be these areas that failure is most likely to occur. All detailing shall be sufficiently reinforced and wrapped around to assure water-tightness. A minimum height of 150 mm from the finished level shall be maintained at all detailing and up stands.

1.12.10.2. TERRACES, CHAJJAS, CANOPIES, HORIZONTAL PROJECTION ETC.

1.12.10.2.1. BY SURFACE METHOD

The treatment will start directly over the RCC slab with laying over of approved waterproof brickbat coba in cement mortar to provide necessary gradient of 1 in 120 for the easy flow away of rainwater. Finally, the brickbat coba will be covered with joint less waterproof layer finishing the surface with 20mm thk jointless layer of 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 mesh of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300mm square 3mm deep as left in rough finish to receive china mosaic flooring on this treatment shall be carried along the inner side of parapet and / or other adjoining wall up to a height of about 300 mm in the shape of a round vata. The average thickness of this treatment shall about 100 mm with a minimum thickness at water outlets being 65 mm. This surface shall be rendered hard and tough, and suitable for all normal residential building use. Due to location of rain water pipes being far apart than 8m and/ or if the water is required to travel on one side only, then the thickness of the treatment increases proportionately to maintain the minimum gradient for easy flow away of rainwater and this additional thickness over and above 100mm thickness of the normal coba shall be measured and payable extra.

- a) Clean the surface from debris and loose mortar and other materials
- b) **Defect Check: Ponding the area:** Before final surface preparation, make the vatta for ponding to the entire area for 24hrs. To find the leakage & defective point mark the leaking & defective points on the slab for rectification.
- c) **Surface Preparation:** All surface to be waterproofed by the waterproofing/chemical treatment shall be cleaned by means of
- Scrapping & chipping all loose mortar / material etc.
 - Wire brushing to remove dirt, dust, moulds etc.
 - Water cleaning & wire brushing to remove finer dust etc.
- d) **Rectification of Construction joints, Defective area & leakage points:**
- Mark the construction joints on plan for record and easy location of joints Construction joints should be racked open by chisel in 'V' grooves. Defective (honey comb) & leakage points, shall be grouted by fixing the nozzle and grouting the same with cement slurry. Construction joints shall be re furnished to original profile by using polymer mortar after pouring the cement slurry in 'V' grooves or grouting the same as and where required. An addition poly mortar layer min 15 mm thick over the 'V' groove min 10mm on either side of groove shall be laid.
- e) **Making coving (Watta)**
- All the spalled concrete and rough area must be smoothened by using cement mortar before application. Make coving in cement mortar at corner, edges, down pipes, slab and wall junction etc.
- f) **Product Application Primer:**
- After water cleaning the entire repaired surface apply waterproofing/chemical treatment primer by roller or brush as per the specified coverage rates.

g) Detailing :

Apply the thick coat of waterproofing/chemical treatment to the coving crack, construction joints and other rectified areas on slab min 50 mm on either side or 150mm to 230 mm to the upturns. A strip of chopped stand mat fiber shall be embedded to the bond coat. And another body coat to be applied over the fiber glass mat.

h) Application:

Apply the waterproofing/chemical treatment coat over the sufficiently dried primer in coats leaving at least 2 to 4 hrs interval between successive coats (depending upon drying time) in specified consumption ratio, using brush or roller. Next day: check for the pinholes and area not covered properly reapply another

i) Curing & Ponding Test:

After 72 hrs of Air curing fill the water for the ponding test for another 24 hrs for the leakage test

j) Protection of membrane:

After 24 hrs of ponding test check the area for leakage cover the membrane by screed or brickbat coba (as specified) laid in required slope and minimum thickness of 50mm at the lowest points.

k) Important note:

Surface to be waterproofed has to be thoroughly cleaned, dry and dust free. Surface must be protected after the application.

l) Detailing :

All smoothed corners and edged down pipes and coving (Watta) and other area of cracks, honey comb and joints etc. Where the failure is most likely to occur, the waterproofing/chemical treatment Application must be reinforced with fiber glass at upturns should be 100mm above for floor finish level

m) Curing :

Air curing does not require water curing. Surface must be protected from mechanical damage. Pinholes and area not covered properly by coating system to be treated by application of 1 coat of waterproofing/chemical treatment

n) Ponding Test:

Ponding test must be done to the treated area after 48 to 72 hrs of application the area shall be ponded for leakage testing.

Protection of the water proofing system area shall be covered by screed / Brick bat coba as per required slope with thickness 50mm min at the lowest point.

**1.12.10.3. RCC UNDER GROUND & OVERHEAD TANK STRUCTURES:
BY FORCE GROUTING AND SURFACE METHOD:**

In the case of RCC underground and overhead water tank structures where there is no access available from outside and below the raft slab; the treatment is given inside with force grouting and surface method. The treatment shall start with forcing cement grout with W.P agent into the structure as and where found necessary. Thereafter, waterproof layer, finished smooth with towel in cement to be laid on the floor and continued on the side and partition walls up to their full height. Average thickness of this treatment to be 65 mm on the floor and 25 mm on the walls. All the fixtures like pipe sleeves, pipe

inserts shall be fixed prior to taking up the above treatment. The water tanks must be filled up with water immediately after treatment.

Waterproofing Treatment to OH and UG tank

a) GENERAL:

Generally, all concrete surfaces shall be in a clean, sound and watertight condition, free of any dust, sand particles, oil and any other unwanted particles to the satisfaction of the Architect.

b) WATERPROOFING MATERIAL:

The waterproofing material to be used shall be a cementitious, ready mixed, efflorescence-free surface waterproofing membrane that consist of hydrophobic properties. Application of the Waterproofing Treatment can be applied by means of slurry coating, trowel or spray application. It can be either applied on the external surface or internal surface or both, depending on the thickness of the wall or floor. The shall consist of rapid-hardening Portland cement, specially treated and graded grain-size distribution, and special chemical ingredients of an inorganic nature. The cementitious waterproofing membrane shall remain waterproofed even under pressure and tested to 7.0 bar, and at the same time allow the concrete to “breathe” by allowing the passage of water vapor through the structure. In addition, the cementitious waterproofing material shall protect the concrete against ground water, aggressive ground water and certain chemical solutions. Cementitious waterproofing membrane shall be able to applied to surface or substrates such as concrete, masonry and render that require proper sealing and protection against the influence of water and moisture. Inside wall and base of the tank will be finished with Gujarat-based white tiles.

c) PREPARATION OF SUBSTRATA:

Concrete to receive the treatment must have a clean surface and an open capillary system to ensure maximum bonding and sealing. All surfaces shall be examined for structural defects and remedied prior to the waterproofing treatment. Faulty concrete such as protrusions and honeycombs shall be chiseled and work back to sound concrete and cleaned (to be done by contractor). Construction joints that are not pre-treated with treatment, and cracks exceeding 0.3 mm widths, shall be routed out to a minimum depth of 25 mm and properly cleaned (to be done by contractor). From ties shall be removed and chiseled back to sound concrete (to be done by contractor). One slurry coat of Super shall be applied over all chiseled out areas, at a coverage of 1.5 kg/m². After the Super has reached its initial set and while Super is still “green” (about 30 mins after application), the chiseled out areas shall be filled with a cement sand mortar (to be done by contractor). Cracks that are found leaking shall be injected with VandexFlexin (separate quotation may be necessary), which is a modified acrylic resin. When in polymerized form Flexin shall be in an insoluble and nontoxic elastic mass, and shall not deteriorate within the structure. The plasticity and sealing capability of chemical shall remain constant in extreme temperatures ranging from –40°C to + 70°C depending on circumstances. Flexin injection shall be injected directly into the defective area at pressure ranging from 10 to 320 bar, depending on the particular application.

d) WATERPROOFING TREATMENT:

Prior to the Waterproofing Treatment, all concrete surfaces shall be properly prepared and remedied as item C above. All concrete surfaces shall be cleaned and free from all forms of scales, laitance,

mould oil, curing agents and any other foreign materials. Extremely smooth concrete surface shall be roughened either by using abrasive disc, sand blasting, wet sand blasting, water blasting or acid etching (using 1-% Muriatic Acid Solution) to assure maximum bonding. All concrete surfaces to be treated with waterproofing material shall be thoroughly wetted down before application. The concrete surfaces shall only be moist (not wet), and laying water shall be removed leaving only a damp condition just prior to the application of the Chemical waterproofing Treatment. The waterproofing material shall be mixed in accordance with the manufacturer's instructions. Application by means of slurry coating shall be applied with a stiff masonry brush or stiff broom and worked into every irregularity on the surface. Chemical Waterproofing can also be applied by trowel or spray.

e) APPLICATION RATES:

Depending on locations, Chemical waterproofing cementitious waterproofing membrane shall be applied in thickness and coverage as recommended below:-

Ground Moisture	0.5 mm thick (3.0 kg/m ²)
Pressure less Surface Water and Seepage	2.0 mm thick (4.0 kg/m ²)
Water Under Pressure	3.0 mm thick (6.0 kg/m ²)

f) CURING OF WATERPROOFING TREATMENT:

The Waterproofing Treatment, whilst setting, shall be protected from rain and direct sunlight. During hot, dry or windy weather conditions, curing shall be done using a constantly wetted matt, or constant application of a fine spray of water (like mist), to prevent the Vandex material from first drying out. Air circulation is necessary in enclosed areas to assure the normal setting of the Waterproofing Treatment. Waterproofing Treatment onto treated surfaces shall not be exposed to aggressive water, chemicals or acids until the Vandex treatment have reached its full strength, which normally take around 14 days.

DECORATION, COATING AND TILING:

Where the treated surfaces are to be decorated with paint, the Treatment shall be allowed to be cured for a minimum period of 4 weeks. The surface shall then be saturated with water and neutralized with a 1.8 muriatic acid solution. Following this, the area shall be thoroughly rinsed with water before any coating works. Paints and coatings to be used shall be vapor permeable. Where a plaster or render finish is required on top of the Treatment, it is essential that a thin rough cast of cement sand shall be applied onto the final layer of the Treatment shall be cleaned and an appropriate bonding agent be applied prior to the rendering.

g) Waterproofing to RCC Retaining Wall & Lift well in plinth with Chemical:

As per the specification of the approved manufacturer. The process should be got approved from Architect/Employer before commencement of said work ,well in advanced, unless otherwise mentioned in the Tender.

h) Defect Rectification:

All honey comb, crack and damaged area, shall be raked open to sound concrete up to min of 25mm depth, treating the same with two coats of Chemical and re plastering to the original profile with Cement mortar using Aqua Bond (Polymer) by the concern agency.

i) Construction joints:

Existing construction joints shall be chased out in 'V' groove up to a depth of 25 – 50 mm and apply 2 coats of Chemical and then fill the groove to original profile in Cement mortar using polymer / aqua bond. For stone coping, 10mm wide silicon sealant joint shall be provided at a maximum distance not exceeding 4.5m.

j) Injection grouting :

Honeycomb, defective area and loose construction joints shall be grouted fixing nozzle and grouting with cement slurry as & where required after finding the leakage.

k) Roughening the surface:

Hacking to be done to the surface at least 85% of area to be hacked and water jetting to be used to remove the laitance for open capillary system.

l) Application of Chemical:

The surface must be cleaned thoroughly using water and also to ensure that the concrete is saturated. The surface water must be removed to make the surface damp only, prior to the application.

m) Mixing ratio:

part of Chemical 2 part of water by mechanical mixer (by volume) add water to Pot life: 15 min, mix only required quantity to be used in 15 min or as per the manufacturer's specifications.

n) Application:

Chemical slurry shall be applied in 2 coats on green surface (1st coat on damp surface & 2nd coat after 30 min over the 1st coat) at the specified coverage rate with the Chemical brush or as per the manufacturers specifications.

o) Curing protection:

Applied surface shall be protected from rain, water and direct sun light till the setting.

Applied surface shall be cured for five days by constantly fine wet spraying on sprinkling.

p) Guarantee:

It shall be guaranteed that the building is completely water and leak proof for a period of 10 years. Such a guarantee shall be directly given by the specialist agency to the Employer in a form approved by the ENGINEER-IN-CHARGE. In the event of failure of the waterproofing system at any time during the guarantee period, the specialist agency shall carry out such treatment as may be necessary to render the structure free from water leakage including breaking and reinstating any other works that may be necessary for the treatment at no extra cost.

1.12.10.4. ROOF COVERING, WATER PROOFING & RAIN WATER PIPES:

a) Exposed roof at terrace floor level of all buildings and roof of staircases, mumty, except sloping roof shall be provided with water proofing treatment with brick coba and acrylic base waterproofing compound. The detailed operation of water proofing treatment with brick coba and acrylic base water proofing compound (on exposed roof terrace floor, roof of staircase, over head tank and mumty) shall be as follows :

- i. Clean the RCC slab surfaces including sides upto 300 mm high by wire brush including raking and cleaning of construction joint if any.
- ii. Applying and grouting a slurry coat of neat cement using 2.75 kg. Per sqm of cement admixed with proprietary acrylic base water proofing compound conforming to IS-2645 over the RCC slab and sides upto 300 mm high.

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- iii. Lay 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to [IS-2645].
 - iv. A layer of broken bricks/ brick bats (coba) to be laid over the layer of 20 mm thick cement mortar (laid at (c) above) giving a gap of 15 to 20 mm and necessary gradient of 1:20 for proper flow of water. The joint/ voids to be filled with cement mortar 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound.
 - v. A gola in cement mortar 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to IS-2645 with brick bats embedded in it at the junction of horizontal surface and side wall.
 - vi. After two days of curing apply second coat of cement slurry admixed with proprietary acrylic based water proofing compound conforming to IS-2645.
 - vii. Finishing the surface with 20 mm thick joint less cement plaster 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to IS-2645 and finally finishing the surface with trowel with neat cement and making of 300 mm x 300 mm false square.
 - viii. 20 mm thick joint less cement plaster 1:4 (1 cement: 4 coarse sand) admixed with proprietary acrylic based waterproofing compound conforming to IS- 2645 over the gola upto 300 mm high on sidewalls. This plaster will be in continuation of plaster provided on horizontal surface as per sub para (vii) above.
 - ix. Average thickness of the above treatment shall be 120 mm and minimum thickness at Khurras is 65 mm.
 - x. The proportion of proprietary acrylic based water proofing compound to be used with ordinary Portland cement for all operations as aforesaid shall be laid down by the manufacturer of particular acrylic based water proofing compound.
 - xi. The whole treated portion shall be flooded with water for five days for curing and testing.
- b) Khurras:** Making khurras 450 x 450 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm nominal size) and laying 1mx1mx400microns PVC sheet finished with 6 mm cement plaster 1:4 (1 cement : 4 coarse sand) and coat of neat cement including rounding of edges and making and finishing the outlets complete.
- c) Gola / watta:** Providing coving 75 mm x 75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge) at the junction of RCC slab and wall including finishing exposed surfaces with cement mortar 1:4 (1 cement : 4 fine sand) as per drawing. Gola shall be done before the plaster of parapet.
- d) Balconies:** Finishing of balconies shall be as shown in the schedule of finishes with matching skirting. The specifications shall be as above :
- Roof slab at balconies to be finished as above shall be cleaned thoroughly and following treatment / covering shall be provided:
- i) For sunken / lowered portion of slabs. Treatment / covering as specified below.
 - ii) In portion of balconies which are not sunken / lowered treatment below".
- e) Unplasticized rainwater pipes:**
- i. The rainwater pipes and fittings shall be provided with unplasticized PVC pipes conforming to IS-4985-81 and ISI marked. The uPVC pipes shall be of outside diameter as shown on drawings and of working pressure 4 kg / sq. cm. Internal and external surfaces of the pipes shall be smooth and clean, reasonably free from grooving and other defects. The uPVC pipes shall be jointed with PVC solution for concealed pipes and for exposed pipes with PVC collars by using lubricating solvent solution. Fittings shall be injection moulded or fabricators type conforming to IS-8008- 1976 (Part I and IV) and / or IS 8360-1970 (Part I to III) and / or as per manufacturers recommendations. The pipe shall start from ground level with bend as shown on drawing. A tee junction shall be provided at all terrace levels to collect water from Khurras and vertical pipe to be fixed properly with factory-made clamps of approved make such as Camry as per approval of ENGINEER-IN-CHARGE, shall be extended upto top of parapet. At top PVC cowl shall also be fitted.

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- ii. Cast iron chamber and grating at the top and outlet of every rainwater pipe shall be provided and shall fit in snugly on the socket end of the pipe. The perforations in the gratings shall be at least 60% of the total area of gratings.
 - iii. Where the rain water pipes are to be provided concealed within masonry the pipes shall be embedded in the walls with PCC 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate 20 mm down gauge) and wherever embedded in adjacent with RCC column or adjacent partly to RCC column and partly to brick work pipes shall be embedded in PCC 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) encasing all round. External surface of the pipes shall be painted with PVC adhesive and then coarse sand shall be sprinkled before embedding the pipe in the concrete for proper gripping with concrete. (d) Rainwater pipes running down along the walls / columns shall be firmly fixed to the walls / column at all joints and at one meter spacing on pipe with PVC clips as per manufacturer instructions. (e) Provide angled end pieces PVC shoe at bottom and splash stones 450 x 300 x 20 mm embedded in plinth protection.
- f) **PVC spouts:** PVC spouts shall be provided to balconies, upward turned chajjas and other similar locations. These shall be 25 mm dia., 300mm long PVC pipe of approve brand
- g) **Plastering and Rendering**
- General**
- a) **Scope :**
This section shall cover internal and external plastering/rendering works as shown in the drawings.
- b) **Mortar :**
The mortar of specified mix shall be used. Cement and sand shall be tested as specified.
- c) **Scaffolding :**
Stage scaffolding shall be provided for plastering work as per Standard Practice and as directed by ENGINEER-IN-CHARGE. This shall be independent of the walls.
- d) **Plaster to Extend:**
All interior plaster shall be extended up to 12 mm below the skirting or dado level at no extra cost wherever required.
- e) **Preparation of Surface:**
Joints of Concrete block work walls shall be raked-out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scraping. Shuttering imperfections of all concrete shall be roughened by hacking with chisel and all resulting dust and loose particles cleaned and the surface shall be thoroughly hacked or bush hammered to the satisfaction of ENGINEER-IN-CHARGE. The surface shall be thoroughly cleaned and kept wet as specified before plastering is commenced.
- f) **Approval of /ENGINEER-IN-CHARGE to be taken :**
No plastering work shall be started before all conduits, pipes, fittings and fixtures clamps, hooks, doors and window frames etc. are embedded, grouted and cured and all defects removed to the satisfaction of ENGINEER-IN-CHARGE A sample of plasterwork shall be prepared and got approved before proceeding with the work. Special approval shall be taken from ENGINEER-IN-CHARGE before starting each plastering work. No cutting of finished plaster shall be allowed. No portion shall be left out initially to be patched up lat on.

1.12.12.1 Exterior Plaster:

a) General:

Exterior plaster shall be 18 mm thick, unless otherwise specified, generally sand aced the base coat shall be about 12 mm thick with coarse sand applied after the base coat has set but not dried. The base coat shall be 1:4 (1 cement: 4 coarse sand) and second coat shall also be 1:4 cement mortar (1 cement: 4 coarse sand). Acrylic waterproof chemical @ 0.5 kg per 50 kg of cement or as recommended by the manufacturer shall be admixed with the plaster, wherever specified in the item.

b) Mixing:

The ingredients shall be mixed in specific proportions by volume. The mixing shall be done in a mechanical mixer or by hand mixing on water-tight platform. The cement and sand shall first be mixed thoroughly dry in the mixer. Water shall then be added gradually and wet mixing continued for at least a minute until mortar attains the consistency of a stiff paste and uniform colour. Mortar shall be used within 30 minutes of addition of water. Mortar which has partially set shall not be used and removed from the site immediately.

c) Application of Plaster

i. General:

Wall plastering shall be started after the completion of ceiling plaster from top and gradually worked down towards floor. It shall not, at any place be thinner than as specified. To ensure even thickness and a true surface, plaster pads of about 75 mm * 75 mm shall be first applied horizontally and vertically at not more than 2 m interval over the entire surface to serve as gauges. The mortar shall then be applied to the wall/surface between the gauges and finished even. All corners, junctions and rounding shall be truly vertical or horizontal and finished carefully. Generally work in an enclosure shall be completed in one day. For larger areas if the work has to be suspended at the end of the day, plaster shall be cut clean to line. When recommencing, the plastering, edge of old work shall be scrapped, cleaned and wetted with cement putty before restarting plastering

ii. Base Coat:

The mix shall be stiff enough to cling and hold when laid. On walls, the mix shall be laid in long even spreads upwards and across using sufficient pressure to force it into the key on the backgrounds. The mortar shall be laid as uniformly as possible. The average thickness shall not exceed that specified. This coat shall be allowed to stand firm till before scratching for key. The surface shall then be combed or cross scratched with a wire scratcher

iii. Second Coat:

A reasonable time (not more than 48 hours) shall be allowed after the application of the base coat for thorough drying before the application of the second coat. After soaking base coat thoroughly with water the mortar for second coat shall be applied with a feather edge rule to a true and even surface. The surface shall then be thoroughly scoured with a wood hand float, and any inequalities filled in. Over working shall be avoided. However, wherever special coating is specified, the second coat shall be finished smooth with cement based putty to the satisfaction of the ENGINEER-IN-CHARGE.

iv. Single Coat Work:

Single coat work shall be finished smooth as specified in second coat work. Special care shall be taken to secure bond with the concrete/brick wall.

v. Plastering over Steel Surfaces:

Where plastering is to be done over steel surface, suitable expanded metal covering the steel surface and secured to the adjoining wall/concrete surface with an overlap of 200 mm shall be provided.

vi. Plastering at Junction of Masonry / R.C.C:

All junction of Masonry wall with R.C. structures e.g. column, beam etc. shall be plastered after providing and fixing of approved 100% virgin homopolymer polypropylene multifilament fibersmesh /pvc mesh 250 mm wide centrally over the length of junction either vertically or horizontally to the satisfaction of ENGINEER-IN-CHARGE. G. I. Chicken Wire Mesh / 100% virgin homopolymer polypropylene multifilament fiber mesh of required width shall also be fixed over the chasing for conduits, pipes etc. on masonry wall before plastering is commenced.

1.12.13.1 WALL FINISHES

Internal surfaces

- a)** Cement plastering internally on all internal surfaces (except surfaces where other type of finishes have been indicated on drawings) including soffits of RCC slabs, beams, chajjas, lintels, all-round shelves, inner side of top parapets and loft walls etc. shall be as under :
- i.** 12 mm thick plaster in cement mortar 1:4 (1 cement: 4 parts 75% fine and 25% coarse sand) mixed with 10% of lime water over brick and concrete surfaces. Dubbing out wherever required (i.e. bringing up the undulation on the rough face of brick work in level with proudest points) shall also be executed in the same mix along with rendering coat.
 - ii.** 6 mm thick plaster in cement mortar 1:4 (1 cement : 4 fine sand) on soffits of RCC slabs, chajjas, lintels and Pantry / pantry, platforms, loft slabs, fins, fascia counters and all-round of cupboard shelves etc.
 - iii.** 10 mm x 6 mm grooves shall be provided in ceiling plaster at junction of wall and ceiling.
 - iv.** 12 mm thick plaster in cement mortar 1:4 (1 cement : 4 parts 75% fine sand & 25% coarse sand) mixed with water proofing compound
 - v.** 12 mm thick plaster in cement mortar 1:3 (1 cement : 4 coarse sand) mixed with water proofing compound to be done on the internal surfaces of RCC / brick / parapet / gutter walls, chajjas, fins, fascia etc. including dubbing whenever required.
 - vi.** 15 mm thick plaster in cement mortar 1:4 (1 cement: 4 coarse sand) shall be provided in internal surface of brick parapet wall at terrace levels.
 - vii.** Before plastering it should be ensured that brick masonry joints are raked out (at least on even surfaces) to a depth of 12 mm and all concrete surfaces are rough enough for proper adhesion of plaster. If not they shall be made rough by hacking or bush hammering at intervals of 50 mm. Efflorescence if any dust / dirt shall be removed. The surfaces shall be wetted adequately before plastering.
 - viii.** GI chicken wire/pvc mesh of 24 gauge / 100% virgin homopolymer polypropylene multifilament fiber mesh and 20 mm mesh shall be fixed all along RCC and brick joints in a width of 150 mm with end lap of 15 cm using cement slurry and nails etc. for fixing mesh before plastering.
 - ix.** Sand used in plaster shall be within the grading zones as stipulated in the IS silt contents shall not exceed 4%. Brick surface shall be raked out at the end of day brick work to afford key to plaster. Plaster surface shall be hard and even without patchy appearance. If they flake or show scratch marks if rubbed by a pointed nail the plaster shall be rejected, dislodged and redone.

b) Drip course: Drip course shall be provided to all projections, chajjas, facings, chopper etc.

c) External Surfaces

External surfaces at following locations shall be finished with 18mm thick plaster with necessary grooves and pattern as shown on the drawings and finally finished extra smooth with cement based putty.

- i. All sides of all the columns except internal sides of columns in Rooms and external faces of beams.
- ii. External surfaces of planters and external vertical surface of RCC over headwater tank.
- iii. Soffits of vaulted arched and flat soffits and bands.
- iv. All external plaster surfaces of the rest of all buildings, internal compound walls, external compound walls shall be finished in latex based paint – in three coats i.e. one coat of cement primer and two or more coats of snowcem paints to achieve even shade.

1.12.15.1 Painting, Varnishing and Rendering

General

i. Materials :

All materials shall be the best of their kind and of approved manufacture for each item. Painting materials such as shellac, thinner, oils, driers, rollers, brushes, etc. shall be of the best approved quality and type. If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by ENGINEER-IN-CHARGE shall be used.

ii. Sealed Containers :

Approved paints, oils or varnishes shall be brought to the site of work by the Contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least fortnight's work. The empty containers shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from Engineer.

iii. Storage:

All materials shall be stored in a neat and orderly fashion in one single clean space. Care shall be taken to maintain this place as clean and dust-free as possible.

iv. Specialized Workmen:

All work shall be done by the specialized skilled workmen experienced in the trade.

v. Work as per Manufacturer's Instructions:

All work shall be done strictly as per this specification and manufacturer's printed instructions. In case these specifications differ in any way from manufacturer's instructions, the latter shall apply.

vi. Finished Surface to ENGINEER-IN-CHARGE Satisfaction:

All finished surface shall be required texture (smooth, rough or any other) and of even shade to the satisfaction of ENGINEER-IN-CHARGE

vii. Protection:

All work done shall be thoroughly protected from damage at all times by suitable methods approved by ENGINEER-IN-CHARGE. All other adjacent work or materials not received the finish at that time shall also be thoroughly protected by suitable canvas or paper covering or by other approved method.

viii. Damages to be made good:

Any damage or disfigurement of other works shall be immediately made good. All paint and varnish spots and other stains shall be thoroughly and carefully removed from all floors, doors, windows, fittings, furniture, glass, hardware and all other surfaces required, by approved paint removers and the places left clean and tidy to the satisfaction of ENGINEER-IN-CHARGE.

ix. Intimation before Starting:

No work under this section shall start without approval from ENGINEER-IN-CHARGE.

x. Samples:

Before starting work under this section large size samples of all work shall be prepared by the Contractor for approval. Only after specific approval has been given to the samples, work shall commence. The actual work done shall be done as per the approved samples.

xi. Preparation:

All surfaces to be finished shall be thoroughly brushed and cleaned of mortar drops, dust, dirt, fungi, rust, mill-scale, efflorescence and all other extraneous material. All loose places and scales shall be removed by scrapping. Surfaces shall be thoroughly, sand-papered to a smooth finish. Further preparation work shall be done as specified under different types of finishes. Before starting painting all floors shall be washed clean and wiped dry.

1.12.17.1 OIL BOUND DISTEMPER:

- a) Oil bound distemper shall be provided to internal plastered surfaces of rooms where indicated on drawings and where directed by ENGINEER-IN-CHARGE and Architect. The oil bound distemper shall be from manufacturers as approved by Project Manager and Architect.
- b) Before application of oil bound distemper, the surface shall be prepared by applying one coat of approved primer as per the directions given by the manufacturer. After the primary coat has dried the surface shall be lightly sand papered with zero grade abrasive paper, taking care not to rub out primary coat and then dust off. This surface so prepared before applying emulsion paint shall be got approved as a stage from the ENGINEER-IN-CHARGE. After the prepared surface is approved, oil bound distemper shall then be applied in two or more coats to give smooth surface as well as even shade to the satisfaction of ENGINEER-IN-CHARGE and the Architect.
- c) Cost of preparation of surface by application of primer and sand papering etc. shall be deemed to be included in the rates of application of oil bound distemper.

1.12.18.1 PAINTING :

- a) **Cement Base Paint:** Two or more coats of cement base paint over one coat of cement primer shall be applied to give even shade on all external cement plaster surfaces, internal cement plaster surfaces of parapets, top of parapets, inner face of gutter walls, soffits of chajjas, lintels, beams, and sills of windows etc. The shade of the paint shall be used as approved by ENGINEER-IN-CHARGE. Each coat shall be cured well by wetting surfaces for at least three days.
- b) **Painting to wooden surfaces:** All exposed wooden surfaces shall be prepared and given a primer coat of approved quality as approved by the Architect. The surface shall then be bodied in with liquid wood filler of approved make, allowed to dry and rubbed with sand paper after moistening the surface with water, the surface cleaned then two or more coats of synthetic enamel paint applied to given an

even shade of approved quality. Tint / shade of synthetic enamel paint shall be as approved by the MC / Architect.

- c) **Painting to Steel Surfaces:** All exposed steel surfaces shall be prepared, cleaned with sand paper to completely remove scales and rusts and shall be painted with two or more coats of synthetic enamel paint to give an even shade over one coat of steel primer. The shade of synthetic enamel paint shall be as approved by ENGINEER-IN-CHARGE.
- d) **Painting to PVC and CPVC Pipes:** All exposed pipes shall be painted by applying two or more coats of enamel paint. The shade and quality shall be as approved by ENGINEER-IN-CHARGE.
- e) **Anti-Termite Solution to woodwork:**
 - i. Anti-termite solution shall 'ASCUPS2' colourless or other equally approved preservative.
 - ii. Surfaces of timber which are in contact and / or buried in concrete / masonry / plaster and concealed surfaces of timber / board / plywood shall be treated with two coats of anti-termite solution before being built in or covered up.
- f) **Painting of concrete surface with epoxy paint of MRF or equivalent**

1.12.19.1 Synthetic enamel paints and primer manufactured by the following firms shall be used. Paints and primer shall be incorporated in the work.

- a. Acro,
- b. I.C.I.,
- c. Asian
- d. Berger
- e. Nerolac

1.12.19.2 The following cement base paints(if required) shall be used :

- a. Acro,
- b. I.C.I.,
- c. Asian
- d. Berger
- e. Nerolac

1.12.19.3 Oil bound distemper:

- a. Acro,
- b. I.C.I.,
- c. Asian
- d. Berger
- e. Nerolac

1.12.20.2 Cement Paint:

a) Preparation of Surface:

For new work, the surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied. In the case of old work, all loose pieces and scales shall be removed and the surface shall be cleaned of all dirt, algae, oil etc. by brushing and washing. Pitting in plaster shall be made good and a coat of best quality water proof cement paint shall be applied over patches after wetting them thoroughly.

b) Preparation of mix:

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement paint Drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

c) Application:

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

d) Precaution:

Water cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

1.12.20.3 Painting with Synthetic Enamel Paint

a. General:

Synthetic enamel paint (conforming to IS: 1932-1964) of approved brand and manufacturer and of the required colour shall be used for the top coat and undercoat of shade to match the top coat as recommended by the manufacturer shall be used.

b. Commencing Work:

Painting shall not be started until Engineer has inspected the items of work to be painted, satisfied himself about their quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm. Painting except the priming coat, shall generally be taken in hand after practically finishing all other builder's work. The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the paint work being started.

c. Painting on New Surface:

Preparation of surface shall be as specified above or as the case may be.

d. Application: The number of coats including the undercoat shall be as stipulated in the Item.

I. Undercoat:

One coat of the specified paint of shade suited to the shade of the top coat shall, be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

II. Top Coat:

Top coats of specified paint of the desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

e. Preparation of Surface

Wood Work:

The surface shall be cleaned and all unevenness removed as specified above. Knots if visible shall be covered with a preparation of red lead. Holes and indentations on the surface shall be filled in with glazier's putty or wood putty and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.

f. Iron and Steel Work:

The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scrapping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

2. TECHNICAL SPECIFICATIONS FOR DRIVEWAY WORK

2.1 Scope of works

The scope of this tender covers: Driveway around the building, Kerb Stone along the driveway, pedestrian pathway around the proposed building with pavers block and cement concrete tiles (Duracrete) as per the drawings and details.

2.2 Consolidation

The sub-grade shall be consolidated with a power road roller of 8 to 12 tonnes. The roller shall run over the sub-grade till the soil is evenly and densely consolidated and behaves as elastic mass (the roller shall pass a minimum of 5 runs on the sub-grade). All undulations in the surface that develop due to rolling shall be made good with material or quarry spoils as the cases may be and the sub-grade re-rolled.

2.3 Surface Regularity

The finished surface shall be uniform and conform to the lines grades and typical cross-sections shown in the drawings. When tested with the templates and straight edge, the variation shall be within the

tolerance. Where the surface irregularity of the sub-grade falls outside the specified tolerances, the Contractor shall be liable to rectify these with fresh materials or quarry spoils as the case may be, and the sub-grade re-rolled to representative.

2.4 Sub-base/Base Courses

This shall be: round soling of size 230 mm. This shall consist of clean crushed coarse aggregate mechanically interlocked by rolling, and voids thereof filled with screening and binding material with the assistance of water, laid on a prepared sub-grade. The sub-base course shall be laid in layers not exceeding 100 mm and base course shall be laid in layers not exceeding 75 mm.

2.5 Spreading Aggregate

The soling stones shall be hand packed and shall be spread uniformly and evenly upon the prepared sub-grade in required quantities. In no case shall these be dumped in heaps directly on the area where these are not to be laid nor shall their hauling over a partly completed sub-grade be permitted. The aggregate shall be spread uniformly to proper profile by using templates placed across the road six metres apart. If desired by ENGINEER-IN-CHARGE approved mechanical devices may be used to spread the aggregates uniformly. The levels along the longitudinal direction up to which the metal shall be laid shall be first obtained at site to the satisfaction of ENGINEER-IN-CHARGE & these shall be adhered to. The surface of the aggregate spread shall be carefully trued up and all high or low spots remedied by removing or adding aggregate as may be require.

2.6 Rolling

Immediately following the spreading of the coarse aggregate, it shall be compacted to the full width by rolling with either a three wheel power roller of 8 to 10 tonnes capacity or an equivalent vibratory roller. Initially, light rolling is to be done, which shall be discontinued when the aggregate is partially compacted with sufficient void space in them to permit application of screenings.

The rolling shall be begun from the edges with the roller running forward and backward and adding the screenings simultaneously until the edges have been firmly compacted. The roller shall then progress gradually from the edges to the center, parallel to the center line of the road and overlapping uniformly each preceding rear wheel. Rolling shall continue until the road metal is thoroughly keyed with no creeping of metal ahead of the roller. Only slight sprinkling of water may be done during rolling, if required. On super elevated curves, the rolling shall proceed from the lower edge and progress gradually continuing towards the upper edge of the pavement.

Rolling shall not be done when the sub-grade is soft or yielding or when the rolling causes a wave like motion in the sub-base or sub-grade. When rolling develops irregularities that exceed 12 mm when tested with a three meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface shall also be checked transversely by template for camber and any irregularities corrected in the manner described above. In no case, shall the use of screenings to make up depressions be permitted.

2.7 Sprinkling water and Rolling

After rolling the surface shall be continuously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screening into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued and additional screenings applied where necessary until the coarse aggregates are well bounded and firmly set for the entire depth and until a grout has been formed of screenings and water that will fill all voids and form a wave of grout ahead of the wheels of the Roller. The quantity of water to be used during the construction shall not be excessive so as to cause damage to the sub-base or sub-grade.

2.10 Application of Binding Material

After the rolling, river sand shall be spread and compacting by sprinkling with water

2.11 Setting and Drying

After final Compaction of the course the road shall be allowed to cure overnight. Next morning defective spots shall be filled with screenings or binding material, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed till the macadam sets. The compacted water bound macadam course should be allowed to dry and set completely before the next pavement course is laid over it.

External Paving

The paving has to extend outside the plot and connect with the existing public road outside the two gates. This extended paving shall be outside the plot premises and shall have precast concrete kerb stone. This shall be part of the work and included in the Item rate contract .

2.23 Precast Concrete Kerbs

2.23.1 Precast Kerb Unit

The precast concrete kerbs shall be cast and installed in accordance with specifications of concrete work given in. The kerbs shall be as per details shown in the drawings and shall be of M20 mix grade (using 20 mm down coarse aggregate) specified. Wherever required so cast-in-situ special kerbs for ramps or way through hall be used, as directed by the ENGINEER-IN-CHARGE at no extra cost.

2.23.2 Bedding and Backing

Cement concrete of 1:3:6 (using 20 mm down coarse aggregate) proportion shall be used as bedding and backing of the kerbs as shown. The concrete shall be laid, after necessary earth work to the dimensions given in the drawings and as directed by the ENGINEER-IN-CHARGE.

2.23.3 Laying

Precast kerbs shall be laid in position in a straight line a profile as required over the bedding and then be grouted with cement sand mortar of 1:2 (1 cement: 2 coarse sand) and re-checked, its profile to the proportion drawings and finally finished smooth with 6 mm thick cement plaster 1:3 (1 cement: 3 coarse sand on exposed surfaces).

2.23.4 Laying Kerbs at Curves

Where kerbs are to be laid on curves the contractor may cast-in-situ kerbs for full length of curves of small radii and between the gaps of precast kerbs laid along the curves of greater radii as and where instructed by ENGINEER-IN-CHARGE.

Boundary Wall

The excavation shall be done with due care with shoring and strutting of adjoining existing boundary walls and perhaps undertaking the excavation in parts in order to prevent any damage to adjoining properties.

The left right and rear boundary walls shall be plastered only on visible exposed face with vertical groove pattern of 8 to 10 mm straight grooves spaced @ 2000 mm centers (max) pressure grouting shall be done in the wall area having earth/ backfill as to prevent any water leakages and dampness etc.

2.24 Concrete Paving

2.24.1 General

Paving shall be designed to suit the Unit operating requirements. In process and utilities units paving shall be provided to give sufficient access and operating space around the equipment. Paved contaminated Process Units shall be provided with trapped catch basins connected to the oily water sewer. The catch basins must be located so that the paving slopes away from process equipment and piperacks. Paving falls shall be within the limits of 1 in 30 maximum to 1 in 120 minimum. In process units the paving may be sloped towards the unit limits to drain to channels.

PLUMBING

TECHNICAL SPECIFICATION OF PLUMBING WORKS:

1.0. Technical Specification of DSR items of Public health works (Based on DSR 2023) mentioned in SOQ shall be as per CPWD specification 2019 VOLUME I AND VOLUME II (corrected up to the last date of submission/uploading of bid).

2.0 For Nonscheduled item mentioned in SOQ shall be installed as per manufacturer's direction approved by the Engineer-in-Charge-in-charge.

3.0 Specification/brands names of fixtures to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified below are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge-in-Charge. The list of approved makes is appended to this document.

TECHNICAL SPECIFICATIONS PLUMBING WORKS

1. BASIS OF DESIGN

The Plumbing, Sanitary, Drainage System for the project is designed keeping in view the following:

- 1.1 Requirement of adequate and equal pressure availability of hot and cold water lines in Public Toilets and Washing Drying areas.
- 1.2 Adequate storage of water in underground + overhead domestic water tanks.
- 1.3 Levels of roads / pavements and other services in the area.
- 1.4 Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

2. CONCEPT OF THE SYSTEM

The following services are envisaged for the building:

- 2.1 Domestic, Flushing water supply through gravity system.
- 2.2 Sewage and Sullage collection system based on IS: 1742 and applicable standards for domestic drainage and connected to outfall into master sewer system
- 2.3 Storm / Rainwater drainage system from various levels of the building and disposal to Rainwater harvesting and over flow to into master system.
- 2.4 Garden Hydrant system with Drip irrigation
- 2.5 External water supply system

3. WATER STORAGE & DISTRIBUTION SYSTEM

3.1 Water Requirement

The water requirement for this project is proposed to be as per the provisions in IS: 1172/NBC and prevalent practices.

3.2 Source of Water

It is expected that part of the daily domestic, flushing & irrigation water requirement shall be met through master water supply.

4. SEWAGE, SULLAGE AND STORM WATER

The soil and waste shall be carried down through one pipe/ 2 pipe drainage system. Venting of system shall be carried out by using separate anti syphonage pipe.

5. WORKMANSHIP

The workmanship shall be best of its kind and shall confirm to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Owner's Site Representative. All materials and/or Workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

6. MATERIALS

All materials shall be best of their kind and shall confirm to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Owner's Site Representative / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

SECTION I: GENERAL INSTRUCTIONS

1.0 GENERAL REQUIREMENTS

1.1 Scope of Work

- 1.1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.
- 1.1.2 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.
- 1.1.3 Without restricting to the generally of the foregoing, the sanitary installations shall include the following:-

A. Plumbing Works

- i) Sanitary Fixtures
- ii) Soil, Waste & Vent and Rainwater Pipes and fittings.
- iii) Water Supply System (Domestic, Flushing & Garden Irrigation System).
- iv) Sewerage & Storm water drainage system
- v) Water Supply system

- 1.1.4 Services rendered under this section shall be done without any extra charge.

1.2 Specifications

- 1.2.1 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

1.2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with up-to-date amendments as applicable in the contract and or as per the requirement of the client or its representative.

1.2.3 Works not covered above in para 1.2.1 and 1.2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

1.3. **Execution of Works**

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

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

1.3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provisions for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

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

1.4 **Drawings**

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

1.4.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

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

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

1.4.5 All drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant

1.5 **Inspection and Testing of Materials**

1.5.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

1.5.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

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

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

1.5.4 All Testing Equipment shall be preferably located in a special room meant for the purpose.

1.5.5 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Architects or kept at site in a sample room as prepared by the owners. Any materials declared defective by Engineer In charge shall be removed from the site within 48 hours.

1.6 **Metric Conversion**

1.6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

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

1.7 **Reference Points**

1.7.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

1.8 **Reference Drawings**

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

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

1.9 **Shop Drawings**

1.9.1 The Contractor shall submit to the Project Manager three copies of the shop drawings.

1.9.2 Shop drawings shall be submitted under following conditions:-

-
- (a) Showing any changes in layout in the plumbing drawings.
 - (b) Equipment layout, piping and wiring diagram.
 - (c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.
- 1.9.3 The Contractor shall submit two copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Project Manager.

1.10 Completion Drawings

- 1.10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Project Manager. These drawings shall have the following information.
- a) Run of all piping, diameters on all floors, vertical stacks and location of external services.
 - b) Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.
 - c) Run of all water supply lines with diameters, locations of control valves, access panels.
 - d) Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted.

- 1.10.2 Contractor shall provide two sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
- 1.10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Project Manager.

1.11. Contractors Rates

- 1.11.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.
- 1.11.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.
- 1.11.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.
- 1.11.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as

directed by Project Manager. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

- 1.11.5 The Contractor shall furnish the Architects with vouchers and test certificates, on request, to prove that the materials as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non tendered items which he may be called upon to be carried out.

1.12 **Testing**

- 1.12.1 Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.

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

- 1.12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

- 1.12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

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

1.13 **Site Clearance and Cleanup**

- 1.13.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

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

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

1.14 **License Permits and Authorities**

- 1.14.1 Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.

- 1.14.2 Contractor shall obtain, from the Municipal and other authority's necessary completion certificate(s) with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall pay all fees/deposits as required to be paid to the authorities towards connection charges.

1.15 **Recovery of Cost for Materials issued to Contractors Free of Cost**

- 1.15.1 If any materials issued to the Contractor free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. plus 100%. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

1.16 **Cutting of Water Proofing Membrane**

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Engineer In Charge. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of water proofing approved by Architects.

1.17 Cutting of Structural Members

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

1.18. Materials Supplied by Owner

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

1.19 Materials

1.19.1 Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specifications mentioned in the list of approved makes attached with the specifications shall be used.

1.19.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Project Manager and returned to the Contractor at the appropriate time.

SECTION II: SANITARY FIXTURES

2. SANITARY FIXTURES

2.1 Scope of Work

2.1.1 Work under this section shall consist of furnishing all materials and labour as necessary and required to completely install all Sanitary Fixtures, chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

2.1.2 Without restricting to the generally of the foregoing the sanitary fixtures shall include the following: -

- a) Sanitary fixtures
- b) Chromium plated fittings
- c) Porcelain or stainless-steel sinks
- d) Accessories e.g. towel rods, toilet paper holders, soap dish, towel rack, coat hooks etc.
- e) Mirrors

-
- f) Connections to all kitchen equipment's pump headers and other equipment requiring water and drainage connections.
- 2.1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.
- 2.1.4 All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.
- 2.2 **General Requirements**
- 2.2.1 Sanitary fixtures shall be of best quality approved by the Project Manager. Wherever particular makes are mentioned, the choice of selection shall remain with the Project Manager. All faucets and cisterns shall have a discharge rate as made mandatory by GRIHA Standard. The contractor shall comply GRIHA Standard given in specifications & BOQ prior to final purchase of the items.
- 2.2.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.
- 2.2.3 Fixing screws shall be half round head Chromium Plated brass screws with C.P. washers where necessary.
- 2.2.4 Contractor shall furnish without cost of all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures and C.P fittings by the manufactures as a part of the original standard supply.
- 2.2.5 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings and 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, tiling or terrace shall be made good at Contractors cost.
- 2.2.6 Contractor seal fixtures fixed near wall, marble and edges. With an approved type of poly-sulphide sealant appropriate for its application.
- 2.3 **Supply of Fixtures & Fittings by Owners**
- 2.3.1 All Porcelain fittings, C.P fittings and accessories shall be supplied by the owners free of cost at site, unless specified otherwise.
- 2.3.2 Contractor shall take the delivery of the materials directly from the suppliers and will be responsible for its safe storage and custody in the godown as provided by the owner.
- 2.3.3 Only materials, accessories and fixing devices supplied as standard supplies by the manufacturer shall be given to the Contractor free of cost at site.

2.3.4 All balance materials e.g. nuts, bolts, CP nuts and bolts; other fixing devices shall be supplied by the Contractor within the quoted rates.

2.3.5 Description and method of fixing is given below for the contractor to understand the scope and extent of the work for which main materials will be supplied by the Owners.

2.4 **Floor Mounted European W.C**

2.4.1 European W.C. shall be wash down or syphonic type floor or wall mounted set flushed by means of porcelain flushing cistern, exposed type flush valve or by imported type plastic flushing systems which will be an integral part of the wall system. **Framework, walling and finishing will not form a part of the Contractor's work.** Where ever applicable flush pipe/bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by a floor mounted chair.

2.4.4 Flushing cistern (exposed/coupled/concealed/others) when provided shall be provided with all internal flushing mechanism, 15mm dia ball cock with unbreakable polyethylene float and overflow pipe. Any frame work required for fixing cistern has to be provided by the Contractor. Each W.C shall be suitable for flushing in low volume of water 5-6 liters.

2.5 **Urinals**

2.5.1 Urinals shall be white glazed Vitreous China of size, shape and type specified in the Schedule of Quantities.

2.5.2 Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete as directed by Project Manager.

2.5.3 Flush pipe shall be uPVC pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities.

2.5.4 Urinals shall be flushed by fully automatically no-touch flush valve with solenoid valves.

2.5.6 Waste pipes for urinals shall be uPVC 6 kg/cm² as per IS 4985. Waste pipes may be exposed on wall or concealed in chase as directed by the Specifications for waste pipes shall be same as given in Section 3.

2.6 **Wash Basin**

2.6.1 Wash basins shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

2.6.2 Each Basin shall be provided with brackets and clips of approved and securely fixed. Placing of Basins over the brackets without secure fixing shall not be accepted.

2.6.3 Each Basin shall be provided with a 32mm dia waste with overflow, pop-up waste or rubber plug and chain as specified in the Schedule of Quantities, 32mm dia PP bottle trap with built-in AAV & pipe to wall and flange.

2.6.4 Each basin shall be provided with mixing fitting as specified in the Schedule of Quantities.

2.6.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Project Manager.

2.7 **Sinks**

2.7.1 Sinks shall be stainless steel or any other material as specified in the Schedule of Quantities.

2.7.2 Each sink shall be provided with brackets of approved and securely fixed. Counter top sinks shall be fixed with suitable brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug as given in the Schedule of Quantities. Fixing shall be done as directed by Project Manager.

2.7.3 Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the Schedule of Quantities.

2.8 **Accessories**

2.8.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Project Manager.

2.8.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Project Manager.

2.8.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer's drawings.

2.9 **Liquid Soap Container**

2.9.1 Liquid Soap Container shall be of approved quality.

2.10 **Towel Ring**

2.10.1 CP Brass towel ring trapezoidal shape 215 mm long, 200 mm wide with minimum distances of 37 mm from wall face with concealed fittings arrangement of approved quality and colour

2.11 **Coat Hook**

2.11.1 Coat hook shall be of brass material and chrome color double hook type of approved make & quality.

2.12 **WC Pan Connector**

2.12.1 straight / offset type flexible single body push fit type WC pan connector of with integral single mould sealing fins made of flexible EVA body to be fixed with manufacture supplied grease, including rubber bush / adaptor for use with uPVC pipe

2.13 **Sink Mixer**

2.13.1 CP Brass Single lever mixer for sink approved make & quality.

2.14 **Water cooler**

2.14.1 water cooler with Inbuilt Aquagaurd / Equivalent RO purification + UV(50LPH) .Cooling capacity shall be 100 liter & 150 liter shall be storage capacity. Its should have 7 stages purification process, fully automatic, rectangular tank with Forced fin and tube condenser, Non-corrosive SS-304 outer body, Food-grade SS-304 stainless steel inner tank (18/8 or 18/10), PUF insulation, Reciprocating compressor with R22 Refrigerant. Water outlet temp is approx. 17 deg c, Operating power supply 230 + 10% V AC,50 Hz,1 PH

2.15 **Two way bib cock**

2.15.1 C.P. brass Two way bib cock of approved quality conforming to IS:8931 approved make & quality.

2.16 **Health faucet**

2.16.1 CP Health faucet to European type W.C. Of approved quality & make.

2.17 **Towel rail**

2.17.1 CP Brass towel rail complete with brackets with CP brass screws with concealed fittings arrangement of approved quality and colour.

2.18 **Soap Dish Holder**

2.18.1 CP Brass Soap Dish Holder complete with brackets with CP brass screws with concealed fittings arrangement of approved quality and colour.

2.19 **Handicap Toilet**

2.19.1 Handicap toilet with 600mm wide grab bar with European WC and and Wash basin

2.20 **Measurement**

2.20.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.

2.20.2 Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

SECTION III: WATER SUPPLY SYSTEM

3. WATER SUPPLY SYSTEM

3.1 Scope of Work

- 3.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- 3.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-
- a. Water connection will be taken from the existing water supply network across the campus.
 - b. Flushing Water Main Distribution System from S.T.P. to U.G.T.
 - c. Transfer pumps set shall be considered for filling of domestic and flushing overhead water tank.
 - d. Level sensor-based solenoid valve will be installed at terrace level in domestic and flushing water tank for automatic operation of water pump set for tank filling purpose. Electronic sensor-based water level indicator is considered for OHT to monitor water level in the tanks.
 - e. Once the Water level in OHT decreases and reaches at desired Low level then domestic and flushing transfer pump will come in operation automatically and start filling the OHT and after reaching the Maximum set level in OHT the transfer Pump will stop.
 - f. Pipe protection and painting.
 - g. Providing insulation to hot & cold-water pipelines wherever required.
 - h. Connections to all plumbing fixtures, kitchen equipment, tanks, appliances, irrigation features.
 - i. Ball valve/butterfly valve/non-Return valve/Float valve/Pressure relief valve/Air valve, masonry chambers & other appurtenances.
 - j. Supports/ Clamps, Excavation& refilling of pipe trenches, required civil work. Water meters, gauges, etc. required.

3.2 General Requirements

- 3.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
- 3.2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 3.2.3 Short or Long bends shall be used on all main pipelines as far as possible. Use of Elbows shall be restricted for short connections.
- 3.2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 3.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 3.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.
- 3.2.7 All pipe clamps, supports, nuts, bolts, and washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 3.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3.3CPVC pipes, fittings & valves

3.3.1 All pipes inside the toilet and where specified, outside the building shall be CPVC pipes tubes conforming to IS 15778:1996. Specific Gravity ASTM D 792 at 23oC should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23oC should be 55N/mm2.

3.3.2 **JOINING PIPE & FITTINGS**

a. Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburring/ Beveling

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

c. Fitting Preparation

A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application

Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. CPVC schedule 40 & 80 heavy bodied CPVC solvent cement only should be used confirming to ASTM-F493.

e. Assembly

After applying the solvent cement on both pipe and fitting socket, pipes should be insert into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Cure prior to pressure testing at 150 psi

S.no	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1.1/4" to 2"
1	Above 15 deg C	1 Hr	2 Hrs

2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

- f. Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10 Bar) for minimum 24hrs. During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

3.3.2 Transition of CPVC to Metals

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adapters) should be used. Plastic threaded connection should not be over torque. Hard tight joints one half turn should be adequate.

3.3.3 Threaded Sealants

Teflon tapes shall be used to make threaded connection leak proof.

3.3.4 Hangers & Supports

For horizontal runs, support should be given at 3 ft (90cms) intervals for diameter of 1" and below and at 4 ft (1.20 mtr) intervals for larger size.

Hangers should not have throw or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

S.No	Size of Pipe	21°C	49°C	71°C	82°C
	Inch	Ft	Ft	Ft	Ft
1	1/2"	5.5	4.5	3.0	2.5
2	3/4"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	1 1/4"	6.5	6.0	3.5	3.5
5	1 1/2"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

- 3.3.5 All special fittings and accessories like internally or externally threaded brass adapters, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc shall be made of CPVC by licensee.

- 3.3.6 The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from 1/2" up to 2" pipes and fittings, single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2", a primer shall be used followed by heavy bodied solvent cement conforming to ASTM F493. **PVC solvent cement should not be used.**

- 3.3.7 Concealed Plumbing:

All internal concealed plumbing for water supply shall be done with CPVC pipes. The pipes & fittings shall conform to CTS (Copper Tube Size) SDR-11 as per ASTM D2846. All pipes and

fittings from ½" up to 2" shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

3.4 uPVC pipes, fittings & valves

3.3.1 All pipes exposed in terrace and shaft and where specified, outside the building shall be uPVC pipes tubes conforming to IS 4985.

3.3.2 JOINING PIPE & FITTINGS

a. Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburring/ Beveling

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

c. Fitting Preparation

A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application

Only uPVC solvent cement should be used for joining pipe with fittings. uPVC schedule 40 solvent cement only should be used.

e. Assembly

After applying the solvent cement on both pipe and fitting socket, pipes should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Cure prior to pressure testing at 150 psi

S.no	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1-1/4" to 2"

1	Above 15 deg C	1 Hr	2 Hrs
2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

- f. Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10 Bar) for minimum 24hrs. During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

3.3.2 Transition of uPVC to Metals

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adopters) should be used. Plastic threaded connection should not be over torque. Hard tight pluts one half turn should be adequate.

3.3.3 Threaded Sealants

Teflon tapes shall be used to make threaded connection leak proof.

3.3.4 Hangers & Supports

For horizontal runs, support should be given at 3 ft (90cms) intervals for diameter of 1" and below and at 4 ft (1.20 mtr) intervals for larger size.

Hangers should not have throw or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

S.No	Size of Pipe	21°C	49°C	71°C	82°C
	Inch	Ft	Ft	Ft	Ft
1	1/2"	5.5	4.5	3.0	2.5
2	3/4"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	1 1/4"	6.5	6.0	3.5	3.5
5	1 1/2"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

- 3.3.5 All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc shall be made of CPVC by licensee.
- 3.3.6 The uPVC solvent cement used for installing uPVC piping systems. Pipes from 1/2" up to 2" pipes and fittings, single step medium bodied uPVC solvent cement should be used. For uPVC pipes and fittings upwards of 2", a primer shall be used followed by heavy bodied solvent cement. ***PVC solvent cement should not be used.***

3.5 Water Supply System

- 3.5.1 Contractor should study the site plan and water supply system diagram for an overview of the system.

3.5.2 Source

Water supply will be acquired from master line and collected in under ground water storage tanks.

3.6 Pipe Supports

3.6.1 All pipes clamps, supports, hangers, rods, pipe supports, nuts and washers shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirements.

3.6.2 SS pipes in shafts and other locations shall be supported by galvanized M.S clamps of design approved by pipes in wall chases shall be anchored by G.I hooks, pipes at ceiling level shall be supported on structural clamps fabricated from M.S structural steel. Pipes in typical shafts shall be supported on Galvanised slotted angles/channels as specified elsewhere.

3.6.3 Clamps

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural steel as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

3.7 Anchor Fasteners

3.7.1 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by an approved type of power drill as recommended and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility, and the contractor shall redo or provide additional support at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

3.8 Unions

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

3.9 Flanges

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S.780. and C.I. butterfly valve to IS: 3095.

3.10 Valves

3.10.1 Ball Valves

Valves upto 50 mm dia. shall be screwed type Ball Valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 16 kg , sq.cm., and accompanying couplings and steel handles.(to BS 5351) protected with thermal insulation.

3.11 Butterfly Valves – Slim Seal Type

3.9.1 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

3.9.2 Butterfly valve shall be of the best quality conforming to IS: 13095.

3.12 Non-Return Valve (Dual Slim Type)

Where specified, non-return valve shall be provided through which flow shall occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

SECTION IV Soils, Waste, Vent Pipes & Fittings

4 Scope of work

1.1 Work under this section shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings and as given in the Schedule of Quantities.

4.1 Without restricting to the generality of the foregoing, the work shall include the following:-

- a. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install for Drainage system (Sewage & Storm water) as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- b. Without restricting to the generality of the foregoing, the drainage system shall include the following: -
- c. All soil/ waste water & rain water lines to various parts of the building including connection to vertical stack & to final disposal point which maybe city sewer / storm manhole / Nalla / Sewage or Effluent Treatment Plant.
- d. Pipe slopes/ gradient to achieve self-cleansing velocity.
- e. Drain Connections to all plumbing fixtures, Floor drains, equipment, tanks, appliances, irrigation features, water bodies.
- f. Supports/ Clamps, Excavation & refilling of pipe trenches, required civil work.

4.2 General requirements

- 4.2.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Engineer In charge.
- 4.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 4.2.3 Pipes shall be fixed in a manner to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 4.2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.
- 4.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

4.3 Piping System

- 4.3.1 Soil, Waste & Vent Pipes

-
- a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, bath tubs, showers, washbasins, AHU's condensate drains and floor drains and is approved by the local authority. Waste stacks have been provided with a "P" trap at basement ceiling.
 - b) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement floor ceiling as shown on the drawings.
 - c) All Floors of toilets, kitchens and other service areas located on structural slab are SUNK by 125 mm to accommodate waste pipes of 40mm, 50mm & 63mm.
 - d) All soil and waste from areas below general ground level will be collected in sumps and pumped into sewer lines.
 - e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

4.5 Fixing

- 4.5.1 All vertical pipes shall be fixed truly vertical to walls with approved type of GI clamp. 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). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-
- 4.5.2 Horizontal pipes running on the floor shall be covered with cement concrete grade M-10, 75mm thick in bed and 75mm thick all around soil and waste pipes under floor
- 4.5.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

4.6 Clamps

- 4.6.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1: 2 : 4 mix blocks 10x10x10 cms deep.
- 4.6.2 Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with **galvanized** 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- 4.6.3 For SWR pipes conforming to IS: 13592 shall be clamped to wall with approved type of uPVC saddle clamp/U-clamp or as given in the Bill of quantities.
- 4.6.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- 4.6.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement

concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

4.6.6 Wherever MS clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.

4.6.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

SYSTEM PERFORMANCE GUARANTEE

a. The Contractor shall guarantee that upon completion of work, all installed systems thereof shall be in full accordance with the requirements of the contract and shall be perfect as to materials and workmanship and shall remain as per contract agreement.

b. Contractor shall submit charts / performance curves for selected equipment with the operating points duly marked on them. If during the shop test it is found that the equipment does not meet specification, any modification/ replacements of any part or equipment as a whole are required, the same shall be done by the Contractor at no extra cost to the Engineer in charge.

MARKINGS:

All pipes shall carry the following markings: Time and date of manufacture; company name; dimension, application class, barcode and material details.

PIPES & FITTINGS:

Soil & Waste Pipes & fittings shall be as per IS 15392 Type-B

INSTALLATION: The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer's installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

4.5 Traps

4.5.1 Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes in sunken area (where required) shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.

4.5.2 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to an uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. UPVC multi-inlet trap can be used where ever possible to be decided by the project Engineer.

Trap & Seals

All traps shall be self cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

Appliance or ware	Material	Trap Type	Seal depth(mm)
Lavatory /wash basin	C.P. cast brass	32 mm dia Bottle	75 mm
Sink	C.P. cast brass	40 mm dia Bottle	75 mm
Kitchen floor drain of fabricated drain boxes	uPVC/C.I.	75/100 mm dia 'P' or 'S'	50 mm
Urinals	uPVC/C.I.	100 mm dia 'P' or 'S'	50 mm

4.5.3 Floor Gratings

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

4.5.4 Jointing

Pipe to pipe and pipe to fitting (SWR) joint shall be with 'O' rubber ring as recommended by the manufacturer. Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to I.S. 4985) and fittings or as recommended by the manufacturers.

4.6 Cleanout Plugs

4.6.1 PP Clean out pipe for Soil, Waste pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.

4.6.2 Cleanout on Drainage Pipes

- a) Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Project Manager. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.
- b) Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

4.7 Waste pipe from appliances

4.7.1 General

- a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be uPVC Pipes 6 kg/sqcm confirming to IS 4985.
- b) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section 1.

4.8 Encasing pipe in Cement Concrete

uPVC soil and waste pipes and drainage under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter. Rate for concreted round pipes shall be inclusive of pillars, supports, shuttering and centering.

4.9 Cutting and making good

4.9.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally,

they shall be made good with cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

4.10 Testing

4.10.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.

4.10.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.

4.10.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

4.10.4 Testing soil, waste and rainwater pipes

- a) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.
- b) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
- c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.

4.10.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in the presence of Project Manager and signed by both.

4.11 Measurements

4.11.1 General

- a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
- b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.
- c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
- d) Rates are inclusive of pre-testing, on site testing, of the installations, materials and commissioning of the works.
- e) Pipes (unit of measurement. Linear meter to the nearest centimeter)

4.11.2 Pipes shall measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter,

method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

- 4.11.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.
- 4.11.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.
- 4.11.5 **Fittings**
Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.
- 4.11.6 **Excavation for soil pipes**
No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.
- 4.11.7 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION V Rainwater Pipes & Fittings

5.1 Scope of work

Work under this section shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rain water pipes and fittings as required by the drawings and as given in the Schedule of Quantities.

5.2 Without restricting to the generality of the foregoing, the work shall include the following: -

- a) Vertical and horizontal rain water pipes, and fittings, joints, clamps and connections to fixtures.
- b) Connection of all pipes to storm lines as shown on the drawings.
- c) Testing of all pipe lines.

5.3 General requirements

- 5.3.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Engineer In charge.
- 5.3.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 5.3.3 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.
- 5.3.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.
- 5.3.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

5.4 Piping System

5.4.1 Rainwater Pipes

-
- a) All terraces shall be drained by providing down-takes rainwater pipes.
 - b) A separate piped drainage system for slopping roof with leaders shall be provided.
 - c) Rainwater pipes are separate and independent connected to the external storm water drainage system as shown on the drawings.

5.4.2 Balcony/Planter drainage

Open balconies, terraces, planters and formal landscape areas will be drained by a separate pipe connected to external storm water drainage system.

5.5 uPVC pipes for SWR Type- A system

5.5.1 Pipes

5.5.1.1 All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be conforming to IS: 13952 type A for rain water.

5.5.1.2 Pipes shall be joined by approved type of socket and 'O' rubber ring (conforms to IS: 5382) joints with rubber lubricant.

5.6. Fittings

5.6.1 Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching IS specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

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

5.6.3 Connection from a vertical stack or position to a horizontal line shall be made only by a "Y" junction.

5.7 Fixing

5.7.1 All vertical pipes shall be fixed truly vertical to walls with approved type of uPVC saddle clamp. 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). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-

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

5.7.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

5.8 Clamps

- 5.8.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1 : 2 : 4 mix blocks 10x10x10 cms deep.
- 5.8.2 Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with **galvanized** 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- 5.8.3 For SWR pipes conforming to IS: 13592 shall be clamped to wall with approved type of uPVC saddle clamp/U-clamp or as given in the Bill of quantities.
- 5.8.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- 5.8.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
- 5.8.6 Wherever MS clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.
- 5.9 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

CLAMP AND PIPE SUPPORT SPACING

S.No.	Type of Pipes & Position	Commercial Pipe Dia. (Spacing in m)						
		15/20	20/25	32/40	50	75/80	100/110	150/160
1	Vertical Pipes							
1.1	GI /MS Pipes	2.4	2.4	3		3.6	4.5	5.4
1.2	uPVC Pipes							
	SWR Pipes	x	x	<----- 1 m ----->				
	IS 13592							
1.3	uPVC /cPVC Pipes							
	IS 4985 for Water Supply	x	x	x		<----- 1 m ----->		
	IS 13585 for SWR	x	x	0.5		0.7	0.9	0.9
2	Horizontal Pipes							
2.1	GI /MS Pipes	<-----2.0 m ----->		2.4 m	3	3.6	4	4.5
2.2	uPVC pipes							
	SWR Pipes			<----- 1.0 m ----->				
	IS							
	Water Supply Pipes uPVC					<----- 1 m ----->		
	IS 4985							
2.3	Fittings	All traps and tees and fittings runing below ceiling shall be supported on both sides						

5.10 Cutting and making good

- 5.10.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

5.11 Testing

- 5.11.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.
- 5.11.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.
- 5.11.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.
- 5.11.4 Testing soil, waste and rainwater pipes
- c) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.
 - d) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
 - c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.

5.11.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Project Manager and signed by both.

5.12 Measurements

5.12.1 General

- a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
- b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.
- c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
- d) Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.
- e) Pipes (unit of measurement. Linear meter to the nearest centimetre)

5.12.2 Pipes shall measured per running meter correct to a centimetre for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

5.12.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

5.12.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

5.13 Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

5.14 Excavation for rain water pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.

5.15 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION VI: EXTERNAL WATER SUPPLY SYSTEM

6. EXTERNAL WATER SUPPLY SYSTEM (DOMESTIC, FLUSHING, IRRIGATION)

6.1 Scope of Work

- 6.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- 6.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-
- a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
 - b) Cold water supply lines from master water supply line underground water tanks.
 - c) Excavation and refilling of pipes trenches.
 - d) Pipe protection and painting.
 - e) Control valves, masonry chambers and other appurtenances.
 - f) Connections to all plumbing fixtures, tanks, appliances and Municipal mains

6.2 General Requirements

- 6.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
- 6.2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 6.2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.

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- 6.2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 6.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 6.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.
- 6.2.7 All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 6.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

6.3 **Water Supply System**

- 6.3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.
- 6.3.2 Source

Water supply will be acquired from master water mains to water storage tanks located in basement.

6.4 **GI pipes, fittings & valves**

- 6.4.1 Domestic & Flushing water supply from the master water supply line to Underground tank shall be GI C Class Heavy duty pipe confirming to IS 1239

6.5 **JOINING PIPE & FITTINGS**

GI Pipe 50mm and below shall be threaded joint and above 50mm shall be welded joint.

6.6 **PAINTING PIPE & FITTINGS**

GI Pipe shall be paint with two coats of anti-corrosive bitumastic paint

6.7 **Trenches**

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows

<u>Dia of pipe</u>	<u>Width of Trench</u>	<u>Depth of Trench</u>
15mm to 50mm	30 cms	75cms
65mm to 100mm	45 cms	100 cms

6.8 **Sand filling**

Pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

6.9 **Painting**

- 6.9.1 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code given in this document or specified by Project Manager.

6.10 Pipe protection

6.10.1 All GI pipes in wall chase and below floor in toilets (where so fixed) shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

6.10.2 G.I. water supply pipes, if buried in ground or sunken slab, shall be protected with multi-layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pypkote" or equivalent.

6.11 Valves

6.11.1 Ball Valves

Valves upto 50 mm dia. shall be screwed type Ball Valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 20 kg, sq.cm., and accompanying couplings and steel handles. (to BS 5351)

6.12 Butterfly Valves – Slim Seal Type

6.12.1 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

6.12.2 Butterfly valve shall be of best quality conforming to IS: 13095.

6.13 Non-Return Valve (Dual Slim Type)

Where specified, non-return valve shall be provided through which flow shall occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

6.14 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

6.15 Testing

All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is more. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage

done due to carelessness, open or burst pipes' or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defect's liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves, which do not effectively operate, shall be replaced by new ones at no extra cost and the same shall be tested as above.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60°C hot water supply.

6.15 All the irrigation Pipe shall be HDPE PE-100 PN-8 Pipe

6.16 Measurement

- a) Pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.
- b) Jointing with teflon tape, white lead, solvent, crimping and insertion gasket of appropriate temperature grade.
- c) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
- d) Excavation, backfilling, disposal of surplus earth and restoring the ground & floor in original condition.

6.17 Pipe Supports

Fabricated and / or galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structurals and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

6.18 Rate quoted for supports & hangers shall be inclusive of :

- a) Expandable anchor fastens.
- b) Galvanising of all supports & hangers.
- c) Cutting holes in walls, ceilings on floors and making good where permitted.
- d) Nuts, bolts and washers for fixing and assembling.
- e) Wooden / PVC pipe saddles for vertical or horizontal runs.

6.18.1 Valves

Gunmetal, cast iron, butterfly and non-return valves and puddle flanges shall measured by numbers and shall include wheels I caps, GI nuts, bolts, washers, insertion gasket.

6.18.2 Painting/pipe protection/insulation

Painting/pipe protection /insulation for pipes shall be measured per linear meter over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

6.19 Irrigation system

Irrigation is by the drip irrigation system with HDPE Pipe

6.20 Water meter

Water meter shall be digital type water meter.

SECTION VII: SEWAGE & STORM WATER WORK

7.1 Scope of work

- 7.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.
- 7.1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-
- a) Sewer lines including excavations, pipelines, manholes, drop connections and connections to the existing sewer.
 - b) Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

7.2 General requirements

- 7.2.2 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Project Manager.
- 7.2.3 Drainage lines and open drains shall be laid to the required gradients and profiles.
- 7.2.4 All drainage work shall be done in accordance with the local municipal bye-laws.
- 7.2.5 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.
- 7.2.6 Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

7.3 Excavation

7.3.2 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Project Manager. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Project Manager.

7.3.3 Excavation in tunnels

The excavation for sewer works shall be open cutting only, unless the permission of the Project Manager is obtained for laying pipes in tunnel where sewers have to be constructed along narrow passages or difficult ground.

7.3.4 Opening out trenches

In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager.

7.3.5 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Project Manager.

7.3.6 Removal of filth

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

7.3.7 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating thereto and so that the inverts may be at the levels given in the sections.

7.3.8 Refilling

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

7.3.9 Contractor to restore settlement and damages

The contractor shall, at his own costs and charges make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be reliable for any accidents caused thereby. He shall also at his own cost and expenses and charges, repair any make of any damage done to the buildings and other property.

7.3.10 Disposal of Surplus Earth

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

7.3.11 Timbering of sewer and trenches

- a) The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose of sandy strata and below the surface of the sub soil water level.
- b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse of subsidence of the walls of the trench shall be take place.
- c) The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

7.3.12 Shoring of Buildings

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

7.3.14 Removal of water from sewer, trench etc

- a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
- b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses.

7.3.15 Width of trench

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

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

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

7.3.17 Jointing of Pipes

- a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.
- b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.
- c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or "Badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

7.4 Testing

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.
- Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar

projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end. (ii) means of a mirror at one and a lamp at the other end. If the pipeline is straight the full circle of light will be seen otherwise obstruction or deviation will be apparent.

- The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.

A test register shall be maintained which shall be signed and dated by Contractor.

7.5 Gully traps

Gully traps shall be of the same quality as described for stoneware pipes in clause 5.4.1 above and used where shown on drawings.

Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40 mm nominal size) and a brick masonry chamber 30x30 cms inside plastered with cement mortar 1:5 with 15x 15 cms grating inside and 30x30 cms C.I. sealed cover and frame weighing not less than 7.3 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

7.6 DWC pipes

- All underground storm water drainage pipes and sewer lines where specified double layer pipe with the outer layer having corrugation and the inner layer with a smooth surface. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

- **Laying**

DWC pipes shall be laid on cement concrete bed or without concrete as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

- **Jointing**

- The jointing procedure of DWC pipes is easy and simple to adopt and is illustrated below.



- **Testing**

All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. The smoke test shall be carried out by the contractor, if directed by the Project Manager and a test register shall be maintained which shall be signed and dated by the Contractor/Project Manager.

7.7 Cement Concrete and masonry works (For Manholes and Chambers)

7.7.1 Materials

a) Water

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for construction purpose.

b) Aggregate for Concrete

The aggregate for concrete shall be in accordance with I.S. 383 and I.S. 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Project Manager. The size of the coarse aggregate shall be done as per I.S.383.

c) Sand

Sand for various constructional purposes shall comply in all respects with I.S 650 and I.S. 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated

particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Project Manager.

d) **Cement**

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I.S. 269.

e) **Mild Steel Reinforcement**

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I.S. 432 (Grade I).

f) **Bricks**

Bricks shall have uniform color, thoroughly burnt but not over burnt, shall have plan rectangular faces with parallel sides and sharp right-angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Project Manager.

g) **Other Materials**

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Project Manager before use.

7.7.2 Cement concrete (plain or reinforced)

- a) Cement concrete pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.
- b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.
- c) All concrete work shall be cured for a period or at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during the curing period.

7.7.3 Masonry

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Schedule of quantities in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

7.7.4 Cement concrete for pipe support

Wherever specified or shown on the drawing, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be as per para 5.3.1.4.

Unless otherwise directed by the Project Engineer, cement concrete for bed, all-round or in haunches shall be laid as follows: -

	upto 1.5 m depth	upto 3 m depth	beyond 3 m depth
dwc pipes In open ground (no sub soil water)	All round (1:4:8)	Haunches (1:4:8)	All round (1:4:8)
R.C.C (In sub soil water)	All round (1:3:6)	Haunches (13:6)	Haunches (1:3:6)
PP Pipes (In all conditions)	All round (1:3:6)	Haunches (13:6)	Haunches (1:3:6)
R.C.C Pipes Or PP Pipes Under or building (Ratio refer to cement: coarse sand: stone aggregate 40 mm nominal size)	All round (1:3:6)	All round (13:6)	All round (1:3:6)

R.C.C pipes or DWC pipes may be supported on brick masonry or precast R.C.C or in situ cradles. Cradles shall be shown on the drawings. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7.8 Manholes and chambers

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

7.8.2 All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule or Quantities or shown in the drawings.

Where not specified, manholes shall be constructed as follows:- (all dimensions internal clear in cms)

Size of manhole type	90x80 Rect.	120x90 Rect.	91 dia 122 dia Conical Conical
Maximum depth	120	240	167 168
Average thickness			

Of R.C.C slab	15	15	-	-
Size of cover and frame cms	60x45	50 dia	50 dia	50 dia
Weight of Cover and frame	38 kg -----	116 or 208 kg	116 or 208 kg	116 or 208 kg

- 7.8.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nom. Size) as per standard details.
- 7.8.4 All manholes shall be plastered with 12mm thick cement mortar 1: 3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.
- 7.8.5 All manholes with depths greater than 1 m. shall be provided with 20 mm square or 25 mm round rods plastic coated catch rings set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.
- 7.8.6 All manholes shall be provided with cast iron/steel fiber reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.
- 7.8.7 Road gullies, ramp drains, gratings in basement shall be cast iron with M.S. frame or Steel Fiber Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.

7.9 Making connections

- 7.9.1 Contractor shall connect the sewer line of the building to the main manhole by providing making holes and channels etc.

7.10 Measurement

7.10.1 Excavation

Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site and specified in the tender.

- A) Ordinary soil
- B) Hard soil (hard moorum & soft rock)
- C) Hard rock requiring chiseling

D) Hard rock requiring blasting

Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth up to 1.5 m or as given in the Schedule of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

Timbering and Shoring Timbering and shoring as described above shall be measured per sq m and paid for as per the type of timbering of shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

Saturated Soil

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipelines or sewers.

Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 1500 m.

7.10.2 DWC Pipes / RCC pipes

DWC /R.C.C. pipes shall be measured for the finished length of the Pipe line per linear meter i.e.

- (a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole
- (b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

7.10.3 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

7.10.4 Cement Concrete for Pipes

Cement concrete in bed and all round or in haunches shall be paid per running meter between the outside walls of manholes at bottom of the trench. No additional payment is admissible in

respect of concreting done for widths greater than specified, for shuttering or centering and concreting in sub soil water conditions.

7.10.5 Manholes, Catch basins & Ramp drains

- a) All manholes and catch basins shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.
- b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.
- a) Ramp drains shall be measured per meter length.

7.10.6 Making Connections

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

END OF SECTION VII

SECTION VIII: WATER COOLER

Water cooler with Inbuilt RO purification + UV(50LPH) .Cooling capacity shall be 60 liter & 80 liter shall be storage capacity. It's should have 7 stages purification process, fully automatic, rectangular tank with Forced fin and tube condenser, on-corrosive SS-304 outer body, Food-grade SS-304 stainless steel inner tank (18/8 or 18/10),PUF insulation, Reciprocating compressor with R22 Refrigerant. Water outlet temp is approx. 17 deg c, Operating power supply 230 + 10% V AC,50 Hz,1 PH, No of Cold-water Faucet-2.

SECTION IX PUMPS &EQUIPMENTS.

8.0 Pumps & Equipment

- 8.1 Work under this sub-head consists of furnishing all labour, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.
- 8.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:
 - a) Motor control panels, power and control cabling and allied electrical works.
 - b) Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

8.3 PUMP SET

8.3.1 Water Supply Pumps

(These specifications are applicable for all clear water pumps and as specified in Bill of Quantities)

- 8.3.2 Water supply pumps shall be suitable for clean water. Pumps shall be single or multistage, monoblock horizontal, vertical, centrifugal pumps with cast iron/stainless steel body and

- stainless steel/bronze impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling or as specified in bill of quantities. Each pump should operate a curve 10m below specified head.
- 8.3.3 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.
- 8.3.4 Each pump shall be provided with a totally enclosed fan cooled induction motor of required H.P. and RPM specified in the bill of quantities and as per requirement.
- 8.3.5 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.
- 8.3.6 Provide vibration-eliminating pads appropriate for each pump.
- 8.3.7 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities (to be paid separately).
- 8.3.8 All water supply pumps shall be provided with mechanical seals, of required specifications.
- 8.3.9 **RANSFER PUMP SYSTEM FOR OHT FILLING**
 This system shall consist of SS vertical multistage centrifugal pump. Each pump shall have TEFC 2900 RPM three phase electric motor. The pump shall have, SS casing, cast Iron head, SS base, SS Shaft/ Impeller/ Intermediate chamber.
 Pump shall be provided with cartridge type mechanical seal. The pump shall be suitable for auto/ manual operation.
 The system shall be with Skid mounted, wall mounted / floor mounted electrical control panel comprising of Control cabinet with an IP 54 enclosure of suitable rating with the keypad and pressure display screen mounted through the outer door. In addition to the electronic pump controller, the control cabinet shall include pressure transmitter, float switches, circuit breakers for each pump and the control circuit, control relays for alarm functions and fuses.

LIST OF APPROVED MAKES

- 1 All materials and equipment used in execution of work shall be of approved makes listed below. Any make offered by Tendered other than the approved makes will be subject to the approval of Owner/ Architect/ Consultant/ Interior Designer. If other makes are offered, the same shall be clearly indicated in tender.
- 2 Contractor shall list out the makes of equipment and materials offered during tender stage itself. Decision about the final selection of the make from the makes included in Agreement shall rest with the Owner/ Architect/ Consultant as applicable.

SI No	Item / Material	Make
1	Sanitary ware & CP Fittings	Hindware / Jaquar/ Parryware/ Bathsense
2	CP Fittings	Hindware / Jaquar/ Parryware/ Bathsense
3	SS Sink	Jayna / Nirala/ Hindware/ Nilkanth
4	Geyser	AO Smith/ Jaquar/ Venus
5	Drinking Water cooler	Bluestar/ Usha/ Voltas
6	WC Pan Connector	Mcalpine/ Supreme/ Astral/ AKG

7	Butterfly Valve	Zoloto/ Sant/ Lehry
8	Check Valve	Zoloto/ Sant/ Lehry
9	Ball Valves	Zoloto/ Sant/ Lehry
10	Pressure Reducing Valves	Zoloto/ Sant/ Lehry
11	Water Meter	Kranti / Kent/ Lehry
12	uPVC Pipes & Fittings	Supreme/ Ashirwad/ Astral/ AKG
13	CPVC Pipes & Fittings	Supreme / Ashirwad/ Astral/ AKG
14	Stainless Steel Grating	Jayna/ Neer / Chilly
15	CI Pipes	Neco/ Hepco/ SKF
16	Channel Grating	Jayna/ Neer / Chilly
17	uPVC Floor Trap	Supreme / Ashirwad/ Astral/ AKG
18	uPVC Floor Drain	Supreme / Ashirwad/ Astral/ AKG
19	uPVC Multi Trap	Supreme / Ashirwad/ Astral/ AKG
20	Air Release Valve	Sant / Zoloto/ Lehry
21	SW Gully Trap	Anand
22	SS Pipe	Jindal/ VSH/ Tata
23	GI Pipes as per IS:1239	Surya Prakash/ Jindal hissar/ Tata/ APL Apollo
24	GI Fittings (Malleable Cast Iron) as per IS:1879	Zoloto / Sant/ Surya Prakash
25	Cables	Polycab/ Sky tone / Finolex
26	RCC Pipes	Om spun Pipes/ Indian Hume Pipe/ Jain Spun pipes/ Shri Balaji Spun Pipe
26	HDPE DWC Pipe	Astral/ Prince/ Supreme
27	S.F.R.C. Manhole covers	Om Spun pipe/ KK Manhole / BRHC
28	CI Manhole covers	NECO / KK / Bengal Iron Corporation
29	Ductile Iron pipe	Jindal Saw Ltd/ Electro steel/ Tata
30	DI Fittings	Electro steel/ Kejriwal/ Jai Balaji (Supra)
31	PVC encapsulated Foot rest	KK Manhole / KGM / Bentex
32	Pumps	Xylem / Lubi / Ground foss

33	Heat Pump	AO Smith/ benchmark/ Suntec
34	Filter & Softener	Pentair/ Ion exchange/ Thermax
35	Chemical Dosing Pumps/Tanks	Toshcon/ ASIA LMI/Edose
36	Level Controller / Lvel Sensor	AIP /Danfoss / Flow line
37	Pressure Gauge	H Guru/ Fiebig/ Emerald
38	Strainer	Sant / Zoloto/ Lehry
39	Pressure Switch	L&T/ Johnson/ Honeywell
40	Fire Sealant/ Fire Reterdant paint	3M/ Hilti/ Powers
41	Pipe Support & Clamps	Chilly/ Euroclamp/ Easyflex
42	Pipe Hangers	Gripple/ Hitech/ Om Fasteners
43	Paints	Asian paints/ Berger / Shalimar Paints
44	Welding rods & Electrodes	Ador/ Cosmos/ Prima (S)
45	Fastener	Fisher/ Hilti/ Mungo
46	Vibration Eliminator	Resistoflox, Noida/ Dwren - Calcutta
47	a) Starter	L & T/ Siemens
	b) SFUs	L & T/ Siemens
	c) Cables	Finolex/ Bonton
	d) Liquid Level Controller	Femack/ Minitec
	e) MCCB	ABB (Imported)/ Merlin Gerin (French Series)/Mitsubishi
	f) MCB	Legrand (Imported)/ Merlin Gerin (France)/ Hager (Imported)
	g) Panel	Tricolite Industries/ Installation control pane /risha Control

FIRE FIGHTING

TECHNICAL SPECIFICATION OFFIRE FIGHTING WORKS:

- A. Technical Specification of DSR items of Fire Fighting works (Based on DSR E&M 2022) mentioned in SOQ shall be as per CPWD General Specification for electrical works Part V (WET RISER AND SPRINKLER SYSTEM) 2020.** (Corrected up to the last date of submission/uploading of bid).
- B.** Specification/brands names of fixtures to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified below are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge-in-Charge. The list of approved makes is appended to this document.

C. Scope of work.

The scope of work in this subhead shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely do all work relating to the supply, installation, testing & commissioning of Fire Fighting System as described herein after and shown on the drawings. The scope of work in general shall include the following.

- i) Fire Fighting Pumps & Accessories and related electrical works.
- ii) Internal & External Fire Hydrant System.
- iii) Sprinkler system.
- iv) Hand Appliances (Fire extinguisher)
- v) Fire suppression system in Sever room & Electrical panel.

Without restricting to the generality of the foregoing, the work shall include the following: A Firefighting System covering the entire complex and consisting of the following:

- (v) Three numbers of Pumps in Pump room & One no. of pump in Terrace – One number Main electric Horizontal type, multistage, centrifugal, split casing pump of

2850 LPM at 70 M head common for both Hydrant system & sprinkler system, one number a Diesel Standby Horizontal type, multistage, centrifugal, split casing pump for Hydrant System of 2850 LPM at 70 M head and Jockey Pump Horizontal type, multistage, centrifugal pump for System pressurization of 180 LPM at 70 M.head. Horizontal type, multistage, centrifugal, split casing Terrace pump of 900 LPM 35 M Head.

- (vi) Complete Internal Hydrant System (including Tapping from Pump, taking tapping at each floor along with Landing Valve and all Hydrant accessories complete shall be in scope of this work.
- (vii) Terrace Booster Pump, piping and its connectivity with each Hydrant Riser, Panel, Cabling etc. as complete system shall be this scope of work.
- (viii) External Hydrant System, External Hydrant Landing Valves, External Hose Cabinet (Wall / Floor Mounted), RRL Hose, Nozzle etc. complete shall be in this scope of work. Buried Piping along with excavation filling and with necessary Testing Method as complete system shall be in this scope of work.
- (ix) Sprinkler Tapping, Installation Control Valve, Sprinkler Tapping at each floor along with Zone Control Valve, Sprinkler piping & Sprinkler Head, Braided Flexible pipe drop etc. as per the requirement as complete Sprinkler system shall be in this scope of work.
- (x) Sprinkler Annunciation Panels / Fire Alarm Panels along with necessary wiring / cabling till each floor shall be in this scope of work. (Sprinkler Annunciation panel shall be integrated with Fire Alarm System). Design, Supply, installation, testing, and commissioning of Local Flooding (Automatic gas suppression system) for panel protection (inside panel) & Room flooding (Automatic gas suppression system) for IBMS Server Room as applicable.
- (xi) The Contractor to get Fire NOC approval from statutory authorities, including taking out necessary number of prints of drawings, submission to accredited agency, coordinating site visits, making any minor modification in drawings for the purpose, etc. shall be in this scope of work.
- (xii) Supporting arrangements needed for the piping, valves and instrumentation, operating platforms /crossovers etc in pump house & all work locations of site shall be in this scope of work.
- (xiii) Performing and submitting Hydraulic calculations in Pipe-net Software shall be in contractors scope.
- (xiv) Radiography, Dye Penetrate Testing, Flushing Cleaning, Hydro/air testing, Holiday Testing for under Ground pipes etc. shall be in contractor's scope.
- (xv) After commissioning and taking over of the project by the Authority, the Contractor shall operate and maintain the entire project for a period as mentioned in tender including the Defect Liability Period (DLP) as mentioned in tender.
- (xvi) To obtain the approval of the relevant drawings before actual installation at site and to get the complete installation inspected and passed by the concerned authorities,

as may be necessary as per local bye-laws. (any fee payable to the local bodies.

D. Contractor's Experience.

- Contractors shall engaged specialist agency only for this work of Fire Fighting systems.
- The selected specialist agency must have sufficient experience in the execution of turnkey projects as specified.
- Contractor must submit with the tender a list of similar jobs carried out by him as required along with the name of works, name and address of clients, year of execution, capacity of plant and value of work.

E. Technical Information.

- Contractor shall submit along with the tender copies of detailed specifications, cuts, leaflets and other technical literature of equipment and accessories offered by him.
- Contractor's attention is specially invited to the special conditions and other clauses in the agreement which required the contractor to: -
 - a. Submit detailed shop drawings.
 - b. Use material of specific makes and brands
 - c. Obtain all approvals from Fire Fighting authorities.
 - d. Execute the entire work on a turn-key basis so as to provide a totally operating plant.

a. Exclusions.

I) Work under the contract does not include the following work.

II) Electrical cable up to incoming motor control centre.

F. Site Accessibility.

- I) The equipment's are to be located in pump house located within the Service block.
- II) The equipment must be carried from the goods receiving station to the site in an extremely careful manner to prevent damage to the equipment building or existing services.
- III) Contractor must visit the site and familiarize himself with above problems to ensure that the equipment offered by him are of dimensions that they can be carried and planed in position without any difficulty.

G. Approvals.

The contractor shall prepare all submission drawings and obtain all approvals of fire fighting works from fire fighting authorizes.

H. System Description.

- I) The Hydrant System shall comprise of AC motor driven pump set, standby diesel pump set, jockey pump set for pressurization and fire booster pump with all required accessories including valves, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.

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- II) The Hydrant System shall be semi-automatic in action and shall be laid covering the entire area externally and all the floors internally with independent piping system for Sprinkler System, a separate piping system shall be installed.
 - III) The Hydrant System shall be kept pressurized at all times. The proposed Hockey Pump shall take care of the leakages the system, pipe lines and valve glands.
 - IV) The pressure in the hydrant pipe work shall be kept constant at 7 Kg/cm². In the event of fire when any of the hydrant valve in the network is opened, the resultant fall in header pressure shall start the AC motor driven fire pump through pressure switches automatically. There shall be one Diesel Engine Driven pump as standby for both hydrant and sprinkler system. In case of failure of electricity or failure of Electric Pump to start on demand, the standby Diesel Pump shall automatically takeover. Minimum Pressure maintain in the hydrant system shall be 3.5 kg/cm²
 - V) However, shutting down of the pump set shall be manual except for the Jockey Pump which shall start and stop automatically through pressure switches. In addition to auto start arrangements, the main pump shall also have an over-riding manual starting facility by push bottom arrangement.
 - VI) The Internal Hydrant System (Wet Risers) shall be provided at points as indicated on the drawing on each floor.
 - VII) The hydrant point shall be directly tapped from the Riser pipes, and shall be furnished with required accessories such as—
 - One no. gunmetal single headed hydrant valves.
 - Two nos. RRL Hoses of size 63mm dia x 15mlong.
 - One no. first aid hose reel 20mm dia x 30mlong.
 - One nos. Branch pipe.
 - VIII) The hydrant risers shall be terminated with air cushion tank at the highest points to release the trapped air in the pipe work.
 - IX) An overhead tank 25000 liters capacity will be connected to the fire hydrant system.
 - X) Sprinkler system shall be distributed entire building so as to cover 9-12 sq.m area with one sprinkler. Sprinkler risers shall be provided with instantaneous control valve with alarm gang. An overhead tank of 25000 liters capacity with makeup line will be connected to sprinkler riser at. A suitable drainage arrangement with bye-ass valve shall be provided to facilitate maintenance of sprinkler pipe work.
 - XI) To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges/water hammer in the underground pipe work Air Vessels shall be furnished in the pump room ear fire pumps. The air vessel shall be normally partly full of water and the remaining being filled with air which shall be under compression when the system is in normal operation.
 - XII) The entire Wet Riser and Sprinkler system shall be fed from the Under ground Water Tank of 175 KL.

GENERAL SPECIFICATIONS.

1.0 Main Fire Pumps

1.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump size shall be 2850 LPM & 70M Head. Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

1.2 The centrifugal pumps shall conform to IS 1520.

a) The pump casing shall be of heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

b) The impeller shall be of bronze, brass or stainless steel. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

c) The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.

d) The shaft sleeve and ring etc. shall be of bronze, brass or stainless steel.

e) The bearings shall be ball or roller type suitable for the duty involved.

1.3 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

1.4 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.

1.5 Pumps shall be provided with approved type of mechanical seals.

1.6 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

1.6(a) The pump shall meet the requirements of the tariff advisory committee and unit shall be design proven in fire protection services.

1.7 Motors for Electric Driven Pumps

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- 1.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.
- 1.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- 1.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
- 1.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.
- 1.7.5 Motors shall be designed for auto start system.
- 1.7.6 Motors shall be capable of handling the required starting torque of the pumps.
- 1.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

1.8 Operating Conditions for the Service Pumps

1.8.1

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks
Jockey pump	One	6.5 kg/cm ²	7.0 kg/cm ²	To auto start and auto stop on pressure switch on air vessel to stop.
Main pump	One	6.0 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
Diesel Fire Pump	One	5.0 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.

(The above ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of Engineer-in-Charge/Project Consultant).

2.0 Diesel Fire Pump

2.1 Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

2.2 General

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

2.3 Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500/2900 RPM as specified in bill of quantities.

2.4 Fire pump

- a) The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2850 lpm as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg./cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 7.0 Kg./cm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.
- b) The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.
- c) The pump casing shall be designed to withstand 1.5 times the working pressure.
- d) Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

2.5 Diesel Engine

2.5.1 Environmental conditions - The engine shall be required to operate under the conditions of environment as specified.

2.5.2 Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump.

Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended upto date.

2.5.3 Engine Accessories - The engine shall be complete with the following accessories: -

- (i) Flywheel dynamically balanced.
- (ii) Direct coupling for pump and coupling guard.
- (iii) Radiator with hoses, fan, water pump, drive arrangement and guard.
- (iv) Corrosion Resister
- (v) Air cleaner, oil bath type/dry type
- (vi) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.

- (vii) Pump for lubricating oil and lub. oil filter
- (viii) Elect. starting battery (2x12 v)
- (ix) Exhaust silencer with necessary pipe work
- (x) Governor
- (xi) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual staring).

- (xii) Necessary safety controls
- (xiii) Winterisation arrangement, where specified.

2.5.4 Starting system - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the flywheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

2.5.5 Exhaust system - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed to be taken out of the building as per statutory requirement. The Contractors are advised to see the drawing and site to assess the length of exhaust pipe required and its cost & installation included with cost of pump. The total backpressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

2.5.6 Engine shut down mechanism - This shall be manually operated and shall return automatically to the starting position after use.

2.5.7 Governing System - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

2.5.8 Engine Instrumentation - Engine instrumentation shall include the following: -

- (i) Lub. oil pressure gauge.
- (ii) Lub. oil temperature gauge
- (iii) Water pressure gauge
- (iv) Water temperature gauge
- (v) Tachometer
- (vi) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

2.5.9 Engine Protection Devices - Following engine protection and automatic shut down facilities shall be provided:-

- (i) Low lub. oil pressure
- (ii) High cooling water temp.
- (iii) High lub. oil temperature
- (iv) Over speed shut down.

2.5.10 Pipe work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems, copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

2.5.11 **Anti Vibration Mounting** - Suitable vibration mounting duly approved by Engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

2.5.12 **Battery Charger** - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

3.0 **Jockey Pumps**

3.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump capacity shall be 180 LPM & 70M Head

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

3.2 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

3.3 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.

3.4 Pumps shall be provided with approved type of mechanical seals.

3.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

3.6 The pump shall meet the requirements of the tariff advisory committee and unit shall be design proven in fire protection services.

3.7 **Motors for Electric Driven Pumps**

3.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.

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- 3.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
 - 3.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
 - 3.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.
 - 3.7.5 Motors shall be designed for auto start system.
 - 3.7.6 Motors shall be capable of handling the required starting torque of the pumps.
 - 3.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

4.0 **Terrace Pumps**

- 4.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump capacity shall be 900 LPM & 35M Head

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.
- 4.2 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.
- 4.3 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.
- 4.4 Pumps shall be provided with approved type of mechanical seals.
- 4.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

-
- 4.6 The pump shall meet the requirements of the tariff advisory committee and unit shall be design proven in fire protection services.

4.7 Motors for Electric Driven Pumps

- 4.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.
- 4.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- 4.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
- 4.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.
- 4.7.5 Motors shall be designed for auto start system.
- 4.7.6 Motors shall be capable of handling the required starting torque of the pumps.
- 4.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

5.0 POWER AND CONTROL PANEL AND OTHER CONTROLCOMPENENTS.

5.1 Scope

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system.

5.1.1 Power and Control Panel.

5.2 Constructional Requirements

General Features.

The power and control panel shall be totally enclosed, free standing floor mounted cubic type, fabricated out of sheet steel not less than 2mm thick. Where necessary, additional stiffening shall be provided by angle iron frame work. General construction shall be of

compartmentalization and sectionalisation such as mains incomes, electric fire pump, diesel fire pump, pressurization pump, and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall also have the space for cable allays. The space for cable alleys shall be at least 200mm wide to the entire depth of panel. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be of concealed type. The doors for bus bar chamber shall be of removable type with the help of bolts. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication the cubicle construction shall be to IP 21 as per IS: 2147.

5.3 Cable entries and gland plates.

All cable entries shall be through gland plates which are removable and sectionalized. Where heavy cable are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries may be from top or bottom depending on the equipment layout and cable scheme as approved.

5.4 Bus bar and Connections.

The Bus bar shall be air insulated, and of aluminium of high conductivity electrolytic quality (grade E 91 E to IS: 5082) and an adequate cross section. Current density shall not exceed 1.3 amps. Per sq.cm. All connections to individual circuits from the bus bars shall preferably be with solid connections. The bus bars and the connections shall be suitable covered with PVC sleeves or in an approved manner. Bus bar shall be suitably supported using non-hygroscopic insulated supports. High tensile bolts and spring washers shall be provided at bus bar joints.

5.5 Earthing Arrangement.

GI strip 24mm x 5mm shall be run at the rate of the board 2 nos., earth terminals shall be provided at the ends of the GI strip for connection to earth system.

5.6 Terminal Blocks and Small Wiring.

Terminal blocks shall be heavy duty type and generally not less than 15 amps 250V grade up to 100V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq.mm size and 600V grade conforming to IS: 694-1977. Suitable colour-coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise, Identification ferrules shall be used at both ends of the wires.

5.7 Instruments and Lamps.

All indication lamps and instruments shall be flush mounted type in front of the panel. The voltmeter and ammeter shall be of size 100mm nominal (dial size) conforming to clause 1.5 of IS 1248 for accuracy.

Current transformers shall be provided with ammeters.

Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indication and battery charging shall be provided in the respective sections.

All indicating lamps and meter shall be protected with HRC cartridge type fuses.

5.8 Labels

All internal components shall be provided with suitable identification labels. Suitably engraved labels shall be fixed at the panel for all switches, instrument push buttons, indicating lamps etc.

5.9 Painting.

The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment and two coat of final paint or approved shade before assembly of various items.

5.10 Equipment Requirements.

5.10.1.1 General

The power and control panel shall comprise individual section for the various equipment's of the system and controls, in a combined cubicle type design. All switches MCCB, MCB and fuse/fuse switch unit shall be conforming to relevant IS.

5.10.1.2 Incomer Section & Outgoing Section.

5.10.1.2.1 Incomer section:

1 no. 630 amps TPMCCB unit complete. One set of 96 mm square Ammeter (0-630 Amps) complete with selector switch and CTS. One set of 96mm square Voltmeter (0-500 V) complete with control fuses and selector switch. One set of phase indicating lights with control fuses. One set of 4 strips of 300 Amps aluminium busbars.

5.10.1.2.2 Outgoing Feeder.

- (i) One number of 250 A, ps TP MCCB unit complete, SP Preventer, ML 4 type contractor for star delta starting, start and stop push buttons, auto-manual switch, Ammeter with CTS, A S S , phase indicating lights. Auxillary Contractors for interlocking / sequence of operation, control terminals complete in all respect with interconnections for Hydrant Pump and sprinkler pump.
- (ii) One numbers of 125 Amps rated TP MCCB unit complete, ML 1.5 type contractor D O L starting with overload relay, start and stop button. Ammeter, CTS and selector

switch, have indicating lights, Auxiliary contacts for interlocking / sequence of operation, control terminals complete in all respect for Jockey Pump & fire booster pump.

- (C) Control wiring from pressure switches of different settings in Hydrant and Jockey Pumps, for sequence of operation shall be included to complete the system.
- (D) Colour code with ferrule marking shall also be made.
- (E) The wiring shall be PVC insulated and PVC armoured aluminium conductor cable of 650 /100 volts grade conforming to IS 1554 as required from Fire Pump Board to motor and cable of suitable size.

5.10.1.3 Electric Fire PumpSection.

This section shall incorporate the following facilities.

- a) MCCB
- b) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
- c) Starter Unit , Current Transformer and ammeter.
- d) Indication lamps, their fuses, terminal block, push buttons, control and selector switches etc. as required.
- e) Pump lock out devices due to faults or abnormalities as specified in operating sequence.
- f) Visual/audio alarms, indications and communications facility as specified in operating sequence.
- g) Necessary inter-connection and control wiring etc.

5.10.1.4 EngineSection.

The engine section shall incorporate the following facilities:-

- i) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
- ii) Instruments, indicator lamps, fuses terminal blocks, push buttons, control and selector switches etc. as are required.
- iii) Engine shut down and block out devices due to faults or abnormalities as specified.
- iv) Visual/audio alarms and indications as specified.
- v) Inter-connection and control wiring etc.

5.10.1.5 Auxiliary PumpSection.

The auxiliary pump section for Jockey pump shall incorporate the following:

- a) TP&NMCBS
- b) Control system components such as relays, times, contractors etc. as are necessary for functional requirements.

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- c) Starter unit, current transformer and ammeter.
 - d) Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
 - e) Inter-connections and control wirings etc.

5.10.1.6 **Control Section.**

This section shall incorporate the following –

- a) Control components integrating the various sections, so as to satisfy the functional requirements.
- b) Battery charger unit with boost / float charge facility with voltmeter, capable of independently charging 2 sets of batteries at a time.
- c) Visual / audio alarms, not covered in individual sections.
- d) Lamps healthy test facility.
- e) Instruments, indicating lamps, pushbuttons, fuse terminal blocks etc. as are required.
- f) Test facility to simulate operation of hydrants.

6.0 FIRE BRIGADE INLET CONNECTIONS

6.1 Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified and as described in the BOQ, for the following purposes:

- i) Fire brigade inlet connection to fire static tank.
- ii) Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of butterfly valve and Non return valve.

6.2 The locations of these Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

7.0 FIRE BRIGADE DRAW CONNECTIONS

7.1 Fire Brigade draw connection shall be provided near the pump house as specified and as described in the BOQ, for the following purposes:

- i) Fire Brigade suction connection for fire static tank with provision of foot valve.

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- ii) Fire brigade draw out connection to the pump room system. Each connection shall be provided with similar dia of Butterfly valve and Non return valve.
 - iii) Fire brigade suction hose coupling (draw out connection) with nut for female coupling as per IS-902 complete with 100mm dia. Suction pipe and foot valve (to be connected to static tank) as per the drawing.

The scope shall include providing necessary reducers, tees bends and special fittings as required. Necessary enclosure made of 2mm thick sheet metal with support shall be provided, as in the case of hose cabinets.

8.0 Pressure Switches.

Pressure switches shall be provided for switching on and off the pressurization pump at present pressures and also for switching off the fire pump at present pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure settings shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

- 9.0 Masonry Chamber 90x90x100 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C.I. surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), 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 standard design :With common burnt clay F.P.S.(non modular) bricks of class designation 7.5

10.0 INTERNAL HYDRANTS

- 10.1 The Internal Hydrant outlet shall comprise "Single Headed Single Outlet Gunmetal Landing Valve" conforming to type 'A' of IS:5290-1977. Separate valve on the head shall form part of the landing valve construction.
- 10.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.
- 10.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

11.0 EXTERNAL HYDRANTS

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- 11.1 The Internal Hydrant outlet shall comprise "Single Headed Single Outlet Gunmetal Landing Valve" conforming to type 'A' of IS:5290-1977. Separate valve on the head shall form part of the landing valve construction.
- 11.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.
- 11.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

12.0 **BRANCH PIPE**

12.1 **Branch pipes**

Branch pipe shall be of Gunmetal or Aluminum alloy as given in BOQ 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

12.2 **Nozzle**

The nozzle shall be of Gunmetal, as specified in BOQ 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

- 12.3 End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

- 12.4 Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

13.0 **ORIFICE PLATE**

- 13.1 Orifice plate made out of 6 mm thick stainless steel (Grade 304) with orifice of required size to be fitted between flange & landing valve of external and internal hydrants to reduce pressure at the outlet to the level of 3.5 kg/cm² complete as required.

14. **HOSE PIPES**

14.1 **Hose pipes**

14.1.1 Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

14.1.2 Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS:903.

15. FIRST-AID HOSE REEL EQUIPMENT

15.1 First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532-1969.

15.2 The hose tubing shall be 20 mm dia and 36.5m long. The G.M nozzle 5mm and globe valve shall be of 20 mm size.

15.3 The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS:884 - 1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser taken independently from ring.

16.0 INTERNAL HOSE CABINET

16.1 The internal hose cabinet shall accommodate the Hose Pipes, Branch Pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge M.S/aluminum sheet as specified in Bill of Quantities. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

16.2 The hose cabinet shall be painted red and stove enameled and words FIRE written in front glazed portion.

17.0 EXTERNAL HOSE CABINET

17.1 The external hose cabinet shall accommodate the Hose Pipes, Branch Pipe, shall be fabricated from 2 mm thick or 14 mm gauge M.S/aluminum sheet as specified in Bill of Quantities. The overall size shall be 900x600x500 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

17.2 The hose cabinet shall be painted red and stove enameled and words FIRE written in front glazed portion.

18.0 FIRE MAN AXE

18.1 Stainless steel standard fireman's axe with heavy insulated rubber handle tested to 20000 volts as per IS : 926

19 PIPES

19.1 All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

19.1.1 Pipes 150 mm dia and below IS: 1239 Heavy Class

19.1.2 Pipe 200 mm dia and above IS 3589 of thickness specified.

19.2 PIPE FITTINGS.

19.2.1 Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

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

19.2.3 When used, they shall be fabricated, welded and inspected in workshops under supervision of Project Managers whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

19.2.4 (a) M.S. Fittings(40 mm dia. and below shall be Forged Steel fittings as per ASTM A 105 3000CL, end connection Socket welded as per ASME B16.11. & one side socket weld and other side threaded as per NPT for fittings used for sprinklers

(b) M.S. Fittings of 50 mm dia& above shall be as per ASTM A 234 Gr. WPB all fittings shall be BW seamless fittings type as per specifications.

19.3 JOINTING

19.3.1 Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed MS forged fittings)

19.3.2 Welded (65 mm dia and above)

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to X Ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase of required current and capacity.

19.4 Flanges.

Flanged joints shall be provided on:

- a) Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- c) For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- d) Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of GKW make or equivalent with 3 mm insertion neoprene gasket complete.

19.5 Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

20.1 PIPE PROTECTION

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- 20.1 All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.
- 20.2 All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.
- 20.3 Proposed pipe for External firefighting is MS pipe (Mild steel pipe). Provide dimension tolerances, acceptance test, jointing, installation and testing process.

20.2. **PIPE SUPPORTS**

- 20.2.1 All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.
- 20.2.2 Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

20.3. **TESTING**

- 20.3.1 All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 Kg/Cm² without drop in the pressure for at least 2 hours.
- 20.3.2 Rectify all leakages, make adjustment and retest as required.

20.4. **ANCHOR BLOCK**

- 20.4.1 Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).
- 21.00 Butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked complete with nuts, bolts, washers, gaskets conforming to IS 13095.

22.0 Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

23.0 Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves upto 65mm shall be of Gunmetal Fullway Valve with wheel tested to 20 Kg./cm² class-II as per I.S: 778-1971. Valve wheels shall be of right-hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing. Pump room Valve shall be with tamper switch. EPDM rubber gasket shall be used.

24.0 Gun metal gate valve with C.I. wheel of approved quality (screwed end)

25.0 Y-strainer fabricated out of 1.6 mm thick stainless steel, Grade 304, sheet with 3 mm dia holes with stainless steel flange.

26.0 25mm dia screwed inlet cast iron single acting air valves on all high points in the system or as

shown on drawings.

27.0 PressureGauges.

Burden type pressure gauges conforming to IS/BS specifications shall be provided at the following locations.

- a) Just above alarmvalve.
- b) Just below alarm valve, on the installation stopvalve.
- c) One pressure gauge on delivery side of eachpump.
- d) Required number of pressure gauges on pressuretank.

28.0 Installation Control valve.

Installation control valves shall comprise of the following:

- a) One-man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.
- b) One automatic alarm valve fitted with handle &cover.
- c) One hydraulic alarm motor and going for sounding a continuous alarm upon out-break of fire. One combined waste and testing valve including 5 mtr. Of tubing and fittings.
- d) Alarm stops valve.
- e) Strainer
- f) Drainplug.
- g) Padlock and strap
- h) Wall box for installation of valve.

29.0 Air vessel made of 250 mm dia, 8 mm thick MS sheet, 1200 mm in height with air release valve on top and flanged connection to riser, drain arrangement with 25 mm dia gun metal wheel valve with required accessories, pressure gauge and painting with

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- synthetic enamel paint of approved shade as required. It shall be paint with Post office red color as per the direction of Engineer -in-charge of PMC and employer
- 30.0 Reinforced neoprene rubber vibration eliminators / expansion joints (to provide relief from stresses at pipe flanges) suitable for upto 20 kg/cm² pressure
- 31.0 MS air vessel tank in Pump room fabricated from 6mm thick MS plate, 450 mm in diameter and 2 m in height with dished ends fabricated from 8mm thick MS plate with Air release valve with stop cock, flanged inlet connection and drain arrangement with 25mm dia valve, pressure gauge with gun metal stop cock complete with all accessories as required and conforming to IS 4736-1968. It shall be paint with Post office red color as per the direction of Engineer -in-charge of PMC and employer
- 32.0 Flow Switch in following 150mm sizes M.S. pipe including connection etc as required.
- 33.0 Inspectors test assembly complete with test valve, sight glass sectional drain valve, union with corrosion resistant orifice
- 34.0 CABLES**
- 34.1 Contractor shall provide all power control cables from the motor control centre to various motors, level controllers and other control devices.
- 34.2 Cables shall conform to IS: 1554 and carry ISI mark.
- 34.3 Wiring cables shall conform to IS 694.
- 34.4 All power and wiring cables shall be aluminium conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.
- 34.5 All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 Volt grade.
- 34.6 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.
- 34.7 All cables joints shall be made in approved manner as per standard practice.
- 34.8 The cable jointing shall be Crimping type.
- 35.0 6 SWG dia G.I. wire on surface or in recess for loop earthing

36.0 CABLE TRAYS

- 36.1 Contractor shall provide G.I. perforated cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities, with G.I. sheet thickness of 1.5mm.
- 36.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates OR Anchor fasteners.
- 36.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

37.0 EARTHING

- 37.1 There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armour clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.
- 37.2 Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centres. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.
- 37.3 A brick masonry manhole 30x30x30xcm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated, in this manhole for testing.

38.0 SprinklerSystem. (Sprinkler system should be UL Listed & FM approved)

i) Sprinkler Heads.

Sprinkler heads shall be of quartzoid bulb type with bulb, 68 degree centigrade temperature rating and K factor 80. The sprinklers shall be approved make and type. 93 degC will be use in the pantry area. 15 NB, with 68°C. temperature rating for Sprinkler bulb and 57°C. for Cover Plate, K 5.6 (80), Pendant type, Standard

Response, Quartzoid bulb sprinkler adjustable royal flush Concealed sprinkler, teflon tape, lock title solution with required accessories etc. complete. 15 NB, 93 deg. K 5.6 (80), Pendant type, Standard Response, Quartzoid bulb sprinkler, teflon tape, lock title solution with required accessories etc. complete

ii) Types

Conventional Pattern.

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling side of wall extra. The sprinklers shall suitable for erection in upright position or pendant position.

Pendent type Sprinklers.

These shall be designed for installation along with the ceiling.

Upright type Sprinklers.

These shall be designed for installation where false ceiling height more than 800mm.

Sprinkler annunciation panel required to configure with Flow switch

Spare sprinkler MS cabinet is required

Construction

- i) **Bulb** – Bulb shall be made of corrosion-free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.
- ii) **Valve assembly** – Water passage of the sprinkler shall be controlling assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.
- iii) **Yoke** :The yoke shall be made of high quality gunmetal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anticorrosive treatment if the same is to be used in corrosive conditions.
- iv) **Deflector** :The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

• **Colour Code.**

The following colour code shall be adopted for classification of sprinkler according to nomination temperature ratings.

- **Sprinkler Temperature Rating.**

- **Size of Sprinklers Orifices.**

The sprinklers shall be of 15mm nominal bore size.

39.0 Sprinkler flexible pipe (UL Listed) of stainless steel complete with 15 NPT on reducer thread with maximum working pressure of 175 PSI test pressure of 875 PSI (Burst) with branch line (Inlet) 25mm NPT male thread to sprinkler head (Outlet) 15mm NPT female thread with reducer, nipple, 2 side brackets, center bracket, stockbar

40.0 Rosette plate for 15mm dia in white finish UL Listed or FM approved.

PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per Bill of Quantities and shall confirm to IS:15683

41.0 ISI marked (IS:15683) Fire Extinguisher, Carbon-di-oxide type capacity 4.5 Kg. Flat base including valve, discharge hose of not less than 10 mm dia, 1M long and complete in all respects including initial fill with CO2 gas conforming to IS:307-1966 and wall suspension bracket.

42.0 6kg ABC (Powder Type) Fire Extinguisher. Mild Steel Cylinders ISI marked fitted with pressure indicating gauge, internal tube, squeeze lever type valve fully charged with ABC 90 powder (Mono Ammonium Phosphate) pressured by Nitrogen complete in all respects including wall suspension bracket and conforming to IS:15683

43.0 Mechanical Foam Based Trolley Mounted Fire Extinguisher, Inside CO2 Cartridge Operated Gas Cartridge Confirming to 'IS 4947' Discharge Hose & Nozzle, Epoxy Polyester Powder Coated As per 'IS16018 : 2012' ISI marked Fire Extinguishers Suitable 'A' 'B' Class of FIRE (for FOAM confirming to IS 4989). The extinguisher body finished externally with red enamel with trolley mounted complete with internal charge.(Capacity 60 Ltr)

44.0 4 kg Kitchen type Fire Extinguisher (Stored Pressure) in SS (304L) body With Special Wet Chemical Based Fire Extinguishers specially for Kitchen Fire (Class F Fire) with Controlling Discharge Mechanism, Discharge nozzle. complete in all respects including wall suspension bracket and conforming to IS:15683

45.0 2 KG Clean Agent (Stored Pressure Type) Fire Extinguishers filled with Clean Agent Gas', Nitrogen Pressurised, Controllable Discharge Mechanism, Pressure Gauge, Discharge Hose (for 4 & 6kg) & Nozzle Epoxy Polyester Powder Coated As per 'IS 15683 : 2018' ISI marked Fire Extinguisher Operating Temperature:- (-)20°C to (+)55°C Suitable for 'A' 'B' 'C' Class of FIRE suspension bracket and conforming to IS:15683 as required as per specifications. (Electrical Panel room & Server room)

46.0 control panel for Terrace Booster pumps .

Incoming: MCCB 125A 1 set of Phase indicating lamps, 1 set of 125A Al bus bars, 3No Ammeter, 3No Voltmeter with phase selector switch Feeder for Booster Pumps - 2 No. 2 No. 50A TP MCCB without releases. DOL starter with over load relay, single phase preventor and indicating lamps with ON/OFF push buttons. 2 No. Automanual selector switch. Suitable for 2 nos. of booster pumps

- 47.0 Tamper switch for pump room valve complete with nuts, bolts, washers, gaskets in the pump room sluice valve.
- 48.0 Direct Low Pressure Pre-Engineered Automatic FK-5-1-12 (equivalent to Novec-1230) (UL Listed) Fire Detection & Suppression System with UL approved tube, UL & PESO approved Filling Plant, CE certified system, Cylinder, Pressure Gauge, other accessories as & if required Valve, Pressure Switch, Push-in tube connector
- 49.0 PESO approved seamless Cylinder (IS 7285) with PESO approved Valve assembly. FM approved & UL-Listed Clean Agent Fire Suppression System FK-5112 for following room at 25 bar pressure with pressure gauge, safety burst filled with FK-5112 at 4.5% concentration as per flow calculation report. Discharge time should be less than 10 seconds. Seamless pipe Sch 40 Gr 'B' , cylinder heads, valves, Safety burst disc, nozzles all necessary accessories, Electrical actuator, Manual actuator, Discharge Hose, cylinder clamp and fittings.
- Gas suppression system is working when any spark happen it will activate the nozzle to emit the Gas FK-5112

50.0 Pipe Supports

All pipes shall be adequately supported from ceiling or walls from structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of primer and two coats of black enamel paint. The contractor shall provide inserts at the time slab casting or anchor fastener later.

51.0 Testing.

- **Testing on Completion of Installation.**
The entire system shall be tested after completion of installation as per the operating sequence specified.

Standard and Codes.

1.	IS-1648-1961	Code of Practice for fire safety of building(general) Fire fighting equipment and maintenance.

2.	IS-3844-1966	Code of practice for installation of internal fire hydrant in multi-storied building.
3.	IS-2217-1963	Recommendation for providing first aid and fire fighting arrangement in public buildings.
4.	IS-2190-971	Code of practice for selection, Installation and maintenance of portable first fire appliance.
5	IS-3589	Electrically Welded Steel pipes (Medium class)
6.	IS-1239	Mild steel tubes, Tubular and other wrought steel fittings (Medium class)
7.	IS-780	C.I. Double flanges sluice valve.
8.	IS-778	Gun Metal Valve.
9.	IS-5290-1969	Internal Landing Valve.
10.	IS-884-1969	First and hose reel.
11.	IS-934-1976	Specification for portable chemical fire Extinguisher soda acid type.
12.	IS-2873-1969	Specification for fire extinguisher for carbon dioxide.
13.	IS-2189 & 2109	Automatic fire alarm system or BSS-3116
14.	IS-15105:2021	Automatic sprinkler System

2.

SECTION 3 TECHNICAL DATA SHEET FOR FIRE FIGHTING SYSTEM

- 1.
2. It is the sole responsibility of the contractor to select the pump/motor to meet the requirements specified in the tender. Contractor is asked to fill up all the datas given below.

1. Fire Hydrant & Sprinkler System.

1.1	Pumps	Elec. Driven Fire Pump	Diesel Driven Pump	Jockey Pump

1.1.1 Makes

1.1.2 Model No.

1.1.3 Rated Discharge (LPM)

1.1.4 Rated Head (M)

1.1.5 Speed (RPM)

1.1.6 No. of Stages

1.1.7 Efficiency at rates
Capacity & head

1.1.8 KW required at rated
Capacity & head

1.1.9 KW required at 150%
Rated discharge

1.1.10 Shut off head (M)

1.1.11 Material of Construction

- a) Body
- b) Impeller
- c) Shaft

1.1.12 Whether pump is capable
of discharging 150% of rated
capacity at a head not less
than 65% of rated head.

1.1.13 Whether Automatic Priming
Arrangement included.

1.2 Pipes

1.2.1 Make

1.2.2 Standard/Class

1.2.3 Thickness

1.2.4 Painting details
for above ground
& exposed pipes

1.2.5 Wrapping & coating

1.2.6 Whether ISI marked

1.3 Fittings

Forged Fittings
(up to 50 mm dia)

Butt welded Fittings
(65 mm dia& above.)

1.3.1 Type

1.3.2 Make

1.3.3 Material

1.3.4 Type of ends

1.3.5 Pressure rating

1.3.6 Whether ISI marked

1.4 Valves

Butterfly

Sluice

Ball valve

1.4.1 Make & Type

1.4.2 Type of ends

1.4.3 Material of construction

1.4.4 Test Pressure

1.4.5 Provided with all
Accessories including
gear system as per

	relevant IS			
1.4.6	Whether ISI marked/ TAC approved			
1.5	Engine/Motors	Engine	Main Pump	Jockey Pump
1.5.1	Make Type & Model No			
1.5.2	Frame Size			
1.5.3	Speed (RPM)			
1.5.4	Rated Cap. (KW)			
1.5.5	Efficiency (%)			
1.6	Control Panel (MCC)			
1.6.1	Manufacturer			
1.6.2	Dimensions			
1.6.3	Type of construction & mounting			
1.6.4	Sheet Metal Enclosure			
	a) Material b) Thickness			
1.6.5	Electrical Rating			
1.6.6	Make of starters/ Contactors			
1.6.7	Rating of Contactors			
1.6.8	Size & material of Bus bar			
1.6.9	Annunciation system			

1.6.10 Approx. weight

1.6.11 Painting details

1.6.12 Whether all equipment/
Components as per
Specification included

1.7 Dual / Disk Type Non Return Valves

1.7.1 Make & Type

1.7.2 Type of ends

1.7.3 Material of construction

1.7.4 Test Pressure

1.7.5 Provided with all
Accessories including
gear system as per
relevant IS

1.7.6 Whether ISI marked/
TAC approved

1.8 G.M. Ball Valve

1.8.1 Make & Type

1.8.2 Type of ends

1.8.3 Whether confirm to
to & marked IS:778

1.9 Hydrant Landing Valve

1.9.1 Make & Type

1.9.2 Material of construction

1.9.3 Details of Flange

O.D. (MM)

P.C.D (MM)

No. of Holes

1.9.4 Whether ISI marked/
TAC approved

1.10 **Hose Pipes** C.P. Hose RRL (Type A)

1.10.1 Make

1.10.2 Test Pressure

1.10.3 Dia (MM)

1.10.4 Length (M)

1.10.5 Material of couplings

1.10.6 Where hose &
Couplings ISI marked

1.11 Branch Pipes & Nozzles

1.11.1 Make

1.11.2 Material

1.11.3 Dia. of Coupling

1.11.4 Dia of Nozzle

1.11.5 Where ISI marked

1.12 Hose Cabinet

1.12.1 Size

1.12.2 Material

1.12.3 Thickness of sheet

1.12.4 Thickness of glass

1.12.5 Whether Rubber Gasket
Provided

1.12.6 Painting Details

1.13 First Aid Hose Reel

1.13.1 Make & Material

a) Drum

b) Hose

1.13.2 Size of Drum
(Dia x length)

1.13.3 Size of Hose
(Dia x length)

1.13.4 Hose test pressure

1.13.5 Size & material of
Nozzle

1.13.6 Size & material of
Shut off valve

1.13.7 Whether complete unit
strictly confirms to
and marked IS:884
TAC approved

1.14 Pressure Switch

1.14.1 Make & Type

1.14.2 Type of ends

1.14.3 Test Pressure

1.14.4 Electrical Rating

1.14.5 Whether ISI marked/
TAC/UL approved

1.14.6 Whether complete with
gland or other accessories

1.15 Pressure Gauge

1.15.1 Make & Type

1.15.2 Dial size (mm)

1.15.3 Range (kg/cm.sq.)

1.15.4 Whether ISI marked/
TAC/UL approved

1.16 Flow Switch

1.16.1 Make & Type

1.16.2 Pressure Rating

1.16.3 Electrical Rating

1.16.4 Whether ISI marked/
TAC/UL approved

2.1	Sprinkler Head	Conventional Pendant / Upright	Side wall	Concealed

2.1.1 Make

2.1.2 Material

2.1.3 Type of sensing
Element & temperature
Rating (C)

2.1.4 Orifice size (MM)

2.1.5 Type (UPRIGHT/PENDENT/
CONVENTIONAL/SIDEWALL
/EXTENDED RANGE)

2.1.6 Whether listed /

Approved by UL/FH

2.2 Wet Alarm Valve

2.2.1 Make

2.2.2 Material

2.2.3 Size (MM)

2.2.4 Whether provided with
electric bell, test valve,
drain valve, & all other
training connections

2.2.5 Whether approved
hydraulic alarm
motor & gong provided

2.2.6 Whether valve & alarm
Motor & gong listed/
approved by
UL/FM/FOC/TAC

-:-

SECTION IV LIST OF APPROVED MAKES OF MATERIALS FOR FIRE

FIGHTING WORKS

S.No	Materials	Brand
1	MS Pipes	SURYA ROSNI / JINDAL HISSAR
2(a)	Forged Steel Fittings	JSI / VS FORGE
(b)	Butt Welded Fittings	JSI / VS FORGE
3.	Gunmetal Ball Valves	ZOOTO / SANT / KARTAR
4.	C.I. Double flanged sluice Valves & check valves	ZOOTO / SANT / KARTAR
5.	Slim Seal Butterfly Valve, Gate Valve, Air Release valve	ZOOTO / SANT / KARTAR
6.	Dual/Disk type Non Return Valves	ZOOTO / SANT / KARTAR
7.	Fire Hydrant Valves, Branch pipe & Fire man Axe.	EXFLAME / NEWAGE / KALPEX
8.	Fire Aid Fire Hose Reels	EXFLAME / NEWAGE / KALPEX
9.	RRL Hose Pipe	EXFLAME / NEWAGE / KALPEX

10.	Sprinkler Head & Flexible drop	TYCO / HD / OMAX
11.	Fire Pumps	KIRLOSKER / CROMTON GRIVES / MATHER+PLATT
12	Motors	KIRLOSKAR / SIEMENS
13	Electrical Switch Gear	L&T / SIEMENS
14	CABLES	SKY TONE/ FINOLEX/ NATIONAL
15	Flow Meter	SANT/ KENT
16	Suction Strainer	DASMESH/ SANT/ ZOLOTO
17	Vibration Eliminator Connectors	RESISTOFLEX/ KANWAL
18	Single Phasing Preventor	SIEMENS/MINILEC/L&T
19	Pipe coat material	PYPKOTE/COALTECK
20	Flow switch	POTTER / SYSTEM SENSOR / JOHNSON CONTROL
21	Diesel Engine	ASHOK LEYLAND / TAC Approved
		KIRLOSKAR /CUMMINS
22	Main control panel	APPLICATION CONTROL PANEL / SK POWER SOLUTION
23	Fire brigade inlet.	EXFLAME / NEWAGE / KALPEX
24	Rubber Hose pipe	EXFLAME / NEWAGE / KALPEX
25	Hose Couplings branch	EXFLAME / NEWAGE / KALPEX
26	Pressure Switches	INDFOSS/SWITZER
27	Pressure Gauge	H.GURU/FIEBIG
28	Battery	EXIDE/ PRESTOLITE
29	Fire Extinguisher	EXFLAME / NEWAGE / KALPEX
30	Enamel paint	ASIAN / NEROLAC / BERGER
31	Annunciation panel	SAFEWAY / AGNI
32	Alaram Valve	MATTER &PALET / HD
33	Contacto	L& T / SIEMENS
34	Tnimbles/Ferrules Tinned Copper	DEWEL
35	Cable gland.	COMMEX / POWER / GRIPWELL
36	Power Capacitor	L&T / CROMPTON / ASIAN
37	Measuring Meter	L&T/SIEMENS/AE
38	MS Conduit	STEEL CRAFT/BEC/AKG
39	Dash Fastener	HILTI FISHER
40	Paint Primers	ASIAN/ JENSAN/ NICHOLSON
41	Weld Electrodes	ADVANI/ESAB/VICTOR

42	Pipe Hangers	CHILLY / BUILD TECH
43	Clean Agent based Fire suppression (FK-5112)	Viking Minimax (Germany)/ sevo/ Siemens/ Honeywell/ Corpusa
44	Installation Control Valve	HD Fire/ Tyco
45	Test assembly	HD Fire/ Tyco
46	Thermal insulation for Exhaust Pipe	UP Twiga/ Lloyd Insulation/ Kimmco
47	Underground Pipe protection Wrap	Pypcote/ Tapex/ Rustfire
48	Ductile iron Pipe	Electro steel/ Neco/ Ianco
49	Welding rods	Advani/ L&T/ ESAB/ Ador
50	Tamper switch for Sluice valve	Honeywell/ Potter/ rapid
51	Footvalve with Strainer	Kirloskar/ Normex/ Kartar
52	Air Vessel	Nema/ Zenith / Equivalent
53	Flow Test metre	Viking/ Newage/ Eureka Forbes
54	EWlectrical Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
55	Manual Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
56	Pneumatic Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
57	Discharge Hoses	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
58	Actuation Hoses	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
59	Manifold Check valves	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
60	Nozzles	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
61	Low Pressure switch	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
62	Nitrogen Pilot cylinder and valve assembly & Pressure gauge	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
63	Discharge Pressure switch	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
64	Seamless pipe for clean agent	Indian Seamless/ Maharashtra Seamless

65	Gas release panel with programmable module & built in listed power supply	Nottifer/ fenwal/ Simples/ Synergy/ Honeywell/ Bosch/ ravel
66	Dual action manual release station	Nottifer/ fenwal/ Simples/ Synergy/ Honeywell/ Bosch/ ravel
67	Dead man type abort switch	Nottifer/ fenwal/ Simples/ Synergy/ Honeywell/ Bosch/ ravel
68	Circuit integrity cables for fire alarm, voice evacuation, suppression,hssd	Polycab/ Varsha Cables / RR kable
69	Lugs & Glands	As per electrical tender

PART – C-I

**TECHNICAL SPECIFICATION FOR
ELECTRICAL SYSTEM FOR
IITK - KOTAK SCHOOL OF SUSTAINABILITY**

1. Eligibility Criteria for associated contractor

Name of Work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur (SH: Electrical Works)

Eligibility condition for Associate agency for execution of Internal Electrical Installation works.

1. The eligible agency should have “A” class valid electrical licence. They should have successfully completed works, as mentioned under during seven years ending previous day of last date of submission of tender
 - i) Three similar works each of value not less than Rs. 489.47 lacs
OR
 - ii) Two similar works each of value not less than Rs. 734.20 lacs
OR
 - iii) One similar work each of value not less than Rs. 978.93 lacs

Similar works mean Internal Electrical installation works

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.

2. The main contractor / agency has to submit detail of such associate agency to Engineer-In charge (Internal Electrical Installation works) within one months from date of start of work. (The associate agency shall be approved by Executive Engineer (Elect.) .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 (Elect.). The new agency / agencies shall also have to satisfy the laid down eligibility criteria. In case Executive Engineer (Elect.) 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.

PROFORMA OF SCHEDULES

(SH: Internal Electrical Installation works)

(Operative schedules shall be supplied separately to each intending tenderer)

SCHEDULE 'A' Internal Electrical Installation works

Schedule of Quantities (as per CPWD-3) As per separate sheet attached for electrical items of works.

SCHEDULE 'B'

Schedule of materials to be issued to the contractor:

S.No	Description of item	Quantity	Rates in figure & words at which the material will be charged to the contractor.	
place of issue				
1	2	3	4	5
..... NIL.....				

SCHEDULE 'C'

Tools and plants to be hired to the contractor

S.No	Description	Hire charges per day	Place of issue
1	2	3	4
..... NIL.....			

SCHEDULE 'D'

Schedule for specific requirement / document for the work if any: As attached in tender form

SCHEDULE 'E'

Reference to General condition of contract- GCC 2023, CPWD form 7 modified and corrected up to last date of receipt of tender. Moreover, any modifications in clauses of GCC-2023 issued by CPWD on account of GST regime in future i.e after the receipt of tender and upto the actual date of completion of the work of the present contract shall also be applicable for this contract.

Name of work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.

Estimated cost of work: **Electrical Items of works Rs. 12,23,66,463/- (Excluding applicable GST)**

Earnest Money

Included on schedules of civil components

ii) Performance Guarantee: As per major components

iii) Security deposit

General Rules of & Directions:

Officer inviting tender;

Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with major component.

SCHEDULE 'F'

Definitions:

2 (v) Engineer-in-charge

Executive Engineer (Elect), IIT Kanpur

2 (vii) Accepting Authority

As per major component

2 (x) Percentage on cost of materials and labour 15%
to cover all overheads and profits

2(xi) Standard schedule of Rates:

Schedule of rates-2022 & MR

2 (xii) Department:

Institute Works Department

9(ii) Standard CPWD contract form:

As per Major Components

Remaining applicable clauses are as per major component.

2.0 MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN

1. M/s Name of the firm with full address
Enlistment status
Valid upto:
Henceforth, called associated contractor
And
2. M/s Name of the firm with full address
Enlistment status
Valid upto:
Henceforth, called associated contractor

Name of work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur (**SH: Electrical Works**)
[Electrical component only] 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 upto dated) and the department (IWD) can enforce all the term 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. Both the parties shall be paid consequent to the execution as per 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 besides forfeiture of the security deposit.
2. All the material, machinery and equipment's, tools and tackles required for execution of the electrical works. As per agreement shall be responsibility of the associated contractor.
3. The site staff required for the electrical work shall be arranged by the associated contractor as per terms and conditions of the agreement.

SIGNATURE OF THE MAIN CONTRACTOR

Date
Place

**SIGNATURE OF ASSOCIATED
CONTRACTOR**

Date
Place

**COUNTERSIGNED
EXECUTIVE ENGINEER (ELECT)**

3.0 WILLINGNESS CERTIFICATE

Name of work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur (**SH: Electrical Works**)

I will execute the work as per specification and conditions for the agreement and as per direction of the Executive Engineer (Elect.). 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.

I/ We undertake and confirm that eligible similar works (s) has / have not been got executed through contractor on back basis. further that, if such a violation comes to the notice of Department, then I/We shall be debarred for tendering in IWD contracts in future forever".

I have also read the complete tender conditions and I am aware that PART-A(civil tender) of this tender document is applicable to me also"

Date:

Signature of Contractor

PART- I: GENERAL

1.1 SCOPE OF WORK

The general character and the scope of work to be carried out under the contract are illustrated in Drawings. 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 in specifications and 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 complex includes Basement, Ground to Fifth floors comprising research spaces, offices, laboratories etc.

The system includes:

- a) Wiring for Normal Electric supply & Emergency supply shall be done in PVC conduit / Cable tray/ Raceway system as per drawings. All exposed conduits will be metal conduits and all concealed conduits will be PVC.
- b) Switches, plug sockets, cover plates and other wiring accessories.
- c) Sub-Mains wires/cables from panel to respective flat DB/Floor.
- d) Distribution boards
- e) Cables on cable trays including installation, cable trays, hangers, supports, cable terminations and all fixing accessories.
- f) Earthing (Grounding) System and Lightning Protection System.
- g) Main LT Panels at ground floor & Distribution Panels on each floor. The general construction shall confirm to IEC 61439-1 & 2.
- h) All cabling from main LT panel at ground floor to each respective distribution panels on each floor.
- i) Cable connections from substations panel to main Building panel shall be in our scope.
- j) Lighting Fixtures and Fans

1.2 RELATED DOCUMENTS

1. These Specifications shall be read in conjunction with the CPWD General specification for Electrical work Part-1 Internal (2013) or latest as on date, Part-2 External (1994) or latest as on date drawings and other document connected with the work.

1. CHAPTER 1: SUB MAINS AND POINT WIRING

1.1.Scope

The scope of this section comprises the supply, installation, testing and commissioning of following as per drawings:

1. Wiring for power and UPS outlets, heavy duty sockets/industrial sockets.
2. Wiring from distribution boards to different switchboards and from there onwards to individual points like light points, Bell Buzzers, Fan points and small exhaust fan points etc for all internal areas.
3. Switchboards, power plugs and its accessories like gang box, front plate, switch etc.
4. Wires and its accessories like conduits, Outlet boxes, junction boxes, pull-through boxes etc.
5. Ceiling rose, Connectors etc. for light points, Fan points, small exhaust fan points etc for all internal areas.
6. Conduit/channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/ light fixture.
7. All fixing accessories such as clips, screws, raw plug etc. as required.
8. Metal switch boxes (as specified) for control switches, regulators, sockets etc, recessed or surface type, and phenolic laminated sheet covers over the same.
9. Control switch or MCB, as specified in drawings.

-
10. Connections to ceiling rose, connector, socket outlet, switch etc.
 11. Flexible conduits from ceiling junction box to the fittings shall be provided duly coupled at both ends where false ceiling is coming. This shall be included within the scope of point wiring.
 12. Interconnecting wiring between switches within the switch box on the same circuit.

1.2. Codes & Standards

More particularly following documents should be strictly followed.

2. CPWD General Specification for Electrical work Part-1 Internal (2013) or latest as on date
3. CPWD General Specification for Electrical work Part-2 External (1994) or latest as on date
4. National Building Code - 2016
5. National Electrical Code - 2023
6. Indian Electricity Act 2003
7. Indian Electricity Rule 1956

Apart from above the relevant Bureau of Indian Standard codes as more particularly stated herein and broadly to all the codes, status and regulations as applicable shall be strictly enforced and adhered to.

1.3. Specifications

1.3.1. Wires:

The wires shall be PVC Insulated Copper Conductor multi stranded FRLS confirming to IS: 694 and amendment up to date.

- a. Wires from light/Fan circuit wiring and point wiring (along with internal loop earthing) shall be of 1.5 sq.mm size.
- b. Wires from DB to 6A Socket outlet (along with internal loop earthing) shall be of 2.5 sq.mm size.
- c. Wires from DB to 6/16A Socket outlet (along with internal loop earthing) shall be of 4 sq.mm. Size.
- d. Wires from DB to Split AC, Geyser, Industrial sockets and Sheet steel MCB/MCCB box shall be as per drawings.

1.3.2. Thimbles/lugs:

The wires shall be terminated with the help of crimping lugs at both the terminals. The lugs shall be suitable for 1100V and the min temperature rating for these lugs shall be 150 degree Celsius. The lugs shall be pin/Hole type with pin designed in such a fashion to prevent damage to the wire from over tightening and ensure a reliable electrical connection. If Aluminum cable is used, aluminum lugs shall be used, for copper cables, copper lugs shall be used and if cable termination is of aluminum conductor and main busbar is copper than tinned copper or bi-metallic lugs shall be used.

1.3.3. PVC conduits and accessories:

Wiring for Light/ Fan/Call Bell/Exhaust Fan point and circuit wiring and power wiring shall be done in PVC conduit confirming to IS:9537 and amendment up to date.

1.3.4. Modular GI Box:

The switch box for mounting modular switches and sockets shall be made out from pre galvanized sheet. The modular GI box having wall thickness not less than 1.2mm for boxes up to size of 20 cm X 30 cm and above this size of 1.6 mm thick shall be used.

1.3.5. Modular Base and cover plate:

The front plate shall have smooth surface from both the side and shall be properly matching the fixing alignment. Perfect alignment shall be maintained while fixing of the back boxes. The color shall be as per the engineer in-charge.

1.3.6. Switch - Socket Outlets:

The switch sockets shall be modular type of reputed make mentioned in preferred approved make list.

1.3.7. Blanking Plate:

Spare space in modular switch box shall be covered by blanking plate.

1.3.8. Electronic fan regulator:

Step Type two module Electronic regulators should be used.

2. CHAPTER 2: DISTRIBUTION BOARD

2.1.1. Distribution Boards

The distribution board shall be made out of CRCA sheet steel with powder coated double metallic door with minimum IP: 42 protection compliance to IS: 8623-1 and 3 and IEC 61439-1 & 3 and amendment up to date.

3. CHAPETER 3: CABLES TRAYS AND RACEWAYS

3.1. CABLE TRAY

Cable tray system shall comprise of perforated Hot Dipped Galvanised Iron cable tray with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders including G.I. bolts & nuts, etc. as required. Refer all specification other than material from CPWD Part-I.

3.2. RACEWAY

1. Material Pre galvanized sheet raceway trunking system with openable cover confirming to EN 50085 - 2 – 2 shall be used.

-
2. Metal raceways combines with Junction Boxes, back Boxes for wiring devices, fixing and coupler accessories shall be of same manufacture of raceway selected.
 3. Standard Thickness: 1.5mm for Body and Cover / 1 mm for divider.

3.3. LT cables

1. The specification covers design, manufacturing, testing, packing, supply & delivery on FOR destination basis of 1100 volts grade,LT Cable, multiple core, Cross linked Polyethylene (XLPE),FRLS,insulated, PVC sheathed, armoured power cables for effectively earthed systems.
2. Unless otherwise specified, the cable shall conform in all respects to IS 7098-Part-1(1988), IS 8130-1984,IEC: 60502 ,IS 5831-1984,IS 10810-1984,IS 3975-1999 and IS 10418-1982 standards with latest amendments thereof.
3. All materials used in manufacturing of cable shall be new, unused and of finest quality. All materials should comply with the requirements / tests as per applicable IS / IEC specification, Indian Electricity Rules and any other statutory provision of rules & regulations.
4. The purchaser reserves the right to ask for documentary evidence of the purchase of various materials, (to be used for the manufacture of cable) as a part of quality control. Quality Assurance plan shall be submitted. Each of cable type and size shall be ISI certified. The manufacturer shall submit self-certified Xerox copy of valid ISI license with the offer.
5. All the cable types and sizes i.e. items offered should have been fully type tested as per IS 7098 (Part-1) with amendments upto date at any NABL accredited Laboratory/ Test house. If the manufacturer's lab is accredited by NABL then it shall be acceptable for type testing. The bidder shall furnish one set of authenticated copy of type test reports along with the offer. These type tests must have been conducted within last five years prior to date of Bid opening. The selection of sample pieces for acceptance test shall be as per Appendix A of IS 7098 (Part-I), of each lot offered for inspection or part thereof. The minimum shall be one drum.

The g acceptance tests shall be carried as per IS: 7098 (Part-I) out on the selected samples.

- (a) Tensile test (for aluminum)
- (b) Wrapping test (for aluminum)
- (c) Conductor resistance test.
- (d) Test for thickness of insulation and sheath
- (e) Hot set test for insulation
- (f) Tensile strength and elongation at break test for insulation and sheath.
- (g) High voltage test.
- (h) Insulation resistance (volume resistivity) test

All the acceptance tests shall be carried out by the firm, in the presence of purchaser's representative at their works. The firm shall give atleast 15 days advance notice to the purchaser to enable him to depute the engineer for witnessing the tests. The test certificates for acceptance tests witnessed by inspecting officer/ engineer shall be submitted for approval before dispatch of material.

6. The following shall constitute the routine tests. The Inspector may also inspect the routine tests at the time of inspection.
 - a. Conductor resistance test
 - b. High-voltage test for 5 minutes [as per Clause 16.2 of IS: 7098 (Part-I)]

4. Chapter – 4: LIGHTNING PROTECTION AND EARTHING SYSTEM

The buildings specified are to be provided Class-III mesh type lightning protection system with Type-B Earthing protection confirming to national building code 2016, Part-8, Section-2. In case NBC does not elaborate a particular parameter, IEC-62305 may be referred.

5. Chapter – 5: MAIN LT Panels/DISTRIBUTION PANELS

5.1.MAIN LT PANELS/DISTRIBUTION PANELS

Distribution Panels and Final Distribution Boards shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase 4 wire system 415 volts/single phase 2 wire system 240 volts, 50 cycles, with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by an approved manufacturer. Distribution panels shall comply with the latest Relevant Indian Standards, National building code-2016 and Electricity Rules and Regulations and general construction as per IS-8623-1993 as amended up to date and degree of protection shall be IP 42 as per 13947 Part- I. Panel Construction should be of 2mm folded metal sheets thickness, except for few internal partitions. The Main LT Panel should be tested according to the latest standards, IEC61439-1&2 and shall be certified by 3rd party Certification body as per IEC 61439-1 & 2. Test reports without certificate shall not be considered admissible proof of compliance. The Certifying Authority shall be qualified under ISO/IEC 17065 as per IEC 61439-1.

5.1.1. Construction Features

Distribution panels shall be fabricated out and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required. Panel should be supplied with double door arrangement, outer door should be transparent in nature to allow maintenance staff to visually access the device status, meter reading, indicating lamp status without opening the door. LT Panel should have Rated Impulse withstand voltage of 12 KV and Rated Insulation Voltage of 1000V. The Panel shall be rated for short time current withstand, I_{cw} (1 Sec) = 50KA. LT Panel should have compartmentalized design with separate totally enclosed compartments for horizontal bus bars, vertical bus bars, ACBs, MCCBs & Cable Alleys. The LV Switchboard shall be rated for degree of Protection as IP 42, and Form of internal separation as Form 3b construction with Metallic Separators & Shrouding only. FRP/Hylem separations not acceptable. The busbar shall be of Aluminum. The panel has to a bolted design and no welding shall be allowed. The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand high operating temperature. Certified design of switchboards shall be proven design from OEM (Original Equipment/ Switchgear Manufacturer). OEM name should be mentioned on top of each column of switchboard. Also, OEM Partnership Certificate shall be furnished by Panel builder. To ensure right performance on Seismic risk, Switchboards shall be validated design for Seismic withstand for Ground Acceleration level of 2g. Test shall be performed in accordance with standard IEEE 693: 2018. Panels shall be rated for mechanical impact level of IK10 level.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. Certified design of switchboards shall be proven design from OEM (Original Equipment/ Switchgear Manufacturer). OEM name should be mentioned on top of each column of switchboard. Also, OEM Partnership Certificate shall be furnished by Panel builder.

5.1.2. Bus Bar Connections

Bus bar and interconnections shall be of high conductivity electrolytic grade aluminum/electric grade copper complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be color coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross-sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid copper / aluminum strips of proper size to carry full rated current and insulated with insulating sleeves. Maximum allowable temperature for the Bus bar to be restricted to 85 deg C. Arc containment level 50kA / 0.3s & with Arcing Class 'C'. Rated Short Time Withstand Current Up-to 65 kA rms 1s. The assembly with AL busbar should be able to withstand and contain full fault current of 50 ka for 0.1 sec as per IEC TR 61641: 2014, edition. Wireless Thermal sensors for Thermal monitoring of Incomer ACBs terminals for continuous data recording and visualization with a centralized monitoring system enables live data monitoring, pre-alarming and event alarming, notification of operators, visualization of trends and historical reporting. DIN rail wireless/battery less sensors for all cable alleys/compartments of the Main LT Panel capable of monitoring the system and generate three-levels of alerts on overheating wire connections or overheating cables depending on the severity of the detected situation. These sensors should fulfill ISO 14025 PEP ecopassport® program requirements.

5.1.3. Temperature - Rise Limit

Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1993. To prevent fire risk and maintain Installation/manpower safety, Cable overheats sensor should be installed in Panel Columns with cable connections, cable alleys etc. This sensor will sense any abnormal heating in the cables inside the Panel due to factors like insulation deterioration or physical damage/ageing and will give alert via mail notification or alarm for preventive/corrective steps to be taken before actual fire incident happens. Panel builder will make the required communication arrangement for local/remote monitoring of these sensors on Customer LAN Network thru web server or HMI on Panel Door. Wireless Thermal sensors for Thermal monitoring of Incomer ACBs terminals for continuous data recording and visualization with a centralized monitoring system enables live data monitoring, pre-alarming and event alarming, notification of operators, visualization of trends and historical reporting.

5.1.4. Cable Compartments

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

The GA drawings of all main/Distribution panels shall be prepared by panels manufacture and got approved by engineer in-charge before fabrication. Factory inspection of panels of engineer in-charge shall be planned before dispatch at site. All main panels/Distribution panels shall be provided with MCCB of appropriate capacity as per single line diagram.

5.2. LT Switchgears:

5.2.1. Standards and Codes

The latest amended up to date Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 2003 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.

5.2.2. Air Circuit Breaker

The ACB shall conform to the requirements of IS/IEC 60947-2 and shall be type tested & certified for compliance to standards from CPRI, ERDA/ any accredited international lab. The circuit breaker shall be suitable for 433 V, 3 phase, 50 Hz supply system. Air Circuit Breakers shall be with molded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" "CIRCUIT HEALTHY" "SPRINK CHARGE" indications.

ACB should be able to carry Rated current as required in the SLD at the yearly maximum ambient temperature applicable for 50 degree centigrade and as per site condition whichever is higher.

ACB should have an operational designed voltage of 690 V for $I_{cs}=100\%$ I_{cu} for $I_{cw}=1$ Sec.

The ACB shall be 3/4 pole with modular construction, draw out, manually or electrically operated version as specified in SLD. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (I_{cs}) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity (I_{cu}) and short circuit withstand values (I_{cw}).

Circuit breakers shall be designed to 'close' and 'trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Mechanical Contact wear indicator shall be mounted directly on the moving contacts to indicate the degree of erosion of the contacts. The ACB shall be provided with a door interlock i.e. door should not be open when circuit breaker is closed, and breaker should not be closed when door is open.

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breakers shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 4 NO and 4 NC auxiliary contacts or as per BOQ requirement w.r.t Manufacturer shall be provided on each breaker. Rated insulation voltage shall be 1000 volts AC.

5.2.3. Cradle:

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on Pin & Cam type/steel balls/rollers and not on flat surfaces.

There shall be 3 distinct and separate position of the circuit breaker on the cradle. Racking Interlock in Connected/Test/Disconnected Position.

- Connected Position: Main isolating contacts & control contacts of the breaker are Engaged
- Test Position : Main isolating contacts are isolated but control contacts are still engaged
- Isolated Position: Both main isolating & control contacts of the breaker are isolated
- There shall be provision for locking the breaker in any or all of the first three positions.
- The following safety features shall be incorporated:-
 - a) Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.
 - b) Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.
 - c) All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.
 - d) All Switchgear module front covers shall have provision for locking.
 - e) Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.
 - f) Actual Contact Inspection should be possible by removing Breaker from the panel – with mechanism connected to moving contacts of ACB.

5.2.4. Protections:

The breaker should be equipped within built battery backup microprocessor LCD display based release to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following five zones:

- Long time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.
- Neutral protection for 4 pole ACBs.

The protection release shall have following features and settings:

a. True RMS Sensing

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current.

b. Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

c. Defined time-current characteristics:

A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

d. Trip Indication

Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis. ACB should display last 10 trip history with date time stamping.

e. The release shall meet the EMI / EMC requirements.

f. The setting range of release shall confirm to IEC- 60947 and its applicable sub-parts. All ACBs shall have over temperature protection of release.

g. Manufacturer should provide the Discrimination coordination study up to the bus fault level for all ACB/MCCB.

All Incomer ACBs shall have temperature rise monitoring at cradle terminals and display thru protection release, LED/LCD display showing all Power & Energy Parameters (Currents, %loading, Voltages, Frequency, PF, Power & Energy (active, reactive & apparent) etc. All incomer ACBs shall have following additional protections other than mentioned above:-

- Under and over voltage
- Under and over frequency
- Restricted Earth Fault protection
- Trip Circuit supervision with PS class CT's.
- Undercurrent, (for DG set only)
- Reverse power (for DG set only)
- Phase sequence reversal
- Load shedding and reconnection thru programmable contacts.

Release should have LCD display for Power parameters.

- Release should be able to capture short circuit current on which ACB has tripped. The trip and alarm shall be stored in memory with the date & time stamping along with type of fault and alarm.

-
- Release should be self-powered.
 - Integral Test facility to test healthiness of release and the trip circuitry shall be provided on the Release.
 - Programmable contact shall be provided with possibility to configure for pre alarm like over load, over temperature etc, and trip functions like OL/SC/EF/OT etc.

5.2.5. Safety Features:

- The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.
- Draw out breakers should not close unless in distinctservice/Test/Isolated positions.
- The insulation material used shall conform to Glow wire test as per IEC60695.
- The ACB shall provide in built electrical and mechanical anti-pumping.

5.2.6. Moulded Case Circuit Breaker (MCCB):

5.2.6.1 General:

- Moulded-Case Circuit Breakers (MCCB) shall comply with IEC 60947-1&2 standards.
- Earth Leakage Relay (30-3000mA) with CBCT shall be used for all outgoing MCCB.
- Earth Fault shall be provided for all incoming MCCB.
- MCCB shall be of category A with a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) on all the ratings.
- MCCB shall have a rated insulation voltage of 690 V AC (50/60 Hz)
- Indication lamp ON, OFF, TRIP shall be provided in MCCBs and ACB.
- MCCB must be available in Microprocessor (250A and above) / Thermal Magnetic (Up to 200 Amp.) type release.
- All thermal magnetic MCCBs up to 160A shall be adjustable thermal and fixed magnetic type and 200A shall be adjustable thermal and adjustable magnetic type ($I_r = 0.8 \times I_n$ to 1.0).
- circuit breakers should be certified for operation in pollution-degree III environments as defined by IEC standards 60947-1 and 60664-1 (industrial environments). circuit breakers should have successfully passed the tests defined by the following standards for extreme atmospheric conditions: b IEC 60068-2-1: dry cold (-55°C) b IEC 60068-2-2: dry heat (+85°C) b IEC 60068-2-30: damp heat (95 % relative humidity at 55°C) b IEC 60068-2-52 severity level 2: salt mist.
- For microprocessor shall have following characteristics: -
 LI : ($I_r=0.4$ to $1 \times I_n$, $I_i=1.5$ to $8 \times I_n$)
 LSI : ($I_r=0.4$ to $1 \times I_n$, $I_{sd}=1.5$ to $8 \times I_n$)
- MCCBs shall be permissible for mounting in all 3 axes (Vertical Wall, Laterally Rotated Wall and Ceiling& Floor mounting) without any adverse effect on electrical performance. It shall have line load reversibility.

5.2.6.2 Construction & Operation:

- For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.
- MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.
- The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are all actually separated & in OFF position, the toggle or handle shall indicate the isolation position.
- MCCBs shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.
- The MCCB should have a trip-free mechanism that ensures the trip process is not prevented even if the operating mechanism is blocked or manually held in the "ON" position.

- The Microprocessor Release MCCBs should be equipped with non-saturable type CTs for reliable & accurate protection.
- All MCCB shall have Built-in μ P based trip unit having protection functions LSIG. Variable current setting for L,S,I and G and variable time delay setting for L,S and G. Neutral O/L protection possible with 3P MCCB (with External Neutral CT) and 4P MCCB. Last Fault trip history on LCD screen of MCCB i.e Faulty phase, Type of Fault and interrupted current. shall be of double make double break design with $I_{cs} = 100\% I_{cu}$, with rotary handle & pad locking arrangement.

5.2.6.3 Current Limit & Selectivity:

- MCCBs shall be Current Limiting type.
- MCCBs, the current ratings of which are identical with the ratings of their trip units, shall ensure selectivity in rated current interval 1:1.6
- -MCCBs shall be equipped with a test facility of the Release by a hand-held device.

5.2.6.4 Accessories:

- MCCBs shall have uniform Internal Accessories platform across the range
- MCCBs Door Mounted Extendible Rotary Handle shall have an option of Illumination Kit to indicate three stable mechanism positions (ON, OFF and TRIPPED).
- MCCBs with TMTU Release should have provision for separate Short Circuit Signal facility.
- MCCBs shall be snap fit type to enable safe on-site installation of auxiliaries, voltage releases, signal contacts etc.
- MCCBs should have symbols engraved in the lid of the accessories compartment to indicate possible mounting position of internal accessories.
- The addition of a motor module or manual rotary handle etc. shall not block device settings.
- MCCB shall be equipped with Phase barrier, tinned copper spreaders.

5.2.6.5 Communications:

- All incomers ACBs & MCCBs in main LT panel and distribution panel shall be BMS compatible in open protocol.

5.2.7. Moulded Case Circuit Breaker (MCB):

Miniature Circuit Breaker shall comply with IS/IEC 60898-1:2002 & EN 60947-2 or IEC-60947-2. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

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

5.2.8. Meter:

5.2.8.1 All meter at incomer level shall have minimum 128 sample per cycle, Accuracy class 0.2s and compliance to IEC 62053-22 for active energy and IEC 62053-24 for reactive energy measurement, should be capable of Individual Harmonics measurement up to 63rd and compliance to relevant IEC standard IEC 61000-3. should be capable for 4 quadrant measurement, Including Demand & should be capable of generating onboard alarms for various critical conditions.

- All voltmeters and indicating lamps shall be through Control MCB's.
- 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 according to connected instrument and load.

5.2.8.2 Digital Multi-Function meter shall be provided in all incomers in main LT panels and distribution panels as shown in SLD, having following characteristics:-

- Digital Electronic multi-function meter with RS-485 port with THD with individual harmonics up-to 31st order and THDi to measure and display the following electrical parameters:-
- Total active energy(KWH/MWH),
- Maximum demand(KVA/MVA)(KW/MW),
- Maximum demand reset count,
- Instantaneous power factor,
- High/Low recording of VLL, VNL, A, Hz, PF, Var, with time stamp.
- K factor V & A to keep check on the losses due to harmonic load current and their effects of transformer heating.
- Load Manager with Demand monitoring and RTC based demand manager.
- Export/Import Net monitoring of Wh, VAH, VARh, inductive/capacitive load hours.
- Auto Scaling Capability in variance of Kilo, Mega, Giga.
- Positive energy accumulation even with CT polarity reversal with reverse lock programmable.
- Byte order option-Field Programmable float/Little Endian/Big Endian data formats.

5.2.8.3 Energy meter shall be provided in all outgoings in main LT panels and distribution panels having following characteristics:-

- Monitors electrical parameters : Amps, W/VA, LLV, LNV, Hz, PF
- Integrated Parameters :KWh /KVah, PF/Watt anyone programmable.
- Old Energy register for back-up of last cleared energy values.
- True RMS measurement with simulations sampling of current and voltage.
- Color coded analog load bar indicators
- CT Reversal : Auto correction of energy integration in Star (WYE) mode
- Password protection for tamper proofing.
- Site Selectable CT/PT.
- Pulse output for integration into a process through PLC/DCS for online energy management.
- Auto& Manual Scaling Capability in variance of Kilo, Mega, Giga
- Seamless integration into any modbus compatible SCADA- Energy Management System (EMS)

5.2.8.4 General Requirements:

- CT polarity correction should be possible through Energy Meter for each phase.
- Import/ Export measurement for KWH/ KVARH is required.
- The current inputs shall be configurable at site for measuring x/5/1 A current transformers
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 70V to 300V, 40-70Hz
- The multifunction meters shall have backlit LCD display with power saving mode/ adjustable contrast.

5.2.9. Current Transformer:

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/ 1 amps secondary for operation of associated metering. The CTs shall conform 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 measurement CTs shall be of accuracy class as per SLD.

5.2.10. Residual Current Circuit Breaker (RCCB)

5.2.10.1 SYSTEM of Operation:

Residual Current Circuit Breaker shall conform to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the torroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage; current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations. RCCBs should have a rated conditional short-circuit current of 10 kA.

5.2.10.2 MECHANICAL Operation:

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

5.2.10.3 Neutral Advance Feature:

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

5.2.10.4 Testing Provision:

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

5.2.11. Switchgear & Protection:

Incomer switchgear shall be TP breaker appropriate rating (minimum 1.8 times the normal current to take care of inrush switching current). Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports. Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 degC.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

5.2.12. Control Circuit & General Protection:

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided.

440 V caution board on the panel shall be provided.

6. CHAPTER 6: FIXTURES AND FAN

The contractor shall submit LM 79 report of the LED Luminaries& LM 80 report from LED manufacture before fixture supplied at site. Driver of the LED fitting should by Potted. The make of LED used shall be Osram/Cree/Nichia/Philips/Lumiled.

All lighting fixtures shall comply the following specifications to meet out the requirement according to relevant CPWD specification/IS code/NBC-2016/ECBC-2017 whichever is high.

LED Light Fixtures - Indoor		
Sl no	Criteria	Specification
1	The Luminaire Construction	Single Piece Pressure die cast Aluminium alloy housing for better thermal conductivity for downlighters/ Extruded aluminium for Linear Profiles/ CRCA for 2x2 or 4x1 recess panels. Seperate driver and optical compartment for Thermal isolation.
2	Beam Angle	Injection Moulded PC diffuser for optimum light transmission or 24/36/60deg beam for focus light fixtures
3	Operating Voltage Range	140 - 270 VAC
4	Frequency	50 Hz
5	Power Factor@240 VAC	≥ 0.95
6	Driver	Driver Efficiency ≥ 85% Driver inbuilt Surge Protection - 2.5 KV Over voltage Protection Short circuit Protection Thermal Protection
7	THD @ 240 VAC	≤ 10%
8	Ingress Protection	IP20
9	Colour Temperature	4000° K/5700° K
10	Color Rendition Index - CRI	≥90
11	Standard Deviation Color Matching (SDCM)	<3
12	System Efficacy	≥120-130 Lumens Per Watt
13	Junction Temperature of LED	≤ 75°Celcius
14	Operating Temperature Range	0°C to 45°C
15	Average Operating Life	>50,000 Hours @ L70
16	Humidity	10% to 80%
17	Compliance/Certificate	BIS, IEC 60364-4-443, EN 55015, EN 61547, IEC 61000-4-5:2017
18	Test Reports	LM79, LM80, TM-21 test reports from NABL accredited lab

LED Light Fixtures - Outdoor		
Sl no	Criteria	Specification

1	The Luminaire Construction	Single Piece Pressure die cast Aluminum alloy housing for better thermal conductivity. Seperate driver and optical compartment for Thermal isolation. Each LED should be covered with IP-66 or more protected PC lens. Luminaire with glass/PC/Acrylic cover/diffuser will not be accepted due to accumulation of insects/dust and decrease in light output.
3	Operating Voltage Range	140 - 270 VAC
4	Frequency	50 Hz
5	Power Factor@240 VAC	≥ 0.95
6	Driver	Driver Efficiency ≥ 85% Driver inbuilt Surge Protection - 5KV Silicon Potted Over voltage Protection Short circuit Protection Thermal Protection
7	THD @ 240 VAC	≤ 10%
8	Ingress Protection	IP66
	Impact Resistance	IK10(Street Lights), IK08 (Flood Lights)
9	Colour Temperature	5700K
10	Color Rendition Index - CRI	≥70
11	Standard Deviation Color Matching (SDCM)	<5
12	System Efficacy	≥130 Lumens Per Watt (Street Light/Floodlight)
13	Junction Temperature of LED	≤ 85°C
14	LED Make	NICHIA/Seoul/ CREE/ OSRAM/ Samsung/ BridgeLux
15	Operating Temperature Range	0°C to 45°C
16	Average Operating Life	>50,000 Hours @ L70B0
17	Unified Glare Rating (UGR)	NA
18	Humidity	10 to 90%
19	Compliance/Certificate	RoHS, EMC/EMI (IEC 61547:2020), CISPR 15:2018, BIS, IEC 60364-4-443, EN 55015, EN 61547, IEC 61000-4-5:2017
20	Test Reports	LM79, LM80, TM-21 test reports from NABL accredited lab

7. CHAPTER 7: fire alarm system and pa System

Fire Alarm System Shall Be Designed As Per IS:2189/NBC-2016/NFPA-72.For Technical specification follows the CPWD- PART-VI (Fire Detection and Alarm System 2018).

8. Lifts

1. Electric Supply

The available system of electric supply is 415 volts between phases and 230 volts between neutral & phase and neutral – 3 phase 4 wire AC 50 Hz system suitable for operation at $\pm 10\%$ of rated supply voltage. In addition for illumination and control power required for elevators and equipment shall be indicated in the tender. Power shall be provided at one point in each Machine Room at a point to be indicated by the Contractor. All subsequent electrical systems shall be the responsibility of the Contractor.

2. Technical Particulars

The technical particulars of the Elevators are detailed in the enclosed schedule. The schedule indicates the capacity, travel, speed, number of openings, machine room and hoist way sizes etc. Should any further information required by the Contractor the same can be obtained from the offices of the Consultants.

3. Driving Mechanism

Elevator Machine

The Elevator machine shall be suitable for 415 volts 3 phase 50 Hz AC supply with a voltage variation of $\pm 10\%$ and shall be placed directly above the hoist way upon the machine room floor slab and steel beam furnished in place by the Contractor.

The machine shall have a high efficiency and low power consumption and shall be designed to withstand the peak currents in lift duties. Anti vibration rubber pads of adequate thickness shall be used below the machine to reduce the noise and vibrations.

The elevator machine shall be worm gearless reduction type and shall consist of a motor, electromechanical brake worm gear, sheave shaft and sheave all completely mounted on a common bed plate. The worm shall be provided with ball bearings to take the end thrust and roller bearings shall be provided for the sheave shaft to ensure alignment and long bearing life. The hard alloy cast iron or steel sheave shall have rope grooves to ensure proper traction and minimum rope wear. Adequate means of lubrication shall be provided for all bearings and worm gear.

Means for manual operation of the lift car shall be made by providing winding wheel suitably marked to indicate the direction of the movement to enable the lift car to be brought to the nearest landing. There shall be a warning display for switching off electrical supply before the manual operations.

Brake

The electromagnetic brake shall be spring applied and electrically released. It shall come into action after the lift has come to a complete halt to hold the car in position. The brake shall operate automatically with the safety devices and release the brake manually such release requiring the action of manual force to move the lift in short stops.

AC Motor

The AC self lubricating motor shall be suitable for elevator use with high starting torque and low starting current. Thermostats shall be embedded in the stator winding to indicate the temperature rise in the motor. The AC motor shall have class F insulation and suitable for 210 starts per hour with a maximum temperature rise of 50°C over the ambient.

Controls

The Elevators control shall be AC variable voltage variable frequency (A.C.V.V.V.F). The system shall control the starting, stopping direction of motion, running of the lift motor and application of the brake and/or safety devices in the event of power failure or any other emergency. It shall be so designed as to ensure a smooth and constant acceleration and retardation under all opening conditions.

The contractor shall be wall/floor mounted, vertical totally enclosed cubicle type with hinged doors on the front and the rear to provide easy access to all components in the controller. The cubicle shall be well ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions in the machine room.

The controller shall operate within the supply voltage variation of plus 10% to minus 20% of the nominal voltage.

- a) Over current
- b) Under voltage
- c) Over voltage
- d) Single phasing
- e) Phase reversal

The controller shall be designed to cut off the power supply, apply the brake and bring the car to a rest in the event of any of the above failures occurring.

The Contractor must state clearly the forms of protection provide for each equipment.

If any devices of the electro mechanical type are used the same shall be equipped with arc chutes to prolong the life of contacts. Contractors must stipulate the type of devices used and the material of the contacts.

Contractors must support such offers with complete details of experience, number of lifts installed and operational in India, collaboration for equipment design and manufacture etc.

Hoist Ropes

Round standard steel wire ropes as per Indian standards shall be used for Lift suspension. The number and size of the hoist way ropes shall be so selected to ensure proper factor of safety minimum 10 and adequate traction for the elevator. The governor ropes shall also be wire ropes.

The Hoist way landing door shall be provided with an interlock such that:

- a) It shall not be possible for the car to be started or kept in motion until all the landing doors and the car door are locked in the closed position.
- b) It shall not be possible to open the landing door from the landing unless the Lift car is within the particular landing zone.
- c) The car doors & Hoist way landing doors open automatically as the car is stopping at a landing. The closing of the car and landing door must occur before the car is set in motion.

Car Platform

The car platform shall be of framed construction and designed on the basis of rated load.

Car Enclosure

The elevator car enclosure shall be as per parameters enclosed in the schedule of quantities. The ceiling shall have an arrangement for a cabin fan mounted on the roof of the car. Indirect fluorescent lighting shall be provided to evenly illuminate the car. The car enclosure shall be pre-laminated particle board 12 mm thick to wall and ceiling in desired shade and grooves covered with teakwood beading of desired shape with floor 5mm thick steel chequered plate.

Car Design:

Car walls finish stainless steel, front and doors in stainless steel, mirror on rear car panel, Dimpled anti skid vinyl flooring

Car operating Panel:

Stylish brushed SS finish car operating panel, visual call confirmation, dot matrix display, car position indicator

Landing doors:

fully automatic landing doors in powder coated finish

Car Door

The car entrance for the elevators shall be protected by Steel collapsible gate duly painted and providing car and landing doors with horizontal biparting as per IS14665

Hoist way Landing Doors

For the hoist way doors at each landing, two mild steel painted panels centre opening horizontal sliding doors shall be provided to give a clear opening as indicated in the technical parameters. These shall be duly painted to the shade approved by the institute and suit to the site condition.

Car and Hoist way Operations

The car and hoist way doors shall be mechanically connected such that both move simultaneously for opening and closing. The hoist way landing door shall be provided with and interlock such that.

It shall not be possible for the car to be started or kept in motion until all the landing doors and the card door are locked in the closed position.

It shall not be possible to open the landing door from the landing unless the lift car is within the particular landing zone.

The car doors and hoist way landing doors open automatically as the car is stopping at a landing. The closing of the car and landing door must occur before the car is set in motion.

Door Hangers and Tracks

The car and the landing door shall be provided with two point suspension sheave type hangers complete with tracks sheaves and rollers shall be steel with moulded nylon collar and shall include shielded ball bearings. Tracks shall be of suitable steel section with smooth surface. The landing doors shall be complete with headers, sills, frames etc as reqd.

Cabin Fan

noiseless cabin fan shall be include for all elevators.

Emergency Light

An emergency light unit using sealed maintenance free battery power pack and fluorescent lamp to operate automatically in case of power failure shall be provided in each elevator car.

Alarm Bell

An emergency alarm bell including wiring shall be provided and connected to plainly marked push button in the car operating panel. The alarm shall be provided in the Ground floor lobby if required, The Owner may at his own cost extend the alarm bell to the security/control room. The alarm unit shall be solid state siren type operated by 2 nos. 9 volts dry batteries to give a waxing and warning siren when the alarm button in the car is pressed momentarily.

Operation Buttons

The following operation buttons shall be provided

In Each Lift Car

Stainless steel return panels of suitable thickness shall be provided on each side of the door with the following flush mounted controls on one side:-

- a) Illuminated type push buttons corresponding to the floors served. Floor nos. on push buttons shall be numbered from 1 to onward.
- b) Door open button
- c) Emergency stop button
- d) Emergency call button connected to a bell for an emergency signal
- e) Two position key operated switch for 'with attendant' and 'without attendant' operation
- f) Ventilation fan ON/OFF switch
- g) Built in intercom of the pick and speak type
- h) UP/DOWN direction display

At Landing

Illuminated type 'UP' and 'DOWN' push buttons at each intermediate landings and single illuminated type push buttons at terminal floors. The push buttons shall illuminated when the same is pressed to indicate that the call has been registered. The button shall remain illuminated until the call is answered.

One set of calling buttons shall be provided for a bank of two elevators

Indications In Each Car

The following indications shall be provided in the cars:

- a) Digital car position indicator provided above door to indicate the landing at which the car is stopped or passing.
- b) Illuminate "UP" and "DOWN" arrows on the position indicator above door to indicate direction of travel.

At all landings

Combined hall position indicator and hall lanterns is not part of the offer. This feature is generally a standard part of the equipment for Duplex Lifts i.e. two Lifts in the same control.

Safety Devices

The following safety devices shall be provided:

Self Leveling

The Lift shall be provided with a +/- 5mm self leveling accuracy feature of the two way automatic type. The self leveling device should automatically correct for under run, over run and rope stretch.

Terminal & Final Limits

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings and final limit switches shall be furnished to automatically cut off the power and apply the brake should the car travel beyond the terminal landings.

Terminal Buffers

Suitable spring buffers shall be used from existing Lift.

Interlocking

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open.

Car Safety and Governor

The car safety shall be provided to stop the car whenever excessive descending speed is attained. The safety will be operated by a centrifugal governor located at the top of the hoist way and connected to the governor through a continuous steel rope. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

Fireman Switch

Each elevator shall have a fireman switch glass front for access by the fireman. The operation of this switch shall cancel all calls to this Lift and will stop at the next nearest landing if traveling upwards. The doors will not open at this landing and the Lift will return to the ground floor. In case the elevator is traveling downwards when the fireman's switch is operated it will go straight to the ground floor by passing all calls enroute. The emergency stop button inside the car shall be rendered inoperative.

4. Gearless machine:

The gearless machine shall consist of a motor, traction sheave and break-drum or brake disc completely aligned on a single shaft. Gearless machine shall be A.C. gearless with VVVF drive.

5. Hand winding wheel or handle:

At times of lift stoppage due to any reasons, it shall be possible to move the lift car to the nearest landing manually. The manual operation shall be by means of winding. Wheel or handle mounted on the end of the motor shaft. The up or down direction of the movement of the car should be clearly marked on the motor or at suitable location. A warning plate written in bold signal red colour advising the maintenance staff to switch off the mains supply before releasing the brake and operating the wheel is to be prominently displayed.

6. Inter- communication system:

Recommends for provision of either an emergency or a telephone inside the car but as a general experience it is seen that over a period of time these devices become inoperative due

to one reasons or the other. Therefore, in order to have at least one device of communication functioning at all the times, as an alternative arrangement, provision of both i.e. telephone with minimum tow connections-one at the operator's room and other at guard room and the emergency signal with re-chargeable batteries as source of supply shall be made in the lift cars.

The device used for emergency signals should incorporate a feature that gives immediate feed-back to the car passengers that the device has worked properly and the signal has been passed on to the intended agency. This shall be achieved by pressing of button from control room which shall give audio signal to the passengers in the car

7. Emergency Power Supply for lift car:

This shall include suitable secondary battery with trickle/boost charge arrangement and inverter power pack with necessary contactors for supplying the light fixtures in the lift car. The same battery shall also feed the alarm bell and communication equipment.

8. Car landings:

All the lift car landing shall be well lit to an illumination level of 150 lux and shall be free from obstructions. The control for landing lights and the sigh lights shall be tamper proof. Wherever stand by power supply is available, these lights shall be connected to standby circuits also.

9. Instructions:

Detailed instructions as specified for guidance of passengers shall be prominently displayed inside the car by contractor and outside the car at all landings by the department. The Braile signage will be posted by the department outside lift lobby at all landings for the lift meant for barrier free requirements as per specifications.

10. Levelling:

All lift (s) shall be incorporated with suitable floor leveling devices. In case of lifts with automatic power operated doors and with A.C. VVVF controller a separate level device for automatic leveling with leveling accuracy of $\pm 5\text{mm}$ shall be incorporated.

11. Counter Weight Guards:

Guards of wire metal/ mesh shall be provided in the lift pit to a suitable height above the pit floor to eliminate the possibility of injuries to the maintenance personnel.

12. Guide shoes:

Two numbers of guide shoes at the top and two numbers at the bottom shall be provided on the lift car and counter-weight.

Type of shoes:

For passenger lifts and bed-cum-passenger lifts

i. For speed upto 1.5 mps sliding guide shoes shall be used. Sliding guide shoes

For car shall be always flexible and for counterweight solid guide shoes can be

Used upto 1.0 mps.

ii. For speeds more than 1.5 mps roller guide shoes shall be used for car and

Counter weight.

13. Rope fastenings:

The ends of lift ropes shall be properly secured to the car and counter weight hitch plates as the case may be with adjustable rope shackles having individual tapers babbitt sockets, or any other suitable arrangement. Each lift rope shackle shall be fitted with a suitable shackle spring, seat washer, shackle nut & shackle nut split pin.

14. Guards for lift ropes:

Where lift ropes run round a sheave or sheaves on the car and/ or counterweight of gearless machine suitable guards shall be provided to prevent injury to maintenance personnel.

15. Number & size of ropes:

The contractor must indicate the number and size of lift ropes and governor ropes proposed to be used, their origin, type, ultimate strength and factor of safety. The contractor should furnish certificate of ropes from the rope manufacturers issued by competent authority.

16. Safety Equipments:

Every lift installation shall necessarily be provided with the following safety features:

The safety gear shall be provided in accordance with IS (part-4-Sec.4):2001, each type of car safety shall be actuated by a speed governor.

17. Governor:

The car safety shall be operated by speed governor located overhead and driven by governor rope suitable connected to the car and mounted on its own pulleys. The rope shall be maintained in tension by means of weighted or spring loaded tension sheaves located in the pit. Governor shall be provided for lifts with a travel of more than 5.5 meters. The governor rope shall be not less than 6mm in dia and shall be made of steel or phosphorbronze. These

shall be in accordance with IS 14665 (part 4/sec-4):2001. Governor for car safety gears shall be adjusted to actuate the safety gear at the following speeds: -

- i. For rated speeds upto 1m/s maximum governor tripping speed shall be either 140 percent of rated speed or 0.88 m/s, whichever is higher. For rated speed above 1m/s maximum governor tripping speed shall be 115 per cent of the rated speed plus 0.25 m/s.
- ii. Minimum governor tripping speed shall be 115 per cent of the rated speed.

The governor shall be of “V” groove wheel design and only wheel is stopped to actuate the car safety upon a pre-determined over speed downward without damaging the rope.

The governor, rope and sheave shall be so located so as to minimize danger of accidental injury to the equipment.

The governor sheave and tension sheave shall be according to clause 2.4 and the sheave bearing shall be according to clause 2.7 of this chapter.

The requirements for field tests on car safety and governor and for drop tests to sliding type can safeties shall be as specified in section IV of this specifications.

Buffers –

Buffers shall be oil resistant rubber pad type for speeds upto 0.25 mps and spring/ oil type for speeds upto 1.5 mps and only oil type for speeds higher than 1.5 mps.

Buffers shall be suitable for installation in the space available. Buffers anchorage at pit floors shall be installed avoiding puncturing of water proofing. Oil buffers of the car and counter weight shall be of the spring return type of gravity type. the partial compression of spring return oil buffers when the car is in level with terminal landing will not be acceptable. All buffers shall be tested at manufacturer’s works and a copy of the test report shall be submitted.

When the lift car rests on fully compressed buffers there shall be at least 60 cms clearance between the lowest point in its car frame and any obstruction in the pit exclusive of buffers and their supports. Similarly when the lift car cross head is 60cm from the nearest obstruction above it, no projection on the car shall strike any part of overhead structure.

The contractor must indicate the name of buffer manufacturers, buffer stroke & certified maximum loads.

18. Door Locks:

Electro-mechanical door lock shall be provided for all the landing doors and they shall be such that the doors cannot open unless the car is at rest at the particular landing. It shall not be possible to move the car unless all the landing doors and the car door are closed and locked. This requirement however does not apply when the lift car is provided with automatic

leveling devices and in such cases, it shall be permitted to move the car with both the doors open in the leveling zone for the purpose of leveling.

Automatic- cum-attendant operation:

i. Single automatic Push Button with/ without attendant – The operating devices for this operation shall incorporate in the car control panel, car buttons corresponding to the various landings served and single landing button at each landing, all electrically connected to controller governing floor selection, direction of travel, acceleration, retardation etc.

This system shall be so arranged that when the car is not in use, on pressing a landing call button the car shall start automatically provided all the doors are closed. During the movement of the car and also when car tops at floor landing, other landing call buttons are in-operative for a predetermined time. The pressing of a car button shall automatically start the car and sent it to the desired landing. In all the cases, the starting of the car is contingent on the establishment of landing door and car inter-lock circuits. To indicate the availability, or ‘in use’ light shall be place in the landing call button panel. When light shall be ‘OFF’ the passenger shall be able to call the car. In case of manual operated door if the lift is standing at any landing with doors open (when not in use), the pressing of the landing call button shall ring a bell, fitted at the top of car to attract the attention of the people soliciting their help for closing the lift door if any one of the them happens to be near the lift incase of power operated doors, the landing and car doors shall be arranged to open automatically when the car is parked at landing after all the calls are served and the lift is parked at any landing. The doors can remain open or alternatively if desired, the car shall be arranged to close after a pre-determined time unless closing is prevented or interpreted by the car doors re-opening device or the door open button.

The lift shall be suitable for dual operation with or without attendant by the provision of key operated transfer switch indicating ‘attendant’ and ‘automatic’ positions. During ‘attendant’ operations the landing call shall be disconnected from the control system and shall be connected to an annunciator in the lift car. The attendant shall then operate the car to answer the registered calls. This operation is recommended for single speed control lift for low rising building having a single lift installation.

19. Simplex Selective-Collective operation with/ without attendant:

Automatic operation by means of one button in the car for each landing level served and by up and down buttons at the landings, wherein all stops registered by the momentary actuation of the car made defined under non-selective Automatic Operation but where in the stops registered by the momentary actuation of the landing buttons are made in the order in which

the landing are reached in each direction of travel (irrespective of the sequence in which the buttons have been actuated). With this type of operation, all 'up' landing calls are answered when the car is traveling in the up direction and all 'down' landing calls are answered when the car is traveling in the down direction, except in the case of the uppermost or lowermost calls which are answered as soon as they are reached in-respective if the direction of travel of the car.

20. Duplex Collective Selective Operation with/ without attendant:

The control system for this operation shall be similar to the one described under simplex selective-collective operation except that in this system there shall be tow lift car adjacent wells. It shall be arranged to co-ordinate both cars for efficient service and prevent them from answering the same calls by the provision of only one set of landing call button fixtures. It shall automatically assign each call to the car that will be in the best position to answer promptly. The system shall be so arranged that when the cars are idle, normally one car will be parked at the lower main landing with its doors closed or open and the other car shall be free car parked with the doors closed or open to the landing where it answered its last call, and shall be the one to attend to the nearest call.

Each car shall always respond to calls registered by its own car call buttons. When either car is parked out of service for any reasons the other car shall function as single car (simplex) selective collective. Besides the control system shall also arranged for independent service from inside the car. A by-pass button (non-stop button) shall also be provided inside the car to enable the attendant to by-pass any landing if the car is full or if otherwise so required.

The two lifts shall be arranged with or without attendant operation and shall function as described using single car selective-collective operation. When the transfer switch is in the attendant position the operation of the cars shall be identical with that described for automatic operations except that:

- i. Closing of doors and starting of cars shall be initiated by the car buttons only.
- ii. Buzzers and directional lights in the car are operative, and
- iii. Landing by-pass shall be effective.

The pressing of an up or down landing call shall illuminate appropriate direction indicator in the car panel, which is to answer that call and if the doors are open shall also sound buzzers as a signal to the attendant. If both cars are parked at the lower landing the above signals shall be given to the car which has been at the floor for longest time.

21. Automatic selection of traffic programme:

The group supervisory control continuously examines traffic conditions in the building and automatically puts into operation the programme which can best cope with the demand at any particular time. This is fully automatic and requires no supervision or attendant. To suit the traffic demand in the building, suitable traffic programmes can be selected for inclusion in this control.

22. Controlling Equipment:

The movement of the car shall be electrically controlled by means of a controller

23. Control circuits:

The control circuit shall be designed to the type of lift specified for safety operation. It shall not be possible to start the car unless all the car and landing doors are fully closed and landing doors locked. The circuit shall have an independent fuse protection for fault and over loads and be arranged so that earth fault or an open circuit shall not create unsafe condition. The circuit shall be so arranged that for the stoppage of the car at specified landing or for actuation of a contactor by emergency switches or operation of safety gears the system shall not depend upon the completion or maintenance of an electrical circuit to cut off power supply and apply the brakes. This requirement is not applicable to dynamic braking and speed control devices.

24. Terminal Boards:

All wiring for external control circuits shall be brought to a terminal board with means of identification of each wire. Metallic/plastic identification tags shall invariably be provided. All connections of wires to terminal boards shall be adequately clamped or screwed.

25. Auxiliary Switches:

i. Emergency stop switches:

On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Stop switch shall be provided in the machine room. Operation of these switches/buttons shall cancel all the registered calls and landing calls for that particular lift.

ii. Maintenance switch on top of the car

For purpose of inspection and maintenance, maintenance switch shall be provided on top of the car. The control circuitry shall be so arranged that in the event of the operation of this switch:

- a. The car speed shall be less than the rated speed not exceeding 0.85 meters/sec.
- b. The car movement shall be possible only on the application of the continuous pressure on a button. It shall be so mounted to prevent any inadvertent operation.

iii. Fireman Switch:

Fireman switch with glass to break for access shall be provided at ground or main floor for all the lifts. The operation of this switch shall isolate/ or cancel all calls to all the lifts and the lifts will stop at the next nearest landing if traveling upward. The doors will not open at this landing and the lifts will start traveling to ground floor. If these were already traveling down, they will go straight to ground floor direct without stopping enroute.

iv. Inspection facility:

An inspector's change over switch and set of test buttons shall be provided in the controller. Operation of the inspector's change over switch shall make both the car and landing buttons inoperative and permit the lift to be worked in either direction from machine room for test purposes by pressing corresponding test buttons in the controller. It shall not however interfere with the emergency stop switches inside the car or on the top of the car.

v. Safety line indicators:

If specified visual tell tale lights may be provided to monitor the conditions of faults in the safety line of the lift for easier fault finding. These indicators will remain lit when safety circuits are normal.

One indicator shall be provided for each safety on the controller. If any indicators fail to light up as the lift proceeds in its sequence of operation, there shall be visual indication of the safety line open circuit and also its location for easier fault finding.

26. Control Wiring:

i. Wiring in machine room:

Power wiring between the controller and main board controller to various landings shall be done in heavy gauge conduit or metal duct & shall conform to I.E. Rules 1956 and CPWD Specifications for electrical works. Following general principles shall be followed in wiring:

- a. i) Control cables carrying DC and power cable carrying AC shall not be run in the same conduit or metal duct and they shall be laid as per I.E. rules.
 - ii) Metal duct with removable inspection cover shall be preferred.
 - iii) in case of control cables also the harness shall be separate as far as feasible for separate functions and laid separately in suitably dimensioned metal duct or in a separate conduit such as the signaling, locking, lamp indication and safeties. Control cables for different voltages in the lift installation works should be laid as per I.E. Rules.
- b. At least 5 percent with a minimum of 5 unconnected spare wires shall be available out of all the lines to be provided in the wiring harness from the midway junction box to the machine room.

-
- c. There shall be a master isolating switch Fuse associated with the controller heavy duty load break, quick make quick break type TP&N preferably interlocked with controller cabinet door. Isolator handle shall have provision for external locking in off position.

All relays shall be suitable for lift service and shall incorporate adequate

Contact wipe for reliable operation. Relays shall operate satisfactorily between 80 percent to 110 percent of their voltage.

Main motor contactors shall be suitable for A.C. duty. Tenderer shall be required to furnish full details of make, type, applicable standard, voltage and current rating, duty class, type and routine tests done etc., on contactors and relays. Copies of type test certificates and other test certificates shall also be furnished by the successful tenderer.

All cables shall be with copper conductors and flame retardant or PVC insulated of appropriate size. The cables feeding motor and in heavy current flow paths shall be so selected that the size matches the protecting fuses and will not result in more than 2 percent voltage drop from the main board to the terminals of motor. Control cables shall not be less than 0.5 sq. mm. or equivalent if stranded; where installation of heavy gauge conduits present difficulties, short lengths of flexible conduits will be permitted but effective electrical continuity and earth bonding shall be ensured. Ferrules shall be slipped at the ends of all cables as per standard control wiring practice. All terminal blocks shall be suitably marked.

27. Trailing Cables:

A single trailing cable for lighting control and signal circuit is permitted, if all the conductors of this trailing cable are insulated for maximum voltage running through any one conductor of this cable. The lengths of the cables shall be adequate to prevent any strain due to movement of the car. All cables shall be properly tagged by metallic/plastic tags for identification.

Trailing cables shall run from a junction box on the top of the car to a junction box located in the shaft near mid point of travel and from these junction boxes conductors shall be run to the various locations

Trailing cables exceeding 30 meters in length shall run so that the strain on individual cable conductors will be reduced to a minimum and the cables are free from contact with the car counterweight, shaft walls or other equipment.

Trailing cables exceeding 30 meters in length shall have steel supporting fillers and shall be suspended directly by them without rubbing over other supports.

Cables less than 30 meters in length shall have no – metallic fillers and shall be suspended by looping cables around supports of porcelain spools type or equivalent.

28. Earthing:

Metal frames and all metal work of the lift controller frame etc., shall be earthed with double earth leads taken to the earth bar. Looping shall be permitted if such routing is feasible. All other individual metallic frame work of components etc., shall be loop earthed.

29. Lift Rope Compensation:

The lift rope compensation for lift travel shall be provided for lift travels beyond 40m in all cases.

30. Automatic Rescue Devices (ARD):

The automatic rescue devices (ARD) meant for the purpose of bringing the lift car to the nearest landing doors are being used selectively and is generally restricted to commercial buildings having heavy traffic. However, frequent power failures being the common phenomenon, the provision of ARD shall be made in all the lifts in public buildings. The ARD shall have the following specifications:

- i. ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator.
- ii. ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.
- iii. In case the normal supply resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing. It will automatically be switched to normal power operation.
- iv. All the lift safeties shall remain active during the ARD mode of operation.
- v. The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usages are at least 30 minutes.

LIST OF APPROVED MAKES for lifts : Johnson/Kone/Otis

Passenger Lifts:

SI No	Reference	Passenger elevators - Option 1
1	Model	Stainless steel hairline finish with SS Doors
2	Persons	15
3	Elevator Type	MRL
4	Machine	Gearless Machine
5	Location of Machine room	N/A
6	Drive	Variable Voltage Variable Frequency, full collective
7	Control	Duplex
8	Capacity	1020 Kg
9	Speed	1 mps
10	Stops	6

11	Openings	6
12	Serving Floors	Ground floor + 1st to 5th floor
13	Travel	22.5 m
14	Available Well	2500 (W) x 2000 (D)
15	Required Pit Depth	1600 mm
16	Available Headroom	4200 mm
17	Ceiling	Stainless steel hairline finish
18	Lighting	LED lighting
19	Hand rail type	HR64S-Round tubular-Dia 38mm-Silver Hairline SS on 3 sides
20	Fan type	Radial In blow 270m3/h
21	Flooring	KONE to provide 20 mm recess
22	Car Size	1600 mm (w) X 1500 mm (d) X 2200 mm (h)
23	Clear Opening	1000 mm (w) X 2000 mm (h)
24	Car & landing Doors type	Automatically operated centre opening power doors- without vision panel
25	Car door & landing doors finish	Stainless steel hairline finish
26	Car Wall materials	
27	Rear Panels	Stainless steel hairline finish
28	Side Panels	Stainless steel hairline finish
29	Entrance Panel	Stainless steel hairline finish
30	Car indicator	KDS 90 integrated in COP
31	Car indicator color	White
32	Car Push Button type	KDS300 Square
33	Car Push Button mounting type	Surface Mounted
34	Car Push button color	White
35	COP	KDS 90 Full Height
36	Landing signal Mounting type	Surface Mounted
37	Landing signal Fixing type	In Wall
38	Hall call buttons	KDS93 Round
39	Hall button color	White
40	FEATURES	Intercom
		Fireman Drive
		Infra Red Light Curtain Door Safety
		KONE Automatic Rescue Device
		Emergency light & alarm
		Load Weighing Device
		OSG electronic switch
		Fire rating of 2 hrs for landing doors

Goods Lift :

SI No	Reference	Goods elevator
1	Model	Stainless steel hairline finish
2	Persons	N/A
3	Elevator Type	MRL
4	Machine	Gearless Machine
5	Location of Machine room	N/A
6	Drive	Variable Voltage Variable Frequency, full collective
7	Control	Simplex
8	Capacity	2000 Kg
9	Speed	0.5 mps
10	Stops	7
11	Openings	8

12	Serving Floors	Basement + Ground floor + 1st to 5th floor
13	Travel	27 m
14	Available Well	2975 (W) x 2550 (D)
15	Required Pit Depth	1800 mm
16	Available Headroom	4200 mm
17	Ceiling	Stainless steel hairline finish
18	Lighting	LED lighting
19	Hand rail type	Buffer Rail on 2 sides
20	Fan type	Axial In blow 1340m3/h
21	Flooring	Checkered Steel
22	Car Size	1700 mm (w) X 2500 mm (d) X 2200 mm (h)
23	Clear Opening	1000 mm (w) X 2000 mm (h)
24	Car & landing Doors type	Automatically operated centre opening power doors- without vision panel
25	Car door & landing doors finish	Stainless steel hairline finish
26	Car Wall materials	
27	Rear Panels	Stainless steel hairline finish
28	Side Panels	Stainless steel hairline finish
29	Entrance Panel	Stainless steel hairline finish
30	Car indicator	KDS 300 integrated in COP
31	Car indicator color	Red
32	Car Push Button type	KDS300 Square
33	Car Push Button mounting type	Surface Mounted
34	Car Push button color	Red
35	COP	KDS 300
36	Landing signal Mounting type	Surface Mounted
37	Landing signal Fixing type	In Wall
38	Hall call buttons	KDS300 Square
39		
40	Hall button color	Red
41		
42	FEATURES	Intercom
		Fireman Drive
		Infra Red Light Curtain Door Safety
		KONE Automatic Rescue Device
		Emergency light & alarm
		Load Weighing Device
		OSG electronic switch

ACCEPTABLE MAKES FOR INTERNAL ELECTRICAL INSTALLATION WORKS

S. No.	ITEMS	MAKES
1	MS Conduit (ISI marked) & Accessories	BEC/ AKG / RM CON / Steel Krafis
2	PVC Conduit & Accessories	BEC/AKG/Polycab/Indeana
3	PVC / XLPE insulated aluminium / Copper conductor armoured /Enamoured MV Cables up to 1100 V (ISI Marked)	KEI / Polycab / Havells/torrent
4	FRLS PVC insulated copper conductor stranded flexible wires i/c control cables (ISI Marked)	KEI / Polycab / havells/finolex
5	Cable Glands	Dowells/ Commet / Gripwell/ Raychem/HMI
6	Cable Lugs & Thimbles	Dowells/ Commet /Ascon
7	Cable Raceway Floor / wall mounted and accessories	Schneider/ Legrand / MK (Honeywell)/excel

8	Cable Tray & Accessories	MEM /BEC/ RM CON/ Indeana/Ralbo
9	Modular Switch , Socket & Accessories	Legrand/ Panasonic / Schneider
10	Metal clad Industrial Socket outlet and Sheet Steel Enclosure for MCCB/MCB	Legrand / Hagar / Schneider/ Hensel
11	Distribution boards	Siemens / Schneider / Legrand / LK / ABB
12	Protection Device (MCB/RCCB/RCBO/ELCB)	Siemens / Schneider / Legrand / LK / ABB
13	LED Lighting fixture	Wipro/Polycab/Havells/Bajaj/Philips/Lighting Technologies
14	External Lighting	Wipro/Polycab/Havells/Bajaj/Philips/K-Lite/Lighting Technologies
15	Emergency Lighting / Exit Sign boards	Bajaj/ Prolite/ Glo-Line/ASES
16	Ceiling Fan, Fresh Air Fan, Exhaust fan	Havells/ Crompton/ Usha/ Orient/Polycab/Bajaj
17	Electrical LT Panel	Allied Engineers/Coronet Engineers/KEPL/Tricolite/ConQuerent Control Systems/Western Control Automation
18	TTA Panels (IEC 61439 Part-1 &2)	Siemens (Sivacon)/ Schneider(Prisma) / Legrand (XL3 DO)/ LK (TI) / ABB (ARTUK)/Eaton (xEnergy)
19	MCCBs	Siemens / Schneider / Legrand / LK / ABB/Eaton
20	ACB(Air Circuit Breaker)	Siemens / Schneider / Legrand / LK / ABB/Eaton
21	Electronic Digital Meters	Schenider / LK/ Secure/ Siemens/ ABB/Elmeasure/Trinity
22	Current transformer /Potential transformer	Entes/ Gilbert & Maxwell/ Pragati/ Precise/L&T/ Kappa/Trinity
23	Indicating Lamps LED type, Push Button	Siemens / Schneider / LK / ABB
24	Power contactor	Siemens / Schneider / Legrand / LK / ABB
25	Surge Protection Devices	Siemens/L&T / Schneider / Legrand/ OBO
26	Selector Switch	Salzer/Seimens/BCH/Kaycee/L&T
27	Auxiliary Relays	Siemens/ L&T / Schneider / Legrand / ABB
28	Paint	Nerolac / Asian / Berger/ICI
29	Lightning Protection System & Earthing	OBO/ Cape Electric/ APS/Indelec
30	G.I. Pipe	Tata, Jindal-Hissar, Prakash Surya
31	Rubber Mat (ISI Marked)	Jyoti / Deep Jyoti/ Premier
32	Fire Alarm System	Notifier/ Johnson Control/ Honeywell Xls-3000/ Apollo/ ASES
33	Public Address System	Honeywell/ASES/Bosch
34	UPS	Eaton/Vertiv/Schneider
35	Solar System	Waveshapes India Pvt Ltd/Gautam Solar Pvt Ltd/ReNew Power
36	Safety Equipment's	ASS/Fire Hut/Reputed

Note: - Any item not mentioned herein shall be ISI marked and shall be as approved by the engineer-in-charge.

QUALITY ASSURANCE, INSPECTION AND TESTING:

- The bidder shall have a Quality Assurance Programme (QAP) for the execution encompassing quality assurance at manufacturers' works, storage, erection, testing and commissioning activities.,
- Bidder shall submit the individual quality plan for various equipment/items after placement of award and obtain approval of IIT KANPUR.
- Drawings and Individual Manufacturing Quality plan (MQP)s and Field quality Plan (FQP)s pertaining to each equipment like LT cables, LT panels, APFC etc shall be submitted by bidder after award for review and approval by IIT Kanpur.

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- d) Suitable inspection call has to be raised for witness the routine test as per approved MQP by the bidder. EIC shall reserve the right to wave off the physical inspection and accept the equipment/material based on the reports submitted by the manufacturer/Bidder.
 - e) Bidder shall strictly adhere to the provisions or approved MQP & FQPs. The bidder shall offer proven and type tested equipment for the project. The type test certificates shall be complete as per the relevant I.S., carried out at independent third-party laboratories like ERDA, CPRI etc. and shall not be older than 5 years as on the date of bid opening.
 - f) All routine and acceptance tests shall be carried out as per approved MQP. The bidders shall arrange to give sufficient advance intimation of the manufacturing and testing schedules to facilitate timely inspection of the equipments by the IIT Kanpur
 - g) The Manufacturing Quality Plans for each equipment submitted by supplier shall cover detailed checks at various stages of raw material, bought out items, in process, final testing, etc. and packing, prior to dispatch. The submitted Quality Plan shall be in line with manufacturer's plant, national/international standards, Approved Data Sheet and contract specification. This shall also contain statutory testing requirements, if any.
 - h) This shall also contain statutory testing requirements, if any. Field Quality Plan (FQP) is intended to cover all activities at site from material receipt and storage, handling, pre-assembly, assembly up to completion of erection activities of equipment.
 - i) Required commissioning checklists shall be submitted for approval for all equipment and systems of the project and putting them into successful commercial operation.

TECHNICAL SPECIFICATION FOR IT NETWORKING, CCTV, ACCESS CONTROL & EPBAX SYSTEM FOR IITK - KOTAK SCHOOL OF SUSTAINABILITY

TECHNICAL COMPLIANCE - CCTV SYSTEM AND DATA NETWORKING SYSTEM.

Technical Specifications			
1.	4MP Dome Camera with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Make and Model	Honeywell/Tyco/Panasonic	
2	Description	4MP HD Dome Network Camera	
3	Image Sensor Type	Minimum 1/2.7" CMOS or Better.	
4	Resolution	2560x1440@30fps or better	
5	Day & Night Capable	Yes	
6	IR Illumination Range (Mtr)	30 Mtr or Better	
7	Lens	2.8 mm fix Lens or better	
8	Focus Mode	Auto, Zooming, Manual, auto back Focus	
9	Frame Rate (Fps)	Equals to or Greater Than 25 FPS	
10	Video Compression	IH+265/H.265/H.264 or better	
11	Audio Support	Yes	
12	Number Of Audio Input Channel	1	
13	Audio Compression	G.711/G.711U/ADPCM	
14	Alarm Support	Yes	
15	Minimum Illumination for Capturing Colour Image (L)	Colour: 0.002Lux@ (F2.0, ACG ON), B/W: 0Lux with IR or better.	
16	WDR (Wide Dynamic Range)	120 dB or better	
17	HLC, BLC	Supported	
18	Privacy Zones	4	
19	Defog	Supported	
20	Supported Protocols	TCP/IP, HTTP, FTP, DHCP, DNS, DDNS, MULTICAST, IPV4, NTP, UDP, Telnet, ICMP, RTP, RTSP, UPnP or better.	

21	Built-In Features	Analytics/	Motion Detection, Mask Alarm, IP Address Conflict, Tripwire, Perimeter.	
22	Vandal Housing	Resistant	IP66, Lightning protection, surge protection	
23	Mounting Bracket		Wall Mounted	
24	Power Input		PoE	
25	Operating Temperature Range		(-)30 to + 60 deg C or better	
26	Warranty (A)		Should be at least 2 Years (OEM)	
27	ONVIF Support		S , G & T.	
28	MAF		Authorization from the OEM is required for the specific tender	
2.	4MP Bullet Camera with below mentioned minimum specifications or better			
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)	
1	Make and Model	Honeywell/Tyco/Panasonic		
2	Description	4MP HD Bullet Network Camera		
3	Image Sensor Type	Minimum 1/2.7" CMOS or Better.		
4	Resolution	2560x1440@30fps or better		
5	Day & Night Capable	Yes		
6	IR Illumination Range (Mtr.)	50 Mtr. or Better		
7	Lens	4.0 mm fix Lens or better		
8	Focus Mode	Auto, Zooming, Manual, auto back Focus		
9	Frame Rate (Fps)	Equals to or Greater Than 25 FPS		
10	Video Compression	IH+265/H.265/H.264 or better		
11	Audio Support	Yes		
12	Number Of Audio Input Channel	1		
13	Audio Compression	G.711/G.711U/ADPCM		
14	Alarm Support	Yes		
15	Minimum Illumination for Capturing Colour Image (L)	Colour: 0.002Lux@ (F2.0, ACG ON), B/W: 0Lux with IR or better.		
16	WDR (Wide Dynamic Range)	120 dB or better		
17	HLC, BLC	Supported		
18	Privacy Zones	4		
19	Defog	Supported		
20	Supported Protocols	TCP/IP, HTTP, FTP, DHCP, DNS, DDNS, MULTICAST, IPV4, NTP, UDP, Telnet, ICMP, RTP, RTSP, UPnP or better.		

21	Built-In Features	Analytics/	Motion Detection, Mask Alarm, IP Address Conflict, Tripwire, Perimeter.	
22	Vandal Housing	Resistant	IP67, Lightning protection, surge protection	
23	Mounting Bracket		Wall Mounted	
24	Power Input		PoE	
25	Operating Temperature Range		(-)30 to + 60 deg C or better	
26	Warranty (A)		Should be at least 2 Years (OEM)	
27	ONVIF Support		S , G & T.	
28	MAF		Authorization from the OEM is required for the specific tender	
3.	64 channel NVR with below mentioned minimum specifications or better			
Sr. No.	Features		Desired Parameter	Compliance (Yes / No)
1	Make and Model		Honeywell/Tyco/Panasonic	
2	Resolution		12MP, 8MP, 5MP, 3MP, 2MP(1080P), 1.3MP(960P), 1.0MP(720P)	
3	Incoming Bandwidth		640M	
4	Outgoing Bandwidth		640M	
5	Compression		Audio: G.711A/G.711U Video : H.264/H.265/H.264+/H.265+	
6	Frame rate		4K:240fps 4MP:480fps 2MP:960fps	
7	Playback		Max 16CH playback	
8	RAID Type		RAID0, RAID1, RAID5, RAID6, RAID10	
9	Fisheye		Support	
10	UI/Monitoring		IE10/11, Safari V12.1 above, Firefox V.52 above, Google chrome V.57 above, Edge V.79 above	
11	Support AI		Face Detection Pedestrian Detection Vehicle Detection Cross Counting Heat Map Crowd Density Detection Perimeter Intrusion Detection Line Crossing Detection Queue Length Detection License Plate Detection Rare Sound Detection	
12	HDMI		3(1024*768, 1280*720, 1280*1024, 1440*900, 1920*1080, 1920*1080, 1600*1200, 1920*1200, 3840*2160/7680*4320/EDID) Async out. *If the output resolution of HDMI 1 is set to 8K, the maximum output resolution of HDMI 3 and 4 will be limited to 1080P, and HDMI 2 will be disabled.	

		1(1024*768, 1280*720, 1280*1024, 1440*900, 1920*1080 /EDID) Async out	
13	Ethernet	Minimum 2 RJ45 100/1000 Base-T	
14	USB	USB2.0*1(front) , USB3.0*2(rear)	
15	HDD	8 SATA HDD, up to 18TB (Enterprise-Class)	
16	Alarm Input/out	16 in /4 out	
17	Operating Temperature/ Humidity	Temperature : -10°C~+50°C (14°F ~ 122°F) Humidity : Less than 90%RH	

4.	60 TB Storage Box with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Storage	06 numbers of 10 TD external HDD/ in built for NVR mentioned above in Sr no 3.	
5.	55"Commercial LED Monitor with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Screen Size	55 inches	
2	Display resolution	3,840 x 2,160 (UHD, RGB)	
3	Back light Module	LED back light technology	
4	Aspect Ratio	16:9	
5	Static Contrast ratio	5000: 1 or more	
6	Brightness	300cd/m2 or more	
7	Refresh rate	60 Hz	
8	Viewing angle(H/V)	178°/178° or higher	
9	Response time	9ms	
10	Sync format	NTSC/PAL	
11	Panel life	More than 50000 hrs.	
12	Video formats	480p,576p,720p,1080i/p	
13	RJP Compatibility	RS-232C, LAN Port,	
14	AUDIO input interface	1 PC audio in	
15	Video Inputs & Outputs Interfaces	1 HDMI	
16	Input Voltage	100-240V AC, 50-60 Hz	
17	Remote control	Multi IR Code	
18	Operating humidity	10% to 90% noncondensing	
19	Certificate	UL / FCC / RoHS, cUL, NOM, Energy Star 7.0	
20	Approved Make	LG, Samsung, Sony, Panasonic	
6.	CAT-6A Cable with below mentioned minimum specifications or better.		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)

1	Type	Unshielded Twisted Pair, Category 6A, TIA / EIA 568-C.2 & ISO/IEC 11801	
2	Conductors	23 AWG solid bare copper	
3	Insulation	High Density Polyethylene	
4	Jacket	FR PVC	
5	Pair Separator	Cross-member (+) fluted Spline	
6	Operating temperature	-20°C to +60°C	
7	Frequency	Tested up to Minimum 250 MHz	
8	Packing Box	305 Meters/Box	
9	Bend Radius	4 * Cable Diameter	
10	DC resistance maximum	9.38 Ohms/100m	
11	Mutual Capacitance	5.6 nF MAX /100 Mtr	
12	Conductor Resistance	73 Ohms Max / KM nominal	
13	Propagation Delay Skew	35 ns/100 Mtr. MAX	
14	Max. strength Tensile	110N	
15	Standard Compliance	ANSI/TIA-568 C.2 category 6, ISO/IEC-11801, Class E/ IEC 61156-5: category 6	
16	Application	IEEE 802.af and IEEE 802.3at for PoE	
17	Certification	UL, CE, ETL Verified, RoHS	
18	Make & Model	DLINK/MOLEX/COMMSCOPE	
7.	CAT-6A Patch Cable with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
	Panel		
1	Material	Powder Coated Steel	
2	Ports	24 Port	
3	Size	483mm X 44.2mm (1U)	
4	Colour	Black	
5	Mounting Style	Punch Down (Module)	
6	Compatible	Compatible with both T568A and T568B wiring options. Backward compatible with Category 5e cabling standards	
7	AWG Support	Supports solid 22-24 AWG wires and stranded 24-26 AWG	
8	Connector Module Holder	High Impact, Flame-Retardant Plastic Compound	
9	Flammability Rating	UL 94V-0	
10	Safety Rating	UL1863	
11	Identification	Each port of the panel is numbered and has a designated label area for clear port identification	
12	Cable Management	Rear cable management bar which should act as stress reliever for terminated cables	
13	Standards Compliance	ISO/IEC 11801 Class E, TIA/EIA-568B.2-1	

14	Application	IEEE 802.af, IEEE 802.3at for PoE applications.	
15	MAF	Authorization from the OEM is required for the specific tender	
16	Certification	UL, CE, RoHS	
	Keystone		
1	Material	High Impact, Flame-Retardant Plastic Compound	
2	Type	Category 6A	
3	Insertion/Extraction life	750 cycle minimum	
4	Jack Contact Material	50μ Nickel over gold	
5	Conductor Compatibility Range	22-26AWG solid cable	
6	IDC Type	Dual (110 Or Krone) Type	
7	Current rating	1.5A max	
8	Insulation resistance	500 M ohm (min)@100 Vdc	
9	Contact Resistance	20 M ohm (max) per contact	
10	Retention	50N	
11	Voltage rating	230 V rms max.	
12	Flammability Rating	UL 94V-0	
13	Safety Rating	UL1863	
14	Color Coding	As Per 568 A/B Standards	
15	Standards Compliance	ANSI/TIA-568-C.2, ISO/IEC-11801, EN50173-2	
16	Application	IEEE 802.af, IEEE 802.3at for PoE applications	
17	Certification	UL, CE, RoHS	
18	Make & Model	DLINK/MOLEX/COMMSCOPE	
8.	RJ-45 with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	DLINK/MOLEX/COMMSCOPE	
2	Features	CAT 6A	
9.	12 Core SM OFC with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Type	12 core OS2 (9/125 micron) Single mode, Loose Tube water blocking jelly, two steel wire as strengthening component, Steel tape armouring, outdoor optical Fibre cable	
2	Outer Jacket	HDPE (High Density Polyethylene)	
3	Strength Members	Two Steel wire	
4	Armouring	Corrugated Steel tape armouring	
5	moisture protection	Waterproof Tape	
6	Loose construction Tube	Water blocking Jelly	
7	Loose Tube Diameter	2.3mm	
8	Cable Outer Diameter	9 +_ .3 mm	
9	Tensile Load	2000 N as per IEC 60794-1-2-E1	

10	Crush Load	2000 N/100 mm as per IEC 60794-1-2-E3	
11	Colour Code	ANSI/TIA/EIA-598-B	
12	Max attenuation	≤ 0.34 dB per km@1310 nm, ≤ 0.20 dB per km@1550nm	
13	Operating temperature	- 10°C to 60°C	
14	Weight	90 kg/km (approx.).	
15	Standard Compliance	ITU-T G.652.D Fibre, ISO/IEC 11801, ISO/IEC24702, ANSII/TIA/EIA 568C.3, IEEE 802.3z Gigabit Ethernet, ROHS compliant Directive 2002/95/EC;	
16	Certification	CE	
17	Make & Model	DLINK/MOLEX/COMMSCOPE	

10. 48/12 LIU with below mentioned minimum specifications or better

Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Type	19" Easy Front Access (EFA) Sliding Rack Mount LC Duplex type	
2	Material	Cold rolled carbon sheet steel with electrostatic spraying	
3	Size	1U; Up to 12/48 LC Ports	
4	Adaptor mounting plate	Up to 4 nos. of 3 Port LC Duplex adaptor plate module can be accommodated	
5	Environment Temperature Relative	(-10 °C to +70 °C)	
6	Intensity	≤ 15 kv (DC) /1min.no spark-over and no flying arc	
7	Fiber Radius Bending	≥ 40 mm	
8	Clamps	Cable clamps on the inner surface for fixing cables.	
9	Splice tray type	Fixed type Splice tray to access pigtails available	
10	Lock	Lockable front door on front with push button	
11	Easy Access Front	Sliding patch panel for easy rework and maintenance.	
12	Standard Compliance	EN 61587-1, Equipment - Tests for IEC 60917 and IEC 60297 Climatic and Environment: EN 61587-1/4.2, IEC60068-2-1, IEC60068-2-2, IEC60068-2-30, Earth Bond: EN61587-1/6.2, Flammability: EN61587-1/6.3, RoHS	
13	Certification	CE	
14	Make & Model	DLINK/MOLEX/COMMSCOPE	

11.Pigtails with below mentioned minimum specifications or better

Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Type	LC Single mode, 1.5 meter	
2	Fibre Type	Single Mode OS2, ITU-T G.652.D	
3	Tight buffered	900µm	
4	Jacket	Low Smoke Zero Halogen (LSZH)	

5	Flame Test	IEC 60332-1	
6	Other LSZH standard	IEC 60754, IEC 61034	
7	Crush Load	800 N	
8	Impact	0.2 Nm	
9	Bend Radius	50mm (min)	
10	Operating Temperature	-10°C to +70°C	
11	Max attenuation	<=0.34 dB per km@1310 nm, <= 0.20 dB per km@ 1550nm	
12	Standard Compliance	ITU-T G.652.D Fibre, ISO/IEC 11801, EN50173 -1, ANSI TIA/EIA 568B	
13	Certification	CE	
14	Make & Model	DLINK/MOLEX/COMMSCOPE	

12. 3 Mtr. OFC Patch Cord with below mentioned minimum specifications or better

Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	DLINK/MOLEX/COMMSCOPE	
2	Features	All optical fibre patch leads shall comprise of Single mode 9/125µm fibre with SC/LC/FC, fibre connectors terminated at each end. The optical fibre patch leads shall comply with the following specifications:	
3		Optical Fibre – Corning Single Mode	
4		Connector: Zirconia ceramic ferrule	
5		Pre-radiuses and pre-polished ferrule	
6		Simplex / Duplex	
7		Color-coded Yellow for SM	
8		Insertion Loss - <0.2 dB	
9		Cable: 9/125, SM	
10		Repeatability - < 0.2 dB	
11		Durability – 1000 mating cycle	
12		Working Temp: -40 deg C.to + 85 deg. C	
13		Standard: G652D, G 657A & G 657B	
14		Length: 1,2,3,5 & on request	

13 Switch 1. 24 PORT POE Switch with below mentioned minimum specifications or better

Sr. No.	Desired Parameter	Compliance (Yes / No)
	Make & Model: CISCO/ARUBA/JUNIPER	
1	Switch Should Support 24 x 10/100/1000BASE-T, 4 SFP ports and RJ-45 console port, POE Power should be minimum to 195W.	
2	Switch Should Support Min. 56 Gbps Switching Capacity and Maximum 64 Byte Packet Forwarding Rate be 41.33 MPPS, 16K MAC address table.	
3	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment. Dying Gasp for quick trouble shooting during	

	power failures or system shut downs	
4	Switch Should Support IGMP Snooping v1, v2 and MLD snooping v1/v2	
5	Switch shall support IEEE 802.1AB Link Layer Discovery Protocol (LLDP) & LLDP-MED.	
6	Switch Should Support IEEE 802.3az Energy Efficient Ethernet (EEE) Power saving Technology, Power Saving by Link Status, Time-based PoE, System hibernation, Port shut off, Cable length detection Etc.	
7	Switch Should Support 4K VLAN ID's, Min 256 static VLAN, Multicast VLAN and Auto Voice & Video VLAN	
8	Switch Should Support Port Mirroring One to one/Many to One,	
9	Switch should support Quality of Service (QoS), 802.1p, Strict, Weighted Round Robin (WRR), Bandwidth Control.	
10	Switch Should Support IP interfaces, Static routing for inter-VLAN Communication	
11	Switch should support Access Control List (ACL), Port Base, MAC Base, IP Based, L2 & L3 ACL (IPv4 and IPv6) ITU-T G.8032 ERPS sub-50 ms protection and recovery	
12	Switch Should Support Security Features like Broadcast/Multicast/Unicast Storm Control, Traffic segmentation, TLS, DoS attack prevention, 802.1X Port-based Access Control, Port Security, ARP Spoofing Prevention, DHCP Server Screening, IP-MAC-Port Binding, ARP Inspection, DHCP Snooping.	
13	Switch Should Support 802.1X Authentication local/RADIUS database (IPv4 & IPv6), port-based access control, EAP, OTP, TLS, TTLS, PEAP and Support MD5 authentication	
14	Switch Should Support features Cable diagnostics, IPv4 & IPv6 Inspection, SSH v2 feature, 802.3x Flow Control and HOL Blocking Prevention	
15	Switch Should Support Management thru Web-based and CLI.	
16	Switch Should Support SNMP v1/v2c/v3, SNTP, ICMP v6, IPv4/v6 Dual Stack, Dual image, Dual configuration	
17	Switch should have SAFETY CERTIFICATE as per UL/IEC/EN 60950	
18	switch should support Operating Temperature -5 to 50 °C (23 to 122 °F)	
14	Switch 2. 24 PORT POE Switch with below mentioned minimum specifications or better	
Sr. No.	Desired Parameter	Compliance (Yes / No)
	Make & Model: CISCO/ARUBA/JUNIPER	

1	Switch Should Support 24 x 10/100/1000BASE-T, 4 SFP ports and RJ-45 console port. POE Power should be minimum to 375W.	
2	Switch Should Support Min. 56 Gbps Switching Capacity and Maximum 64 Byte Packet Forwarding Rate be 41.33 MPPS, 16K MAC address table.	
3	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment. Dying Gasp for quick trouble shooting during power failures or system shut downs	
4	Switch Should Support IGMP Snooping v1, v2 and MLD snooping v1/v2	
5	Switch shall support IEEE 802.1AB Link Layer Discovery Protocol (LLDP) & LLDP-MED.	
6	Switch Should Support IEEE 802.3az Energy Efficient Ethernet (EEE) Power saving Technology, Power Saving by Link Status, Time-based PoE, System hibernation, Port shut off, Cable length detection Etc.	
7	Switch Should Support 4K VLAN ID's, Min 256 static VLAN, Multicast VLAN and Auto Voice & Video VLAN	
8	Switch Should Support Port Mirroring One to one/Many to One,	
9	Switch should support Quality of Service (QoS), 802.1p, Strict, Weighted Round Robin (WRR), Bandwidth Control.	
10	Switch Should Support IP interfaces, Static routing for inter-VLAN Communication	
11	Switch should support Access Control List (ACL), Port Base, MAC Base, IP Based, L2 & L3 ACL (IPv4 and IPv6) ITU-T G.8032 ERPS sub-50 ms protection and recovery	
12	Switch Should Support Security Features like Broadcast/Multicast/Unicast Storm Control, Traffic segmentation, TLS, DoS attack prevention, 802.1X Port-based Access Control, Port Security, ARP Spoofing Prevention, DHCP Server Screening, IP-MAC-Port Binding, ARP Inspection, DHCP Snooping.	
13	Switch Should Support 802.1X Authentication local/RADIUS database (IPv4 & IPv6), port-based access control, EAP, OTP, TLS, TTLS, PEAP and Support MD5 authentication	
14	Switch Should Support features Cable diagnostics, IPv4 & IPv6 Inspection, SSH v2 feature, 802.3x Flow Control and HOL Blocking Prevention	
15	Switch Should Support Management thru Web-based and CLI.	
16	Switch Should Support SNMP v1/v2c/v3, SNTP, ICMP v6, IPv4/v6 Dual Stack, Dual image, Dual configuration	
17	Switch should have SAFETY CERTIFICATE as per UL/IEC/EN 60950	
18	switch should support Operating Temperature -5 to 50 °C (23 to 122 °F)	
15	Switch 3. 48 PORT NON-POE Switch with below mentioned minimum specifications or better	

Sr. No.	Desired Parameter	Compliance (Yes / No)
	Make & Model: CISCO/ARUBA/JUNIPER	
1	Switch Should Support 48 x 10/100/1000BASE-T, 4 SFP ports and RJ-45 console port,	
2	Switch Should Support Min. 104 Gbps Switching Capacity and Maximum 64 Byte Packet Forwarding Rate be 77.3 MPPS, 16K MAC address table.	
3	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment. Dying Gasp for quick trouble shooting during power failures or system shut downs	
4	Switch Should Support IGMP Snooping v1, v2 and MLD snooping v1/v2	
5	Switch shall support IEEE 802.1AB Link Layer Discovery Protocol (LLDP) & LLDP-MED.	
6	Switch Should Support IEEE 802.3az Energy Efficient Ethernet (EEE) Power saving Technology, Power Saving by Link Status, Time-based PoE, System hibernation, Port shut off, Cable length detection Etc.	
7	Switch Should Support 4K VLAN ID's, Min 256 static VLAN, Multicast VLAN and Auto Voice & Video VLAN	
8	Switch Should Support Port Mirroring One to one/Many to One,	
9	Switch should support Quality of Service (QoS), 802.1p, Strict, Weighted Round Robin (WRR), Bandwidth Control.	
10	Switch Should Support IP interfaces, Static routing for inter-VLAN Communication	
11	Switch should support Access Control List (ACL), Port Base, MAC Base, IP Based, L2 & L3 ACL (IPv4 and IPv6) ITU-T G.8032 ERPS sub-50 ms protection and recovery	
12	Switch Should Support Security Features like Broadcast/Multicast/Unicast Storm Control, Traffic segmentation, TLS, DoS attack prevention, 802.1X Port-based Access Control, Port Security, ARP Spoofing Prevention, DHCP Server Screening, IP-MAC-Port Binding, ARP Inspection, DHCP Snooping.	
13	Switch Should Support 802.1X Authentication local/RADIUS database (IPv4 & IPv6), port-based access control, EAP, OTP, TLS, TTLS, PEAP and Support MD5 authentication	
14	Switch Should Support features Cable diagnostics, IPv4 & IPv6 Inspection, SSH v2 feature, 802.3x Flow Control and HOL Blocking Prevention	
15	Switch Should Support Management thru Web-based and CLI.	
16	Switch Should Support SNMP v1/v2c/v3, SNTP, ICMP v6, IPv4/v6 Dual Stack, Dual image, Dual configuration	

17	Switch should have SAFETY CERTIFICATE as per UL/IEC/EN 60950	
18	switch should support Operating Temperature -5 to 50 °C (23 to 122 °F)	
16	Switch 4. 48 PORT POE Switch with below mentioned minimum specifications or better	
Sr. No.	Desired Parameter	Compliance (Yes / No)
	Make & Model: CISCO/ARUBA/JUNIPER	
1	Switch Should Support 48 x 10/100/1000BASE-T, 4 SFP ports and RJ-45 console port, POE Power should be minimum to 375W.	
2	Switch Should Support Min. 104 Gbps Switching Capacity and Maximum 64 Byte Packet Forwarding Rate be 77.3 MPPS, 16K MAC address table.	
3	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment. Dying Gasp for quick trouble shooting during power failures or system shut downs	
4	Switch Should Support IGMP Snooping v1, v2 and MLD snooping v1/v2	
5	Switch shall support IEEE 802.1AB Link Layer Discovery Protocol (LLDP) & LLDP-MED.	
6	Switch Should Support IEEE 802.3az Energy Efficient Ethernet (EEE) Power saving Technology, Power Saving by Link Status, Time-based PoE, System hibernation, Port shut off, Cable length detection Etc.	
7	Switch Should Support 4K VLAN ID's, Min 256 static VLAN, Multicast VLAN and Auto Voice & Video VLAN	
8	Switch Should Support Port Mirroring One to one/Many to One,	
9	Switch should support Quality of Service (QoS), 802.1p, Strict, Weighted Round Robin (WRR), Bandwidth Control.	
10	Switch Should Support IP interfaces, Static routing for inter-VLAN Communication	
11	Switch should support Access Control List (ACL), Port Base, MAC Base, IP Based, L2 & L3 ACL (IPv4 and IPv6) ITU-T G.8032 ERPS sub-50 ms protection and recovery	
12	Switch Should Support Security Features like Broadcast/Multicast/Unicast Storm Control, Traffic segmentation, TLS, DoS attack prevention, 802.1X Port-based Access Control, Port Security, ARP Spoofing Prevention, DHCP Server Screening, IP-MAC-Port Binding, ARP Inspection, DHCP Snooping.	
13	Switch Should Support 802.1X Authentication local/RADIUS database (IPv4 & IPv6), port-based access control, EAP, OTP, TLS, TTLS, PEAP and Support MD5 authentication	

14	Switch Should Support features Cable diagnostics, IPv4 & IPv6 Inspection, SSH v2 feature, 802.3x Flow Control and HOL Blocking Prevention		
15	Switch Should Support Management thru Web-based and CLI.		
16	Switch Should Support SNMP v1/v2c/v3, SNTP, ICMP v6, IPv4/v6 Dual Stack, Dual image, Dual configuration		
17	Switch should have SAFETY CERTIFICATE as per UL/ IEC/EN 60950		
18	switch should support Operating Temperature -5 to 50 °C (23 to 122 °F)		
17	SFP Module with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	CISCO/ARUBA/JUNIPER	
2	Features	Transceiver should be Small Form-Pluggable (SFP) form factor and compatible with quoted switches.	
3		Transceiver should be Hot pluggable and support 1G speed on Single Mode.	
4		Should be RoHS Compliant.	
5		Should be Multi-Source Agreement (MSA) specification compliant.	
6		Transceiver should be fcompliant with IEEE802.3z standards.	
7		Transceiver distance capacity should be 10Km.	
8		Transceiver interface should be Duplex LC connector.	
9		Transceiver should support Single-mode 9 um fibre.	
10		Operating Temperature: 0 to 60 °C	
18.	24U Rack with below mentioned minimum specifications or better		
Sr. No	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	DYNAMIC/MTS/DIGITEK	
2	General	Adjustable 19" equipment mounting verticals provide the better mounting flexibility and maximizes the usable mounting space	
3		Depth adjustable mounting slots	
4		Precision engineering capabilities and best efficient software configuration product technology provides the best product quality	
5		Top and bottom Panel with ventilation and cable entry facility	
6		Provision to mount the cooling fans on the top panel	

7		Powder coated finish with pre-treatment process meeting all industry standards	
8		Grounding and Bonding Options. 100% assured compatibility with all equipment conforming to DIN 41494 (General industrial standard for equipment)	
9	Specification		
10	Rack Standard	Conforms to DIN 41494 or equivalent standard	
11	Construction	Welded	
12	Front Door	Lockable Toughened Glass Door	
13	Basic Frame	Steel	
14	Equipment Mounting	DIN Standard Slots	
15	Mounting Angle	19" Mounting angles made of formed steel	
16	Standard Finish	Powder Coated	
17	Top and Bottom Cover	Welded to Frame, Vented and Field Cable entry cut outs	
18	Standard Color	Grey or Black	
19	9U Rack with below mentioned minimum specifications or better		
Sr. No	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	DYNAMIC/MTS/DIGITEK	
2	General	Adjustable 19" equipment mounting verticals provide the better mounting flexibility and maximizes the usable mounting space	
3		Depth adjustable mounting slots	
4		Precision engineering capabilities and best efficient software configuration product technology provides the best product quality	
5		Top and bottom Panel with ventilation and cable entry facility	
6		Provision to mount the cooling fans on the top panel	
7		Powder coated finish with pre-treatment process meeting all industry standards	
8		Grounding and Bonding Options. 100% assured compatibility with all equipment conforming to DIN 41494 (General industrial standard for equipment)	
9	Specification		
10	Rack Standard	Conforms to DIN 41494 or equivalent standard	
11	Construction	Welded	
12	Front Door	Lockable Toughened Glass Door	
13	Basic Frame	Steel	
14	Equipment Mounting	DIN Standard Slots	

15	Mounting Angle	19" Mounting angles made of formed steel	
16	Standard Finish	Powder Coated	
17	Top and Bottom Cover	Welded to Frame, Vented and Field Cable entry exit cut outs	
18	Standard Colour	Grey or Black	
19	Static Load	40 kgs.	
20	PVC Pipe with below mentioned minimum specifications or better		
Sr. No.	Features	Desired Parameter	Compliance (Yes / No)
1	Make & Model	Any standard makes	
2	Type	1" conduit/ pipe with all accessories like elbow, tee, socket, flexible pipe joint, screw, clamp and other required for installation etc. (all accessories for 1" conduit.) ISI Marked.	

2. TECHNICAL SPACIFICATION- EPBAX SYSTEM

Sr.No.	Desired Parameter	Compliance (Yes / No)
	MAKE LIST: MATRIX/CISCO/TADIRAN	
1	Machine should support 99 VoIP (SIP) trunks, 64 GSM# ports, 24 T1/E1 ISDN PRI ports, and 128 analog trunks with up to 2000 UC users, 128 digital users, and 1296 analog users. New-generation wireless telecom networks like POTS, ISDN, T1/E1, and GSM/3G/4G/LTE.	
2	USB Ports: Internal USB 2.0 External USB 3.0 USB Storage: Internal USB - Up to 64GB (8GB - for Software Firmware and 260 Hours of Recording (Factory Fitted), 64GB Pen Drive can be used for 2170 Hours of Recording)	
3	Group Conference (3-Party): minimum 15 Numbers of 3-Party Conferences. Maximum participants in Single Conference: 21	
4	Voice Messages (16 seconds each): minimum 15 Auto-Attendant, Voice Help, Voice Tones	
5	Ethernet Ports (Gigabit): 2 (Web-based Configuration, PMS, SMDR, System Log, VOIP (LAN and WAN) and VMS).	
6	TECHNOLOGY: Minimum requirement need to be fulfil. Type of Switching: IP at Core Processor Speed: 900 MHz Dual Core Slots Type: Universal	
7	Max. Concurrent calls from IP User to other IP User: Minimum 500 IP-IP Audio Calls without Transcoding.	
8	Max. Concurrent calls from IP User to other IP User: Minimum 128 IP-IP Audio Calls with Transcoding	
9	Max Concurrent IP-TDM calls: 248 IP-TDM Audio Calls	

10	Features need VMS channel (NX DBM VMS 64 needed): Conversation Recording/Call Tapping - for each IP Call, Retrieval of Voice Mail - from each IP user, IVR (Interactive Voice Response).	
11	Operating Temperature: 0 oC to +45oC (32oF to113oF) Operating Humidity: 5-95% RH, Non-Condensing	
12	Safety: IEC 62368-1: 2018, EN 62368-1:2020 + A11:2020 Environment Test: Cold Test IS:9000 Part 2/Section 4, Dry Heat Test IS:9000 Part 3/Section 5 ,Damp test IS:9000 Part 5/Section 1.	

3. TECHNICAL SPACIFICATION FOR ACCESS CONTROL SYSTEM

Access Control & Security Management System (ACS)

Hardware and Software Specifications

Terminology:

ACS: Access Control & Security management system

ADC: Access Door Controller

API: Application Programming Interface

CCS: Central Control Server

CCTV: Closed-Circuit TeleVision

CPU: Central Processing Unit

DVR: Digital Video Recorder

GUI: Graphical User Interface

I/O: Inputs/Outputs

LED: Light-Emitting Diode

NVR: Network Video Recorder

PCB: Printed Circuit Board

PoE: Power over Ethernet

PSU: Power Supply Unit

TCP/IP: Transmission Control Protocol/Internet Protocol

1. System Overview

Minimum System Capacities and Features

SYSTEM CAPABILITY	
Number of Cards per ADC	2,000 - 160,000 according to the RAM
Online Remote Site	LAN/WAN
ADC with RS-485 / RS-232 / TCP/IP	Unlimited
Card/Keypad readers	Unlimited
Monitored Points (Inputs)	Unlimited
Door Lock Outputs (Relays)	Unlimited
Lift Floors (Lift relays)	64 per ADC
Access Groups	Unlimited
Daily Schedule of 8 Intervals Each	255 max
Weekly Schedule for 7 days and Holidays	127 max
Holidays and Special Days	180
Multiple Operators per Workstation	Yes
Operator profiles / Security Levels	Unlimited
System Operators with Usernames and Passwords	Unlimited
Strong Operator Password rules	Unlimited
Integration with Microsoft Active Directory	Yes
Multi-Language	Yes
Translation Tool for Software Localization	Yes
License	License Key Activation
On-line Help	Yes
ARCHITECTURE	
Operating System / Compatibility	Windows 10 and higher
	Windows Server 2016 and higher
Windows approved software signature	Yes
Graphic user interface	Advanced (WPF)
Dockable UI	Yes
Multi Task	Yes
Multi-process (N-tier) architecture	Yes
Communication motor as service	Yes
Communication load distribution between several PCs	Yes
Multisite management	Yes
Multi-Company / Multi-Tenant management	Yes
Database type	MS-SQL
Web client application	Yes
FUNCTIONS & FEATURES	
Infrastructure setup wizard	Yes
USB reader enrollment support	Yes
QR code reading and printing	Yes
User Database Import	Via Excel spreadsheet or from AD
User Defined User Fields	20
User ID Photo Capture	Yes
Real Time Photo Display	Yes
Integration with License Plate Recognition system	Yes
Real time users' location tracking and counting	Yes
Automated tasks/Global Reflex Triggering	Yes
Anti Passback feature	local / timed / global
Parking Management	Yes

Duress Keypad Code	Yes
Integrated Badge Printing	view / print / edit layout
Lift Management	Yes
Integration with Destination Dispatch Lift system	Yes
Advanced Report wizard	view / print / export
Time and Attendance Reporting	Yes
Send an e-mail on event	Yes
Muster report sent by e-mail	Yes
Multiple change on users' definitions	Yes
Web Interface for Visitor management	Yes
Integration with CCTV system	Yes
Diagnostic tools	Yes
Backup/Restore database tool	Yes
Automatic Journal archiving	Yes
Third Party protocols	API (RESTfull)
ALARMS AND GRAPHICS	
Integration with an Alarm Panel	Yes
Reader Sabotage Detection	Yes
Alarm Priority Levels	255
Alarm zones management	Yes
Site Maps	Yes
Icons for Inputs, Relays, Doors, etc.	Yes
Real Time Animated Icons	Yes
Icon Tooltips	Yes
Camera popup on map	Yes
Graphic Display Events (Alarm/Access)	Yes
ACCESS DOOR CONTROLLER	
Doors	1, 2
Readers	4
Inputs	Up to 4 Supervised
Outputs	Up to 4
I/O diagnostic LEDs	Yes
Communication Port(s)	Yes
Integrated TCP/IP Ethernet Port	Yes
Communication encryption	Yes, optional
Max. Number of Events in ADC Memory	Up to 100,000 according to the no. of cards in the system
Multi Technology Cards per Reader	Yes
Multiple cards per user	Yes
32-bit CPU	Yes, optional
Firmware in Flash memory (upgradable)	Yes
Low battery monitoring	Yes
PSU failed monitoring	Yes
Removable connectors	Yes
Housing tamper detection	Yes
DIN Rail support	Yes

READERS	
Fingerprint / Facial Recognition readers	Yes
Mifare / Desfire serial readers	Yes
Magnetic card readers	Yes, ISO1 & ISO2 protocol
Proximity EM Marine/HID card readers	Yes, Clock & Data / Wiegand protocols

2. Access Control and Security management system (ACS)

2.1. ACS General Features

The functional requirements of the ACS shall be as follows:

- 2.1.1. The Access Control and Security management system (ACS) shall provide a number of security automation functions, including the ability to regulate access through specific doors and gates to secured areas.
- 2.1.2. The ACS shall be designed to perform a wide variety of feature rich functions as part of an integrated security automation and management system.
- 2.1.3. The ACS shall have the following functions:
 - a) Access control configuration and management
 - b) Web client interface
 - c) User location tracking
 - d) Integration with Lift (elevator) system
 - e) Parking management
 - f) Integration with License plate recognition system
 - g) Biometric verification
 - h) Operator and User definition
 - i) Visitor management
 - j) Card designing and printing facility
 - k) Time & attendance recording
 - l) Intrusion detection and alarm monitoring
 - m) Pre-defined automatic actions
 - n) Live graphics
 - o) Event history
 - p) Integration with CCTV system
 - q) Third-party interfaces
- 2.1.4. The ACS shall be developed so that all modules (access control, alarm monitoring, CCTV, intrusion detection, etc.) shall seamlessly integrate into a single application with GUI.
- 2.1.5. The ACS shall be modular in nature and easily scalable without any hardware/software limitations.
- 2.1.6. ACS capacity parameters and security items shall be as follows:
 - a) Graphical site plans: unlimited.
 - b) ADC: unlimited.
 - c) Access point (readers): unlimited.
 - d) CCTV servers: unlimited.
 - e) Fully supervised alarm inputs (4 states): Up to 8 per ADC.

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- f) Output relays: Up to 4 per ADC.
 - g) Access control zones (access groups): unlimited.
 - h) Time zones per day: 4
 - i) Holidays and special days: Up to 180
 - j) Operators: unlimited
 - k) Users: Up to 160,000
 - l) User customized fields: 20
- 2.1.7.** The ACS shall support distributed architecture with central monitoring and control.
- 2.1.8.** The ACS shall have a Central Control Server (CCS) that supports many Clients with all functionality available from Client on the network.
- 2.1.9.** The Client shall provide a fully integrated ACS application with a user-friendly Windows Graphical User interface (GUI).
- 2.1.10.** The ACS shall provide a fully multilingual software package with menus, system descriptions and device descriptions in multiple languages. Different Clients shall be configured with different languages. A user-friendly tool shall be provided for translating the GUI into other languages. This tool shall not require any knowledge of databases or programming.
- 2.1.11.** The GUI shall be adapted for each category of operator: Technicians, Security Guards and Card managers. Each operator type should have its own set of screens.
- 2.1.12.** Each site shall be able to use the ACS independently. From any Client GUI, any operator shall be able to control his own site only. In this mode, each operator shall be able to consult the ADC, the User data, the access events and the alarms of his own site only. Some operators shall control several or all the sites according to their authorization rights.
- 2.1.13.** The ACS shall allow to be shared by independent tenants. In this mode, each company shall have one or more operators that shall be able to consult the ADC, the User data, the access events and the alarms of their own company only. For real time events, the system background process shall read all events – but display only those relevant for the current operator according to his/her company. For common parts like building entrance readers, it shall be possible to share ADC with two or more companies, allowing other tenants to use same ADC.
- 2.1.14.** The CCS shall have services in order to be launched automatically when the PC starts up. A watchdog should check that the services are always running.
- 2.1.15.** It shall be possible to relocate the ADC communication services allowing the CCS load to be distributed among several to third-party machines. A communication service shall be selected to manage all the data processing that takes place in a specific ADC network.
- 2.1.16.** The system shall support Microsoft SQL as database engine.
- 2.1.17.** The ACS shall be able to install its own database engine as well as use an existing SQL Server.
- 2.1.18.** The ACS shall have a separated database for all events and logs.
- 2.1.19.** The ACS shall allow the administrator to backup the database manually and automatically.
- 2.1.20.** The CCS shall support Microsoft Windows 10 / Server 2016 and higher operating systems.

2.2. Access control configuration and management

- 2.2.1. The ACS shall provide means to configure control access to nominated doors and to secure areas of premises by configuring the access privileges stored in Access Door Controllers (ADC). These privileges define the access rights of cards presented at readers.
- 2.2.2. The software shall include built-in default setting for quick setup, such as: default ADC(s), access group(s), and two weekly programs: Always & Never.
- 2.2.3. The ACS shall provide a setup wizard to create and to activate of a large amount of ADC in a single operation.
- 2.2.4. When a new ADC is being defined by the operator, the ACS shall automatically define, according to the ADC type, all its components: readers, inputs and relays. The following basic ADC parameters should also be automatically defined and configured: door alarm inputs, door open times, request to exit inputs, reader weekly programs. The newly created readers should be automatically added to the default access group which allows door pass on all doors, at any time.
- 2.2.5. Weekly programs of the system shall be displayed in a table with their Time zones (1 row per Time zone) where it shall be possible to customize column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
- 2.2.6. There shall be a dynamic search function for a Daily program or a specific hour in order to find weekly program quickly.
- 2.2.7. This table shall be able to be exported manually to a PDF or Excel file or sent to a printer.
- 2.2.8. It shall be easy to generate a report of all the access points included in a specific access group, or to find out which access groups a given reader belongs to. Access groups shall be displayed in a table with the list of their access points where it shall be possible to customize column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
- 2.2.9. There shall be a dynamic search function for a Reader name or Door relay name in order to find access group quickly.
- 2.2.10. This table shall be able to be exported manually to a PDF or Excel file or sent to a printer.
- 2.2.11. It shall be easy to find out who has access rights to a specific reader or which readers a specific user can access. Authorized readers by user shall be displayed in a table with their Access groups and Temporary readers where it shall be possible to customize column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
- 2.2.12. There shall be a dynamic search function for a Reader name, Access group name or a User name in order to quickly find who has access rights to a specific reader or which readers a specific user can access.
- 2.2.13. This table shall be able to be exported manually to a PDF or Excel file or sent to a printer.
- 2.2.14. The operator shall be able to create an unlimited number of user-defined card formats by specifying the length, position and format (hexadecimal or decimal) of the badge code with optional length, position, value and format (hexadecimal or decimal) of the site code.

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- 2.2.15. The ACS GUI shall display the ADC(s) in a tree with its readers, inputs and relays. The tree shall have a search function to find any component easily. The tree shall display the communication status of each ADC.
- 2.2.16. The ACS GUI shall display the list of the ADC that are in communication failure.
- 2.2.17. The following features shall be a part of the ACS application:
- a) Time Zones with intervals.
 - b) Multiple Access Groups
 - c) Holidays
 - d) Field hardware communication
 - e) Field hardware configuration
 - f) Area controls with local Anti Passback
 - g) Alarm and event logging
 - h) Schedule operations
 - i) Multiple card formats
 - j) On-line help with a powerful search engine
 - k) Monitor zones
 - l) Text instructions
 - m) Alarm priorities
 - n) Alarm event mapping
 - o) System download ability
- 2.2.18. Each user shall have a Personal Identity Number (PIN) to be used on readers with keypad.
- 2.2.19. The ACS shall support the following operations:
- a) PIN code and/or Card management. It shall be possible to change the door access mode at certain times of the day.
 - b) Fingerprint and/or face management.
 - c) Change PIN/Card status to: valid/invalid/lost/stolen
 - d) Program unlimited access groups
 - e) Assign or add temporary user access rights
 - f) Allow door to be constantly unlocked at given times according to time zones.
 - g) Allow door to be constantly locked at given times according to time zones so that it cannot be opened even with a valid PIN code / Card / fingerprint.
 - h) Program more than 250 daily programs for various applications. Each weekly program schedule shall be composed of a 4 'on' (or 'green') time intervals. Any time not included in these intervals is considered 'off' (or 'red'). Hence, there will be a total of 9 intervals: four 'on/green' and five 'off/red' times.
 - i) Change system time and date. In addition, the system must automatically adjust for time changes as necessary.
 - j) Define more than 150 holidays or 'special days'. These days shall be assigned to the weekly programs in order to allow auto switching of security mode during these days.

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- 2.2.20. The ACS shall provide an option to define users that should be escorted by another user. When a user must be escorted, the access at the relevant reader should be granted only after presenting two valid credentials at the same reader successively. This option shall be applied according to time zones (eg. from 8:00 to 17:00 only). It shall be possible to deactivate this option for certain people.
 - 2.2.21. The ACS shall provide an option to define Local Anti Passback as well as Timed Anti Passback in order to prevent users from passing their credentials back to a second person to access a same door. This option shall be applied according to time zones (eg. from 8:00 to 17:00 only). It shall be possible to deactivate this option for certain people.
 - 2.2.22. The ACS shall provide an option to define Global Anti PassBack feature on readers that must be used in a sequence to enter or leave a defined area. This option would help the operator to create rules to force users to follow a predetermined path in the facility. It shall be possible to remotely reset this option for any user if necessary.
 - 2.2.23. The ACS shall allow to limit movement quickly in case of a major crisis such as a fire, a theft, an attack, etc. The ACS shall provide a system-wide security setting that can be changed with a single click instead of changing access permissions for multiple users, which would involve downloading new settings for each user to each ADC. For this purpose, the ACS shall provide up to 8 different crisis levels to be given to each user. In the event of high-risk violent situations, the operator shall be able to change the crisis level of one or more readers, through a protocol message broadcast to all ADCs. Thus, users will be able to access the readers whose crisis level is equal or lower than theirs and will no longer be allowed access the readers whose crisis level is higher than theirs.
 - 2.2.24. The ACS shall provide an option to link a reader to an Alarm Zone for restricting the access at this reader to specific people only when the Alarm Zone is armed. When authorized people present their credentials at such reader, if the Alarm Zone is armed, the access shall be granted and the Alarm Zone shall be temporarily disarmed during a pre-defined Entrance delay. This provides a grace time to allow these people to access and to disarm the zone manually from a keypad. After this delay, if the Alarm Zone is not disarmed, it shall be armed automatically.
 - 2.2.25. The ACS shall provide an option to activate two different relays upon a granted access for different durations.
 - 2.2.26. It shall be possible to schedule an Access Zone for a 'First Card Unlock' mode, whereby the defined area is scheduled to switch to Free Access when a suitably card is badged at the reader. A second card swipe shall allow to secure the Access Zone again.
 - 2.2.27. The system shall allow to define readers that support multi-technology credentials (eg. 125kHz, 13.56MHz and NFC).

2.3. User location tracking

- 2.3.1. According to the operator restrictions, the Client GUI shall be able to display all access events in real time.

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- 2.3.2. It shall be possible to have the user's information (eg. his name, department and company). The operator shall be able to open the user details for more details by double click or right click on an access event.
 - 2.3.3. Right-clicking on access events shall display a context menu allowing to open the reader details or to unlock the corresponding door for 5 seconds.
 - 2.3.4. For unknown access events, this context menu shall allow to assign the unknown card to a new or existing user. When a visitor arrives who is not in the system, this option shall allow to open a 'New user' pop-up window with the unknown badge already assigned.
 - 2.3.5. The operator shall be able to sort the access events by date, filter them by reader name and group them by type of events.
 - 2.3.6. ACS operators shall have an option to display each access event type (e.g., Granted / Denied) in the real time log and another one to save them in the database for the ability to generate future reports.
 - 2.3.7. Each denied access shall be displayed with the denied reason (e.g., Access group, unknown card, stolen card, etc.)
 - 2.3.8. The operator shall be able to select the text color of each event type in the real time log.
 - 2.3.9. Photo Identification: Upon swiping a card/finger at any reader, the software shall be capable of automatically displaying in a separate window the relevant user information with a picture of the user, in order to positively identify the owner of the card. This feature shall allow to filter access events by one or more selected readers, based on operator preferences.
 - 2.3.10. It shall be possible to open multiple photo identification screens simultaneously and use each screen to view a different set of readers. The screen shall store the latest access events for easy browsing with a Play/Pause button to control the display.
 - 2.3.11. If using the option where users must be escorted by another user, the picture of the escort shall be displayed too.
 - 2.3.12. It shall be possible to open the user details from the photo identification screen.
 - 2.3.13. The ACS shall be able to provide the name of the last reader where the user swiped including the date/time of this event.
 - 2.3.14. For each door, the ACS shall display the total number of users authorized at this door.
 - 2.3.15. The ACS application shall allow to define the different areas of the facility in order to be able to know which people are located in which area of the building in real time. It shall be possible to enter the maximum capacity of each area in order to automatically lock the area entrance when the area is full.
 - 2.3.16. The areas shall be presented in a tree structure to have a hierarchy such that it shall be possible for one area to be the sub-area of another.
 - 2.3.17. The ACS shall provide an option to enable Global Anti PassBack feature for predefined Areas to force users to follow a predetermined path in the facility.

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- 2.3.18. The system shall include a tracking screen providing the location of every user in the site. This screen shall allow viewing, for each defined area (and sub area), the real time list of users currently present in the area and show their total count. The areas and sub areas should be shown in a tree view. Area icons of the tree shall change when the maximum capacity of the relevant area has been reached.
 - 2.3.19. It shall be possible to display the name of the users within the areas along with their entry time, their company, their department and their employee number.
 - 2.3.20. From the tracking screen, ACS operators shall have the possibility to manually change the location of a user by drag and drop without the need to physically present the card at a reader.
 - 2.3.21. If using the option where users must be escorted by another user, the ACS shall provide an option to update the escort area also or to remain his location unchanged after both badges are swiped at the door's reader.
 - 2.3.22. It shall be possible to print/export the list of users currently present in a specific area. The ACS shall provide an option to automatically send the list of users currently present in a specific area by mail.

2.4. Operator definition

- 2.4.1. The system shall provide the ability to prohibit / allow any screen of the software for each operator including the possibility to authorize screens in read only mode.
- 2.4.2. The operator shall be able to save/load a layout snapshot of his current screen setup. In addition, it shall be possible to automatically load a layout snapshot when the operator logs in to the system.
- 2.4.3. The operator shall be required to enter a user name and password to log into the system. These credentials are assigned a security level which authorizes or filters access to certain system functions/screens.
- 2.4.4. The ACS shall provide an option to force operators to use a strong operator password. Operator password rules shall be customizable and follow Standard Policies and Guidelines: Password History policy, Maximum Password Age policy, Minimum Password Length policy, Password Complexity Requirements policy.
- 2.4.5. At any moment, any operator shall be able to change his password at his discretion.
- 2.4.6. The ACS shall provide an option to force any operator to change his password the next time he logs in.
- 2.4.7. All the operator passwords shall be hashed in the database in order to protect the software from possible hackers.
- 2.4.8. The ACS shall provide an option to lock an operator's login after a specified number of invalid login attempts. Only a valid operator will be able to unlock operators whose login has been locked out. All lockout actions shall be able to be displayed in a report.
- 2.4.9. The ACS shall provide an option to login with Windows Active Directory credentials too. It shall be possible to link any ACS operator to an existing Active Directory user and import his personal data like Email, Phone, Address, etc. There shall be a button to synchronize the operator data with the Active Directory profile information of the linked profile.
- 2.4.10. There shall be an option to force operators to log in only with their Active Directory credentials.

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- 2.4.11. If the Active Directory user is disabled, the ACS shall lock out the relevant operator's login. An explanation of the connection failure shall appear on the Login screen.
 - 2.4.12. The operators' permissions in the software shall include an option to define the list of the doors for which the operator is authorized to give the access to the users.
 - 2.4.13. The ACS shall allow to display menus and screens in the relevant operator language. Different operators may have different languages, so the GUI shall be translated into the right language according to the operators' settings.
 - 2.4.14. Operators' information shall be displayed in a table where it shall be possible to customize column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
 - 2.4.15. This table shall be able to be exported manually to a PDF or Excel file or sent to a printer.
 - 2.4.16. It shall be possible to display the list of screen names and authorization parameters assigned to each operator. This list shall be customizable according to column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
 - 2.4.17. This list shall be able to be exported manually to a PDF or Excel file or sent to a printer.

2.5. User definition

- 2.5.1. The following minimum features shall be a part of card enrolment and personal data management:
 - a) Creating and maintaining a user database with photo attributes
 - b) Modify existing field names of the user form
 - c) Assigning of access rights to the readers
 - d) Bulk assignment/modification/deletion of access rights
 - e) Record searching
- 2.5.2. The system shall allow to add/edit/delete users.
- 2.5.3. The ACS shall allow to define an unlimited number of user types: Employee, Guard, Visitor, etc. The software shall provide a way to filter users by type.
- 2.5.4. The ACS shall allow the ability of assigning users with different cards for each reader technology type (Magnetic, Wiegand, etc.). It shall be possible to assign to a same person several cards of the same technology.
- 2.5.5. It shall be possible to associate a user picture by attaching a photo file or by taking a still image using a web cam or other camera. The picture taking process must be operated directly from within the access control software.
- 2.5.6. The ACS shall allow setting cards status to: In use, Free, Canceled, Lost or Stolen. It shall be possible to change the status of many cards manually in a single operation.
- 2.5.7. The system shall include a function enabling the operator to view cards' list with their status (e.g. free, in use, lost, etc.). The ACS shall provide the possibility to filter and order the cards by code or by status. The ACS shall provide an option for saving and loading the filters.
- 2.5.8. There shall be a dynamic search function for a card code in order to find a card quickly.

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- 2.5.9. Allow creating of two or more users with the same first name and last name. The distinction in these cases shall be based on a special administrative number.
 - 2.5.10. It shall be possible to validate or invalidate users manually or automatically.
 - 2.5.11. The ACS shall provide an option to automatically disable users who have no activity for a specified number of days.
 - 2.5.12. There shall be an option to automatically release the badges of any automatically invalidated cardholder.
 - 2.5.13. It shall be possible to validate users for a given period by setting the start date and end date. In addition, the operator shall be able to give/restrict user access rights on specific doors for a short period.
 - 2.5.14. The ACS shall allow the global change (in a single operation) for many users simultaneously, like validate or invalidate many users manually, adding access at a new door to many users, changing access rights, department, validation date, etc.
 - 2.5.15. The operator shall be able to define a default set of access rights for each department. Thus, new users will automatically have access to the set of doors relating to their department.
 - 2.5.16. Department names shall be displayed in a table with their default set of access rights where it shall be possible to customize column selections, column filters, column sorts and grouping fields. The ACS shall provide an option for saving and loading the filters.
 - 2.5.17. There shall be a dynamic search function for a Department name or set of access rights in order to find department quickly.
 - 2.5.18. This table shall be able to be exported manually to a PDF or Excel file or sent to a printer.
 - 2.5.19. The ACS shall allow a group of users to access the same door but according to their own personal time slot.
 - 2.5.20. The ACS shall support an import utility that provides importing of user information into the ACS database via an Excel file.
 - 2.5.21. The ACS shall allow user information to be imported and synchronized with Microsoft Active Directory (AD) data. The ACS shall enable mapping to be configured by aligning the users' properties with the AD user's attributes.
 - 2.5.22. There shall be a special option for manually importing an individual AD user by selecting it from the list of AD users not already attached to a user. The AD attributes belonging to the AD user shall be then synced with the user.
 - 2.5.23. There shall be another option for manually synchronizing a batch of AD user attributes and adding new AD users who are not already attached to a user.
 - 2.5.24. An option shall be provided to automatically synchronize AD user attributes with users. It shall be possible to define the frequency of the AD synchronization with users. Another option shall allow to determine the action to be taken when the attached AD user is no longer accessible.

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- 2.5.25. The ACS shall provide an option to archive users. The program should not remove these users from the database but it should mark them as 'archived', remove their card and hide them from the list of users (unless the operator explicitly asks to show the archived ones). Operators shall be able to revert the status back to normal. There shall be a special option to delete all archived users in one operation.
 - 2.5.26. There shall be a special option to delete all users that do not have any card in one operation.
 - 2.5.27. In addition to the standard information fields (address, phone, etc.) in the user screen, the operator shall be able to create customized fields (e.g. height, eye color, army rank, etc.) that may take the form of a text field, a Yes/No slider, a number field or a date & time field.
 - 2.5.28. The ACS shall allow the operator to select which information fields (including custom fields) require a value before saving the user's details.
 - 2.5.29. The system shall include a function enabling the operator to view and print the users' list with information fields (e.g. photo, company, employee number, car license plate, etc.). Any field shall be sortable and filterable.
 - 2.5.30. There shall be a dynamic search function for a user's name, company name or department name in order to find people quickly.
 - 2.5.31. The users' list shall be exportable in PDF or XLS (MS-Excel) format. The operator shall be able to select which fields to display / export.
 - 2.5.32. The ACS shall provide the possibility to filter, group and order the users by any field and an option for saving and loading the filters. The ACS shall provide an option for saving and loading the filters.
 - 2.5.33. The operator shall be able to print or export exactly what he sees on the screen.
 - 2.5.34. When several sites are using the ACS independently, the ACS shall distinct between 3 types of users: Local, Shared & Global:
 - a) Local users are people who are authorized to access the doors of their own site only.
 - b) In addition to doors of their own site, Shared users are people who are authorized to access other sites from time to time. For this purpose, the data of those users shall be accessible by other sites' operators in 'read only' mode.
 - c) Global users are people that shall be editable by any operator from any site.

2.6. Card designing and printing facility

- 2.6.1. The ACS shall allow to create and design an unlimited number of card layouts in order to print the users' badge with the required information on a badge printer. Any field shall be able to be added to badge templates.
- 2.6.2. It shall be possible to include a barcode or a QR code in the badge layouts.
- 2.6.3. An operator shall be able to define a card layout for each user type (eg. employees, visitors, contractors, etc.) so when printing a badge, the default layout will be used according to the user type.
- 2.6.4. It shall be possible to print a badge by right click on the user/badge list.
- 2.6.5. The ACS shall allow to allocate or update the users' badge layout from the User interface or via an Excel file.

2.7. Time & attendance recording

- 2.7.1. The system shall provide a Time & Attendance (T&A) report. For each reader it shall be possible to define whether it is an IN (entrance), OUT (exit), or None (i.e., its events should not be included in the attendance report).
- 2.7.2. The T&A report shall contain the total work hours for each user based on all the relevant access events.
- 2.7.3. Operators shall be able to export the T&A report in PDF or CSV format.

2.8. Pre-defined automatic actions

- 2.8.1. The ACS shall allow the operator to define automatic actions that will be triggered when pre-defined conditions are true, i.e., automatic activation of some relays upon a specific event or a pre-defined schedule.
- 2.8.2. The pre-defined conditions capable to activate automatic actions shall be:
 - a) Any granted/denied access event from any or predefined users from any or selected department at any or specific readers,
 - b) Any or specific alarm from any or selected Alarm Zone,
 - c) Any alarm acknowledgment,
 - d) A predefined occupancy rate of a specific area,
 - e) Unknown card events from any or specific readers
 - f) A specific time & date or a specific period.
- 2.8.3. The pre-defined conditions shall allow “OR” and “AND” logical operators. By selecting the AND operator, all conditions in the event trigger group must be true, within a specified time, for the assigned action(s) to take place.
- 2.8.4. The ACS shall allow the following automatic actions:
 - a) Relay activation/deactivation,
 - b) Unlock/Secure all doors temporarily or constantly,
 - c) Alarm zone arming/disarming,
 - d) Validate/invalidate a specific user,
 - e) Display a predefined message on the screen,
 - f) Play a selected sound,
 - g) Insert a predefined comment in the journal,
 - h) Backup the database,
 - i) Import of user information into the ACS database via an Excel file,
 - j) Run a specific external application,
 - k) Display the list of people present in a specific area, or export this report by mail,
 - l) Send a predefined email.
- 2.8.5. It shall be possible to execute different actions simultaneously or sequentially.
- 2.8.6. The operator shall be able to add/remove conditions and actions with the mouse.
- 2.8.7. The ACS shall provide an option to add buttons on the main toolbar for executing pre-defined actions manually like open a door in remote, etc.

2.9. Event history

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- 2.9.1. The system shall include a report function enabling the operator to view and print reports containing the history of access events and alarms and all hardware components like ADC, readers, etc.
 - 2.9.2. The ACS shall display, export and print reports containing details of changes made to the system by operators.
 - 2.9.3. All reports shall be exportable in PDF or XLS (MS-Excel) format.
 - 2.9.4. The ACS shall provide the possibility to filter, group and order the data by any field. The ACS shall provide an option for saving and loading the filters.
 - 2.9.5. The operator shall be able to print or export exactly what he sees on the screen.
 - 2.9.6. For avoiding to manually rebuild a report each time, the operator shall be able to save report templates with the filtering rules for future use.
 - 2.9.7. Upon a selected event or a pre-defined schedule, the system shall allow automatic export and email sending of any predefined report containing the current updated values (e.g., recent events).
 - 2.9.8. The ACS shall provide an automatic archive process for the active event journal in order to secure older journal entries. Archived events shall be easily searchable.

2.10. Third-party interfaces

- 2.10.1. The ACS shall be able to be integrated with third-party software products.
- 2.10.2. The ACS shall have a RESTful API that provide commands for creating/editing/deleting cards and users from third-party software.
- 2.10.3. The RESTful API shall provide the ability to subscribe to alarms and ACS events from third-party software.
- 2.10.4. The RESTful API shall provide commands for opening doors remotely from third-party software.
- 2.10.5. The RESTful API shall be hosted as a Microsoft Windows service.

3. *Access Door Controller (ADC)*

3.1. Hardware

- 3.1.1. The ADC shall contain the following items:
 - a) Flash Memory for firmware updates via communication port.
 - b) Card capacity up to 100,000 cards
 - c) High speed microprocessor with on-board real-time clock (RTC)
 - d) Support for minimum two Card/Keypad Readers
 - e) Shall interface with any standard Wiegand or Clock&Data card reader.
 - f) Shall control the three LEDs ('On', 'Pass', 'Fail') of each reader and the reader buzzer.
 - g) Shall provide at least 4 supervised (EOL Monitored) 4-state inputs and 4 relays.
 - h) Inputs and outputs shall have +/- 50V surge protections
 - i) Shall provide a dedicated input for the box tamper (housing control)
 - j) Shall provide a dedicated input for power status.
 - k) A lithium battery shall maintain data in RAM and supply power for the on-board RTC, for the duration of 10 years even while no other power source is available.

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- l) Shall have 9-14V DC input power.
 - m) In case of a power failure, a 12V/7A battery shall maintain the system in function for up to 25 hours.
 - n) Shall provide a 'Battery low' signal to alert the operator.
 - o) Shall support plug-in modules to expand the I/O number.
 - p) Shall provide LED's for power status and I/O status
 - q) The ADC PCB shall be a six layers board to provide increased protection against communication interferences, lightening, and other electrical noises.
 - r) Failure of one ADC may not affect the rest of the system.
 - s) Shall provide removable connectors.

3.2. Communication with the CCS

- a) The communication between ADC and CCS shall be done via RS485 link or TCP/IP link.
- b) The communication baud rate shall be programmable.
- c) Each serial port shall have protection against ESD and surge currents. There shall be an option for Lighting protection.
- d) The ADC shall provide LED's for monitoring the communication.

3.2.1. If the communication with the Central Control Server (CCS) fails, the ADC shall continue providing access based on the predefined security configurations until the communication is restored. All event logs and alarms shall be stored locally (based on ADC capacity). These events shall be sent to the CCS, when the communication is regained.

3.2.2. In a case of global communication failure, each ADC shall continue to grant access following to the card number (site code included), i.e. downgraded mode shall not exist.

3.3. Firmware

- 3.3.1.** The ADC shall provide fully distributed processing of access control & alarm monitoring operations.
- 3.3.2.** Access levels, hardware configurations, and programmed alarm outputs assigned at the administration client workstation shall be downloaded to the ADC, which shall store this information and function using its high speed, local microprocessor.
- 3.3.3.** All access granted/denied decisions must be made at the ADC to provide fast responses to card reader transactions.
- 3.3.4.** A fully configured ADC shall require less than one-half (0.5) seconds to grant access to an authorized user or deny access to an unauthorized user.
- 3.3.5.** Downloading of all the parameters, including users (up to 10.000), from the ACS to the ADC with a standard memory download shall require no more than a couple of minutes.
- 3.3.6.** All ACS software or firmware upgrades shall be downloadable through the network to the ADC.
- 3.3.7.** The ADC shall continue to function normally (no downgraded mode in stand- alone) in the event that it loses communication with the ACS Server.
- 3.3.8.** The ADC must contain the full card database to allow full operation in case of lost of communication with the ACS server.

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- 3.3.9.** While in this off-line state, the ADC is required to make access granted/denied decisions and maintain a log of the events that have occurred. Events shall be stored in local memory, and then uploaded automatically to the ACS database after communication has been restored.
- 3.3.10.** The ADC shall support multiple card technologies with various card formats and facility codes. It shall support at least Magnetic ISO1 & ISO2 and Wiegand technologies. The technology shall be set by on-board DIP switches and the format within the chosen technology shall be programmable from the ACS server.
- 3.3.11.** The ADC shall support readers with a built-in keypad. The keypad must have the capacity to operate alone or in conjunction with a card reader for PIN verification. It must be possible to assign a different PIN to each user.
- 3.3.12.** ADC shall automatically detect a card reader disconnection.
- 3.3.13.** ADC shall have up to 16 inputs which can be allocated (from the ACS server) to monitor door position, request to exit button and standard alarm inputs. Door alarm shall be raised immediately if the door is forced or after a pre-defined delay in case the door was left open for too long.
- 3.3.14.** ADC shall support up to 255 daily schedules of 8 intervals each and up to 127 weekly schedules.
- 3.3.15.** ADC shall support up to 180 holidays and special days.
- 3.3.16.** Up to 127 Weekly Schedule of 7 Daily Schedules, Holiday and special days schedules
- 3.3.17.** Each individual input should be able to be programmed either as Normally Open (NO) or as Normally Closed (NC).
- 3.3.18.** Output relays shall be capable of responding to:
- a) ADC control (Door control, alarms, etc.). Door open times shall be adjustable.
 - b) Input alarms from the same ADC, or another ADC connected to the same communication bus.
 - c) Commands from ACS server
 - d) Time zone control for automatic operation.
- 3.3.19.** Inputs must have the possibility to trigger a set of relays of the same ADC. This feature shall work even when the ACS server is down.
- 3.3.20.** ADC shall have an option to register access event only after the door was actually opened (and not immediately after the card/code/finger pass).
- 3.3.21.** ADC shall manage Mantraps, like in the following examples.
Example 1: In a system of 2 doors, the first door is allowed to be opened only whilst the second door is closed.
Example 2: Same as above, but the 2nd door is automatically opened as soon as the first one is closed.
- 3.3.22.** ADC shall have an option to allow access only after presenting two valid credentials at the same reader successively. This option shall be applied according to time zones (eg. from 8:00 to 17:00 only). It shall be possible to deactivate this option for certain people.

- 3.3.23.** ADC shall support local Anti Passback as well as Timed Anti Passback in order to prevent users from passing their credentials back to a second person to access a same door. This option shall be applied according to time zones (eg. from 8:00 to 17:00 only). It shall be possible to deactivate this option for certain people.
- 3.3.24.** ADC shall allow the readers to work in the following modes:
- a) Card only
 - b) PIN code only
 - c) Card or PIN code
 - d) Card and PIN code
- 3.3.25.** ADC shall allow the readers to work following to two different modes according to time zones (eg. 'Card only' mode from 8:00 to 17:00, then 'Card and PIN code' are required from 17:00).
- 3.3.26.** Door open time and door close time (i.e. the delay the door may be left open before triggering an alarm) must be programmable.

ACCEPTABLE MAKES FOR INTERNAL ELECTRICAL INSTALLATION WORKS

S. No.	ITEMS	MAKES
1	Camera/ NVR	Honeywell/Tyco/panasonic
2	Hard Disk	SEAGATE/WD/KINGSTON
3	LED Display Monitor	SAMSUNG/LG/PHILIPS
4	POE Switches	CISCO/ARUBA/JUNIPER
5	IT Passive Components	DLINK/MOLEX/COMMScope
6	IT Racks	DYNAMIC/MTS/DIGITEK
7	EPBAX	MATRIX/CISCO/TADIRAN
8	Analogue phone	BEETEL/REPUTED
9	Krone Box	ITL / Krone / MALSON
10	Access Door Controller	Tyco softwarehouse/Honeywell Temaline/DDS
11	Smart card readers	HID/SUPREMA
12	Recessed/Surface mounted Electromagnetic Locks	Ebelco/Algatech/Bel
13	Server	DELL/HP/LENOVO

Note: - Any item not mentioned herein shall be ISI marked and shall be as approved by the engineer-in-charge

PART C-II

HVAC COMPONENT

Name of work: Construction of Kotak School of Sustainability at IIT Kanpur- HVAC Works

2. Eligibility Criteria for associated contractor

Name of Work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur. (SH: HVAC Works)

Eligibility condition for Associate agency for execution of HVAC works.

2. They should have successfully completed works, as mentioned under during seven years ending previous day of last date of submission of tender

i) Three similar works each of value not less than Rs. 262.62 lacs

OR

ii) Two similar works each of value not less than Rs. 393.94lacs

OR

iii) One similar work each of value not less than Rs. 525.25 lacs

Similar works means execution of central airconditioning works i.e SITC of AHU's, chilled water piping, ducting, insulation and associated controls.

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.

2. The main contractor / agency has to submit detail of such associate agency to Engineer-In charge (HVAC works) within one months from date of start of work. (The associate agency shall be approved by Executive Engineer (Elect &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) The new agency / agencies 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.

PROFORMA OF SCHEDULES**(SH: HVAC works)****(Operative schedules shall be supplied separately to each intending tenderer)****SCHEDULE 'A' HVAC works****Schedule of Quantities (as per CPWD-3) As per separate sheet attached for electrical items of works.****SCHEDULE 'B'****Schedule of materials to be issued to the contractor:**

S.No	Description of item	Quantity	Rates in figure & words at which the material will be charged to the contractor.	
place of issue				
1	2	3	4	5
..... NIL.....				

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

S.No	Description	Hire charges per day	Place of issue
1	2	3	4
..... NIL.....			

SCHEDULE 'D'**Schedule for specific requirement / document for the work if any: As attached in tender form****SCHEDULE 'E'**

Reference to General condition of contract- GCC 2023, CPWD form 7 modified and corrected up to last date of receipt of tender. Moreover, any modifications in clauses of GCC-2023 issued by CPWD on account of GST regime in future i.e after the receipt of tender and upto the actual date of completion of the work of the present contract shall also be applicable for this contract.

Name of work: Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur– 208016.

Estimated cost of work: HVAC works Rs. 6,56,56,892/- (Excluding applicable GST)
Earnest Money Included on schedules of HVAC components

ii) Performance Guarantee: As per major components

iii) Security deposit

General Rules of & Directions: Officer inviting tender;
Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with major component.

SCHEDULE 'F'**Definitions:**

2 (v) Engineer-in-charge Executive Engineer (Elect. & AC), IIT Kanpur
2 (vii) Accepting Authority As per major component
2 (x) Percentage on cost of materials and labour 15%
to cover all overheads and profits

2(xi) Standard schedule of Rates: Schedule of rates-2022 & MR
2 (xii) Department: Institute Works Department
9(ii) Standard CPWD contract form: As per Major Components
Remaining applicable clauses are as per major component.

2.0 MEMORANDUM OF UNDERSTANDING [M.O.U] BETWEEN

1. M/s Name of the firm with full address
Enlistment status
Valid upto:
Henceforth, called associated contractor
And
2. M/s Name of the firm with full address
Enlistment status
Valid upto:
Henceforth, called associated contractor

Name of work: Construction of Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur. **(SH: HVAC Works)**

[HVAC component only] 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 upto dated) and the department (IWD) can enforce all the term 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. Both the parties shall be paid consequent to the execution as per 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 besides forfeiture of the security deposit.
2. All the material, machinery and equipment's, tools and tackles required for execution of the electrical works. As per agreement shall be responsibility of the associated contractor.
3. The site staff required for the HVAC work shall be arranged by the associated contractor as per terms and conditions of the agreement.

SIGNATURE OF THE MAIN CONTRACTOR

Date
Place

**SIGNATURE OF ASSOCIATED
CONTRACTOR**

Date
Place

**COUNTERSIGNED
EXECUTIVE ENGINEER (AC)**

3.0 WILLINGNESS CERTIFICATE

Name of work: Construction of Construction of Kotak School of Sustainability including Finishing works, Water Supply & Sanitary installations, Electrical, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone Data System, CCTV, LIFTS, Mechanical Ventilation (HVAC) and Development Works at IIT Kanpur Campus, Kanpur. (SH: HVAC Works)

I will execute the work as per specification and conditions for the agreement and as per direction of the Executive Engineer (Elect. & AC). Also, I will employee full time technically qualified supervisor for the works. I will attend inspection of officers of the department as and when required.

I/ We undertake and confirm that eligible similar works (s) has / have not been got executed through contractor on back basis. further that, if such a violation comes to the notice of Department, then I/We shall be debarred for tendering in IWD contracts in future forever".

I have also read the complete tender conditions and I am aware that PART-A (HVAC tender) of this tender document is applicable to me also"

Date:

Signature of Contractor

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 PAC, 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 grilles/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 associated electrical work comprising of control panel, power cabling, earthing etc.
 - 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
g.	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.

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- 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.

14 **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 breakup 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 quadruplicate, 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, Statuary 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 upto date corrections.
- General specifications for electrical works Part-VII (DG set) 2013 with upto date corrections.
- General specifications for electrical works Part-IV Sub-station- 2013 with upto 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. 2,79,14,863/-
OR

-
- ii) Two similar works each of value not less than Rs. 4,18,72,295/-
OR
 - iii) One similar work each of value not less than Rs. 5,58,29,726/-
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, DX type VRF AC system, PAC units, 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 similarHVAC 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 Sub contractor]

And

2] M/S [Name of firm with full address]

Enlistment Status

Valid Upto :

[Henceforth called the main contractor]

Name of work :- Construction of Kotak School of Sustainability at IIT Kanpur- HVAC Works
[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

DATE

PLACE

SIGNATURE OF MAIN CONTRACTOR

DATE

PLACE

COUNTER SIGNED

EXECUTIVE ENGINEER (AC)

PERFORMA-B
WILLINGNESS CERTIFICATE

Name of work :- Construction of Kotak School of Sustainability at IIT Kanpur- HVAC Works

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

**KOTAK SCHOOL OF SUSTAINABILITY
AT
IIT KANPUR**

TECHNICAL SPECIFICATIONS
FOR
HVAC WORK

3. HVAC SYSTEM GENERAL

The work shall be executed as per CPWD's general specification for Heating, Ventilation & Air-Conditioning (HVAC)–2024. Indian Standards amended up to date and as per direction of Engineer in charge. Specifications shall be read in conjunction with CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) Works (2024), General Conditions of Contract, Special Condition of Contracts, Schedule of Work, Drawings and other documents connected with the work.

In case of if any discrepancy with respect to above mentioned document, the order of precedence mentioned in NIT shall be followed.

4. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract are illustrated in the Drawings, Specifications and Scope of work. 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/client. The contractor shall furnish all labor, materials and equipment and specified otherwise, transportation and incidental necessary for Design, Supply, Installation, Testing, Commissioning, final testing, putting into operation, equipment capacity computation and handing over of the complete air conditioning system as described in the Specifications and as shown in the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Scope of work, Drawings / Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

All capacities, quantities, rating indicated in drawings, datasheet, schematic and tender documents are indicative only. It lies the responsibility with the BIDDER to arrive at the exact requirement, quantity, and rating of entire equipment from the drawings & other Scope of works documents as applicable. Items which are not indicated in specification but however required for completeness of system are deemed necessary to be considered by the Bidder

The details of Heating, Ventilation and Air-Conditioning (HVAC) system for various areas are given below:

5. SYSTEM DESCRIPTION

It is proposed to have a Central Water-Cooled System for Cooling. The Chilled Water required for buildings cooling will be sourced from the existing plant room on site and delivered to the building. This will be done through the existing chilled water distribution system, which will transport the chilled water to the designated connection point at the building's perimeter. From there the building's internal HVAC system will distribute the chilled water to various cooling units, such as AHU, CSU, TFA & FCUs etc. to maintain appropriate temperature and comfort level at the building. For proper chilled water distribution at buildings Tertiary Pumping system shall be provided with Electrical Panel.

This plant room is consisting of following major chilled water equipment.

- a) Tertiary Variable pumps – There are 3 numbers (2 working + 1 stand by) of Tertiary variable pumping having capacity approx. 780 gpm @ 30m head installed within the plant room. These pumps shall be provided with dedicated VFD panels along with sensors and controls.

Note- Vendor shall submit the calculation to confirm capacity before ordering the equipment.

- b) Closed Expansion tanks (if required) - There will be one 1000 Liter capacity closed expansion tanks is proposed for chilled water system. These are installed on the Utility area of Building with Air Separator. The contractor shall ensure the requirements of the tank.

Note- Vendor shall submit the calculation to confirm the requirement & capacity before ordering the equipment.

- c) HVAC Electrical Panels – Electrical panels with power cabling will be provided within plant room to feed electrical power to all equipment mentioned above.

6. WATER DISTRIBUTION

Chilled water piping with insulation will be routed from respective connecting point to the building through masonry shafts.

Chilled water piping with insulation will be provided with air vent and drain valve at the highest and lowest level respectively. Chilled water Ring-main/Riser shall be provided in shafts and Corridor area at each floor for chilled water piping and dedicated branch pipes are taken to each Floors, CSUs and AHUs. As AHU rooms are stacked one above other the chilled water piping will travel vertically up through shafts up to individual AHU room and further continuing to the floor to connect with CSU/FCUs. Air Vents will be provided in the vertical risers at the topmost ends. Isolation valves will be provided in

the chilled water pipes for individual riser for ease of isolation. 2 way Modulating PIBCV valves will be provided on the individual AHU chilled water return lines to sense the actual room loads and vary the pump flow accordingly. Each AHU will be provided with insulated condensate drain piping up to the nearest floor drain.

7. AIR DISTRIBUTION

Dedicated AHU Rooms will be provided based on the zoning and application requirement. AHU Rooms will be acoustically insulated to reduce noise transfer from the AHU to connected spaces (Acoustic insulation is part of civil scope). These AHUs will be further ducted to supply/ return and distribute the cool air. The initial duct of supply air duct (almost 3 mtr.) will be acoustically lined to reduce air borne noise.

All Office areas, Labs, Cabins, Multipurpose halls & Conference rooms will be air conditioned with separate AHU/CSU/FCU. All AHU will be connected to fresh air Ducts from Treated Fresh Air AHUs with motorized dampers/VAV. Treated Fresh air is directly supplied into the room, which is serviced by FCU.

Centralized Treated Fresh Air Units which includes Pre-filter (ISOcoarse greater than 60%), Fine filter (ePM1 with PM efficiency 50-70%), Chemical filter, Cooling Coil, EC fan, UVGI lamps for cooling coil, etc. It will be provided and located on the terrace level and Capacity will be based on grouping of AHUs/ CSUs /FCUs at respective floors. All TFAs will be kept on the terrace.

The fresh air supply form TFA shall be modulated to maintain the required CO2 level inside the conditioned space. The location of CO2 sensors for AHUs serving single space or multiple spaces will be in the return air duct in the AHU Rooms and fresh air will be served by Demand control ventilation. The threshold limit for the differential CO2 will be as per ASHRAE 62.1 & LEED requirements.

All recircuited AHUs will be provided with Pre-filter (ISOcoarse greater than 60%), Fine filter (ePM1 with PM efficiency 50-70%), chilled water coil, UVGI lamps for cooling coil , EC fans, etc. In addition to this all supply air ducts of respective AHUs will be provided with duct mounted UVGI system to disinfect supply air.

In order to maintain better IAQ for the condition space, all the AHUs/CSUs are provided with combination of Pre-filter (ISOcoarse greater than 60%), Fine filter (ePM1 with PM efficiency 50-70%). In addition to this all-cooling coils are provided with UVGI lamp & to disinfect supply air completely the UVGI system is also provided in supply air duct of

each AHU. To maintain adequate CO2 level inside the air conditioning spaces demand control ventilation system is provided.

All areas like toilets, pantry, storeroom, STP, electrical room, utility rooms etc will be ventilated as per NBC 2016.

All staircases, lift wells, Lift lobbies will be pressurized as per NBC 2016. Pressurization fans shall be kept on the terrace and air shall be thrown inside lift well / stair well shafts.

8. WATER REQUIREMENT FOR HVAC WORK

Total Water requirement per day will be calculated considering 12-hour operation of Building. Water shall be required for the following purpose:

- i) For Minor Makeup in the Chilled Water Lines, to be supplied to the Closed Expansion Tank (Intermittent supply).
- ii) For Filling of Chilled Water Pipelines at Initial Stage. Successful bidder shall arrange the water for flushing, pressure testing & initial fill on his own. Water quality of initial fill shall also comply with the following requirement.

Quality of Water for HVAC system shall be meeting the following characteristics.

Table : 1

Sr. No.	Parameter	Value
1	pH	6.8 -7
2	TDS mg/l	< 250
3	Chlorides mg/l	< 50
4	Alkalinity mg/l	< 100
5	Hardness mg/l	< 50

9. FIRE STRATEGIES

Entire building is divided into number of fire zones as per NBC 2016. In case of fire all AHUs in affected zone shall be OFF. All fresh air and smoke spills fans in the affected zones shall be ON. Fresh air shall be pumped in affected zone through supply air ducts and smoke shall be evacuated through return air ducts. Return air ducts shall be fire rated to with stand for 250 deg C for 2 Hrs as per NBC 2016.

Lift well, Stair well and Lift Lobby pressurization fans in the affected zones shall be ON to provide the necessary differential pressure of 50Pa. All pressurization, make up and smoke spill fans in affected zone shall be ON and all AHUs in affected zone shall be OFF after receiving signal from fire panel.

10. DESIGN CRITERIA FOR COOLING LOAD CALCULATION

- a) Reference Architectural drawings (Latest), Master plans and subsequent revisions.
- b) Occupancy – as per Architectural Plans and ASHRAE 62.1-2016.
- c) Equipment & Lighting Load – As per ASHRAE 90.1 2016 & data received from Electrical Department.
- d) Building Envelope requirement as per table given below.
- e) Platinum rated Buildings considering based on confirmation provided by the Architects.
- f) Building Envelope data.

Table : 2

Building Envelope	Maximum U Factor
Wall	0.22 (W/sqm. K)
Roofs	0.26 (W/sqm. K)

SHGC of Glass – 0.24 SHGC for

Skylight – 0.35

g) Outdoor Design Conditions

The outside design conditions are given below in table for Lucknow are based on ASHRAE Meteo Conditions @ 0.4 % occurrence.

Latitude: 26.761 N

Altitude: 125 M above mean sea level.

Note: Lucknow is approx. 72 Km away from IIT Kanpur site location. As IIT Kanpur weather data is not available, Hence we have considered nearest weather data i.e. Lucknow for the calculations.

Table : 3

Sl. No.	Season	Dry Bulb Temperature °C	Wet Bulb Temperature °C
1	Summer	42.8	23.4
2	Monsoon	34.4	29.8
3	Winter	6.5	-

h) Indoor Design Conditions of all air-conditioned areas:

- i. For Office areas, Conference/Meeting rooms, Exhibition/ Multipurpose Hall, Cafeteria, Cabins are given below:

Dry bulb temperature: 24 ± 1 °C

Relative humidity: 50%-60%

- ii. For Dry Labs, Wet Labs and Computer Labs are given below: Dry

bulb temperature: 24 ± 1 °C

Relative humidity: 50%-60%

- iii. For Enclosed - Passages, Common Lobby, Entrances area & Corridors Dry

bulb temperature: 26 ± 1 °C

Relative humidity: 50%-60%

- iv. Server room, UPS rooms are given below: Dry

bulb temperature: 22 ± 2 °C

Relative humidity: Not exceeding 60%

- v. Spot cooling supply air temperatures (Kitchen area): Dry

bulb temperature: maximum 26 °C.

- i) Duration of Operation:

a. Office areas: 10-12 hours Operation

b. UPS, ELV, CCTV Surveillance, FCC & Server room: 24 hours continuous operation.

- j) Internal Heat Gain from Occupants (ASHRAE Handbook)

Table : 4

Activity Level	Sensible Heat (Btu/hr)	Latent Heat (Btu/hr)

Office / light work	240	160
Standing/ Walking Slowly	245	205
Cafeteria	280	270

k) Internal Heat Gain from Equipment shall be as per actual data.

Fresh Air Quantity for Air-Conditioned areas shall be considered from ASHRAE 62.1 latest version.

Table : 5

Location	Air Qty. (cfm)/ Person (Nos.)	Air Qty. (cfm)/
		Area (Sqft.)
Office Building	5	0.06
Cafeteria	7.5	0.12
Dry/Wet Labs	10	0.18
Computer Labs	10	0.12

Heat Load Calculations and Equipment Selection

- i. The successful bidder/ contractor should give detailed heat load calculations, ventilation & pressurization calculations, static head calculations immediately after award of work as per requirement separately for all the seasons in which, the specified conditions are to be maintained.
- ii. The equipment selection, pipe and duct design shall be made based on the above calculations.

11. DESIGN CRITERIA FOR VENTILATION CALCULATION:

Air Quantities will be based on Dry Bulb Temperature: < Ambient + 3° C (Permitted Temperature Rise) or Air Changes per hours (ACPH) as per NBC 2016, whichever is higher.

Table : 6

Sr. No.	Space	ACPH
1.	Toilets/Changing Rooms	10

2.	Smoke evacuation system	12
3.	Housekeeping/ Stores	6
4.	WWTP	30
5.	Utility Room	15
6.	Kitchen	As per Kitchen Hood Requirements
7.	Basement Car Parking	6 in case of Normal Mode/ 12 in case of Fire Mode
8.	Pantry	15
9.	Battery Room	15
10.	Fume Hoods	As per Hood Requirements

Note- Battery room will be provided with explosion proof exhaust fans.

12. DESIGN PARAMETERS FOR EQUIPMENT AND ASSOCIATED ITEMS

a) Design Parameters for Air and Water Distribution System

Table : 7

Discription	Range
Max. Air flow velocity in ducts for Air-Conditioning, m/sec	7.6
Max. Air flow velocity in ducts for Ventilation, m/sec	9.0
Max. Friction, cm wg. / 100 m duct length	1.0
Outlet velocity at Grille/ Diffusers, m/sec	2.0 to 2.5
Max. Water flow velocity in Chilled Water and Condenser Water Pipes to 50 mm Dia, m/sec	1.5
Max. Water flow velocity in Chilled Water and Condenser Water Pipes above 50 mm Dia. m/sec	2.5
Max. Friction, m wg. / 100 m pipe length	5.0

b) Water Pumps:

The Water Pumps will be selected for the design flow rate and pressure head including the following parameters:

Table : 8

End Suction / Horizontal Split Casing Pumps	
Minimum Pump Efficiency, %	80
Noise level at 1.5 m, dBA	85
Pump vibration isolation:	Inertia Base
Max. Pump Motor speed (RPM)	1440
Starter for Fan Motor	VFD
Motor Type	TEFC, insulation class F or equal

c) Air Handling Units:

Table : 9

Double skin PUF Insulated, DIDW Backward Curved Centrifugal type fan	
Temperature of Chilled water entering Cooling Coil, ° F (° C)	44 (6.67)
Temperature of Chilled water leaving Cooling Coil, ° F (° C)	54 (12.22)
Water Flow Rate (US gpm / TR)	2.4
Max. Face Velocity Across the Coil & Filters, fpm (m/sec)	500 (2.5)
Max. Outlet Velocity of the Fan, fpm (m/sec)	1800 (9)
Min. Motor Efficiency, rating for Induction type fan motors.	IE3

Min. Motor Efficiency, rating for EC fan motors.	OEM Std.
Min. Coil Row Depth for chilled water coil	6
Filters	- ISO Coarse Grade with efficiency greater than 60%(confirming to ISO16890) - ISO ePM1 with PM efficiency (50%-70%) (confirming to ISO16890)

d) Ventilation Fans:

Table : 10

Maximum fan outlet velocity FPM (m/s)	1800 (9.0)
Smokes pills fans fire rating for 250 Deg. C	120 Min
Motor Efficiency (IE2/IE3)	As indicated in specifications

* The Velocities are indicative, the fan selection shall be based on actual design parameters, capacities required as per calculations selections & output produced/ acknowledged from selection software, where noise & optimum fan efficiency will be the main criteria for selection of fans.

e) VRF Units:

Table : 11

Design Outdoor Temperature, ° C (° F)	43.2 (109.7)

Design Indoor Temperature, ° C (° F)	22.0±1 (71.6±)
Building Height, m	25

13. TENDER DRAWINGS, DRAWINGS FOR APPROVAL.

The drawings provided to the bidder with the tender documents give a general scheme of the system and are not meant to be the working drawings. The contractor shall design the system as per buildings/clients requirements and furnish the shop drawings to be sent to the Engineer in charge of all the equipment/ layouts, after award of the contract and the same shall be approved by the Engineer in charge. No work shall be allowed to be executed without the approved shop drawings.

i) Tender Drawings

The drawings appended with the tender documents are intended to show the areas to be conditioned, space allotted for various equipment, tentative cable and pipe routes. The equipment offered shall be suitable for installation in the spaces shown in these drawings.

ii) Drawings for approval on award of the work

The contractor shall prepare & submit required sets of following drawings and get them approved from the Engineer-in-charge/client before the start of the work. Which shall include detailed design good enough of execution of equipment, ducting, piping, cabling etc. 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.

- a) Layout drawings of the equipment's to be installed in various rooms.
- b) Drawings including section, showing the details of erection of entire equipment including their foundations.
- c) Plumbing drawings showing the layout of entire piping, Dia & length of pipes, valves and isometric drawings showing connections to various equipment.
- d) Electrical wiring diagrams for all electrical equipment and controls including the sizes and capacities of the various cables and equipment.
- e) Dimensioned drawings of all Electrical Equipment's and control panels.
- f) Drawings showing the details of all insulations and vapor barrier works.
- g) Drawings showing details of supports for equipment's, Ducts, pipes & cable trays etc.
- h) Any other drawings relevant to the work.

14. REFERENCE CODES AND STANDARDS

All equipment, system and works covered under this specification shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Also, all equipment shall conform to the latest applicable Indian or other International Standards established to be equivalent or superior to the Codes and Standards specified in the tender. The list of some of the major standards applicable are furnished below:

- a) National Building Code of India (NBC) 2016.
- b) Energy conservation building code (ECBC 2017)
- c) ASHRAE Handbooks.
- d) ANSI/ASHRAE standard 90.1-: Energy standard for buildings except low rise residential buildings.
- e) ASHRAE standard 55: Thermal comfort.
- f) Indoor air quality as per ASHRAE 62.1.
- g) Duct construction standards as per IS 655.
- h) GI Sheets IS: 277.
- i) Aluminum Sheets IS: 737
- j) Piping IS1239 Part I & II, IS 3589.
- k) Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment as per AHRI 1230.
- l) IS1391:1992 (Part I & II), for Room Air Conditioners.
- m) Bureau of Energy Efficiency.
- n) AHRI 410- with Addenda 1, 2 and 3: Forced-Circulation Air-Cooling and Air-Heating Coils.
- o) ANSI/AHRI 430: Central Station Air Handling Units.
- p) ANSI/AHRI 440: Performance Rating of Room Fan-Coils.
- q) AHRI 575: Standard for method of measuring machinery sound within equipment room.
- r) ASME B31.5: Code for Refrigeration piping.
- s) Air Filters as per ASHRAE 52.1
- t) Three-phase induction motors IS: 325
- u) Safety code for air conditioning, IS: 659
- v) Safety code for mechanical refrigeration, IS: 660
- w) Expanded polystyrene for thermal insulation purposes, IS: 4671
- x) Centrifugal Fans IS: 4894

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- y) Pipe & Pipe Fitting IS: 1239 & IS 3589
 - z) Fire Damper UL555 S
 - aa) AMCA 210 Laboratory Method of Testing Fans for rating.
 - bb) LEED (Leadership in Energy and Environmental Design) for Building Sustainability parameters.

15. RECIRCULATION PUMPS

Pumps shall be sequenced based on run-time; the pumps with the lowest number of run hours as the lead pump, the pump with the second lowest number of run hours as the second pump, and so forth.

Chilled water pumps (Scope of Pump Logic Control System)

The secondary pumps maintain a differential pressure at a specific point in the system. This point is the pressure difference across the most significant distant load. The pressure difference is the coil, piping, and control valve pressure drop at design flow. As the building cooling loads are satisfied, the coil two-way control valves move toward the closed position, this increases the differential pressure measured across the cooling coil, valve and piping.

As the differential pressure starts to rise, the frequency converter slows

The secondary pump to maintain the differential pressure setpoint value. The frequency converter setpoint value is the sum of the pressure drop of the cooling coil, coil piping, and PICV under design flow conditions.

Pump Logic Control System (Diff. Pressure Sensor) is continuously monitoring the individual chiller flow. If particular chiller flow goes below the required chiller flow then PLCS will ramp up the VFD speed.

When CPM/Scheduler gives start command to Chiller Plant, CPM will give first command to PLCS to start initially chilled water pumps. Once Chilled water flow established in chillers, CPM will give command to Condenser Pump & Cooling Towers. Now Chiller will conform the condenser flow also & thus CPM will give command to Chiller.

CPM will also give feedback of total running chillers to PLCS.

1 CIRCULATING WATER PUMPS

Please refer to Chapter 8 "CIRCULATING WATER PUMP" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

2 AIR HANDLING UNITS

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of double skin construction air handling units, conforming to these Specifications and in accordance with requirements of drawings and building requirements.

TYPE

The air handling units shall be double skin construction, draw-thru type in sectionalized construction consisting of blower section, coil section, humidification section (where specified), filter section, and insulated drain pan, mixing box (wherever the return air and fresh air are ducted) as shown on drawings and building requirements.

CAPACITY

The air handling capacities and static pressure shall be based on approved calculations & equipment selection sheets approved by Engineer in charge/ client.

- i) The capacity of the cooling/heating 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 500 fpm.
- iii) The requisite static pressure demanded by the air circuit shall be developed by the fan at the selected operating speed. The static pressure value shall not in any case be less than 40 mm water gauge in normal cases, not less than 75 mm water gauge where (- ISO Coarse Grade with efficiency greater than 60%(confirming to ISO16890) & ISO ePM1 with PM efficiency (50%-70%) (confirming to ISO16890)) filters are also used and not less than 100 mm water gauge where absolute filters are also used. The fan motor HP shall be suitable to satisfy these requirements and the drive losses.
- iv) The air outlet velocity from the blower fan shall not exceed 1800 FPM.
- v) Noise level at a distance of 1.5 M from AHU shall not exceed 75 dBA. CASING

The casing of the air handling unit shall be of double skin construction, complying with EN 1886 or AHRI 1350 standard for mechanical characteristics. The structure shall be made of Extruded Aluminium sections with polyamide thermal break profile for ensuring thermal bridging performance. The polyamide strip should be crimped to extruded aluminium sections for leak proof fitment. The structure shall be assembled using die cast Glass filled Nylon joints to make a sturdy, strong & self-supporting framework for

various sections. The profile shall have built in coved aluminium profile having smooth curvature from inside to avoid dust accumulation.

Double Skin Panels shall be minimum min 48 ± 2 mm thick constructed as follows

- Outer skin

Pre-painted Galvanised Sheet Steel of 0.8 mm thickness with PVC guard film.

- Inner skin

Aluzinc Sheet or plain GI sheet of 0.8 mm thickness having 270 gsm zinc coating.

The outer and inner skin shall be sandwiched with self-extinguishing CFC – HFC free PUF insulation (density 40 kg/m³ with K factor not exceeding 0.02 Watt/mk). The panels shall be screwed to the structure using soft food grade gasket to make it leak proof. Airtight access doors/panels with die cast zinc hinges shall be provided for access to various sections for maintenance.

The door shall be fitted with double wall inspection window of 200 mm diameter and robust glass filled nylon handles operational from both sides with optional locking arrangement. Each section should have inspection doors with duly wired marine lights and on/off switch mounted on wall of the unit. The entire housing shall be mounted on Rolled Formed channel made out of 270 gsm zinc coated heavy duty GSS channel framework with provision for handling the units at site.

Drain Pan shall be constructed of 18 G 304 Stainless Steel with dual slope to facilitate immediate discharge of condensate. Specially designed drain pan with all round edges allow complete cleaning & avoid microbial growth as per ASHARE 62 standard. The drain tray will be insulated externally with 19 mm nitrile rubber & extended at least 300 mm beyond the coil. Necessary arrangement will be provided to slide the coil in the drain pan.

Mechanical performance of AHU casing shall be tested as per EN1886 or AHRI 1350 standard by internationally renowned laboratory or certification body like AHRI/ Eurovent / Intertek / UL and should meet the following characteristics.

Table : 1.1

Mechanical Characteristics	As per EN 1886	As per AHRI 1350
Mechanical Strength	D1	CD 4
Thermal Bridging	TB2	CB 2
Thermal Transmittance	T2	CT 2
Air Leakage	L1	CL 2

MIXING BOX

AHU's requiring mixing boxes as specified or as per requirements shall be complete with fresh and return air dampers.

DAMPER

Dampers shall be opposed blade type. Blades shall be made of double skinned aero- foil aluminum sections with integral gasket and assembled within a rigid extruded aluminium alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

PLUG FAN WITH EC MOTOR

The complete EC Fan unit shall be of rugged bolted construction made of sheet steel, statically and dynamically balanced.

Fan: The fan section shall be equipped with a Single Inlet Centrifugal Impeller with High Efficiency Backward curved blades and external rotor EC (Electronically Commutated) motor, energy optimized for operation without spiral housing for high efficiency and favorable acoustic behaviour. The high efficiency backward curved impeller with rotating diffuser, made of high-performance composite material / welded aluminum sheet material, with external rotor motor balanced together statically and dynamically according to DIN ISO 1940 Part 1.

The EC fan should be capable of being fitted in horizontal or vertical position in the AHU, depending on the application. Inlet cone shall be provided with a nozzle for volume flow measurement of the fan.

AHU manufacturer should supply cover plates for EC Fans in sufficient quantity for maintenance purposes.

Motor: the motor shall be a permanent magnet external rotor motor with integrated electronics and suitable for continuous operation. The speed of the motor shall be variable depending on an external control signal. The fans shall be Modbus RTU compatible for communication with BMS (Building Management System). The fan in totality shall be of the most efficient type so that the power consumption and noise level is minimal. The EC motor shall have a wide voltage input range: 3~380...480V, 50/60 Hz. The motor shall be minimum IP54 protection class, with Thermal class 155 (Insulation class F). The EC motor shall be provided with suitable protection from moisture & hot climate. The ball bearing shall be provided with long time lubrication for maintenance free operation.

The EC motor shall meet all necessary EMC (Electromagnetic Compatibility) directives. The EC motor should comply to applicable EMC standards: Interference

Emission Standard EN 61000-6-3 / 2. EC Motor shall be Integrated with VSD (Variable Speed Drive) for speed modulation of fans.

The EC motor shall have the following protective features integrated in the controller:

- Overvoltage protection
- Short Circuit protection
- Under voltage/ Over voltage detection
- Locked rotor protection
- Line fault detection
- Alarm relay 250V/2A
- Over temperature protection of electronic and motor
- External LED display shall be provided for indication of the status of the fan

COOLING COILS

Chilled water coils shall have 12.5 to 15 mm dia (O.D) tubes made from seamless solid drawn copper minimum 0.5 mm thick with 0.15 mm thick sine wave aluminium fins firmly bonded to copper tubes assembled in 304 Stainless Steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across the coil shall not exceed 500 fpm. The chilled water coil shall be 6-row or 8-row deep coil and the hot water coil shall be 2 row deep. In the 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. The coil shall be pitched in the unit casing for proper drainage. The coil shall have a copper header with chilled water supply & return connections protruding out of AHU casing by minimum 150 mm and fitted with dielectric coupling for connection with MS pipes. 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. Each coil shall be factory-tested at 21 kg per sq. m air pressure underwater. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 - 12 fins per INCH. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. Water pressure drop in coil shall not exceed 10 PSIG.

The cooling coil shall be provided with hydrophilic coating. Computerized cooling / heating coil selection output shall be submitted, and all Coils shall be AHRI certified. Stacked coils shall have an Intermediate drain pan made from 304 grade stainless steel, extending to the entire finned length of the coil. Cooling coils in stacks- section shall not be acceptable unless provided with an intermediate drain pan. The intermediate drain pan shall have drop tubes to guide condensate to the main drain pan.

PRE FILTERS (MANDATORY)

Each unit shall be provided with a ISO 9001: 2015 factory assembled filter section containing 50mm thick disposable air filters having aluminium extruded mill finished frame. The filter shall have minimum efficiency of ISO coarse greater than 60%. The media shall be blended polyester in pleated construction or supported with HDPE mesh on one side and aluminium mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. The filter framework shall be fully sealed, constructed from aluminium alloy or aluminium extruded mill finished frame. Face velocity across these filters shall not exceed 500 FPM. Each filter shall carry a certificate from the manufacturer for the ISO 16890 Conformity and a sample test report. The filter area shall be made up of panels of size convenient for handling. The filter testing method shall be as per ISO 16890 latest edition.

Table : 1.2

Parameter	Filter
Type	Box Type or Flange Type
Grade	ISO Coarse Grade with efficiency greater than 60% (confirming to ISO16890)
Initial P (mm WG) - clean condition	7.5+/- 15%mm WC – Initial Pressure Drop
Final P (mm WG) - clogged condition	20mm WC – Final Pressure Drop
Casing	Aluminium Anodized
Sealing of medium	Epoxy or equivalent
Medium	The media shall be blended polyester in pleated construction or supported with HDPE mesh on one side and aluminium mesh on other side.
Test Method	The filter testing method shall be as per ISO 16890 latest editions.
Disposable	Yes
Test certificate from manufacturer	Yes

FINE FILTERS (MANDATORY)

Each unit shall be provided with a factory assembled filter section containing 300mm thick bag type synthetic media type air filters having anodized aluminium frame. The filter shall have a minimum MERV 13 Rating. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. The filter framework shall be fully sealed and constructed from aluminium alloy. Face velocity across these filters shall not exceed 500 fpm. Each filter shall carry test certificate from manufacturer. The filter area shall be made up of panels of size convenient for handling. The filter testing method shall be as per ASHRAE 52.1 latest edition. Design Parameters of Filters.

Table : 1.2

Parameter	Filter
Type	Flange/ Box type
Grade	ISO ePM1 with PM efficiency (50%-70%) (confirming to ISO16890)
Initial P (mm WG) - clean condition	7.5 $\pm$ 15% mm WC – Initial Pressure Drop
Final P (mm WG) - clogged condition	20mm WC – Final Pressure Drop
Casing	Aluminium Anodized
Sealing of medium	Epoxy or equivalent
Medium	The media shall be blended polyester in pleated construction or supported with HDPE mesh on one side and aluminium mesh on other side.
Test Method	The filter testing method shall be as per ISO 16890 latest editions.
Disposable	Yes
Test certificate from manufacturer	Yes

16. UVGI FOR AHU COILS

A) General:

The UVGI System shall be provided with the primary objective of achieving substantial reduction in microbial count, both airborne and on the surface of cooling coil.

B) Selection Criteria :

- a) The UVGI system shall be designed to cover the entire face area of the cooling coil and to achieve UVC (254 nm wavelength) irradiation with an exposure time of 15 minutes at irradiation intensity of 4016 $\mu\text{W}/\text{cm}^2$ based on ISHRAE recommendation.

-
- b) The lamps shall not operate at wave length 180 nm or lower, to ensure no uncontrolled ozone is put out by the lamps.
 - c) The face velocity of dehumidified air over the coil will not be more than 500 FPM.
 - d) The UVGI system shall be designed to achieve log 2 deactivation of microbial growth on the cooling coil. Subsequently, the UVGI system switching based on site requirement can be done to ensure that the microbial growth does not re- occur.
 - e) The number of lamps in an UVGI System shall be calculated to ensure the minimum Average Intensity of $100\mu\text{W}/\text{cm}^2$ on the surface of cooling coil is achieved.
 - f) Selection criteria of UV lamps to achieve the required parameters shall be got approved from Engineer In charge.
 - g) An undertaking from manufacturer regarding rectification/replacement of UV Lamps during effective life as specified by manufacturer shall be provided by successful tenderer.

C) Specifications :

General:

- a) The UVGI system shall be suitable to operate with 220-240 V, single phase A.C. supply. The power supply to the system shall be made available from AHU panel by contractor.
- b) The entire UVGI system shall be factory tested with test certificate from the reputed Lab. 3rd party test certificate can be provided either by contractor
- c) The UVGI system shall be installed in front of cooling coil with lamp facing coil to cover the drain pan.
- d) The selection and placement of the UVGI system shall ensure full irradiation of the entire face area of the cooling coil and drain pan.
- e) The UVGI System shall be free standing and be mounted in such a manner that lamps are in perpendicular plane to air flow.
- f) The electronic driver shall be installed in the control panel outside the AHU to avoid any effect on the electronic components due to moisture and to avoid additional heat generated load in AHU.

17. UV LAMPS

The UV lamps shall meet following criteria:

-
- a) Lamp shall be High Output Quartz type, with current efficient.
 - b) The lamp shall produce UVC as required to achieve the required parameters.

Support and framework:

- a) The entire framework and support inside AHU shall be fabricated out of Aluminum Alloy. All material used shall be UV resistant.
- b) The framework shall be free standing and suitable for quick assembly.
- c) The reflectors shall be in Aluminum Alloy of high UV reflectivity and parabolic in shape.
- d) All parts should be corrosion resistant.

Control Panel :

Shall consist of the following :

- a) Electronic ballasts with high power factor of > 0.90 , High output Lamps required which will working on 800Ma.
- b) The ballasts shall be constant current output ballast over input voltage range of 190 to 270 VAC, single phase.
- c) Microprocessor based control panel with LCD Display.
- d) Individual Lamp run hours for timely and easy replacement
- e) Individual lamp On/Off/Error Indicator
- f) Real Time Clock to have the exact time and duration of the system and individual lamps.
- g) Programmable Real time On/Off switching for system
- h) Shall be BMS Compatible
- i) Ballast Protection Circuit
- j) Lamp change reminder on Display
- k) ON/Off for incoming power - Mains Power

Safety :

- a) Ballast Protection Circuit is provided in Control panel to ensure ballast is turned off for protecting it after 2 minutes if the lamp does not start.
- b) Fire resistant FRLS cables.
- c) Proper UV caution labels shall be applied to control panel and on the AHU sides and strategic points.

Certificates:

The contractor shall provide the manufacturer's test certificates for main items like lamp, ballast, system etc.

Installation: -

The UVGI lamps shall be mounted on a self-supporting rigid frame and the flow of air shall be perpendicular to the direction of air flow.

All safety and certification from UL/CE will be attached with the technical submittal of the system.

Testing & Commissioning:

The intensity of the UV Lamps across the coil will be measured using a calibrated radiometer.

18. ULTRA SONIC HUMIDIFIER (WHEREVER REQUIRED)

An ultrasonic humidifier uses a metal diaphragm vibrating at an ultrasonic frequency to create water droplets that silently exit the humidifier in the form of a cool fog. Ultrasonic humidifiers use a piezoelectric transducer to create a high frequency mechanical oscillation in a film of water. This forms an extremely fine mist of droplets about one micron in diameter, which is quickly evaporated into the air flow.

Following are minimum design requirements of Ultra Sonic Humidifier.

Unit must be provided with Single mist outlet pipe till 5 kg/hr capacity & minimum 2 nos of mist outlet for capacity more than 5 kg/ hr.

Water inlet connection and water storage tank made up of SS304L, minimum thickness of 1.5 mm.

ACCESSORIES

Each air handling unit shall be provided with manual air vent at high point in the cooling coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, & quantities separately identified in schedule of Quantities.

Insulated butterfly valves, balancing valves, 'Y' strainer, union & condensate drain piping with 'U' trap up to sump or floor drain in air handling unit room, as described in section "Piping".

Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled water supply and return lines as per the section "Instruments".

PAINTING

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

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 TREATED FRESH AIR UNITS

TYPE

The unit shall be double skin construction, comprising of supply air section, return air section. The supply air section shall include Pre-filter section, Fine-filter section, Supply air fan section, Cooling coil Section, Damper Section, Inspection Section.

CASING

Casing shall be of double skin construction as specified in the data sheet.

- a) Double skin wall panels shall be min 48 ± 2 mm thick made of GSS, pressure injected with poly-urethane (PUF) foam insulation of density 40-Kg/M³ and K factor not exceeding 0.02W/M°C. Double skin wall panels shall be fixed to 2.5 mm thick aluminium alloy twin box section structural framework with stainless steel screws. Outer sheet of the panels shall be made of 0.8 mm thick GSS pre-coated. Inner sheet shall be 0.8 mm thick plain GSS.

The Frame work shall be extruded Al. hollow profile. The entire frame work shall be mounted on a 100 mm (minimum) aluminium alloy channel base. The panels shall be sealed to the frame work by heavy duty "O" ring neoprene gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots. Handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly match drilled, with bolts, nuts and continuous neoprene rubber gaskets. All fixing and gaskets shall be concealed.

The structure shall be made of Extruded Aluminium sections with polyamide thermal break profile for ensuring thermal bridging performance. The polyamide strip should

be crimped to extruded aluminium sections for leak proof fitment. The structure shall be assembled using die cast Glass filled Nylon joints to make a sturdy, strong & self-supporting framework for various sections.

Floor and roof panels shall be double skin type and shall be of same construction as the wall panels.

TFA's shall have hinged quick-opening insulated access door on fan and filter sections. Access doors shall be double skin type and shall be of same construction as the wall panels.

Four (4) lifting lugs shall be bolted to each base section for lifting or placing the ERU in place.

All connecting fasteners and related hardware and its accessories shall be in stainless steel.

- b) For TFA provided with cooling coil, sloping condensate drain pan shall be fabricated from SS 304 18G with all corner welded. It shall be isolated from bottom floor panel through 19 mm thick closed cell Nitrile rubber insulation. Drain pan shall extend beyond the coil.
- c) Casing shall be of air-tight construction and sufficiently rigid to exclude vibrations, throughout the working capacity range of the TFA.
- d) For Outdoor Installation units have factory installed galvanized sheet metal canopy with necessary projection to protect the electrical panel.

COOLING COILS

Chilled water coil shall have 12.5 to 15 mm dia (O.D) tubes made from seamless solid drawn copper minimum 0.5 mm thick with 0.15 mm thick sine wave aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across the coil shall not exceed 500 fpm. The chilled water coil shall be 6-row or 8-row deep coil. In the 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. The coil shall be pitched in the unit casing for proper drainage. The coil shall have a copper header with chilled water supply & return connections protruding out of AHU casing by minimum 150 mm and fitted with dielectric coupling for connection with MS pipes. 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.

Each coil shall be factory-tested at 21 kg per sq. m air pressure underwater. Tube shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 - 12 fins per INCH. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. Water pressure drop in coil shall not exceed 10 PSIG.

The cooling coil shall be provided with hydrophilic coating. Computerized cooling coil selection output shall be submitted. FILTERS

Pre Filters

Each unit shall be provided with a ISO 9001: 2015 factory assembled filter of Panel type less than or equal to 300 mm depth glass fibre media type air filters having Metal or Recyclable ABS frames. Media should have minimum 12 months shelf life. The filter shall have minimum ePM1 50-70% Rating. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed from aluminum alloy/ Galvanized Steel /Recyclable ABS. Face velocity across these filters shall not exceed 500fpm. Each filter shall carry certificate from manufacturer for the ISO 16890 Conformity and a sample test report. The filter area shall be made up of panels of size convenient for handling. The filter testing method shall be as per ISO 16890 latest edition

Design Parameters of Filters

Table : 1.3

Parameter	Filter
Type	Flange/ Box type
Grade	ISO ePM1 with PM efficiency (50%-70%) (confirming to ISO16890)
Initial P (mm WG) - clean condition	7.5 ± 15% mm WC – Initial Pressure Drop
Final P (mm WG) - clogged condition	20mm WC – Final Pressure Drop
Casing	Aluminium Anodized
Sealing of medium	Epoxy or equivalent
Medium	The media shall be blended polyester in pleated construction or supported with HDPE mesh on one

	side and aluminium mesh on other side.
Test Method	The filter testing method shall be as per ISO 16890 latest editions.
Disposable	Yes
Test certificate from manufacturer	Yes

Fine Filters

Each unit shall be provided with a ISO 9001: 2015 factory assembled filter of Panel type less than or equal to 300 mm depth glass fibre media type air filters having Metal or Recyclable ABS frames. Media should have minimum 12 months shelf life. The filter shall have minimum ePM1 50-70% Rating. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed from aluminum alloy/ Galvanized Steel /Recyclable ABS. Face velocity across these filters shall not exceed 500fpm. Each filter shall carry certificate from manufacturer for the ISO 16890 Conformity and a sample test report. The filter area shall be made up of panels of size convenient for handling. The filter testing method shall be as per ISO 16890 latest edition

Table : 1.4

Parameter	Filter
Type	Flange/ Box type
Grade	ISO ePM1 with PM efficiency (50%-70%) (confirming to ISO16890)
Initial P (mm WG) - clean condition	7.5 ± 15% mm WC – Initial Pressure Drop
Final P (mm WG) - clogged condition	20mm WC – Final Pressure Drop
Casing	Aluminium Anodized
Sealing of medium	Epoxy or equivalent
Medium	The media shall be blended polyester in pleated construction or supported with HDPE mesh on one

	side and aluminium mesh on other side.
Test Method	The filter testing method shall be as per ISO 16890 latest edition.
Disposable	No
Test certificate from manufacturer	Yes

CHEMICAL FILTERS

Chemical filters for adsorption of various type of Volatile organic compounds which includes Boron, Ozone, H₂S, SO₂, NO₂, Odor, VOCs, Food Aromas, Tobacco Smoke odor etc.

Filters should be of standard sizes - 595x595mm, 289x595mm & filter depth shall be 150 / 300 mm.

Gas adsorbing chemicals should be coated on non-woven media surface with media having thickness of 2.2mm. Chemical coating on surface should be minimum 590- 600 grams/ sq. meter. Sealant should be PU based.

Pressure drop across the filter for 3400CMH should not be more than 100pa for 292mm thickness and 1700CMH – 125pa for 150mm thickness.

ULTRAVIOLET -C (UVC) EMITTERS

Contractor shall refer AHU specifications for UVC emitters,

ACCESSORIES

- a) Each air handling unit shall be provided with manual air vent at high point in the cooling coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections.
- b) Insulated butterfly valves, balancing valves, 'Y' strainer, union & condensate drain piping with 'U' trap up to sump or floor drain in air handling unit room, as described in section "Piping".
- c) Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled water supply and return lines as per the section "Instruments".

PAINTING

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

INSTALLATION

- a) The air handling unit shall be so installed as to transmit a 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.
- b) The contractor shall be responsible for delivering the AHUs as per the approved shop drawings considering left, right hand side coil, drain, cabling & panel locations to adequately consider maintenance requirement in AHU Room.

4 SPOT COOLING AHU

Contractor shall refer TFA units specifications for spot cooling AHUs.

5 AHU FAN SECTION

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of double skin construction air handling units fan section, conforming to these Specifications and in accordance with requirements of drawings and of the building.

TYPE

The air handling units shall be double skin construction, draw-thru type in sectionalized construction consisting of blower section, filter section as applicable or shall be based on approved calculations & equipment's selection sheets approved by Engineer in charge/ client.

CAPACITY

The air handling capacities and static pressure shall be based on approved calculations & equipment selection sheets approved by Engineer in charge/ client.

The requisite static pressure demanded by the air circuit shall be developed by the fan at the selected operating speed. The static pressure value shall not in any case be less than 25 mm water gauge in normal cases, not less than 75 mm water gauge where micro-vees are also used. The fan motor HP shall be suitable to satisfy these requirements and the drive losses.

The air outlet velocity from the blower fan shall not exceed 2000 fpm. Noise level at a distance of 1.5 M from AHU shall not exceed 75 dBA. CASING

Double skinned panels shall be 25 mm thick made of galvanized steel, pressure injected with foam insulation (density 40 kg/m³) with K factor not exceeding 0.02 Watt/m²°C shall be fixed to 1.5 mm thick aluminum alloy twin box section structural framework with stainless steel screws. Double skin panels shall be minimum 25mm thick made of 0.8mm pre-plasticized sheet with PVC coating with polyester finish, GSS sheet on outside and 0.8mm plain galvanized sheet inside. 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 housing shall be so made that it can be delivered at site in total/semi knocked down conditions depending upon the requirements.

The entire framework shall be mounted on an aluminium alloy or galvanized steel (depending on size) channel base as per manufacturer's recommendation. The panels shall be sealed to the framework by heavy duty 'O' ring gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots, handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly with continuous foam gasket. All fixing and gaskets shall be concealed.

Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type.

MOTOR AND DRIVE

Fan motors shall be IE-3 energy efficient and shall be 415±10% volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-65 protection or EC motors wherever it is required. Motors shall be especially designed for quiet operation. All the motor shall be suitable for use with variable frequency drive.

Belts shall be of the oil-resistant type. FAN

Fans shall be AMCA certified centrifugal, aero-foil backward curved fans. Minimum fan efficiency shall be 70%. The air outlet velocity from the fan shall not exceed 2000FPM.

Fans driven by variable frequency drive shall be backward inclined irrespective of air quantity (CFM) and static pressure value. Fan casing shall be made of galvanised steel sheet. Fan wheels shall be made of galvanised steel. Fan shaft shall be grounded C40 carbon steel and supported in self-aligning Plummer block operating less than 75% of first critical speed, grease lubricated bearings. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard. Computerized fan selection shall be submitted as and when required by Engineer In charge.

Motors shall be mounted inside the AHU casing on slide rails for easy belt tensioning, and be totally enclosed, fan cooled, to be class 'F' insulation.

Both fan and motors assemblies shall be mounted on a deep section aluminum alloy or galvanized steel (depending on size) base frame.

Combination spring and rubber anti vibration mounts shall be provided for isolating the unit casing. Frame retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan discharge wherever applicable.

PAINTING

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

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.

6 VENTILATION FANS

Please refer to Chapter 15 "MECHANICAL VENTILATION SYSTEM AND ETAC PLANTS" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

19. CABINET FANS

The cabinet fan shall be complete in all respect and shall generally comply with the following specifications given below: The cabinet fan shall be of GI sheet metal sectionalized construction and shall include fan section, filter section, motor drive etc.

i) The housing of cabinet fan shall be of double skin construction. The framework shall be of extruded aluminium hollow section. All the frames shall be assembled using pressure dye cast aluminium joints of various sections, strong and self-supporting framework of various sections. The double skin panels shall be made of 0.8mm pre- plasticized outside & 0.8 mm non coated inside layer with 25mm thick PUF insulation injected in between by injection moulding machine. These panels shall be screwed on to the framework with soft rubber gasket in between to make the joints air tight. Suitable air-tight access doors with hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on extruded aluminium channel framework having pressure dye cast aluminium joints.

ii) Fan: The fan shall be backward curved double inlet, double width type. The wheel and housing shall be fabricated from heavy SWG galvanised steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron framework and pillow block heavy duty ball bearing. The impeller and fan shall be statically and dynamically balanced. The fan shall be selected for a speed not exceeding 1000 RPM. Frame housing with motor shall be mounted on a common extruded aluminium base mounted inside the housing on anti-vibration mounds. Fan outlet shall be connected to casing with the help of fire-retardant fabric acting as flexible connection for anti- vibration. The manual 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. Velocity at blower outlet shall not exceed 10 m/sec (2000 FPM).

iii) The fans which are used in the Labs for exhausting the fumes shall be Fiber- reinforced plastic (FRP) coated with minimum 85DFT for chemical & corrosive fume extraction. The motor shall be fire resistant, spark proof and compatible with the fume exhaust system in the labs.

iv) Motor & Drive: The fan motor shall be suitable for $415 \pm 10\%$ volts 50 cycle 3 phase squirrel case totally enclosed fan cooled with IP 55 protection. The motor speed shall not exceed 1450 rpm. The drive to the fan shall be provided through belt arrangement. The Fan motor shall be energy efficient with the efficiency level of IE-3.

v) Accessories:

vi) Necessary accessories shall be provided wherever necessarily required for proper operation and shall also include:

- Spring type Vibration isolations for the blowers. -
- Canvass connections at the outlet of each fan
- Nuts, bolts, shims etc. as required for the grouting of the equipment.

20. INLINE EXHAUST FANS

Inline fan shall incorporate centrifugal direct driven with TEFC motor. Casing shall be of Galvanized steel with minimum 200 GSM zing coating and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Impeller material shall be either Galvanized Steel or Glass Reinforced Polypropylene (Fan shall be insulated type if required).

Flanges shall be provided on both sides of the Inline fan to facilitate easy connection. Flexible anti-vibration joints shall be provided to arrest vibration being communicated to other equipments connected to the Inline fan.

Motor shall be single phase/three phase as per duty conditions. All single-phase fans shall be provided with speed regulators while all three phase fans shall be provided with opposed blade damper in GSS construction at fan outlet for air balancing.

The fan shall be provided with accessories like outlet cone, inlet cone, fan silencers (if required), wire guards on fan outlet/inlet not connected to the duct work.

The fans which are used in the hazardous area for exhausting the fumes shall be chemical and corrosive proof. The motor shall be fire resistant, spark proof and compatible with the fume exhaust system in the labs.

All equipment shall be supplied with the manufacturer's standard finished painting.

21. BATTERY ROOM EXHAUST

Supply, Installation, Testing & Commissioning of Battery Exhaust Fans with Hydrogen Sensors, Hooters, Panels as per requirements.

22. FANS FOR SMOKE EXHAUST

a). Supply, Installation, testing & Commissioning of Smoke Evacuation Tube Axial fan for Room Smoke exhaust complete with MS channel base, housing, fire retardant flexible connection with nut bolts at outlet, mounting, vibration isolators, & bird screen, wherever required for complete installation include Lifting, shifting, assembling & positioning of the equipment comprising of the following and complete as per specification.

b). Fan shall be provided with TEFC Sq. Cage, direct driven 'H' Class induction motor for exhaust application & 'F' Class induction motor for fresh air with minimum IE-3 rating having Fire Rating for 250°C for 2 hrs & suitable for 415V±10%, 50 Hz. 3 phase electric supply.

The motor and impeller speed shall be as per specification and capacities shall be as per requirements.

The Fan must be selected for minimum power consumption & Maximum efficiency at respective duty point. & Min fan efficiency should be 70%.

However, If OEM is not able to meet 70% efficiency for any specific case, 65-70% fan efficiency can be excepted subject to detail technical justifications from Vendor/OEM.

Motor shall be of 3 phase squirrel-cage totally enclosed; fan cooled type. Motor and starter shall be in accordance with para 6.2.3.4(v) and 13.9 respectively. The speed of fan shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1450 RPM for fans with impeller diameter of 450 mm and less. Max. noise level shall be 85 dBA at 3 meter in hemispherical reverberant room condition.

c). The complete fan assembly shall be CE Certified in accordance with EN-12101- 2:2015 or UL Listed conforming to UL-705 Power Ventilator for smoke exhaust OR TUV SUD PSB Pte Ltd (Vendor shall submit the certifications for below listed fans) Fan casing shall be de-rusted, cleaned, primed and finish coated with enamel paint or shall be hot dip galvanized with min. 220 GSM coating. Fan casing, motor mount support brackets for ceiling suspension shall be welded or bolted to the casing for connection to hanger bolts. Hub and Blades of Axial fans Impeller/Rotor shall be constructed for cast aluminium or aluminium alloy. Extended grease leads for external lubrication shall be provided for motors above 180 frame size. The fan pitch control maybe manually readjusts able at site or at manufacturer's facility. The motor and impeller speed shall be as per specification and capacities shall be as follows.

7 AIR WASHER

Please refer to Chapter 15 "MECHANICAL VENTILATION SYSTEM AND ETAC PLANTS" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of air washer conforming to these specifications and in accordance with the requirement of drawings and buildings.

TYPE

The air washers shall be Pad type as indicated on drawings and identified in Schedule of Quantities.

CAPACITY

The capacity of air washer shall be as shown on drawings or shall be based on approved calculations & equipment's selection sheets approved by Engineer in charge/ client.

PAD TYPE AIR WASHER

The air washer shall be draw through type with minimum 90% saturation efficiency with imported cellulose paper pads. The air washer shall be selected & designed for lowering inside temperature by 5 – 10°C dependent on ambient conditions.

HOUSING

Double skinned panels shall be 23-25 mm thick made of galvanized steel, pressure injected with foam insulation (density 40 kg / m³) with K factor not exceeding 0.02 watt

/ Mc shall be fixed to 1.5 mm thick aluminium alloy section structural framework with self drilling and tapping screws. Outer sheet of panels shall be made of galvanized preplasticised sheet of 0.8 mm thick, and inner sheet of 0.8mm thick galvanized pre- plasticised.

The entire framework shall be mounted on aluminium alloy or galvanized steel (depending on size and as per manufacturer's recommendation.) channel base of minimum 200 mm. The panels shall be sealed to the framework by heavy duty gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots, handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly with continuous foam gasket. All fixing and gaskets shall be concealed.

Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type.

Re-circulation tank shall be fabricated from 18 G 304 Stainless Steel. The tank shall be complete with double brass strainers, makes-up connection with float, drain and overflow connections.

FAN

The fan section shall be equipped with double inlet (DIDW) centrifugal type blower with high efficiency backward aerofoil curved blades. The fan housing shall be of Galvanized sheet steel and the impellers shall be fabricated from heavy gauge

Galvanized steel sheet as per approved manufacturers' 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 with angle iron frame and pillow block heavy-duty ball bearings on larger fans above 710 Dia. Fan housing and motor shall be mounted on a common extruded aluminum base mounted inside the fan section on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant & anti-fungal fabric to avoid any vibration from the unit on to the ducts. All fans shall bear the AMCA seal for sound and performance and shall be tested in accordance with AMCA standard. The fan outlet velocity shall not exceed 10.2 m/s.

MOTORS

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, 3 phase, squirrel - cage, totally enclosed fan cooled with IP-55 protection 50Hz. A.C supply. Motor R.P.M. shall not exceed 2880R.P.M. The fan motor combination shall be of most efficient type, so that power consumption and noise level may be minimized. The motor should be mounted on the same isolation base as the fan. The motor should be mounted on a base that is adjustable in two planes

COOLING PADS

Cooling Pads shall be of imported cellulose paper pads and of cross fluted configuration assembled in self supporting pads in a lightweight construction. The pads shall be able to redistribute the water and shall be impregnated with insoluble anti-rot salts, rigidifying saturants and wetting agents with built in eliminators. The velocity across the pads shall not exceed 350 fpm (1.8 m/s) and shall not allow carryover of water. Minimum thickness of Pads shall be 200 mm and minimum efficiency of pads 90%.

WATER DISTRIBUTOR

A FRP distributor shall evenly distribute water on the Pads. FILTERS

The Filters section shall incorporate synthetic washable filters of at least 50 mm thickness in suitable aluminum frame. Velocity of air across the filters shall not exceed 500 FPM.

ELIMINATOR

Eliminator plates shall be four bend made from 24 SWG galvanized sheet steel or PVC.

Interconnecting Pipes

Air washer shall be complete with interconnecting GI piping from pumps to air washer, valves, SWG, fittings, strainers etc.

PUMPS

Specification for recirculation pumps shall be as listed in earlier section of the tender. PAINTING

Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed, and spot primed over the affected areas, than coated with minimum 80 DFT paint to match the finish over the adjoining shop painted surface.

TESTING

Efficiency of air washer shall be computed from the measurements of air flow and dry and wet bulb temperature of air entering and leaving the air washer and ambient temperatures.

The unit contains indirect evaporative cooling section, which lowers both dry bulb and wet bulb temperature of the incoming fresh supply air. This cooling is at constant humidity level. A reservoir purges and drains during off cycles to prevent biological growth.

8 SCRUBBER

8.1 DRY SCRUBBER

SCOPE

The Dry scrubber unit shall be UL/CE certified and of the type as indicated on Drawings and identified in Schedule of Quantities.

TYPE

The unit shall provide efficiency of 90% or better for single pass based on ASHRAE test method at flow rates of 800 – 1300 CFM per module (supported by sample test report by a US laboratory).

Multiple units can be joined together for increased volume. The system shall be suitable to connect to fan section with average velocity of not exceeding 500 FPM across air cleaner.

The unit shall be designed and constructed and supplied by a manufacturer specializing in the research, design and manufacture of products specified in this section with a minimum of three years of documented experience, and capable of issuing complete catalogue data on the total product.

HOUSING

Housing shall be 16-gauge zinc coated GSS/Cold-rolled steel sheet with powder coating construction to protect against rust and corrosion. Each section shall include single door access, located one side of the unit. The access door shall be mounted on steel hinges and secured with adjustable, gasket sealed lever latches allowing for component access and removal. All doors shall be gasketed to prevent air and water leakage. Doors to charged high voltage components shall be equipped with electrical interlocks, for interconnection into the primary power supply, to prevent access when the components are energized. The housing shall be furnished completely assembled for ease of shipment and installation. Between each section, a permanent 1/8" thick gasket shall be installed to prevent leakage. The bottom drain pan under ESP section containing integral washing systems shall be pitched downward 1/4" per foot minimum toward a 3" NPT drain nipple.

The sections are to be mounted on a structural C-channel or floor mounting or ceiling suspension. Lifting lugs shall be incorporated in the base channel to allow for rigging, if ordered.

The external casing finish shall be a durable industrial grade semi gloss baked-on epoxy ester, not less than 3 mil minimum thicknesses.

CELL WASH MODULE

The Cells Wash module shall incorporate mechanical filtration. The stationary filter from the direction of airflow will be a metal mesh filters with single, gasketed access doors. Wash manifolds and headers are supplied to wash the module during the normal wash cycle.

ELECTROSTATIC PRICIPITATOR MODULE

The electronic air cleaner shall be the two-stage dual voltage plate type cells, rated at not less than 90% efficiency as per the ASHRAE test standards for dry particulate (supported by sample test report by a reputed laboratory for the make and model supplied for this project). The collection cells shall be in Single Pass arrangement to provide for maximum collection efficiency. The system shall be suitable to connect to fan section with average velocity of not exceeding 500 FPM across air cleaner.

IONISING COLLECTION CELL

Ionizing-Collecting cell(s) shall be of one-piece construction 14.23" inches deep in direction of airflow. All support framing, end plates and ionizer ground electrodes shall be 0.090 inch thick aluminium. Both repelling and collector plates shall be 0.020 inch thick aluminium, 9.125 inch deep in direction of airflow and rigidly retained in place with tubular spacers and tie rods. Spacing between plates shall be no less than 0.175 inch. Ionizing electrodes shall be 24 gauge stainless steel spiked design, ionization wires are not acceptable, rigidly supported both vertically and laterally. High voltage support insulators shall be of self-glazing Cordierite ceramic with all surfaces, including center hole, glazed to enhance dielectric strength and retard tracking. Insulators shall be mounted out of the airstream, to reduce contaminant buildup. All high voltage electrical connections within each tier of cells, shall be between cells and automatically made when cells are installed. All electrical connections between unit tiers and high voltage connections between power packs and cells shall be located on the access door end of the cabinet and manually connected for ease of service.

POWER SUPPLIES

Power supplies shall be 100% solid state, UL Listed. operate on 200 to 240 VAC, 50 HZ, 1 Phase input and provide a dual high voltage output of (+) 12 to 13 KVDC for the ionizer and (+) 6.0 to 6.5 KVDC for the collector. A regulated output of up to 2.7 to 5.5 MA shall be supplied to maintain the specified collection efficiency. Integrally mounted electrical interlocks shall be provided to prevent access to the high voltage components without first interrupting the primary input power. The power supply shall operate over a temperature range of -10°C /14°F to 60°C /140 °F, be self-protecting and accommodate an LED light indicating the performance status of the ionizing/collecting cell. High voltage output leads shall be sealed and a bleed resistor incorporated to remove stored electrical charge where the power supply(s) are de-energized. Module of capacity above 3000 CFM shall be equipped with Pulse width modulating (PWM) to maintain the specified collection efficiency by maintaining a constant charge in the event of Low/High Voltage from source thus ensuring that the unit functionality is not affected with these voltage fluctuations. Power Consumption should not be more than 50 watts per ESP cell.

SYSTEM CONTROLS

Programmable Logic Controller (PLC) shall be housed in a NEMA-12 type enclosure. Controller shall be shipped for remote mounting and must be installed indoors or

other means of weather protection provided if installed. Terminals shall be provided to interconnect the system fan and shall sequence the detergent wash, soak, rinse fan force dry and return to operation cycle. All sequence times shall be factory set. Control initiation shall be semiautomatic, push button initiated, or fully automatic by time clock, with semiautomatic push button override.

A remote mounted Sleep Mode Reset Switch (momentary contact push button type) shall be supplied to be installed at the kitchen hood location to re-energize the air cleaning system after the wash system has completed. The switch may optionally be installed on the panel of the ATS control enclosure.

The control cabinet shall be furnished with a factory installed and wired 7-day initiator clock with battery backup.

WATER /DETERGENT WASH SYSTEM

AUTO Detergent wash and rinse will be accomplished with manifolds located on the air entering sides of the (pre-filter wash collar if supplied) ionizing/collecting cell tier through spray nozzles delivering a cone shaped pattern. The detergent reservoir, pump, motor and bypass valve shall be provided as a pre-packaged assembly with an adjustable detergent volume setting. The detergent pump motor shall be 0.75kW TEFV motor, 220v/50hz/1ph, with pump of positive displacement self priming and deliver not less that 6 GPM at 50 PSIG minimum outlet pressure. Pump motor shall contain built-in overload protection. Main water line strainer and solenoid valves are to be factory furnished with the system. Detergent system shall a 30-gallon tank for remote mounting with initial supply of biodegradable detergent as per unit manufacturer’s recommendations.

STATIC PRESSURE DROPS

The pressure drop shall not exceed the following (inches H2O): ESP

Section	0.14”
Metal Mesh prefilter or after filter	0.10”

The ESP section must have both an internal pre-filter and an after filter, select and add for each.

External losses for ductwork, exhaust hoods, manufacturing equipment with associated entry losses, kitchen hoods, etc. must be added with the above internal equipment losses to calculate total fan static pressure required.

ABSORBER MODULE

The Absorber Module shall be designed to utilize optimum number of trays that are powder painted for corrosion resistance, may be reused and are secured in a V-bank arrangement on steel slide tracks. Trays shall be charged with minimum 15 lbs. of activated carbon granules.

8.2 WET SCRUBBER

Wet scrubber shall be with Fan section with SISW belt driven centrifugal non-Spark proof fan, with drive set and pulley & NON FLP motor with IE-3 efficiency.

Unit shall be 40 mm thick double skinned casing consisting of 0.8mm thick powder coated GSS outside sheet & 0.8mm thick FRP coated GSS inside sheet with factory injected with 40 mm thick PUF insulation (density-38 kg/m³). Unit shall have 2 bank of water spray nozzle along with Eliminator section with 4pass PVC mist eliminator. For fresh air intake GI louvers required along with Pre-Filter 50 mm thick (EU-4) flanged type filter on face

Unit shall have inbuild water pump 2 Nos. (1w+1s), cover pipe, distribution water pipe, filters at air inlet, min. 300mm deep water tank, make up & quick fill water connection with valves/ball valves, drain and overflow connection. Mounted on a common base with spring type vibration isolators, multi sheave pulleys for fan and fan motor. The fan capacity shall be based on outlet velocity not exceeding 2000 FPM. Max. noise level of Scrubber Unit shall be 70 dBA at 1.0 meter. as per specifications and drawings. The complete unit shall be corrosion proof, chemical resistant from inside having 5mm thick FRP coating on casing, fan, supports, etc. and all piping, valves, hardware, nut, bolt etc. shall be made of SS 316.

9 FAN COIL UNITS

Please refer to Chapter 6 “FACTORY BUILT AIR HANDLING UNIT (AHU), FAN COIL UNIT (FCU) AND OTHER AIR DISTRIBUTION SYSTEMS” of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

Please refer only Fan Coil Unit (FCU) from this chapter.

10 DX SYSTEM

HI-WALL TYPE SPLIT AC SYSTEM SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of BEE 5 star rated air cooled Hi-wall type split units (Cooling application) conforming to this specification and in accordance with the requirements of buildings.

- i) Outdoor Units
- ii) Indoor Units
- iii) Refrigerant Piping & Insulation
- iv) Drain Piping & Insulation
- v) Control Cabling
- vi) Stabilizer.

OUTDOOR UNIT

- i) The outdoor unit shall be factory assembled, weatherproof casing (Material of construction of casing shall be Contractor standard design), constructed from heavy SWG GI sheets steel panels and coated with baked enamel finish minimum 40 microns thick. The outdoor unit shall be completely factory wired, tested with all necessary controls & filled with first charge of refrigerant before delivering at site. The outdoor unit shall be provided with hydrophilic coating.
- ii) The outdoor units should have anti corrosion paint free plate for easy mounting of unit.
- iii) The outdoor unit shall be provided with epoxy painted MS angle supports suspend from Wall/ ceiling for mounting the outdoor unit or floor mounted epoxy painted MS angle frame for mounting outdoor unit with vibration isolators. All the supports/angles shall be coated with hop dip galvanized of minimum 80micron DFT.
- iv) The outdoor unit should be fitted with low noise level and should not be more than 65db (A) at normal operation when measured at 1.5m distance from the equipment.
- v) The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss and should be fixed with DC/ AC fan motor for better efficiency.
- vi) Refrigerant Circuit: The refrigerant (R-410a/R32) circuit shall include liquid and gas shut-off valves at condenser end. All necessary safety devices shall be provided to ensure the safe operation of the system including high pressure switch, fuse, fan drive overload protector, fusible plug, crankcase heater, over load relay.

INDOOR UNIT

The unit shall be high wall mounted type for cooling application. The unit shall include pre-filters, fan section and DX- coil section. The housing of the unit shall be powder coated/ heat treated galvanized steel. The body shall be light in weight and shall be able to suspend from four comers. The fan shall be aerodynamically designed diffuser turbo fan type. Unit shall have an external attractive panel for supply and return air.

- i) 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 support from housing.
- ii) 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 21 kg/sq.m .air pressure under water.
- iii) Indoor unit shall have cleanable type filter fixed to an integrally molded plastic frame. The filter shall be with inbuilt ionizer; UV filter and germi control filters and shall be slide in and neatly insert able type. It shall be possible to clean the filters either with compressed air or water.
- iv) Each unit shall have PID control for maintaining designed room temperature. Each unit shall be provided with microprocessor thermostat for cooling.
- v) Each indoor high wall unit shall be with cordless infrared remote controller as standard features. Cordless remote shall have standard features as per standard design of manufacturers.

REFRIGERANT PIPING

Refrigerant piping for the split air-conditioning system shall be of soft seamless copper tubes. Forged copper fittings shall be used for the refrigerant piping. The refrigerant piping arrangements shall be in accordance with good engineering practices as applicable to the air-conditioning industry, and shall include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

- i) Before joining any copper pipe or fittings, its internals shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. Subsequently it shall be thoroughly blown out using nitrogen gas.

-
- ii) After completion of installation of the refrigerant piping, the refrigerant piping system shall be pressure tested using nitrogen gas at a suitable pressure as specified by OEM (Original Equipment Manufacturer).
 - iii) The supplier of air-conditioning system shall choose sizes as designed and erect proper interconnections of the complete refrigerant circuit. The thickness of copper piping shall not be less than 20 SWG.
 - iv) The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturer's specified diameter. All refrigerant pipes shall be properly supported and anchored to the building/structure using steel hangers, fasteners, brackets and supports which shall be fixed to the building/structure by means of inserts or expansion shields or anchor fasteners of adequate size and number to support the load imposed thereon.
 - v) The refrigerant piping should be laid in such a way that it should not distort the interior of the room, wherever the refrigerant pipe has to be laid across the room, it should be laid in a concealed manner by making appropriate boxing arrangement matching with the interior of the room. All associated minor Civil Engineering works (like chasing on wall, ceiling & re-plastering & repainting etc.) related with the above items are included in the scope of work. The above scope does not include false ceiling wherever required.
 - vi) Entire liquid and suction refrigerant pipe lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm thick elastomeric Nitrile rubber with mechanical and UV protection.
 - vii) Piping work shall be recessed in wall/floor wherever required as per direction of Engineer-in-charge without any extra cost.

DRAIN PIPING

- i) The drain pipe connection of each indoor unit should be 25 mm dia. The drain- pipe should be heavy duty CPVC pipe ISI marked and conforming to relevant IS complete with fitting as required whereas the connection of the indoor unit to the CPVC pipe should be with flexible braided pipe. The drain piping should be insulated with 9mm thick tubular Nitrile rubber Elastomeric insulation.
- ii) For proper drainage of condensate U trap shall be provided in the drain piping wherever required. The condensate drain pipe arrangement for disposal of condensate water be made in such a way that there should not be any leakages of condensate water inside rooms as well in the route of drain water pipe line & water should be

discharged at the location jointly decided with Engineer in charge. All associated Civil Engineering works as per requirement at site in above connection like making chase in the wall & restoring it original shape by re-plastering & repainting, etc. are included in the scope of work. The arrangement of drain-pipe shall be made in such a way that it should not affect the aesthetic of the building as well as maintenance friendly & easily accessible.

INSTALLATION

- i) Wherever split A.C. are planned in the new buildings, necessary openings in wall may be provided by with use of 75 mm CPVC pipe sleeves at suitable locations for taking refrigerant pipes and cable to outdoor unit, so as to avoid unnecessary cutting/ damage to walls at a later stage. The slope of sleeve of CPVC pipe should be towards exterior to avoid seepage of water into the room. This opening should be sealed properly after installation to avoid entry of vermin and rain water.
- ii) For condensate drain, CPVC pipe be also provided and taken to nearest drain or up to the stack for collection & disposal of condensate. The slope of such pipe also should be downwards. As far as possible, joints should be avoided in this pipe.
- iii) The length of connecting refrigerant pipes between outdoor and indoor unit be kept to minimum feasible at site. However, it should not exceed 9 m, as the efficiency of the unit gets severely affected on increase of distance. The refrigerant pipes should be taken along the walls/ columns etc. duly clamped to their surface by saddles. If walls etc. are not available, tray be used to support the refrigerant pipes. Where bending of 18 SWG refrigerant pipes is required, proper pipe bending tool should be used to avoid pinching of pipes.
- iv) The refrigerant pipes should be properly insulated as per the recommendations of the manufacturer of split type AC units.

11 AIR-COOLED VARIABLE REFRIGERANT FLOW (VRF) SYSTEM

Please refer to Chapter 4 “PACKAGED TYPE AIR CONDITIONING PLANTS AND VARIBALE REFRIGERANT FLOW/ VOLUME SYSTEMS” of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

12 PRECISION AIR CONDITIONING UNIT (PAC) YSTEM

SCOPE OF WORK

The Scope of Work covers the supply, installation, commissioning and warranty of Precision Air conditioner (herein referred to as "product") and services provided for the same.

23. GENERAL

The AC Units should have high sensible heat ratios, to match high sensible loads of Computer/Server Rooms/ Switch room/UPS. A Microprocessor controlled Precision package AC system with R-410a.

The Indoor unit shall be of dual fluid type comprising of Variable capacity Digital/Inverter/Combination of fixed & variable Scroll Compressor, corrosion resistant composite material EC fans, Evaporator DX + Chilled water Cooling Coil with hydrophilic coating, Microprocessor controllers, Thermostatic Expansion valves, Driers, G4 Filter, Suction and Discharge piping, Internal power and Control wiring, Crankcase heaters, Infrared/Electrode Humidifier, Heaters, HP/LP Cutouts, Power and Control contactors and Other Electrical accessories.

24. THE AIR-COOLED PRECISION PACKAGE UNIT SHALL BE DESIGNED AS PER THE FOLLOWING CONDITIONS.

1. Gross Sensible Capacity : As per requirements
2. Air Flow Direction : Bottom/Top discharge (As per requirements)
3. Air inlet Temp & RH : Set point $\pm 1^{\circ}\text{C}$ (DB) & Set point $\pm 5\%$ (Return Air)
4. The units shall control logic that enables:
 - compressor/valve modulation thru supply air temperature sensor installed in false floor
 - fan speed modulation thru remote rack temperature sensors
 - humidity control thru return air sensors

-
5. The Units shall be designed for 75 dBA at 1.5 meter from the unit outlet quiet operation with all moving parts mounted on anti-vibration mounting and carefully balanced to ensure minimum vibration.
 6. If required, the unit shall be tested at site for performance. The performance test shall be a heat load test using heater & data loggers supplied by the Precision unit supplier.
 7. Its mandatory to submit software selection output of the proposed unit. The specific power consumption and other performance details shall be as per selection sheets.

25. THE TECHNICAL SPECIFICATIONS OF THE CONSTRUCTION OF UNIT ARE AS UNDER:

12.1 Design Requirements

The environmental control system shall be Factory assembled unit. It shall be floor mounted, optimized for maximum cooling capacity in a minimum footprint. It shall be specifically designed for service from the front of the unit. The system shall be designed for draw-through air arrangement to insure even air distribution to the entire face area of the coil. The unit shall modulate cooling capacity and airflow based on requirements.

The unit shall be ready to allow the installation of shackles for top handling. Forklift handling should be possible as well.

12.2 Quality Assurance

The specified system shall be factory end of line tested (functionality test) before shipment and designed to meet CE requirements. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

12.3 Cabinet

The cabinet shall be manufactured from galvanized steel sheet, externally painted with RAL7021 colour epoxy-polyester powder paint and assembled using stainless steel screws and high tensile rivets.

The Side and rear section panels shall be double-skinned, with Class 'O' (A1 EU) fireproof insulation sandwiched between the skins to reduce noise emission and heat loss. The frontal panel(s) are assembled on hinges to make the access easier; this can be opened by the fast closing lock.

The rear and side panels are screwed to the supports. The rear panel(s) are screwed directly to the frame.

12.4 Compressor

The compressor shall be of the high efficiency Digital/Inverter Scroll design, with an

E.E.R. (energy efficiency ratio) of not less than 11.1 BTUH/watt (C.O.P. of not less than 3.25) at ARI rating conditions. The compressor shall be charged with oil and designed for operation on 410A Refrigerant.

Each unit should be equipped with minimum one Digital/Inverter Scroll compressors. Each compressor shall have internal motor protection and be mounted on vibration isolators

12.5 Cooling circuits

One (Two) refrigeration circuit(s), (each) incorporating one (two) high efficiency, fully hermetic Digital Scroll/Inverter Scroll compressor/s, combination of Fixed and Variable scroll (for higher capacities) with crankcase heater, air-cooled condenser, safety valve, filter drier, moisture indicating sight glass, liquid line solenoid valve and an electronic/thermostatic expansion valve directly controlled by the unit microprocessor to allow the highest energy saving. Only fixed capacity compressors with no stepless modulation shall not be allowed.

Each circuit is equipped with pre-set high-pressure switch and low-pressure transducer for protection against high condensing and low evaporating temperatures. The low- pressure transducer is managed by microprocessor controller, whilst to avoid compressor cycling at high discharge pressures, the high-pressure switch is equipped with a manual reset.

The unit shall house DX and Chilled water inclined evaporator coil shall be manufactured from copper tubes, mechanically bonded to hydrophilic painted aluminium fins, with a stainless-steel condensate drain pan with insulation. The coil shall be designed for a large face area-low velocity that facilitates precise control of temperature and humidity during cooling and dehumidification & optimizes fluid velocity and minimize pressure drop.

For units with multiple circuits, the evaporator shall be staged coil to allow a maximum efficiency on partial loads.

The moisture indicating sight glass and liquid line solenoid valve for each circuit mounted shall be visible from a service window, immediately accessible once open the frontal door/s, to allow checking and adjustment while the unit is in operation.

12.6 Fan section

The unit shall be fitted with one (two, three as per airflow requirement) direct-driven, high efficiency, single inlet, backward curved, centrifugal 'plug' type innovating EC fan(s).

The fan motors are Electronically Commutated, IP54, with internal protections, continuous speed regulation via controller signal. The motor is three-phase with IP54 protection; provided with internal thermal protection.

The fan wheel is statically and dynamically balanced; the bearings are self-lubricating.

For units with multiple fans, there shall be an "S" shape separator design to eliminate turbulence effects of one fan to the others; it shall be also designed to increase efficiency compared to simple plate separator.

Fan(s) removal(s) shall be made faster using the buttonhole specifically designed and tested to allow 10 cm increasing height during the operation.

12.7 Humidifier

The humidification system is provided by an electronic control humidifier. The dehumidification function, which is supplied as standard when the humidifier option is installed, acts by reducing the fan speed with consequent reduction of the air flow and at the same time operating the variable capacity compressors at full capacity

Humidification control may be of the proportional or of the on-off type, according to the requirements of the installation: on/off is set as standard. Any amongst the following two may be used for Humidification:

1. Infrared Humidifier

The unit fitted with an infrared humidifier should be suitable for use with water of varying degrees of hardness.

The humidifier is complete with a water inlet valve, and a maximum water level sensor; the humidifier includes

high-intensity quartz lamps shine on water creating instantaneous moisture using almost any water quality. The cleanable stainless steel humidifier pan is removable from front of the unit

2. Electrode Humidifier

The unit fitted with an electrode boiler should be suitable for use with water of varying degrees of hardness, provided that the water is not treated or demineralized (Conductivity range 125-1250 $\mu\text{S/cm}$). The humidifier is complete with a water inlet valve, water outlet pump and a maximum water level sensor. If the humidifier requires a specific quality of water, same shall be arranged by the bidder at no additional cost. Steam from the cylinder to be mixed with the discharge air from the evaporating coil by means of a copper steam distributor.

The unit controller to monitor the condition of the steam cylinder and generates an alarm when the cylinder needs to be changed. Cylinder replacement should be easy and quick.

The humidifier should be complete with a self-adapting flow control system, which monitors and controls the electrical current passing through the cylinder. Output adjustment is from 30-100% via the unit controller.

Ultrasonic Humidifier -Specification shall be as per the specified in AHU section.

12.8 Heating / reheating

The heating resistors should follow rigid design for extended operational life and to be normally utilised to maintain room dry-bulb conditions during a system call for dehumidification. Each heating element of heaters is made of finned armoured stainless steel AISI 304 to maintain a low surfaces power density. Ionization effects are eliminated owing to the low heater surface temperature.

Heating control shall be of the ON-OFF type. The heaters should be phase balanced and provided with a manual reset safety thermostat to disable them in the event of a high temperature.

The heating system should also incorporate Miniature Circuit Breaker(s) which protects the heater(s) from short circuits, should the harness be damaged accidentally.

12.9 Air filtration

The filter chamber shall be an integral part of the system and withdraw able from the front of the unit. Filtration shall be provided by dry media disposable filters capable of filtering air to 95% down to 5 micron efficiency and shall be replaceable from the top of

the unit. Filtration shall be provided by deep V form G4 performance dry disposable media to ASI324.

12.10 Remote Air Cooled Condenser

The factory matched air-cooled condensers shall be the low profile, weatherproof type incorporating high efficiency, direct drive, external rotor motors with axial blade fans along with the fan speed controller. The condenser shall be constructed from heavy duty GI and corrosion resistant components. Heavy duty mounting legs and all assembly hardware shall be included. Condensers shall be suitable for 24-hour operation and be capable of providing vertical or horizontal discharge. The condenser shall be fully factory wired to an input isolator and require 230-volt 1 phase 50Hz electrical service.

The high-performance heat exchanger condenser shall include mechanically expanded enhanced surface copper tubes and aluminium fins for efficient heat transfer.

12.11 Monitoring

The unit shall be supplied with card suitable for both SNMP & ModBus connectivity.

The unit shall also include input for remote on-off and volt-free contacts for simple remote monitoring of low and high priority alarms: high/low temperature, fan/control failure, and others are available.

12.12 Electrical panel

The electrical panel, located at the front of the unit in a compartment isolated from the airflow, contains the MCB's, contactors, transformers, controller PCB, overload relays etc. Each high voltage system component is provided with an MCB over-current protective device. All high voltage components are touch protected by means of a plastic cover. The electrical panel complies with the IEC norm en60204-1.

Electrical power supply is 400V ($\pm 10\%$) / 3Ph / 50Hz ($\pm 2\text{Hz}$) +N +E and are fitted with a mains isolator, mechanically interlocked with the electrical panel cover.

12.13 Microprocessor controller

The Control System is P/PI/PID microprocessor based. It can be programmed to control the function of every device within the unit via I/O.

The controller allows setting and monitoring of the following room parameters via a 3 button keypad:

-
- Air Temperature
 - Temperature set-point
 - Temperature band
 - Humidity
 - Humidity set-point
 - Humidity band

The parameters are indicated using symbols and text on a back-lit, 3 digits Liquid Crystal Display. Cooling and heating modes are also indicated on the LCD screen. Alarm conditions activate a visual indicator. Three LED's indicate the unit status – 'Power on' (Yellow), 'Unit on' (Green) and 'Warning/Alarm activated' (Red)

The controller shall provide **Unit to Unit Ethernet connection** to operate with multiple units, run/stand-by rotation, automatic changeover and parameter sharing functions, external communications through BMS, sequential auto restart timer, with adjustable time delays to be applied to unit restart after a power loss.

The following warnings / alarms are included:

- High temperature
- Low temperature
- High relative humidity
- Low relative humidity
- Humidifier failure
- Fan failure
- Electrical heater high temperature (When applicable)
- Sensor failure
- Controller errors

Terminals are provided for remote start/stop control plus Volt-free 'Common Alarm' and 'Unit Run' indication

The display shall provide with track recorded of temperature and humidity with graphically display on the screen.

A buzzer provides audible indication of a 'Warning' or 'Alarm' condition

Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm Unit memory shall hold the 400 most recent events with id number, time and date stamp for each event

Menu shall display accumulative component operating hours for major components including compressors, fan motor, humidifier and reheat.

The controller shall facilitate auto sequencing of units in the given zone, team mode operation, master- slave configuration, auto changeover of master unit in a event of master unit failure, cascade operations 7 lead-lag operation.

26. SAFETY INTERLOCKS:

Operation of heaters & humidifiers shall be possible only when blower fan is in operation. Fire detection signal from fire detector system shall be able to switch off the package unit operation in event of fire in conditioned space.

27. REFRIGERANT PIPING:

Each refrigerant circuit shall be suitable for operation on R410a and shall include the following items:

Expansion valve with pressure equalization;

Removable liquid line drier / filter.

Liquid line sight glass with moisture indicator. Hand shut off valves.

28. ELECTRICAL WORK

Each Precision AC unit should be provided with in-built electrical panel. Necessary 415 Volts +/- 10%, 3 Phase, 4 Wire (With Neutral), 50 Hz +/- 5% Power shall be provided by Customer at each unit's electrical panel. Balance distribution of Power is in the Scope of Bidder. All Electrical cabling should be of armored Copper.

29. VIBRATION ISOLATORS:

The PAC units shall be provided with ribbed rubber pad vibration isolators.

30. **PAINTING:**

PAC - units shall be factory finished with durable alkyd spray enamel. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

31. PERFORMANCE RATING:

The unit shall be selected for the lowest operating noise level (75 dBA at 1.5m). Capacity rating and power consumption with operating points clearly indicated shall be submitted and same shall be verified at the time of testing and commissioning of the installation. For site verification of working of humidification / dehumidification systems, set point RH shall be changed below / above (respectively) actual RH. Similar procedure shall be adopted for temperature control system. Test report shall indicated selected set point for RH and temperature and achieved values of these process variables after humidification / dehumidification cycles are activated.

13 PIPING WORKS:

Please refer to Chapter 10 "WATER PLUMBING WORK" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

32. VALVES

MOTORIZED BUTTERFLY VALVES

These valves shall be made of cast iron body, seat of black Nitrile rubber (tight shut- off), nylon coated SS disc, PTFE coated SS (AISI 410) shaft, complete with companion flanges, nuts, bolts, gaskets etc. as required. These valves shall conform to IS, and shall be designed to fit without gaskets between mating flanges. The valves shall be suitable for flow in either direction and seal in both directions. The valves shall be of integral moulded design. Actuator shall have potential free contacts for status monitoring. The valves shall be complete with (Push Button for ON/OFF arrangement & ON /OFF valve indications) companion flanges, nuts, bolts, gaskets etc. The actuator shall be IP55 rating capable of accepting upto 10V DC Necessary step down transformer shall be included considering single phase 230 V AC supply and upto 20mA electric signal and providing similar transduced feedback output to control system as required. These valves shall have wheel for manual operation also.

PRESSURE INDEPENDENT BALANCING CUM CONTROL VALVES

2Way Pressure Independent Balancing Cum Control Valve with Integrated in a single Body with Globe Type in Construction.

Control – Valve should be equipped with electronic modulating actuator which can accept either 4(0)-20 mA / 2(0)-10V DC signals. Operating voltage for actuator shall be 24 V AC or 10V DC. Delta p controller should ensure 100% valve authority at all

loads (part load Actuator shall be able to work against maximum closing pressure of 6 Bar at full load) with feedback signal to Control system. The necessary stepdown transformer shall be included considering single phase 230 V AC supply.

Balancing – Each Valve should have steeples adjustable maximum flow limitation as per the designed flow rate of coils. Balancing should be done only in Valve not in actuator so that at any given condition of failure balancing is not lost and easily accessible.

All Valve actuators shall be microprocessor based with self-calibrating features. The actuator shall be BMS compatible for command and feedback

Valve should be of linear control characteristics with stepless characteristics. Valve

specifications

Table : 12.1

Description	For 15 to 32mm	For 40 to 150mm
Diff Pressure (P1-P3)	16 To 400 kPa	35 To 600 kPa
Media Temperature	+1 to 110 ⁰ C	-10 ⁰ to 120 ⁰ C
Body Material	Brass	Grey iron / Ductile iron
Test Ports	Needle measuring nipple	Needle measuring nipple
Shutoff Leakage	Max. 0.05% of Kvs	Max. 0.05% of Kvs
Stem Seals	EPDM	EPDM
Maximum Close Off Pr	As per OEM	As per OEM
Pressure rating	PN16 or above	PN 16 or above

Actuator specifications for all sizes

Supply Voltage: 230 V AC for on/ off type actuator and 24V for modulating actuator Max. Power

Consumption: 10W or 12VA

Frequency : 50HZ

Control Input:	2-10V DC, 4-20mA, 3-point Selection
Position Output:	2-10V DC 4-20mA

Valve Body and Characteristics

- i) Pressure Controller Device should maintain the Pressure, irrespective of fluctuations in the system with the help of a self-adjusting diaphragm.
- ii) Control valve shall accurately control the flow, with help of Modulating Actuator.
- iii) All Valve Sizes should have Testing Ports for verifying the flow with respect to the Differential Pressure.

Valve Actuator and Housing:

- i) Control/Dip Switch Setting should be easy to access for doing the balancing at site.
- ii) The valve should be mounted with the actuator above the valve to prevent condensation water leaking into the actuator.

Valve Flow Balancing:

- i) Balancing & Control: Balancing should be accomplished by the Diaphragm and Control should be taken care by Actuator receiving signals from Room Thermostats or BMS.
- ii) Manual Override facility shall be provided to either open or close the valve.
- iii) Flow Setting Balancing (Commissioning) for the Valves should be simple and not require measuring devices.
- iv) Proper operation of the valve should not be dependent on additional operations like de-airing of the valve or flushing procedures.

THREE WAY MIXING VALVE

3-way modulating Valve with Integrated in a single Body with Globe Type in Construction.

The valve shall be complete with globe type 3-way mixing valve, suitable valve linkages, modulating motor, proportionate thermostats suitable for proportionate operation etc. The valve should be suitable for operation on the signal received from proportionate Thermostat located in AHU room.

Table : 12.2

Sr.No	Valve Tag No.	AHU	
1	Valve Body	G.M. / C.I. / BRASS	
2	End	Up to 50 mm - Screwed And 65 mm & Above -Flanged	

Sr.No	Valve Tag No.	AHU	
3	Stem Material	Stainless Steel, Grade to be indicated	
4	Seal Material	EPDM	
5	Linkages	-----Required -----	
6	Valve Position indicator	-----Required -----	
7	Hot water Flow rate (gpm)	NA	
8	Hot water Line Size mm dia	NA	
9	Hot water pr.drop across coil	NA	
10	3-Way valve Size mm dia	As per requirements	
11	Valve Characteristic	-----Linear----	
12	Quantity	As per requirements	
13	Fluid	As per requirements	
14	Actuator	Modulating Motor suitable for proportionate operation required	
15	Proportionate Thermostats	-----Required -----	
16	Electric Supply available	24 VAC / 1ph / 50 Hz AC Supply	
17	Pressure rating	PN16	

BALL VALVES AND BUTTERFLY VALVES:

- i) For room side:
 - a) Ball valve shall be of minimum PN 16.
 - b) Ball Valves below 40mm dia shall be lever operated bronze forged body, chrome plated bronze ball. The shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete with FTA ends for connection.
 - c) Necessary insulation shall be provided to avoid condensation

ii) For Air vent & drain

a) Wherever necessary & required to complete the function, air vent shall be installed at the highest position in the piping. The location where anticipated to form air lock in the piping routine, necessary auto air vent shall be provided.

b) If the position of air vent is within false ceiling, Auto Air Vent should be installed. The information about the AAV should be marked by the CONTRACTOR on AS BUILT layout.

c) CONTRACTOR should carefully make Engineer In Charge/Client aware while conducting onsite testing & commission so that the special care should be taken to avoid water spillage & damage of other property.

d) Air vents shall be of brass construction and of automatic type. Similarly drain valves shall be provided at all dirty legs. The size of the valves shall be 25 mm size for pipes upto 150 mm. Drain shall be closed with dummy caps to prevent accidental opening.

Ball and butterfly valves conforming to the following specifications shall be provided as shown on Drawings:

Table : 12.3

Size	Construction	Ends	Type
15 to 40 mm	Brass ASTM B62	Screwed	Ball
50 mm and over	Body Cast iron	Wafer	Butterfly

Type and requirements shall be as indicated in Schedule of Quantities. Valves shall have non-rising spindles unless specified otherwise and shall be suitable for PN16 rating as indicated in the schedule of quantities

FLANGES

These flanges shall be of approved make. The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of bolts, washers, nuts and suitable asbestos fibre / rubber insertion gaskets (minimum 3 mm thick).

33. AIR SEPARATOR

Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall inlet and outlet connections tangential to the vessel shell. The unit shall have an internal stainless steel collector tube with 5/32" (4mm) diameter perforations and 63% open area designed to direct accumulated air to the compression tank on an air control system or an air vent on an air elimination via an NPT vent connection at top of the unit.

A blowdown connection shall be provided to facilitate routine cleaning of the separator. Manufacturer furnishes data sheet specifying air collection efficiency and pressure drop at rated flow.

Vessel shell diameter is to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction. The air separator must be designed, constructed and stamped for 125 psig@350°F(862 kPa @177°C) in accordance with section VIII, division I of the ASME Boiler and pressure vessel inspectors or as per OEM standard. The air separator(s) shall be painted with one shop coat of light gray air-dry enamel.

A manufacturer's data report for pressure vessels, Form U-1 as required by the provisions of the ASME boiler and pressure vessel code, shall be furnished for each air separator.

34. EXPANSION BELLOWS:

- i. The Expansion Bellows 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. The Bellow shall work for a temperature range of minus 10°C to 70°C.
- ii. The length and working pressure of bellows shall be as follows:

Table: 12.4

Nominal Bore (mm)	Length (mm)	Pressure Rating
Upto 200	150	PN16
above 200	200	PN16

-
- iii. Bellows shall be provided with control rods to control the excessive elongation or compression of piping systems.
 - iv. It shall have torsional movement upto 3° without damage.
 - v. Bellows shall be single arch.

35. DRAIN PIPING:

- i. All pipes to be used for drain from AHU and FCU drains pans and Chilled water pump glands, drain and fittings shall be CPVC pipe (6 Kg /cm² pressure).
- ii. All pipes supports shall be mild steel, thoroughly cleaned and given one primary coat of red oxide paint before being installed.
- iii. Fittings shall be same material of pipe and pressure rating suitable for the piping system. Tee-off connection shall be through equal or reducing tees. Fittings shall form part of piping and are not separately identified in Schedule of Quantities.
- iv. For proper drainage of AHU and FCU Condensate, 'U' trap shall be provided in the drain piping.
- v. All condensate drain piping shall be insulated and painted as per the section "Insulation".

36. GROOVED MECHANICAL COUPLINGS:

Grooved Mechanical Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard Victaulic. Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.

37. AIR VENTING

Air valve shall be provided at the summit of piping system for air venting. Needle valve for 10mm air vent and ball valve for 15mm air vent of same size as air valves shall be incorporated. All such valves will be measured & paid.

38. PRESSURE GAUGES

- Pressure gauges shall be of bourdon type with stainless steel construction of 150mm dia. and of range (0-10 bar) / (0-150 psi) as required and be complete with brass valves (3/8" Dia.) and SS tubing duly calibrated before installations
- It shall be weather proof with an IP 55 enclosure
- Pressure gauges shall have snubbers to suppress the effect of pressure pulses and pressure peaks for high fluctuating applications like pump discharge applications etc.

39. THERMOMETER:

Direct reading 255 mm long industrial mercury filled thermometers shall be provided at the inlet and outlet of all heat ex-changers to read water entering and leaving temperature.

Thermometers shall be of stainless-steel construction with dial of 150mm dia and range up to 50°C, with 0.5°C least count and shall be calibrated before installation.

The thermometers shall be installed in separate brass oil wells of 1/2" size with a stem of minimum 3/4th of pipe. Thermometers for insulated piping shall be installed in extended neck to avoid damage or deformation of the insulation.

14 DUCTING :

Please refer to Chapter 9 "DUCTING" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

Spiral Duct :

Table 8 Thickness of Sheet for Circular Spiral Galvanized Steel Sheet Duct
(Clause 6.2.3)

Classification of Duct by Pressure (1)	Low Pressure Duct (2)	Medium Pressure Duct and High Pressure Duct (3)	Thickness of Sheet, <i>Min</i> mm (4)
Internal diameter of duct (<i>d</i>), mm	$d \leq 450$	$d \leq 200$	0.5
	$450 < d \leq 710$	$200 < d \leq 560$	0.6
	$710 < d \leq 1\ 000$	$560 < d \leq 1\ 000$	0.8
	$1\ 000 < d$	$800 < d \leq 1\ 000$	1.0
	—	$1\ 000 < d$	1.2

14.1 DUCT SUPPORTS & HANGERS

- i) Rectangular duct shall be supported from ceiling using trapeze hangers. Ducts shall rest on supporting angle or channel and this supporting angle or channel shall be supported by CS rods or angles or channels on both sides of ducts with weld or bolts. All the supports shall be coated with 2 layers of epoxy of 80DFT each layer.
- i. Supporting details for low-pressure system shall be as given below.
- ii. Zinc coated anchor fasteners or embedded plates shall be provided for upper attachments to the building. Anchor fasteners shall be provided by contractor. Embedded plates shall be provided by contractor. Contractor shall provide duct supports from angle cleats welded to the embedded plates. Anchor fasteners shall be loaded to maximum 20% of the maximum rated capacity specified by the manufacturer. Site Engineer IN Charge shall approve all anchor fasteners used for supporting duct.
- iii. In case of insulated duct, anchor fasteners shall be selected based on actual total load.

14.2 FABRICATION STANDARDS & EQUIPMENT

Ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

- i) Coil (Sheet metal in Roll Form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.
- ii) All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.
- iii) All edges to be machine treated using lock formers, flangers and rollers for turning up edges.

14.3 FIRE & SMOKE DAMPERS:

- i) All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with fire dampers of at least 90 min. CBRI tested as per UL 555S Standards. These shall be multi leaf dampers.
- ii) Fire dampers blades and outer frames shall be of 16SWG GSS construction. The damper blades shall be provided on both ends using chrome plated spindles in self- lubricated bronze bushes. Stop shall be provided on top and bottom of damper

housing made of 16SWG GSS. For preventing smoke leakage, side metallic compression seals shall be provided.

- iii) Fire damper shall be provided with factory fitted sleeves. Access doors shall be provided within the duct in accordance with the manufacturer's recommendation.
- iv) Fire isolating dampers complete with outer frame, damper blades, motorized or fusible link actuator, linkages and sleeves, shall be installed in all locations as may be required by the relevant Authorities. In particulars, fire dampers shall be installed in ducts where they pass through compartmentation walls, fire walls and concrete floors except in the case where the duct itself is in a fire isolated shaft.
- v) Inspection door shall be provided for fire dampers. All fire dampers shall be complete with factory fabricated and fitted duct sleeve. The joints at the sleeve end shall be slip on type.
- vi) The fire damper shall be installed in the duct in such a manner that vibration and rattling does not occur due to the passage of air.
- vii) Fire dampers shall be motorized smoke & fire dampers type. 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.
- viii) 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.
- ix) The actuator shall be of 24V AC, 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. The power point with an isolator near the fire damper will be provided by other agencies.

40. FIRE RATED DUCTWORK

All the duct work for Smoke extraction system shall be provide with high-build Fire Retardant Coating for outside surface of the duct. The optimum thickness shall be achieved for fire paint for attaining a Fire Rating minimum of 2 hours.

Same shall be tested at CBRI Roorkee to properties as per the requirements of BS 476: 6 & 7, including non-combustibility Class 0 and fire propagation Class 1 surface spread of flame & materials in accordance with Building Regulations.

41. METHODOLOGY-

- Fire rated painting is to be done at enclosed, dry and properly ventilated space.
 - First the factory / site fabricated duct piece shall be kept on the ground. The flange of the duct shall be ready with holes for nut bolting .
 - Duct shall be properly cleaned before start of the painting work to ensure no oil, dust , water & Rust to the surface.
 - Apply Two coats of Fire-retardant solvent based base coat with minimum 250- micron layer per coat , in regular 4-6 hour Interval by Roller Brush/ Air less spray method without thinning of solvent.
- Let the base coat dry for min -6-8 Hours for normal shiny day.
 - Then Apply 2-3 coats of fire-resistant water based Top coat in approximately 6-8 hours interval (depend upon weather conditions) As coat thickness shall be sufficient to achieve desired fire rating.
 - Duct supports including nut bolt , washers also shall be cleaned and applied with fire paint as described above.
 - First the supports shall be installed in place as per approved ducting layout followed by installation of fire painted ducts.
 - Fire rated ducts shall be joined with fire rated nut bolts and fire rated gasket in between two pieces.
 - After installation of duct work assembly in-place , if required final touch up of fire paint shall be applied where ever necessary .
 - Entire duct assembly including supports shall be rated to withstand 250 deg C temperature for 2 hours.

14.4 DAMPERS & SPLITTERS

Dampers shall be provided in the duct work for proper control and balancing of air distribution.

Dampers shall have easily accessible operating mechanism of opposed blade type. The operating mechanism shall consist of links, levers and quadrants as required for proper control and setting in a desired position. The position of the handle of Damper operating mechanism shall be clearly visible and it shall indicate the position of the damper in duct. Dampers, splitters and their operating mechanism shall be fabricated of GS sheets of 16 SWG and shall be easily accessible through suitable access doors in the ducts.

Dampers shall be installed in duct at all required locations such as chutes, branches etc.

14.5 LOUVERS

Louvers complete with bird screen etc., shall be measured from the approved drawings

/ as built drawing on the basis of core area (excluding margin flanges) and paid per unit area. Louvers in supply and exhaust fan units are part of fan units and no separate payment will be made for the same. The louvers shall be made of extruded aluminium power coated, min. 2mm thick frame & min. 1.5mm thick fins within it.

- i) Any supports, nuts, bolts, anchors, fasteners, gasket, tools, gadgets etc. required for successful operation and acceptance shall be provided at no extra cost to the owner.
- 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.

14.6 APPARATUS AND EQUIPMENT CONNECTIONS

Equipment such as air handling units shall be connected to the duct by means of double canvas sleeve of 15 ounce, woven asbestos cloth connection of at least 150mm long.

Duct sleeves made of 20 SWG thick galvanized sheet shall be used for ducts passing through load bearing walls or partitions. Sleeves shall provide 25 mm clearance all around as per duct or insulated duct. The space between sleeve and duct shall be packed with twisted asbestos.

All the sheet metal plenums required to confine the flow of air through filters and fans, shall be fabricated out of 18 SWG galvanized sheet steel, and suitably braced as required. Suitable access doors shall be provided for plenums.

14.7 JET NOZZLE

Jet nozzles shall be suitable for installation on circular ducts. The discharge nozzle and face cover ring shall be made of aluminium, the mounting plate for the eyeball is aluminium or sheet steel, The duct connection element and duct connection pieces shall be of galvanised sheet steel. Jet nozzle, cover ring, eyeball, mounting plates shall be finish powder coated, resistant to saturate environment for minimum 100 hours without deterioration. Jet nozzle shall be available with rear mounted perforated sheet steel plate for flow rate control.

Jet nozzles shall be suitable for long throw distances with optimum acoustic properties, preferably used for cooling in critical areas. Jet nozzles shall provide the adjustment facility manual or automatic using an electric actuator which allows variation in discharge angle to compensate for changing temperature differences, adjustment angular range 30° upwards to 30° downwards.

Jet nozzle shall be selected for minimum pressure drop and sound level not exceeding 35NC, contractor shall submit the selection curves of product ratings from the manufacturer.

14.8 OZONE GENERATORS SCOPE

The scope of this section comprises the supply and installation of duct mounted Ozone Generator in STP exhaust ductwork for control of organic odor confirming to these specifications

42. GENRAL REQUIREMENTS.

Ozone Generators shall be provided with the primary aim of achieving reduction in Volatile Organic Compounds (VOC), hydrocarbon gases, and organic odours, in Indoor / outdoor environment. The aim is to ensure pure and odourless air where ozone concentration shall be kept below the TLV (Threshold Limit Value) for occupied areas, as recommended by OSHA and or ACGIH.

Ozone Generators shall be provided where called for, with a number of corona discharge plates as listed in the schedules. Ozone Generators shall be compact, self- contained units, with all components factory mounted in one neat, compact package.

Parts of the generators in contact with air stream shall be kept to as minimum as required.

Components in contact with air stream shall be enclosed in stainless steel casing 18 G thick, with sufficient stamped integral openings to allow adequate flow of air over the corona discharge plates. The generator plates shall be mounted on generator head fabricated out of materials that repel accumulation and formation of sediments by tar, nicotine and grease. This is an extremely important prerequisite to enhance the operational reliability and ease of maintenance of the generator plates.

The generators shall be suitable for mounting on ducts with air flow in horizontal, vertical or angular directions. The generators shall operate effectively with air flow in either direction, that is left to right or vice versa in horizontal ducts, and top to bottom or vice versa in vertical ducts.

The generators shall be suitable for mounting inside the ducts. It shall be provided with flange suitable for mounting on a metal frame, to be installed inside the duct. Openings in the ducts shall be made with sheet metal shears or cutters. Metal saw or grinding machine shall not be used, except to make an initial cut to permit use of metal shear. This precaution is taken to prevent metal debris from falling into the ducts.

Air filter (efficiency 80%) shall be provided in the duct to prevent particulate in the air stream from reaching the ozone generator.

Generation of ozone shall be only by principles of corona discharge. Multiple numbers of corona discharge plates shall be used to provide the necessary quantity of ozone. All the corona discharge plates shall be housed in one common stainless steel enclosure. Only multiple plate type corona surfaces shall be used for ozone generation. Production density of ozone per sq inch (or sq cm) of surface area of corona surface shall be as low as possible. Rate of variation of production of ozone shall follow approximately the rate of variation of fouling smell in the air flow.

Ozone shall be detected in the same gaseous stream, and ozone production shall be in this stream. To ensure this, ozone generator shall be duct mounted type. Ozone generators shall not require any consumable for its operation, except for use of electricity.

The system shall not rely on initial or replacement of filters of any sort to remove odours and chemicals. The ozone generators shall be capable of operating on 220 to 240 Volts, single phase power supply, 50 Hz. They shall be properly grounded.

Ease of maintenance is important consideration. They shall be manufactured to permit easy withdrawals and refitting on the ducts, with minimum use of tools of hardware to remove or refit the generators to the ducts.

43. OZONE CONCENTRATION SENSOR, MONITOR AND CUTOFF SWITCH

Ozone concentration monitor cum sensor shall be provided to monitor ozone concentration. The monitor shall be installed in a side stream duct and not in the main duct. This is to ensure the sensor element is not exposed to high velocity of air found typically in all HVAC ducts. This ensures accuracy of sensor readings, and prolongs life of the sensor element. Lowest detection of the monitor shall be down to 20 PPB

(v) or 0.02 PPM (v).

Visual display shall be provided on the outer case of the Monitor. This shall comprise series of at least 10 pilot indicating lights, 4 green, 3 yellow and 3 red. When illuminated, they indicate the concentration of ozone in the following order.

First green: Always On. Indicates power is ON. Next 3 green lights: Concentration of 20, 30 and 40 PPB respectively. Three yellow lights: Concentration of 50, 70 and 80 PPB respectively. First red light: 100 PPB (Maximum specified by OSHA). Second and third red lights: 120 and 140 PPB respectively.

The sensor, monitor and all components shall be mounted in one neat and compact case, suitable for wall mounting. The indicating lights shall be mounted on the cover of the case. All components shall be factory mounted.

The monitor shall have electrical leads to provide an open contact. In the event concentration of ozone reaches the set alarm value, 'Normally Close' changes to 'Normally Open' position. This will be used to electrically cut out the ozone generator, when concentration reaches the set value.

Additionally, it shall also have an audible alarm, which is activated if the concentration reaches the set level. Switch shall be provided on the case of the monitor, to turn off the alarm, at the option of the user. The alarm shall be factory set at 50 PPB. However, it shall be possible to change this setting in the field to any desired level.

The monitor shall provide a linear 0 to 2 Volts DC output voltage, proportional to concentration of ozone. This will be interfaced with the BMS to record continuously concentration in PPB or PPM, and also to produce hard copy printouts. This will also enable shutting down the ozone generators through the BMS, if the set high level is reached.

The monitor shall be capable of interfacing with BMS. Necessary transponders to enable this will be provided by others. It shall also be possible to set the high ozone cut out level through the BMS, and to shut down the ozone generators through BMS, in the event the set alarm is reached.

The monitor shall be suitable for continuous operation. Input power source is 24 volts, DC, provided. Suitable adaptor for this shall be provided with the Monitor.

44. VARIABLE LOAD CONTROLLER

Controller shall be solid state, mounted in rugged stainless steel enclosure. It shall be fully factory assembled. Field provided connections shall be limited to power wiring. The Controller shall be suitable for accepting signals from the Sensor. Based on the signals received, it shall provide variable output to operate ozonator.

Input voltage to controller shall be 120 Volts, 1 Ph, 60 Hz or 220 to 240 Volts, 1 Ph, 50 Hz (Factory set). It shall be suitable for load rating of 10 Amps.

Controller shall be provided with terminal block to connect incoming power, variable outgoing power, and for interlock to blower motor and to safety device such as high ozone cut out switch. The Controller shall be provided with receptacle to accept easy plug in cable connector, for communication to Sensor. Controller shall be provided with 3 Lamps to indicate Power On Automatic, Manual Bypass.

Controller shall be provided with rocker switch to choose Automatic or Manual Mode of operation. In the Manual Bypass Mode, voltage output of the Controller shall be 100% of input voltage, regardless of the level of VOC.

Cable connector between Controller and Sensor, length not less than 7.5 M (25ft) shall be factory provided (specify length if longer than 25 feet is required). This shall be complete with cables to provide power to Sensor and transfer signals for the different levels of VOC from Sensor to Controller.

45. UVGI (ULTRAVIOLET GERMICIDAL IRRADIATION) SYSTEM FOR DUCT

A) General:

The UVGI System shall be provided with the primary objective of killing bacteria and virus such as corona virus from the conditioned air supplied to the spaces.

B) Selection Criteria :

- a) UVGI System is designed to achieve Kill Rate not less than, 3000 $\mu\text{wsec}/\text{cm}^2$ to achieve kill rate at least 99.0% (Log 2) of Corona virus and suitable for installation in any duct size.
- b) The design intensity of the Lamp shall be based on wavelength 254 nm. Lamp shall not perform at wavelength 180 nm or lower, to prevent release of uncontrolled and unmodulated ozone.
- c) The Lamps shall be high output type 800 mA minimum each to provide Rated Average Life of 16,000 Hrs. Lower intensity Lamp is not acceptable.

-
- d) The face velocity of dehumidified air over the duct will not be more than 9.15m/s (1800 FPM).
 - e) Length of each lamp used in the germicidal system shall be adequately long to cover 90% or more of the duct width. . Note - As long as delivered doses are as per requirement & space availability in AHU room, these lamps can be placed in Air flow direction
 - f) The System shall be suitable for operation in air flow temperature of 2°C to 60°C & RH 0 to 100% condensing or non-condensing, and with water droplets due to carry over moisture from Cooling Coil.
 - g) Selection criteria of UV lamps to achieve the delivery of designed intensity of Kill Rate based on duct width, height, air velocity on UVGI, length of Contact Ducts, and Lamp Energy intensity. Individual Selection shall be provided for each unit based on above parameters for approval of Engineer In charge.
 - h) An undertaking from manufacturer regarding rectification/replacement of UV Lamps during effective life as specified by manufacturer shall be provided by successful tenderer.
 - i) The UVGI Equipment shall be listed to UL 1995 and certified for Smoke and Fire Safety to UL 2043.

C) Specifications

: General :

- a) The UVGI system shall be suitable to operate with 220-240 V, single phase A.C. supply. The power supply to the system shall be made available near to unit by others.
- b) The entire UVGI system shall be factory tested with test certificate from the reputed Lab. 3rd party test certificate can be provided either by contractor
- c) The electronic driver shall be installed in the control panel in respective AHU room for ease of monitoring and maintenance.

UV Lamps: The UV lamps shall meet following criteria:

- a) Lamp shall be High Output Quartz type, with current efficient.
- b) The lamp shall produce specified wavelength & Intensity to achieve the required parameters.
- c) Each Lamp shall be provided with externally and readily visible indication to show lamp operation or failure, without the need to open access door, or shut down the System.

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- d) It shall be possible to replace lamp safe without removing the Quartz Sleeve, or access door, or drawing the UVGI assembly out of the duct.

Support and framework:

- a) The entire framework and support shall be fabricated out of Aluminum Alloy. All material used shall be UV resistant.
- b) The reflectors shall be in Aluminum Alloy of high UV reflectivity and parabolic in shape.
- c) All parts should be corrosion resistant.
- d) Terminals shall be provided to interlock UVGI with AHU.

Control Panel :

Shall consist of the following :

- a) Electronic ballasts with high power factor of > 0.90 , High output Lamps required which will working on 800mA.
- b) The ballasts shall be constant current output ballast over input voltage range of 110 to 270 VAC, single phase.
- c) Ballasts shall be electronic type, rated for greater than 15,000 starts, and conform to Sound Rating A.
- d) Microprocessor based control panel with LCD Display.
- e) All electrical components such as Ballasts, Disconnect Switch, Fuse, Hour Meter etc. shall be housed in remotely mounted 18G CRS powder coated Electrical Box.
- f) Individual Lamp run hours for timely and easy replacement
- g) Individual lamp On/Off/Error Indicator
- h) Real Time Clock to have the exact time and duration of the system and individual lamps.
- i) Programmable Real time On/Off switching for system
- j) Shall be BMS Compatible
- k) Ballast Protection Circuit
- l) Lamp change reminder on Display
- m) ON/Off for incoming power - Mains Power

Safety :

-
- a) Ballast Protection Circuit shall be provided in Control panel to ensure ballast is turned off for protecting it after 2 minutes if the lamp does not start.

-
- b) Fire resistant FRLS cables.
 - c) Proper UV caution labels shall be applied to control panel and on the duct sides and strategic points.

Certificates:

The contractor shall provide manufacturer's test certificates for main items like lamp, ballast, system etc.

Installation:-

- a) Installation of UVGI frame in the duct shall be on Guide Rails and Installation Rails. Cover Plates and all necessary hardware required for installation shall also be provided.

Testing & Commissioning:

The intensity of the UV Lamps across the coil will be measured using a calibrated radiometer.

15 INSULATION

Please refer to Chapter 11 "INSULATION WORKK" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR- CONDITIONING (HVAC) WORKS (2024).

- a) The Inside surface of the first 3.0 meters of supply and return air-conditioning duct from AHU/CSU/ TFA/ FCU on which the acoustic lining is to be provided shall be thoroughly cleaned and rendered free from all dust and grease. The portion of supply air duct which is acoustically (internal) insulated need not be insulated thermally (external).
- b) Good quality adhesive as per manufacturer recommendation should be used for pasting 100% surface area of insulation to the duct surface without leaving any air bubble or sag between two surfaces. The joints shall be paste along the thickness of the insulating material. The longitudinal & radial joints should have overlapping 3" strip of same material with min 3mm thickness. Mechanical fasteners shall be used to ensure adherence of duct insulation to surface of the ducts.
- c) The insulation material shall be open cell nitrile rubber and the thickness of insulation shall be 10mm for FCU duct and 15mm for the AHU/ TFA duct.

i) DUCT THERMAL INSULATION USING CLOSED CELL NITRILE RUBBER

ii) DETAIL SPECIFICATION OF INSULATION IS TO BE GIVEN.

- a) The outer surface of the supply and return air-conditioning duct on which the insulation is to be provided shall be thoroughly cleaned and rendered free from all dust and grease.
- b) Good quality adhesive as per manufacturer recommendation should be used for pasting 100% surface area of insulation to the duct surface without leaving any air bubble or sag between two surfaces. The joints shall be paste along the thickness of the insulating material. The longitudinal & radial joints should have overlapping 2" strip of same material with min 3mm thickness.
- c) The insulation material shall be aluminium foil faced closed cell nitrile rubber and the thickness of insulation shall be as per following table or identified in the schedule of quantity:

Supply Duct in conditioned space (return above FC)	19 mm thick
Return Duct in conditioned space	13 mm thick
Supply Duct in exposed / non-conditioned space	25 mm thick
Return Duct in exposed / non-conditioned space	19 mm thick

iii) Refrigerant/ Drainpipe Insulation using closed cell nitrile rubber

- a) The outer surface of the pipes on which the insulation is to be provided shall be thoroughly cleaned and rendered free from all dust and grease.
- b) Good quality adhesive as per manufacturer recommendation should be used for pasting 100% surface area of insulation to the pipe surface without leaving any air bubble or sag between two surfaces. The joints shall be paste along the thickness of the insulating material. The longitudinal & radial joints should have overlapping 2" strip of same material with min 3mm thickness.
- c) The insulation material shall be closed cell nitrile rubber covered with 6-7 mil minimum thickness and 200 gram/sqmt $\pm 10\%$ interwoven glass fabric for UV and mechanical protection and the thickness of insulation shall be as identified in the schedule of quantity. All valves, fittings 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.

iv) Chilled water piping Insulation using closed cell nitrile rubber (inside the building)

- a) The outer surface of the pipes on which the insulation is to be provided shall be thoroughly cleaned and rendered free from all dust and grease. All MS pipes shall be provided with a coat of zinc chromate/bituminous primer.
- b) Good quality adhesive as per manufacturer recommendation should be used for pasting 100% surface area of insulation to the pipe surface without leaving any air bubble or sag between two surfaces. The joints shall be paste along the thickness of the insulating material.
- c) The insulation material shall be closed cell nitrile rubber shall be in sleeve form for pipe size up to 80mm. These sleeves shall be factory cut and self adhesive type. For bigger sizes, factory precut sheet shall be used made for particular pipe sizes. The thickness of insulation shall be as identified in the schedule of quantity. The insulation joints shall be butted tightly.
- d) Insulation for union and expansion joints shall be built up type with a slabs and the insulation shall extend 12 mm beyond the adjoining insulation for identifications. The ends of piping insulation shall be sealed with glass cloth.
- e) All insulated pipes shall be labeled (S, R or RR) and provided with 300 mm wide band of paint along the circumference at every 1200 mm distance for color coding. Direction of fluid shall also be marked.
- f) 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.

v) Chilled water piping Insulation using expanded polystyrene finished with aluminium cladding (inside the chiller plant room/Risers)

- a) The outer surface of the pipes on which the insulation is to be provided shall be thoroughly cleaned and rendered free from all dust and grease. All MS pipes shall be provided with a coat of zinc chromate/bituminous primer.
- b) Good quality adhesive as per manufacturer recommendation should be used for pasting 100% surface area of insulation to the pipe surface without leaving any air bubble or sag between two surfaces. The joints shall be paste along the thickness of the insulating material.
- c) The insulation material shall be Expanded polystyrene shall be in pre form pipe section in 2 halves for pipe size up to 400mm. For bigger sizes, sheet shall be

used. The thickness of insulation shall be as identified in the schedule of quantity. The insulation joints shall be butted tightly.

- d) The insulation shall be covered with 500 SWG polythene faced hessian, (the polythene facing outwards), with 50 mm overlap. All joints shall be sealed with bitumen. This shall be covered with 24 SWG aluminium sheet cladding fixed with grooving machine and self tapping Aluminum/Brass screws. All longitudinal and transverse joints in cladding shall have minimum overlap of 50 mm duly beaded and grooved and shall be sealed with elastomeric metal sealant. Self tapping screws/pop rivets spots shall be sealed with above sealant. The cladding shall be done in a neat & clean manner to give true surface.
- e) All insulated pipes shall be labeled (S, R or RR) and provided with 300 mm wide band of paint along the circumference at every 1200 mm distance for color coding. Direction of fluid shall also be marked.
- f) 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.

Alternate for Piping insulation

- i) 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

S.No.	Dia. Of MS Pipe		Minimum Thickness of PUF in (mm)	Minimum Thickness of G.I. Cladding	Minimum Thickness of Al. Cladding
1.	20mm		33	26 gauge	24 gauge
2.	25mm		33	26 gauge	24 gauge
3.	32mm		33	26 gauge	24 gauge
4.	40mm		33	26 gauge	24 gauge
5.	50mm		33	26 gauge	24 gauge
6.	65mm		36	26 gauge	24 gauge
7.	80mm		42	26 gauge	24 gauge
8.	100mm		42	26 gauge	24 gauge
9.	125mm		42	26 gauge	24 gauge
10.	150mm		42	26 gauge	24 gauge
11.	200mm		52	26 gauge	24 gauge

12.	250mm		62	26 gauge	24 gauge
13.	300mm		62	26 gauge	24 gauge
14.	350mm		62	26 gauge	24 gauge

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.

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.

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.

All straight pipe lengths will have water tight end seal. All fittings will have square cut insulation cutback.

For leak identification purpose 2 wire diagnostic wiring shall also be provided.

Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

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:

S.No.	Dia. Of MS Pipe	PUF Thickness (mm)	Thickness of HDPE Cladding (mm)
1.	20mm	30	2.5
2.	25mm	36	2.5
3.	32mm	36	2.5
4.	40mm	36	2.5
5.	50mm	37	3.0
6.	65mm	39	3.0
7.	80mm	43	3.0
8.	100mm	43	3.2
9.	125mm	43	3.5
10.	150mm	53	4.4
11.	200mm	63	5.0
12.	250mm	63	6.3
13.	300mm	63	7.0
14.	350mm	64	7.8

46.

47. OVERDECK INSULATION

Overdeck insulation is covered part of civil contractor scope of work.

Equipment:

All equipment such as AHUs, Fan coil units, water chiller equipment, pumps, expansion tank shall be suitably insulated as required and as per manufacturer's requirements. The cost of such insulation is deemed to be included in the cost of equipment. The insulation shall be applied after applying of necessary primer.

16 VARIABLE FREQUENCY DRIVES FOR HVAC SYSTEMS

SCOPE

The scope of this section comprises the supply and installation of Variable Frequency Drives for equipment like AHUs , circulating water pumps and cooling towers, etc. conforming to these specifications.

GENERAL REQUIREMENTS

This section describes the type of Variable Frequency Drive (VFD) for fan/pump speed control. The drive shall not be general purpose product, but a dedicated HVAC design. VFD shall be of variable voltage and variable frequency type, suitable mounting for variable torque application (fans).

The VFD shall be tested to UL 508C. The appropriate UL label shall be applied or The VFD shall be CE marked and conform to the European Union Electro Magnetic Compatibility directive. The VFD should have UL, CUL, C-Tick approvals and confirm to Electromagnetic approvals compatibility directive. The VFD should have CE marking. Further, the VFD shall comply to EMC directive as per IEC 61800-3: 2004, category C2 or C3, on both conducted and radiated emission. Necessary Harmonic filters in built non saturating type DC links on both DC rails/DC reactors with matching inductance with load so that it reduces effect of harmonics and adds protection from AC transients. The drive shall be tested as per UL 508 and as per UL 508 and listed for 100 KA. Harmonic distortion shall be restricted to 5%. Suitable filters will be supplied with all VFDs. AC choke can be accepted however Choke design should ensure to avoid the voltage dip in the VFD due to the dip in the incoming power line and nuisance trip. VFD should operate in the voltage range specified in the tender.

Generally, as DC choke is connected after the input diodes, the diodes may get unprotected from voltage transients. DC choke can be accepted however it shall ensure that the proper protection to diodes.

The HVAC contractor shall collect the details of supply transformer rating, impedances, etc. from the Client to feed to the VFD.

TECHNICAL REQUIREMENTS

The drive should be suitable for three phase 415V, 50 HZ, AC supply, with a voltage description range of 380-480 V. The overload rating of drive should be 110% of its normal duty. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable Frequency and voltage for controlling the speed of three-phase AC motors. The VFD shall convert 380 – 440 V, 3 phase, 50 Hertz utility power supply to an adjustable output voltage and frequency. The VFD

shall continue to deliver full motor output voltage even if the supply is at (380 – 10%). The voltage to frequency ratio shall be suitable for fan control. It should not be possible to set a constant V/F ratio to prevent damage to connected equipment and to optimize energy usage.

The VFD shall be capable of running with no motor connected for service functions. The VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor.

The VFD shall be of sufficient capacity to provide a quality wave form so as to achieve full output of the motor, without causing additional heat rise. The VFD shall have following features:

- a) Minimum efficiency @ 100% load - above 96% and @20% load - 92%
- b) Efficiency of Variable frequency drive - Minimum 96% at full load Requirement
Displacement power factor-0.98.
- c) Rated input voltage $380V \pm 10\%$, 3 phase, 48-62 + 1% HZ
- d) Working ambient temperature range – 10C to +40C, humidity to 95% RH.
- e) Output frequency range – 0 to 1000 HZ.
- f) Output voltage range 0 to full mains input voltage, 3 phase even at (-) 10% of full mains voltage input.
- g) Connection of oversized motors within the current rating of the VFD shall be allowed.
- h) Output torque should be limited to 1.05 x F.L.T. to prevent damage to connected plant.
- i) The VFD shall accept 3 analog inputs of either 0-10V; 4-20mA as well as resistive inputs as a control signal.

The VFD shall have a dual DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics.

The VFDs shall comply with the emission and immunity requirements of IEC 61800-3, Category C1 OR C3 with 50m motor cable (unrestricted distribution). The suppliers of VFDs shall include additional EMC filters if required to meet compliance to this requirement. The VFD's full load output current rating shall meet or exceed the normal rated currents of standard IEC induction motors. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.

VFD Shall have THD less than 5%. Active / passive filters must be use to achieve desired THD levels which will be in scope of Drive authorized supplier of OEM as per list of approved make.

The VFD shall be capable of running the system at programmed lower speed at a lower frequency, in case of a phase loss. It should also be capable of sensing a loss of load (broken belt) and provide signal for the same.

The VFD design shall comprise a diode input bridge, fixed voltage D.C. link section with both inductors and capacitors to form a filter and inverting bridge comprising

I.G.B.T's (Insulated Gate Bipolar Transistors) and output inductors in the motor lines. All equipment must be housed within the VFD enclosure.

The inverting bridge shall be controlled by a 32 bit processor and A.S.I.Cs (Application Specific Integrated Circuits) to produce a V.V.C. (Voltage Vector Controlled) P.W.M. waveform naturally resulting in full motor voltage and sinusoidal current of mains supply quality in the motor circuit. Other forms of current source or 8 pulse converters are not accepted.

PID controllers shall be provided in the drive, allowing pressure or flow signals to be connected to VFD for a close loop control. The VFD shall be capable of powering a sensor cum transmitter supplied by others. The PID set point should be adjustable from VFD keypad, analog input or communication bus.

A programmable automatic energy optimization selection feature shall be provided as standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings. The VFD must be able to produce full torque at low speed to operate direct driven fans. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.

The VFD shall allow up to at least 100 meters of SWA (Single Wire Armour) cable to be used between the FC and the motor and allow the use of MICS (Mineral Insulated Copper Sheath) cable in the motor circuit for fire locations.

PROTECTIVE FEATURES

Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.

Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition,

the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

The following user adjustable parameters shall be provided in the VFD-acceleration time, deceleration time, minimum frequency, maximum frequency. The drive shall be complete with hot pluggable local control panel with alpha numeric/graphical display of frequency, voltage, current, KWHr, running hours, active power, RPM, etc.

In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.

The VFD shall have temperature-controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

Protect from output switching: The VFD shall be fully protected from switching a contactor / isolator at the output without causing tripping e.g.: for switching on/off the isolators of the AHU / ventilation fans / pumps near the motor with VFD in ON mode.

When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

The design shall include a full 4 term independent PID control (proportional integral derivable) as standard to provide closed loop control direct from a single transmitter without the need for external signal conditioning. The VFD shall not exhibit an inrush current when a 'start' signal is given and current must not exceed 105% at any time to prevent damage to connected equipment.

The VFD design shall be suitable for either local or remote control, selectable. The VFD shall not be damaged if it is energized with a 'start' signal without a motor connected.

INTERFACE FEATURES

The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.

Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.

The VFD shall have 4 PID controllers which can also be used to control damper and valve positioners in the system and to provide setpoint reset.

Four simultaneous meter displays shall be available. They shall be selectable from (at a minimum), frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, feedback signals in their own units, among others.

VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F). Examples can be room temperature in 0 deg. C, return air temperature in 0 deg. C, supply air temperature in 0 deg. C, CO2 concentration in ppm, pressure in bar, differential pressure in PSI etc.

VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the BACnet over IP. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

STANDARD INPUTS AND OUTPUTS

- a) 4-6 dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

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- b) Two/Four programmable relay outputs rated 250 V AC 1A/30 V DC 1A, for resistive, inductive or capacitive load. Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.
 - c) Each shall be independently selectable to be used with either an analog voltage or current signal.
 - d) A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.
 - e) The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,
 - f) It shall be possible to command all digital and analog output through the serial communication bus.
 - g) Modules may include such items as:
 - h) Additional digital outputs, including relay outputs
 - i) Additional digital inputs
 - j) Additional analog outputs
 - k) Additional analog inputs, including Ni or Pt temperature sensor inputs
 - l) It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

A real-time clock shall be an integral part of the VFD.

- a) It shall be possible to program unique events that occur only during normal workdays, other that occur only on non-workdays, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.
- b) The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.
- c) The VFD shall include a Cascade Controller which allows the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 3 additional constant speed motor starters.

COMMUNICATIONS & BMS compatibility

VFD should be able to provide following inputs/outputs-6 Nos Digital input,3 Nos relay output,2 Nos analog input, 2 nos. analog output.

Standard EIA 485 (RS 485) communication port and capability with BMS over BACnet/MODBUS RTU protocols is required.

The VFD shall include a RS-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

VFD shall have standard USB/USS/Modbus RTU/BACnet MS/TP port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.

The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

OPTIONAL FEATURES

All optional features shall be built and mounted by VFD manufacturer as an inbuilt factory solution. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.

SERVICE CONDITIONS

Ambient temperature at full speed, full load operation with continuous drive rated output current: - 10 to 40°C for ratings up to 250 kW without derating and up to 60°C with de-rating :

Relative Humidity : 0 to 95%, non-condensing.

AC line voltage variation : + 10% of nominal with full output.

VFD Enclosure protection : IP 55, integral, with no additional cabinets. Side Clearances :

No side clearance shall be required for cooling

All VFDs shall be plenum rated.

QUALITY ASSURANCE

The VFD shall be fully tested at the manufacturer's works. The test certificates shall be submitted.

The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.

All optional features shall be functionally tested at the factory for proper operation.

17 BMS FOR HVAC SYSTEM

Please refer to Chapter 12 "CONTROLS" of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

SCOPE:

This chapter covers the requirements of Building Automation System required for HVAC system to monitor and control HVAC equipment's to achieve desired space conditions.

48. 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 philosophy shall be referred in BMS part of this tender.
- ii) For cooling applications in plants other than package type AC (PTAC) units, control shall be achieved by PICV in chilled water coil. In the case of PTAC type units, the control of the units is achieved through snap acting room thermostat.
- iii) The size of PICV valves shall be selected to match the coil wherein the flow is to be regulated. The make and size shall be indicated in the technical documents in the tender.
- iv) Operation of the modulating motor of PICV valve shall be controlled by proportional type

thermostat.

- v) One snap acting humidistat shall be provided for each humidifier.
- a. Variable Speed Drive (VSD)

49. CHILLED WATER FLOW CONTROL

Variable Speed Drive (VSDs) for controlling the chilled water flow rate in the secondary circuit shall be provided and where the secondary chilled water system has been provided. Requirement and Specifications of VSD system shall be as follows:

The VSD System shall function to supply variable chilled water flow in the secondary circuit of air-conditioning system in response to the load variations including that due to variations in ambient conditions to maintain the inside designed temperature conditions. However, under any circumstances, the secondary chilled water pump speed shall not fall below the 30% of the nominal speed or any other suitable minimum speed as per the system requirement. The VSD shall have the provision to switch over to the manual mode as and when required and facility for the manual speed variation from VSD itself. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept two feedback signals (from differential pressure transmitters installed across the two farthest, most significant AHUs of the zone to select either maximum of the two or average of the two (as selected by the user) feedback signals using HVAC terminology, to regulate the speed of the secondary chilled water pump motors in response to the load variations. In case, any additional sensor (s) including wiring etc. if required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD.

50. AIR QUANTITY FLOW CONTROL

The VAV System/Motorized Dampers shall function to supply variable air quantity in the AHU/ 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, CO2 level as per PPM and pressure conditions. The system shall have the provision to switch over to the manual mode as and when required.

Air Handling Unit Controls

Air handling Units shall be provided with EC fans with controller to modulate fan air quantity to maintain desired space conditions along with chilled / Hot water flow control and operation of Humidifier. UV lamp is provided to keep cooling coil dry and disinfected.

AHU shall have optimum start control to ensure the desired space temperature whenever office is started. AHU also shall have night purge facility to remove foul smell and storage heat effect from the air-conditioned spaces.

AHU: shall have following controls

- **Modulating PICV**
- **Proportionate thermostat**
- **EC fan controller to control fan speed.**
- **Interlocking with fire panel to shut off AHU.**
- **Suitable Controls for Humidifier operation.**
- **Suitable Controls for UV lamp operation.**

Treated Fresh Air Unit Controls

TFA Units shall be provided with EC fans with controller to modulate treated fresh air quantity to maintain desired CO2 level inside the air-conditioned spaces along with chilled water flow control and operation of Heat recovery wheel.

TFA shall have following controls

- **Modulating PICV with modulator motor.**
- **Proportionate thermostat.**
- **EC fan controller to control fan speed.**
- **Interlocking with fire panel to shut off TFA.**

AIR WASHER Controls

Air washer shall be provided with plug fans with VFD to controller to modulate treated fresh air quantity to maintain temperature below the ambient temperature inside kitchen area along with potable water flow control to maintain humidity.

Air washer: shall have following controls

- **VFD driven fan to control fan speed.**
- **Interlocking with fire panel to shut off air washer**
- **Humidity Controls for recirculation pump operation**

DUCT MOUNTED UVGI SYSTEM

Duct mounted UVGI system is provided to kill the bacteria and viruses to maintain supply air clean and disinfected. The system is provided with UV lamps, reflectors, ballast and necessary safety controls.

VENTILATION FANS

All ventilation fans like Toilet, Pantry, Kitchen, Store, Plant room, Basement, Atrium, etc ventilation fans shall be ON & OFF as per time schedule through BMS. These fans will be OFF in case of fire emergency through FIRE PANEL.

FIRE STRATEGIES

Entire building is divided into number of fire zones. In case of fire all AHUs in affected zone and zones connected to affected zones shall be OFF. All fresh air and smoke spills fans in the affected zones shall be ON. Fresh air shall be pumped in affected zone through supply air ducts and smoke shall be evacuated through return air ducts. Return air ducts shall be fire rated to with stand for 250 deg C for 2 Hrs as per NBC 2016.

Lift well and Stair well pressurization fans in the affected zones shall be ON to provide the necessary pressurization effect. All pressurization, make up and smoke spill fans in affected zone shall be ON and all AHUs in affected zone shall be OFF after receiving signal from fire panel.

Integration with Fire Alarm System:

- Controlling action of fire dampers based on signal from fire control module.
- Operation of smoke evacuation and pressurization systems.
- HVAC system will be interfaced with fire detection and alarm system. In case of fire, HVAC equipment of fire zone will be switched off automatically through hardwired interlock with Fire Alarm System.

18 ELECTRICAL

Please refer to CPWD's general specification for Electrical Works, Part-I-2013, For Internal Works, "Heating, Ventilation & Air-Conditioning (HVAC)–2024, For electrical works Part-IV-2013 for Sub-Station.

For Electrical requirement of HVAC works shall be referred from Electrical services specifications provided along with this tender document.

19 PAINTING WORK

All equipment shall be painted as specified under respective headings. Grilles/ diffusers shall be powder coated as per approved colour matching with interiors. The contractor has to get approval of Engineer In charge/Clients for the quality and colour of paints for all types of painting work.

Colour scheme for the plant and equipment

Please refer to Chapter 1 “GENERAL” of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

20 INSPECTION, TESTING AND COMMISSIONING

Please refer to Chapter 17 “INSPECTION, TESTING AND COMMISSIONING” of CPWD document for GENERAL SPECIFICATIONS for HEATING, VENTILATION & AIR-CONDITIONING (HVAC) WORKS (2024).

21 RUNNING IN PERIOD & DATE OF ACCEPTANCE

- i) After the installation work has been completed by the contractor, tests shall be conducted by the contractor and necessary adjustments shall be made satisfying that the plant including low side equipments is capable of continuous running. There after contractor shall offer to the employer a running-in period of 7 days subject to a minimum aggregate of 120 hrs at his cost. The duty cycle of the plant during this running in period shall be same as that specified in the tender documents. In case of multiple compressor installations, all the compressors should be run by rotation.
- ii) The plant shall be operated and a log of all parameters shall be maintained during this period. The contractor shall be free to carry out necessary adjustments etc. during this period without stopping the plant. Record of inside conditions shall be made during this period to check the same are as per NIT requirements. The plant shall be said to have successfully completed the running-in-period, if no break down or abnormal/ unsatisfactory operation of any machinery occurs during this period. After this the plant shall be made available for beneficial use.
- iii) After the plant has operated without any major break down/ trouble and inside conditions are maintained as per NIT requirements for the above specified running in period, it shall be taken over by the employer subject to guarantee clause mentioned below. This date of taking over of plant after trouble free operation during the running in period shall be the date of acceptance.
- iv) Any loss of refrigerant or oil during the running in period shall be made good by the contractor free of charge.
- v) Capacity test of the chilling unit & other major equipments shall be carried out as and when conditions become stabilized.
- vi) Seasonal testing may be carried out as & when outside conditions become suitable.

22 DATA TO BE FURNISHED BY THE CONTRACTOR AFTER THE AWARD OF CONTRACT AND BEFORE INSTALLATION

- a) HVAC Calculation sheets, Schedule of drawings and Equipment's selection documents to be submitted for review, approval and information with submission dates.
- b) Quality Assurance Plan (QAP).
- c) Detailed P & I diagram showing clearly the scope of supply of equipment, piping with line sizes and material specifications, valves, specialties, instrumentation and control and all accessories. This drawing or documents mentioned under following clauses shall include all design data and information furnished in data sheets. The makes of all major components and controls shall be indicated.
- d) Dimensioned general arrangement drawing showing all equipment with accessories, mounting details, etc.
- e) Overall space and head room requirement with details of handling during erection, operation and maintenance.
- f) Foundation drawing with static and dynamic loading data, pocket details, foundation outline, etc., for all items.
- g) Cross-sectional drawings of all items with part list and materials of construction.
- h) Performance curves and selection charts for Pumps, AHUs, Fans, VRF/ Split Units, Coils, filters, UVGI etc. Selection charts and calculation for cooling coil.
- i) Operation and maintenance manual with lubrication schedule.
- j) Catalogues furnishing detailed technical data for Pumps, AHUs, Fans, VRF/ Split Units, Coils, filters, etc.
- k) Final List of Essential Spares.
- l) Technical Datasheet, Instrument data sheet and drawings.
- m) Internal power and control wiring diagram of the unit mounted electrical panel indicating all interlocks
- n) Complete electrical data of the unit with amperages of unit in various conditions, suggested incomer cable etc.
- o) Motor terminal drawing (s), Motor data sheet, drawing and torque-speed curve
- p) Refrigerant, lubricating and oil control schematics.

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- q) Method Statement.
 - r) Procedure for performance testing.
 - s) List of insulation materials with specifications and properties like density, thermal conductivity etc.
 - t) List of insulation adhesives, vapor barriers and finishing materials with specifications.
 - u) Sample Materials such as Grille, Diffusers, Dampers etc. for approval.
 - v) Test Certificates for the materials.
 - w) Manufacturer's printed catalogue for each primer and finish paint material indicating brand name, composition, technical specifications, storage and handling instructions, directions for use, surface preparation requirements and safety information etc.
 - x) Storing and Handling Practices and Procedures for materials.
 - y) Erection, Start-up, Operation and maintenance manual with lubrication schedule. list of routine maintenance checks to be carried out, list of alarms / trip settings, troubleshooting guidelines etc.

23 DATA TO BE FURNISHED BY THE CONTRACTOR AFTER TESTING AND COMMISSIONING

Completion Drawings.

Three setsof the following laminated drawings shall be submitted by the contractor while handing over the installation to the Department. Out of this one of the sets shall be laminated on a hard base for display in the A.C. Plant room. In addition one set shall be given on compact disc.

- a) Plant installation drawings giving complete details of all the equipment's, including their foundations.
- b) Plumbing layout drawings include insulation giving sizes and lengths of all the pipes and the sizes and locations of all types of valves and including isometric drawings for the entire piping including the pipe connections to the various equipments and insulation details wherever required.
- c) Line diagram and layout of all electrical control panels giving switchgear ratings and their disposition, cable feeder sizes and their layout,

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- d) Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits.

24 LIST OF APPROVED MAKES

MATERIAL/EQUIPMENT	APPROVED MAKE
Air handling Units /treated fresh air units	Edgetech /Citizen/ ZECO/ Stulz/ VTS/ System Air/Flaktwood
Air Washer	Edgetech /Citizen/ ZECO/ Stulz/ VTS/ Carryaire/ Zair/ Airflow
Air Separator	Xylem / Emerald/ Anergy /Armstrong/ Grundfos
Al. Sheets	Hindalco / Balco / Nalco
Aluminium tape	Johnson/Birla-3M/Nippon Industries
Anchor/Fastener	Hilti/Fisher/MUPRO
Auto Air Vent	Anergy/Rapid Control/Sant Industries /Honeywell
Balancing Valves	Johnson Controls / Belimo/Honeywell/Siemens/ Advance /Audco/ Danfoss
Ball Valves set with &without Y.	Honeywell/ Zoloto /Sant/ Advance/ Emerald / Rapid control/ BAP
Strainer For FCU	
Butterfly Valves	Audco/Advance/Honeywell/Sant/ C & R / Kirlosker
Ball Valve	Audco/Advance/Honeywell/Sant/Emerald/Zoloto/Leader/Sant
Cabinet Fans	Systemair/Kruger/Greenheck/ Nicotra/ Maico
Centrifugal Fans for ventilation/AHUs/ Airwasher	Systemair /Kruger/Greenheck/ Nicotra
Celdek Pad	DRI / Humidin/ Munters
Check Valves	Audco/Advance/Honeywell/Sant/ SKS / Zoloto
Closed / Open Cell Nitrile rubber insulation/ EPDM insulation	Armacell / K- Flex/ A-Flex/ ALP aeroflex/ Supreme
Closed Expansion Tank	Xylem/Armstrong /Emerald /Anergy
FLRS Cables	As per Electrical Section make list
Differential Pressure Switch (Water)	Johnson Control/Honeywell/ Siemens/ Indfoss
DX units and VRF	Voltas/Hitachi/Carrier/Panasonic/Blue star/Daikin/Mitsubishi Electric

Dry/Wet Scrubber	Trion/ Ryd Air/Humidin/ ESPAIR/ ZECO/ Edgetech/Zair
EC Fan	Ziehl Abegg/ Rosenberg /Ebm-papst
Expansion Bellows/Vibration Isolators/ Duct Flexile Connections	Resistoflex/Kanwal (Easyflex)/Cori
Fan coil Units	Edgetech/ Citizen/ Zeco/ Midea/ Bhutoria/ Kubic/ Cruise / Trane
Filters (Pre)	Dyna Filters/American Air Filter/Camfil/Thermodyne
Flexible Duct	Twiga/Ruskin Titus/Atco/Kimmco / Sevenstar
Flow switch	Rapid cool/Siemens/Anergy/Honeywell/Danfoss
FRP Material	Reichhold/Equivalent
Fiber glass insulation	Owens corning/ U.P. Twiga
Fire Paint	Flame bar/ AMEETUFF /3M/Promat, Cischem
G.I. Pipes	SAIL/Tata/Jindal/QST
G.I. Sheets	Sail/Tata/Jindal/Bhusan
Grills/ Diffusers/ Fire Dampers/ Louvers/ Volume Control Dampers/ Back Draft Dampers	Systemair/Caryaire/Cosmos/Trox/ Greenheck/ RUSKIN
GSS Factory Fabricated Ducts/ Duct Flanges	Zeco/ Ductofab/ Asawa / Dustech/ Waves aircon/GP Spira
Inline Fans	Systemair /Kruger/Greenheck / Nicotra/ Maico
M.S. Pipes	SAIL/Tata/Jindal/QST
M.S. Sheets	Sail/Tata/Jindal
Motorized Actuator for Valves & Damper	Johnson Controls / Belimo/Honeywell/Siemens
Motorized Butterfly valves	Audco/Advance/Honeywell/ Belimo
Motors	ABB/Siemens/CGL/Bharat Bijlee
Ozone Generator	Ultra fresh/Eltech/Omniscient/Chemotronic / Oz Air

PIBC Valves	Johnson Controls /Siemens/Belimo/ Honeywell
Plug Fans	Ziehl Abegg/Kruger/Nicotra/Greenheck/Systemair
Pot/Y-Strainers	Advance/Honeywell/Emerald/ SANT
Precision AC	Emerson/FläktGroup/ Stulz / Schnider / Bluebox
Pressure Gauge	Fiebig/H.Guru/ Anergy /Emerald
Pressure Relief Dampers	Trox/Systemair / Cosmos/ Caryaire/ RUSKIN
Pressurization Unit	Xylem/Armstrong/Emerald/ Anergy
Propeller Fans	Kruger/Greenheck/Crompton/ Orient/ Nicotra/ Maico
Puff pipe support	Malanpur/Lloyd /Beardsell
PVC Eliminators	Munters/BKBextrusions/D.P. Engineers/Enviro Tech
PVC Pipes	Finolex/ Prince/ Supreme/ Ashirwad /Astral
Refrigerant Piping	Mandev / Mexflow / Rajco
Rock Wool insulation	Roxul-Rockwool/Rockwool India/Lloyd insulation/Owens corning
Spiral Round/Oval ducts	GPSpira/Dustech/Spiral Tubes/Asawa
Split/Window AC	Carrier/Daikin/Hitachi/Mitsubishi/Voltas/ LG
Star bond/Lag Protective Coating	Paramount polytreat/Pidilite
Thermometers	Fiebig/H.Guru/Emerald/ Anergy
Tube Axial flow Fans	Kruger/Greenheck/Systemair/ Maico
‘TF’ Quality expanded polystyrene	Beardsell/Styrene/Toshiba
Ultrasonic/Electromagnetic Flow meter	ABB / Siemens / Emerson
Ultrasonic Humidifier	Carel/Das pass/ Rapid cool/ Stulz
UV lamp	ALFAA UV/ Aeropure/ Sanuvax/ Ruks engineers ltd / Honeywell / Trane / Bonphul/ UVHEAL

UVGI	ALFAA UV/ Aeropure/ Sanuvox/ Ruks engineers ltd / Honeywell / Trane / Bonphul/ UVHEAL
Variable frequency drive	ABB/Danfoss/Siemens/ Schneider
VAV/ CAV	Trox/Trane/JohnsonControls / Honeywell / Systemair/ Cosmos
Flexible Coupling	Victaulic/Tyco
Welding Rods	Advani/L&T/ESAB
2-way/3-way Modulating Valves and Thermostat	Johnson Controls/Siemens/Honeywell/ Belimo
Active/ passive Harmonic filter for VFD	L&T/ EPCOS/ Schneider / Danfoss / ABB

4. FIRE FIGHTING WORKS

TENDER DRAWINGS, DRAWINGS FOR APPROVAL & COMPLETION DRAWINGS

The drawings provided to the bidder with the tender documents give a general scheme of the system and are not meant to be the working drawings. The contractor shall furnish the shop drawings to be sent to the Architect and Engineer in charge, of all the equipment/ layouts after award of the contract and the same shall be approved by the Architect and Engineer in charge. No work shall be allowed to be executed without the approved shop drawings.

i) Tender Drawings

The drawings appended with the tender documents are intended to show, space allotted for various equipment, tentative cable and pipe routes. The equipment offered shall be suitable for installation in the spaces shown in these drawings.

ii) Drawings for approval on award of the work

The contractor shall prepare & required set of following drawings and get them approved from the Architect and 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.

- a) Layout drawings of the equipment to be installed in various rooms such as plant room and other equipment.
- b) Drawings including section, showing the details of erection of entire equipment including their foundations, etc.
- c) Plumbing drawings and equipment showing the layout of entire piping, dia & length of pipes, valves and isometric drawings showing connections to various equipment.
- d) Electrical wiring diagrams for all electrical equipment and controls including the sizes and capacities of the various cables and equipment,
- e) Dimensioned drawings of all electrical and control panels,
- f) Drawings showing the details of all insulations and vapour barrier works,
- g) Drawings showing details of supports for pipes, cable trays etc. Any other drawings relevant to the work

4.1 CODES AND STANDARDS

Following codes and standards have been referred.

- Unified Building Byelaws of Delhi 2016 (UBBL-2016).
- In case of information not being clear or not available in UBBL-2016, NBC, IS & NFPA shall be followed as applicable.
- All equipment, supply, erection, testing and commissioning shall comply with the requirements of all latest Codes and Standards issued by the Bureau of Indian Standards.

PART -D

The bill of quantity for Civil, Electrical & HVAC work is uploaded separately page no 1 to 81 is part of the contract agreement.

PART-E
LEED
Green Building Construction
Guidelines

Kotak School of Sustainability
IIT Kanpur

LEED Green Building Construction Guidelines

The project Kotak Sustainability School is aiming for USGBC LEED v4 "PLATINUM" Rating. To achieve the same, the entire site team is responsible for ensuring following requirements. The below are the minimum requirements to be met. In case any requirement is considered difficult to be achieved, kindly contact LEED consultant to find alternative measures to meet the green building intent during construction.

1. Worker Health and Safety

Care must be taken to ensure the health and safety of the labour on site at all times.

- Provide safety hats, boots to all workers and visitors at site
- Safety masks & gloves must be worn by workers wherever required like bar bending area, stone/tile cutting, painting etc.
- Separate toilets for male and female workers are to be provided. For every 25 workers, 1 WC and 1 Urinal shall be provided. Toilets should be provided separate for men and women workers.
- Daily cleaning of toilets is required.
- First aid facility must be available at site at all times.
- Provide clean drinking water at site.
- Keep record of drinking water tests during construction stage. Drinking Water Test must be conducted every 3 months for all sources of drinking water provided to workers.
- Ensure adequate provision of ventilation & daylight in worker hutment.
- There should be no water logging or waste water logging. Toilets and bathing areas for worker should have proper drainage and sewage disposal connection.
- Provide crèche for children of labour working at site. No children should be allowed to enter construction area.

2. Top Soil Preservation

- The top soil (top 200mm layer of soil) at site should be tested for fertility from NABL accredited labs. If the soil is tested to be fertile, then it should be preserved at site or sent to nursery or another site for re-use as fertile top soil only.
- If the top soil is preserved at site, then it should be stripped from all the areas of the site to be disturbed due to construction activity including areas to be used for building, roads, paving, labour hutment etc. The stripped top soil should be stacked in designated area and covered with hessian cloth or geotextile membrane to prevent erosion from wind and storm water. It can also be mulched or seeded with grass temporarily to stabilise it. It is advised to plant the stacked top soil with plants to maintain its fertility during construction.
- In case the top soil is sent off-site for preservation or re-use, it must be documented well in terms of total quantity being sent. Also document the receiving of top soil on the receiver's letter head with clear mention of quantity and purpose of reuse of top soil.
- Take photographs of process of stripping of top soil, stacking it for preservation at site or sending it off site in trucks.

3. Existing Trees Protected and Barricaded

- Existing trees at site should be fenced with brick work/steel bars/empty gunny bags/caution tape/green mesh for protection.
 - Nothing should be dumped within the fenced area & protected tree.
- 4. Construction Area Fencing Up To Minimum 3m Height**
- The entire construction area requires a 3m high barricade on all sides of the plot. Metal sheeting or green mesh or temporary brick wall will suffice.
- 5. Covering of Excavated Soil**
- Excavated soil must be properly stored and covered to prevent erosion. Covering with green mesh or the growing of native plants on the soil mound is acceptable.
 - Any excavated soil sent offsite through trucks should be covered properly by tarpaulin.
 - In case excavated soil is kept at site temporarily and covering it is not possible, then it must be sprinkled with water on daily basis and compacted to prevent erosion.
- 6. Daily Water Sprinkling**
- Daily water sprinkling on excavated soil and fine aggregate is required to prevent erosion / pollution.
 - Water sprinkling is also required in areas with vehicular movement.
 - Water sprinkling is advised to be done by recycled water or harvested rain water during construction.
- 7. Vehicle Tyre Wash Facility**
- Ensure that all vehicles entering and existing construction site including trucks, cars, water tankers etc have their tyres cleaned off properly with pressure water gun or tyre wash pit. The tyre wash pit must be located at all vehicular site entrance and exit points. The tyre wash pit must be minimum as wide as the width of the entrance/exit gate and 3.6m long.
- 8. Truck Top Covering**
- Trucks carrying fine aggregate or other materials that have the potential to cause pollution should be adequately covered with tarpaulin to prevent spillage.
- 9. Temporary Storm Water Drains**
- Storm water drains should be maintained minimum around the site periphery to allow for proper discharge of storm water from site.
 - Temporary storm water drain can be built leading to a sedimentation pond to prevent eroded soil choking the municipal drainage network.
 - Overflow from the sedimentation pond must be filtered through gravel bed/ gravel dam before discharge into the municipal drains.
 - The filtration gravel beds or gravel dam must be cleaned after every major rain shower to prevent clogging.
 - Sedimentation tanks must be maintained to reduce movement of soil from the site.
 - Accumulated sludge at the bottom must be regularly cleaned.
- 10. Diesel Generator Sets**
- All DG sets must have exhaust at least 3 m above ground level.
 - DG sets must be placed on a proper platform to prevent spillage of diesel and other pollutants.
 - The area surrounding the DG set should be kept free from pollution such as the seepage of oil. This can be ensured by placing trays underneath storage drums.

- Hazardous wastes produced during operation / maintenance such as choked filters etc. should be disposed of properly and should not contaminate the surrounding space.
 - All diesel storage drums at site should be kept on over a paved area. The drum being used for diesel dispensing should be kept over a metal spill collection tray to collect any spilled oil for reuse.
- 11. Properly Stacked Raw Materials**
- Raw materials such as bricks, AAC blocks etc. must be properly stored and stacked.
 - Toe wall should be provided around all fine and course aggregates stored at site to prevent spillage, wastage and pollution.
 - All construction chemicals should be kept on proper paved area, dry and shaded from sun and rain.
- 12. Separate Waste Bin Provision**
- Provide adequate number of waste bins such that there is a bin within 30 m radius at all times at all points of site where workers are working and labour hutment.
- 13. Construction Waste Segregation**
- Dedicated areas to be provided for each segregated waste such as steel scrap, aluminium scrap, broken bricks, broken tiles, stone cut pieces, empty cement bags, empty chemical drums, paint buckets, packaging cardboard, broken glass, concrete debris etc. and properly stored on site.
 - All different types of waste must be properly segregated.
 - Only government authorised waste haulers and scrap dealers must be allowed to take away scrap from the site. Contractor must seek pre-approval of scrap dealers and waste haulers from LEED consultant or project engineer – in charge. Scrap dealer / waste hauler must only be allowed to take away waste which they are authorised for by government of India.
 - Any waste scrap sold to recycler or waste hauler must be documented in weight (Kilograms) for each time.
 - Maintain a full log book records along with supporting challans/receipts for the recyclable waste being sold from the site. Ensure all the challans have waste materials documented with their actual weight.
 - Ensure all the construction waste being reused at site like broken bricks, debris, empty cement bags etc are documented with their approximate quantities. Maintain photographs of their storage before reuse at site as segregated waste and after reuse.
 - The contractor is responsible to document all construction waste generated at site, sold to waste recycler and waste reuse at site up to minimum 95% accuracy (by weight) and share documentation with LEED consultant or Engineer-In-charge.
- 14. Indoor Air Quality Management Plan during Construction**
- **HVAC protection**
 - Ideally, permanently installed HVAC equipment's like ducts, dampers, grills, split AC units etc. should not be used during the construction process as it can cause contamination of the HVAC system. The same was properly covered up to ensure that it will remain free from Dust and Grime during the construction.
 - Equipment's mentioned above should be stored in such a place such that it will not be impacted by the dust, debris, water, and other contaminants.
 - Dedicated places should be assigned for storage of ducting & HVAC materials. equipment rooms should not be used for storage of such materials.
 - Coating on ductwork, internal insulation must be checked for dusts before installation.

- Duct Ends should be covered by plastic sheets. Covering should be of good quality Plastic sheet or a Tarpaulin.
- Duct's open ends and overnight pending works should be properly sealed which in turn tied firmly with String or Chord.
- **Source control**
 - Low VOC compliant materials such as paints, adhesives & sealants as well as carpet, composite wood those have low toxicity levels should be used.
 - Containers housing toxic materials were recovered & isolated, and in some cases ventilated.
 - Low emitting materials & non-toxic eco-friendly certified chemicals should be procured for cleaning of glasses, hard surfaces, toilet bowls, wash rooms etc.
 - To minimize the dustiness, odor during construction work, use exhaust fans which are directed to outdoors or consider air-cleaners if exhaust is not feasible in some areas (i.e. interior space)
- **Pathway interruption**
 - Areas of work were isolated to prevent contamination of clean or occupied spaces, during construction.

PART E: OTHER DOCUMENTS

 - Suppressing & minimizing the migration (flying) of dust from one area to another were taken care by wetting the mop & cleaning the space.
 - Water spills in the workplace were picked-up immediately by cloth mop & surface to be dried up.
 - Materials which are potential source of pollution (like cement bags, painting items, insulation materials etc.) were kept isolated & far off places from HVAC equipment's and During interior fit-out works, the entry-way doors were kept closed to isolate the office fit-out areas from being impacted by outside dust.
 - Temporary barriers were used to prevent dust entry from construction site to finished area
- **Housekeeping**
 - Regular cleaning of debris, construction waste should be done to avoid piling up of waste, which may cause health hazards for workers working on site.
 - All construction workers should be provided with dust control masks to prevent from health hazards.
 - All workmen instructed to put the remains of lunch packs, cups & other litter in a trash can provided.
 - All electrical panels should be covered with water proofing covers to protect from water entry.
 - All moisture absorbing agents like carpets, furniture, adhesives, sealants, cements etc. were stored in moisture proof dry room.
 - All finished areas were vacuum cleaned to avoid dust flying off in the air.
- **Scheduling**
 - All construction activities over the duration of the project will be sequenced carefully to minimize the impact on the indoor air quality.
 - Proper planning will be done to allocate adequate time for finishing the construction activities so that flush-out & IAQ test procedures can be completed prior to occupancy.
 - Where storage of construction materials is necessary:
 - Identify storage location by material
 - Keep dry, off floor, covered
 - Inspect at least weekly, daily is better
 - Keep checklist(s) in storage area
 - Upon completion of construction, replace all filtration media immediately prior to occupancy, installing only a single set of final filtration media
- **Other Strategies to be followed:**
 - Protect absorptive materials stored on-site and installed from moisture damage.

- Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2007, with errata (or media with ISO coarse 90% or higher, as defined by ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer's recommendations.
- Prohibit the use of smoking inside the building and within 25 feet (7.5 meters) of the building openings during construction

15. Building Commissioning

- The contractor shall be responsible for submitting commissioning reports of all MEP systems as per the LEED Pre-functional checklist. The pre-functional checklist will be provided to the contractor by LEED consultant so that documentation of building system commissioning is done as per LEED requirements.
- The contractor shall be responsible for submitting O&M manuals for all MEP systems in PDF format for LEED submission.
- The contractor shall be responsible for commissioning activities for the building's thermal envelope in accordance with ASHRAE Guideline 0–2013 and ASTM E2947-16: Standard Guide for Building Enclosure Commissioning, as they relate to energy, air and water tightness, indoor environmental quality, and durability. The building enclosure commissioning report shall be submitted to and approved by LEED consultant.

16. Documentation for LEED

- The contractor shall be responsible for submitting original Purchase Invoices for total quantities of each and every construction material, MEP equipment, Interior finishes works, exterior finishes works and external development works. The contractor can hide the price and rate from the copies of Purchase invoices shared with LEED consultant for LEED documentation purpose.
- The contractor shall be responsible for submitting Technical data sheets of all the MEP systems, components, equipments etc as per the requirement of LEED.
- Contractor shall be responsible for submission of date stamped coloured photographs (in .jpeg format only) on monthly basis for all the green building construction site practices as highlighted in this document.