कोचिन पत्तन प्राधिकरण
Cochin Port Authority

COCHIN PORT AUTHORITY

Tele: 91-0484 -2666414/0484-258-2400
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TENDER DOCUMENT FOR RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

(e-Tendering Mode)
Website: www.tenderwizard.com/CPT

Tender No. T1/T-2079/2026-C

COCHIN PORT AUTHORITY
CHIEF ENGINEER'S OFFICE
COCHIN-682 009

Price: Rs.11800/- (Rs.10,000/-+18% GST)

COCHIN PORT AUHTORITY

CIVIL ENGINEERING DEPARTMENT

Tender No: **T1/T-2079/2026-C**

Tender for

TENDER DOCUMENT FOR RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

SECTION -I

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SECTION -I

COCHIN PORT AUTHORITY

Chief Engineer's Office
Cochin Port Authority
W/Island , Cochin – 682009, KERALA
Tele: 91-0484-2666414/0484-258-2400
website: www.cochinport.gov.in

COCHIN PORT
कोचिन पत्तन प्राधिकरण
Cochin Port Authority

Tender No. T1/T-2079/2026-C **Dated:10/01/2026**

1. NOTICE INVITING TENDER

Electronic Tenders **(e-tenders)** on percentage basis are invited by Cochin Port Authority from reputed contractors in Single Stage Two Cover bidding procedure [Technical Bid and Financial Bid], meeting the Minimum Eligibility Criteria specified below for the work of **"RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II"**.

1) MINIMUM ELIGIBILITY CRITERIA:

a) Experience

The tenderers should have experience of having successfully completed during the last 7 (seven) years ending **31st December, 2025,** at least either:

i. Three Similar Works each costing not less than **Rs. 7,12,77,792.00**

(OR)

ii. Two Similar Works each costing not less than **Rs.8,90,97,240.00**

(OR)

iii. One Similar Work costing not less than **Rs. 14,25,55,584.00**

b) Financial Turnover

Average Financial Turnover of the tenderer over the last three financial years ending 31st March 2024 of the previous financial year *[2022-'23, 2023-'24, 2024- 25]* shall not be less than **Rs.5,34,58,344.00**

Explanatory Notes to a) & b) :

Note 1:- **Similar Work(s) means "Remodeling/Renovation/Refurbishment/ interior fit-out of a commercial building/corporate office space/ institutional building"**

Note 2:- Following enhancement factors will be used for the costs of works executed for bringing the financial figures to a common base value in respect of the works completed in past years.

Table 1

Year before	**Multiplying factor**
One year *[December, 2024]*	1.07
Two years [*December, 2023]*	1.14
Three years *[December, 2022]*	1.21
Four years *[December, 2021]*	1.28
Five years [*December, 2020]*	1.35
Six years *[December, 2019]*	1.42

Note 3:- The experience certificate of works executed in private sectors / organisations shall be considered for qualification, only on submission of TDS certificate along with work order and completion certificate.

Note 4:- Satisfactory Client / Owners's Certificate or documentary proof shall be submitted in support of the assignments / works performed and claimed by the tenderer to fulfill the eligibility criteria for qualification. A statement duly certified by the Chartered Accountant showing the Average Annual Financial Turnover over the last 3 financial years and audited financial statements for the last three years shall be submitted.

Note 5:- The works reckoned for the above purpose are those executed by the tenderers as prime contractor or proportionately as member of joint venture or as a sub-contractor authorized and approved by the Employer of the work(s) against which the tenderer has claimed his experience; it will be considered for qualification only if documentary proof of such authorization / approval of the Employer are submitted.

Note6:- The contractor can also engage Subcontractor for

i)Electrical works having Class B Electrical contractor license and having similar experience in Electrical works for a client in India during the last 5 years ending 31.12.2025

ii)Having similar experience in ELV works viz., establishing Network Infrastructure including structured cabling & configuration of network devices for a client in India during the last five years ending 31.12.2025 and

iii. having similar experience in HVAC including firefighting, MEP for a client in India during the last five years ending 31.12.2025

iv. The Contractor can also engage Sub-contractor for installation of Fire Fighting System who had experience of successfully completed the installation of Fire Fighting System as per NBC Part IV.

SUB CONTRACTOR ELIGIBILITY CRITERIA

Work Description	**1 similar work costing not less than**	**2 similar works costing not less than**	**3 similar works costing not less than**	**Financial turnover not less than**
Fire Fighting System	59,23,698.40	37,02,311.50	29,61,849.20	22,21,386.90
Electrical Works	1,56,08,306.60	97,55,191.63	78,04,153.30	58,53,114.98
HVAC	1,22,18,480.80	76,36,550.50	61,09,240.40	45,81,930.30
ELV Works	1,91,12,948.80	1,19,45,593.00	95,56,474.40	71,67,355.80

The details of the subcontractor shall be submitted either along with the tender or subsequently after issuance of the work order. The main contractor shall obtain prior approval from CoPA before engaging any subcontractor for verification of the firm's credentials. Engagement of the subcontractor shall be subject to approval by CoPA.

2) Other Eligibility Considerations

a) Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

i) made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or

ii) record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures, black listing/ debarring by Govt. departments etc.

b) The bidders having EPF/ ESI registration certificates only shall be considered for qualification in the tenderers, if applicable, as per EPF /ESI Acts. In case, the Tenderer does not have the required number of employees which makes such registration mandatory, an Undertaking as per Annexure – 11 to the effect shall be furnished.

3) **Pertinent information to the tender is given in the following Tables:**

i) **Schedule of different activities till submission of the bid are detailed as under:**

Table 2

Sl. No.	Particulars	Date and Time
1	Tender e- publication date	***10/01/2026***
2	Download period of Bid Documents	***10/01/2026 to 06/02/2026***
3	Last date for seeking clarification	***20/01/2025 up to 15:30 hrs***
4	Date of Pre-Bid meeting	***21/01/2026***
5	Last date and time of submission of Bid	***06/02/2026*** **up to 14.30 hrs**
6	Date and time of opening the Bid	***06.02.2026*** **after 15.00 hrs**

Bid information:

Table 3

i)	Estimated Amount put to Tender	: **Rs 17,81,94,481**
ii)	Earnest Money Deposit	:**Rs 35,63,890/-** furnished through Demand Draft or Banker's Cheque drawn in favour of Financial Adviser & Chief Accounts Officer, CoPA from any Nationalised Bank/ Scheduled Bank in India / Insurance Surety Bond from the Insurance Company duly approved by Insurance Regulatory and Development Authority of India or through RTGS/NEFT mode as per Bank details at Annexure-
iii)	Cost of Bid document	**Rs.11800/-** (Rs.10,000 + 18% GST) (Non refundable) furnished either through Demand Draft/ Banker's Cheque drawn in favour of the Financial Adviser & Chief Accounts Officer, CoPA from any Commercial Bank in India, or through RTGS/NEFT mode mode as per Bank details at Annexure- being the cost of single copy of the tender document.
iv)	Validity period of Tender	120 days from the Last Date of Submission of Bid.
v)	Time for Completion	8 Months

4) This work essentially comprises of the following:

A. Civil & Architectural Works

1. Demolition, dismantling, and safe disposal of existing PCC, RCC, brickwork, partitions, doors, windows, false ceilings, stone/tile flooring, skirting, dado, steel hand railings, glazing, and all related components, including complete debris clearance.
2. Providing and laying fully vitrified tiles, Matt/Antiskid finish Vitrified tiles, wall tiles, polished granite stone and finishing materials in all rooms, toilets, and pantry areas. Filling sunken floor areas in toilets using AAC brickbat concrete.
3. RCC works for lintels, shafts and roof slab.
4. Upgradation of existing meeting spaces including conversion of the Ground Floor conference room into an Auditorium and revamping of the Sixth Floor and Second Floor conference rooms.
5. Remodelling of workspaces into chambers, cabins, cubicles, and workstations, including integrated furniture layout.
6. Masonry works using precast concrete solid blocks.
7. Replacement of existing aluminium windows with UPVC units.
8. Joinery works including FRP doors, flush doors, wooden doors, UPVC windows/louvered doors/ventilators/aluminium glazed doors, fire resistant doors, frameless toughened glass door and associated frames.
9. Waterproofing treatment for sunken areas in WCs
10. Structural steel works for washbasin counters, second-floor roof, and conference hall stage, including protective epoxy coating.
11. Cement plastering of 12 mm thickness on new brickwork and repair plastering (12–20 mm) wherever required.
12. Complete interior painting works with premium quality paint including primer, putty, and finishing coats.
13. Partition Walls - Installation of 1.5m high half-height decorative laminate partition with aluminium framework, double skin cladded with 12mmthick BWP 710 on both sides; urinal partitions with HPL Compact Board; toilet cubicle; Fixed Glass Partition for Cabins; Gypsum Board Partition; Fibre Cement Board for covering ducts etc.
14. False ceiling works using gypsum moisture resistant boards in cabins and aluminium grid ceilings in toilets and passages.
15. Laminated wooden false ceiling using 710 BWP plywood (12 mm / 6 mm) in conference rooms and designated areas.
16. Laminated/decorative veneer/fluted Wall panelling using 710 BWP plywood/flexible plywood at the board room, lobby, corridors, reception and other specified locations. WPC fluted wall panelling/acoustic PET panelling at Board room and conference room.
17. Miscellaneous interior finishing works including installation of mirrors, decorative vertical panels, 3D artwork, office signage, acrylic LED illuminated logo, frosted privacy film/sticker, heavy-duty adhesive applications, and PVC coated polyester fabric roller blinds.
18. External development works like Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels; Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units;

Providing & Laying of Cement Concrete paver blocks; GRC column works; Kota stone work; tactile tile work etc.

19. Fabrication and installation of office furniture such as tables, chairs, workstations, conference room/Board room furniture, and built-in storage units.

B. MEP Works

The MEP scope includes the supply, installation, testing, and commissioning of the following systems:

B.1 Plumbing System

20. Installation of water supply lines, drainage networks, sanitary fittings, fixtures, and accessories.
21. Dismantling of existing sanitary fittings and replacement with new fixtures.

B.2 Electrical & ELV Works

22. Providing new Electrical wiring, conduiting, DBs, switch Boards, LED / Electrical fittings, LED light driver, TPN Tap off boxes, Cable trays etc. as per the schedule/ BOQ.
23. Providing new Main MV panels, DG synchronizing panels, Sub Panels, terminations etc. as per the schedule/BOQ.
24. Providing New DG set, shifting of old DG sets with panels, housing of DG sets, Exhaust pipes with insulation, foundations, earthing of DGs etc. as per the schedule/BOQ
25. Providing new UPS systems with batteries as per the schedule/BOQ.
26. Providing and terminations of cables, Earthing and commissioning of the entire work as per the schedule / BOQ
27. Providing new HVAC items including AC outdoor and indoor units, ventilation fans, ducting, copper piping, copper piping and duct thermal insulation, duct acoustic insulation, control wiring, wired and wireless controllers, raise ways/duct /shaft etc. for routing the same as per the schedule/BOQ
28. Providing new ELV system with telephone, DATA sockets, Data and telephone cabling and conduiting, Telephone units, EPABX, OFC cabling, Network switches, Network racks, cable trays for ELV, CCTV cameras, CCTV NVR, WiFi access points and wireless controllers, SFP modules, Patch panels and patch cables, and related items as per the schedule / BOQ
29. Providing new ELV-Audio/Video system with LED wall screen, Amplifiers, Mixers, Speakers, Interactive LED screens, Microphone, All in one video conferencing equipment, cabling, conduiting, network racks, LED TVs and related items as per the schedule / BOQ
30. Providing new Fire Fighting items with Electrical Fire pumps, Fire pump with Diesel engine, Air vessel, Pressure gauges, Flow switches, MS piping, Valves, Hydrant valves, yard hydrants, Branch pipes, Non percolated RRL hoses, Hose reels, Hose cabins, Sprinklers, smoke and heat detectors, air release valves, fire brigade connection ,Tank filling unit, Pipe supports ,Electrical wiring and conduiting for FAS and PA system, Manual call points, Fire alarm sounder, talk back unit system, Fire alarm panels ,PA speaker system with mic and amplifier, Fire extinguishers and signages as per the schedule / BOQ
31. Dismantling and removing the old existing Electrical wiring/Distribution items, Panels, Electrical fittings, Switch Board, DB’s, cables, ELV items, old lightning arrestor strips/Mast, Fire Fighting items, AC systems etc. for enabling the proposed new work installation.

B.3 HVAC & Ventilation

32. Installation of air-conditioning equipment, ducting networks, ventilation systems, and relevant accessories.

B.4 Fire Protection System

33. Provision and installation of fire hydrants, sprinkler systems, fire extinguishers, pumps, pipelines, valves, and associated fire-safety infrastructure.

5) The **proposed site of work is the New Administrative Building located at the North End of Cochin Port Authority, Willingdon Island. The building comprises Ground Floor plus eight floors (G+8). The works are to be carried out in an operational office; therefore, only partial displacement of occupants may be carried** out**. In the first phase, the work shall be executed on the Ground Floor and the 6th Floor. Subsequently, the remaining floors shall be taken up in a phased manner. The 7th and 8th Floors are critical operational areas and cannot be vacated; hence, work in these areas shall also be carried out simultaneously with other floors. The entire scope of work shall be completed within a period of Eight (8) months.**

6) Tender documents can be downloaded from the e-Tendering portal ***www.tenderwizard.com/CPT*** on the dates specified in Table 2 given above by making online requisition. Bid document will also be available in Cochin Port website (www.cochinport.gov.in) as well as Govt. tender website, www.tenders.gov.in, which can be downloaded for submission. The cost of bid document shall be furnished in the form of Demand Draft/ Banker's Cheque drawn in favour of FA & CAO, CoPA along with the submission of bid.

7) The bidders need to obtain the one-time User ID & password for log-in to in **e- Tendering** system from the service provider **KEONICS** by paying registration amount of **Rs.1124/-** by online Payment using Credit/Debit Card/Net banking or DD in favour of "KSEDCL, Bangalore".

8) The intending bidder must have valid Class-II or III digital signature certificate to submit the bid. For further details and to obtain the digital signature, please contact e-Tender Help Desk No.080-40482000 / 9746118529 / 9605557738.

9) Tenders shall be submitted "**online**" strictly in accordance with the Instructions to Tenderers and Terms & Conditions given in the tender document.

10) The bidder is responsible to download Addenda/ Amendments/ Errata/ Replies to the queries of the bidders etc., if any, issued by the Employer, from the website before submission of the bid. **Any shortfall in uploading the said Addenda/ Amendments/ Errata/ Replies to the queries of Tenderer etc. duly signed along with the downloaded documents while uploading the Tender will render the Tender incomplete and incomplete Tender Documents may be rejected**.

11) All Bids are to be submitted **online only** on the website www.tenderwizard.com/CPT. No Bids shall be accepted off-line (Hard copy). Cochin Port Authority will not be held responsible for any technical snag or network failure during online bidding. It is the bidder's responsibility to comply with the system requirements i.e. hardware, software and internet connectivity at bidder's premises, to access the e-Tender portal. Under any circumstances, Cochin Port Authority shall not be liable to the bidders for any direct/indirect loss or damages incurred by them arising out of incorrect use of the e-Tender system or internet connectivity failures.

12) The Bidder shall submit Originals of: (i) DD / Banker's Cheque/ Pay Order / Insurance Security Bond / Bank Guarantee towards the cost of Tender document / EMD and (ii) Power of Attorney in favour of signatory(s) to the tender along with letter of submission and (iii) duly signed Integrity Pact in a sealed cover **to the Chief Engineer, Cochin Port Authority, W/Island, Cochin – 682009, KERALA**, before opening date and time of the tender. **Non submission of original financial document towards cost of Tender document and EMD Declaration, before opening date and time, of the Tender will be liable for rejection**.

13) **Micro and Small Enterprises (MSE's) Bidders who are registered with District Industries Centre (DIC) or Khadi and Village Industries Commission (KVIC) or Khadi and Village Industries Board (KVIB) or Coir Board or National Small Industries Corporation (NSIC) or directorate of Handicrafts and Handlooms or Udyog Aadhaar Memorandum or any other body specified by Ministry of MSME for similar nature of Works shall be eligible for issue of Bid Document free of cost and exemption from payment for issue of tender document & payment of EMD. They are required to submit documentary proof of such registration along with the offer, as detailed in Instructions to Bidders, for claiming the available exemptions and a scanned copy of Exemption Certificate duly notarized shall be uploaded in the e- Tender Portal. If the Registration Certificate does not pertain to the Category of "Similar Works" mentioned above, the Tender will be rejected.**

14) **Integrity Pact (IP)** shall cover this tender throughout its various phases, and IP would be deemed as a part of the contract through an appropriate provision. The bidders should sign and submit an —Integrity Pact to be executed between the bidder and Cochin Port Authority along with the bid in a separate envelope super scribed —Integrity Pact in Technical Bid. Bids not accompanied by a duly signed —Integrity Pact shall be liable for rejection. IP would be implemented through the following Independent External Monitor (IEM) for this tender:

1. Shri.Harishwar Dayal,IDSE(Retd),
H-2, Lawyer Colony, Bypass Road,
Agra-282 005 (UP) Mobile No.9412095786.
e-mail id: dayalagra@gmail.com

2. Shri.Deepak Chaturvedi, ITS(Retd),
Flat No.1, Sanchar Vihar, C-5814,
Sector-62, Uttar Pradesh, Noida -201301
Mobile No.9930408711.
e-mail id :chaturvedideep@rediffmail.com

For full details of the scheme of IP, you may visit the website of Central Vigilance Commission, New Delhi.

15) The undersigned reserves the right to reject/cancel/postpone any one or all tenders at any stage of the tender, which shall be binding on all bidders.

CHIEF ENGINEER
COCHIN PORT AUTHORITY

SECTION I

COCHIN PORT AUTHORITY

2. INSTRUCTIONS TO TENDERERS

1. Introduction

This tender is invited for "**RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II**". The work essentially comprises of the following:

A. Civil & Architectural Works

1. Demolition, dismantling, and safe disposal of existing PCC, RCC, brickwork, partitions, doors, windows, false ceilings, stone/tile flooring, skirting, dado, steel hand railings, glazing, and all related components, including complete debris clearance.
2. Providing and laying fully vitrified tiles, Matt/Antiskid finish Vitrified tiles, wall tiles, polished granite stone and finishing materials in all rooms, toilets, and pantry areas. Filling sunken floor areas in toilets using AAC brickbat concrete.
3. RCC works for lintels, shafts and roof slab.
4. Upgradation of existing meeting spaces including conversion of the Ground Floor conference room into an Auditorium and revamping of the Sixth Floor and Second Floor conference rooms.
5. Remodelling of workspaces into chambers, cabins, cubicles, and workstations, including integrated furniture layout.
6. Masonry works using precast concrete solid blocks.
7. Replacement of existing aluminium windows with UPVC units.
8. Joinery works including FRP doors, flush doors, wooden doors, UPVC windows/louvered doors/ventilators/aluminium glazed doors, fire resistant doors, frameless toughened glass door and associated frames.
9. Waterproofing treatment for sunken areas in WCs
10. Structural steel works for washbasin counters, second-floor roof, and conference hall stage, including protective epoxy coating.
11. Cement plastering of 12 mm thickness on new brickwork and repair plastering (12–20 mm) wherever required.
12. Complete interior painting works with premium quality paint including primer, putty, and finishing coats.
13. Partition Walls - Installation of 1.5m high half-height decorative laminate partition with aluminium framework, double skin cladded with 12mmthick BWP 710 on both sides; urinal partitions with HPL Compact Board; toilet cubicle; Fixed Glass Partition for Cabins; Gypsum Board Partition; Fibre Cement Board for covering ducts etc.
14. False ceiling works using gypsum moisture resistant boards in cabins and aluminium grid ceilings in toilets and passages.
15. Laminated wooden false ceiling using 710 BWP plywood (12 mm / 6 mm) in conference rooms and designated areas.
16. Laminated/decorative veneer/fluted Wall panelling using 710 BWP plywood/flexible plywood at the board room, lobby, corridors, reception and other specified locations. WPC fluted wall panelling/acoustic PET panelling at Board room and conference room.
17. Miscellaneous interior finishing works including installation of mirrors, decorative vertical panels, 3D artwork, office signage, acrylic LED illuminated logo, frosted privacy

film/sticker, heavy-duty adhesive applications, and PVC coated polyester fabric roller blinds.

18. External development works like Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels; Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units; Providing & Laying of Cement Concrete paver blocks; GRC column works; Kota stone work; tactile tile work etc.
19. Fabrication and installation of office furniture such as tables, chairs, workstations, conference room/Board room furniture, and built-in storage units.

B. MEP Works

The MEP scope includes the supply, installation, testing, and commissioning of the following systems:

B.1 Plumbing System

20. Installation of water supply lines, drainage networks, sanitary fittings, fixtures, and accessories.
21. Dismantling of existing sanitary fittings and replacement with new fixtures.

B.2 Electrical & ELV Works

22. Providing new Electrical wiring, conduiting, DBs, switch Boards, LED / Electrical fittings, LED light driver, TPN Tap off boxes, Cable trays etc. as per the schedule/ BOQ.
23. Providing new Main MV panels, DG synchronizing panels, Sub Panels, terminations etc. as per the schedule/BOQ.
24. Providing New DG set, shifting of old DG sets with panels, housing of DG sets, Exhaust pipes with insulation, foundations, earthing of DGs etc. as per the schedule/BOQ
25. Providing new UPS systems with batteries as per the schedule/BOQ.
26. Providing and terminations of cables, Earthing and commissioning of the entire work as per the schedule / BOQ
27. Providing new HVAC items including AC outdoor and indoor units, ventilation fans, ducting, copper piping, copper piping and duct thermal insulation, duct acoustic insulation, control wiring, wired and wireless controllers, raise ways/duct /shaft etc. for routing the same as per the schedule/BOQ
28. Providing new ELV system with telephone, DATA sockets, Data and telephone cabling and conduiting, Telephone units, EPABX, OFC cabling, Network switches, Network racks, cable trays for ELV, CCTV cameras, CCTV NVR, WiFi access points and wireless controllers, SFP modules, Patch panels and patch cables, and related items as per the schedule / BOQ
29. Providing new ELV-Audio/Video system with LED wall screen, Amplifiers, Mixers, Speakers, Interactive LED screens, Microphone, All in one video conferencing equipment, cabling, conduiting, network racks, LED TVs and related items as per the schedule / BOQ
30. Providing new Fire Fighting items with Electrical Fire pumps, Fire pump with Diesel engine, Air vessel, Pressure gauges, Flow switches, MS piping, Valves ,Hydrant valves, yard hydrants, Branch pipes, Non percolated RRL hoses, Hose reels, Hose cabins, Sprinklers, smoke and heat detectors, air release valves, fire brigade connection ,Tank

filling unit, Pipe supports, Electrical wiring and conduiting for FAS and PA system, Manual call points, Fire alarm sounder, talk back unit system, Fire alarm panels ,PA speaker system with mic and amplifier, Fire extinguishers and signages as per the schedule / BOQ

31. Dismantling and removing the old existing Electrical wiring/Distribution items, Panels, Electrical fittings, Switch Board, DB's, cables, ELV items, old lightning arrestor strips/Mast, Fire Fighting items, AC systems etc. for enabling the proposed new work installation.

B.3 HVAC & Ventilation

32. Installation of air-conditioning equipment, ducting networks, ventilation systems, and relevant accessories.

B.4 Fire Protection System

33. Provision and installation of fire hydrants, sprinkler systems, fire extinguishers, pumps, pipelines, valves, and associated fire-safety infrastructure.

2. General Instructions

2.1 The work is to be executed as described in the Bid document and in particular in the Technical Specifications, Special Conditions, Schedule of Quantities and Drawings and in general includes, but is not limited to supplying all including consumables and equipment necessary to execute the work as described in the Bid Document.

2.2 Before submitting the Bid, the bidder shall examine carefully all conditions of contract, specifications, drawings etc. supplied herewith. The bidders shall inspect the site of work with prior appointment with the concerned Section Engineer of the work to get himself acquainted with the site conditions and to assess and satisfy himself of the difficulties and constraints which may be involved in executing the work in the location. It will be deemed that prior to the submission of Tender, the tenderer has visited the site and has satisfied himself as to the nature and location of the work, general and local conditions, particularly those pertaining to transportation, handling and availability and storage of materials, availability of labour, weather conditions, tidal variations at site, working conditions, ground level, nature of soil etc. and that the tenderer has estimated his cost accordingly; the Port Authority will be in no way responsible for the lack of such knowledge and also consequences thereof to the Tenderer. Failure to visit the site will in no way relieve the successful bidder of any of the obligations in performing the work in accordance with this Bid Document including Addenda / Corrigenda, within the quoted price.

2.3 A bidder shall be deemed to have full knowledge of all documents, site conditions etc. whether he has inspected them or not. The submission of a Bid by the bidder implies that he has read the notice and conditions of contract and has made himself aware of the scope and specifications and other factors bearing on the bid and that they are binding on him.

2.4 The bidders may please note that the EMPLOYER will not entertain any correspondence or query on the status of the offers received against this Bid. Bidders are also requested not to depute any of their personnel or agents to visit the Employer's offices for making such enquiries till finalization of the bid. Should the EMPLOYER find it necessary to seek any clarification, technical or otherwise, the concerned bidder will be duly contacted by the EMPLOYER.

2.5 Canvassing in any form by the bidder or by any other agency acting on behalf of the bidder after submission of the bid may disqualify the said bidder. The Employer's decision in this regard shall be final and binding on the bidder.

2.6 EMPLOYER will not be liable for any financial obligation in connection with the work until such time the EMPLOYER has communicated to the successful bidder in writing his decision to entrust the Work (covered by the bid document issued to him).

2.7 E-mail offers will not be considered. Bidders should prepare their bid themselves and submit it "online". Bids submitted by agents will not be recognized.

2.8 Bids received after the due date and time and any change in bid after the specified date & time will be rejected. EMPLOYER will not be responsible for the loss of the bid document or for the delay in postal transit.

2.9 In case of an unscheduled holiday on the prescribed closing/opening day of the bid, the next working day will be treated as the scheduled prescribed day of closing/opening of the bid.

2.10 While evaluating the document, regard would be to National defense and security considerations, at the discretion of the Cochin Port Authority. Bid received from any bidder may be summarily rejected on National security consideration without any intimation thereof to the bidder.

2.11 If there are varying or conflicting provisions made in any document forming part of the contract, the Chief Engineer, Cochin Port Authority, Cochin – 682009, shall be the deciding authority with regard to the intention of the document which shall be binding on the Bidder.

2.12 In case the department desires to inspect the equipments / machinery for confirmation of its availability and capacity etc., necessary arrangements shall be made by the contractor for such inspection at his own cost.

2.13 Any error in description, and any omissions there from shall not vitiate the contract or release the Contractor from the execution of whole or any part of the works comprised therein according to drawings and specifications or from any of his obligations under the contract

2.14 All the Bank Guarantees (BGs) to be furnished except for EMD by the Contractors in connection with the tender shall be sent to the Chief Engineer, Cochin Port Authority directly by the issuing bank under registered post with AD. The Contractor shall take the responsibility of sending BGs directly to the Port Authority by the issuing bank.

2.15 ***The Contractor / approved Sub-Contractor if any, shall comply with all the provisions of the Indian Employer Compensations Act, Provident Fund Regulations, Employees Provident Fund and ESI Act etc. amended from time to time and rules framed there under and other laws affecting the contract labour that may be brought into force from time to time.***

2.16 ***If applicable as per EPF/ESI Acts, the Tenderer shall be registered under EPF and ESI Act and the employees employed under them shall be covered in the EPF and ESI scheme. In such cases, who are registered under EPF Organization and ESI Corporation and furnish documentary evidence in support of valid registration shall only be considered for qualification for opening of Price Bids. In case, the Tenderer does not have the required number of employees which makes such registration mandatory, an undertaking as per Annexure – 11 to the effect shall be furnished.***

2.17 ***The Contractor shall regularly remit the Employer and Employee contribution to the authorities. If not, the Employer would remit the same and the amount so remitted shall be deducted from the part/final bill of Contractor.***

2.18 ***The contractor shall be registered under GST and shall furnish documentary evidence in support of valid GST registration.***

3. **Micro and Small Enterprises (MSE's) Bidders who are registered with District Industries Centre (DIC) or Khadi and Village Industries Commission (KVIC) or Khadi and Village Industries Board (KVIB) or Coir Board or National Small Industries Corporation (NSIC) or directorate of Handicrafts and Handlooms or Udyog Aadhaar Memorandum or any other body specified by Ministry of MSME for similar nature of Works shall be eligible for issue of Bid Document free of cost and exemption from payment for issue of tender document & payment of EMD. They are required to submit documentary proof of such registration along with the offer, as detailed in Instructions to Bidders, for claiming the available exemptions and a scanned copy of Exemption Certificate duly notarized shall be uploaded in the e-Tender Portal. If the Registration Certificate does not pertain to the Category of „Similar Works" mentioned above, the Tender will be rejected.**

4. If a bidder has already been awarded or qualified for a similar nature work with a higher value or equivalent value within the last 6 months from the date of Notice Inviting Tender, the tender of such bidder shall be evaluated / considered for qualification with the documents submitted by the bidders in those tenders provided the Bidder clearly states the details of above such works in the Letter of Submission.

5. **In the Letter of submission, the Bidder shall compulsorily indicate 2 nos. of** current active e-mail IDs to which further Bid related communication can be sent by CoPA. All communication from CoPA shall be deemed to have been delivered when the e-mail is sent to the specified e-mail ID and the date of sending the e- mail by CoPA shall be considered as the receipt by the Bidder. CoPA shall no way be responsible for the non-receipt of any such communication by the Bidder whatever be the reason due to which this has occurred

6. **Invitation for Bids:**

The Invitation for Bids is open to all eligible bidders meeting the Minimum Eligibility Criteria.

7. **Downloading of Tender Documents:**

Tender documents can be downloaded from the e-Tendering portal **www.tenderwizard.com/CPT** on the dates specified in NIT by making online requisition. Tender document can also be downloaded from Cochin Port website **www.cochinport.gov.in** or Government of India (GOI) tender portal **www.tenders.gov.in.** Demand Draft /Banker's cheque for cost of tender document drawn in favour of the Financial Adviser & Chief Accounts Officer(FA &CAO), CoPA from any Scheduled / Nationalized Bank having its branch at Cochin shall be submitted at the time of submission of bids and scanned copy of the same shall be attached with the e-tender.

In case of tender document being downloaded from the website, at the time of uploading, the tenderer shall give an undertaking that no changes have been made in the document. Port's Tender document will be treated as the authentic Tender document and if any discrepancy is noticed at any stage between the Port's Tender document and the one submitted by the Tenderer, the Port's document shall prevail. For the discrepancies found at any time, the Tenderer shall be liable for legal action.

8. One Bid per Bidder:

Each bidder shall submit only one bid. A bidder who submits or participates in more than one Bid will cause all the proposals with the Bidder's participation to be disqualified.

9. The Bidder

The Bidder shall be a single entity only.

10. Cost of Bidding:

The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will, in no case, be responsible and liable for those costs.

11. Site visit:

The Bidder, at the Bidder's own responsibility and risk is encouraged to visit and examine the work site and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for execution of the Works. The cost of visiting the site shall be at the Bidders own expense.

12. Clarification of the Bidding Documents:

12.1 The Tenderers are advised to examine the Tender Document carefully and if there be or appear to be any ambiguity or discrepancy in the documents, or any clarifications needed on the Tender Documents; these shall be referred to the Chief Engineer in writing at the following address, so as to reach him at least by ***20/01/2026.*** It is to be noted that no queries, clarifications will be answered after this date.

THE CHIEF ENGINEER, CHIEF ENGINEER's OFFICE, COCHIN PORT AUTHORITY, WILLINGDON ISLAND, KOCHI-9,
KERALA, INDIA.
Ph: - 91-0484-2666414/2582400. Fax:-91-0484-2666414.
Email: coptce@gmail.com / ce@cochinport.gov.in

13. Pre-Bid Meeting

The pre-bid meeting will be held on 21/01/2026. Requests for clarification on the bidding documents must reach the CE's office on or before 20/01/2026. No queries/clarifications on Bid Document shall be entertained after this date. The replies/clarifications/decisions shall be hosted at the Cochin Port Authority website www.cochinport.gov.in, e-Tendering Portal and CPP Portal.

At any time prior to the deadline for submission of Bid, CoPA may, for any reason, whether at its own initiative or in response to clarifications requested by a Bidder, modify the Bid Document by the issuance of Addenda /Corrigenda.

14. Any Addenda/ Corrigenda / Errata/ Replies to the queries of Bidder etc., if any,

issued by CoPA will be hosted in Cochin Port Authority website www.cochinport.gov.in, e-Tendering Portal and CPP Portal only and the Bidder shall be responsible to check and download those Documents, if any, issued by CoPA, from the website before submission of Bid. Bids with any shortfall in uploading the said Addenda/ Corrigenda / Errata/ Replies to the queries of Tenderer etc. duly signed along with the downloaded documents while uploading the Tender will render the Tender incomplete and incomplete Tender Documents may be rejected. In order to afford Bidders with reasonable time to take an Addendum into account, or for any other reason, the CoPA may, at its discretion, extend the Bid Submission Date and the Bid extension notice shall be hosted in the websites only.

15. Amendment of Bidding Documents:

The Chief Engineer, Cochin Port Authority, shall have the right to omit or suspend certain items of work or revise or amend the Bid documents prior to the due date of submission of the Bid by issuance of Addenda / Corrigenda. Any Addendum / Corrigendum thus issued shall be part of the Tender documents. The Addenda / Corrigenda, if any, shall only be hosted in the e-tender portal as well as in the website of the Cochin Port. It is the responsibility of the Bidders to download such Addenda / Corrigenda hosted in the website and submit the same duly signed along with the Bid. In order to afford the Bidders with reasonable time to take Addendum into account, or for any other reason, the Port Authority may, at its discretion, extend the due date for submission of Bid and bid extension notice shall be hosted in the web site.

16. Preparation of bids:

All documents relating to the bid shall be in the English language.

17. Minimum Eligibility Criteria:

(a) Experience

The tenderers should have experience of having successfully completed during the last 7 (seven) years ending **31st December, 2025,** at least either:

i. Three Similar Works each costing not less than **Rs.7,12,77,792/-**

(OR)

ii Two Similar Works each costing not less than **Rs.8,90,97,240/-**

(OR)

iii One Similar Work costing not less than **Rs.14,25,55,584/-**

(b) Financial Turnover

Average Financial Turnover of the tenderer over the last three financial years ending 31st March 2025 of the previous financial year *[2022-’23, 2023-’24, 2024- 25]* shall not be less than **Rs.5,34,58,344**

Explanatory Notes to (a) & (b):

Note 1:- **Similar Work(s) means "Remodeling/Renovation/Refurbishment/ interior fit-out of a commercial building/corporate office space/ institutional building"**

Note 2:-Following enhancement factors will be used for the costs of works executed for bringing the financial figures to a common base value in respect of the works completed in past years.

Table 1

Year before	**Multiplying factor**
One year *[December, 2024]*	1.07
Two years [*December, 2023]*	1.14
Three years *[December, 2022]*	1.21
Four years *[December, 2021]*	1.28
Five years [*December, 2020]*	1.35
Six years *[December, 2019]*	1.42

Note 3:- The experience certificate of works executed in private sectors / organizations shall be considered for qualification, only on submission of TDS certificate along with work order and completion certificate.

Note 4:- Satisfactory Client / Owner's Certificate or documentary proof shall be submitted in support of the assignments / works performed and claimed by the tenderer to fulfill the eligibility criteria for qualification. A statement duly certified by the Chartered accountant showing the average annual Financial Turnover over the last 3 financial years and audited financial statements for the last three years shall be submitted.

Note 5:- The works reckoned for the above purpose are those executed by the tenderers as prime contractor or proportionately as member of joint venture or as a sub-contractor authorized and approved by the Employer of the work(s) against which the tenderer has claimed his experience; it will be considered for qualification only if documentary proof of such authorization / approval of the Employer is submitted.

Note6:- The contractor can also engage Subcontractor for

i)Electrical works having Class B Electrical contractor license and having similar experience in Electrical works for a client in India during the last 5 years ending 31.12.2025

ii)Having similar experience in ELV works viz., establishing Network Infrastructure including structured cabling & configuration of network devices for a client in India during the last five years ending 31/12/2025 and

iii. having similar experience in HVAC including firefighting, MEP for a client in India during the last five years ending 31/12/2025

iv. The Contractor can also engage Sub-contractor for installation of Fire Fighting System who had experience of successfully completed the installation of Fire Fighting System as per NBC Part IV.

SUB CONTRACTOR ELIGIBILITY CRITERIA

Work Description	**1 similar work costing not less than**	**2 similar works costing not less than**	**3 similar works costing not less than**	**Financial turnover not less than**
Fire Fighting System	59,23,698.40	37,02,311.50	29,61,849.20	22,21,386.90
Electrical Works	1,56,08,306.60	97,55,191.63	78,04,153.30	58,53,114.98
HVAC	1,22,18,480.80	76,36,550.50	61,09,240.40	45,81,930.30
ELV Works	1,91,12,948.80	1,19,45,593.00	95,56,474.40	71,67,355.80

The details of the subcontractor shall be submitted either along with the tender or subsequently after issuance of the work order. The main contractor shall obtain prior approval from CoPA before engaging any subcontractor for verification of the firm's credentials. Engagement of the subcontractor shall be subject to approval by CoPA.

18. Other Eligibility Considerations

18.1 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

a. made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
b. record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures, black listing/ debarring by Govt. departments etc.

18.2 The bidders having EPF/ ESI registration certificates only shall be considered for qualification in the tenderers, if applicable, as per EPF /ESI Acts. In case, the Tenderer does not have the required number of employees which makes such registration mandatory, an Undertaking as per Annexure – 11 to the effect shall be furnished.

19. Bid Prices:

19.1 **Percentage Basis Contract**

The Bidder shall fill the percentage above / below in the Bidder's Quoting Area under "Percentage Quoted" in the Schedule-II (Schedule of Quantities to be done on Contract) both in **<u>figures and words</u>**. The Bidder shall also fill"Above / Below" column.

19.2 On scrutiny, if there are differences between the percentage given in figures and in words, the following procedure shall be followed: -

a) When there is a difference between the percentage quoted in figures and in words, the percentage in words shall be taken as correct.

b) When the sign (+) / (-) and Above / Below does not correspond with each other, the "words" under "Above / Below" shall be taken as correct.

19.3 Rates Quoted

The rate quoted by the Tenderer shall be inclusive of the cost of provision of plant and equipment, materials, labour, execution, supervision, maintenance, overheads and profits and every incidental and contingent cost and charges whatsoever <u>excluding Goods and Service Tax (GST)</u>. GST as may be applicable from time to time shall be shown separately in the invoice.

19.4 The Contract shall be for the whole Work based on the priced Bill of Quantities submitted by the Bidder. **<u>The Bidder should ensure that his tendered percentage as per Price Bid is not mentioned anywhere in any documents in Technical Bid submission, directly or indirectly. If any such mention is made, the tender will become invalid and shall become liable for rejection</u>.**

19.5 Currencies of Bid and Payment:

The unit rates and the prices shown in Schedule II of this document are in Indian National Rupees (INR).

20 Bid Validity:

20.1 Bids shall remain valid for a period not less than One Hundred and Twenty days (120 days) from the deadline date for bid submission. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.

20.2 In exceptional circumstances, prior to expiry of the original time limit, the Employer may request the Bidder to extend the period of validity for an additional period. The request and bidders' response shall be made in writing. A bidder agreeing to the request will not be permitted to modify his bid (ie, the extension shall be unconditional).

21 Bid Security / EMD:

21.1 Each tender should be accompanied by an Earnest Money amounting to **Rs 35,63,890/- (Rupees Thirty-Five Lakhs Sixty-Three Thousand and Eight Hundred and Ninety).** EMD shall be deposited /furnished either through Demand Draft or Banker's Cheque drawn in favour of Financial Adviser & Chief Accounts Officer, CoPA from any Nationalised Bank/ Scheduled Bank in India / Insurance Surety Bond from the Insurance Company duly approved by Insurance Regulatory and Development Authority of India or through RTGS/NEFT mode as per Bank details at Annexure. Any bid not accompanied by an acceptable Bid Security shall be treated as Non-responsive and shall be rejected by the Employer.

22 Forfeiture of Bid security / EMD

Bid Security/EMD will be forfeited in the following cases:

(a) If a Bidder withdraws his bid during the period of bid validity.

(b) The Bidder does not accept the correction of the Bid Price pursuant to any arithmetical errors.

(c) In case of a successful bidder fails

(i) to commence the work, within the specified time limit

(ii) to sign the Agreement or furnish the required Performance Security within the specified time limit

23 No Alternative Proposals by Bidders:

Bidders shall submit offers that comply with the requirements of the bidding documents. Alternatives will not be considered.

24 Format and Signing of Bid:

24.1 The Tenderer shall prepare one set of his Tender (all Volumes), duly completed and signed, along with the set of Drawings and other documents mentioned hereinafter. The Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder with signature duly witnessed and company seal affixed. The Power of Attorney (in original) authorizing the signatory/s of the Tender shall be enclosed. All pages of the bid where entries or amendments have been made shall be signed by the person or persons signing the bid.

24.2 If the tender is made by an individual, it shall be signed by his full name and his address shall be given. In the event of the tender being submitted by a registered partnership firm, it must be signed individually by each partner thereof. In the event of absence of any partner, it must be signed on his behalf by person holding a proper power-of- attorney authorizing him to do so and to bind the partner in all matters pertaining to the contract including the arbitration clause, such power-of- attorney to be attached with the tender which must disclose that the firm is duly registered under Indian Partnership Act. If the tender is made by a Limited Company, it shall be signed by a duly authorized person who shall produce with the tender satisfactory evidence of the authorization. In the case of a Limited Company the tender should be accompanied by the Memorandum and Articles of Association of the Company.

25 Bid Submission:

25.1 Bid shall be submitted in two parts, **Part - I: Technical Bid** and **Part - II: Price Bid** through **e- tender mode before 14.30 Hrs on 06/02/2026**.

25.2 The Technical Bid document and the scanned copies of the documents as detailed in clause 22 below shall be submitted through e-Tendering mode on**www.tenderwizard.com/CPT**.

25.3 Price bid (Schedule-II) in the provided format shall be submitted **only through e-T**endering mode on www.tenderwizard.com/CPT before 14.30 Hrs. on 06.02.2026. In no case shall filled in Price Bid (Schedule II) be submitted in hard copy, as it shall result in rejection of the tender.

25.4 Tenders shall be submitted "**online"** strictly in accordance with the Instructions to Tenderers and Terms & Conditions given in the tender document. The bidders shall submit scanned copy of all the required documents such as DD / Banker's Cheque towards the cost of tender, proof of experience, financial details etc. through the e-tendering portal.

25.5 The Bidder shall submit **Original (i) DD / Pay Order / Bankers Cheque**

Insurance Security Bond / Irrevocable Bank Guarantee towards the cost of Tender document / EMD (ii) Integrity Pact, duly signed (vide Annexure-12) and (iii) Power of Attorney along with Letter of submission in a sealed cover, super scribing there on the Tender Number, Name of Work, date notified for submission of tender and the name of the tenderer. Tenders can be brought either in person or sent by registered post/ courier to **the Chief Engineer, Cochin Port Authority, W/Island, Cochin - 682009, KERALA,** before opening date & time of the tender**.** Tenders brought in person, shall be put in the Tender Box on or before the due date and closing time specified above.

25.6 Tenders without submitting the original documents towards (i) Cost of tender document, (ii) EMD (iii) duly signed Integrity Pact and (iii) Power of Attorney as above, before opening date and time of the tender will be liable for rejection.

25.7 The successful Bidder shall submit original copy of complete Technical Bid already submitted in e-mode within 7 days of receipt of Letter of Acceptance issued for the work.

26 Information Required in the Bid

26.1 Part I -Technical Bid shall contain the following:

a) Letter of Submission (vide ***Annexure-1***)
b) Bid Security / EMD as described in Clause 17.1 above.
c) Cost of Tender Document
d) Check list as per ***Schedule I*** attached along with Technical Bid in the e-Tendering Portal
e) Power of Attorney (in original) in favour of signatory/s to the Tender, duly authenticated by Notary Public. (vide ***Annexure-2***)
f) Organization Details (vide ***Annexure-3***)
g) Details of experience as per ***Annexures -4a &4b*** and Certificates in proof of experience in Similar Works as detailed under Clause 13 of Instructions to Tenderers.

Explanatory notes:

(1) Original or Notary certified copy of completion certificates of each work issued by the owner/ the responsible officers of the owner under whom he has executed such contracts along with work order shall be attached. The certificate shall invariably contain the following among other things.
   (i) Details of work involved specifying the nature of work
   (ii) The completion cost of the work
   (iii) Date of commencement; and
   (iv) Date of completion of the work.
(2) If the experience in Similar Works is as a member of joint venture, Notary attested copy of joint venture agreement in this respect shall be attached.
(3) If the experience in Similar Works is as a subcontractor, Notary attested copy(s) of approval issued by the Employer(s) authorizing as a sub- contractor; in proof of the claim of the tenderer as a sub-contractor shall be attached.

(4) The works indicated in *Annexure-4a* will only be considered for evaluation. Mere submission of work completion certificate will not be considered towards Eligible Assignments

h) A statement duly certified by Chartered Accountant showing the Average Annual Financial Turnover of the tenderer over the last three financial years [2022-"23, 2023-24"& 2024-25"] (vide ***Annexure-5***) supported by Audited Financial statements for the last three years.

i) Form of Bid duly signed and sealed

j) **Bid document including all Addenda / Corrigenda duly signed and sealed**

k) Partnership Deed or Memorandum and Articles of Association of the Company and Registration certificate of the company as the case may be.

l) **Copies of EPF, ESI, PAN and GST registration**

m) Documentary proof for NSIC registration, if applicable.

n) A detailed Method Statement (Technical Note) for carrying out of the works, along with an Implementation Schedule showing sequence of operation and the time frame for various segments of temporary and permanent works. (vide ***Annexure-6***). The information provided will form part of the Work Methodology and the same shall be in line with the Specifications and Bill of quantities.

o) A list of Plant and equipment proposed to be engaged for the work (vide ***Annexure-7***).

p) A declaration to the effect that (vide ***Annexure-8***):-

   i) All details regarding construction plant and machinery, temporary work and personnel for site organization considered necessary and sufficient for the work have been furnished in the ***Annexure-7*** and that such plant, temporary works and personnel for site organization will be available at appropriate time of relevant works for which the equipment have been proposed at site till the completion of the respective work.

   ii) No conditions are incorporated in the Price Bid. In case any conditions are specified in the Price Bid, the tender will be rejected summarily without making any further reference to the bidder.

   iii) We have not made any payment or illegal gratification to any persons/ authority connected with the bid process so as to influence the bid process and have not committed any offence under PC Act in connection with the bid.

   iv) We disclose with that we have made / not made (strike out whichever is not applicable) payments or propose to be made to any intermediaries (agents) etc. in connection with the bid.

   v) We do hereby confirm that no changes have been made in the Tender document uploaded by us for the above bid. <u>Port Tender document will be treated as the authentic Tender Document and if any discrepancy is noticed at any stage between the Port's tender document and the one submitted by the tenderer, the Port's document shall prevail.</u>

q) Bank information for e- Payment system as per ***Annexure-9.***

r) Details of litigation history, blacklisting etc. of the Bidder as per ***Annexure- 10***.

s) Undertaking regarding EPF & ESI Registration as per ***Annexure-11***.

t) Duly signed Integrity Pact (vide ***Annexure-12***)

u) Mandate for receiving payments through NEFT/RTGS from COCHIN PORT AUTHORITY as per (***Annexure-13)***

26.2 Scanned copy of all the above documents shall be uploaded for on line submission of Technical Bid.

NOTE: If a bidder has already been awarded or qualified for a similar nature work with a higher value or equivalent value within the last 6 months from the date of notice inviting tender, the tender of such bidder shall be evaluated /

considered for qualification with the documents submitted by the bidders in those tenders, <u>provided the Bidder clearly states the details of above such works</u> <u>in the Letter of Submission.</u>

26.3List of Documents to be Submitted in Original.

i) DD / Pay Order / Bankers Cheque towards Cost of Tender document
ii) DD / Pay Order / Bankers Cheque / Insurance Security Bond / Irrevocable Bank Guarantee towards Bid Security / EMD**.**
iii)Power of Attorney, duly authenticated by Notary Public (vide ***Annexure-2***)
iv)Letter of Submission (vide ***Annexure-1***)
v) Integrity Pact duly signed (vide Annexure-12)

26.4**Part II :**"**Price Bid**" shall contain the Preamble to BoQ and Bill of Quantities-**Schedule II** shall be duly filled in and fully priced, which shall be submitted only **in e-tendering mode**.

27 Deadline for Submission of the Bids:

E-tenders attaching all documents shall be submitted „**online**" in the **e tender portal** strictly in accordance with the terms and conditions of tender document before ***the time and the day notified*** in Table 2 of NIT.

The (i) Original DD / Pay Order / Bankers Cheque towards the Cost of Tender document,(ii) DD / Pay Order / Bankers Cheque / Insurance Security Bond / Irrevocable Bank Guarantee towards the Bid Security / EMD ~~and~~ (iii) Power of Attorney with letter of submission and (iv) in a sealed cover in original superscribed with the Tender Number, Name of Work, date notified for submission of tender and the Name of the Tenderer, should reach the office of the Chief Engineer, Cochin Port Authority, Cochin-9, on or before the time and the day notified in Table 2 of NIT.

28 Late Bids:

Any Bid received by the Employer after the Bid Due Date will be returned unopened to the bidder.

29 Bid Opening

29.1The Officer inviting the tender or his duly authorized assistant will open the tenders in the presence of intending tenderers who may be present at the time in person or through their authorized representative. In the case of the tenders invited under Two Cover System, the technical bids of the tenders received will be opened first.

29.2**Technical Bid**: Technical Bid shall be opened in the office of the **Chief Engineer, Cochin Port Authority** after **15.00** Hours on **06/02/2026** for receiving the Tenders. Submission of EMD and Cost of Tender Document is verified initially. In case the Earnest Money and Cost of Bid Document are not deposited/ submitted or is not in order, the Bid will not be opened further and hard copy submitted will be returned.

29.3If all Bidders have submitted unconditional Bids together with requisite Bid Security/ EMD then all Bidders will be so informed then and there. If any Bid contains any deviation from the Bid documents and /or if the same does not contain Bid Security Declaration in the manner prescribed in the Bid documents, then that Bid will be rejected and the Bidder will be informed accordingly. The Price Bid submitted in e- mode will not be opened.

30 Bid Opening – Price Bid:

Price Bid of those Tenderers found responsive on evaluation of Technical Bids, will be opened later. **Short listed bidders will be communicated about the date and time of opening of the Price Bid through e-tender portal notification / communication and there will be no direct communication from department in this regard.** The Bidder's name, the Bid percentages, the total amount of each Bid, any discounts, Bid modifications and withdrawals, and such other details as the Employer may consider appropriate, will be announced by the Employer at the time of opening.

31 Clarification of Bids:

To assist in the examination and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdown of unit rates. The request for clarification and the response shall be in writing, but no change in the price or substance of the Bid shall be sought, offered, or permitted.

No Bidder shall contact the Employer on any matter relating to his bid from the time of the bid opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the Employer, he should do so in writing.

Any effort by the Bidder to influence the Employer's bid evaluation, bid comparison or contract award decisions, may result in the rejection of his bid.

32 Examination of Bids and Determination of Responsiveness:

32.1 Prior to detailed evaluation of Bids, Cochin Port Authority will determine whether each Bid

(a) Meets the Minimum Eligibility Criteria defined in Clause 13.

(b) has been properly signed by an authorised signatory (accredited representative) holding Power of Attorney in his favour. The Power of Attorney shall inter alia include a provision to bind the Bidder to settlement of disputes clause;

(c) is accompanied by the required Bid Security Declaration and cost of bid document.

(d) Undertaking in the Technical Bid that he has not incorporated any conditions in the Price Bid.

A responsive Bid is one which conforms to all the terms, conditions and specification of the Bidding documents, without material deviation or reservation. A material deviation or reservation is one;

i) which affects in any substantial way the scope, quality or performance of the Works;

ii) which limits in any substantial way, the Employer's rights or the Bidder's obligations under the Contract; or

iii) whose rectification would affect unfairly the competitive position of other Bidders presenting responsive Bids.

(e) is responsive to the requirements of the Bidding documents.

32.2 If a Bid is not substantially responsive, it shall be rejected by the Employer, and shall not subsequently be made responsive by correction or withdrawal of the non- conforming deviation or reservation.

33 Correction of Errors:

Bids determined to be responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as detailed in Clause 19.2. The amount stated in the Bid will be adjusted by the Employer in accordance with the above stated procedure for the correction of errors and shall be considered as binding upon the bidder. If the Bidder does not accept the corrected amount, the Bid shall be rejected and the Bid security shall be forfeited in accordance with Clause 22.

34 Evaluation and Comparison of Bids:

The Employer will evaluate and compare only the Bids determined to be responsive in accordance with Clause 32. In evaluating the Bids, the Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:

(a) making any correction for errors pursuant to Clause 33;
(b) making appropriate adjustments to reflect discounts or other price modifications offered.

35 Alteration of tender documents:

No alteration shall be made in any of the tender documents or in the Bill of Quantities and the tender shall comply strictly with the terms and conditions of the tender document. The Employer may however ask any tenderer for clarifications of his tender if required. Nevertheless, no tenderer will be permitted to alter his tender price after opening of the tender.

36 Alternative Conditions and Proposals:

The Tenderer shall note that alternative or qualifying tender conditions, or alternative design proposal for whole or part of the work will not be acceptable. Tenders containing any qualifying conditions or even Tenderer's clarifications in any form will be treated as non-responsive and will run the risk of rejection. Price Bid of such Tenderer's will not be opened.

37 Award of Contract:

The Employer will award the Contract to the bidder whose bid has been determined to be responsive to the bidding documents and who has offered the lowest evaluated bid price, provided that such bidder has been determined to be
(a) Eligible in accordance with the provisions of Clause 17, and
(b) Qualified in accordance with the provisions of Clause 17.

38 Securities

38.1 Security Deposit (SD) shall be at 10% of the contract value or value of the work done whichever is higher and it shall consist of two parts:

a) Retention Money to be recovered from Running Bills as detailed below;

The Employer shall retain from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.

38.2 For civil works, Retention Money shall be deducted at 5% of the gross amount of the bill from the first Running Account bill onwards till the recovered sum amounts to 5% of the contract value or the value of the work done whichever is higher. Retention money shall be refunded to the Contractor within 14days from the date of payment of final bill.

38.3 The total amount thus deposited towards SD will be retained as security for the due and proper fulfillment of the contract and will not carry any interest. Such deposit shall be forfeited on failure to perform or non-fulfillment by the Contractor of the terms and conditions of the contract.

b) Performance Security to be submitted at award of the work

38.4 Performance Security

Performance Security for civil works shall be 5% of the Contract value.

38.5 The Performance Security shall be provided by the Contractor to the Employer not later than 21 days for domestic bids and 28 days for international bids from the date of letter of acceptance and shall be furnished in one of the following forms: i) Banker's Cheque/Demand Draft/Pay Order of a Scheduled Bank. ii) An irrevocable Bank Guarantee (BG) enforceable and encashable at Cochin, drawn from any nationalized / scheduled bank operating in India as per the proforma

38.6 The BG furnished towards the Performance Security shall be valid for a period until a date 30days from the day of expiry of the defect liability period stipulated as per the terms of the contract.

38.7 Unless performance Security is furnished within the period as specified in clause 38.5 above or such extension of that period as may be permitted by the Engineer in writing, the Earnest Money will be liable to forfeiture and the contract to cancellation.

38.8 Performance Security will be released / refunded to the Contractor not later than 30 days from the date of completion of Defect Liability / warranty period of the work.

38.9 If the Cost of Work done exceeds the Contract Value, the total amount retained as Security Deposit considering the Performance Security initially submitted together with the Retention Money recovered from the running account bills, shall amount to 10% of the Cost of Work done.

38.10 In cases where cost of Work done exceeds the Contract Value while releasing the Retention Money after payment of Final Bill, only 5% cost of Work Done is released, instead of the entire Retention Money recovered from the bills. The balance amount shall be retained; to make up for the shortage in the Performance Security, upto the completion of Defects Liability Period. The BG shall be issued in favour of Cochin Port Authority in the format enclosed in ***Annexure-A of GCC.***

39 Signing of Agreement

39.1 The Successful Tenderer will be required to execute an Agreement at his expense within 28 (twenty-eight) days from the date of Letter of Acceptance / Work Order, on proper value Kerala State Stamp Paper in the prescribed form**.** The agreement as finally executed will include the Employer's Bid Documents and the Bidder's offer as finally accepted by the EMPLOYER together with Addendum / Corrigenda, bid clarification and all correspondences exchanged between EMPLOYER and the bidder, if any. Till the formal agreement is executed, the Letter of Acceptance together with the offer as finally accepted along with correspondence shall form a binding contract between the two parties.

39.2 The Contractor shall made 10 copies of the Agreement and submit to the Employer within 7 days following the date of signing of Agreement.

39.3 In the event of the tenderer, after the issue of the communication of acceptance of offer by the Board, failing /refusing to execute the agreement as hereinafter provided, the tenderer shall be deemed to have abandoned the contract and such an act shall amount to and be construed as the contractor's calculated and the willful breach of the contract, the cost and consequence of which shall be to the sole account of the tenderer and upon such an event the Board shall have full right to claim damages therefore.

40 Fraud and Corrupt Practices:

40.1 The bidder and their respective officers, employees, agents and advisers shall observe the highest standard of ethics during the Selection Process. Notwithstanding anything to the contrary contained in this document, the Port shall reject the tender without being liable in any manner whatsoever to the bidder, if it determines that the bidder has, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice (collectively the "Prohibited Practices") in the Selection Process. In such an event, the Port shall, without prejudice to its any other rights or remedies, forfeit and appropriate the Bid Security or Performance Security, as the case may be, as mutually agreed genuine pre- estimated compensation and damages payable to the Port for, inter alia, time, cost and effort of the Authority, in regard to the Tender, including consideration and evaluation of such Bidder's Proposal. Such Bidder shall not be eligible to participate in any tender or RFP issued by the Authority during a period of **2 (two)**years from the date such Bidder is found by the Authority to have directly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice, as the case may be. For the purposes of this Clause, the following terms shall have the meaning hereinafter respectively assigned to them:

(a) "corrupt practice" means

(i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the action of any person connected with the Selection Process (for avoidance of doubt, offering of employment to or employing or engaging in any manner whatsoever, directly or indirectly, any official of the Authority who is or has been associated in any manner, directly or indirectly with the Selection Process or the LOA or has dealt with matters concerning the Agreement or arising there from, before or after the execution thereof, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the Authority, shall be deemed to constitute influencing the actions of a person connected with the Selection Process; or

(ii) engaging in any manner whatsoever, whether during the Selection Process or after the issue of the LOA or after the execution of the Agreement, as the case may be, any person in respect of any matter relating to the Project or the LOA or the Agreement, who at any time has been or is a legal, financial or technical consultant/ adviser of the Authority in relation to any matter concerning the Project;

(b) "Fraudulent practice" means a misrepresentation or omission of facts or disclosure of incomplete facts, in order to influence the Selection Process;

(c) "Coercive practice" means impairing or harming or threatening to impair or harm, directly or indirectly, any persons or property to influence any person's participation or action in the Selection Process;

(d) "Undesirable practice" means

(i) establishing contact with any person connected with or employed or engaged by the Authority with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Selection

Process; or

(ii) having a Conflict of Interest; and

(e) “Restrictive practice” means forming a cartel or arriving at any understanding or arrangement among Applicants with the objective of restricting or manipulating a full and fair competition in the Selection Process.

41 Rejection of Tender:

Any Tender not conforming to the foregoing instructions will not be considered. The Employer does not bind himself to accept the lowest or any tender and has the right to reject any tender without assigning any reason thereof. No representation whatsoever will be entertained on this account.

SIGNATURE OF BIDDER

COCHIN PORT AUTHORITY

SECTION I

3. FORM OF BID

To

The Board of Cochin Port Authority

Through

The Chief Engineer
Cochin Port Authority, Cochin -9

Tender for the work of "**(**RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II**)"**

I/We have read and examined the Notice inviting tenders, Instructions to tenderers, Form of Agreement, Contract Data, General Conditions of Contract, General description of work, Special conditions of Contract, Technical Specifications, Drawings, Preamble, Bill of Quantities, & other documents and rules referred to in the General Conditions of Contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified in the underwritten memorandum within the time specified in such memorandum at the rates specified in the schedule attached hereto and in accordance in all respects with the specifications designs, drawings and instructions in writing referred to in clause 16 of the General Conditions of Contract and with such materials as are provided for, by and in all other respects in accordance with such conditions so far as applicable.

M E M O R A N D U M

a)	General description of work …	:	RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II
b)	Estimated cost	:	**Rs. 17,81,94,481**
c)	Earnest Money	:	**Rs. 35,63,890/-**
d)	Security Deposit	:	**10%** of the value of the contract awarded or the value of the work done whichever is higher [performance guarantee @ 5% and retention money @5%].
e)	Percentage, if any, to be deducted from the bills, drawings etc.	:	The retention money will be recovered from the first running bill onwards at the rate of 5% of the gross amount of each bill
f)	Time allowed for commencement of work from the date of receipt of work order	:-	7 days
g)	Time allowed for the work from the date of commencement of work	:-	8 Months
h)	Schedule, Specification, conditions	:-	As Per Content Sheet Attached

I/ We agree to keep the tender open for 120 days from the due date of submission Should this Bid be accepted, I/We hereby agree to abide by and fulfill all the terms and provisions of the said conditions of contract annexed hereto. I/We further agree to execute an agreement with the Board in the prescribed form

Should this tender be accepted, I/We hereby agree to abide by and fulfill all the terms and provisions of the said conditions of contract annexed here to so far as applicable or in default thereof forfeit and pay to the Board the sum of money mentioned in the said conditions and to execute an agreement with the Board in the prescribed form or in default thereof to forfeit the earnest money deposited by me/us.

The sum of Rs....................... is hereby forwarded in Port challan receipt / Bankers cheque or demand Draft of a scheduled bank / Bank Guarantee issued by a Scheduled bank drawn in favour of Financial Adviser and Chief Accounts Officer of the Port Authority as earnest money (a) the full value of which is to be absolutely forfeited to the Board in office without prejudice to any other rights or remedies of the said Board in office should I/We fail to commence the work specified in the Contract data or should I/We not deposit the full amount of Performance Security specified in the above Memorandum in accordance with clause 52 of the said conditions of contract otherwise the said sum of Rs. shall be retained by the Board as on account of such security deposit as aforesaid or (b) the full value of which shall be retained by the Board on account of the security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered, upto maximum of the percentage mentioned in Clause 40.1 of General Conditions of Contract and those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 40.3 of the General Conditions of Contract.

Dated the ....……………........... day of .... 2026.

Signature of the Tenderer

Address:-

Witness:-

Address:-

Occupation:-

ACCEPTANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf of the Board of Major Port Authority for a sum of Rs… ....(Rupees ………………………………………………………………………)

The letters referred to below shall form part of this Contract Agreement

a) ..
b) ..
c)

Dated…………

Chief Engineer
Cochin Port Authority

COCHIN PORT AUTHORITY

SECTION – I

4. FORM OF AGREEMENT

AGREEMENT No……of 20…….

AGREEMENT FOR THE WORK OF RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

THIS AGREEMENT IS MADE on this day .... of ……………, 2026 BETWEEN THE BOARD OF MAJOR PORT AUTHORITIES FOR COCHIN PORT AUTHORITY, a body corporate under the Major Port Authority Act, 2021 having office on Willingdon Island, Cochin – 682009 represented by its Chief Engineer ...., S/o. ...., aged .... years residing at .... (hereinafter referred to as the Employer which expression shall include his successors, assignees and administrators in the office) of the one part and M/s.. represented by Sri. ...., aged .... years, S/o Sri. ...., residing at .... (hereinafter referred as "Contractors" which expression shall include his successors, assignees and administrators) of the other part.

WHEREAS the Employer invited tenders for ……………………… …………………………… vide Tender Notice Date … and the Contractor submitted a tender for the same giving rates subject to the terms and conditions etc. of the tender document **AND WHEREAS** the said tender submitted by the Contractor has been accepted by the **Employer** vide work order No ……………………… dated, issued to the Contractor while accepting their tender.

NOW THESE PRESENTS WITNESSETH and the parties hereby agree as follows.

1. The tender submitted by the Contractor for execution for the Board, of the work specified in the underwritten memorandum within the time specified in such memorandum at the rates specified in the schedule attached hereto and in accordance in all respects with the specifications, designs, drawings and instructions in writing referred to in Clause 16 of the "General Conditions of Contract" and with such materials as are provided for, by and in all other respects in accordance with such conditions is accepted.
2. It is mutually understood and agreed that, notwithstanding that the works has been sectioned, every part of it shall be deemed to be supplementary to and complementary of every other part and shall be read with it or into it.
3. The Contractor agreed to abide by and fulfill all the terms and provisions of the said Conditions of Contract or in default thereof forfeit and pay to the Board the sum of money mentioned in the said conditions.

4. The sum of Rs…………../- [Rupees…………………………..only) has been deposited by the Contractor with Financial Adviser and Chief Accounts Officer of the Port Authority as Performance Security (a) the full value of which is to be absolutely forfeited to the Board in office without prejudice to any other rights or remedies of the said Board in office should the Contractor fail to commence the work specified in underwritten memorandum or should the Contractor not deposit the full amount of security deposit specified in underwritten memorandum otherwise the said sum of Rs………../- shall be retained by the Board as on account of such security deposit as aforesaid or (b) the full value of which shall be retained by the Board on account of the security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered, up to maximum of the percentage mentioned in Clause 40.1 of the Conditions of Contract and those in excess of that limit at the rates to be determined in accordance with the provisions contained in Clause 40.3 of the Conditions of Contract.

5. It is mutually agreed that the tender submitted in its entirety shall form part of this agreement. Apart from the tender the following shall also form part of the agreement
   (a) The Letter of Acceptance ;
   (b) Bill of Quantities and
   (c) Letters exchanged between the Employer and the Tenderer upto the issue of Letter of Acceptance as separately listed and annexed here to.
   (d) Replies to Prebid queries and amendments issued, if any.

M E M O R A N D U M

a)	General description of work ………………………………………………	:	RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II
b)	Estimated cost	:	**Rs. 17,81,94,481**
c)	Tendered cost	:	Rs. ……………..
d)	Earnest Money	:	**Rs 35,63,890**
e)	Security Deposit	:	Rs…………..(**10%** of the value of the contract awarded or the value of the work done whichever is higher [performance guarantee @ 5% and retention money @5%].).
f)	Percentage, if any, to be deducted from the bills	:	The retention money will be recovered from the first running bill onwards at the rate of 5% of the gross amount of each bill. In case, where the value of work done exceeds Contract Value, Additional Security Deposit @ 5% of the excess amount will be deducted from the respective RA Bills, while making the payment.

g) Time allowed for commencement of work from the date of receipt of work order : ____7___days

h) Time allowed for the work from the date of commencement of work. : **______8_____ Months**

i) Schedule, specifications, conditions, drawings etc. as per contents sheet attached. :

IN WITNESS WHEREOF THE CONTRACTOR hereunto set his hand and seal on behalf of M/s… .... and on behalf of **The Board of Major Port Authority** of COCHIN PORT AUTHORITY, the CHIEF ENGINEER has set his hand and seal and common seal of Cochin Port authority has been hereunto affixed the day and year first written above.

CONTRACTOR

- (Retain only the authority signing the agreement)

Signed, sealed and delivered by

Shri……………………of M/s. ………………………

(Common Seal of the Firm)

Signed and affixed seal in the presence of :

1) Signature with address :

2) Signature with address :

EMPLOYER

Signed, sealed and delivered by the

CHIEF ENGINEER
Cochin Port Authority
On behalf of The Board of
Major Port Authority of Cochin.

Signed and affixed the common seal of

Board of Major Port Authority of Cochin Port Authority

In the presence of

1)

2)

COCHIN PORT AUTHORITY

SECTION I

5.CONTRACT DATA

[*To be filled up before issuing tender document as applicable for each tender]*

Items marked "N/A" do not apply in this Contract.

<table>
<tr><th>Sl. No.</th><th>Description</th><th>Reference Clause No. in GCC</th></tr>
<tr><td>1</td><td>The following documents are also part of the Contract</td><td></td></tr>
<tr><td></td><td>The Schedule of other Contractors

(Will be informed in due course)</td><td>(8.2)</td></tr>
<tr><td></td><td>The Schedule of Key personnel
<table>
<tr><th>Designation/ Qualification of Staff</th><th>No.</th><th>Min. Experience (Years)</th><th>Rate of recovery in case of non compliance</th></tr>
<tr><td>Graduate Engineer in Civil/Interior Design/Architectural Engineering,
-OR- Diploma Engineer -do-</td><td>2</td><td>2

5</td><td>Rs.40,000/- per month</td></tr>
<tr><td>Graduate Engineer in Electrical & Electronics and Telecommunication
Or

Diploma Engineer -do-</td><td>1 Each</td><td>2

5</td><td>Rs.40,000/- per month</td></tr>
<tr><td>Graduate Engineer in Mechanical Engineering

Or Diploma Engineer -do-</td><td>1</td><td>2

5</td><td>Rs1,500/- per day on nonavailability of such personnels when MEP works done.</td></tr>
</table></td><td>(9)</td></tr>
<tr><td>2</td><td>The Employer is</td><td>(1)</td></tr>
</table>

	The Board of Major Port Authority, **Cochin Port Authority,** **Cochin -9**	
	Name of Authorized Representative:	
	Name: **Shri.Kasiviswanathan** **The Chairperson,** **Cochin Port Authority** **Cochin -9**	
3	The Engineer is	
	Name: **Shri. Jassar S M** **Chief Engineer** **Cochin Port Authority,** **Cochin-9**	
	Name of Nominee(s) is **:Will be notified in LoA/ LoI**	
4	Name of Contract:RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II Tender No**: T1/T-2079/2026-C**	(1)
5	**10** copies of Contract Agreement shall be furnished by the Contractor	[7.1]
6	Tender document and other data are available at the following web sites : 1) www.cochinport.gov.in 2) www.tenders.gov.in 3) tenderwizard.com/cpt	(7.2)
7	The Intended Completion Date for the whole of the Work is **Eight Months**	(17,28)
8	Milestone dates:	

Physical works to be completed	Period from the date of commencement of work

The activity wise schedule needs to be submitted by the Contractor within **7 days** of receipt of LoA from CoPA. This needs to be strictly followed for the timely completion of the work.

9	The following shall form part of the Contract Document: (1) Agreement (2) Letter of Acceptance (3) Bill of Quantities (4) Contractor's Bid (5) Correspondence exchanged after the opening of the Bid and before the issue of Letter of Acceptance by which the Condition of Contract are amended, varied or modified in any way by mutual consent (to be enumerated). (6) Contract Data (7) General Conditions of Contract (8) General Description and Special Conditions of Contract (9) Technical Specifications (10) Drawings and (11) Any other documents listed in the Contract Data as forming part of the Contract.	(2.3)
10	The Contractor shall submit a Program for the Works within **21 days** of date of the Letter of Acceptance/LoI.	(27)
11	**The site possession date** The site will be handed over within **7 days** after issue of LoA/LoI	(21)
12	The start date shall be **7 days f**rom the date of receipt of the Letter of Acceptance (LoA)/LoI by the Contractor.	(1)
13	The site is located Willingdon Island	
14	The Defects Liability Period is **One year from the date of completion of the work.**	(35)
15	The minimum insurance cover for physical property, injury and death is **Rs.10 lakhs (Rupees Ten Lakhs)** per occurrence with the number of occurrences unlimited. After each occurrence, Contractor will pay additional premium necessary to make insurance valid always.	**(13)**
16	The following events shall also be Compensation Events:	(44)

Sl. No.	**Description**	**Reference Clause No. in GCC**
	(Nil)	
17	The period between Programme updates shall be 15 ~~90~~ days.	(27)
18	The amount to be withheld for late submission of an updated Programme shall be **Rs.25,000**/-.	(27)
19	The language of the Contract documents is **English.**	(3)
20	The law, which applies to the Contract, is the law of Union of India.	(3)
21	The currency of the Contract is **Indian Rupees.**	(46)
22	The proportion of payments retained (retention money) shall be 5% from each bill subject to a maximum of 5% of the contract price or cost of work done whichever is higher.	(48)
23	The maximum amount of liquidated damages for the whole of the works is **10%** of the Contract Price.	[49]

24	The amounts of the Advance Payments:			[51]
	Nature of Advance	**Amount (Rs)**	**Conditions to be fulfilled**	
	1.Secured Advance for non-perishable Materials brought to site	75% of Invoice value or Market value whichever is Lower.	a) The non perishable materials, in accordance with Tender	
			b) Such materials have been delivered to site and are properly stored and protected against damage or deterioration to the satisfaction of the Engineer or his nominee. The contractor shall store the bulk material in measurable stacks.	
			c)The Contractor's records of the requirements, orders, receipt and use of materials are kept in a form approved by the Engineer or his nominee and such records shall be	

Sl. No.	**Description**			**Reference Clause No. in GCC**
			available for inspection by the Engineer or his nominee.	
25	Repayment of advance payment for mobilization : NA			[51]
26	Repayment of advance payment for Construction and equipment: NA			[51]
27	Repayment of Secured advance:			[51.6]
	The advance shall be repaid from each succeeding monthly payment to the extent materials for which advance was previously paid pursuant to Clause 51.6 of Conditions of Contract on being incorporated into the Works.			

28	The date by which "As-Built" drawings are required is within 30 **days** of issue of certificate of completion of whole or section of the work, as the case may be.	(58)
29	The amount to be withheld for failing to supply "As Built" drawings and/or operating and maintenance manuals by the date required is Rs.50,000/-.	(58)
30	Schedule of Rates Applicable: (**DSR 2023+ Cost Index 35%) multiplied by a factor 0.8246 to exclude GST**	
31	Base Rate for materials to be considered for price variation **: NA**	**(47)**
32	Permissible wastage on theoretical quantities of (a) Cement : (+) 2% (b) Steel Reinforcement and structural steel sections for each diameter, section and category : (+) 5.99 %	**(47)**

COCHIN PORT AUTHORITY

SECTION I

6. ANNEXURES

Annexure-1

COCHIN PORT AUTHORITY
RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II
LETTER OF SUBMISSION- COVERING LETTER
(*On the Letter Head of the Bidder*)

No…………… Date:…………..

To

The Chief Engineer,
Cochin Port Authority.

Sir,

Sub: Tender for "**RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II**

~~~~~~~

Being duly authorized to represent and act on behalf of …………………… (Hereinafter referred to as "the Bidder") and having reviewed and fully understood all of the requirements of the bid document and information provided, the undersigned hereby apply for the project referred above.

We are submitting our Bid enclosing the following, with the details as per the requirements of the Bid Document, for your evaluation.

(i) EMD
(ii) Power of Attorney (***Annexure-2***)
(iii) Cost of Tender Document

We have also uploaded the following documents for online submission of Technical Bid.

(i) Organization Details (***Annexure-3***)
(ii) Details to fulfill the "Minimum Eligibility Criteria" and certificates (***Annexure-4a***)
(iii) Details of Past Experience of Contractor for Similar works (***Annexure-4b***)
(iv) Average Financial Turnover over the last three financial year (***Annexure-5)***
(v) Detailed Method Statement (Technical Note) (***Annexure-6***)
(vi) List of Plant and Equipment (***Annexure-7***)
(vii) Declaration (***Annexure -8***)
(viii) Bankers Details (***Annexure-9***)
(ix) Details of litigation history / blacklisting of the bidder (***Annexure-10***)
(x) Undertaking regarding EPF & ESI registration. (***Annexure-11***)
(xi) Pre Contract Integrity Pact (**Annexure-12**)
(xii) Tender Document along with Addenda Nos---- ,
(xiii) Copies of EPF,ESI,PAN & GST Registration.
(xiv) Checklist as per Schedule-I
(xv) Partnership deed or Memorandum and Articles of Association of the company and Registration Certificate of the company (as the case may be)
(xvi) Document proof for NSIC Registration,(if applicable)

We also certify that further Bid related communication, if any, will be sent to the following e-mail IDs by CoPA.

(i)………………….
(ii)…………………..
(Furnish 2 nos. current active e-mail IDs)

Signature
(Authorized Signatory)
~~~~~~~

Annexure- 2

PROFORMA OF POWER- OF-ATTORNEY/LETTER OF AUTHORITY

(To be submitted on Non-judicial Stamp Paper of appropriate value)

To

The Chief Engineer,
Cochin Port Authority,
Cochin 682009.
Kerala, India.

Dear Sir,

We____ do hereby confirm that Mr./Ms./Messrs_____________________________ [***INSERT NAME AND ADDRESS]***, whose signature is given below, is /are authorized to represent us to bid, negotiate and conclude the agreement on our behalf with you against Tender for **RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II (Tender No___________).**

We confirm that we shall be bound by all and whatsoever our said agents shall commit.

Signature of the authorized person:

Name & Designation :

Yours faithfully,

Signature, name and seal of the certifying authority

Annexure -3

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II
ORGANIZATION DETAILS

CONTRACT No.:

NAME OF APPLICANT:

1. Name of the Owner:

2. Address:

   E-mail:

   Telephone No. :

   Fax No.

3. Description of Applicant
   (For e.g. General, Civil Engineering
   Contract or Joint Venture/Consortium etc.)

4. Registration and Classification
   of Contractors

5. Name and address of bankers

6. Number of years of experience
   as a general contractor :-

   In own Country:

   Internationally:

7. Number of years of experience
   as a sub contractor

8. Name and Address of partners or
   associated companies to be involved
   in the project and whether Parent/

Subsidiary/other

6. Name and address of any associates knowledgeable in the procedures of customs, immigration and local experience in various aspect of the project etc.

10. Name and address of the companies/ Sub-contractors who will be involved in the execution of works, namely:

11. Name and address of companies who will be involved in the supply of bought out items

    a) Fenders, stainless chains and accessories
    b) Bollards, Capstan, Remote control Quick release Mooring systems

12. Attach organization chart showing the structure of the company including names of Directors/ Key Personnel at Head Office who would be responsible for the project and a separate chart showing proposed Site Construction Organization.

Signature
(Authorized Signatory)

Annexure –4a

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

Tenderer shall furnish Details of “Eligibility Works Experience” as per Clause 13 of Minimum Eligible Criteria (MEC) of Instruction to Tenderer and certificates in the following format (Client Certificates/work completion certificates or any other documentary evidences with respect to the eligibility work)

ELIGIBLE ASSIGNMENT DETAILS FOR MEC

Assignment Number:

Description	**Bidder to fill up the details here**
Name and Address of the Client	
Title of the Eligible Assignment	
Date of completion of the Eligible Assignment	
Project Completion Cost	
Reference No. of the enclosed Client Completion Certificate/ Documentary Evidence for having successfully completed the Eligible assignment	
Name, telephone no, telefax no and email address of the client’s representative	
Description and Scope of Work	

Instructions:

i) Bidders are expected to provide information in respect of Eligible Assignments in this Section. The assignments cited must comply with the criteria specified Clause No. 13Minimum Eligibility of the Instructions to Tenderers”.

ii) A separate sheet should be filled for each of the eligible assignments.

iii) The details are to be supplemented by documentary proof from the respective client /owner for having carried out such assignment duly certified by clients/ owner.

iv) The works indicated in this **Annexure-4a** will be only being considered for evaluation. Mere submission of work completion certificate will not be considered as Eligible Assignments

v) Original or Notary certified copy of completion certificates of each work issued by the owner/ the responsible officers of the owner under whom he has executed such contracts shall be attached. The certificate shall invariably contain the following among other things.

a) Details of work involved specifying the nature of work
b) The completion cost of the work and
c) Date of commencement ; and
d) Date of completion of the work.

vi) If the experience in Similar Works is as a member of joint venture, Notary attested copy of joint venture agreement in this respect shall be attached.

vii) If the experience in Similar Works is as a subcontractor, Notary attested copy(s) of approval issued by the Employer(s) authorizing as a sub-contractor; in proof of the claim of the tenderer as a sub-contractor shall be attached.

viii) If the experience in Similar Work is in works executed in private sectors/organizations, the TDS certificate along with Notary attested copy(s) of work order and completion certificate shall be attached.

ix) In case of bid submitted by JV/ Consortium, the Minimum Eligibility Criteria EXCEPT Financial Turnover can be fulfilled collectively by the Partners of the JV/ Consortium.

x) The tenderer shall also be obligated to produce the original of the certified copy(s), on request by the department.

Signature
(Authorized Signatory)

Annexure –4b

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

DETAILS OF PAST EXPERIENCE OF CONTRACTORS FOR SIMILAR WORKS

Sl. No.	Name & Location of Project	Owner's Complete address including TeleFax No. with contact Person	Value of Contract	Duration of Contract			Details of work including major items of work involved	Reference No. & Date of letter of intent & completion certificate enclosed
				Commen-cement date	Scheduled completion date	Actual completion date		
1	2	3	4	5	6	7	8	9

Note: 1) Bidder to enclose completion certificate issued by owner, certified by a Notary Public or equivalent certifying authority.

2) If the Bidder is claiming his experience as Subcontractor; it will be considered for qualification only if documentary proof of sub-contractor authorized and approved by the Employer of the work(s) is submitted.

SIGNATURE OF TENDERER

Annexure5

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

FINANCIAL CAPABLITY

(A) Average Annual Turnover of the Bidder

Turnover (Rs.)			
Year 1	**Year 2**	**Year 3**	**Average**

<u>Instructions:</u>

(i). Year 1 will be the Financial Year-2024-25**.** Year 2 shall be the year immediately preceding Year 1 and Year 3 shall be the year immediately preceding Year 2.

(ii).The Bidder shall provide audited Annual Reports / Audited financial statements such as balance sheets and profit & loss account statements as required under this Bid Document.

(iii). Annual Turnover of the bidder shall be submitted duly verified by Charted Accountant or Competent Authority.

Certified by Chartered Accountant

Signature
(Authorized Signatory)

Annexure -6

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

DETAILS OF PROPOSED APPROACH & METHODOLOGY

Bidder shall furnish a detailed Method Statement (Technical Note) for carrying out of the works, along with a construction programme [Preferably in MS project / Primavera] showing sequence of operation and the time frame for various segments of temporary and permanent works showing critical path of activities.

Signature
(Authorized Signatory)

Annexure 7

COCHIN PORT AUTHORITY

RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

PLANT AND EQUIPMENT PROPOSED FOR THE WORK

Please indicate the main plant and equipments considered to be necessary and proposed to be deployed for undertaking this work and whether this plant is ready in ownership or will be purchased or hired.

Sl. No.	Description of equipment	Requirement No. / Capacity	Owned / leased / to be procured	Nos / Capacity	Age / Condition	Remarks (From whom to be purchased)	At what Stage of contract period the Equipment will be available

Signature
(Authorized Signatory)

Annexure -8

COCHIN PORT AUTHORITY

RE-MODELING OF NEW

ADMINISTRATIVE BUILDING PHASE II

DECLARATION

We M/s *(Name & address of the bidder)* hereby declare that:-

1. All details regarding construction plant, temporary work and personnel for site organization considered necessary and sufficient for the work have been furnished in the ***Annexure-6*** and that such plant, temporary works and personnel for site organization will be available at the site till the completion of the respective work.

2. No conditions are incorporated in the Financial/ Price bid. In case any conditions are specified in the financial bid, the tender will be rejected summarily without making any further reference to the bidder.

3. We have not made any payment or illegal gratification to any persons/ authority connected with the bid process so as to influence the bid process and have not committed any offence under PC Act in connection with the bid.

4. We disclose with that we have ***** made / not made payments or propose to be made to any intermediaries (agents) etc in connection with the bid.

5. We do hereby confirm that no changes have been made in the tender document downloaded and uploaded by us for the above bid. Port Tender document will be treated as authentic tender and if any discrepancy is noticed at any stage between the Port's tender document and the one uploaded by the tenderer, the Port's document shall prevail.

Signature
(Authorized Signatory)

**** Notes:***

(i) Delete whichever is not applicable.

(ii) The above Declaration shall be submitted in the Letter head

Annexure- 9

FORMAT FOR FURNISHING BANK INFORMATION FOR e-PAYMENT

1	Name and full address of the beneficiary	
2	Credit Account No. (Should be full 14 digit)	
3	Account Type (SB or CA or OD)	
4	Name of the Bank	
5	Branch (Full address with telephone No.)	
6	MICR code (Should be 9 digit)	
7	Telephone/Mobile/Fax No. of the beneficiary	Telephone:
		Mobile :
		Fax :
8	Cancelled Cheque	

Signature with seal
(Authorized Signatory)

Annexure-10

LITIGATION HISTORY AND DETAILS OF BLACK LISTING

(A). Details of Litigation History till 31st December, 2025 in accordance with clause 22.1(r) of Instruction to Bidders are as follows:

Sl No	Date, month & Year of award	Amount of Award, INR	Contract Identification	Total Contract Amount INR
1	*[insert date]*	*[insert amount]*	*Contract Identification: [indicate complete contract name, number, date and any other identification]* *Name of Employer: [insert full name]* *Address of Employer: [insert street/city/country]* *Matter in dispute: [indicate main issues in dispute]* *Party who initiated the dispute: [indicate "Employer" or "Contractor"]* *Status of dispute: [Indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]*	*[insert amount]*
2				
3				

(B). Details of Black listing/ debarring by the Govt. departments for last 5 years till 31st December, 2025:

Sl. No	Date, month & year of Black listing / de barring	Name of Agency Black listed / de barred	Period of Black listing / de barring	Ending date of Black listing / de barring
1	*[insert date, month & year]*	*[insert name and place of agency]*	*[insert period in years& months]*	*[insert date, month & year]*
2				

(C). Details of Pending Litigation upto 31st December, 2025:

Sl No	Date, month & Year of award	Amount of Award, INR	Contract Identification	Total Contract Amount INR
1	*[insert date]*	*[insert amount]*	*Contract Identification: [indicate complete contract name, number, date and any other identification]* *Name of Employer: [insert full name]* *Address of Employer: [insert street/city/country]* *Matter in dispute: [indicate main issues in dispute]* *Party who initiated the dispute: [indicate "Employer" or "Contractor"]* *Status of dispute: [Indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]*	*[insert amount]*
2				

Certified that the above information is correct as per records and nothing has been omitted / concealed.

….. *(Signature of the Statutory Auditor)*

…...*(Full Name of the Statutory Auditor)*

…..*(Name of the Statutory Auditor's Firm)*

…..*(Complete Address of the Statutory Auditor's Firm)*

…................................... *(Telephone/fax numbers, including country and city codes)*
…..*(E-mail of the Statutory Auditor)*
…..*(Seal of the Statutory Auditor)*

Membership No. of the Statutory Auditor: ………………………
Notes:

(i) The Tenderer shall provide accurate information about any litigation or arbitration resulting from contracts completed or ongoing under its execution over the last three years.

(ii) This may be noted that under this category only cases of arbitration /litigation finally settled against the Tenderer should be listed. If the case is pending at any level of arbitration or judiciary, the same should be listed in Pending Litigation and NOT under Litigation History. A consistent history of awards against the Tenderer may result in failure of the Application/Tender.

Date:

Tenderer's Signature
With Stamp

Annexure - 11

COCHIN PORT AUTHORITY
RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II

UNDERTAKING REGARDING EPF AND ESI REGISTRATION

I/We, M/s. ……………………………………..*(Name & address of the Tenderer)* solemnly affirm and undertake that I/We do not have the required number of employees for taking registration under EPF Organisation and ESI Corporation. I/We also undertake that I/We take the full responsibility for all the consequences arising due to the above and indemnify CoPA officials for any actions taken in this regard.

SIGNATURE OF TENDERER

Annexure-12

PROFORMA OF PRE CONTRACT INTEGRITY PACT

General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on____________ day of the month of _______________ 20__, between, on one hand, the Board of Major Port Authority for Cochin Port Authority acting through Shri. ________________, (Designation of the Officer), Cochin Port Authority (hereinafter called the 'BUYER/ EMPLOYER', which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns) of the First Part and M/s. ___________________ represented by Shri.___________________________, Chief Executive Officer (hereinafter called the "BIDDER/SELLER" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns) of the Second Part.

WHEREAS the 'BUYER/ EMPLOYER' has invited bids for the project of "RE-MODELING OF NEW ADMINISTRATIVE BUILDING PHASE II" (hereinafter referred to as the "Project") and the BIDDER/SELLER is submitting his bid for the project and

WHEREAS the BIDDER is a Private Limited company/Public Limited company/Government undertaking/registered partnership firm/ constituted in accordance with the relevant law in the matter and the 'BUYER/ EMPLOYER' is Cochin Port Authority.

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling BIDDERS to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the 'BUYER/ EMPLOYER' will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

1. Commitments of the 'BUYER/ EMPLOYER'

1.1 The 'BUYER/ EMPLOYER' undertakes that no official of the 'BUYER/ EMPLOYER', connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

1.2 The 'BUYER/ EMPLOYER' will, during the pre-contract stage, treat all BIDDERS alike and will provide to all BIDDERS the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERS

1.3 All the officials of the 'BUYER/ EMPLOYER' will report to the appropriate Government office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

1.4 In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the 'BUYER/ EMPLOYER' with full and verifiable facts and the same is prima facie found to be correct by the 'BUYER/ EMPLOYER' necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the 'BUYER/ EMPLOYER' and such a person shall be debarred from further dealings related-to the contract process. In such a case while an enquiry is being conducted by the 'BUYER/ EMPLOYER' the proceedings under the contract would not be stalled.

2. Commitments of BIDDERS

2.1The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following:-

2.2The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the 'BUYER/ EMPLOYER' connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

2.3The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the 'BUYER/ EMPLOYER' or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or forbearing to show favour or disfavour to any person in relation to the contract or any other contract with the Government.

2.4BIDDERS shall disclose the name and address of agents and representatives and Indian BIDDERS shall disclose their foreign principals or associates.

2.5BIDDERS shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

2.6The BIDDER further confirms and declares to the 'BUYER/ EMPLOYER' that the BIDDER has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

2.7The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the 'BUYER/ EMPLOYER' or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

2.8The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

2.9The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

2.10 The BIDDER shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the 'BUYER/ EMPLOYER' as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.

2.11 The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

2.12 The BIDDER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

2.13 If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the 'BUYER/ EMPLOYER' or alternatively, if any relative of an officer of the 'BUYER/ EMPLOYER' has financial interest/stake in the bidder's firm, the same shall be disclosed by the BIDDER at the time of filing of tender.

2.14 The term 'relative' for this purpose would be as defined in Section 6 of the Companies Act 1956.

2.15 The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the 'BUYER/ EMPLOYER'.

3. Previous Transgression

3.1 The BIDDER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify bidder's exclusion from the tender process.

3.2 The BIDDER agrees that if it makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

4. Earnest Money (Security Deposit)

4.1 While submitting commercial bid, the BIDDER shall deposit an amount ____ (to be specified in Bid Document) as Earnest Money, with the 'BUYER/ EMPLOYER' through any of the following instruments:

(i) Bank Draft or a Pay Order in favour of _______

(ii) Any other mode or through any other instrument (to be specified in the Bid Document).

4.2 The Earnest Money shall be valid upto a period of 180 days from the Bid Due Date.

4.3 In case of the successful BIDDER, a Performance Guarantee in the form of Bank Guarantee valid till 30 days after the end of defect liability period will also be furnished to the BUYER/ EMPLOYER 'within 21 days of Letter of Acceptance of the Bid by the 'BUYER/ EMPLOYER.

4.4 In case of the successful BIDDER, a clause would also be incorporated in the Article pertaining to Performance Security in the Project Contract that the provisions of Sanctions for Violation shall be applicable for forfeiture of Performance Security in case of a decision by the BUYER/ EMPLOYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

4.5 No interest shall be payable by the 'BUYER/ EMPLOYER' to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

5. Sanctions for Violations

5.1 Any breach of the aforesaid provisions by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the 'BUYER/ EMPLOYER' to take all or any one of the following actions, wherever required:-

(i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.

(ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the 'BUYER/ EMPLOYER' and the 'BUYER/ EMPLOYER' shall not be required to assign any reason therefore.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.

(iv) To cancel all or any other Contracts with the BIDDER. The BIDDER shall, be liable to pay compensation for any loss or damage to the 'BUYER/ EMPLOYER' resulting from such cancellation/rescission and the 'BUYER/ EMPLOYER' shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

(v) To debar the BIDDER from participating in future bidding processes of the Government of India for a minimum period of five years, which may be further extended at the discretion of the 'BUYER/ EMPLOYER'

(vi) To recover all sums paid in violation of this Pact by BIDDER(s) to any middleman or agent or broker with a view to securing the contract.

(vii) Forfeiture of Performance Guarantee in case of a decision by the 'BUYER/ EMPLOYER' to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.2 The 'BUYER/ EMPLOYER' will be entitled to take all or any of the actions mentioned at para 6.1(i) to (vii) of this Pact also on the Commission by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in Chapter IX of the Indian Penal code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

5.3 The decision of the 'BUYER/ EMPLOYER' to the effect that a breach of the provisions of this Pact has been committed by the BIDDER shall be final and conclusive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes of this Pact.

6. Fall Clause

The BIDDER undertakes that it has not performed/is not performing similar project at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar project was performed by the BIDDER to any other Ministry/Department of the Government of India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the 'BUYER/ EMPLOYER', if the contract has already been concluded.

7. Independent Monitors

7.1 The 'BUYER/ EMPLOYER' has appointed the following Independent Monitors (hereinafter referred to as Monitors) for this Pact in consultation with the Central Vigilance Commission.

1. Shri.Harishwar Dayal,IDSE(Retd),
H-2, Lawyer Colony, Bypass Road,

Agra-282 005 (UP) Mobile No.9412095786.
e-mail id: dayalagra@gmail.com

2. Shri.Deepak Chaturvedi, ITS(Retd),
Flat No.1, Sanchar Vihar, C-5814, Sector-62,
Uttar Pradesh, Noida -201301 Mobile No.9930408711.
e-mail id :chaturvedideep@rediffmail.com

7.2The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.
7.3The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

7.4Both the parties accept that the Monitors have the right to access all the documents relating to the project/bidding, including minutes of meetings.

7.5As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the BUYER/ EMPLOYER,

7.6The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER/ EMPLOYER, including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.

7.7The BUYER/ EMPLOYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

7.8The Monitor will submit a written report to the designated Authority of BUYER/ EMPLOYER within 8 to 10 weeks from the date of reference or intimation to him by the BUYER/ EMPLOYER/ BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

8. Facilitation of Investigation

In case of any allegation of violation of any provisions of this pact or payment of commission, the BUYER/ EMPLOYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

9. Law and Place of Jurisdiction

This Pact is subject to Indian Law.' The place of performance and jurisdiction is the seat of the BUYER/ EMPLOYER

10.Other Legal Actions

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

11.Validity

11.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of the BUYER/ EMPLOYER and the BIDDER/SELLER, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

11.2 Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions.

11.3 The parties hereby sign this Integrity Pact at_______on________

BUYER/ EMPLOYER	BIDDER
Name of the Officer. Designation Dept./MINISTRY/PSU	CHIEF EXECUTIVE OFFICER
Witness	Witness
1. ________________	1.___________________
2. _________________	2.___________________,

* Provisions of these clauses would need to be amended/ deleted in line with the policy of the BUYER/ EMPLOYER in regard to involvement of Indian agents of foreign bidders.

Annexure 13

National Electronic Fund Transfer (NEFT/RTGS) Mandate Form

(Mandate for receiving payment s through NEFT/RTGS from COCHIN PORT AUTHORITY)

1	Vendor Name/Beneficiary Name	**COCHIN PORT AUTHORITY**
2	Vendor code	
3	**Permanent Account Number(PAN)**	**AAALC - 1134F**
4	**TAN NO**	**CHNC04095A**
5	**GST NO:**	**32AAALC1134F1ZZ**
6	Particulars of Bank Account	Savings Account
	A. Name of Bank	**STATE BANK OF INDIA**
	B. Name of Branch	Cochin Port Authority
	C. Branch Code	6367
	D. Address	Cochin Port Authority , Willingdon Island - 682009
	E. City Name	Cochin
	F. Telephone No	2582614
	G. NEFT/IFSC Code	**SBIN0006367**
	H. SWIFT Code:	**SBININBB**
	I. 9.digit MICR code on the Cheque Book.	682002021
	J. Type of Account	Savings Account
	K. Account No.	**41401802288**
5	Vendor Email-id	cash@cochinport.gov.in

(Please enclose a photocopy of the Cancelled cheque to enable usto verify the details mentioned above)

We hereby declare that the particulars given above are correct and complete. If the transaction is delayed or lost because of incomplete or incorrect information. We would not hold the company responsible.

SD/-

FINANCIAL ADVISER &

CHIEF ACCOUNTS OFFICER

COCHIN PORT AUTHORITY

Bank Certificate

We certify that ____________________has current account No _____________________with us and we confirm that the details given above are correct as per our records.

Date :

Place: Authorised Official of Bank

SECTION II

INDEX

SECTION -II

SECTION -II
COCHIN PORT AUTHORITY

1. GENERAL CONDITIONS OF CONTRACT (GCC) - PART A - G

(GCC ATTACHED AS SEPARATE VOLUME)

SECTION -II
COCHIN PORT AUTHORITY

2. FORM OF SECURITIES (ANNEXURE A & B)

Annexure –A

PROFORMA OF BANK GUARANTEE FOR PERFORMANCE GUARANTEE/ SECURITY DEPOSIT

(To be executed on non-judicial Stamp Paper of appropriate value)

[The bank, as requested by the successful Tenderer, shall fill in this form in accordance with the instructions indicated]

In consideration of the Board of Trustees of the Port of ***[insert name of Port]*** incorporated by **The Board of Major Port Authority** Act, 1963 as amended by Major Port Authority (Amendment) Act 1974 (hereinafter called "The Board" which expression shall unless excluded by or repugnant to the context or meaning thereof be deemed to include the Board of Trustees of the Port of ***[insert name of Port]***, its successors and assigns) having agreed to exempt ____(hereinafter called the "Contractor")"
(Name of the Contractor/s)
from the demand under the terms and conditions of the Contract, vide ______________________________„s letter No.____________________
(Name of the Department)
date _______________ made between the Contractors and the Board for execution of ____ covered under Tender No._________________________dated __________(hereinafter called "the said contract") for the payment of Security Deposit in cash or Lodgement of Government Promissory Loan Notes for the due fulfilment by the said Contractors of the terms and conditions of the said Contract, on production of a Bank Guarantee for Rs.__________________ (Rupees____) only we, the (Name of the Bank and Address) ________________________________ ____ (hereinafter referred to as "the Bank") at the request of the Contractors do hereby undertake to pay to the Board an amount not exceeding Rs.____________ (Rupees _____________________________________) only against any loss or damage caused to or suffered or which would be caused to or suffered by the Board by reason of any breach by the Contractors of any of the terms and conditions of the said contract.

42 We, ______________________, _____________________, do hereby

(Name of Bank) (Name of Branch)

undertake to pay the amounts due and payable under this guarantee without any demur merely on a demand from the Board stating that the amount claimed is due by way of loss or damage caused to or which would be caused to or suffered by the Board by reason of any breach by the Contractors of any of the terms and conditions of the said contract or by reason of the Contractors failure to perform the said contract. 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 any amount not exceeding Rs. ______________(Rupees _____________________________________) only.

43 We, _____________(Name of Bank and Branch)_____________________, undertake to pay to the

Board 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 there under and the Contractor(s) shall have no claim against us for making such payment.

44 We, ____________(Name of Bank and Branch) further agree with the Board that the guarantee herein contained shall remain in full force and effect during the period that would be taken for performance of the said contract and that it shall continue to be enforceable till all the dues of the Board under or by virtue of the said contract have been fully paid and its claims satisfied or discharged or till the ____

(Name of the user department)

of the said certifies that the terms and conditions of the said contract have been fully and properly carried out by the said Contractors and accordingly discharge this guarantee. PROVIDED HOWEVER that the Bank shall be the request of the Board but at the cost of the Contractors, renew or extend this guarantee for such further period or periods as the Board may require from time to time.

45 We, _______________________________further agree with the Board

(Name of Bank and Branch)

that the Board shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said contract or to extend the time of performance by the said contract or to extend the time of performance by the said Contractors from time to time or to postpone for any time or from time to time any of the powers exercisable by the Board against the said Contractors and to forebear or enforce any of the terms and conditions relating to the said contract and we shall not be relieved from our liability by reason of any such variation or extensions being granted to be Contractors or for any forbearance, act or omission on the part of the Board or any indulgence shown by the Board to the Contractors 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.

46 This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

47 It is also hereby agreed that the Courts in ***[insert city]*** would have exclusive jurisdiction in respect of claims, if any, under this Guarantee.

48 We, __________________________Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Board in writing.

49 Notwithstanding anything contained herein :

49.1 Our liability under this Bank Guarantee shall not exceed Rs.__________

(Rupees ____________________________________only);

49.2 this Bank Guarantee shall be valid upto ___*__________; and

49.3 we are liable to pay the guarantee amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before _______________________(date of expiry of Guarantee)."

Date ______________________day of_______________20

For (Name of Bank)

(Name)

Signature

* The date will be thirty (30)days after the end of the period of Defect Liability as specified in the Contract.

Annexure - B

PROFORMA OF BANK GUARANTEE FOR SECURED ADVANCE

(SECURED ADVANCE)

(To be executed on Non-judicial stamp paper of appropriate value)

THIS INDENTURE made BETWEEN (Name and address of the contractor . . . .

. ... (hereinafter called the contractor which expression shall where the context so admits of implies be deemed to include his executers, administrators and assigns) of the one part and THE CHIEF ENGINEER, COCHIN PORT AUTHORITY (hereinafter called the Chief Engineer which expression shall where the context so admit or implies be deemed to include his successors in office and assigns) of the other part.

WHEREAS by an arrangement No. . . . . .dated........................... (hereinafter called the agreement) the contractor has agreed for execution of the work of (Name of the work).

AND WHEREAS the contractor has applied to the Chief Engineer that he may be allowed advances on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charges)

AND WHEREAS the Chief Engineer has agreed to advance to the Contractor the sum of Rupees................................on the security of materials the quantities and other particulars of which are detailed in the Schedule- A, signed both by the contractor and the Chief Engineer has reserved to herself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

Now THIS INDENTURE WITNESSETH THAT in pursuance of the said agreement and consideration of the sum of Rupees . . . .on or before the execution of these presents paid to the Contractor by the Chief Engineer (the receipt of whereof the contractor doth hereby acknowledge) and of such further advance (if any) as may be made to him as aforesaid the Contractor doth hereby covenant and agree with the Chief Engineer and declare as follows:

That the said sum of Rupees ....advanced by the Chief to the contractor as aforesaid and all or any further sum or advanced as aforesaid shall be employed by the contractor in or towards expediting the execution of the said works and for no other purpose whatsoever.

That the materials detailed in Schedule –A which have been offered to and accepted by the Chief Engineeras security are absolutely the Contractor's own property and free from encumbrances of any kind and the contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnifies the Chief Engineer against all claims to any material in respect of which advances has been made to him as aforesaid.

That the materials detailed in the said Schedule –A and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Executive Engineer (hereinafter called the Divisional Officer) and in the terms of the said agreement.

That the contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractors custody and his own responsibility and shall at all times be open to inspection by the Divisional Officer or any Officer authorised by him. In the event of the said materials or any part thereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof the contractor will forthwith replace the same with other materials of like quality or repair and make good the same as required by the Divisional Officer.

That the said materials shall not on any account be removed from the site of the said works except with the written permission of the divisional Officer authorised by him on that behalf

That the advance shall be repayable in full when or before the contractor receives the payment from the Chief Engineer of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments made to the contractor on account of the work done than on occasion of each such payment the Chief Engineer will be at liberty to make a recovery from the contractor's bill for such payment by deducting there from the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously, the value for this purpose being determined in respect of each description of materials at the rates at which the amount of the advance made under these presents were calculated.

That if the contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement of these presents the total amount of the advance or advances that may still be owing to the Chief Engineer shall immediately on the happening of such default be repayable by the Contractor to the Chief Engineer together with interest thereon at twelve percent per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs, charges, damages, and expenses incurred by the Chief Engineer in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the Chief Engineer to repay and pay the same respectively to him/her accordingly.

That the contractor hereby charges all the said materials with the repayment to the Chief Engineer of the said sum of Rupees. . . . . and any further sum or sums advanced as aforesaid and all costs, charges, damages and expenses payable under these presents PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and whenever the covenant for payment and repayment herein before contained shall become enforceable and the money owing shall not be paid in accordance therewith the Chief Engineer may at anytime thereafter adopt all or any of the following courses as she may deem best.

a) Seize and utilize the said materials or any part thereof in the completion of the said works on behalf of the contractor in accordance with the provisions in that behalf contained in the said agreement debiting the contractor with actual cost of affecting such completion and the amount due in respect of advances under these presents and crediting the contractor with the value of work done as if he has carried it out in accordance with the said agreement and at therates thereby provided. If the balance is against the contractor he is to pay same to the Chief Engineer on demand.

b)Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable to the Chief Engineer under these presents and pay over the surplus, (if any) to the contractor.

c)Deduct all or any part of the moneys owing out of the security deposit or any sum due to the contractor under the said agreement.

That expect in the event of such default on the part of the contractor as aforesaid interest on the said advance shall not be payable.

That in the event of any conflict between the provision of these presents and the said agreement the provisions of these shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been herein before expressly provided for the same shall be referred to the Chief Engineer whose decision shall be final and the provision of the Indian Arbitration Act for the time being in force shall apply to any such reference.

In witness whereof the said Contractor and the Chief Engineer have hereunto set their respective hands the day and year first above written.

Signed, sealed and delivered by

the said Contractor in presence of

SIGNATURE

WITNESS NAME

ADDRESS

Signed, sealed and delivered by The

Chief Engineer in presence of

SIGNATURE

WITNESS NAME

ADDRESS

SECTION III

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SECTION -III

SECTION -III
COCHIN PORT AUTHORITY

1. GENERAL DESCRIPTION OF WORK

SECTION -III
COCHIN PORT AUTHORITY

1. GENERAL DESCRIPTION OF WORK

1 General

Where it is mentioned in the Specifications that the Contractor shall perform certain Work or provide certain facilities, it is understood that the Contractor shall do so at his own Cost.

The materials, design and workmanship shall satisfy the relevant Indian Standard Specification and conditions herein referred to. Where the Specifications stipulate requirement in addition to those contained in the Standard codes and Specifications, these additional requirements shall also be satisfied.

1.1 Definitions

"Contract" means the agreement entered into between the Employer and the Contractor, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein;

"Contract Price" means the price payable to the Contractor under the Contract for the full and proper performance of its contractual obligations;

"Employer / Client" means Cochin Port Authority, the Organization purchasing the Works and Services.

"Contractor" means the individual or firm supplying the Works and Services under this Contract.

"Engineer-in-Charge" means the nominee/representative of the Employer/Consultant authorized to give instruction to the Contractor during the various stages of execution of the Work.

2. Scope of work

2.1 This work essentially comprises of works of the following:

A. <u>Civil & Architectural Works</u>

1. Demolition, dismantling, and safe disposal of existing PCC, RCC, brickwork, partitions, doors, windows, false ceilings, stone/tile flooring, skirting, dado, steel hand railings, glazing, and all related components, including complete debris clearance.
2. Providing and laying fully vitrified tiles, Matt/Antiskid finish Vitrified tiles, wall tiles, polished granite stone and finishing materials in all rooms, toilets, and pantry areas. Filling sunken floor areas in toilets using AAC brick-bat concrete.
3. RCC works for lintels, shafts and roof slab.
4. Upgradation of existing meeting spaces including conversion of the Ground Floor conference room into an Auditorium and revamping of the Sixth Floor and Second Floor conference rooms.
5. Remodelling of workspaces into chambers, cabins, cubicles, and workstations, including integrated furniture layout.
6. Masonry works using precast concrete solid blocks.
7. Replacement of existing aluminium windows with UPVC units.
8. Joinery works including FRP doors, flush doors, wooden doors, UPVC windows/louvered doors/ventilators/aluminium glazed doors, fire resistant doors, frameless toughened glass door and associated frames.
9. Waterproofing treatment for sunken areas in WCs

10. Structural steel works for washbasin counters, second-floor roof, and conference hall stage, including protective epoxy coating.
11. Cement plastering of 12 mm thickness on new brickwork and repair plastering (12–20 mm) wherever required.
12. Complete interior painting works with premium quality paint including primer, putty, and finishing coats.
13. Partition Walls - Installation of 1.5m high half-height decorative laminate partition with aluminium framework, double skin cladded with 12mm thick BWP 710 on both sides; urinal partitions with HPL Compact Board; toilet cubicle; Fixed Glass Partition for Cabins; Gypsum Board Partition; Fibre Cement Board for covering ducts etc.
14. False ceiling works using gypsum moisture resistant boards in cabins and aluminium grid ceilings in toilets and passages.
15. Laminated wooden false ceiling using 710 BWP plywood (12 mm / 6 mm) in conference rooms and designated areas.
16. Laminated/decorative veneer/fluted Wall panelling using 710 BWP plywood/flexible plywood at the board room, lobby, corridors, reception and other specified locations. WPC fluted wall panelling/acoustic PET panelling at Board room and conference room.
17. Miscellaneous interior finishing works including installation of mirrors, decorative vertical panels, 3D artwork, office signage, acrylic LED illuminated logo, frosted privacy film/sticker, heavy-duty adhesive applications, and PVC coated polyester fabric roller blinds.
18. External development works like Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels; Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units; Providing & Laying of Cement Concrete paver blocks; GRC column works; Kota stone work; tactile tile work etc.
19. Fabrication and installation of office furniture such as tables, chairs, workstations, conference room/Board room furniture, and built-in storage units.

B. MEP Works

The MEP scope includes the supply, installation, testing, and commissioning of the following systems:

Plumbing System

20. Installation of water supply lines, drainage networks, sanitary fittings, fixtures, and accessories.
21. Dismantling of existing sanitary fittings and replacement with new fixtures.

Electrical & ELV Works

22. Providing new Electrical wiring, conduiting, DBs, switch Boards, LED / Electrical fittings, LED light driver, TPN Tap off boxes, Cable trays etc. as per the schedule/ BOQ.
23. Providing new Main MV panels, DG synchronizing panels, Sub Panels, terminations etc. as per the schedule/BOQ.
24. Providing New DG set, shifting of old DG sets with panels, housing of DG sets, Exhaust pipes with insulation, foundations, earthing of DGs etc. as per the schedule/BOQ
25. Providing new UPS systems with batteries as per the schedule/BOQ.

26. Providing and terminations of cables, Earthing and commissioning of the entire work as per the schedule / BOQ
27. Providing new HVAC items including AC outdoor and indoor units, ventilation fans, ducting, copper piping, copper piping and duct thermal insulation, duct acoustic insulation, control wiring, wired and wireless controllers, raise ways/duct /shaft etc. for routing the same as per the schedule/BOQ
28. Providing new ELV system with telephone, DATA sockets, Data and telephone cabling and conduiting, Telephone units, EPABX, OFC cabling, Network switches, Network racks, cable trays for ELV, CCTV cameras, CCTV NVR, Wifi access points and wireless controllers, SFP modules, Patch panels and patch cables, and related items as per the schedule / BOQ
29. Providing new ELV-Audio/Video system with LED wall screen, Amplifiers, Mixers, Speakers, Interactive LED screens, Microphone, All in one video conferencing equipment, cabling, conduiting, network racks, LED TVs and related items as per the schedule / BOQ
30. Providing new Fire Fighting items with Electrical Fire pumps, Fire pump with Diesel engine, Air vessel ,Pressure gauges, Flow switches, MS piping, Valves, Hydrant valves, yard hydrants, Branch pipes, Non percolated RRL hoses, Hose reels, Hose cabins, Sprinklers, smoke and heat detectors, air release valves, fire brigade connection ,Tank filling unit, Pipe supports ,Electrical wiring and conduiting for FAS and PA system, Manual call points, Fire alarm sounder, talk back unit system, Fire alarm panels ,PA speaker system with mic and amplifier, Fire extinguishers and signages as per the schedule / BOQ
31. Dismantling and removing the old existing Electrical wiring/Distribution items, Panels ,Electrical fittings, Switch Board, DB's , cables , ELV items, Old lightning arrestor strips/Mast , Fire Fighting items, AC systems etc. for enabling the proposed new work installation.

HVAC & Ventilation

32. Installation of air-conditioning equipment, ducting networks, ventilation systems, and relevant accessories.

Fire Protection System

33. Provision and installation of fire hydrants, sprinkler systems, fire extinguishers, pumps, pipelines, valves, and associated fire-safety infrastructure.

3. Site conditions

a. **Location**

The proposed site of work is the New Administrative Building located at the North End of Cochin Port Authority, Willingdon Island. The building comprises Ground Floor plus eight floors (G+8). The work are to be carried out in an operational office; therefore, only partial displacement of occupants may be carried out. In the first phase, the work shall be executed on the Ground Floor and the 6th Floor. Subsequently, the remaining floors shall be taken up in a phased manner. The 7th and 8th Floors are critical operational areas and cannot be vacated; hence, work in these areas shall also be carried out simultaneously with other floors. The entire scope of work shall be completed within a period of Eight (8) months.

b. Reference Level

All the levels indicated in the drawings and/or specifications are with reference to

Port Chart Datum, which is at 0.582 m below Mean Sea Level. The contractor shall establish reference benchmarks at suitable spots. The maintenance of these reference benchmarks will be the responsibility of the contractor for which no payment will be made. The tenderers shall make their own arrangements for inspecting the area and satisfying themselves regarding the water depth available in this area. However, the sounding chart in the location of the berth is enclosed for reference.

c. Wind

Wind at Cochin is highly influenced by the land and sea breezes. Wind direction changes from north-east during morning hours to west during evening for the period of October to May. During peak of south-west monsoon, especially from June to September, predominant wind direction remains south-west both during morning and evening hours. Due to strong monsoon winds, effect of land winds is not dominant during south-west monsoon. During the non-monsoon periods, the predominant wind direction is from north east during the morning and west during the evening which shows influence of land breeze.

d. Rainfall

The climate is characterized by dry and wet seasons. The wet seasons starts in late May and ends in November. During this period, two monsoons pass by one after another. The major monsoon is south-west monsoon which lasts from June to September. This is followed by north-east monsoon during October and November. The average annual rainfall is about 3000mm; and the major portion is during south-west monsoon.

e. Temperature

Cochin experiences moderate temperatures throughout the year. The temperature varies from 22°C to 34°C. The low temperature occurs during the southwest monsoon, December and January. Daytime temperature goes upto 30°C even during this period. The hot months are from March to May.

4. Time Schedule and monitoring of progress

a. Tenderer shall prepare and attach with the tender a detailed work schedule [preferably in MS Project / Primavera] indicating key activities and critical items showing critical path of activities for completing the work within the stipulated contract period. This time schedule forms the basis for monitoring the progress of work. Issue of working drawings, if any, by the department will be regulated as per the time schedule approved by the department.

b. The contractor shall furnish to the Engineer-in-Charge monthly progress reports of the work during execution in the approved proforma indicating delay, if any, its reason and proposal to cover up the delay.

5. Facilities to be provided by the Port

a. Contractor's work area:

Work area as per availability near to the site will be made available to the contractor, free of rent.

b. Power

Electric power required for the work can be supplied by the department from the nearest existing line of the Port Authority at prevailing rates. The cost of drawing temporary lines/ cables/ providing switches and making connection and metering arrangements etc, shall be borne by the Contractor. If there is any disruption in the power supply due to supply failure/ restrictions imposed by the Kerala State Electricity Board, the department shall not be held responsible and the Contractor has to make suitable alternative arrangements at their cost

6. Contractor's responsibility

a. All materials for use on the works shall be supplied and provided by the contractor at his own cost and shall conform to relevant BIS Specification unless otherwise specified.

b. Samples of all materials including fixtures, if any, to be incorporated in the work shall be got approved by the Engineer-in-Charge before procurement.

c. The contractor shall thoroughly study the specifications and drawings and errors/omissions/modifications, if any, shall be brought to the notice of the Engineer-in-Charge well in advance so that a final decision in the matter could be given in time.

d. All labour, skilled or unskilled shall be provided by the contractor. Settling any dispute with the labour will be contractor's responsibility.

e. The contractor shall take all care to observe no / least disturbance to the functioning of the officers at the working places.

f. The contractor shall be solely responsible for any damage or injury to the persons or things caused or suffered during the execution of the work and these shall be made good or compensated at his risk & cost. The contractor shall ensure that valid Insurance Policy as per contract document is available at all times.

g. The contractor shall take all care and precautionary measures for avoiding any kind of damage/accident in the work site on any account. The department shall not entertain any claim from the contractor whatsoever towards compensation for any damage/accidents at the site due to negligence from his part, during the execution of work.

h. The contractor shall prior to commencement of the work insure in the joint names of the Employer and the contractor against all loss or damage from whatever cause arising for which he is responsible under the terms of contract.

i. The work shall be arranged by the contractor without causing any damage to Port's/ any other structures. Any damage caused by the contractor's operation shall be compensated/ made good at contractor's risk and cost to the satisfaction of the Engineer-in-Charge of the works, failing which department will do the rectification work and the cost incurred will be recovered from any sum due to him from the Port.

j. All plants and equipments and consumables required for the whole work shall be provided by the contractor at his own cost.

k. The contractor shall not construct any structure, even of temporary nature, for any purpose at site, except with the written permission of the Engineer-in-Charge of the work and any construction so put up shall be removed by the contractor whenever the Engineer-in-Charge calls upon the contractor to do so.

l. The Contractor shall be responsible for the true and proper setting out of the works in relation to original points, lines and levels of reference given by the Engineer-in-charge and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection therewith. If at any time during the progress of work any error shall appear or arrive in the position, levels, dimensions or alignment of any part of the works, the contractor on being required to do so by the Engineer-in-

Charge shall, at his own cost, rectify such error to the satisfaction of the Engineer-in-Charge, unless such error is based on incorrect data supplied by the Engineer-in-Charge, in which case the expense of rectifying the same shall be borne by the department. The checking of any setting out or of any line or level by the Engineer-in-charge shall not in any way relieve the contractor of his responsibility for the correctness thereof and the contractor shall carefully protect and preserve all bench marks, pegs, other things used in setting out the work and measurement purpose.

m. Qualified Engineers with sufficient experience in works of similar nature as indicated in "Contract Data" shall be available at site throughout the contract period during working hours in order to receive instructions from department and to implement them properly and in time.

n. The contractor shall take all care and precautionary measures for avoiding damage or accidents to other operations in the area. The department will not entertain any claim from the contractor whatsoever, towards compensation for any such damage or accident occurring during the execution of the contract.

o. The contractor shall observe all safety regulations during the execution of the work. Safety measures, precautions, warning signals etc. shall be done at the contractor's cost as directed by the Engineer-in-charge of the work. **The contractor shall provide all necessary personnel protection equipments such as helmet, lifeguard, goggles, boots etc. to the workmen at his own cost. It shall be the contractor's responsibility to ensure that the workmen make use of the personnel protection equipments during the execution of work**

p. The work shall be arranged by the contractor without causing any hindrance to the works performing in the area. No damage shall be caused to the structures in the area, equipment, installations, vehicles operating in the area. Any damage or accident caused by the contractor's operations shall be compensated / made good at the contractor's risk and cost.

q. No information or photograph concerning the works shall be published without the prior permission of the Chief Engineer and drafts of all such proposal/ publication shall be submitted for approval.

r. The information and data shown in the drawing and detailed elsewhere in the tender document are furnished for general information and guidance only and the Port Authority in no case will be held responsible for the strict accuracy thereof or any deduction, interpretation or conclusion drawn by the tenderer.

s. The contractor shall observe the conservancy rules relating to the Port and shall always take necessary steps to keep the Port water free of noxious or unhygienic matter due to the work, as are required by the Engineer-in-Charge. Under no circumstances, inflammable materials are allowed to spill into Port waters.

t. The Cochin Port is an International Ship & Port Facility Security (ISPS) code compliant Port and the contractor is obliged to comply with the provisions of the code in force and as amended from time to time.

u. The contractor shall provide necessary arrangements as desired by the Engineer-in-Charge for inspection of work without any extra cost from commencement till completion of work.

v. The Contractor shall ensure that no labourers with criminal background are engaged for the work.

w. All fossils, coins, articles of value or antiques and structures and other remains or things of geological or archaeological interest discovered in the site of work shall be deemed to be the absolute property of the Port Authority and the contractor shall take responsible precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall immediately upon discovery thereof and before removal, acquaint the departmental officers of such recovery and carry out at the expense of the department, the Engineer-in-Charge's orders as to the disposal of the same.

x. The contractor shall remove any plant (floating or otherwise) belonging to him or to any person employed by him which might have sunk in the course of work or otherwise deal with the same as directed by the Engineer-in-Charge and until the same is raised and removed, the contractor shall set on such buoys and display at night such lights for avoiding any mishaps.

y. Water required for the construction works including curing work shall be arranged by the contractor at his own cost.

z. The contractor shall take all precautions for not to damage any cables/pipes etc. passing through the area of work. Damages, if any, caused to electrical cables/ water lines/ telephone lines/OFC cables shall be rectified by the Contractor at his cost and risk.

aa. The contractor shall remove all materials brought to work site / stacked at the work site or anywhere else within the Port area and clear the site at his cost to the full satisfaction of the Engineer-in-Charge before the site is returned to the Port Authority. All such materials including debris, tools & plants etc. shall be disposed off to any place as pointed out by the Engineer-in-Charge or be taken away from the location and shall be cleared in every respect and to reinstate to its original condition at no extra cost to the Port Authority immediately after completion of the work. In case, any such material is found left in the work site or anywhere in the Port area, rent for the storage space occupied by the contractor, either for stacking the materials /debris or for areas used for such purpose but not cleared thereafter, will be recovered as per the prevailing Scale of Rate of Cochin Port Authority, for the rent applicable for open storage space for commercial purpose, for the period for which the area had been occupied by the contractor. In addition to the above, in case the Port requires the area immediately for its use, Port will repossess the land after restoring it to its original condition, material will be confiscated and disposed off at the risk and cost of the contractor, after issuing two notices giving 15 days' time each for removing the material. All expenses incurred on this shall be recovered by disposing off the material if any confiscated. If any balance amount still remains to be realized that will be recovered from the contractor by appropriate means.

bb. The contractor shall extend all facilitations and cooperation for other contractors for simultaneous execution of other works in the area entrusted by Cochin Port Authority.

cc. The contractor shall comply with all the provisions of the Indian Workmen's Compensations Act, Provident Fund Regulations, Employees Provident Fund and ESI Act etc. amended from time to time and rules framed there under and other laws affecting the contract labour that may be brought in to force from time to time."

dd. The contractor shall be registered under EPF and ESI Act and the employees employed under them shall be covered in the EPF and ESI scheme. Work Order shall be issued only to the contractors who are registered under EPF organization and ESI Corporation. The contractors shall regularly remit the employer and employee contribution to the authorities. If not, the Department would remit the same and the amount so remitted shall be deducted from the part/final bill of contractors.

ee. The contractor shall provide, at every work place, at which 20 or more women workers are ordinarily employed, crèches of reasonable size and with adequate facility for the use of their children under at the age of six years at his risk and cost.

7. Workmanship

a. All the works shall be done strictly according to relevant B.I.S. specifications unless otherwise specified.

b. The whole work shall be completed in a diligent manner within the contract period and defect or imperfection if any, observed during the defect liability period/ guarantee period, shall be rectified at contractor's cost to the full satisfaction of the Engineer-in-Charge within the time allowed.

c. **The work shall be arranged in the order of preference if so directed by the Engineer-in-Charge of work. In addition to above, contractor shall submit a Quality Assurance Plan (QAP) for the entire works under this contract and it shall be approved by the Engineer-in-Charge before commencing the work and shall be ensured strict compliance of the same. The QAP shall contain the details of tests to be conducted for each material to be used in the work and work.**

8. Temporary works

a. All scaffolding, staging, bracing and other temporary works required for proper execution of the works, shall be provided by the contractor at his own cost, unless stated otherwise and that should be inclusive of all materials, labour, supervision and other facilities. The layout and details of such temporary works shall have prior approval of the Engineer-in-Charge, but the contractor shall be responsible for proper strength and safety of the same. All temporary works shall be so constructed as not to interfere with any permanent work or with the work of other agencies. If it is necessary to remove any of the temporary works at any time to facilitate execution of works or work by other agencies, such removal and re erection, if required, shall be carried out by the Contractor at the direction of Engineer-in-Charge without any delay and any extra cost on this account shall be borne by the contractor.

b. On completion of the works, temporary works if any provided by the contractor shall be removed from the site and the area shall be reinstated to the original condition at his own risk and cost.

9. Time For Completion

a. The time allowed for the remodeling work is Eight months.

b. The time allowed for carrying out the work as mentioned in the memorandum shall be strictly observed by the contractor. The work shall throughout the time period be proceeded with diligence, time being deemed to be the essence of the contract.

c. The completion of work may entail working in monsoon period/rainy season without any extra cost. The contractor shall take such an eventuality into consideration while quoting for the work. Normally, no extension of time will be admissible for work in monsoon.

d. The whole work shall be completed in the stipulated time, accordance with the provisions under Memorandum included under "Form of Tender" or such extended time as may be allowed under clause 29 of Conditions of Contract included in the GCC.

10. Working time

The normal working time of the Port Authority is from 8 a.m. to 4.00 p.m. on all working days. If the Contractor wishes to carry out the work beyond normal working hours and or on holidays, he should get specific approval from the Engineer-in-Charge for the same. Necessary supervision will be arranged by the department and the expenditure to be incurred in this connection will be borne by the department.

11. Method of Execution

The contractor shall clearly indicate in their tender as per ***Annexure-6,*** the method proposed by them for executing the various items of works. During the actual execution of the works if modifications or changes in the method of execution of work are found necessary the contractor shall obtain approval from the Engineer-in-charge of work for such modifications or changes in the method. No claim from the contractor for additional payment shall be entertained by the department on the above account.

The detailed list of equipment/machineries/tools & plants proposed to be mobilized for the deployment in the work as furnished as per ***Annexure-*****7** of **Section- I** and method of execution furnished under clause above, are considered only for the technical appreciation of the proposal of the contractors and it shall not relieve the contractor of his responsibility of executing the work with the quality specified in the tender and any discrepancy occurs, the construction procedures detailed/specified in the tender will prevail. In case, any additional equipment are required to be mobilized than those listed in the tender for deployment in the work, it shall be arranged and the work executed as per the tender specifications without any extra cost to the Department

12. Alterations and Additions

The Employer shall have power and authority from time to time and at all times to make amendments or additions or alternations or changes in the scope of the work, and specifications, drawings and bill of quantities and give such further instructions and directions as may appear to the Employer necessary and proper for the guidance of the Contractor and the good and efficient execution of the works and the contractor shall receive, obey and be bound by the same according to the true intent and meaning thereof as if the same had been mentioned or referred to in the scope of the work, specifications, Bill of Quantities and Schedules and drawings. The Employer may also vary or alter the lines, levels or positions of any of the works contemplated or may order any of the works contemplated thereby to be omitted, with or without the substitution of any other works in lieu thereof, or may order any work or any portion of works executed or partially executed to be removed, changed or altered, if required, and may order that other work shall be substituted in lieu thereof and any difference in the cost occasioned by any such diminution or alteration so ordered and directed shall be added to or deducted from the Contract Price based on rates available in the contract or where the rates are not specified a suitable rate backed up by rate analysis shall be submitted by the contractor and agreed upon between the contractor and the Employer. In the event of disagreement, the Employer shall fix such rates or prices as shall in their opinion, be reasonable and proper having regard to the circumstances. The contractor shall give to the Employer before the tenth day of every month, a statement in writing of any extra work which he may have performed during the preceding month, failing which any claim for which he may afterwards make for payment on account of any such extra work will not be allowed.

COCHIN PORT AUTHORITY

2. SPECIAL CONDITIONS OF CONTRACT

1. GENERAL

1.1 Special Conditions shall be read in conjunction with the General Conditions of Contract, Specifications, Drawings and any other document forming part of this Contract wherever the context so requires.

1.2 Notwithstanding the subdivision of the documents into separate section and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.

1.3 Where any portion of the General Conditions of Contract is repugnant to or at variance with any provision of the Special Conditions, the provisions of the Special Conditions shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy of variations, prevail.

2. RATES FOR VARIOUS ITEMS

2.1 The rates percentage /lump sum amount as applicable shall except in so far as the contract otherwise provides, cover all obligations of the contractor under this contract and all matters and things necessary for the proper completion and maintenance of the works. The rates/percentage

2.2 The lump sum amount quoted for each item shall be all inclusive value of the finished work as per drawings and specifications and shall cover the cost of all constructional plants, temporary works, appliances, materials, both for the works and temporary works, labour and all other matter in connection with each item quoted for.

2.3 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 stated in the Schedule of Quantities.

2.4 The contractor’s rates and prices shall include all taxes, duties and fees including Port charges like wharfage, Port dues, berth hire, pilotage etc. if any applicable, all charges and taxes whatsoever excluding Goods and Service Tax (GST) in respect of materials, labour and plant and all other things obtained or used by the contractor for the execution and maintenance of the works or any temporary works and also considering the base rates indicated in Sl. No.31 of Contract Data.

3. WORKS EXECUTED THROUGH SUBLETTING

3.1 The contractor may sublet any portion of the contract, as per clause 8 of Conditions of Contract of GCC.

3.2 Notwithstanding any subletting with such approval as required under above and notwithstanding that the Engineer-in-Charge shall have received copies of any sub-contract, the contractor shall be solely responsible for the quality and proper execution of the works, performance of all conditions of contract in all respects as if such subletting had not taken place and as if such work has been done directly by the contractor.

3.3 If any sub-contractor engaged upon the works at the site executes, any work which, in the opinion of the Engineer-in-Charge, is not in accordance with the contract condition, written notice may be given to the contractor requesting him to terminate such sub contract and the contractor upon receipt of such notice shall terminate such sub contract and the said sub contractor shall forthwith leave the works, failing which the department shall have right to remove such sub contractors from site. No action taken by the department under this clause shall relieve the contractor of any of his liabilities under the contract or give rise to any compensation, extension of time or otherwise.

4. MEASUREMENTS OF WORK DONE

4.1 In addition to the Clause-26 of GCC- 'Computerized Measurement Book', measurement of the work can also be done as detailed below

4.2 Executive Engineer (hereinafter called the Engineer's Nominee) shall, except as otherwise provided, ascertain and determine by measurement the value in accordance with the Contract of work done.

4.3 All measurement of all items having financial value shall be entered in Measurement Book and/or level field book so that a complete record is obtained of all works performed under the Contract.

4.4 All measurements and levels shall be taken jointly by the Engineer's Nominee or his authorized representative and by the Contractor or his authorized representative from time to time during the progress of the work and such measurements shall be signed and dated by the Engineer's Nominee and the Contractor or their representatives in token of their acceptance. If the Contractor objects to any of the measurements recorded, a note shall be made to that effect with reason and signed by both the parties.

4.5 Department shall not entertain any claim from Contractor for any loss or damages on this account. If the Contractor or his authorized representative does not remain present at the time of such measurements after the Contractor or his authorized representative has been given a notice in writing three (3) days in advance or fails to countersign or to record objection within a week from the date of the measurement, then such measurements recorded in his absence by the Engineer's Nominee or his representative shall be deemed to be accepted by the Contractor.

4.6 The Contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for measurements and recording levels.

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

4.8 The Contractor shall give not less than seven days' notice to the Engineer's Nominee or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer's Nominee or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of measurements without such notice having been given or the Engineer's Nominee's consent being obtained in writing the same shall be uncovered at the

Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

4.9 Engineer’s Nominee or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded jointly or otherwise as aforesaid and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

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

5. BASIC RATES AND ADJUSTMENT FOR SUBSEQUENT PRICE VARIATION

5.1 Price adjustment is not applicable

6. LIQUDATED DAMAGES

For levying compensation as per Clause-49 of General Conditions of Contract, the Employer is not required to have documentary evidence to quantify or prove the losses suffered by the Employer due to delay in completion of work by the contractor, as per agreement conditions.

7. ADVANCE

No Mobilization Advance and Construction/Installation equipment Advance will be given. Secured Advance shall be given for non - perishable materials as provided in clause 51.6 of General Conditions of Contract. Cement is not considered as a non - perishable item.

8. CARE OF WORKS

From the commencement to the completion of the work the contractor shall take full responsibility for the care of the work and his employees in connection with the work thereof and in case any damage, loss or injury shall happen to the works or any part thereof or to any temporary work from any cause whatsoever (save and except the excepted risks as defined in clause 5 given below shall at his own cost repair and make good the same so that the work shall be completed in good order and in conformity in every respect with requirement of the contract. In the event of any such damage, loss or injury happening from any of the excepted risks, the Contractor shall if and to the extent required by the Engineer-in-Charge, make good the same as aforesaid and it will be to the account of the Board.

9. EXCEPTED RISKS

The excepted risks are riot (in so far as it is uninsurable) war, invasion, act of foreign enemies, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military usurped power or a cause solely due to use of occupation by the Board of any portion of the work, any operation of the forces of nature that the contractor could not have foreseen or reasonably provided against. (All of such are herein collectively referred to as the excepted risks).

10. INSURANCE OF WORKS

10.1 The insurance cover for the loss of or damage to the Works, plant, materials and equipment stated in the clause 13 of GCC shall be as follows:

a) The insurance cover for the Works for the time being executed to the estimated current contract value thereof plus 10(ten) percent thereon to allow any additional costs and professional fees resulting from the loss or damage.

b) The constructional plant and other things brought on to the site by the Contractor to the replacement value of such constructional plant and other things.

10.2 It shall be the responsibility of the Contractor to notify the insurer of any change in the nature and extent of the Works and to ensure the adequacy of the insurance cover at all times in accordance with the provisions of this clause.

11. PAYMENTS OF SALARY / WAGES AND OTHER BENEFITS etc. TO CONTRACT / CASUAL WORKERS

11.1 **The Contractors shall make all payments of salary/wages and other benefits etc. to the contract / casual workers deployed for the work through Bank / Cheque only.**

11.2 **All the payments to the contractors would be released only on submission of undertaking to comply with the clause 10.1 above.**

12. MODIFICATIONS TO GCC

The following clauses of General Conditions of Contract (GCC) shall be replaced and modified as below.

1. DEFINITIONS

Following Definitions stands replaced as:

The **Completion Date** is the date of completion of the Works as certified by the Engineer or his Nominee in accordance with Sub Clause **56.1**

Market Rate is the rate as decided by the Engineer on the basis of the cost of materials and labour at the site where the work is to be executed plus **15%** to cover all overheads and profits.

21. POSSESSION OF THE SITE

Clause 21.1 of GCC stand replaced as:

The Employer shall give possession of sites by the dates mentioned in Contract Data. If possession of a part is not given by the date stated in the Contract Data the Employer is deemed to have delayed the start of the relevant activities and this will be a Compensation Event unless it is due to the default of the Contractor.

25. SETTLEMENT OF DISPUTES AND ARBITRATION

Clauses 25 of GCC stands replaced as:

The seat & venue of the arbitration shall be at Cochin. Only comes in Cochin will have Jurisdiction.

25.1 General

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

If the Contractor considers any work demanded of him to be outside the requirements of the contract, or disputes any drawings, record or decision given in writing by the Engineer on any matter in connection with or arising out of the contract or carrying out of the work, to be unacceptable, he shall promptly within 15 days request the Engineer in writing for written instruction or decision. Thereupon, the Engineer shall give his written instructions or decision within a period of one month from the receipt of the Contractor's letter.

If the Engineer fails to give his instructions or decision in writing within the aforesaid period or if the Contractor is dissatisfied with the instructions or decision of the Engineer, the Contractor may, within 15 days of the receipt of Engineer's decision, appeal to the Chairman who shall afford an opportunity to the Contractor to be heard, if the latter so desires, and to offer evidence in support of his appeal. The Chairman shall give his decision within 30 days of receipt of Contractor's appeal. If the Contractor is dissatisfied with this decision then:

a) The Dispute value upto Rs. 1crore shall not be referred for adjudication through arbitration and.

b) If the value of the dispute is exceeding Rs.1 crore and upto Rs.5 crores, the Dispute shall be resolved through arbitration as follows;

   i. The Parties together shall appoint a Sole Arbitrator by mutual consent to resolve the dispute as per the provisions of the Arbitration and Conciliation Act, 1996. The award of the Arbitrator so appointed shall be final and conclusive and binding on all the Parties to the Agreement subject to as amended from time to time or any statutory re-enactment thereof for the time being in force. The Arbitrator may, with the consent of the Parties extend the time, from time to time, to make and publish award as the case may be.

   (ii) If the Arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacates his office due to any reason whatsoever, another Sole Arbitrator shall be appointed in the manner aforesaid. Such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor.

c) In case of the dispute or difference is relating to interpretation and application of the provisions of commercial contract between Central Public Sector Enterprises (CPSE), Port Authority inter se or CPSE and Government Department shall be referred by either party for arbitration to the Permanent Machinery of Arbitrators in the Department of Public Enterprises through the Secretary to the Government of Public Enterprises as per the guidelines issued by Department of Public Enterprises OM No.4 (1) 2011- DPE (PMA) – GL dtd. 12.06.2013 or any statutory amendment thereof.

25.2.1 It is a term of this contract that the party invoking arbitration shall give a list of disputes with amounts claimed in respect of each such dispute along with the notice for appointment of arbitrator and giving reference to the rejection by the Chairman of the appeal.

25.2.2 It is also a term of this contract that no person other than person / persons appointed as aforesaid should act as arbitrator / arbitrators and if for any reason that is not possible, the matter shall not be referred to arbitration at all.

25.2.3 It is also a term of this contract that if the Contractor does not make any demand for appointment of arbitrator in respect of any claims in writing as aforesaid within 30 days of receiving the intimation from the Engineer that the final bill is ready for payment, the claim of the Contractor shall be deemed to have been waived and absolutely barred and the Employer or his authorized representative shall be discharged and released of all liabilities under the contract in respect of these claims.

25.2.4 The arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act, 1996 (26 of 1996) or any statutory modifications or reenactment thereof and the rules made there under and for the time being in force shall apply to the arbitration proceeding under this clause.

25.2.5 It is also a term of this contract that the Arbitrator / Arbitral Tribunal shall adjudicate only on such disputes as are referred to him/them and give separate award against each dispute and claim referred and in all cases where the total amount of the claims by any party exceeds Rs. 1,00,000/- the arbitrator shall give reasons for the award.

25.2.6 It is also a term of the contract that if any fees are payable to the arbitrator these shall be paid equally by both the parties.

25.2.7 It is also a term of the contract that the arbitrator/arbitrators shall be deemed to have entered on the reference on the date he / they issues notice to both the parties calling them to submit their statement of claims and counter statement of claims. The fees, if any, of the arbitrator shall, if required to be paid before the award is made and published, be paid half and half by each of the parties. The cost of the reference and of the award (including the fees, if any, of the arbitrator) shall be in the discretion of the arbitrator who may direct to any party by whom and in what manner, such costs or any part thereof shall be paid and fix or settle the amount of costs to be so paid.”

26. COMPUTERIZED MEASUREMENT BOOK

5th para stands replaced as follows:

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

40. PAYMENTS FOR VARIATIONS

Clauses 40.2 and 40.3 shall be replaced as follow:

40.2 For items not existing in the Bill of Quantities or substitution to items in the Bill of Quantities, rate payable should be determined by methods given below and in the order given below:

i) Rates and prices derived from the rate of similar items in Contract.

ii) Rates and prices in the Schedule of Rates applicable to the Contract plus Ruling percentage.

iii) Market rates of materials and labour, hire charges of plant and machinery used, plus **15%** for overheads and profits of Contractor.

40.3 For items in the Bill of Quantities but where quantities have increased beyond the variation limits, the rate payable for quantity in excess of the quantity in the Bill of Quantity plus the permissible variation shall be as determined by methods given below:

i) Rates and prices in the Schedule of Rates applicable to the Contract plus Ruling percentage.

ii) Market rates of materials and labour, hire charges of plant and machinery used plus**15%** for overheads and profits of Contractor.

whichever is lower, but not less than the rate in the Bill of Quantities

43. PAYMENTS

Clause 43.2 stands replaced as follows:

43.2 Payment of bills for Civil Works shall be regulated as detailed hereunder:

43.2.1 Any Interim/Final bill which is **incomplete in any respect** shall be returned to the Contractor within 4 days of date of submission of bill to the Engineer or his Nominee.

43.2.2 Interim bills shall be paid within 21 days of date of submission of bills in full shape, by the Contractor, as detailed below:

43.2.2.1 Clarifications/corrections if any required on an Interim bill submitted, shall be sought from the Contractor within 4 days of submission of the bill and also, all such clarifications/corrections required shall be sought at one go except in exceptional circumstances. The Contractor shall submit the clarifications including carrying out corrections in the bill, if required, within 4 days thereafter. The clarified / corrected bill shall be verified and forwarded to Finance Department within the next 4 days. Clarifications if any required by the Finance Department shall be sought within 3 days and the Engineer/Nominee shall clear it on top priority within the next 3 days and, finally, the bill shall be paid to the Contractor within 3 days thereafter, i.e., within a total 21 days of date of submission of bills in full shape, as indicated above.

43.2.2.2 However, on request by the Contractor, 75% of the bill amount shall be paid within 7 days of submission of the bill. Balance amount of the verified bill shall be paid within 21 days of the submission of the bill, on completion of all contractual requirements as brought out at sub clause 43.2.3. below.

43.2.3 Final bill shall be paid within 3 months of issue of Taking Over Certificate by the Engineer / Nominee, as detailed below:

43.2.3.1 The Contractor shall submit the Final bill to the Engineer / Nominee within 20 days of issue of Taking Over Certificate by the Engineer / Nominee. The bill shall be checked and all clarifications/corrections required on the bill submitted, shall be sought from the Contractor within 15 days thereafter. The Contractor shall submit the clarifications including carrying out corrections in the bill, if required, within the next 10 days. The clarified / corrected bill shall be verified and forwarded to Finance Department within the next 15 days. Thereafter, clarifications if any required by the Finance Department shall be sought within 10 days and the Engineer/Nominee shall clear it on top priority within the next 10 days and, finally, the bill shall be paid to the Contractor within 10 days thereafter, i.e., within a total 3 months of issue of Taking Over Certificate by the Engineer / Nominee, as indicated above.

43.2.3.2 However, on request by the Contractor, 50 % of the final bill amount shall be paid within 7 days of submission of the bill, which will be adjusted against the final bill payment, on completion of all contractual requirements as brought out at sub clause 43.2.6. above.

(b)All other sub clauses under Clause 43 remain the same.

44. COMPENSATION EVENTS

44.1 (c) to (e) - Deleted.

All other clauses under clause 44 remains the same.

45. RATES FOR ITEMS TO BE INCLUSIVE OF TAXES

Clause 45 stands replaced as follows:

45.1 The rate quoted by the Contractor shall be inclusive of the cost of provision of plant and equipment, materials, labour, execution, supervision, maintenance, overheads and profits and every incidental and contingent cost and charges whatsoever excluding Goods and Service Tax (GST). GST as may be applicable from time to time shall be shown separately in the invoice. The Employer will perform such duties in regard to the deduction of such taxes at sources as per applicable law. Any new Taxes, levies, duties imposed after signing the Contract shall be reimbursed by the Employer on production of documentary evidence.

45.2 The invoice to be submitted by the Contractor should include the GST Registration Number of the Contractor as well as the Employer.

47. PRICE ADJUSTMENTS

Deleted

55. COMPLETION

(a) Clause 55.4 shall be added as follows:

55.4 The Completion Report / Certificate to the Contractor will be issued only after obtaining ‘No Claim Certificate’ from the Contractor in the format approved by the department stating that they have no further claims against CoPA in respect of the Work.

(b)All other sub clauses under Clause 55 remain the same.

82. TAXES AND DUTIES

80.1 -Deleted

80.2 -Deleted

80.3 -Income Tax

The Contractor and his staff shall be responsible for payment of all personal income taxes to the concerned authorities as per the law in force from time to time. Deduction of Income Tax shall be made by the Employer from each certificate of payment to the Contractor at the rate as per prevailing rates or such other rates as may be specified by the Central Government from time to time, on the gross amount of the Contractor's bill for payment. The Contractor shall comply with all the GST Regulations, viz. timely uploading of bills, issue of debit/ credit notes etc.

80.4 GST -TDS Under GST Law Shall Be Deducted As Per Prevailing Rate.

G. Salient Features of Some Major Laws Applicable To Establishments Engaged In Construction Work.

Clauses [d] & [l(i)] stands replaced as follows:

(d) Maternity Benefit Act 1961 or Maternity Benefit Amendment Act 2017:- The Acts provide for leave and some other benefits to workmen/ employees in case of confinement or miscarriage etc.

(l) ESI Act, 1948:-

(i) As per the Govt. Notification dt. 20.7.09, Cochin Port Authority has registered under the ESI Act with ESI Corporation and provision of ESI Act, 1948 are applicable to contract/casual employees drawing wages/Salary upto**Rs.20,000/-** per month and working in Cochin Port Authority. Workers covered under ESI Act, are entitled for full medical care for self and family, besides, cash benefit in the event of sickness, maternity and employment injury. Accordingly, the contractual/casual employees drawing wages upto**Rs.20,000/-** per month employed either directly by Port Authority or through contractor are covered under ESI Act, 1948. It is obligatory on the part of the Employer to calculate and remit ESI contribution comprising of Employers' share of 4.75% plus Employees' share of 1.75% which is payable on or before 21st of the following month, to which the salary relates.

SIGNATURE OF TENDERER

SECTION IV

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SECTION -IV

COCHIN PORT AUTHORITY

1.TECHNICAL SPECIFICATIONS (CIVIL AND INTERIOR)

1.1. DETAILED CIVIL AND INTERIOR SPECIFICATIONS FOR MATERIALS TO BE USED FOR WORKS

1.1.1. GENERAL

1.1.1.1. Except where otherwise specified or authorized by the Engineer-in-Charge, materials supplied by the contractor shall conform to the latest edition of code of practices published by the Bureau of Indian Standard. Samples of materials to be supplied by the contractor shall be shown to the Engineer-in-Charge sufficiently in advance for approval of its quality for use on the work.

1.1.1.2. All the materials to be used on the works shall have BIS certification mark if so available, unless otherwise specified elsewhere or shall be of approved brand with equivalent material as approved by the Engineer-in-Charge

1.1.1.3. All materials supplied shall be stored appropriately to prevent deterioration/ damage from any cause what so ever and to the entire satisfaction of the Engineer-in Charge.

1.1.1.4. The materials required for the work shall be brought to the site and stacked at places shown by the Engineer-in-Charge and the same shall be got approved for use in work sufficiently in advance so that the progress of the work is not affected by the supply of materials.

1.1.1.5. Tolls are payable by the contractor as per rules for vehicles using the Port’s Road for supplying the materials.

1.1.2. AGGREGATES FOR CONCRETE

1.1.2.1. Aggregates (fine and coarse) for concrete shall comply with the requirements of IS: 383 – „Specifications for coarse and fine aggregate from natural sources for concrete‟. Aggregate shall be obtained from sources approved by the Engineer-in-Charge. Aggregates, which are not perfectly clean, shall be washed in clean water to the entire satisfaction of the Engineer-in-Charge.

1.1.2.2. The fine aggregate shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or other deleterious substances.

1.1.2.3. Each type of aggregate shall be stored separately for the approval of Engineer-in-Charge. Wet aggregate delivered at the site shall be kept in storage for at least 24 hours to ensure adequate drainage before being used for concreting.

1.1.2.4. Contractor shall maintain at site at all times such quantities of each type of aggregate as are considered by the Engineer-in-Charge to be sufficient to ensure continuity of work.

1.1.2.5. Stone Aggregate: It shall consist of naturally occurring (uncrushed, crushed or broken) stones. It shall be hard, strong, dense, durable and clean. It shall be free from veins, adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided. Aggregates from other than natural resources shall comply with the requirements of IS 383.

1.1.2.6. Light weight aggregate such as sintered fly ash aggregate may also be used provided the Engineer-in-Charge is satisfied with the data on the proportion of concrete made with them.

1.1.2.7. Coarse aggregate shall not contain any deleterious material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete. Coarse aggregate to be used for reinforced cement concrete. Coarse aggregate to be used for reinforced cement concrete shall not contain any material liable to attack the steel reinforcement. Aggregates which are chemically reactive with alkalis of cement shall not be used. The maximum quantity of deleterious material shall not be more than five percent of the weight of coarse aggregate when determined in accordance with IS 2386.

1.1.2.8. Aggregate shall be stacked on a hard, dry and level patch of ground. When stack piling, the aggregate shall not form pyramids resulting in segregation of different sized materials. It shall be stacked separately according to nominal size of coarse aggregates. Stacking shall be done in regular stacks, of height not exceeding 100 cm.

1.1.2.9. Coarse aggregate shall be tested for the followings (as per IS 2386)

(a) Determination of particle size and shape

(b) Estimation of organic impurities (as per IS 2386 - Part II)

(c) Surface moisture

(d) Determination of 10% fine value

1.1.3. CEMENT

1.1.3.1. Quality of cement used for the work shall be 53 grade ordinary Portland cement conforming to IS:12269 or Pozzolona cement conforming to I.S. 1489 unless otherwise approved by the Engineer-in-Charge.

1.1.3.2. The cement required for the work will have to be procured by the contractor and shall comply with the relevant IS. As far as possible, the cement required for the work will have to be procured from the government agencies. The cement shall, if required by the Chief Engineer / Engineer-in-Charge, be tested and analyzed by an independent analyst at the Contractor's cost and result produced to the Engineer-in-Charge.

1.1.3.3. Supply of cement shall be taken in 50kg bags bearing manufacture's name and BIS marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant BIS codes. In case, test results indicate that the cement arranged by the Contractor does not conform to the relevant BIS codes, 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.

1.1.3.4. A cement godown of adequate capacity as directed by the Engineer-in-Charge shall be constructed by the contractors at the site of the work for which no extra payment shall be made. Double lock provision shall be made to the door of the cement godown. The key 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.

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

1.1.3.6. The cement shall be stored in a weather proof building with facilities for inspection.

1.1.3.7. The contractor shall maintain a cement register showing dates of receipt and issue, quantities used daily and balance which shall be accessible to the Engineer-in-Charge.

1.1.3.8. Different types of cement shall not be mixed together. In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

Setting time of cement of any type of any grade when tested by Vicat apparatus method described in IS 4031 (Part-5)-1988 (Reaffirm-2014) shall conform to the following requirement:

(a) Initial setting time: Not less than 30 minutes

(b) Final setting time: Not more than 600 minutes.

1.1.3.9. Every consignment of cement must have identification marks on packages indicating date of manufacturing grade and type of cement batch no. etc. Cement brought to works shall not be more than 6 weeks old from the date of manufacture.

1.1.3.10. Effective precautionary measures shall be taken to eliminate dust-nuisance during loading or transferring cement.

1.1.3.11. Cement in bags shall be stored and stacked in a shed which is dry, leakproof and as moisture-proof as possible. Flooring of the shed shall consist of the two layers of dry bricks laid on well consolidated earth to avoid contact of cement bags with the floor. Stacking shall be done about 150 to 200 mm clear above the floor using wooden planks. Cement bags shall be stacked at least 450 mm clear off the walls and in rows of two bags leaving in a space of at least 600 mm between two consecutive rows. In each row the cement bags shall be kept close together so as to reduce air circulation. Stacking shall not be more than 10 bags high to avoid lumping under pressure. In stacks more than 8 bags high, the cement bags shall be arranged in header and stretcher fashion i.e. alternately lengthwise and crosswise so as to tie the stacks together and minimise the danger of toppling over.

1.1.3.12. Different types of cement shall be stacked and stored separately. Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received. For extra safety during monsoon, or when cement is expected to be stored for an unusually long period, each stack shall be completely enclosed by a water proofing membrane, such as polyethylene, which shall cover the top of the stack. Care shall be taken to see that the water proofing membrane is not damaged at any time during use.

1.1.3.13. Storage of cement at the work site shall be at the contractor's expense and risk. Any damage occurring to cement due to faulty storage in contractor's shed or on account of negligence on his part shall be the liability of the contractor.

1.1.4. WATER

1.1.4.1. Clean fresh water free from oils, acids, alkalis, salt, sugar, organic materials or other harmful materials shall be used for washing aggregates, mixing and curing of concrete. The water used shall comply with clause 5.4 of IS:456- 2000. Potable water is generally considered good for mixing concrete. The PH value of water shall be not less than 6

1.1.4.2. **Cochin Port Authority will not provide/supply water for the work**. Water has to be arranged by the contractor himself for the construction works including curing work at his own risk and cost.

1.1.4.3. Samples of water arranged by the contractor shall be taken by the Engineer in Charge and got tested in accordance with the provisions of relevant BIS codes. In case test results indicate that the water arranged by the contractor does not conform to the relevant BIS codes, the same shall not be used for any works. The cost of tests shall be borne by the contractor.

1.1.4.4. Maximum permissible limits of solids when tested in accordance with IS 3025 shall be as under:

Organic - 200 mg/l

Inorganic - 3000 mg/l

Sulphates - 400 mg/l

Chlorides - 2000 mg/ litre for concrete not containing embedded steel and 500 mg./ltr for reinforced concrete work.

Suspended matter - 2000 mg/ litre

1.1.4.5. Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

1.1.4.6. Sea water shall not be used for mixing or curing .

1.1.5. ADMIXTURES IN CONCRETE

1.1.5.1. Admixture in concrete will be allowed only with prior approval of the Engineer–in–Charge. The contractor shall produce test certificates from recognized laboratories before use, if so desired by the Engineer–in–Charge.

1.1.5.2. Admixture manufacturer’s recommendation shall be carefully followed so as to ensure complete solution of the product or to prepare a standard solution of uniform strength for easier use.

1.1.5.3. No admixtures shall be accepted for use in concrete unless these are tested in accordance with IS 9103 and the test results are approved by the Engineer-in-Charge.

1.1.5.4. Two or more admixtures may not be compatible in the same solution. It is therefore mandatory that when two admixtures manufactured by the same manufacturers is being used simultaneously, the manufacturer shall certify their compatibility. In case the two or more admixtures are produces by different manufacturers, then, before their use in concrete, test shall be performed by the manufacturer to establish their compatibility, all such test reports shall be furnished to the Engineer-in-Charge for his approval before their use in concrete.

1.1.6. REINFORCEMENT STEEL

1.1.7.1 Material for reinforcement shall consist of Thermo Mechanically Treated (TMT) bars of grade Fe-500D conforming to IS:1786, or higher grade as approved by the Engineer-in-Charge. The reinforcement steel shall be of tested quality and free from loose mill scale, rust, oil, paint, mud, or any other coating that may impair the bond between concrete and steel. All reinforcement bars shall be cleaned thoroughly before being placed in position.

1.1.7.2 Bars shall be cut, bent, cranked, hooked, or welded (where necessary) to the required shapes and dimensions as shown in the structural drawings or as directed by the Engineer-in-Charge. Cutting, bending and fabrication shall be carried out using approved mechanical equipment to ensure accuracy. All laps, splices, bends, hooks, and anchorage lengths shall be provided in accordance with relevant IS codes and as specified in the drawings. Welding of reinforcement**,** if permitted, shall be carried out in accordance with IS:2751 and IS:9417, using approved electrodes and qualified welders.

1.1.7.3 The binding wire used for tying reinforcement shall be annealed mild steel wire of 16 gauge (1.6 mm diameter) conforming to IS:280**,** and shall be tied securely at every intersection and joint to prevent displacement of bars during concreting. Adequate cover blocks and supports made of cement mortar or non-corrosive material of the same grade of concrete shall be provided to maintain the specified cover to reinforcement. Reinforcement bars shall be properly supported and secured using chairs, spacers, and stools to maintain their correct position and alignment before and during concreting.

1.1.7. FINE AGGREGATE FOR MAKING MORTAR FOR MASONRY WORK / PLASTERING WORK

1.1.7.1. Fine Aggregate used for masonry mortar shall conform to IS:2116. Sand used for plastering shall conform to IS:1542-1992.

1.1.8. PRECAST CEMENT CONCRETE BLOCKS

1.1.8.1. Concrete blocks shall be of size 30 cm × 20 cm × 20 cm & 30 cm × 20 cm × 10 cm in plain cement concrete of M-10 grade. The blocks shall be laid in cement mortar 1:6 (1 cement: 6 coarse sand) up to the floor level). This work includes scaffolding, raking out of joints, curing, and all costs and conveyance of materials, labor, lead, and lift. The masonry work shall be carried out for all types of masonry in the superstructure above the highest plinth level, at all levels, as directed by the Engineer-in-Charge.

1.1.8.2. However, the length and shape of blocks to be provided at junctions shall be suitably modified to fit into the general configuration. These blocks are to be cast in appropriate moulds preferably steel moulds, which shall provide a smooth surface. Blocks used at junctions as required also be cast in same way. The finished blocks shall be cured properly for a minimum period of 14 days. Blocks damaged during the removal of forms and handling will be rejected. Blocks of sizes other than those specified herein above may also be used by mutual agreement between the employer and the Contractor. In case of special concrete Masonry units such as jali wall blocks and ornamental blocks, the specified sizes may not necessarily apply.

1.1.9. FIBRE GLASS REINFORCED PLASTIC DOOR FRAMES

1.1.9.1. The FRP door frames shall be of cross-section 90mm x 45mm having single rebate of 32mm x 15mm to receive shutter of 30mm thickness. The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat . Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. Stainless steel stay shall be provided at the bottom to steady the frame.

1.1.9.2. FRP door shall be manufactured as per specifications laid down in IS:14856, nomenclature of items & direction of Engineer-in-Charge.

1.1.9.3. Tolerance of size of frame to be + 2 mm and on size of rebate to be + 1 mm.

1.1.9.4. The surface of the moulded frame shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregate defects, as mentioned in IS 14856. Scattered pin holes duly repaired and finished by applying resin and not noticeable shall be acceptable. Frame laminate shall be flat and shall have smooth and level surface. Laminate shall be finished in colour & shade as approved by Engineer- in-Charge.

1.1.10. FIBRE GLASS REINFORCED PLASTIC (FRP) SHUTTERS

1.1.10.1. FRP Shutters shall be of factory made conforming to the specifications as per IS:14856 and nomenclature of item & direction of Engineer-in-Charge.

1.1.10.2. The shutter has to be 30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter of required colour and approved brand and manufacture, made with fire - retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate for forming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5 mm thick FRP laminate for panels conforming to IS:

14856, including fixing to frames.

1.1.11. FLUSH DOOR

1.1.11.1. Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS:2202 (Part I). Nominal thickness of decorative shutters shall be 35 mm and non decorative shutters shall be 30mm.

1.1.11.2. Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer-in- Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS:1708.

1.1.11.3. The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles. End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

1.1.11.4. The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS:1328.

1.1.11.5. Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

1.1.11.6. In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30mm.

1.1.12. UPVC JOINERIES

1.1.12.1. UPVC joinery systems shall be as per the specification given in Schedule of Quantities. Sealing sides top and bottom with silicon sealant etc. Windows and ventilators shall have approved colour and shade. The joinery shall be water resistant by providing water channel & EPDM gasket. Impact modifiers shall be used to ensure strength and durability and special additives to ensure UV resistance. UPVC Profiles shall withstand extreme temperature 0 – 50 degree temperature and ensure low maintenance. All fixtures shall be made up of stainless steel. The frame shall be fixed in prepared opening in the walls. All civil works shall be completed before fixing the frames.

1.1.12.2. Fixed/sliding/openable type windows/ventilators fabricated using UPVC reinforced profiles of Approved makes (test report of CIPET to be produced) of approximate thickness and dimensions for outer frame, shutter frames and mullions as specified in Schedule of Quantities shall be provided.

1.1.12.3. The UPVC profiles manufacturer shall provide **warranty of 10 years** for colour fastness and any manufacturing defects in respect of UPVC profiles as well as water and air tightness in case of casement UPVC window/ventilator unit.

1.1.12.4. UPVC door/windows hardware and fittings manufacturer shall provide **warranty of 10 years** for any manufacturing defects.

1.1.13. ALUMINIUM DOORS AND PARTITIONS

1.1.13.1. Aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / panelling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. For fixed portion- Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15) shall be used.

1.1.13.2. Glazing in aluminium door, window, ventilator shutters and partitions etc. shall be done with toughened glass panes of thickness mentioned in the schedule of quantities with EPDM rubber / neoprene gasket etc. as per the architectural drawings and the directions of Engineer-in-Charge.

1.1.14. FRAMELESS TOUGHENED GLASS DOOR SHUTTER

1.1.14.1. The toughened glass door shutter has to be 12 mm thick frameless from an approved brand and manufacturer. This includes the installation of top and bottom pivots, along with a double-action hydraulic floor spring-type fixing arrangement. Necessary holes shall be made for the installation of required door fittings, following the directions of the Engineer-in-Charge.

1.1.15. STRUCTURAL STEEL

1.1.15.1. The mild steel flats / plates/ angles/ channels/ I-sections used for the work shall conform to IS:2062. The material shall be free from visible as well as hidden defects such as pitting cracks, laminations, twists etc. and excessive rusting.

1.1.15.2. It is not necessary for the Contractor to obtain separate approval in case mild steel plate is purchased from Steel Authority of India Ltd or TATA Iron & Steel or Jindal Steel & Power Ltd. (JSPL) In case of purchase from Tata Iron & Steel & JSPL, valid license certificate from BIS shall be produced. For purchase from other sources, the contractor shall apply sufficiently in advance and obtain written permission of the Engineer-in-Charge for making purchase from such sources.

1.1.16. INTERIOR ACRYLIC EMULSION PAINT

1.1.16.1. The interior acrylic emulsion paint must be of approved premium quality and from a recognized manufacturer. The coverage of both paints shall adhere to the specifications provided by the manufacturer. The colour and shade of the paints shall be determined as per the directives of the Engineer-in-Charge.

1.1.16.2. The application of wall paint shall consist of two coats of premium quality interior-grade acrylic emulsion paint, which contains a volatile organic compound (VOC) content of less than 50 grams per litre from an approved brand and manufacturer. Additional coats shall be applied as necessary to achieve a uniform shade and colour.

1.1.17. PRIMER

1.1.17.1. The contractor shall use cement primer as a base coat on all wall finishes including cement plaster, lime plaster, lime-cement plaster and non-asbestos cement surfaces prior to the application of oil-emulsion distemper paint. The primer shall consist of a medium and pigments resistant to the alkalinity present in cement-based surfaces and shall provide an effective barrier for the protection of subsequent paint coats. The contractor shall ensure that the surface is thoroughly cleaned of dust, dirt, and any existing white or colour wash by washing and scrubbing, and then allowed to dry for at least 48 hours. The surface shall be sandpapered to achieve a smooth finish, and any unevenness shall be rectified with putty made of plaster of Paris mixed with water, followed by further sanding after drying. The contractor shall apply the cement primer only on clean, dry, and properly prepared surfaces, using brushes and not by spraying. Primer shall be applied with horizontal strokes followed by vertical strokes to obtain a uniform coat free from brush marks. The primed surface shall be allowed to dry for a minimum of 48 hours before applying any oil-emulsion distemper paint, all complete as directed by the Engineer-in-Charge.

1.1.18. EPOXY PAINT

1.1.18.1. Epoxy paint shall have excellent adhesion properties and shall offer a balanced aesthetic and corrosion protective surface. Epoxy paint shall offer good resistance to water and humidity. Epoxy paint used shall have outstanding chemical resistance, durability, low porosity and strong bond strength and shall provide dry tough and protective coatings.

1.1.19. VITRIFIED TILE

1.1.19.1. The tiles shall be of approved premium quality of Matt/Glazed/Polished etc. conforming to IS: 15622, with a water absorption of less than 0.08%. The tiles shall be laid using cement-based high polymer modified quickset tile adhesive conforming to IS: 15477. The contractor shall ensure that the work is executed by skilled personnel with proven experience. The tiles shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be nominal size of 1200 mm x 600 mm, 1200 mm x 1800 mm, 1200 mm x 2400 mm, 3200 mm x1 600 mm, and of minimum thickness 6 mm and as directed and approved by the Employer. **The size, colour and shade shall be got approved from the Engineer-in-Charge before purchasing. The minimum rate of the tile to be used for the work is specified in the schedule of quantities. The contractor shall produce invoice for verifying the rate. Purchase rate of tile will be considered for regulating payment.** The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

1.1.10.2 The top surface shall be free from welts, chips, craze, specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one meter. The top surface shall be either polished or matt as specified.

1.1.10.3 Minimum 95% of tiles shall be free from visible defects that would impair the appearance of a major area of tiles.

1.1.10.4 The tiles shall conform to IS 15622 for dimensional tolerance, physical and chemical properties. Half tiles for use as full tiles shall have dimensions which shall be such as to make the half tiles when jointed together (with joints matching the pattern of floor tiles) match with dimensions of full tiles.

1.1.20. EPOXY GROUT

1.1.11.1 Grout is the material that is used to fill the space between adjacent tiles and support the joints.

1.1.11.2 The Epoxy grout shall consist of mix of 0.70 kg of organic coated filler of desired shade and mixing of 0.10kg of hardener and 0.20 kg of resin per kg. They shall have very low water absorption, higher compressive strength and are resistant to staining and easy to maintain. Epoxy grout is a waterless mix formed by mixing a base material (Part A) and a hardener (Part B). These components are mixed at site just prior to grouting.

1.1.11.3 Generally, epoxy grouts require no additional sealer to protect the surface.

1.1.21. GRANITE STONE FLOORING

Granite shall be of approved best quality and pre-polished and generally confirm to relevant BIS specification. The thickness of slab shall not be less than 18mm. The surface shall be even without any veins, cracks or flaws. The slabs shall be of selected quality, hard, sound, dense, and homogeneous in texture, free from cracks, decay, weathering and flakes. The colour, shade and sample of granite slab shall be got approved from the Engineer-in- Charge before purchasing and use on the work. The slabs shall be machine cut to the requisite dimension. The size of slab shall be such that minimum joints shall be provided in longitudinal and transverse directions. The minimum rate of granite slab to be used for work is specified in schedule of Quantities. The Contractor shall produce invoice for verifying the same.

1.1.22. MULTI WOOD

1.1.22.1. Multiwood is a premium engineered synthetic wood panel manufactured from 100% polymer-based thermoplastic resins, primarily PVC, combined with fillers and stabilizers to form a solid, homogeneous, and non-porous material. It is designed as a durable, termite-proof, water-resistant, and borer-resistant alternative to conventional plywood, making it ideal for interior and semi-exposed applications. The panels shall have a thickness of 18 mm with a density of approximately 600–750 kg/m³, offering high screw-holding capacity, excellent dimensional stability, and ease of cutting, drilling, shaping, or routing without cracking or delamination. Both surfaces are smooth and suitable for laminates, veneers, or direct painting. Multiwood is fully resistant to moisture, termites, and fungal attacks, retains its strength under humid conditions, and is self-extinguishing in nature as per relevant fire safety norms. Standard sheet sizes shall be 2440 mm × 1220 mm or as approved. The material shall be sourced from reputed and approved manufacturers or equivalent, ensuring long-lasting, maintenance-free, and eco-friendly performance in wall paneling, partitions, false ceilings, furniture, and other interior joinery works as per design and directions of the Engineer-in-Charge.

1.1.23. WOOD POLYMER COMPOSITION BOARDS (WPC BOARDS)

1.1.23.1. WPC Boards are made from 70% virgin polymer,15% of wood powder & rest 15 % of additives and requisite chemicals.

1.1.24. BWP GRADE PLY WOOD

1.1.24.1. BWP grade plywood shall be generally conforming to IS 710. Selection of timber species for manufacture of plywood shall be as prescribed in IS 710 and as far as possible a single species of timber shall be used.

1.1.24.2. Adhesive: The adhesive used for bonding the veneer shall be of the hot press synthetic resin, phenol formaldehyde type (BWP) and shall conform to IS 848. Extender shall not be added to the adhesive by the plywood manufactures. Fillers, if used, shall not exceed 10 percent by mass of solid content of the glue.

1.1.24.3. The Dimensions and Tolerances: The dimensions and tolerances of BWP grade ply shall be quoted in following order. The first dimension shall represent the length, the second dimension the width and the third dimension the thickness. The dimensions and tolerances shall be as per IS 12049.

The following tolerance on nominal thickness shall be permissible.

(a) Less than 6 mm + 10%

(b) 6 mm and above + 5%

The thickness of any board shall not exceed the number of pieces multiplied by 2.5 mm. The two face veneers in finished board shall be of the same nominal thickness.

1.1.24.4. BIS Certification marking: The board shall be marked with standard mark governed by BIS Act, 1986.

1.1.25. SANITARY INSTALLATIONS

1.1.25.1. Supply and fitting of Sanitary fittings like European Water Closet, Wash Basin, Urinal with sensor, Health Faucet, Soap tray, long body tap, angle valve, pillar tap, bottle trap, SS gratings etc. of approved make as per Schedule of Quantities and as per directions of Engineer in charge. The minimum rate of the fittings to be used for the work is specified in the schedule. The contractor shall produce invoice for verifying the rate.

1.1.25.2. **Warranty**

All items shall be supplied with a minimum 1-year warranty against manufacturing defects, material failure, and faulty workmanship. The warranty shall cover repair or replacement of defective parts at no extra cost during the warranty period.

1.1.26. MATERIAL NOT SPECIFIED

1.1.26.1. All materials not here in detailed and fully specified but which may be required for use on works, shall be subjected to the approval of the Engineer-in-Charge without which they shall not be used anywhere in the permanent works

1.1.27. SAMPLING AND TESTING OF MATERIALS

1.1.27.1. Sampling and testing of the material supplied by the contractor for use on the work shall be done as per the provisions of the relevant BIS codes/specifications. In the absence of BIS specification in a particular case, the sampling and testing shall be done as directed by the Engineer-in-Charge as sound engineering practice. Material conforming to the specifications and approved by the Engineer-in-Charge shall only be used by the contractor.

1.1.27.2. All the sampling and testing shall be done at the contractor's cost.

1.2. DETAILED SPECIFICATIONS OF ITEMS FOR WORKS

1.2.1. GENERAL

1.2.1.1. Except where otherwise specified or authorized by the Engineer-in-Charge all items of works executed by the Contractor must conform to the latest edition of the Bureau of Indian Standard (BIS) Specifications, I.RC., MORT&H's specifications and Code of practices published by BIS. Where no such specifications or code of adoption. The tenderer while indicating such specifications shall practice exists the latest BIS codes of practice shall also be considered for enclose the full set of the publication so referred and not in extracts. Photostat / Xerox copies in duplicate shall be forwarded which shall not be returned to the Contractor. In absence of any specification the department reserves the right to adopt trade specifications and /or sound engineering practices for the specialized work as may be decided by the Engineer-in-Charge which shall be final, conclusive and binding on the contractor.

1.2.2. DISMANTLING AND DEMOLISHING

1.2.2.1. During demolition or dismantling, every precaution shall be taken by the contractor to prevent damage to any part of the structure and also to any adjacent structures which are to be left intact. Any damage caused to the structures, due to the carelessness and negligence of the contractor shall be made good by him at his own expense. Care must be taken by the contractor in such a way that debris shall not fall into water and if falls to be removed immediately.

1.2.2.2. All materials obtained from dismantling or demolition shall be the property of the CoPA unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer-in-Charge.

1.2.2.3. The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work. Due care shall be taken to maintain the safety measures prescribed in IS 4130 and construction and demolition waste management rules 2016 shall be followed.

1.2.2.4. Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge. It shall be ensured that no dust is generated while demolishing. Barricading shall be provided wherever required.

1.2.2.5. Necessary steps shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in- Charge. Helmets, goggle, safety belts etc., should be used whenever required and as directed by the Engineer-in-Charge. The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public.

1.2.2.6. Aluminum/ Gypsum partitions, doors, windows and clerestory window shutters (steel or wood) including chowkhats, architrave, hold fast, fixed glazing and false ceiling shall be dismantled as mentioned in the schedule and as directed by Engineer-in-charge. Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cutters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

1.2.2.7. Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within a lead of 50 meters. All unserviceable materials, rubbish etc. shall be disposed off at authorized locations as directed by the Engineer-in-Charge.

1.2.2.8. Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

1.2.2.9. Appropriate screens shall be placed where necessary to prevent injuries due to falling pieces. Water spray shall be used to reduce dust while tearing down plaster from brick work. Safety belts shall be used by laborers while working at higher level to prevent falling from the structure. Wherever, possible mechanized working platform shall be used. First-aid equipment shall be made available at all demolition works of any magnitude.

1.2.2.10. The contractor shall maintain/disconnect existing services, whether temporary or permanent, wherever required by the Engineer-in-Charge.

1.2.3. PLAIN AND REINFORCED CEMENT CONCRETE

1.2.3.1. **General**

The concrete used for all works, concreting procedure etc. shall be in accordance with IS:456-2000.

1.2.3.2. **Concrete Mix**

Mix used for R.C.C. shall be of M25 and M30 grade unless otherwise specified.

1.2.3.3. **Nominal Mix**

For nominal mix concrete, proportion of fine aggregate to coarse aggregate shall be 1:2 by mass. The minimum cement content per cubic meter of nominal mix concrete shall be as per table 5 of IS: 456-2000.

1.2.3.4. **Design Mix**

1.2.3.4.1. For design mix concrete of following grades of concrete the minimum cement content per cubic metre and maximum water cement ratio are as given below.

Sl. No	Grade of Concrete	Minimum cement content	Maximum free Water cement
1.	M25	360	0.40

1.2.3.4.2. For design mix concrete, the contractor shall make calculations jointly with Engineer-in-Charge and carryout all necessary tests at contractor’s cost to determine the proportion by weight of cement, aggregates (coarse and fine), admixture if required and water necessary to produce concrete of required grade having the desired workability and, water cement ratio not exceeding the allowable limit, prior to commencement of work. The contractor shall submit the following for the approval of Engineer-in-Charge.

(i) The proportion of cement, coarse aggregate, fine aggregate and water so determined.

(ii) The sieve analysis of aggregates which he proposes to use in the works.

(iii) Full details of the tests conducted.

(iv) All calculations relevant to mix design.

1.2.3.4.3. When the proportions are submitted to the Engineer-in-Charge which he considers will produce concrete having the required properties, it shall become the declared proportions to be used for the work. The agreement by the Engineer-in-Charge to such declared proportions shall not relieve the contractor of any of his responsibilities to use in the work at all times concrete having the required properties. No deviation from the declared proportions shall be allowed unless and until the Engineer-in-Charge shall have given his written authorization for the adoption of revised proportions for the concrete.

1.2.3.4.4. Sampling, testing and acceptance criteria for designed mix concrete shall be as per clause 15, 16 & 17 of IS:456-2000 unless otherwise specified. Sampling and testing shall be done at contractor's own cost. Testing shall be done in a laboratory approved by the Engineer-in-Charge.

1.2.3.5. **Size of Coarse Aggregate**

1.2.3.5.1. For all concrete, plain or reinforced of M20 and higher grades, 20 mm size graded aggregate conforming to IS:383-2016 shall be used unless otherwise specified. If 20 mm graded aggregates as per IS:383 are not readily available, graded 20 mm aggregate shall be obtained by blending 20 mm and 12.5/ 10 mm aggregates in the proportion arrived based on the combined sieving of aggregates.

1.2.3.6. **Batching and Mixing**

1.2.3.6.1. For production of concrete, concrete batching and mixing plant, with type and capacity approved by the Engineer-in-Charge shall be installed at site by the contractor. The plant shall be approved by the Engineer-in-Charge and shall be installed at an approved location. All measuring equipments should be maintained in a clean serviceable condition, and their accuracy shall be periodically checked as directed by the Engineer-in-Charge.

1.2.3.6.2. In proportioning concrete, the quantity of both cement and aggregate should be determined by weight. Where the weight of cement is determined on the basis of weight of cement per bag, a reasonable number of bags should be weighed periodically to check the net weight. Where the cement is weighed on the site and not in bags, it should be weighed separately from the aggregates. Water should be either measured by volume in calibrated tanks or weighed. Any solid admixture that may be added may be measured by weight; liquid and paste admixture by volume or weight.

1.2.3.6.3. Except where it can be shown to the satisfaction of the Engineer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportion when required, different sizes being stacked in separate stock piles. The grading of coarse and fine aggregate should be checked frequently for a given job being determined by the Engineer-in-Charge to ensure that the specified grading is maintained.

1.2.3.6.4. Under unavoidable circumstances, change from weigh batching to volume batching may be permitted by Engineer-in-Charge, on specific request from the contractor.

1.2.3.6.5. Ready mix concrete from outside source shall be allowed for use on the work subject to the conditions that: (i) written permission shall be obtained from the Engineer-in-Charge, (ii) all quality control measures as stipulated by the Engineer-in-Charge are strictly adhered to by the contractor at his cost, (iii) all design mix calculations shall be submitted by the contractor for approval of the Engineer-in-Charge & approval obtained; and (iv) all expenses towards conveyance and incidentals of providing departmental supervision at the mixing plant shall be borne by the contractor.

1.2.3.7. **Cover to Reinforcement**

1.2.3.7.1. Cover as specified in drawing shall be provided by using precast cement concrete block made from concrete of same grade as that of main work unless otherwise directed by the Engineer-in-Charge.

1.2.3.8. **Transporting, placing, compacting and curing of concrete**

1.2.3.8.1. Transporting placing, compacting and curing of concrete shall be as per clause 13 of IS:456-2000. Placement of concrete shall be done with concrete pumps and pipelines unless otherwise approved by the Engineer-in-Charge in special cases.

1.2.3.8.2. Concrete shall be transported from the mixer to the worksite as rapidly as possible which will prevent the segregation or loss of any ingredient, and for maintaining the workability.

1.2.3.8.3. The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.

1.2.3.8.4. All concrete shall be vibrated unless otherwise specified or approved by the Engineer-in-Charge and such vibrating shall be as required by the Engineer- in-Charge. The mechanical vibrators complying with IS:2505, IS:2506 or IS:4656 shall be used for compacting concrete. All vibrations shall be carried out to a plan approved by the Engineer-in-Charge. No workman shall be allowed to operate the vibrator without having received instructions and training in its use. Care must be taken to avoid segregation and excessive vibration.

1.2.3.8.5. Concreting shall be carried out continuously up to construction joints, the positions and arrangement of which shall be as directed by the Engineer-in-Charge. When the work has to be resumed the construction joints shall be prepared in accordance with clause 13.4 of IS:456-2000.

1.2.3.8.6. Unless otherwise specified, all concrete shall be kept continuously in a damp condition by ponding or by covering with a layer of sacking, canvas, hessian or similar materials with fresh water for not less than 7 days after laying the concrete. If curing is not done properly the department will be at liberty to engage labour for curing and the expenditure incurred will be recovered from the contractor's bill. The decision of the Engineer-in-Charge will be final on this.

1.2.3.8.7. Stripping time for the form work shall be as stipulated in clause 11.3 of IS:456-2000. Any impression, fins etc. that may occur from the form work shall be removed and treated with cement mortar 1:1.5 (1 cement: 1.5 sand).

1.2.3.8.8. Contractor shall arrange to fix any fixtures wherever necessary while doing concreting work without any extra cost.

1.2.3.8.9. The unit rate quoted by the tenderer shall be for the finished work and deemed to include cost of all materials and labour, form work, provision of holes, recess, other contingent items etc. required for the completion of work as specified etc.

1.2.4. FORM WORK

1.2.4.1. The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs, etc., including ties anchors, hangers' inserts, etc., complete which shall be properly designed and planned for the work. False work shall be so constructed that necessary adjustment can be made to compensate for take up and settlements. Wedge may be used at the top or bottom of timber shores but not at both ends to facilitate vertical adjustment or dismantling of the formwork.

1.2.4.2. **Type of Formwork**

1.2.4.3. Form work may be of timber, plywood, metal, plastic, solid block or concrete. For special finishes the formwork may be lined with plywood, steel, sheets, oil, tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

1.2.4.4. **Form work Requirements**

1.2.4.5. Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, braces, ties, straps, etc., shall be used to hold the forms in proper position without any distortion whatsoever until the concrete is set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight splits or other defects. Joints shall be sufficiently tight to prevent loss of water or any fine material from concrete.

1.2.4.6. Plywood shall be used for exposed concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Formwork with linings shall be permitted.

1.2.4.7. All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces.

Form timber unsatisfactory in any respect shall not be used and if rejected by Engineer shall be removed from the site.

1.2.4.8. Shores supporting successive members shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundations.

1.2.4.9. Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete.

1.2.4.10. Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

1.2.4.11. Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by engineer.

1.2.4.12. **Bracings struts and props**

1.2.4.13. Shuttering shall be braced, strutted, propped and so supported that it shall not deform underweight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

1.2.4.14. The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms.

1.2.4.15. Re propping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be generally lowered vertically while striking the shuttering. If the shuttering for a column, is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3 M or as directed by Engineer.

1.2.4.16. **Mould Oil**

1.2.4.17. Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete, adjoining concrete surface shall also be protected against contamination from the coating material.

1.2.4.18. **Chamfers and fillets**

1.2.4.19. All corners and angles exposed in the finished structure shall be formed with molding to form chamfers or fillets on the finished concrete. The standard dimension of chamfers and fillers, unless otherwise specified shall be 20 mm x 20 mm. Care shall be exercised to ensure accurate mould. The diagonal face of the mould shall be planned or surfaced to the same texture as the forms to which it is attached.

1.2.4.20. **Wall ties**

1.2.4.21. Wire ties passing through the walls shall not be allowed. In their place bolts through sleeves be used.

1.2.4.22. **Reuse of forms**

1.2.4.23. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped timber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

1.2.4.24. **Removal of forms**

1.2.4.25. Contractor shall record on the drawings and in a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed therefrom. The Contractor shall remove the shuttering after obtaining the approval of the Engineer.

1.2.4.26. In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self-weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

1.2.4.27. In normal circumstances (generally where temperatures are above 20 Deg. Cent.) forms may be removed after expiry of the following periods:

1.2.4.28. Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibration, by gently easing the wedges. If after removing the form work, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

1.2.4.29. Reinforced temporary openings shall be provided as directed by Engineer to facilitate removal of formwork which otherwise may be inaccessible.

1.2.4.30. Tie rods, clamps, form bolts etc., which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hrs. after the concrete have been deposited. Ties, except those required to hold forms in place, may be removed at the same time, Ties, withdrawn from walls and grade beams shall be pulled towards the inside face cutting ties back from the faces of walls and grade beams will not be permitted.

1.2.4.31. For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at25mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

1.2.5. REINFORCEEMENT STEEL

1.2.5.1. General

1.2.5.2. Reinforcement bars, if supplies are arranged by contractor unless otherwise specified, shall be either plain round mild steel bars grade I as per IS 432 (Part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer. Plain round mild steel in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS 1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery, etc. All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

1.2.5.3. All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

1.2.5.4. Providing, fabricating and placing in position reinforcement steel

The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings and binding with 16-gauge GI binding wire etc. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

1.2.5.5. Bending

1.2.5.6. Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement binding fabricating work.

1.2.5.7. All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32 mm in diameter which may be bent hot if specifically approved by Engineer. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845oC) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebinding shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having kink or bends other than those required by design shall not be used.

1.2.5.8. Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of cover blocks, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two no. 16 gauge annealed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

1.2.5.9. Cover

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be provided as per codal requirements.

1.2.5.10. **Inspection**

Erected and secured reinforcement shall be inspected, jointly measured and recorded and approved by Engineer prior to placement of concrete.

1.2.6. MASONRY & PLASTERING WORK

1.2.6.1. PROVIDING AND LAYING PRECAST CONCRETE SOLID BLOCK MASONRY

1.2.6.1.1 The contractor shall provide and lay factory-made precast concrete solid blocks of 200 mm thickness of grade M10 in the superstructure above the plinth. The blocks shall be laid in cement mortar 1:6 (1 cement: 6 coarse sand) up to the floor level. Additionally, the contractor shall construct solid block masonry using precast solid blocks of size 30 cm × 20 cm × 20 cm (or the nearest available size) conforming to IS 2185 Part I of 1979, for the superstructure above the floor five level up to the eighth floor, with a thickness of 20 cm. These blocks shall also be laid in cement mortar 1:6 (1 cement: 6 coarse sand). Furthermore, the contractor shall construct solid concrete block masonry using M-10 grade solid blocks of size 30 cm × 20 cm × 10 cm (or nearest and approved size), laid in cement mortar 1:6 (1 cement: 6 coarse sand). This work includes scaffolding, raking out of joints, curing, and all costs and conveyance of materials, labor, lead, and lift. The masonry work shall be carried out for all types of masonry in the superstructure above the highest plinth level, at all levels, as directed by the Engineer-in-Charge.

1.2.6.1.2 Full length and half-length U-blocks may also be manufactured for the purposes of band and lintels. The nominal dimensions of the units are so designed that taking account of the thickness or mortar joints, they will produce wall lengths and heights which will conform to the principles of modular co-ordination. Blocks of sizes other than those specified may also be used by mutual agreement between the purchaser and the supplier. In the case of special concrete masonry units such as jali wall blocks and ornamental blocks, the specified sizes may not necessarily apply. The variation in the length of the units shall not be more than 5 mm and variation in height and width of units, not more than + 3 mm.

1.2.6.2. **Manufacture**

1.2.6.2.1 The concrete mix used for blocks shall not be richer than the specified ratio of combined aggregates before mixing. In machine moulded blocks, the web markings on the units as they come from the machine give a good indication as to whether the proper consistency of concrete has been used. In addition to the grading of the aggregate and the quantity of the cement, the amount of water required for mix will depend to an extent on the type of machine on which blocks are produced. The amount of water required for mix should be electronically measured and controlled in the mixing drum.

1.2.6.2.2 Batching of the ingredients should be done accurately and concrete mixing shall be done in mixer to achieve homogeneous mix. Mixing shall be continued until there is a uniform distribution of the materials, and the mass is uniform in colour and consistency.

1.2.6.3. **Placing and Compaction**

1.2.6.3.1 The block should be compacted by vibro-compaction and finished to proper size – without broken edges. After ejection /demolding, the "blocks shall be handled carefully to avoid damage. The blocks shall be protected until they are sufficiently hardened before starting curing.

1.2.6.4. **Curing**

The blocks hardened, shall then be cured as per 13.5 of IS 456 or by mist curing. So as to deliver the specified strength of block. The blocks hardened may alternatively be cured by steam.

1.2.6.5. **Drying**

After curing the blocks, they shall be dried for a period of 4 weeks before being used on the work. In case of curing, once low-pressure steam curing has been done, the blocks shall - be dried at ambient temperature for a period of seven days. The blocks shall then be stacked with voids horizontal to facilitate through passage of air. It shall be ensured that the blocks have been thoroughly dried and allowed to complete their initial drying shrinkage before supply to the work-site.

1.2.6.6. **Surface Texture and Finish**

1.2.6.6.1 Concrete masonry units can be given a variety of surface textures ranging from a very fine close texture to a coarse open texture by the proper selection grading, and proportioning of aggregates at the time IS 2185 (Part 1): 2005 of manufacture.

1.2.6.6.2 Textures may also be developed by treating the face of the units while still-green by wire brushing or combing, slightly eroding the surface by playing a fine spray of water upon it, and by splitting (split block). Colour maybe introduced by incorporating non-fading mineral pigments in the facing concrete, or by applying a coloured cement grout or paint to the face of the units soon after they are removed from the moulds. Selected coloured aggregates may also be used in the facing and exposed by washing with water or dilute hydrochloric acid followed by thorough washing with water to ensure no traces of acid are left on the surface. Well-made concrete masonry may not require plaster in case of unimportant buildings in low rainfall areas; two or three coats of a cement paint being sufficient to render it resistant to rain water. If, however, it is intended to plaster concrete masonry, the block shall have a sufficiently rough surface to afford a good key to the plaster. Water proofing admixtures may be used for preparing the plaster

1.2.6.7. **Physical Requirements**

1.2.6.7.1 All units shall be sound and free of cracks or other defects which interfere with the proper placing of the unit or impair the strength or performance of the construction. Minor chipping resulting from the customary methods of handling during delivery, shall not be deemed grounds for rejection.

1.2.6.7.2 Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks, or other imperfections, except that if not more than 5 percent of a consignment contains slight cracks or small chippings not larger than 25 mm, this shall not be deemed grounds for rejection.

1.2.6.8. **Dimensions**

The overall dimensions of the units when measured as given above shall in accordance with subject to the tolerances mentioned therein.

1.2.6.9. **Blocks Density**

The block density when determined as per code shall conform to the requirement.

1.2.6.10. **Compressive Strength**

The minimum compressive strength at 28 days being the average of eight units, and the minimum compressive strength at 28 days of individual units, when tested in the manner described in code.

1.2.6.11. **Water Absorption**

The water absorption, being the average of three units, when determined in the manner prescribed in code shall not be more than 10 percent by mass.

1.2.6.12. **Drying Shrinkage**

The drying shrinkage of the units when unrestrained being the average of three units, shall be determined in the manner described in code and shall not exceed 0.06 percent.

1.2.6.13. **Moisture Movement**

The moisture movement of the dried blocks on immersion in water, being the average of three units, when determined in the manner described in code, shall not exceed percent mentioned in the code.

1.2.6.14. **Tests**

Tests shall be conducted on samples of units selected according to the sampling procedure to ensure conformity with the physical requirements.

1.2.7. PROVIDING AND FIXING FIBER GLASS REINFORCED PLASTIC (FRP) DOOR FRAMES

The contractor shall provide and fix FRP door frames with a cross-section of 90 mm × 45 mm, having a single rebate of 32 mm × 15 mm to receive a shutter of 30 mm thickness. The door frame laminate shall be 2 mm thick and made using fire-resistant grade unsaturated polyester resin and chopped mat. The frame shall be filled with suitable wooden blocks in all three legs, and it shall be covered with fiberglass from all sides. A mild steel (MS) stay shall be provided at the bottom to steady the frame.

1.2.8. PROVIDING AND FIXING FIBERGLASS REINFORCED PLASTIC (FRP) FLUSH DOOR SHUTTER

The contractor shall provide and fix a 30 mm thick fiberglass reinforced plastic (FRP) flush door shutter, available in various plain and wood finishes. The door shall be made with fire retardant grade unsaturated polyester resin, molded to 3 mm thick FRP laminate all around, and filled with polyurethane foam (PUF) or polystyrene foam throughout the hollow panel. The door shall be monolithically casted and meet the testing parameters of FRP laminate as per IS: 14856. The shutter shall include wooden blocks inside for fixing fittings and be fixed with a locking mechanism as per the direction of the Engineer-in-Charge.

1.2.9. PROVIDING AND FIXING FIRE-RATED SOLID STAINLESS STEEL LEVER HANDLE AND MORTISE LOCK

The contractor shall supply and fix a pair of fire-rated solid stainless steel lever handles and mortise lock cases with a cylinder of approved size and quality, suitable for 2-hour fire-rated steel doors. The work shall include all required fixtures as directed by the Engineer-in-Charge.

1.2.10. PROVIDING AND FIXING STAINLESS STEEL BUTT HINGES

The contractor shall provide and fix ISI-marked stainless steel butt hinges with stainless steel screws, complete as per the direction of the Engineer-in-Charge. The size of the hinges shall be 100 mm.

1.2.11. PROVIDING AND FIXING ALUMINIUM EXTRUDED SECTION BODY TUBULAR TYPE UNIVERSAL HYDRAULIC DOOR CLOSER

The contractor shall provide and fix an aluminum extruded section body tubular type universal hydraulic door closer, brand logo embossed with ISI certification (IS: 3564). The door closer shall be suitable for doors weighing up to 36 kg to 80 kg and with a door width from 701 mm to 1000 mm. The door closer shall include double-speed adjustment, necessary accessories, and screws, all to be installed complete.

1.2.12. PROVIDING AND FIXING ANODIZED ALUMINIUM FRAME GLAZED DOOR (GD)

The contractor shall provide and fix an anodized aluminium frame glazed door with an 8 mm thick clear toughened glass infill. The door shall include approved slim frame aluminium sections, necessary clips, seals, fittings, and hardware such as a door closer with slide channel and hold-open function, offset handle with narrow stile deadlock, and door drop-down seal, finished in the approved color and texture, including anodizing, as per architectural drawing and as directed by the Engineer-in-Charge.

1.2.13. PROVIDING AND FIXING FACTORY-MADE UPVC WINDOW SYSTEMS

1.2.13.1. The contractor shall supply and fix factory-made uPVC window systems of varying sizes and configurations, including multi-panel sliding, fixed, casement, louvered, or any combination thereof. The window system shall be fabricated from multi-chamber uPVC profiles (min. 62 mm series) in white color, internally reinforced with galvanized steel for rigidity. Each shutter shall be fitted with 10 mm clear toughened glass, mounted with EPDM gaskets, and shall slide smoothly on double-wheel adjustable rollers. The window shall include a multi-point locking system and white espag handles (without key). All corners shall be fusion-welded, and the installation shall include proper fixing with stainless-steel screws and sealing of all perimeter joints using weather-proof silicone sealant.

1.2.13.2. **Sizes**:

- W1: 1500 mm × 2000 mm (Fixed + Sliding Window)
- W2: 1000 mm × 2000 mm (Fixed + Sliding Window)
- W3: 4000 mm × 2000 mm (Fixed + Sliding Window)
- W4A: 2450 mm × 2000 mm (Fixed + Sliding Window)
- W4B: 2880 mm × 2000 mm (Fixed + Sliding Window)
- W5A & W5B: 1770 mm × 2000 mm (Fixed + Sliding Window)
- W6: 2600 mm × 1000 mm (Openable/Fixed + Louvered with Exhaust Provision)
- W7: 2250 mm × 2100 mm (Openable/Fixed Window)

1.2.14. PROVIDING AND FIXING FACTORY-MADE UPVC CASEMENT VENTILATOR

1.2.14.1. The contractor shall provide and fix factory-made uPVC casement ventilator of size 1000 mm (W) × 900 mm (H), fabricated from multi-chamber uPVC profiles (min. 62 mm series) internally reinforced with galvanized steel for rigidity. The system shall include the outer frame, sash, and mullion members, with 8 mm toughened frosted glass fixed with EPDM gaskets, and designed to open as per the requirement. The ventilator shall be fusion-welded at all corners, and installation shall include proper fixing with stainless-steel screws and sealing of perimeter joints using weather-proof silicone sealant.
Size: 1000 mm × 900 mm (Openable + Louvered + Fixed Glass with Exhaust Provision)

1.2.15. PROVIDING AND FIXING FACTORY-MADE UPVC LOUVERED VENTILATOR

The contractor shall supply and fix a factory-made uPVC louvered ventilator of size 450 mm (W) × 600 mm (H), fabricated from multi-chamber uPVC profiles (min. 62 mm series) internally reinforced with galvanized steel for rigidity. The system shall include the outer frame and fixed/slanted uPVC louvers designed for ventilation while restricting direct vision and rainwater entry. The ventilator shall be fusion-welded at all corners, and installation shall include proper fixing with stainless-steel screws and sealing of perimeter gaps using weather-proof silicone sealant.

1.2.16. PROVIDING AND FIXING FIRE-RESISTANT GLAZED DOOR SHUTTERS

The contractor shall provide and fix 60 mm thick glazed fire-resistant door shutters with 120-minute fire rating, conforming to IS: 3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory-approved standards. The door shall consist of vertical styles, top rail, side rail (60 mm x 60 mm wide), and a bottom rail of 110 mm x 60 mm made out of 1.6 mm thick G.I. sheet, duly filled with mineral wool insulation of minimum 96 kg/m³ density. The shutter shall be mounted on stainless-steel ball-bearing hinges of size 100x89x3mm of approved make. A coat of approved fire-resistant primer or powder coating (not less than 30 microns) shall be applied. This work shall be executed as per the directions of the Engineer-in-Charge.

1.2.17. PROVIDING AND FIXING FIRE-RESISTANT DOOR FRAMES

The contractor shall provide and fix fire-resistant door frames with dimensions 50 mm × 60 mm on the horizontal side and 35 mm × 60 mm on the vertical sides, having a built-in rebate made of 1.6 mm thick GI sheet (zinc coating not less than 120 gm/m²). The frame shall be filled with mineral wool insulation of minimum 96 kg/m³ density and shall include provision for G.I. anchor fasteners (14 nos) for proper fixing in the opening, as well as factory-made templates for SS ball-bearing hinges. The frame shall be finished with an approved fire-resistant primer or powder coating (not less than 30 microns) in the desired shade, as per the directions of the Engineer-in-Charge.

1.2.18. PROVIDING AND FIXING GLAZING IN FIRE-RESISTANT DOOR SHUTTERS

The contractor shall provide and fix glazing in fire-resistant door shutters using G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) and a special ceramic tape of size 5 mm × 20 mm. The glass shall meet the requirements of a 120-minute fire resistance rating (EW120) for integrity and radiation control, with a minimum 20-minute insulation (EI20). The manufacturer shall provide a test report/certification of fire-resistant glass, and the glass shall be stamped with the E, EW, and EI values. All work shall be executed as per NBC 2016, IS 16231 (Part 3):2016, and the direction of the Engineer-in-Charge.

1.2.19. PROVIDING AND FIXING UPVC LOUVERED DUCT DOOR

The contractor shall provide and fix a factory-made uPVC louvered duct door fabricated from multi-chamber uPVC profiles (minimum 48–60 mm series) with integrated or panel-mounted non-vision uPVC louvers for ventilation. The door shall be internally reinforced with galvanized steel for rigidity and include stainless-steel hinges, tower bolts, handles, and suitable locking arrangements. All corners shall be fusion-welded, and the door shall be installed using stainless-steel screws/anchor fasteners, complete with all necessary materials, labor, and installation as per the architectural drawings and as directed by the Engineer-in-Charge.

1.2.20. PROVIDING AND FIXING WOOD WORK IN FRAMES OF DOORS

1.2.20.1. Timber for door shall be as specified. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates, rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of ± 2 mm shall be permitted in the specified finished dimensions of timber sections in frames.

1.2.20.2. The frames shall be got approved by the Engineer -in -Charge before being painted, oiled or otherwise treated and before fixing in position. The surface of the frames abutting masonry or concrete and the portions of the frames embedded in floors shall be given a coating of coal tar. Frames shall be fixed to the abutting masonry or concrete with holdfasts or metallic fasteners as specified. After fixing, the jamb posts of the frames shall be plugged suitably and finished neat. Vertical members of the door frames shall be embedded in the floor for the full thickness of the floor finish and shall be suitably strutted and wedged in order to prevent warping during construction. A minimum of three hold fasts shall be fixed on each side of door and window frames one at centre point and other two at 30 cm from the top and bottom of the frames. In case of window and ventilator frames of less than 1 m in height two hold fasts shall be fixed on each side at quarter point of the frames. Wood work wrought, framed and fixed shall be measured for finished dimension without any allowance for the wastage or for dimensions beyond specified dimension. However, in case of members having mouldings, roundings or rebates and members of circular or varying sections, finished dimensions shall be taken as the sides of the smallest square or rectangle from which such a section can be cut. Length of each member shall be measured over all to the nearest cm so as to include projection for tenons. Width and thickness shall be measured to the nearest mm and the quantity shall be worked out in unit of upto three places of decimal.

1.2.21. PROVIDING AND FIXING ISI MARKED FLUSH DOOR SHUTTERS

The contractor shall provide and fix ISI-marked flush door shutters conforming to IS: 2202 (Part I), decorative type, with a core of blockboard construction, framed with 1st class hardwood and well-matched teak 3-ply veneering with vertical grains or cross bands and face veneers on both faces of the shutters. The shutters shall include ISI-marked stainless steel butt hinges with necessary screws. The shutters shall be 35 mm thick.

1.2.22. PROVIDING AND FIXING CARBON STEEL GALVANIZED DASH FASTENERS

The contractor shall provide and fix carbon steel galvanized (minimum coating 5 microns) dash fasteners of 10 mm diameter, double-threaded, with a counter-sunk head. The fasteners shall include a 10 mm polyamide PA 6 grade sleeve, and the installation shall include drilling holes in frames, concrete, or masonry as per the direction of the Engineer-in-Charge.

1.2.23. PROVIDING AND FIXING BRIGHT FINISHED BRASS MORTICE LATCH AND LOCK

The contractor shall provide and fix a bright finished brass 100 mm mortice latch and lock, ISI marked, with six levers, and a pair of anodized (anodic coating not less than grade AC 10 as per IS: 1868) aluminum lever handles of approved quality with necessary screws, as directed by the Engineer-in-Charge.

1.2.24. PROVIDING AND FIXING FLY PROOF WIRE GAUZE

The contractor shall provide and fix fly-proof wire gauze to windows, clerestory windows, and doors, using M.S. flat 15 × 3 mm and nuts & bolts. The stainless steel (grade 304) wire gauze shall have 0.5 mm diameter wire and 1.4 mm aperture on both sides.

1.2.25. PROVIDING AND FIXING FRAMELESS TOUGHENED GLASS DOOR SHUTTER

The contractor shall provide and fix a 12 mm thick frameless toughened glass door shutter of an approved brand and manufacturer. The work shall include the provision and fixing of top & bottom pivots, a double-acting hydraulic floor spring type fixing arrangement, and the necessary holes for door fittings, complete as directed by the Engineer-in-Charge.

1.2.26. WATER PROOFING TREATMENT IN SUNKEN PORTION OF WCs, BATHROOMS ETC.

1.2.26.1. Water proofing treatment in sunken portion of WCs, bathroom etc., shall be done by applying cement slurry mixed with water proofing cement compound consisting of applying :

(a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/ sqm. This layer will be allowed to air cure for 4 hours.

Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. (The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry.)

1.2.26.2. Before the water proofing treatment, the internal plaster of ceiling and walls of WC block leaving the portion for dado/skirting should be completed.

1.2.26.3. Grooving / chasing for doing the concealed work of GI/CI pipes/Electrical conduits should be completed. Cleaning the depressed/sunken portion of WC of all debris, extra mortar sticking to the vertical and horizontal surface etc. Necessary holes for "P" trap /Nhani trap/Water escape pipe etc should be completed.

1.2.26.4. Extra mortar sticking to the surface should be removed and the surface should be cleaned thoroughly. Fixing the "P" trap in position and all other pipes work including the water escape pipe shall be fixed properly and the holes should be plugged carefully before taking up the water proofing work.

1.2.26.5. Providing and Laying of Slurry for First Layer - The consistency of the slurry should be such as to cover the desired area by using 0.488 kg of blended cement per sqm of area. On deciding the correct quantity of water required per sqm. area the required quantity of slurry should be prepared which can be applied over the desired surface within half an hour of mixing with 0.488 kg. of grey cement + 0.253 kg. water proofing compound as per manufacturer specifications + x litres of water per sqm. area and the required quantity of slurry thus prepared should only be used for first application. The first layer shall be applied with painting brushes over the specified and dampened area carefully including the corners, holes on the surfaces and joints of pipes in concrete etc. and the application should continue at least up to 150 mm height of fixtures of pipes from the surface. The surface on application shall be air cured for 4 hours.

1.2.26.6. Providing and Laying of Slurry for Second Layer - The quantity of slurry required for second application to be covered within an hour of mixing shall be prepared with 0.242 kg. cement + 0.126 kg. water proofing compound + y liters of water per sqm. area and the required quantity of slurry thus prepared should only be used for second application. The application of 2nd layer of slurry is same as for first layer as detailed in Clause 1.2.26.5. The applied surface shall be allowed to air cure for 4 hours and thereafter water curing shall be done for full 48 hours.

1.2.26.7. **Warranty**

1.2.26.8. Waterproofing work should be carried out by approved applicator & should be inspected and tested in accordance with quality check and inspection test report of the manufacturer. This report will be used to verify compliance of the waterproofing work. Applicator and manufacturer should together give 10 year warranty for the waterproofing.

1.2.27. STRUCTURAL STEEL

1.2.27.1. Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer. Workmanship of structural steel shall be in accordance with IS 800.The material shall be free from visible as well as hidden defects such as pitting cracks, laminations, twists etc. and excessive rusting. Finishing shall be done with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer’s specifications including appropriate priming coat, preparation of surface, etc.

1.2.27.2. All structural steel members and parts shall have straight edges and blunt surfaces. If necessary, they shall be straightened or flattened by pressure unless they are required to be of curvilinear forms. They shall also be free from twist.

Pressure applied for straightening or flattening shall be such as would not injure the materials. Hammering shall not be permitted. Adjacent surfaces or edges shall be in close contact or at uniform distance throughout.

1.2.28. CEMENT PLASTERING

1.2.28.1. Cement plastering shall be with the grade of mortar and of thickness specified in the schedule. The surface to be plastered shall be thoroughly cleaned and kept wet for 4 hours before plastering.

1.2.28.2. All the corners shall be rounded off to a radius of 25 mm unless otherwise specified.

1.2.28.3. Where smooth finishing is specified in the schedule the plastering shall be floated over with neat cement slurry using 2.2 kg of cement per square meter immediately after the final coat of plastering and rate quoted for plastering shall include cost of this finishing work.

1.2.28.4. The plastered surface on which glazed tiles or other similar type of finishing are to be provided subsequently shall not be finished smooth but shall be scarified for forming a base for providing the final surface finish as required.

1.2.28.5. The surface shall be cured for 7 days.

1.2.28.6. The rate shall include all labour and materials including scaffolding, curing etc. complete. required for completion of work. Measurement of the work under this head shall be made on the basis of the area of work done.

1.2.28.7. Repairs to plaster shall comprise restoring damaged wall surfaces in patches up to 2.5 sq.m each by cutting the defective areas to proper shape, raking out all loose material and joints, thoroughly cleaning and preparing the base, and applying new plaster 12 mm to 20 mm thick in cement mortar 1:4 (1 part cement : 4 parts fine sand). The work shall include wetting the surface, providing a bonding coat where required, finishing the repaired surface to match the existing wall texture, curing the plaster adequately, and disposing all debris and rubbish to the designated dumping ground within a lead of 50 meters, complete in all respects.

1.2.29. WHITE CEMENT BASED PUTTY

1.2.29.1. White Cement based Putty shall be approved qood quality and of approved make.

1.2.29.2. Remove all loosely adhering material from the wall surface with the help of sand paper, putty blade or wire brush. The substrate should be clean, free from dust, grease and loose materials

1.2.29.3. Mixing

Mixing with 40-45% clean water slowly to make a paste. It is very important that water be added to putty to make a mix and not vice versa. Continue the mixing or 10-15 minutes till a uniform paste is formed. It is very important that the mixing of putty should be done thoroughly. This will help in easy application, obtaining more coverage and smooth uniform shade. Only prepare a quantity which can be used within 2-3 hours of mixing with water.

1.2.29.4. Application

1.2.29.4.1 After thoroughly mixing Putty apply the first coat on the moistened wall surface from bottom to upward direction uniformly with the aid of putty blade. This would ensure minimum wastage and proper finish.

1.2.29.4.2 After drying of first coat of putty just rub the surface gently with wet sponge or very gently with the putty blade in order to remove the loose particles.

1.2.29.4.3 Allow the surface to dry for at least 3 hours and then apply second coat of putty. Leave the surface to dry completely. After drying of second coat remove any type of marks with the help of moist sponge or rub the surface very gently with putty blade.

1.2.29.4.4 Leave the surface to dry, preferably overnight/10-12 hours.

1.2.29.4.5 Always prepare a required quantity of putty and use it within 2-3 hours of mixing with water.

1.2.29.4.6 The total thickness of the coats should be limited to maximum 1.5 mm.

1.2.29.4.7 It is not necessary to rub the surface done with putty. However, if at all there is a need to remove unevenness before applying any kind of paint/distemper, gently level the surface with very fine water proof emery paper of not less than 500 number to get a glossy white surface.

1.2.29.5. Precautions during application

1.2.29.5.1 Mixing of the Putty is very important. Hence extreme care should be taken for proper and thorough mixing. It should be preferably mixed with mechanical stirrer in order to get best results. Mixing is to be continued till a uniform paste is formed. Do not add putty into water.

1.2.29.5.2 It is recommended not to rub the surface done with Putty strongly & harshly with rough emery paper. This breaks the film formed over it which decreases the water repellence properties.

1.2.29.5.3 In case of fresh concrete/mortar surface it is recommended that two coats of cement wash be done before application of Putty.

1.2.29.6. Scaffolding

Scaffolding has to be in steel, arranged by the contractor at his own cost for carrying out entire painting jobs at all height and provide all facilities for proper inspection of surface at various stages. Material has to be erected as per safe methods. Ropes and guy wires shall be used for tying etc. The scaffolding shall be of steel and shall not endanger the painter. Scaffolding shall be sufficiently away from the surface to be painted so as to enable the painter to work with ease. The scaffolding shall be removed by the contractor promptly after completion of the work.

1.2.29.7. Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be painted, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

1.2.29.8. Measurements

Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals. Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements. The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq. cm. each with material similar in composition to the surface to be prepared

1.2.30. PROVIDING AND APPLYING INTERIOR ACRYLIC EMULSION PAINT

1.2.30.1. The surface shall be thoroughly cleaned of dust and then be sand papered to give a smooth and even surface. Over the prepared surface one base coat of primer for interior emulsion paint of same brand shall be applied with hand brush in horizontal stroke followed immediately by a vertical one which together shall constitute one coat. After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth. All loose particles shall be dusted off after rubbing and the surface cleaned well. The first finishing coat of interior emulsion paint shall then be applied with hand brush in horizontal stroke followed immediately by a vertical one which together shall constitute one coat. The second coat shall be applied in the same way of first coat to obtain an even surface, after the first finishing coat dried as per the directions of the Engineer-in –Charge

1.2.30.2. Measurements of the work under this head shall be made on the basis of the area of work done and rate quoted shall include the cost of labour, materials, scaffolding etc. required for the completion of work

1.2.30.3. Application: The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces. The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions. The surface on finishing shall present a flat 137 velvety smooth finish. If necessary, more coats will be applied till the surface presents a uniform appearance.

1.2.30.4. Precautions

Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc. (c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening. (d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

1.2.30.5. Measurements

The length and breadth shall be measured correct to a cm. Measurements of the work under this head shall be made on the basis of the area of work done and the rate quoted shall include the cost of labour, materials scaffoldings etc. required for the completion of the work.

1.2.31. FINISHING WALLS WITH TEXTURED INTERIOR PAINT

1.2.31.1. The contractor shall provide finishing of walls with textured interior paint of the required shade for new work, applying two or more coats at a coverage rate of 3.28 litres per 10 sq.m, over and including a priming coat of interior primer applied at 2.20 kg per 10 sq.m. The rate shall include the cost and conveyance of all materials, labour charges, scaffolding, and all sundries necessary to complete the work as directed by the Engineer-in-Charge at all levels.

1.2.32. APPLICATION OF EPOXY PAINT

1.2.32.1. Epoxy paint (two or more coats) shall be applied as per manufacturer's specifications after applying appropriate priming coat on exposed iron/steel surfaces.

1.2.32.2. All rust, scales and old paint shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed. Surface must be dried, cleaned & made free from oil, grease, dirt, dust & all other contaminants that could interfere with adhesion of coating. If the surface is wet, it shall be dried before priming coat is undertaken. Before primer is applied, holes and undulations, shall be filled up and rubbed smooth.

1.2.32.3. The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

1.2.32.4. Epoxy paint is supplied in two parts i.e. (base and hardener). Stir the base and hardener separately. Mix hardener gradually into the base under continuous stirring as per mixing ratio as specified by the manufacturers.

1.2.32.5. The epoxy paint shall be consumed with in the working pot life as specified by the manufacturers. Part mixing should be avoided. To achieve optimum performance of the product, minimum 2-3 coats by brushing would be required to get the desired dry film thickness (DFT) as specified by the manufacturer.

1.2.32.6. Rate shall include the cost of all labour and material involved in all operation including priming coat.

1.2.33. PROVIDING FLOORING WITH VITRIFIED FLOOR TILES

1.2.33.1. The contractor shall supply and lay fully vitrified floor tiles of approved brand and manufacturer conforming to IS: 15622 with water absorption less than 0.08%. The tiles shall be laid in various sizes as specified for different areas, using cement-based high polymer modified quickset tile adhesive conforming to IS:15477, applied at an average thickness of 6 mm or as per manufacturer's specification. The work shall be executed by agencies with proven experience and skilled personnel. **The size, colour and shade shall be got approved from the Engineer-in-Charge before purchasing. The minimum rate of the tile to be used for the work is specified in the schedule. The contractor shall produce invoice for verifying the rate. Purchase cost will be considered for regulating payment.**

1.2.33.2. All tile joints, approximately 3 mm wide, shall be grouted using an epoxy grout mix consisting of organic coated filler, hardener, and resin in manufacturer-recommended ratios. Grouting shall be finished to a smooth, uniform surface matching the tile shade and shall be done as per the Engineer-in-Charge's instructions.

1.2.33.3. The tiles shall be set in cement mortar 1:4 (1 cement : 4 sand) of average 20mm thick laid to required level/ slope. Before laying cement mortar, the concrete surface shall be scrubbed with wire brush, all loose particles, foreign matters etc. shall be removed and the surface shall be made clean. Any undulations in the concrete shall be chipped off or made good with additional concrete of the same grade used for the under layer. The surface thus prepared shall be wetted and smeared with a coat of cement slurry using cement at the rate of 2.2 kg/m2 of area just before the application of the mortar, so as to get good bond between base course concrete and plastering. For fixing tiles to mortar, neat cement slurry of honey like consistency using cement at the rate of 3.3 kg/m2 shall be smeared on top of mortar bed. The joints between the tiles shall be uniform and of 3mm width.

1.2.33.4. After laying the tiles, the surplus cement grout along the joints shall be cleaned off. The day after the tiles are laid, all joints shall be cleaned with wire brush to a depth of 5mm and pointed with epoxy based grout, of approved make.

1.2.34. EPOXY BASED GROUTING FOR TILES

1.2.34.1. It shall be ensured that tiles are firmly set and adhesive or mortar is completely dry for 24 hours. All spacers, pegs, ropes and string shall be removed and joints be cleaned by removing free loose dirt particles.

1.2.34.2. The complete unit Part A (Base) and Part B (Hardener) shall be properly mixed in given ratio. The desired colour of grout shall be obtained by mixing required quantity of colour with base to ensure homogeneity. The grout shall be pressed firmly by using a hard rubber squeeze into joints ensuring that joints are filled. Excess grout material shall be removed from joints and surface by moving squeeze on grout line after 22 to 25 minutes. The damp sponge shall be used in circular motion on tile surface to achieve the flush joint. After completion of work the grout haze shall be cleaned with clean water or soap solution. The suitable rubber gloves shall be used to avoid skin contact during application.

1.2.34.3. Length and breadth of grouted tile area shall be measured correct to a cm and the area shall be calculated in sqm correct to two places of decimal.

1.2.34.4. The rate shall include the cost of all materials and labour involved in all operations described above. Nothing extra shall be paid.

1.2.35. GRANITE

1.2.35.1. The contractor shall provide all labour, materials, tools, and equipment required for providing and laying polished granite stone flooring in the required designs and patterns, in both linear and curvilinear portions of the building, complete as per the architectural drawings. The work includes supplying and fixing 18 mm thick polished granite stone slabs over an average 20 mm thick cement mortar (1:4) bed, laying and jointing with cement slurry, and pointing with white cement slurry admixed with matching pigment. The work also includes rubbing, curing, polishing, and finishing the surface to achieve a uniform and high-quality finish, all complete as specified and as directed by the Engineer-in-Charge. Granite shades shall be Jet Black, Cherry Red, Elite Brown, Cat Eye or an approved equivalent.

1.2.35.2. All tile and granite works shall be executed with strict adherence to manufacturer's instructions, proper substrate preparation, curing, and quality control to ensure durability, aesthetic quality, and safety. The contractor shall remove all debris and maintain cleanliness throughout the work.

1.2.36. PARTITION WALLS

1.2.36.1. **12 MM SOILD COMPACT LAMINATE FOR TOILET CUBICLES**

1.2.36.1.1 Providing and fixing toilet cubicles of standard dimensions, including 600 mm door width, using 12 mm thick solid compact laminate (SCL) panels, heat, water, chemical, impact, scratch, bacteria, and anti-bacterial resistant. Panels shall have Suede finish in approved shade as per drawings, conforming to IS 2046, fire retardant BS-476/97, and Green Guard Certified.

1.2.36.1.2 Hardware: Supply and fix all necessary hardware including D-post door channels (anodized), hinge adaptors, gravity hinges, privacy thumb turn with occupancy indicator, coat hooks, door knobs, noise deadening tape, screws, and wall plugs. Hardware shall be SS Grade 302 and Polyamide-6 as applicable, with anodized aluminium top rails.

1.2.36.1.3 Aluminium Components: Aluminium D-post channels of 40 mm dia fixed to walls with SS-304 screws; doors held with hinge adaptor and hinges; rubber strips incorporated to reduce noise.

1.2.36.1.4 Installation: Complete installation as per approved drawings and manufacturer specifications, ensuring alignment, smooth door operation, and compliance with relevant standards and certifications.

1.2.37. HIGH PRESSURE LAMINATE COMPACT BOARD FOR URINAL PARTITIONS

1.2.37.1. Material:

The partitions shall be fabricated from HPL compact board of 12 mm thickness with decorative finish on both faces in approved shade and texture. The material shall be moisture-proof, scratch-resistant, and chemical-resistant, with antibacterial properties to maintain hygiene. All edges shall be machine-cut, smoothened, and sealed to prevent moisture ingress and ensure safety.

1.2.37.2. Dimensions:

Each partition shall have an overall height of 1980 mm (from finished floor level) and a width ranging from 600 mm to 900 mm, depending on site conditions and approved drawings. The bottom edge shall be maintained at a uniform height above the floor as per design requirements.

1.2.37.3. Hardware

All supporting and fixing hardware shall be of stainless steel (Grade 304), including brackets, clamps, U-channels, screws, and fasteners. Fixing to walls shall be done using nylon sleeves and stainless steel fasteners to ensure strength and corrosion resistance. All joints shall be tight and neatly finished.

1.2.37.4. Installation:

Partitions shall be installed in true line and plumb position as per manufacturer's instructions and the direction of the Engineer-in-Charge. Fixing shall ensure stability, alignment, and clean finish. Adequate spacing between partitions shall be maintained for proper function and appearance.

1.2.37.5. Finish:

Both faces of the compact board shall have a decorative laminate finish of approved shade and design. The finish shall be non-porous, easy to clean, and resistant to wear, ensuring long-term appearance and hygiene.

1.2.38. 1.5 M HIGH HALF-HEIGHT DECORATIVE LAMINATE PARTITION

1.2.38.1. Contractor shall fix 1.5 m high half-height decorative laminate partition with aluminium framework (50×50×1.4 mm) at 600 mm c/c, double-skin cladded with 12 mm thick BWP 710 plywood on both sides and finished with 1 mm thick decorative laminate (matte or gloss finish) on all exposed surfaces. All edges finished with matching aluminium channels or trims, complete with necessary fittings, adhesives, labour, and materials as per drawings and direction of Engineer-in-Charge.

1.2.39. FIXED GLASS PARTITION

1.2.39.1. Contractor shall supply and install Fixed Glass Partition for Cabin using minimal frame, room dividing solutions. Single glazed mullion free demountable glass partition using Toughened glass in proprietary natural anodized/Black aluminium sections of size 50mm x 30mm with Concealed sealing (No visible Gaskets/Seals) with acoustic rating of Minimum 32 db with third party test certificate. The profile will have Carpert Groove at the Bottom on both sides for accommodating max. mm carpets. The Glass to be fixed with help of Proprietary Stability Gripper Clamp to have a stable system. It should consist of intermediate slim junction for Glass to Glass vertical joints, 90 Degree L Junction and T Junction pro les suitably to be used as per room configuration designs. No Visible Clip Lines to provide clutter free view at both side of section. The Glass to be Offset mounted towards outer edge leading to minimum aluminium frame on one side. Optional Profile Bottom Seal pair for additional accoustic if required. Glass thickness - 10mm (LSG). All Profiles are min 1.5mm thickness including 20 microns of Anodizing.

1.2.40. GYPSUM PARTITION

1.2.40.1. The Contractor shall provide and fix 100 mm thick double layer Gypsum Board Partition as per design. 48mm C stud (0.5mm thick having one flange of 34mm and another flange of 36mm made of GI Steel) placed at 610mm centre to centre in 50mm floor and ceiling channel (0.5mm thick have equal flanges of 32mm made of GI steel), which is anchored to the floor & true ceiling using suitable anchor fasteners. The boards are to be fixed to the framework with joints staggered to avoid leakage through joints. A fixing channel of 50mm width

(0.9mm thick having two flanges of 9.5mm each) has to be provided at the horizontal joints of the outer layer of boards screw fixed to the studs using metal to metal flat head screws. Also to have an additional 19mm thick ply supports (wherever required) as spacer at the false ceiling level and as sub frames for doors and glazed openings as per details or as per Engineer in charge instruction. Infill with 25mm glass wool of density 20kg/m³ shall be provided from finished flooring level till false ceiling level as an acoustic requirement, as indicated in the drawing. The framework to be cladded with inner layer 12.5mm plain board (IS-2095 Part 1:2011) and outer layer with12mm Fireline board fixed on either side with Drywall screws of 35mm at 300mm C/c and 150mm C/c at periphery of wall. The board or to be fixed vertically to the frame work with joins staggered to avoid leakage through joins. Finally square and tapered edges of the boards are to be jointed and finished so as to have a flush look which includes filling and finishing with jointing compound, Joint paper tape as per recommended practices Ultra nogging channel is to be fixed using metal to metal flat head screws at the horizontal joints of the board. The Junction of the partition with masonry and all penetration through the partition has to be treated with Hilti / 3M fire and acoustic sealant.

1.2.40.2. The rate shall include all connectors, accessories, fasteners, profiles, adhesive tapes, seals, making necessary opening and accessories for Electrical/Data/Voice switches and sockets and all required materials, providing & removing of necessary scaffolding work etc. complete as per standards, specification and directed by the Engineer-in-charge.

1.2.41. FALSE CEILING

1.2.42. Gypsum False Ceiling (12.5 mm Moisture-Resistant Board)

1.2.42.1. Providing and fixing a suspended false ceiling at all heights using a framework made of special sections power-pressed from MS sheets and galvanized with zinc coating of 120 g/sqm (both sides) as per IS: 277. The system shall include angle cleats of 25 mm width and 1.6 mm thickness with 27 mm and 37 mm flanges, fixed to the slab at 1200 mm centers using 12.5 mm dia × 50 mm long dash fasteners with 6 mm bolts. Angle hangers of 25×10×0.50 mm shall be connected to these cleats and fixed to intermediate G.I. channels of 45×15×0.9 mm spaced at 1200 mm centers. Ceiling sections of 0.5 mm thick bottom wedge type, 80 mm wide with 26 mm tapered flanges and 10.5 mm lips, shall be placed perpendicular to the G.I. channels at 450 mm centers using 2.64 mm dia, 230 mm long G.I. wire clips. Perimeter channels of 0.5 mm thickness, 27 mm height, and flanges of 20 mm and 30 mm shall be fixed to walls using rawl plugs at 450 mm centers with 25 mm drywall screws at 230 mm spacing. Gypsum moisture-resistant boards of 12.5 mm thickness shall be fixed to ceiling sections with 3.5×25 mm drywall screws at 230 mm centers. Joints shall be finished flush using jointing compound, joint tape, and three-layer finishing extended 150 mm on both sides, followed by two coats of primer suitable for gypsum boards. The scope includes making openings for lights, diffusers, and cutouts with properly framed edges. Work shall be executed as per specification, drawings, and directions of the Engineer-in-Charge.

1.2.43. Laminated Wooden Ceiling – (12 mm BWP Plywood + Laminate)

1.2.43.1. Providing and fixing a laminated wooden ceiling using 12 mm thick BWP 710 grade plywood panels finished with 1 mm thick decorative laminate (plain or wood-grain). The panels shall be mounted on a concealed framework made of 18 mm thick BWP 710 grade plywood sections, consisting of 50 mm wide runners and cross members placed at not more than 600 mm centers in both directions. The framework shall be securely anchored to the ceiling using approved anchor fasteners or wooden cleats. Plywood panels shall be fixed using screws and adhesive to form a level and uniform surface. Laminate shall be bonded using approved synthetic resin adhesive to achieve a smooth, bubble-free finish. All exposed panel edges shall receive matching laminate strips or hardwood lipping. Joints shall be finished with grooves, cover battens, or matching trims as per design. The work shall include provision of trapdoors with matching laminate finish wherever required. Complete execution shall include preparation, cutting, fixing, finishing, labor, tools, and all incidentals.

1.2.44. Aluminium Grid Ceiling –(600×600 mm Tiles)

1.2.44.1. Providing and fixing 600×600 mm aluminium lay-in grid false ceiling in toilet areas using a 15 mm T-framework of module 600×600 mm. Ceiling tiles of 584×584 mm, manufactured from 0.7 mm thick Aluminium Alloy AA 3105, shall be beveled-edge type with total vertical height of 12 mm, including a 2 mm bevel, and an outward lip of 7 mm. Tiles shall be polyester-based and powder-coated in white. The suspension system shall consist of roll-formed galvanised steel tees with white G.I. capping. Main tees (15 mm) shall be spaced at 1200 mm centers and suspended using 4 mm G.I. rods. Cross tees of 15 mm shall be installed at 600 mm centers, forming a rigid grid. Suspension shall be provided at 1200–1500 mm centers.

1.2.45. Aluminium Grid Ceiling –(1200×600 mm Tiles)

1.2.45.1. Providing and fixing 1200×600 mm aluminium grid ceiling in common lobby passages using a 15 mm T-framework with 1200×600 mm module. The lay-in panels shall be 1184×584 mm in size, manufactured from 0.9 mm thick Aluminium Alloy AA 3105, beveled-edge type with 12 mm height and 2 mm bevel, including a 7 mm outward lip. The tiles shall be polyester powder-coated in white. The grid system shall consist of roll-formed galvanised steel tees with white G.I. capping. Main tees spaced at 1200 mm centers shall be suspended using 4 mm G.I. rods from the slab. Cross tees at 600 mm intervals shall lock to form the 1200×600 module. Suspension points shall be spaced 1200–1500 mm apart.

1.2.46. Veneer Wooden Ceiling – (12 mm BWP Plywood + Veneer Finish)

1.2.46.1. Providing and fixing a veneer-finished wooden ceiling using 12 mm thick BWP 710 grade plywood panels with decorative veneer finish, fixed over a concealed framework of 18 mm plywood runners and cross members placed at maximum 600 mm centers. Panels shall be bonded using synthetic resin adhesive and fixed with screws and adhesive to ensure a level, smooth ceiling surface. All exposed edges shall be finished with matching veneer strips or hardwood beading. Joints shall be finished with grooves, cover trims, or design-specified detailing. Work shall also include providing and fixing a trapdoor with matching veneer finish. All materials, labor, tools, cutting, polishing (where applicable), and incidentals are included.

1.2.47. Ceiling Cove – (12 mm MR Plywood + Laminate)

1.2.47.1. Supply and installation of ceiling coves fabricated from 12 mm thick moisture-resistant plywood finished with high-pressure decorative laminate in approved color and texture. The cove shall have smooth, edge-banded profiles with tightly fitted joints and shall be fixed securely to the ceiling and wall structure using mechanical fasteners and approved adhesives. The installed cove shall be aligned, plumb, and flush, providing a durable, moisture-resistant, easy-to-clean surface that creates a seamless aesthetic transition between the ceiling and the adjacent walls.

1.2.48. PANELLING WORKS

1.2.49. WALL PANEL WORK -710 GRADE PLYWOOD

1.2.49.1. The work includes providing and fixing wall paneling with approved materials, complete in all respects, as per drawings, specifications, and as directed by the Engineer-in-Charge.

1.2.49.2. Materials:

Wall paneling shall be executed using 12 mm thick 710 BWP grade plywood**,** conforming to IS:303, finished with 1 mm thick decorative laminate of approved shade, texture, and make, conforming to IS:2046. The supporting framework shall consist of aluminium box sections of size 50×50×1.4 mm, placed at 600 mm center-to-center both ways or as directed. Suitable brackets, cleats, fasteners, and screws of approved quality shall be used for fixing the aluminium framework securely to the wall surface.

1.2.49.3. Workmanship:

The aluminium framework shall be fixed in true line, level, and alignment using proper mechanical fasteners, ensuring adequate spacing and stability. The plywood panels shall be fixed over the aluminium framework using self-tapping screws through pre-drilled holes, ensuring firm attachment and an even surface. The decorative laminate shall be bonded to the plywood using an approved synthetic resin adhesive, applied uniformly under controlled pressure to achieve a smooth, bubble-free surface. All joints between laminate sheets shall be butt jointed and finished neatly with PVC or wooden cover strips or matching edge tape as per approved design. All exposed edges shall be finished with matching laminate or hardwood lipping, properly polished or sealed as required.

1.2.49.4. Finishing:

The entire surface shall be finished smooth, clean, and free from adhesive marks or irregularities. The finished work shall present a uniform appearance with neat joints and properly aligned edges. The contractor shall ensure proper protection of the finished surfaces until completion and handing over.

1.2.49.5. Measurement:

Measurement shall be taken for the actual finished area of wall paneling in square metres (m^2), including all necessary cutting, wastage, and edge finishing, as per site conditions and approved drawings

1.2.50. WALL PANNELING WORK – BWP 710 PLYWOOD WITH VENEER FINISH

1.2.50.1. The work includes providing and fixing wall paneling comprising an aluminium framework, 12 mm thick moisture-resistant plywood backing, and natural decorative veneer finish. The work shall include supply of all materials, labour, tools, equipment, and accessories required for complete installation as per approved drawings and as directed by the Engineer-in-Charge.

1.2.50.2. Materials:

The aluminium framework shall be made out of aluminium box sections of size 50 mm x 50 mm or as specified in the drawings. The sections shall conform to IS:733 / IS:1285 and be free from dents, bends, or surface defects. The framework shall be placed at 600 mm center-to-center both ways or as per approved drawings.

1.2.50.3. The plywood shall be 12 mm thick 710 BWP grade conforming to IS:303. The plywood shall be of approved quality, free from warping, cracks, or delamination, and shall be securely fixed to the aluminium frame using countersunk screws through pre-drilled holes.

1.2.50.4. The natural decorative veneer shall be 0.6 mm to 1.0 mm thick, of approved design, shade, and grain pattern as per the direction of the Engineer-in-Charge. The veneer shall be of uniform colour and properly matched. The veneer shall be bonded to the plywood using synthetic resin adhesive conforming to IS:848, ensuring uniform adhesion without bubbles or waviness. Stainless steel screws, aluminium cleats, or stainless-steel brackets shall be used for fixing the framework to the wall surface.

1.2.50.5. Workmanship:

The aluminium framework shall be rigidly fixed to the base wall using aluminium cleats or stainless-steel brackets, ensuring perfect alignment, plumb, and level. The plywood shall be properly fixed over the framework using countersunk screws. Veneer shall be bonded over plywood using approved synthetic resin adhesive under uniform pressure to achieve a smooth, bubble-free surface.

1.2.50.6. All exposed edges shall be finished with matching veneer edge banding or hardwood lipping to ensure a neat and durable finish. Joints between panels shall be flush or provided with grooves as per the approved design intent. Exposed veneer surfaces shall be finished with melamine polish or PU coating, either matt or glossy, as specified. Proper sanding, sealing, and surface preparation shall be carried out before final finishing to ensure smoothness and uniformity.

1.2.50.7. Finishing:
The surface shall be finished with melamine polish or PU coating of approved shade and finish, applied in multiple coats as per manufacturer's specifications. The finish shall be even, free from brush marks, streaks, and uneven colouration.

1.2.50.8. Approved polish brands shall be ICA, Paints, Nerolac, MRF, or equivalent approved make.

1.2.51. WALL PANNELING WITH FLUTED PANEL FINISH

1.2.51.1. The work includes providing and fixing wall paneling using 6 mm thick flexible plywood (flexi ply) finished with approved factory-made fluted panels on the exposed surface, fixed over a concealed framework made of 18 mm thick BWP 710 grade plywood. The item includes all materials, labour, tools, scaffolding, surface preparation, and finishing required to complete the work as per approved drawings and as directed by the Engineer-in-Charge.

1.2.51.2. The concealed framework shall be made from 18 mm thick 710 BWP grade plywood conforming to IS:303. The framework shall consist of horizontal and vertical members of minimum 50 mm width, fixed to the wall using rawl plugs, screws, or anchor fasteners at spacing not exceeding 600 mm center-to-center or as per site requirements. The flexible plywood (flexi ply) shall be 6 mm thick, of approved make and quality, capable of bending and shaping to the required curvature without cracking or delamination. It shall be fixed over the plywood frame using wood screws and approved synthetic resin adhesive to form the desired profile.

1.2.51.3. The fluted panels shall be factory-made, decorative panels made of pre-laminated MDF, WPC, PVC, or veneer-finished boards as specified in the drawing or approved by the Engineer-in-Charge. The fluted panels shall be of uniform size and thickness, with precisely formed grooves or profiles to ensure an even and aligned surface. The adhesive used for bonding panels shall be a synthetic resin type conforming to IS:848. All screws, anchor fasteners, and fixing accessories shall be of stainless steel or zinc-coated metal, ensuring corrosion resistance and firm installation.

1.2.51.4. Workmanship:

The 710 BWP grade plywood framework shall be fixed securely and accurately to the wall surface, ensuring correct alignment, level, and plumb. The 6 mm thick flexi ply shall be bent and fixed over the plywood framework to achieve the required curvature or contour, using adhesive and screws to maintain a smooth and stable surface. The fluted panels shall then be fixed over the prepared flexi ply base using approved adhesive and concealed fasteners to create a seamless finish without visible joints. All joints between panels shall be finished with matching trims, groove profiles, or edge moldings as per design intent. Exposed edges shall be finished with matching edge banding or wooden lipping. All surfaces shall be cleaned and checked for uniform alignment, ensuring no gaps, unevenness, or surface defects.

1.2.51.5. Finishing:

The fluted panel surface shall be finished as per the approved design, either with factory finish or with on-site polishing, PU coating, or paint finish where applicable. All finishes shall be even, smooth, and uniform in texture and shade, free from scratches, stains, or waviness. Approved polish and coating brands shall include ICA, Asian Paints, Nerolac, or MRF, or equivalent approved make.

1.2.52. PROVIDING AND FIXING 100 MM X 100 MM BOX SECTION (FLEXI PLY)

1.2.52.1. The contractor shall provide and fix a 100 mm x 100 mm box section made from 6 mm thick flexible plywood (flexi ply), finished with 1 mm thick decorative laminate (plain or wood grain finish) on all exposed surfaces. The box shall be fabricated in a true square or curved form as per design, with properly joined corners using approved wood adhesive and mechanical fastening (screws or pins) to maintain shape. The laminate shall be bonded to the outer surfaces using synthetic resin adhesive, pressed uniformly to ensure a smooth, bubble-free finish. All exposed edges shall be finished with matching laminate strips or hardwood lipping as per the design intent.

1.2.52.2. The boxes shall be fixed to the wall using concealed wooden cleats made from 18 mm thick BWP 710 grade plywood or hardwood battens, securely anchored to the wall with rawl plugs and countersunk screws. The box sections shall be screwed from the inside or backside onto the cleats, ensuring no visible screw heads on the outer surface. Alternatively, heavy-duty adhesive may be used in combination with concealed screws where specified. Installation shall ensure straight alignment, level placement, and secure fixing.

1.2.52.3. The work includes all materials, fabrication, adhesive, cleats, screws, edge finishing, labor, and installation, completed in all respects as per approved drawings and as directed by the Engineer-in-Charge.

1.2.53. PROVIDING AND FIXING WPC FLUTED WALL PANELING

1.2.53.1. The contractor shall provide and fix WPC fluted wall paneling (of approved design, shade, and texture) on the exposed surface, fixed over a framework of aluminium box section (50×50×1.4 mm or as specified) at 600 mm c/c both ways or as directed. The aluminium framework shall be securely fixed to the wall using suitable brackets/cleats and fasteners, ensuring proper alignment and spacing as per the manufacturer’s recommendations, ensuring a neat, aligned, and seamless installation.

1.2.53.2. All joints between fluted panels shall be treated with matching joint trims or profiles, or as per design. Exposed edges shall be finished with matching WPC edge trims or hardwood lipping, as specified. All materials used shall be of approved make and quality. The work shall be completed in all respects, including surface preparation, cutting, fixing, jointing, edge finishing, cleaning, and all related incidentals, in accordance with drawings and as directed by the Engineer-in-Charge.

1.2.54. PROVIDING AND FIXING ACOUSTIC PET PANELS

1.2.54.1. The contractor shall provide and fix 12 mm thick acoustic PET (Polyethylene Terephthalate) panels with a minimum NRC of 0.75 or as specified, mounted over an 18 mm thick BWP 710 grade plywood backing, which is fixed onto a concealed aluminium framework. The aluminium framework shall be fabricated from powder-coated or anodized extruded aluminium sections (50×50×1.4 mm), securely anchored to the wall or ceiling substrate using approved anchor fasteners at a maximum spacing of 600 mm c/c.

1.2.54.2. The 12 mm plywood shall be fixed onto the aluminium frame using countersunk screws and construction adhesive. The PET panels shall be bonded to the plywood surface using high-strength adhesive or concealed mechanical clips, ensuring a seamless, level, and secure finish. All edges shall be neatly finished with matching trims or groove joints as per design.

1.2.54.3. The work shall include the supply of all materials, fabrication, cutting, edge finishing, installation, and cleaning, completed as per approved drawings and as directed by the Engineer-in-Charge.

1.2.55. PROVIDING AND FIXING WASH BASIN COUNTER

1.2.54.1 The contractor shall provide and fix a wash basin counter made of 18 mm thick high-density multiwood finished with an 18 mm thick approved granite slab on top, fixed over an MS framework made of 25×25×3.2 mm thick square hollow sections (SHS), finished with black epoxy paint. (MS framework shall be executed and paid separately under the relevant item.)

1.2.54.2 The multiwood shall be cut to required sizes and securely fixed to the MS frame using self-tapping screws through pre-drilled holes or treated wooden battens fixed to the MS structure as required. The granite slab shall be fixed over the multiwood surface using approved stone adhesive, ensuring uniform bonding and a level surface.

1.2.54.3 All joints shall be properly aligned, leveled, and finished as per architectural design. The work includes supply, cutting, shaping, edge finishing, fastening, and installation of granite and multiwood, complete in all respects as per drawings and as directed by the Engineer-in-Charge.

1.2.56. PROVIDING AND FIXING STAGE/PODIUM PLATFORM FOR CONFERENCE ROOM

1.2.55.1 The contractor shall provide and fix a stage/podium platform for the conference room with 18 mm thick BWP 710 grade plywood, with Polypropylene carpet (400 GSM) covering of 3 mm thickness over MS framework, finished with black color epoxy paint. The MS framework shall be executed and paid separately under the relevant item.

1.2.55.2 The plywood shall conform to IS:710 (BWP 710 grade), cut to required sizes and securely fixed to the MS frame using self-tapping screws through pre-drilled holes or by using treated wooden battens fixed to the MS structure as required. All joints shall be aligned, leveled, and prepared to receive the final finish as per architectural design.

1.2.55.3 The work includes supply, cutting, shaping, edge finishing, fastening, and installation of plywood panels, entry steps, etc., complete, all as per drawings and as directed by the Engineer-in-Charge. The shade of the carpet shall be as per approved color.

1.2.57. MISCELLANEOUS ITEMS

1.2.56.1 DECORATIVE VERTICAL SCREEN PANEL

1.2.56.1.1 The work includes the supply and installation of a decorative vertical screen panel measuring 80.0 cm in width and 240.0 cm in height, fabricated from high-quality plywood with an external laminate finish in the approved colour and texture. The item includes complete fabrication, finishing, and installation with all materials, labour, tools, and accessories required for proper completion of the work as per approved architectural drawings and as directed by the Engineer-in-Charge.

1.2.56.1.2 The panel shall be made from high-quality 710 BWP grade plywood conforming to IS:303, of thickness as required to maintain rigidity and stability. The plywood shall be smooth, free from warping, cracks, or delamination. The panel shall have a 15.0 cm wide plywood frame and internal grid members of 3.0 cm width, designed to form a precise geometric pattern consisting of diagonal triangular infills and square openings. The base portion shall be solid, 12.6 cm high, providing structural stability and visual balance. The laminate finish shall be of 1.0 mm thickness (minimum), of approved make and texture, applied uniformly on the exposed surfaces using synthetic resin adhesive conforming to IS:848. The plywood edges shall be sealed and edge-banded using matching laminate or PVC edge strips to achieve a neat and durable finish.

1.2.56.1.3 All components of the decorative panel shall be machine-cut and assembled to maintain uniform geometry, alignment, and dimensional accuracy. The grid members shall be securely fixed within the outer frame using adhesive and concealed fasteners, ensuring a seamless appearance. The open grid area, measuring approximately 221.4 cm in height, shall be precisely aligned to achieve a consistent pattern with partial transparency. The surface laminate shall be bonded under uniform pressure to avoid air bubbles or waviness. All exposed edges shall be properly edge-banded or sealed to prevent moisture ingress. The entire assembly shall be smooth, clean, and free from visible fixings, scratches, or irregularities.

1.2.56.1.4 The panel shall be installed securely in the designated position, fixed to the adjacent wall or structural frame using appropriate mechanical fasteners, brackets, or cleats. Installation shall ensure the panel is plumb, level, and flush with adjoining surfaces. All joints shall be tight and even, and fixing details shall be concealed wherever possible for a refined appearance.

1.2.56.1.5 The surface finish shall be as per the approved sample, with a smooth, uniform texture and colour. The final installed panel shall exhibit a high-quality decorative appearance, free from defects, stains, or surface irregularities.

1.2.56.2 3D ARTWORK IN CEMENT MORTAR

1.2.56.2.1 The work includes providing and fixing 3D artwork in the specified area, formed using cement mortar of approved mix and anchored with screwed rods or other suitable fasteners to ensure the desired design, alignment, and structural stability. The scope covers complete execution of 3D modeling, surface preparation, finishing, and painting as per approved architectural drawings and as directed by the Engineer-in-Charge.

1.2.56.2.2 Materials:

The base material shall be a cement mortar mix of approved proportion, prepared using Ordinary Portland Cement (OPC) conforming to IS:269 or Portland Pozzolana Cement (PPC) conforming to IS:1489, clean river sand, and potable water. The mix proportion shall generally be 1:3 (cement : sand) or as approved by the Engineer-in-Charge, adjusted as per design requirements.

1.2.56.2.3 Screwed rods, anchor bolts, or mechanical fasteners shall be of stainless steel or galvanized iron, providing adequate strength and corrosion resistance. These shall be securely fixed to the backing surface or structure to support the mortar sculpture. Wire mesh reinforcement may be provided where required to control shrinkage and ensure adhesion.

1.2.56.2.4 Wall putty shall be of high-quality polymer-based type conforming to IS:8042, used for surface levelling and smoothing. Paint shall be of approved make and finish—acrylic emulsion, exterior-grade texture, or PU coating—depending on the location and design requirement.

1.2.56.2.5 Workmanship:

The 3D artwork shall be executed by skilled artisans under close supervision, strictly following the approved drawings, dimensions, and design intent. The surface where the mortar is to be applied shall be properly cleaned, roughened, and dampened before application. The cement mortar shall be applied in layers, built up to the desired form and detailing, and properly cured to prevent shrinkage cracks.

1.2.56.2.6 All profiles, curves, and textures shall be shaped accurately to match the approved model or reference image. Necessary mechanical anchoring using screwed rods or other supports shall be provided to ensure stability and adhesion of the mortar to the substrate. Upon completion of modeling, the surface shall be finished with two coats of high-quality wall putty, sanded smooth, and prepared for the final paint finish.

1.2.56.2.7 Finishing:

After putty application, the surface shall be painted with approved-grade paint in the specified colour, texture, and sheen. The paint shall be applied in multiple coats as per manufacturer's instructions to achieve a uniform and durable finish. All surfaces shall be free from brush marks, streaks, or uneven colouration. Where required, protective coatings may be applied to enhance weather resistance and longevity.

1.2.56.2.8 Installation:

The finished artwork shall be properly aligned and fixed in position using suitable fasteners and anchoring systems to ensure safety and rigidity. Scaffolding shall be provided wherever necessary to facilitate safe and accurate installation. The work shall be executed without causing damage to surrounding finishes or structure

1.2.56.3 TITANIUM GOLD PVD METAL SIGNAGE

1.2.56.3.1 The Contractor shall provide and fix office signage of size 300 mm × 100 mm, fabricated from brushed stainless steel or aluminium sheet with titanium-gold PVD coating, complete with computer-cut vinyl or engraved text/graphics as per the approved design and font. The signage shall have smooth polished edges, a uniform titanium-gold finish and shall be suitable for indoor office use.

1.2.56.3.2 The signage shall be installed at approved locations and mounting heights using concealed fixing methods such as stainless-steel studs, approved adhesives or concealed brackets, ensuring that each sign is level, secure and free from visible damage. All materials used shall be corrosion-resistant, durable and of high finish quality.

1.2.56.3.3 The Contractor shall provide all materials, fabrication, polishing, transportation, installation, cleaning and finishing, including removal of protective films and clearing the site of waste. The Contractor shall also coordinate installation with other ongoing site works and adhere to all required safety and ergonomic guidelines. All labour, tools, equipment, fixing hardware and supervision necessary to complete the work shall be provided by the Contractor.

1.2.56.3.4 A minimum 12-month warranty shall be provided on materials and installation workmanship. Final acceptance of the work shall be subject to inspection and approval by the client or the authorized representative.

1.2.56.4 ACRYLIC SIGNAGE

1.2.56.4.1 The Contractor shall provide and fix office signage of size 300 mm × 100 mm, fabricated from high-quality acrylic sheet (minimum 4 mm thick) in approved colour and finish, including computer-cut vinyl text/graphics or engraved lettering as per the approved design and font. The signage shall have smooth, polished edges and a clean glossy finish suitable for indoor office applications.

1.2.56.4.2 The signage shall be installed at approved locations and mounting heights using concealed fixing arrangements such as acrylic spacers, stainless steel studs or approved adhesives, ensuring proper alignment, level and uniform appearance. All materials shall be UV-stable, fade-resistant and durable.

1.2.56.4.3 The Contractor shall provide all materials, fabrication, transportation, installation, cleaning and finishing, including removal of protective films and disposal of waste. The Contractor shall coordinate installation with other site works and comply with applicable safety and ergonomic guidelines. All labour, tools, equipment, mounting hardware and supervision required for proper installation shall be provided by the Contractor.

1.2.56.4.4 A minimum 12-month warranty shall be provided for materials and installation workmanship. Final acceptance shall be subject to inspection and approval by the client or the authorized representative.

1.2.56.5 SUPPLY AND INSTALLATION OF FROSTED PRIVACY FILM/STICKER

1.2.56.5.1 The Contractor shall provide and fix high-quality frosted privacy film/sticker on designated glass surfaces, including thorough cleaning of the substrate, precise cutting of the film to the required size and pattern, and application using a water-based adhesive solution to achieve a smooth, uniform and bubble-free finish. The work shall be executed strictly as per the approved design/pattern and as directed by the Engineer-in-Charge.

1.2.56.5.2 The rate shall include the cost of all materials, labour, tools, cleaning, surface preparation, finishing, and all charges required to complete the work in all respects.

1.2.56.6 ACRYLIC LED LETTER SIGNBOARD

1.2.56.6.1 The work includes the supply, fabrication, and installation of a solid acrylic LED letter signboard displaying "Cochin Port, Cochin Port Authority" with logo, as per approved design, drawings, and branding. The signboard shall be fabricated, wired, and installed to ensure uniform illumination, accurate letter sizing, and alignment. The installation shall be carried out at the specified location, ensuring the signboard is level, plumb, and securely fixed.

1.2.56.6.2 Materials:

The signboard letters and logo shall be fabricated from high-quality solid acrylic of approved thickness, suitable for LED illumination. Letter heights shall be: "Cochin Port" – 12 cm, "Cochin Port Authority" – 6.5 cm, logo – 32 cm. The LED illumination shall be single-colour, energy-efficient, and evenly diffused across each letter. The letters shall have a 30 mm projection from the mounting surface. All wiring, connectors, and LED modules shall be of approved make, compliant with electrical safety standards. Protective backing, brackets, or support structures shall be provided to ensure stability and flush installation. Approved brands for acrylic and LEDs are used there.

1.2.56.6.3 Letters and logo shall be precisely cut, smooth, and free of defects. LEDs shall be installed to provide uniform brightness without hotspots or flicker. The signboard shall be installed securely using appropriate anchors, brackets, or adhesive, with concealed fixings wherever possible. All electrical connections shall comply with safety standards and be tested for functionality.

1.2.56.6.4 The acrylic surfaces shall be clean, polished, and free from scratches, stains, or damage. Protective films shall be removed after installation. The final installation shall present a neat, professional, and durable finish.

1.2.56.7 HEAVY DUTY EPOXY INJECTION ADHESIVE FOR REBAR

1.2.56.7.1 The work includes providing, supplying, and installing heavy-duty epoxy resin-based injection adhesive for rebar fixing in concrete. The epoxy system shall be suitable for anchoring rebars as per structural consultant's specifications and embedment depth. The work includes supply of the two-component epoxy system (resin and hardener) in the recommended ratio, application, and installation of rebars in drilled holes as per manufacturer's guidelines. The work shall be carried out by skilled personnel with prior experience in chemical anchoring systems under the supervision of the Engineer-in-Charge.

1.2.56.7.2 The chemical anchoring adhesive shall be Hilti HIT-RE 500 V3 (330/500 ml) two-component epoxy resin with hardener supplied in 3:1 ratio. The adhesive shall be suitable for wet and dry concrete conditions, corrosion-tested, and shall carry ETA, COLA, DIBT, and fire approvals. It shall comply with all relevant European/International standards for chemical anchors. Drilled holes shall be made using hammer drills or diamond coring equipment of required diameter (14–16 mm for 12 mm dia rebar). The epoxy adhesive shall be injected into the hole using standard dispensers before inserting the rebar, ensuring full embedment and uniform filling. The installation shall strictly follow the manufacturer's instructions regarding mixing, dispensing, curing, and load capacity.

1.2.56.7.3 All installation shall be executed by trained and experienced personnel. Rebars shall be positioned correctly to maintain alignment and embedment depth. The work shall ensure proper cleaning of holes, correct injection of adhesive, and full insertion of rebars to achieve maximum bonding and structural performance. Skid marks, voids, or improper fixing shall be rectified immediately. After installation, exposed areas shall be cleaned of any adhesive residues. Proper curing time shall be observed as per manufacturer's recommendations. All work shall follow site safety standards, including use of PPE, scaffolding, and handling of chemicals.

1.2.56.8 PVC COATED POLYESTER FABRIC ROLLER BLINDS

1.2.56.8.1 The work includes supplying and fixing PVC-coated polyester fabric roller blinds of approved make, design, and shade, complete with all necessary components and accessories. The item covers full installation at all heights, including materials, labour, and finishing, as per manufacturer's specifications and directions of the Engineer-in-Charge.

1.2.56.8.2 The roller blind fabric shall be high-quality PVC-coated polyester, durable, fire-retardant, and of approved colour and shade. The roller tube shall be an extruded aluminium tube, minimum 1.2 mm thick, ensuring smooth rolling and stability. Brackets and fittings shall be powder-coated aluminium of approved make and finish. The bottom rail shall provide proper weight and balance to the blind fabric. Control mechanism shall be stainless steel bead chain or any other approved mechanism as specified, providing smooth and safe operation. All accessories, including end caps, bearings, and mounting hardware, shall be of approved quality. Approved brands include Saint-Gobain,

1.2.56.8.3 The roller blinds shall be accurately measured, cut, and installed to ensure proper fit, alignment, and operation. All brackets and tubes shall be securely fixed to the wall, ceiling, or window frame as per site requirements. The fabric shall roll evenly without creasing or sagging, and the control mechanism shall function smoothly. Installation shall be coordinated to avoid damage to surrounding finishes. After installation, all protective films shall be removed. The blinds shall be tested for smooth operation, proper alignment, and overall aesthetics. The site shall be cleared of debris and left clean.

1.2.56.9 SEMI-UNITIZED STRUCTURAL GLAZING SYSTEM

1.2.56.9.1 The contractor shall supply, design, fabricate, test, protect, install, and fix in position a semi (grid) unitized structural glazing system with open joints. The system shall be suitable for both linear and curvilinear portions of the building at all heights and levels. The contractor shall ensure that the system includes all materials, components, accessories, and performance features necessary to achieve structural integrity, watertightness, fire safety, durability, and aesthetic alignment, in accordance with the architectural drawings, approved shop drawings, and as directed by the Engineer-in-Charge.

1.2.56.9.2 **Design and Engineering**

1.2.56.9.3 The contractor shall supply and carry out structural analysis, design, and preparation of detailed shop drawings for the glazing system. The design shall conform to IS 875 Part III for the specified design loads. The contractor shall ensure that the system passes a proof test at 1.5 times the design wind pressure without any failure. The contractor shall supply functional aluminum sections for fixing glazing panels of various thicknesses, aluminum cleats, sleeves, splice plates, gaskets, screws, toggles, nuts, bolts, clamps, structural and weather silicone sealants, flashings, fire-stop cum smoke seals, microwave-cured EPDM gaskets, and all other components necessary to ensure watertightness, pressure equalization, drainage, and fire protection.

1.2.56.9.4 **Fabrication and Supply of Supporting Components**

1.2.56.9.5 The contractor shall supply and fabricate serrated M.S. hot-dip galvanized or aluminum alloy (6005 T5) brackets, sleeves, cleats, and profiles of required sizes, sections, and profiles to accommodate three-dimensional movement and achieve precise verticality. The contractor shall supply and fix the structural glazing system to the RCC, masonry, or structural steel framework using stainless steel anchor fasteners and bolts, along with nylon separators to prevent bimetallic contact, and all necessary nuts, washers, and hardware of stainless steel grade 316.

1.2.56.9.6 **Sealants and Glazing Installation**

1.2.56.9.7 The contractor shall supply and apply two-part structural silicone sealant and one-part weather silicone sealant compatible with each other, in a controlled factory or workshop environment. The contractor shall supply and install double-sided spacer tape, setting blocks, and backer rods of approved grade, brand, and manufacturer. The contractor shall ensure sealant application around the full perimeter of glazing panels to provide proper retention and watertightness as per the approved sealant design.

1.2.56.9.8 **Flashings and Water Tightness**

1.2.56.9.9 The contractor shall supply and fix solid aluminum sheet flashings, 1 mm thick, of required shapes, sizes, and profiles to seal interfaces between the structural glazing and the building structure. The contractor shall supply all services necessary for design approval, shop drawing review by a structural designer, site mock-ups, component testing in NABL-accredited laboratories, field tests on assembled systems, and protection of the glazing until building handover. Payment shall be based on the actual external face area of the structural glazing, measured in square meters up to two decimal places.

1.2.56.9.10 **Performance Testing**

1.2.56.9.11 The contractor shall supply all necessary equipment and arrangements for performance testing of the structural glazing system in NABL-accredited laboratories or equivalent. The contractor shall conduct tests for air leakage, static water penetration, dynamic water penetration, structural performance for deflection and deformation under 1.5 times design wind pressure, seismic movement, and onsite water leakage. The requirement and scope of testing shall be as determined by the NIT approving authority.

1.2.56.9.12 **Drainage and Pressure Equalization**

1.2.56.9.13 The contractor shall supply provisions for drainage of moisture and water entering the glazing system, ensuring watertightness through principles of pressure equalization. The contractor shall supply suitable gutter profiles and weep holes as required. All design, fabrication, installation of aluminum grids, glazing units, scaffolding, temporary structures, cranes, and other equipment necessary for execution shall be supplied by the contractor.

1.2.56.9.14 **Insulated Glass Units (IGUs)**

1.2.56.9.15 The contractor shall supply, assemble, and install insulated glass units (IGUs) comprising hermetically sealed double-glazed vision panels of 6-12-6 mm configuration. The contractor shall supply outer 6 mm heat-strengthened toughened glass with approved reflective soft coating on face #2, a 12 mm spacer tube with desiccant, and an inner 6 mm heat-strengthened toughened glass. The contractor shall supply primary and secondary seals as per design requirements. IGUs shall be factory-assembled and meet performance specifications including visible light transmittance (VLT) of 25–35%, internal reflection of 10–15%, external reflection of 10–20%, shading coefficient of 0.25–0.28, and U-value of 3.0–3.3 $W/m^2 \cdot K$. Payment shall be based on the actual area of glass on face #1, excluding grooves and weather sealant.

1.2.56.9.16 **Final Deliverables**

1.2.56.9.17 The contractor shall supply and deliver a complete, fully watertight, structurally sound, and aesthetically aligned glazing system, including all components, accessories, sealants, flashings, drainage provisions, and IGUs. The work shall conform to the approved architectural and shop drawings, specifications, and as directed by the Engineer-in-Charge.

1.2.56.10 PROVIDING AND LAYING FACTORY MADE CHAMFERED EDGE CEMENT CONCRETE PAVER BLOCKS

1.2.56.10.1 The contractor shall provide and lay factory-made chamfered edge cement concrete paver blocks in footpaths, parks, lawns, driveways, light traffic parking areas, or other similar locations as directed. The paver blocks shall be of the required strength, thickness, and size/shape, manufactured by the table vibratory method using PU molds. The blocks shall be laid in the required color and pattern over a 50 mm thick compacted bed of sand.

1.2.56.10.2 The contractor shall ensure proper compacting and embedding of the interlocking paver blocks into the sand bedding layer through vibratory compaction using a plate vibrator. After the pavers are laid, the joints shall be filled with sand, and the paver blocks shall be cut to the required size and pattern as per the specifications.

1.2.56.10.3 The work shall include the finishing of the surface, sweeping of any excess sand, and ensuring that the paver blocks are securely laid, compacted, and properly aligned. The paver blocks to be used shall be 80 mm thick, made of M-35 grade cement concrete, with an approved color, design, and pattern, all in accordance with the directions of the Engineer-in-Charge.

1.2.56.11 SUPPLY AND INSTALLATION OF CUSTOM-MADE GLASS REINFORCED CONCRETE (GRC) COLUMN

1.2.56.11.1 The contractor shall supply and install custom-made Glass Reinforced Concrete (GRC) columns for aesthetic elevational purposes, complete with bottom and top coping as per the approved design and drawings. The GRC shall be manufactured using a mixture of white cement, alkali-resistant glass fibers, silica sand, water with admixtures, and pigments, all cured with acrylic thermoplastic. The dimensions of the GRC column shall be in the range of 575–600 mm in diameter and a height of 7.3 meters, or as per the approved drawing.

1.2.56.11.2 The rate shall include the following: finishing the column with acid wash as per the specifications, molding any patterns as per the conceptual design, including the preparation of molds for casting. The contractor shall also be responsible for making the GRC composite material, applying it into molds, demolding the cured GRC elements, grinding, and finishing the demolded elements. The GRC column shall be fixed at the site as per the drawings, and the grooves shall be finished as specified. All applications shall be carried out strictly in accordance with the manufacturer's specifications.

1.2.56.12 KOTA STONE SLAB FLOORING

1.2.56.12.1 The contractor shall provide and lay Kota stone slab flooring with a 20 mm (average) thick base, laid over and joined with grey cement slurry mixed with pigment to match the shade of the slab. The flooring shall include rubbing and polishing, completed with a base of cement mortar in a 1:4 ratio (1 part cement to 4 parts coarse sand). The thickness of the slab shall be 25 mm. This work shall be carried out above the car porch area as per the approved design.

1.2.56.13 KOTA STONE SLABS FOR RISERS, SKIRTING, DADO, AND PILLARS

1.2.56.13.1 The contractor shall provide and lay 20 mm thick Kota stone slabs in the risers of steps, skirting, dado, and pillars, on a 12 mm (average) thick cement mortar layer in a 1:3 ratio (1 part cement to 3 parts coarse sand). The joints shall be finished with grey cement slurry mixed with pigment to match the shade of the slabs. The work shall include rubbing and polishing, and shall be carried out above the car porch area as per the approved design.

1.2.56.14 PROVIDING AND LAYING TACTILE TILES

1.2.56.14.1 The contractor shall provide and lay tactile tiles of size 300x300x9.8 mm with a water absorption rate of less than 0.5% and conforming to IS:15622. These tactile tiles shall be of an approved make and available in all colors and shades for outdoor floors such as footpaths, courtyards, and multi-modal locations. The tiles shall be laid on a 20 mm thick base of cement mortar in a 1:4 ratio (1 part cement to 4 parts coarse sand), in various shapes and patterns as per the design. The joints shall be grouted with white cement mixed with matching pigments. This work shall be completed as per the directions of the Engineer-in-Charge for the ramp area.

1.2.56.15 FURNITURES

1.2.56.15.1 All furniture supplied under this tender shall comply with recognized quality, safety, environmental, and sustainability standards. The furniture must be duly certified by relevant authorities and shall possess certifications including, but not limited to, **ISO, BIFMA-Level-1, Green Guard, Griha, IGBC, IAQ** or equivalent nationally/internationally recognized certifications. Valid documentary evidence of such certifications shall be submitted along with the technical bid for verification. The minimum rate of the furniture to be used for the work is specified in the schedule. The contractor shall produce invoice for verifying the rate. All tables shall be supplied with a minimum 3-year manufacturer warranty.

1.2.56.16 PROVIDING AND FIXING L-SHAPED OFFICE TABLE WITH INTEGRATED SIDE STORAGE

1.2.56.16.1 The contractor shall supply and fix an L-shaped office table with integrated side storage, with overall dimensions of 2400 mm × 2300 mm × 750 mm height, fabricated from 25 mm thick pre-laminated particle board with decorative laminate finish on both sides and 2 mm thick matching PVC edge lipping on all exposed edges, as per the approved drawing and design. The table shall be supported on gable ends, a modesty panel, and a side storage unit for rigidity. The side storage unit (750 mm height) shall consist of 2 open shelves, 2 shutters, and 2 drawers, complete with all required hardware such as concealed hinges, soft-close telescopic drawer channels, stainless steel handles (approximately 100 mm long), and locking arrangement of approved make. All materials, labor, hardware, tools, and incidental charges shall be included. The work shall be completed as per the approved drawing, manufacturer's specifications, and as directed by the Engineer-in-Charge.

1.2.56.17 PROVIDING AND FIXING EXECUTIVE L-SHAPED TABLE

1.2.56.17.1 The contractor shall provide and fix an executive cabin table (L-shaped) of approximate size 2400 mm (L) × 2300 mm (W) × 750 mm (H), made of 18 mm thick pre-laminated engineered wood board conforming to IS:12823, with 2 mm PVC edge banding all around. The table shall include a modesty panel, a return unit with a lockable 3-drawer pedestal (1 filing drawer and 2 utility drawers), a CPU unit, a cable manager, and a keyboard tray. The surface shall be scratch-resistant, heat-resistant, and stain-resistant, finished in the approved color and shade. The table shall be installed complete with all fittings, accessories, and installation as directed by the Engineer in charge.

1.2.56.18 PROVIDING AND FIXING CABIN TABLE WITH SIDE COMPOSITE STORAGE

1.2.56.18.1 The contractor shall supply and fix a T3 cabin table of overall size 1800 mm (L) × 750 mm (D) × 750 mm (H), with a side storage unit of 1200 mm (L) × 450 mm (D) × 750 mm (H), made of 25 mm thick pre-laminated particle board (E1 grade), finished with 2 mm PVC edge banding on all exposed edges. The table shall be supported on MS powder-coated "Colours" type legs with horizontal MS support beams, all MS parts powder-coated with a minimum 60-micron thickness in the approved colour. The table shall include a 450 mm high perforated metal modesty panel, a 450 mm long aluminum flip-up wire manager with soft closure, MS cable dump, and vertical MS vertebrae for cable management. The side storage unit shall be made of 18 mm thick pre-laminated particle board for the top, sides, and shutters, and 9 mm thick pre-laminated particle board for the back, all exposed edges with 2 mm PVC lipping, fitted with finger groove handles and a Cam Lock (T3 type).The entire table and storage shall be factory finished, smooth, durable, and installed complete as per approved drawings and as directed by the Engineer-in-Charge.

1.2.56.19 PROVIDING AND FIXING T4 CUBICLE TABLE

1.2.56.19.1 The contractor shall supply and fix a T4 cubicle table with a table top made of 25 mm thick pre-laminated particle board conforming to E1 norms, finished with 2 mm thick PVC edge banding on all exposed edges. The table shall be supported on MS powder-coated "Colours" type legs with supporting MS beams for rigidity and stability, all MS components powder-coated with a minimum 60-micron thickness in the approved shade. The wire management system shall consist of a 450 mm long aluminum flip-up cover with a soft closure mechanism and provisions for mounting electrical switches and sockets on the MS tray, along with an intermediate leg with a wire entry cover for neat cable routing. The unit shall be factory finished, installed complete in position, and executed as per approved drawings and as directed by the Engineer-in-Charge.

1.2.56.20 PROVIDING AND FIXING WORKSTATION PARTITION SYSTEM

1.2.56.20.1 The contractor shall provide and fix a workstation of size 1350 mm × 600 mm with a partition height of 1200 mm, framed with top and sides in aluminum trims and junctions with die-cast caps. The table top shall be 25 mm thick pre-laminated particle board with 2 mm PVC edge lipping on all exposed edges. The partition shall include 18 mm thick pre-laminated gable ends, and wire management shall consist of a 65 mm grommet cap on the table and a metal raceway tile to mount switches below the table top level for power, and a skirting tile for data. The tile finishes above the table top level shall include fabric tiles, one g yae3lass marker tile, and one magnetic tile per workstation. The tile finishes below the table top level shall include pre-laminated tiles and metal skirting tile on the main spine towards the user. The work shall be completed in accordance with the approved drawing, manufacturer's specifications, and as directed by the Engineer-in-Charge.

1.2.56.21 V SHAPED TABLE INSIDE BOARD ROOM

1.2.56.21.1 The work includes the design, supply, fabrication, delivery, and installation of a V-shaped boardroom meeting table suitable for seating approximately 26–28 persons, complete with tabletop, under structure, modesty panels, leg frames, and an integrated cable management system. The item shall be executed in accordance with approved drawings, design details, and as directed by the Engineer-in-Charge. The entire assembly shall be factory finished, modular, and installed complete in position.

1.2.56.21.2 The overall layout of the table shall be as per the approved architectural drawing for the Board Room (size 1253 cm × 943 cm), designed in a V-shaped configuration with an inner recessed presentation zone. The table shall be suitable for comfortable seating of approximately 26–28 persons and shall have an overall height of 750 mm, with an inner recessed presentation area of 650 mm height.

1.2.56.21.3 The tabletop shall be made of 25 mm thick pre-laminated particle board of E1 grade conforming to IS:12823–2020. The top surface shall be finished with 1 mm thick high-pressure laminate (HPL) of approved make, colour, and texture (such as walnut, oak, or equivalent wood grain shade). The bottom surface shall be balanced with white or matching lamination to prevent warping. All exposed edges shall be finished with 2 mm thick PVC edge banding, machine-pressed using hot-melt adhesive and all edges shall be rounded to ensure a smooth and safe finish. The tabletop shall be divided into modular segments for ease of transport and assembly, with all joints perfectly aligned and flush at installation.

1.2.56.21.4 The under structure shall be fabricated from 50 × 25 × 1.6 mm thick mild steel rectangular hollow sections (RHS) conforming to IS:4923–2017. The framework shall include adequate cross-supports and bracings to provide rigidity and prevent sagging or vibration of the tabletop. All MS components shall be thoroughly cleaned, pre-treated, and epoxy powder-coated in approved colour with a minimum coating thickness of 60 microns. Each leg frame shall be provided with adjustable levelling glides at the base to ensure uniform height and stability on uneven floor surfaces. The under structure shall be designed for modular assembly, facilitating ease of dismantling and reinstallation if required.

1.2.56.21.5 Modesty panels shall be provided along the inner and front faces of the table as per approved design. These shall be made of 18 mm thick pre-laminated MDF or particle board finished in matching shade and texture to the tabletop. Panels shall contribute to structural stability while concealing cables and electrical conduits within the underframe.

1.2.56.21.6 The table shall be provided with an integrated cable management system, including 450 mm long aluminium flip-up boxes with soft closure mechanisms at designated seating intervals. Each box shall be fitted with provisions for power sockets, data ports, and AV connections as per layout requirements. All cables shall be routed through powder-coated MS trays mounted below the tabletop and further concealed within the MS frame using flexible vertical cable conduits (vertebrae). The entire system shall ensure concealed, organised, and easily maintainable electrical and data connections without visible wiring.

1.2.56.21.7 All laminated surfaces shall be smooth, scratch-resistant, stain-resistant, and easy to maintain. The finish shall be in the approved laminate shade (such as walnut, oak, or equivalent), with matching modesty panels and powder-coated metal legs. The final assembly shall present a premium appearance with uniform joints, alignment, and surface quality suitable for a high-end boardroom environment.

1.2.56.21.8 All fittings shall be concealed type wherever possible and designed for durability and easy reassembly. The fixing and alignment shall be carried out using precision tools to ensure tight joints and perfect levels.

1.2.56.21.9 All components shall be factory-made using precision cutting and edge-banding machinery to ensure accuracy and uniformity. The workmanship shall be of the highest quality, ensuring smooth surfaces, flush joints, and concealed fixing. The entire system shall be installed by skilled personnel using manufacturer-approved assembly techniques.

1.2.56.21.10 The complete table shall be delivered to site, assembled, and installed in position as per the approved layout. The finished work shall be stable, level, and free from scratches, dents, or surface irregularities. All surfaces shall be cleaned, and protective coverings shall be removed upon completion. The work shall include all accessories, fasteners, and consumables required for installation. Measurement shall be made on an overall job basis for the complete installation of the V-shaped boardroom table as per approved design and drawings. It shall be supplied with a minimum 3-year manufacturer warranty. The rate quoted shall include the cost of all materials, labour, tools, plant, transport, powder coating, hardware, finishing, and installation, complete in all respects as directed by the Engineer-in-Charge.

1.2.56.22 PROVIDING AND SUPPLYING CENTRE TABLE

1.2.56.22.1 The contractor shall provide and supply a centre table with dimensions of 900 mm (L) × 600 mm (W) × 600 mm (H), suitable for waiting areas. The table shall have a wooden frame and legs made of high-quality seasoned hardwood, finished with an approved wood stain and protective clear polish. The tabletop shall be fitted with an 8 mm thick clear glass top with polished edges, fixed securely over the wooden frame using clear silicone spacers. All joints and surfaces shall be neatly finished, and the item shall be completed in all respects as per the approved design and directions of the Engineer

1.2.56.22.2 All materials shall be of first-class quality and free from visible defects. Edges shall be smooth and well finished. The entire table shall be stable, level, and free from sharp edges. The glass shall conform to IS:2553 (Part 1) for toughened safety glass. The final installation shall be clean, stable, and ready for use.

1.2.56.22.3 Warranty

All centre tables shall carry a minimum one-year warranty covering manufacturing and installation defects.

1.2.56.23 PROVIDING AND FIXING CUSTOM RECEPTION TABLE

1.2.56.23.1 The contractor shall provide and fix a custom reception table with dimensions of 8000 mm (L) × 700 mm (D) × 1100 mm (H), fabricated using 19 mm thick or nearest size, BWP 710 plywood with necessary internal supports. The table shall have all exposed surfaces finished with 12 mm thick solid acrylic surface of an approved make, and all recess ed/internal surfaces shall be finished with 1 mm thick laminate in an approved shade. The table shall include a 6 mm thick lacquered glass fixed with 3M double-sided tape, as per the architectural drawing.

1.2.56.23.2 Additionally, the table shall include one modular 3-drawer mobile pedestal unit, one powder-coated metal CPU trolley, and a 75 mm diameter wire manager for cable management. The item shall be equipped with necessary hardware, including SS 'H' handles, telescopic slides, ISI-marked locks with a master key, hinges, teakwood lipping/moulding finished with melamine polish, and all required fasteners. The complete work shall be executed in all respects as per the architectural drawing and as per the instructions of the Engineer-in-Charge. Table shall carry a minimum 3-year warranty covering manufacturing and installation defects.

1.2.56.24 ERGONOMIC CHAIRS

1.2.56.24.1 The work includes providing, supplying, and installing ergonomic office chairs of various types such as executive high-back, medium-back mesh, and visitor models suitable for boardrooms, workstations, and visitor seating areas. All chairs shall be of high-quality design conforming to BIFMA standards, ergonomically contoured for comfort and posture support, and aesthetically suitable for modern office interiors. The work shall be carried out as per approved drawings, finishes, and as directed by the Engineer-in-Charge.

1.2.56.24.2 All chairs shall be ergonomically designed with contoured seat and back profiles providing adequate lumbar support. The seat and back shall be made of high-density moulded PU foam of minimum density not less than 45 kg/m^3 for the seat and 35 kg/m^3 for the back. Upholstery shall be of premium quality leather, leatherette, or fabric finish as specified, neatly stitched and fitted. The structure shall consist of injection-moulded or fabricated components made from durable PP, nylon, or aluminium materials to ensure long service life and user comfort.

1.2.56.25 PROVIDING AND FIXING MEDIUM BACK REVOLVING OFFICE CHAIR

1.2.56.25.1 The contractor shall provide and fix a medium back revolving office chair with an adjustable headrest; ergonomically designed mesh back made of a high-quality nylon frame with breathable mesh upholstery. The chair shall feature a self-calibrating multi-lock reclining mechanism for synchronized back and seat movement, height-adjustable lumbar support, and one-way (height-adjustable) armrests with soft-touch pads. The seat shall be constructed from durable plywood with high-density PU-moulded foam, upholstered in approved fabric. The chair shall be supported on a heavy-duty five-star nylon base with smooth-rolling twin-wheel casters. The cost includes the conveyance of all materials, labour, tools, and tackles, as well as the installation, as directed by the Engineer-in-Charge. The colour shall be as approved by the Engineer-in-Charge, and the chair shall be supplied with a minimum 3-year manufacturer warranty.

1.2.56.26 PROVIDING AND FIXING MEDIUM BACK MESH OFFICE CHAIR

1.2.56.26.1 The contractor shall provide and fix a medium back mesh office chair with an ergonomically designed mesh back made of a high-quality nylon frame and breathable mesh upholstery. The chair shall include a self-calibrating multi-lock reclining mechanism for synchronized back and seat movement, height-adjustable lumbar support, one-way (height-adjustable) armrests with soft-touch pads. The seat shall be made from durable plywood with high-density PU-moulded foam, upholstered with approved fabric. The chair shall be supported on a heavy-duty nylon five-star base with smooth-rolling twin-wheel PU casters. The cost includes the conveyance of all materials, labour, tools, and tackles, as well as the installation, as directed by the Engineer-in-Charge. The colour shall be as approved by the Engineer-in-Charge, and the chair shall be supplied with a minimum 3-year manufacturer warranty

1.2.56.27 PROVIDING AND FIXING MEDIUM BACK VISITOR CHAIR

1.2.56.27.1 The contractor shall provide and fix a medium back visitor chair with a backrest made of PP (Polypropylene) with a fibre outer shell and square mesh upholstery. The chair shall have fixed armrests made of PP with fibre, and the seat shall be constructed from durable material upholstered with approved fabric. The chair shall be supported on a 2.1 mm thick fixed round tubular mild steel cantilever base, powder-coated with a chrome finish. The cost includes the conveyance of all materials, labour, tools, and tackles, as well as the installation, as directed by the Engineer-in-Charge. The colour shall be as approved by the Engineer-in-Charge, and the chair shall be supplied with a minimum 3-year manufacturer warranty covering defects in materials, mechanisms, and workmanship.

1.2.56.28 PROVIDING AND FIXING STORAGE UNIT

1.2.56.28.1 The contractor shall provide and fix a storage unit made of 18 mm thick BWP 710 plywood for the carcass and shutter, finished with selected 1 mm laminate of an approved make. The internal shelves shall be made of 9 mm thick BWP 710 plywood, finished with approved 0.7 mm thick colour laminate. All external surfaces, including the top, sides, and shutters, shall be finished with 1.0 mm thick approved laminate in specified colours and make.

1.2.56.28.2 The storage unit shall run on an approved channel, with hinges, wheels, and guides of approved materials. The unit shall include a locking arrangement to secure the storage, and the work shall be completed in all respects as per the approved design and the instructions of the Engineer-in-Charge.

1.2.56.28.3 Warranty

All items shall be supplied with a minimum 3-year warranty against manufacturing defects, material failure, and faulty workmanship. The warranty shall cover repair or replacement of defective parts at no extra cost during the warranty period.

LIST OF APPROVED MAKES

Sl No.	ITEM	APPROVED MAKE
1.	Adhesive	Pidilite, Araldite
2.	Admixture for concrete	Sika AG, Fosroc or equivalaent as approved
3.	Aluminium Sections	Hindalco Industries Ltd, Jindal, Banco or equivalent as approved
4.	Auto Closer Hinges	Hafele, Ozone, Dorma or equivalent as approved
5.	Cement	Ultratech , ACC , Zuari, JSW or Equivalent as approved
6.	Epoxy based chemical for anchoring grout	HILTI, Fischer or equivalent as approved
7.	Door Closer	Dorma, Ozone, Dorset or equivalent as approved
8.	Door Locks and latch	Dorma, Ozone, Dorset or equivalent as approved
9.	Fire-rated doors	Saint Gobain, Dormakaba, or equivalent as approved
10.	GI Section for partitions & False Ceiling	TATA, JSW or equivalent as approved
11.	Glass Hardware	Dorma, Ozone or equivalent as approved
12.	Gypsum False Ceiling / Partition and Suspension system	Saint Gobain, Gyproc India Ltd, Knauff- USG Board, SHERA, Everest or equivalent as approved
13.	Hardwares	Dorma, Ozone, Dorset, Hafele or equivalent as approved
14.	Paint & Primer	Asian, ICI, Jotun, Berger or equivalent as approved
15.	Plywood (BWP 710)	Greenply, Century, Kitply, Torjan
16.	HPL/Laminate /Veneer	Greenlam, Century, Merino or equivalent as approved
17.	Fluted wall panel	Greenlam, Century, Mikasa, Alstone or equivalent as approved
18.	UPVC System Windows/ Louvers	Encraft, Fenesta, Prominance or equivalent as approved
19.	Silicon Sealant	Dow Corning, Saint Gobain or equivalent as approved
20.	Stainless steel	Hindalco, Jindal or equivalent as approved
21.	Stainless Steel Bolts, cleats, brackets, Washers and Nuts, Pressure plates, screws, Anchor bolts	Hilti, Fischer, Kundan or equivalent as approved.
22.	Hinges, Locks, Channels, Handle, minifix connecters	Hettich, Häfele, Ebco or equivalent as approved.
23.	Structural Steel	Tata, Vizag, SAIL, JSW or equivalent as approved

24.	Structural Steel MS Plates, ISMB, Tubular section, Etc	Tata, Vizag, Sail or equivalent as approved
25.	Synthetic Enamel paint	Asian, ICI, Jotun, Berger or equivalent as approved
26.	Epoxy paint	Asian, ICI, Jotun, Berger or equivalent as approved
27.	Primer	Asian, ICI, Jotun, Berger or equivalent as approved
28.	Interior/Exterior Paint	Asian, ICI, Jotun, Berger or equivalent as approved
29.	Tile Adhesive / Epoxy grout	MYK Laticrete, Keralol equivalent as approved
30.	Toilet cubical	Merino, Greenlam, Stylam
31.	Texture Paint	Asian, ICI, Jotun , Berger or equivalent as approved
32.	Vitrified Tile	Kajaria, Varmora, Italica, Sunheart or equivalent as approved
33.	Wall putty	Asian, ICI, Jotun, Berger or equivalent as approved
34.	Waterproofing System	Fosroc, Sika, Pidilite, or equivalent as approved
35.	Reinforcement steel	TATA , JSW, SAIL, VIZAG or Equivalent as approved
36.	Multiwood	Thomson or Equivalent as approved
37.	Aluminium Grid Ceiling and Suspension system	Armstrong, Gyproc, Hunter Douglar or Equivalent as approved
38.	Fiber Reinforced Polymer door	Duroplast, Polyline or Equivalent as approved
39.	Mirrors	Saint Gobain, or Equivalent as approved
40.	Furniture	Featherlite, Godrej or Equivalent as approved
41.	ACP	Alstone, Alcobond, Reynobond
42.	Acoustic Pet Panel	TAP, Nishabd or Equivalent as approved
43.	Flush Door	MIKASA, Kitply, Jacson or Equivalent as approved

Note:Even if an approved make is listed in the table, the offered product shall fully comply with all specifications and technical requirements detailed in this tender.

2. TECHNICAL SPECIFICATIONS (MEP AND SERVICES)

A. PLUMBING

1. CONDITIONS FOR PLUMBING INSTALLATION WORKS

1.PIPING – PREPARATION

Pipes and tubes shall be cut perpendicular to the axis, with approved cutting tools , the ends reamed and burrs removed. Scale and dirt, on inside and outside and weld splatter shall be removed before assembly. Piping connections to equipment shall be made with flanges or unions.

2.PIPING – SPACING AND LOCATION

Piping shall be installed in such a way that conserves building space and not interfering with the use of space. Exposed piping shall be installed parallel or at right angles to the building walls, except where otherwise shown on the Contract drawings. Minimum clearances shall be provided between piping covered by this section and those of other trades. Adequate clearance shall be provided around piping for installation of insulation and access to valves and fittings. Piping shall be grouped at common elevations wherever possible. Piping shall be installed in such a way that allows for expansion and contraction without stressing pipe joints or connected equipment. Access doors shall be provided where valves and fittings are not exposed. Size and location of access doors shall be coordinated with the Civil Work.

3.PIPE FITTINGS

Tapered reducer fittings shall be installed where changes in pipe sizes occur. Use of site fabricated fittings or bushings shall not be permitted.

Tapered, factory manufactured reducer fittings (eccentric type at suction and concentric type at discharge) shall be installed at pump connections. Eccentric reducer fittings shall be installed with level crown.

Factory manufactured fittings shall be installed where changes in pipe direction occur. Bending or forming of piping shall not be permitted without the written permission of the Engineer.

Test – tees shall be installed in soil, waste, vent and rainwater pipe risers at minimum

450 mm (18 inch) above the ground floor level , at every alternate level and at other locations as shown on the Contract Drawings.

Connections shall not be made between piping of different services, under any circumstance. The existence of any one such connection in the project, whether temporary or permanent , shall make the Contractor liable for an anti – confusion test for all of the co permanent, vices .

4.SLOPES AND INVERTS

Invert elevations shall be established and drainage pipes sloped to one percent minimum unless otherwise stated. The minimum gradients that are shown on the Contract Drawings shall be maintained. Water supply piping shall be sloped to facilitate complete drainage of the piping for maintenance purposes. Elevations of buried piping, outside the building, shall be established to ensure not less than 900mm(3ft) of cover, especially in areas subject to traffic loading. The crown (or suffix) levels of the pipes shall be matched when joining horizontal drainage pipes of differing sizes, as far as possible. This shall apply to stepped reducers in drainage piping and connections in manholes (saddle joints in drainage mains excluded)

5.PROTECTION DURING CONSTRUCTION

Ends of piping shall kept closed with factory manufactured plugs or blind flanges with integral indicating flange , to prevent entry of foreign matter , during the progress of the work such plugs or flanges shall be removed on completion of the work .Water supply piping outlets in wet areas shall be kept closed with threaded (PVC) pipe stub with one end crimped or closed otherwise until the time of installing the out let fittings .The piping surface shall be protected from splashes of cement , plaster , paint and similar construction materials .The piping shall be blown out using dry compressed air , prior to testing .

6.SPECIALITY CONNECTORS

Chrome plated brass extension pieces shall be installed at the water supply piping outlets for sanitary fittings in wet areas. these shall be of variable length for making the outlet flush with the wall finished and shall have internal hexagonal water way for fixation by Allenkeys. Fixture waste adapters of rubber or neoprene shall be used to connect tail pipes of sanitary fixtures /drains to the waste piping.

7.SETTING OUT FOR EXTERNAL SERVICES

The existing ground shall be cleared along the line of piping, particularly at all manholes building connections and other appurtenances. Sight rails shall be set in position, using a surveyor,s level and properly established temporary bench marks alongside the work . The practice of transferring level by means of a straight edge and spirit level shall not be allowed. Where long lengths of slightly sloping sewers are to be laid in trenches , sight rails should be fixed across the trench at intervals of at least 20m at a height equal to the length of the boning rod to be used above the required invert level of the drain or sewer at the point where sight rail is fixed .there shall at no time be less than three sight rails in position on each length of sewer or drain under construction at any one gradient . Deviations from given levels may not be greater than +2cm and in gradients not greater than 1/20 of given gradient .

8.LAYING OF EXTERNAL PIPING

Pipes shall be laid and connected at the required depth in straight line and true to the gradient on an even foundation , over the full length of the barrel , with the sockets facing up the gradient .When jointing pipes , a mark shall be made to check the position of the end of the barrel in view of the flexibility of the joint , a gap 5 to 10 mm shall be left between the end of the pipes . When pipes are laid in curves , the pipes may not be bent sideways unit the connection has been made .Piping shall be kept free of earth , dirt and extraneous matter and every pipe shall be cleaned after installation by special cleaning tools approved by the Engineer to inspect the pipelines at any time during construction .No pipe shall be laid when , in the opinion of the Engineer , conditions are unsuitable

9.ENCASEMENT FOR EXTERNAL PIPING

Foundation of cement concrete shall be provided under the pipes, hunching with similar concrete up to half the diameter of the barrel ; in weak soils, as required. Pipes laid in areas subject to t4raffic loading shall be encased with concrete, as stated below. pipes with 1000 to 4000mm earth cover need not be encased. hunching and encasing of pipes shall be done in two stages, after completion of tests.

- Concrete bed of 50mm thickness shall be cast to scheduled slopes and levels.
- Blocks of concrete (100mm thick and length equal to the external diameter of the pipe) shall be fixed on the bed with cement and sand mortar (1:3).
- Hunching or encasing concrete shall be cast from one side of the pipe only,

vibrating until it is raised on the opposite side by 50mm over the bottom of the pipe.

- Expansion joints shall be made in the protective concrete with fiber board or other suitable filling material.

10.BACKDROPS TO MANHOLES

Drop connections shall be executed at the inlet to sewage manhole, when the drop exceeds 600mm and benching shall be provided at the bottom .These shall be constructed vertically adjacent to the external face of the external face of the manhole shaft in order to reach the level inside the manhole .

11.VALVES

Valves shall be installed with stem upright or horizontal , not inverted ; except with the written permission of the Engineer for each location .Valves shall be same size as pipeline , except where shown otherwise on the Contract Drawings .Valves with flanged ends shall be used in valve pits and when directly buried , irrespective of size .Ball and gate valves shall be used for shutoff and to isolate equipment part of systems or risers .full bore ball valves shall be used for water storage tank , drain and for isolation purposes in gravity fed systems (which are not subjected to shock conditions) Globe valves shall be used for throttling , bypass or manual flow control services .Drain valves shall be installed at system low points and at the foot of risers .Appropriate valves gland packing , sealing and gasket materials shall be selected for the temperature and pressure encountered .

12.SUPPORTS AND HANGERS FOR PIPING

Horizontal cast iron piping shall be supported independently of other piping. Sports shall be provided for fittings grouped together in horizontal runs, as appropriate.Piping shall be anchored at horizontal changes in direction, at clean outs and at start or horizontal lines. Floor clamps shall be provided at every floor and offset clamps below the branch take off joint in vertical risers.

SUPPORTS AND HANGERS FOR PLASTIC PIPING.

Horizontal piping shall be supported as scheduled below:

Pipe size Rod Diaz.	Maximum spacing	Hanger
UP to 25mm nom dial	1.2m	8mm(5/16”)
32 to 50mm nom .dial	1.5m	10mm(3/8”)
65 to 75 mm nom. dial	1.8 m	10mm(3/8”)
100 to 150mm nom .dial.	2.4m	12mm

(1/2”)

Risers of all sizes shall be supported at one quarter (1/4) points of floor-to-floor height support to spacing of 2.0 m shall not be exceeded .Manufacturer’s recommendations (which will supersede this specification) shall be conformed to in major PVC drainage system).

13.SLEEVES

Sleeves shall be set in position in form work and additional reinforcement provided around sleeves. Where sleeves in concrete structural elements are omitted due to error , the required openings shall be cored only after obtaining written permission of the Engineer. Sleeves with puddle flanges resting on the concrete surface shall be placed and the sleeves fixed in position by non –shrink grout. Cutting of hole by chiseling shall not be permitted. All sleeves in wet areas shall be projected by at least 50mm(2inch) above the finish floor level. Sleeves shall be erected in the from work , perpendicular to the wall face and rigidly to resist displace grout.ring pouring of concrete. Sleeves shall be large enough to allow for movement of pipe due to expansion or contraction, Provision of during of concrete.

14.PUDDLE FLANGES

Puddle flanges shall be erected in the form work perpendicular to the wall face and rigidly to resist displacement during pouring of concrete .Verticality of the flange faces and alignment of bolt holes with connecting equipment (valves etc.) shall be checked and ensured. Openings in the form work, around puddle flanges, shall be sealed so as to avoid leakage (and resultant honey combing) and undesirable formation of concrete. Alignment of puddle flanges shall be checked (and adjusted if necessary) immediately after pouring of concrete

15.EXCAVATION TO BE TAKEN TO PROPER DEPTH

Trenches shall be excavated in all condition of soil and to such a depth that sewers shall be set as described in the several clauses relating thereto and so that the inverts may be at the levels given on the section. In bad ground , the Engineer may order the contractor to excavated to a greater depth than shown in the drawings and fill up the excavation to the level of the sewer with concrete ; sand , gravel or other materials. But if the contractor should excavate the trench to greater depth than is required without a specific order to that effect in writing of the Engineer , the extra depth shall have to be filled up with concrete at the contractor’s own cost t o the requirements and satisfaction of the

Engineer.

16.REFILLING

After the sewer or other work has been laid and proved to be water-tight , the trench or other excavation shall be refilled . Utmost care shall be taken in doing this ,so that no damage shall be caused to the sewer and other permanent works . Filling in he trenches up to 50cm above the crown of the sewer shall consist of the finest selected materials placed carefully and consolidated . After this has been laid , the trench and other excavation, each layer being watered and consolidated .

17.CONTRACTOR SHALL RESTORE SETTLEMENT AND DAMAGES

The contractor shall at his own cost make good promptly , during the whole period the work are in hand, any settlement that may occur in the surfaces of roads , beams , footpaths, gardens open spaces etc . whether public or private caused by his trenches or his other excavations and he shall be liable for any accidents cased thereby .He also shall, at his own expense and charge repair and make good any damage done to buildings and other properties.

18.1-WATER SUPPLY-GENERAL SPECIFICATIONS

18.2 GENERAL REQUIREMENTS

18.2.1 Any damage caused to the building, or to electric, sanitary water supply or other installations etc. therein either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installations shall be restored to its original condition by the contractor. Nothing extra shall be paid for it, except where otherwise specified.

18.2.2 All water supply installation work shall be carried out through licensed plumbers.

18.2.3 It is most important to ensure that wholesome water supply provided for drinking and culinary purposes, is in no way liable to contamination from any less satisfactory water. There shall, therefore, be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for conveying or containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed valves shall not be construed a permissible substitute for complete absence of cross-connection.

18.2.4 Where a supply of wholesome water is required as an alternative or standby to supply of less satisfactory water or is required to be mixed with the latter, it shall be delivered only into a cistern, and by a pipe or fitting discharging into the air gap at a height above the top edge of the cistern equal to twice its nominal bore, and in no case less than 15 cm.

18.2.5 No piping shall be laid or fixed so as to pass into, through or adjoining any sewer, scour outlet or drain or any manhole connected therewith nor through any ash pit or manure-pit or any material of such nature that can cause undue deterioration of the pipe.

18.2.6 Where the laying of any pipe through fouled soil or previous material is unavoidable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or by some other suitable means. Any piping or fitting laid or fixed which does not comply with the above requirements, shall be removed and re-laid in conformity with the above requirements.

18.2.7 The design of the pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliance whether by siphonage or otherwise, and reflux or non- return valves shall not be relied upon to prevent such back flow.

18.2.8 All pipe work shall be so designed, laid or fixed, and maintained so that it remains completely watertight, thereby avoiding wastage of water, damage to property and the risk of contamination of the water conveyed.

18.2.9 In designing and planning the layout of the pipe work, due attention shall be given to the maximum rate of discharge, required economy in labour and materials, protection against damage and corrosion, protection from frost, if required, and to avoidance of airlocks, noise transmission and unsightly arrangement.

18.2.10 To reduce frictional losses, piping shall be as smooth as possible inside. Methods of jointing shall be such as to avoid internal roughness and projection at the joints, whether of the jointing materials or otherwise.

18.2.11 Change in diameter and in direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made so as to materially reduce or alter the cross-section.

18.2.12 Underground piping shall be laid at such a depth that it is unlikely to be damaged by frost or traffic loads and vibrations. It shall not be laid in ground liable to subsidence, but where such ground cannot be avoided; special precautions shall be taken to avoid damage to the piping. Where piping has to be laid across recently disturbed ground, the ground shall be thoroughly consolidated so as to provide a continuous and even support.

18.2.13 Where the service pipe is of diameter less than 50 mm the stop valves shall be of the screw- down type and shall have loose washer plates to act as non-return valves. Other stop valves in the service line may be of the gate type.

18.2.14 In flats and tenements supplied by a common service pipe a stop valve shall be fixed to control the each branch separately. In large buildings a sufficient number of stop valves shall be fixed on branch pipes, and to control groups of ball valves and draw off taps, so as to minimize interruption of the supply during repairs, all such stop valves shall be fixed in accessible positions and properly protected from being tampered with, they may be of the gate type to minimize loss of head by friction.

18.2.15 Water for drinking or for culinary purposes as far as possible shall be on branch pipes connected directly to the service pipe.

18.2.16 Pumps shall not be allowed on the service pipe as they cause a drop of pressure on the suction side thereby affecting the supply to the adjoining properties. In cases where pumping is required, a properly protected storage tank of adequate capacity shall be provided to feed the pump.

18.2.17 Service pipes shall be so designed and constructed as to avoid air-locks, so that all piping and fittings above ground can be completely emptied of water to facilitate repairs. There shall be draining taps or draw-off taps (not underground) at the lowest points, from which the piping shall rise continuously to draw-off taps, ball valves, cisterns, or vents (where provided at the high points).

18.2.18 Service pipes shall be designed so as to reduce the production and transmission of noise as much as possible. Appliances which create noise shall be installed as far distant as possible from the living rooms of the house. High velocity of water in piping and fittings shall be avoided.Piping shall be confined, as far as possible, to rooms where appliances are fixed, it shall have easy bends, and where quietness is particularly desired, holder bats or clamps shall be insulated from the piping by suitable pads.

18.2.19 The rising pipe to the storage cistern, if any, or to any feed cistern shall be taken as directly as possible to the cistern and shall be fixed away from windows or ventilators.

18.2.20 All pipe work shall be planned so that the piping is accessible for inspection, replacement and repair. To avoid its being unsightly, it is usually possible to arrange it in or adjacent to cupboards, recesses, etc. provided there is sufficient space to work on the piping with the usual tools. Piping shall not be buried in walls or solid floors. Where unavoidable, piping may be buried for short distances provided that adequate protection is given against damage and that no joints are buried. If piping is laid in ducts or chases, these shall be roomy enough to facilitate repairs and shall be so constructed as to prevent the entry of vermin. To facilitate removal of pipe casing, floor boards covering piping shall be fixed with screws or bolts.

18.2.21 When it is necessary for a pipe to pass through a wall or floor, a sleeve shall be fixed therein for insertion of the pipe and to allow freedom for expansion, contraction and other movement. Piping laid in wood floors shall, where possible, be parallel with the joists.

18.2.22 Where storage tanks are provided to meet overall requirements of water connection of service pipe with any distributing pipe shall not be permitted except one direct connection for culinary or drinking requirements.

18.2.23 No service pipe shall be connected to any water closet or urinal. All such supplies shall be from flushing cisterns which shall have supply from storage tank.

18.2.24 No service or supply pipe shall be connected directly to any hot-water system or to any apparatus used for heating other than through a feed cistern thereof.

18.3 MATERIALS

The standard size of brass or gun metal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Engineer-in-Charge and all supplies made according to the approved samples.All cast iron fittings shall be sound and free from laps, blow holes and pitting. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging, stopping or patching of the casting shall not be permissible. The bodies, bonnets, spindles and other parts shall be truly machined so that when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the water way of the fittings shall not be less than area of the nominal bore, chromium plating wherever specified shall be of 0.3 micron. The chromium shall never be deposited on brass unless a heavy coating of nickel is interposed. In the case of iron a thick coat of copper shall first be applied, then one of nickel and finally the chromium. In finish and appearance the plated articles when inspected shall be free from plating defects such as blisters, pits roughness and unplated areas and shall not be stained or discoloured. Before fitting is plated, the washer plate shall be removed from the fittings, the gland packing shall be protected from the plating solution.

18.3.1 Ball Valve (Brass)

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 (Fig. 18.1). The ball valve shall be of following two classes:—

(a) High Pressure: High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.

(b) Low Pressure: Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762.

18.3.2 Bib Taps and Stop Valve

Brass : A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

18.4 LAYING AND JOINTING OF PIPES AND FITTINGS

18.4.1 Unloading

18.4.1.1 The pipes shall be unloaded where they are required.

18.4.1.2 Unloading (except where mechanical handling facilities are available) : Pipes weighing up to 60 kg shall be handled by two persons by hand passing. Heavier pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with ropes and sliding over planks set not steeper than 45 degree. The planks shall be sufficiently rigid and two ropes shall always be used to roll the pipes down the planks. The ropes should be tied on the side opposite the unloading. Only one pipe shall be unloaded at a time.

18.4.1.3 Under no circumstances shall the pipes be thrown down from the carriers or be dragged or rolled along hard surfaces.

18.4.1.4 The pipes shall be checked for any visible damage (such as broken edges, cracking or spalling of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded.

18.4.2 Storing

18.4.2.1 The pipes and specials shall be handled with sufficient care to avoid damage to them. These shall be lined up on one side of the alignment of the trench, socket facing upgrade when line runs uphill and upstream when line runs on level ground.

18.4.2.2 Each stack shall contain pipes of same class and size, consignment or batch number and particulars of suppliers, wherever possible, shall be marked on the stack.

18.4.2.3 Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

18.4.3 Cutting

18.4.3.1 Cutting of pipes may be necessary when pipes are to be laid in lengths shorter than the lengths supplied, such as while replacing accessories like tees, bends, etc. at fixed position in the pipe lines.

18.4.3.2 A line shall be marked around the pipe with a chalk piece at the point where it is to be cut. The line shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe. The pipe shall be rigidly held on two parallel rafters nailed to cross beams, taking care that the portion to be cut does not overhang and the cut mark is between the two rafters. The pipe shall be neatly cut at the chalk mark with carpenter's saw or hacksaw having a long blade, by slowly rotating the pipe around its longitudinal axis so as to have the uncut portion on top for cutting. Cutting of the pipe at the overhang should, as far as possible, be avoided, as an overhanging and is liable to tear off due to its weight before the cutting is complete.

18.4.4 Trenches

18.4.4.1 The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

18.4.4.2 Cover shall be measured from top of pipe to the surface of the ground.

18.4.4.3 The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.

18.4.4.4 If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe. Where excavation requires blasting operation, it shall be ensured that no pipes have been stacked in the vicinity and completed pipe line in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipes in the vicinity by falling stones as a result of blasting.

18.4.4.5 After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

18.4.4.6 Roots of trees within a distance of about 0.5 metre from the side of the pipe line shall be removed or killed.

18.4.4.7 The excavated materials shall not be placed within 1 metre or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling they may be re-laid and compacted in the same order to the satisfaction of the Engineer-in-Charge.

18.4.4.8 The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after dewatering the trenches.

18.4.4.9 Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water mains cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the PLUMBING and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the Engineer-in-Charge.

18.4.5 Laying

18.4.5.1 The pipes shall be lowered into the trench by means of suitable pulley blocks, sheer legs chains ropes etc. In no case the pipes shall be rolled and dropped into the trench. One end of each rope may be tied to a wooden or steel peg driven into the ground and the other end held by men which when slowly released will lower the pipe into the trench. After lowering, the pipes shall be arranged so that the spigot of one pipe is carefully centered into the socket of the next pipe, and pushed to the full distance that it can go. The pipe line shall be laid to the levels required. Specials shall also be laid in their proper position as stated above.

18.4.5.2 Where so directed, the pipes and specials may be laid on masonry or concrete pillars. The pipe laid on the level ground, shall be laid with socket facing the direction of flow of water.

18.4.5.3 The pipes shall rest continuously on the bottom of the trench. The pipes shall not rest on lumps of earth or on the joints. Four metre long wooden templates may be used to check the level of the bed. Clearance of approximately 100 mm in depth and width equal to length of the collar plus 30mm on both sides shall be provided at the joint which shall be refilled from sides after the joint is made.

18.4.5.4 In unstable soils, such as soft soils and dry lumpy soils it shall be checked whether the soils can support the pipe lines and if required suitable special foundation shall be provided.

18.4.5.5 Some clayey soils (for example black cotton soil) are drastically affected by extremes of saturation and dryness. In changing from saturated to a dry condition, these soils are subjected to extraordinary shrinkage which is usually seen in the form of wide and deep cracks in the earth surface and may result in damages to under ground structures, including pipe materials.

The clay forms a tight gripping bond with the pipe, subjecting it to excessive stresses as the clay shrinks. It is recommended that in such cases an envelope of a minimum 100 mm of tamped sand shall be made around the pipe line to avoid any bonding.

18.4.5.6 In places where rock is encountered, cushion of fine earth or sand shall be provided for a depth of 150 mm by excavating extra depth of the trench, if necessary, and the pipes laid over the cushion. Where the gradient of the bed slopes is more than 30 degree it may be necessary to anchor a few pipes against sliding downwards .

18.4.6 Thrust Blocks

18.4.6.0 Thrust blocks are required to transfer the resulting hydraulic thrust from the fitting of pipe on to a larger load bearing soil section.

18.4.6.1 Thrust blocks shall be installed wherever there is a change in the direction/size of the pipe line or the pressure line diagram, or when the pipe line ends at a dead end. If necessary, thrust blocks may be constructed at valves also.

18.4.6.2 Thrust blocks shall be constructed taking into account the pipe size, water pressure, type of fitting, gravity component when laid on slopes and the type of soil. The location of thrust blocks for various types' fittings is given in.

18.4.6.3 When a fitting is used to make a vertical bend, it shall be anchored to a concrete thrust block designed to have enough weight to resist the upward and outward thrust. Similarly at joints, deflected in vertical plane, it shall be ensured that the weight of the pipe, the water in the pipe and the weight of the soil over the pipe provide resistance to upward movement. If it is not enough, ballast or concrete shall be placed around the pipe in sufficient weight to counteract the thrust.

18.4.6.4 When the line is under pressure there is an outward thrust at each coupling. Good soil, properly tamped is usually sufficient to hold pipe from side movement. However, if soft soil conditions are encountered, it may be necessary to provide side thrust blocks of other means of anchoring. In such cases only pipe on each side of the deflected coupling shall be anchored without restricting the coupling.

18.4.6.5 Pipes on slopes need be anchored only when there is a possibility of the back fill around the pipe sloping down the hill and carrying the pipe with it. Generally for slopes up to 30 degree good well drained soil carefully tamped in layers of 100 mm under and over the pipe, right up to the top of trench will not require anchoring.

18.4.6.6 For steeper slopes, one out of every three pipes shall be held by straps fastened to vertical supports anchored in concrete.

18.4.7 Back Filling and Tamping

18.4.7.1 Back filling shall follow pipe installation as closely as possible to protect pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trench and shifting pipe out of line by caved in soil.

18.4.7.2 The soil under the pipe and coupling shall be solidly tamped to provide firm and continuous support for the pipe line. Tamping shall be done either by tamping bars or by using water to consolidate the back fill materials.

18.4.7.3 The initial back fill material used shall be free of large stones and dry lumps. In stony areas the material for initial back fill can be shaved from the sides of the trenches. In bogs and marshes, the excavated material is usually little more than vegetable matter and this should not be used for bedding purposes. In such cases, gravel or crushed stone shall be hauled in.

18.4.7.4 The initial back fill shall be placed evenly in a layer of about 100 mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300 mm of cover over the pipe.

18.4.7.5 If it is desired to observe the joint or coupling during the testing of mains they shall be left exposed. Sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing.

18.4.7.6 Balance of the back fill need not be so carefully selected as the initial material. However, care shall be taken to avoid back filling with large stones which might damage the pipe when spaded into the trench.

18.4.7.7 Pipes in trenches on a slope shall have extra attention to make certain that the newly placed back fill will not become a blind drain in effect because until back fill becomes completely consolidated there is a tendency for ground or surface water to move along this looser soil resulting in a loss of support to the pipe. In such cases, the back fill shall be tamped with extra care and the tamping continued in 100 mm layers right up to the ground level.

18.4.8 Hydrostatic Tests

18.4.8.1 After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

(a) Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

(b) Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

18.4.8.2 Hydrostatic Tests: The portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500 m.

18.4.8.3 Where any section of a main is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete is cast. If rapid hardening cement has been used in these blocks or anchorages, test shall not be made until at least two days have elapsed.

18.4.8.4 Prior to testing, enough back fill shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary bracing shall be used.

18.4.8.5 The open end of the section shall be sealed temporarily with an end cap having an outlet which can serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate

18.4.8.6 The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and causes difficulty in raising the required pressure for the pressure strength test.

18.4.8.7 The test pressure shall be gradually raised at the rate of approximately one Kg./sq. cm./min. The duration of the test period if not specified shall be sufficient to make a careful check on the pipe line section.

18.5 Trench Filling

The pipes shall be laid on a layer of 7.5 cm sand and filled up to 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth as described in 20.3.7. The surplus earth shall be disposed off as directed.

18..6 Piping Installation Support

Piping shall be properly supported by means of wall support clamps as specified and as required, keeping in view the proper designing for expansion and contraction. Risers shall be supported at each floor with clamps.Due to high coefficient of thermal expansion the heat losses though the pipes is highly reduced. Therefore, for internal Bathroom hot geyser water distribution lines, the insulation is often not required.

18.7 The pressure test is performed in 3 steps being preliminary test, main test and final test. For the preliminary test a pressure which is 1.5 times higher than the possible working pressure is applied and this is repeated two times in 30 minutes with intervals of 10 minutes. After a test period of 30 minutes, the test pressure must not be dropped more than 0.6 bar and no leak must occur. Main test follows the preliminary test. Test time is two hours, in doing so the test pressure taken from the preliminary test must not have fallen more than 0.2 bar. After completion of these tests, the final test comes which has to be done under a test pressure of 10 bars and 5 bar in the interval of 15 minutes. Between the respective test courses, pressure has to be removed.

All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner. System may be tested in sections and such sections shall be entirely checked on completion of connection to the overhead tanks or pumping system or mains. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required. 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 are not working efficiently shall be replaced by new ones.

18.8 PROCEDURE FOR PRESSURE TEST

1. Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants and blow-offs. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

2. If the trench has been partially back-filled the specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer-in-Charge. The duration of the test shall not be less than 5 minutes.

3. Examination under Pressure: All exposed pipes, fittings, valves, hydrants and joints should be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the authority. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Engineer-in-Charge.

4. If the trench has been back-filled to the top, the section shall be first subjected to water pressure

normal to the area and the exposed parts shall be carefully examined. If any defects are found, they shall be repaired and the pressure test repeated until no defects are found. The duration of the final pressure tests shall be at least one hour.

Procedure for Leakage Test

5. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

Variation from Permissible Leakage: Should any test of pipe laid in position discloses leakage greater than that specified ,the defective joints shall be repaired until the leakage is within the specified allowance.

19.DRAINAGE-GENERAL SPECIFICATIONS

19.1 GENERAL REQUIREMENTS

19.1.1 Installing a drainage system for building(s), the aim shall be to provide a self cleansing conduit for the conveyance of soil, waste, surface or sub-surface waters and for the removal of such wastes speedily and efficiently to a sewer or other outlet, without risk of nuisance and hazard to health.

19.1.2 The discharge of water through a domestic drain is intermittent and limited in quantity and therefore, small accumulations of solid matter are liable to form in the drains between the building and the public sewer. There is usually a gradual shifting of these deposits as discharges take place. Gradients shall be sufficient to prevent these temporary accumulations building up and blocking the drains.

19.1.3 Normally, the sewer shall be designed for discharging three times the dry weather flow flowing half-full with a minimum self cleansing velocity of 0.75 metre per second. The sizes and slopes shall conform to Local Municipal Bye-laws.

19.1.4 In cases, where it is practically not possible to conform to the minimum gradients, a flatter gradient may be used but the minimum velocity in such cases shall on no account be less than 0.61 metres per second.

19.1.5 On the other hand, it is undesirable to employ gradients giving velocity of flow greater than 2.4 metres per second.

19.2-The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under a roadway, a minimum cover of 90 cm is recommended for adoption, but it may be modified to suit local conditions. The trench shall be excavated only so far in advance of pipe laying as specified by the Engineer-in-Charge. The trench shall be so shored and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains.

The excavation shall be carried out with manual labour or with suitable mechanical equipment as approved by the Engineer-in-Charge.

Unless otherwise specified by the Engineer-in-Charge, the width at bottom of trenches for different diameters of pipes laid at different depths shall be as given below:—

(a) For all diameters, up to an average depth of 120 cm, width of trench in cm = diameter of pipe + 30 cm.

(b) For all diameters for depths above 120 cm, width of trench in cm = diameter of pipe + 40 cm.

(c) Notwithstanding (a) and (b) the total width of trench shall not be less than 75 cm for depths exceeding 90 cm.

19.3 : Where the pipes are laid on soft soil with maximum water table lying at invert level of the pipe, the pipes shall be bedded in cement concrete with thickness and mix as specified, projecting on each side of the pipe to the specified width of the trench . The pipes with their crown level at 1.20 m depth and less from ground shall be covered with 15 cm thick. Concrete above the crown of the pipe and sloped off to meet the outer edges of the concrete, to give a minimum thickness of 15 cm all-around the pipe .Pipes laid at a depth greater than 1.20 m at crown and maximum water table level rising above the invert level of pipe, shall be concreted at the sides up to the level of the centre of the pipe and sloped off from the edges to meet the pipe tangentially .The pipe shall be carefully laid to the alignments, levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. The pipes shall be laid with socket ends facing upstream. The body of the pipe shall for its entire length rest on an even bed of concrete and places shall be excavated in the concrete to receive the socket of the pipe.Where pipes are not bedded on concrete, the trench floor shall be left slightly high and carefully bottomed up as pipe laying proceeds, so that the pipe barrels rest on firm and undisturbed ground. If the excavation has been carried too low, the desired levels shall be made up with concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) for which no extra payment shall be made.If the floor of the trench consists of rock or very hard ground that cannot easily be excavated to smooth surface the pipe shall be laid on a levelling course of concrete as desired.

19.4 Testing of Joints : Pipes used for sewers shall be subjected to a test pressure of 2.5 m head of water at the highest point of the section under test. Before commencing test, the pipeline shall be filled with water and maintained full for 24 hours under head of 0.6 m of water. The test shall be carried out by suitably plugging the lower end of the drain and the ends of the connection if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head, or the top may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation. The tolerance of two liters per centimeter of diameter per kilometer may be allowed during a period of 10 minutes.

If any leakage is visible, the defective part of the work shall be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

19.5 Refilling : In cases where pipes are not bedded on concrete special care shall be taken in refilling trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe, and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping should be done within 15 cm of the top of pipe.

19.6 Measurements : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.

Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

19.7 MANHOLE COVERS & FRAMES

19.7.1 Manhole Covers

The covers and frames shall conform to IS 1726 for cast Iron and IS 12592 for pre-cast concrete covers and shall be of the following grades and types.

Grades

Designation		Type/shape of cover
Light Duty	LD - 2.5	Rectangular, Square, Circular

Medium Duty MD - 10 Rectangular, Circular and Square (for pre-cast concrete manhole covers)

Heavy Duty HD - 20 Circular-Square, Rectangular, (Scrapper Manhole)

Extra Heavy DutyEHD - 35 Circular, Square, Rectangular, (Scrapper Manhole)

19.7.1.1 Cast Iron Manhole Covers and Frames

(i) Manhole covers and frame shall be manufactured from appropriate grade of grey cast iron not inferior than FG150 grade of IS 210.

(ii) They shall be cleanly cast and shall be free from air and sand holes, cold shuts and warping.

(iii) Covers shall have on its operative top a raised chequered design to provide for an adequate no-slip grip. The rise of chequers shall be not less than 4mm.

(iv) Key holes, keys and lifting devices shall be provided in the manhole covered to facilitate their placement in the frames and their operative maintenance.

(v) Manhole covers and frames shall be coated with materials having base with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to temperature of 63°C and shall not be so brittle as to chip off at temperature of 0°C.

(vi) Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726.

(vii) Each manhole covers and frame shall have cast on them the following information: (a) Manufacturer's name or trade-mark

(b) Grade designation

(c) Date of manufacturer

(d) The words SWD or 'Sewer' to denote 'storm water drain' or 'sewer' respectively

(e) Identification marks as required by Engineer-in-Charge. (viii) The cover shall be gas tight and water tight.

(ix) The sizes of covers specified shall be taken as the clear internal dimensions of the frame.

(x) The approximate weight of the various type of manhole covers and frames shall be as per IS 1726.

(xi) The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner.

19.7.2 Pre-Cast Concrete Manhole Covers & Frames

Pre-cast reinforced cement concrete manhole covers intended for use in sewerage and water works shall generally conform to IS 12592.

19.7.2.1 Materials

- Cement: Cement used for the manufacture of pre-cast concrete manhole covers shall be 43 grade Portland cement conforming to IS-8112.
- Aggregates: The aggregates used shall be clean and free from deleterious matter and shall conform to the requirements of IS-383. The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.
- Concrete: The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combing etc. The minimum cement content in the concrete shall be 410 kg/m3 with a maximum water cement ratio of 0.45. Concrete weaker than grade M-30 (design mix) shall not be used. Compaction of concrete shall be done by machine vibration.
- Reinforcement
- (a) The reinforcement steel shall conform to IS 1786. Reinforcement shall be clean and free from loose mill scale, loose rust, and mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A light film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.
- (b) Fibers Steel: The diameter/equivalent diameter of steel fibers where used, shall not be greater than 0.75 mm. The aspect ratio shall be in the range of 50 to 80. The minimum volume of fibers shall be 0.5 percent of the volume of concrete.

20 DISPOSAL OF SURPLUS

The contractor shall at his own cost dispose within the site or as directed all surplus excavated materials not required to be used on the work unless otherwise specified.

21.SHORING

The contractor shall at all times support efficiently the sides of trenches and other excavations by suitable timbering , piling , sheeting, etc . Trenches shall be close timbered in loose or sandy strata and below the surface of the sub – soil water table .All timbering , sheeting and piling with their wailings and supports shall be of adequate dimensions and strength and fully braced and strutted so that there is no risk of collapse or subsidence of the walls of trenches . The contractor shall be held accountable and responsible for the sufficiency of all timbering , bracing , sheeting and piling used for all damages to persons and property resulting from the improper quality , strength , placing , maintenance or removing of the same

22.BAILING OUT WATER

The contractor shall at all times, during the progress of work, keep trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to public nor to 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 .

23.PROTECTION OF EXISTING SERVICES

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported.

24.CONCRETING

All pipes at shallow road crossings and made –up ground shall be laid on a bed of 6" (150mm) plain cement concrete (1 cement : 4 sand :8 stone metal of ¾''(20mm) or smaller) properly consolidated. Concrete shall be laid to full width of trench and also in haunches.

25.WATER SUPPLY

UPVC PRESSURE PIPES AND FITTINGS

25.1 LAYING AND FIXING

Pipes are to be cut to size and threaded with standard GI threading die . Pipes and fittings shall be jointed using Teflon tape as thread sealant. Pipes and fittings can be tightened by hand also to achieve leak –proof joint. Pipes shall be fixed by means of holder bat clamps keeping them 12mm off walls for easy maintenance. Pipes running on roof slabs shall be suitably supported

blocks and to be projected from ultra violet radiation

Pipes shall be tested to a hydrostatic pressure of 10 kg/sq cm and pressure shall be maintained for at least eight hours without appreciable drop in pressure . In addition to sectional testing of water supply pipes , the contractor shall test the whole of the installation to the entire satisfaction of the Engineer .

25.2 PVC PIPES

LAYING AND JOINTING

For PVC pipes ,pasted joints are preferred .The socket length should be 11/2 times the outer diameter for size above 110mm diameter . The surface to be glued should be thoroughly scoured with dry cloth and preferably chamfered to 30o.Slovent cement is to be applied evenly with a brush outside surface of the spigot of one pipe and to the inside surface of the socket of the other . The spigot end should then be inserted immediately into the socket should be wiped out at once with a clean dry cloth . Jointing should be carried out quickly , taking not more than one minute to completed joint should not be disturbed for at least 5 minutes . Gluing should be avoided in rainy or foggy weather to avoid water contamination of the solvent cement . Pipes should be supported at distance of 1.20 m for vertical runs with appropriate MS clips and support blocks or wooden plugs fixed on walls , floors or ceiling . Holder bat clamps are to be used to keep pipes 12mm clear off walls.

25.3 CHLORINATED POLY VINYL CHLORIDE PIPES (CPVC PIPES)

The pipe may cut to the required lengths using circular tubing cutters, Ratchet type cutters or chop saws .The cuts shall be square . Burrs and fillings shall be removed from outside and inside the pipes using a chamfering tool

For jointing CPVC pipes special solvent cement is required. The surfaces are to be dry before solvent cement shall not be allowed puddle in the fitting and pipe assembly . The pipe may then be rotated to one quarter to half turn while inserting into the fitting socket. Whenthe pipe end is seated it may hold in place for ten second s to allow the joint to set. Teflon tape may be used as thread sealant.Water testing to a pressure of 10kg/cm2 may be carried out for CPVC piping system . Air testing shall not be done

25.4 POLYPROPYLENE PIPES (PP PIPES)

The installation of PP pipes may be carried out similar to metal pipes . The pipes may be cut to the desired length using special cutters , the cuts being perpendicular to the axis. Jointing of PP pipes may be done using Fusion welding by special welding machines . The pipes can be bent by heating , but the pipes shall not put to flame . The welding Fusion joint process involves

heating , fusion and cooling .Before welding, the pipe ends may be cleaned with a cloth and alcohol water solution . after heating the ends on the welding machine for a few second , the pipe may be removed from the welding machine and the ends may be connected using a little pressure without twisting . It may be allowed to cool down for a few seconds. The joints may be kept in a tight condition during cooling. Water testing shall be adopted for testing PP pipes. The pressure applied shall be 10kg /cm2 . The test time is to be 2 Hours.

27.WATER FITTINGS (TAPS, STOP COCKS ETC.)

All water fittings shall be of approved quality and design and shall generally comply with latest I .S. Specifications.

28.VALVES AND PRESSURE GAUGES.

Pressure gauges shall have not less than 115mm dia , 10mm BSP full threads , brass body siphon and gauge cock of 10mm size . Dial gauges shall be adequate for pressure encountered and specified (0-15 kg/sq cm) . Valves shall comply with IS:780 (Class I) for CIsluice valves and IS: 778 for GM valves and tested and approved by the Municipal Corporation .

29.BALL COCKS

Ball cocks used for storage tanks shall be high pressure brass/ gun metal ball cocks with brass lever road and PVC floats.

30.PVC SWR PIPES AND FITTING

30.1 LAYING.

PVC Pipes shall be laid under ground , in suspended ceiling , in sunk slabs or on walls either buried or exposed as the case may be as shown on drawings . The minimum thickness of the fittings shall be32mm. Fittings shall be injection molded type with rubber ring socket.Exposed pipes and fitting shall be capable of with standing sun –rays without any cracks or de- colorization.

30.2 JOINTING

Jointing of pipes to fittings shall be done as per manufacture's instructions/recommendation .

30.3 TESTING

PVC pipe and fittings shall be tested for three meters of water head .Openings of pipes shall be sealed for the section to be tested .Water pressure shall be maintained for maximum of one hour. The Engineer shall examine carefully all the joints for leakage.

30.4 SEWER APPURTENANCES.

30.4.1 LOCATION AND SIZES

The sizes given on drawings shall be internal sizes of chamber, man –hole etc Unless otherwise specified, man – hole and inspection chambers shall be provided at all changes in direction of drain and where branch drain meets main drain .The Minimum internal sizes shall be taken as per detailed drawings, standards specified and local bye- laws if any

30.4.2BED CONCRETE.

Bed Concrete shall be in 1:4:8 cement concrete 150mm thick for inspection chambers, 230mm for depths up to 2.1m and 300mm for greater depths in case of man-holes.

30.4.3BRICK MASONRY

Brick work shall be with best quality table - moulded bricks in 1:6 cement mortar as per specification for brick masonry.

30.4.4PLASTER

Inside of the walls of chambers / man –holes shall be plastered with 15mm thick cement plaster

1:3 mixed with waterproofing material and finished smooth with a flushing coat of neat cement

31.CHAMBER / MAN HOLE COVER.

Covers shall be of cast iron / Ductile Iron with lifting hooks as per IS: 1726-1967, details given on drawings and fixed on CI frame s embedded in concrete . Cover placed on the frames shall be air -tight. Height of frame and cover shall be as per schedule of quantities. Covers for chambers / man – holes coming within buildings should be Double Seal Type.

31.1 STEPS

CI /PVC steps duly painted shall be provided whenever depth of man – hole / chamber is more than 1.2m.

31.2DROP CONNECTIONS.

In case the difference in invert levels between the main drain and the branch line requires a drop of more than 600mm , a drop connection should be provided with cast iron, stoneware or PVC four -way junction, fixed at right angles to the drop pipe at the level where branch pipe enters man- holes. Access for cleaning bends should be provided at finished ground level.

32.MODE OF MEASUREMENTS

32.1.CAST IRON, SWR PVC PIPES AND COPPER PIPES

These pipes shall be measured along the centre line of pipes including all specials in (Rm) Quoted rate for respective items shall include. The following:

a) Cost of jointing materials.

b) Laying, fixing and jointing with necessary clamps, brackets, screws etc .and curing.

Making good all damages to the building to suit the surroundings. Painting buried surfaces of CI pipes with bit mastic paint (no painting for AC pipes). esting and making good defects, if any.

32.2.INSPECTION CHAMBERS

Inspection chambers shall be measures in numbers and rate quoted shall also be per number only . Quoted rate shall include cost of all the following items.

a) Bed Concrete

b) Brick work

c) Plastering

d) Concrete benching channeling

e) PCC bed for fixing the frame.

f) Providing holes and embedding pipes for all connections

g) Curing

h) Testing

32.3.MAN-HOLES

Man -holes shall be measured in numbers. Depth of man – holes shall be reckoned from invert of channel to top of man- hole cover. Quoted rates shall cover the range of +/-240mm on the depth specified and also cost of all the following items.

a) Bed concrete

b) Brick work

c) Plastering

d) Concrete benching and channeling including drop connections

e) Fixing steps

f) Providing holes and embedding pipes for all connections.

g) Curing

h) Embedding frame in concrete bed

i) Testing

32.4.GULLY TRAP CHAMBERS

Gully trap chambers shall be measured in numbers and rate quoted shall also be Per number only. Quoted rate shall include cost of all following items:

a) Bed concrete

b) Brick work

c) Plastering

d) Concrete to embed gully trap

e) Chamber cover and frame

f) Providing holes and embedding pipes for all connections .

g) Excavation , refilling , necessary dewatering and disposing off extra materials to a place as directed by the Engineer

32.5. G I PIPES AND FITTINGS

GI Pipes above ground shall be measured along the center line of pipes and fittings . Quoted rate for respective items shall be per (rm) and shall include the following:

Laying, fixing and jointing with necessary clamps. Cutting holes and chases in walls, floors, beams etc. and making good the same. All supporting arrangements, brackets etc. Testing and making good defects , if any .GI pipes below ground shall be measured as stated in (a) and (b).

32.6 UPVC, PVC PRESSURE PIPES AND FITTINGS

PVC pipes and UPVC pipes shall be measured along the center line of pipes and fittings quoted rate respective items shall be per (rm) and shall include the following.

(a) Laying, fixing and jointing with necessary clamps.

(b) Cutting holes and chases in walls, floors, beams etc. and making good the same.

(c) All supporting arrangements, brackets etc.

(d) Testing and making good defects, if any.

32.7 WATER FITTINGS (TAPS, STOP COCKS, ETC.)

These items shall be measured in numbers unless included as part of other items viz wash basins inlets to cisterns etc . Cost of fittings shall include Cost of fixing accessories like bolts, nuts, washers, Cost of thread or fixing taps.

32.8 VALVES AND GAUGES

Valves shall be measured in numbers and cost shall include.

a) cost of jointing material

b) Fixing and jointing material

c) Testing and making good defects , if any .

33. SCHEDULE OF WORKS

The schedule of works annexed with the tender documents form the schedule of works to this agreement which shall be read and construed as forming part of this agreement. The quantities of various items given in the schedule of works are subject to alterations, omissions, deductions or additions as provided for in the conditions of contract and do not necessarily show the actual quantities of work to be done.

34.SPECIFICATION

The following specifications of which the contractor has full knowledge and information shall be followed for various items of work and the order of priority for specification shall be as noted below.

a) General specifications annexed with the tender documents

b) Indian Standard Specifications

c) CPWD Specifications for Plumbing

d) I.S.I Codes & Uniform Plumbing Code

APPENDIX-1

GUARANTEE PROFORMA

GUARANTEE FOR PLUMBING INSTALLATION

We hereby guarantee the PLUMBING System which we have installed in the Project described below :

Project :

Location :

Owner :

For a period of 12 Months from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorise the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

WE ALSO HEREBY UNDERTAKE to test the entire installation upon completion and ensure that all units are functioning satisfactorily.

SIGNATURE OF CONTRACTOR
for PLUMBING INSTALLATION

DATE SEAL

B.TECHNICAL SPECIFICATION-FIRE PROTECTION SYSTEMS

FIRE PUMPS

1 SCOPE

covers the requirements of water pumps for main fire pump, jockey pump and terrace pump.

2 TYPE

Pumps conforming to IS 12469 shall be exclusively used for Firefighting purposes. The pumps shall be centrifugal type direct driven with a 3 phase, 415 V $\pm$ 10%, 50 Hz, A.C. motor. The standby fire pump shall be driven by diesel engine. The pumps may be either of horizontal split casing (HSC) type with operating speed not exceeding 1500 rpm, or solid casing with operating speed not exceeding 3000 rpm as specified in the tender documents.

3 RATING

The main fire pump and terrace pump shall be suitable for continuous operation in the system. The jockey pump shall be suitable for intermittent operation to buildup pressure in the system on account of leakage. The head and discharge requirements shall be as specified in the tender documents. The head shall be suitable for the system and shall take into consideration the pressure drops across the various components in the water circuit as well as the frictional losses.

The rated discharge of Electric Driven and Diesel Engine Driven pump shall be as specified in boq. Pump shall be capable of discharging not less than 150 percent of the rated discharge at a head of not less than 65 percent of the rated head. The shut off head shall not exceed 120 percent of the rated head in the case of horizontal Pumps.

4 MATERIAL AND CONSTRUCTION

(i) The centrifugal pumps shall conform to IS 1520.

(ii) 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.

(iii) 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.

(iv) 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.

(v) The shaft sleeve and wearing ring etc. shall be of bronze, brass or stainless steel.

(vi) The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water.

(vii) The shaft seal shall be mechanical type, so as to allow minimum leakage. A drip well shall be provided beneath the seal.

(viii) The pumps shall be directly coupled to the motor/diesel engine shaft through a flexible coupling protected by a coupling guard.

(ix) The pump and motor/diesel engine shall be mounted on a common robust bed plate fabricated from mild steel section. The bed plate shall have rigid, flat and true surfaces to receive the pump and motor/diesel engine mounting feet. The pump will be perfectly aligned with the motor/engine so as to avoid any vibration during operation at all variations of load.

5 ACCESSORIES

Each pump shall be provided with the following accessories: -

(a) Sluice valves on suction and delivery.

(b) Reducers, as may be required to match the sizes of the connected pipe work.

(c) Non-return valve at the delivery.

(d) Pressure gauge at delivery side between pump and the non-return valve.

(e) Flexible coupling/connections shall be provided between Pump sets and Valves on suction and delivery sides of all the pump sets.

Note:

1) No butterfly valves shall be installed inside the pump room.

2) The size of the non-return valve and cut off (Sluice valve) shall not be less than the size of the initial delivery pipe.

5.1 INSTALLATION

(i) The pump and motor/engine assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or to the pipe work.

(ii) The pump and motor/engine assembly shall be installed on suitable RCC foundation. The length and width of the foundation shall be such that 100 mm space is left all around the base frame. The height of foundation shall be so decided that the total weight of foundation block is 1.5 times the operating weight of the pump assembly. The foundation shall be isolated from the floor by vibration isolating pads. Angle iron frame of size 35 mm x 35 mm x 3 mm shall be provided on the top edges of the foundation.

(iii) More than one pump and motor assembly shall not be installed on a single base or cement concrete block.

(iv) The suction/discharge pipe shall be independently supported and their weight shall not be transferred to the pump. It should be possible to disconnect any pump for repairs without disturbing the connecting pipe line.

(v) A minimum clearance of 1 m around the main pumps shall be provided. For jockey pump-clearance of 75 cm shall be adequate.

(vi) Sufficient space is to be left in front for the radiator of diesel engine for free discharge of hot air. Arrangement for discharging hot air to outside the pump house shall be provided so that hot air does not stagnate in the pump house.

DIESEL ENGINE FOR FIRE PUMP

6.1SCOPE

This chapter covers the details of requirements of a diesel engine for main fire pump to act as standby.

6.2 GENERAL

The diesel engine shall be suitable for automatic operation complete with necessary automatic starting gear, 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.

6.3 DRIVE

The pump shall be only direct driven by means of a flexible coupling. The coupling between the engine and the pump shall allow each unit to be removed without disturbing the other. Coupling guard shall be provided. The speed shall be 1500 RPM.

6.4 DIESEL ENGINE

6.4.1 ***Environment conditions***- The engine shall be suitable to operate under the conditions of environment at site.

6.4.2 ***Engine Rating***- The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled, 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 specified environment conditions. The engine rating shall be suitable to drive the pump at 150 percent of its rated discharge with at least 65 percent of rated head or 20% in excess of the maximum brake horsepower required to drive the pump at its duty point, whichever is higher. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

The engine shall be:

a)naturally aspirated, supercharged or turbo-charged and rather air or water- cooled.

b) provided with an in-built tachometer to indicate rpm of the engine.

c)suitable for cold starting for which suitable heaters shall be provided in lubricating oil.

d) able to develop full load within 15 seconds from the receipt of the signal to start.

e)The diesel engine shall conform to BS 649/ IS 1601/ IS 10002, amended up to date.

6.4.3 **Engine Accessories-** The engine shall be complete with following accessories:

(i) Fly wheel dynamically balanced

(ii) Direct coupling for pump and coupling guard

(iii) Radiator with hoses, fan, water pump, drive arrangement and guard

(iv) Air cleaner dry type

(v) Fuel service tank with necessary pipe work

(vi) Fuelfilter

(vii) Pump for lubricating oil and lub. oil filter

(viii) Electric starting battery 12 V/24 V with 2 Nos. batteries

(ix) Exhaust silencer with necessary pipe work

(ix)Governor

(x) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting)

(xi) Necessary safety controls

(xii) Winterisation arrangement

(xiii) Hand operated semi rotary pump for filling the service tank

(xiv) A standard kit of tools (this shall be kept on hand at all times)

6.4.4 **Cooling System-** The engine shall be radiator water cooled. The radiator assembly shall be mounted on the engine. The radiator fan shall be driven by the engine as its auxiliary with multiple fan belts. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

6.4.5 Fuel System- The fuel system shall be gravity fed from the fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either adjacent to the engine or suitably wall mounted on brackets. The fuel filter shall be suitably located to permit easy servicing.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator(protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediments into the fuel line to the engine.

Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position.

All fuel tubing to the engine shall be with M.S.'C' class pipe with flexible hose connections where required. Pipe joints shall not be soldered and plastic tubing shall not be used.

The following shall be provided:

i) A sludge and sediment trap shall be provided.

ii) An inspection and cleaning hole

iii) Means to enable the entire fuel system to be bled of air (Air relief cocks are not allowed; screwed plugs are permitted)

6.4.6 Lubricating Oil System- Forced feed lubricating Oil system shall be employed for positive lubrication. Necessary lubricating oil filters shall be provided, located suitably for convenient servicing.

6.4.7 Starting System- The starting system shall comprise of necessary batteries 12 Volts/ 24 Volts, starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Suitable protection to protect starting motor from excessively long cranking runs shall be suitably integrated with engine protection system. The capacity of the battery 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. Three attempt starting facility shall be provided. If the engine fails

to start after third attempt, the engine shall be locked out and suitable audio-visual alarm shall be given to indicate engine failure. The starter motor used for automatic starting may also be used for manual starting provided there are separate batteries for manual starting. The scope shall cover all cabling, terminals, initial charging etc.

6.4.8 ***Exhaust System***- The exhaust system shall be complete with residential grade silencer suitable for outdoor installation and silencer piping shall be extended up to 1 m, outside pump house duly insulated with 50 mm thick glass wool and 1.0 mm thick aluminum sheet cladding. Retrofitted emission-control equipment shall be used having a minimum specified PM-capturing efficiency of at least 70%, type approved by one of the five CPCB recognized labs. (Recommendations of National Clean Air Program 2019 launched by Ministry of Environment, Forest and Climate Change)

6.4.9 ***Engine shut down mechanism-*** This shall be manually operated and shall return automatically to the starting position afteruse.

6.4.10 ***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.

6.4.11 ***Engine Instrumentation*** - Engine instrumentation shall include the folIowing:-

(i) Lub.oil pressure gauge

(ii) Lub.oil temperature gauge

(iii) Water temperature gauge

(iv) Tachometer

(v) Hour meter

The instrumentation panel shall be suitably mounted on the engine.

6.4.12 ***Engine protection devices*** - Following engine protection and automatic shut down facilities shall be provided:-

(i) Low lub. oil pressure.

(ii) High cooling water temperature.

(iii) High lub. oil temperature.

(iv) Over speed shut down

6.4.13 ***Pipe work***- All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems.

6.4.14 ***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.

6.4.15 ***Battery Charger-***

Battery of diesel engine operated fire pump shall have separate charger from emergency power supply circuit. Necessary float and boost charger shall be incorporated in the control section of power and control panel with manual selection of boost charge, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickle charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined.

6.4.16 The engine installation shall be approved by the representative of engine manufacturer (who shall carry out after sales service under AMC).

6.4.17 The following spare parts shall be supplied with the engine and kept on hand:

a) Two sets of fuel filters, elements and seals;

b) Two sets of lubricating oil filters, elements and seals;

c) Two sets of belts(where used);

d) One complete set of engine-joints, gaskets and hoses;

e) Two injector nozzles;

f) One complete set of piston rings for each cylinder; and

g) One inlet valve and one exhaust valve).

PIPE WORK

7.1 SCOPE

This chapter covers the requirements of pipe work in firefighting installations.

7.2 PLUMBING DESIGN

Pipe sizes shown in tender documents are purely for contractor's guidance.

The contractor shall be responsible for selection of sizes as per detailed engineering to be done by him. Plumbing design to be done by the contractor shall incorporate the following: -

(i) (a) Sluice valves shall be provided at suction and delivery sides of pumps.

(b) External hydrant

(c) Fire service connection/inlet.

(d) Test valve.

(e) Drain connections.

(ii) For testing the system healthiness and automatic operation on daily basis, one test pipe with sluice valve shall be provided in common discharge header. For avoiding wastage of water, this pipe shall discharge water in the tank.

(iii) Non-return valve shall be provided at the delivery of each pump and fire service inlet. This shall be of swing type.

(iv) Air release valves with ball valve shall be provided in the piping system for venting trapped air with a size of 25 mm for pipes up to 100 mm and 40 mm for larger pipes.

(v) Plumbing drawings showing the sizes of pipe, valves, layout and other details shall be prepared and shall be got approved from the Engineer-in- Charge before the execution of the plumbing work.

7.3 PIPE MATERIALS

Pipes shall be of the following materials:

(a) Mild steel heavy class (C-class) conforming to IS:1239 for sizes up to 150 mm.

(b) Welded black steel pipe, Class 2, conforming to IS: 3589, for sizes greater than 150 mm. These pipes shall be factory rolled and fabricated from minimum 6mm thick M.S. Sheet for pipes upto 350 mm diameter and from minimum 7 mm thick M.S. sheet for pipes of 400 mm diameter and above. MS pipes may be allowed for extension of existing systems which are laid with CI pipes.

(c) Cast iron double flanged pipe, Class-A conforming to IS 1536 or IS: 1537 (to be provided only in underground application).

Note: For pipe work of Automatic Sprinkler System inside the building, Stainless Steel Pipes and fittings of grade AISI 304 as per JIS standard 3448 are also permitted particularly where replacement of pipes is not easy like areas above false ceiling etc., subject to the condition that these pipes with associated fittings are suitable to safely withstand the system test pressures.

(d) (i) GI Pipe medium Class (B-class) conforming to IS:1239 (For Drain)

(ii)Cadmium plated steel nuts/bolts/washers shall be used.

(iii)Flex drop of stainless steel metallic pipe with mounting accessories, frame for installation on false ceiling.

7.4 PIPE JOINTS

i) Electric welding joints shall be provided in the MS pipe work. Flanged joints shall be provided for connections to valves, pumps, air vessels etc. and also on straight lengths at suitable points to facilitate erection and subsequent maintenance.

ii) For connection of C.I.Pipe, fittings shall also be of C. I. heavy grade conforming to IS:1538. The flanges shall be smooth faced and neoprene gasket shall be provided between joints. All bolt holes in flanges shall be drilled. The drilling of each flange shall be in accordance with the relevant Indian Standards. Where un-avoidable and to connect underground pipe with risers, MS pipe may be used in the form of distant pieces. The joint between C.I. and MS pipe shall be flanged type. MS pipe laid at such locations shall be provided anti-corrosive treatment as per Para 7.5.

iii) Mild steel flanges shall be in accordance with Table - 17 of IS : 6392 i.e. "Plate Flanges for Welding" and flange thickness shall be as under. Gasket thickness shall not be less than 3 mm.

Pipe diameter	Flange Thickness
200 mm	24 mm
150 mm and 125 mm	22 mm
100 mm and 80 mm	20 mm
65 mm	18 mm
40 mm and below	16 mm

iv) Fittings installed underground shall be of cast iron 'heavy' grade conforming to IS 1538 whereas those installed above ground shall normally be of medium grade wrought steel or mild steel conforming to IS 1239 (Part 2) or malleable iron fittings conforming to IS 1879.

v) All hardware items such as Nuts, Bolts, Washers shall be of appropriate size. Washers shall be used on both sides of the bolt.

7.5 ANTI-CORROSIVE PROTECTION ON UNDER GROUND MS PIPE

Corrosion protection tape shall be wrapped on MS pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fibre and minimum 4 mm thick and conform to requirement of IS : 10221-Code of practice for coating and wrapping of underground mild steel pipe line. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15 mm and 250 mm shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated insitu after the pipe line is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre- heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry.Holiday Testing for wrapping and

coating is essential. Holiday testing may preferably be carried by flexible and detachable ring probe, which will enable the entire 360^{o} of the surface of the pipe to be scanned. At least 10 percent of all the welded joints shall be radio graphically tested and half of the joints radio graphed shall be the 'field joints'.

7.6 VALVES

Each pump shall be provided with a non-return valve and a sluice valve on the delivery side, the sluice valve being installed on the upstream side of the non- return valve. A pressure gauge shall also be provided between the pump and the non-return valve. The size of the non-return valve and cut off (sluice) valve shall not be less than the size of the initial delivery pipe and, in no case, less than the delivery outlet of the pump. No butterfly valves shall be installed inside the pump room. Sluice valve shall conform to IS: 780. Butterfly valve, wherever used, shall conform to IS:13095. All valves shall be suitable to with-stand the pressure in the system and rating shall be PN 1.6. All valves shall be right-handed (i.e. handle or key shall be rotated clock wise to close the valve), the direction of opening and closing shall be marked and an open/shunt indicator fitted.

(i) The material of valves shall be as under: Body -

Cast iron

Disc - Cast Bronze or Stainless Steel Seat

- Either integral or Nitrile rubber O-ring

- Nitrite/ Silicon

(ii) Non return valves shall be swing check type in horizontal run and lift check type in vertical run of pipes.

(iii) Air release valves shall be of gunmetal body.

7.7 ISOLATION VALVES :

(i) Isolation valves shall be provided in the network to enable isolation of any section of the network without affecting the flow in the rest. These valves are distributed according to the general layout of the installation. The isolation valves shall be normally located near the loop junctions. Additional valves shall be provided in the segments where the length of the segment exceeds 300 m.

(ii) Cut-off valves shall conform to IS 780 (PN 1.6 rating)/IS 14846, Class 3.

(iii) Butterfly valves can be accepted subject to the condition that the valves of diameter exceeding 150 mm shall necessary be of gear operated.

(iv) All Cut-off valves shall be of the right-hand type and enclosed in properly constructed surface boxes, at least 1 m^2 in area so as to allow for broken joints being easily remade. The top of the surface box shall be 80 mm above ground level, except where it is located on a road. Valve wheels shall have an arrowhead engraved or cast thereon showing direction for turning open and close.

It is recommended that the position of the surface box be indicated by an iron plate painted fire red with distinct lettering. Such plates shall also show the open and close direction as cast or indicated on the valves and the serial number of the sluice valve.

(v) Locations where vehicles can pass shall be avoided for provision of valve below ground. (CPWD Specs Para 7.10 (xii))

(vi) In case of installations in earthquake prone zones, flexible couplings shall be used for jointing purposes at required locations.

7.8 Valves in fixed firefighting installations shall have supervisory switch with its signalling to fire alarm panel or to have chain(s), pad lock(s), label and temper-proof security tag(s) with serial number to prevent tempering/unauthorized operation. These valves shall be kept in their intended 'open' position.

7.9 STRAINERS

Stainless steel strainers shall have minimum 1 mm thick screen with 3 mm perforations. Strainers shall be provided with flanges.

7.10 ORIFICE PLATE

Orifice plate shall be made of 6 mm thick stainless steel and shall have an identification tag projecting beyond any flange between which it is clamped. The orifice shall be plain central hole without burs and diameter not less than one-half of the internal diameter of the pipe to which it is fitted.

7.11 INSTRUMENTS

(i) Pressure gauge of appropriate range and 150 mm diameter size shall be provided.

(ii) The pressure gauge shall be duly calibrated before installation and shall be complete with shut off valve.

7.12 AIR VESSEL

Air vessel shall be provided on top of each riser and shall be fabricated out of 8 mm thick M.S. Sheet. The ends shall be dished. This shall be of 250 mm diameter, 1.2 m high and installed vertically on suitable legs. The legs shall be provided with M.S. Plate of size 75 mm x 75 mm x 5 mm at the bottom so that the legs do not puncture the roof. The legs shall be grouted in CC foundation. Flange connection shall be provided for connection with wet riser pipe. Air release valve and pressure gauge with shut off valv shall be provided. The air vessel shall be tested at 25 kgf/cm^2 pressure before installation.

7.13 INSTALLATION

(i) The installation work shall be carried out in accordance with the detailed drawings prepared by the contractor and approved by the Engineer-in-charge.

(ii) In pipe above ground level, expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.

(iii) Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

(iv) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.

(v) Piping installation shall be supported on or suspended from structure adequately.The contractor shall provide, clamps, hangers etc. in accordance with Para 7.16. Proper lines and levels shall be maintained while installing exposed pipes.

(vi) Pipe supports in pump house shall be floor mounted and of mild steel/ G. I. Spacing of pipe supports shall not be more than that specified below:

Nominal Pipe Size (mm)	Spacing (m)
20 and 25	2.00
32 to 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes.

(vii)Anti-vibration pads, springs or liners of resilient and non-deteriorating material shall be provided at each support, so as to prevent transmission of vibration through the supports.

(viii) Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.

(ix) (a) Vertical risers shall be parallel to walls and column lines and shall be straight and in plumb. Risers passing from floor to floor shall be supported at each floor by clamps as per Para 7.16.

(b) The space in the floor cut outs around the pipe work shall be closed using cement concrete (1:2:4 mix) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the structure.

(c) Riser shall have suitable supports at the lowest point.

(x) Where mild steel pipes shall be buried under ground the same shall be treated in accordance with Para 7.5 before laying. The top of the pipes shall be not less than 1m below the ground level. Where this is not practicable, permission of the Engineer-in-charge shall be obtained for burying the pipes at lesser depth. Masonry or C.C.blocks shall be provided for supporting the pipes at interval in accordance with Para 7.11(vi). After the pipes have been laid, the trench shall be refilled with the excavated soil in layers of 20 cm and rammed and any extra soil shall be removed from the site of work by the contractor.

(xi) Underground pipe shall be laid at least 2m away from the face of the building preferably along the roads and foot paths. As far as possible laying of pipes under road, pavement and large open spaces shall be avoided. Pipes shall not be laid under buildings and where unavoidable, these shall be laid in masonry trenches with removable covers and cut-off valves shall be provided at points of entry and exit.

(xii) Pipe over ground shall be painted in red color as per Para 1.13. Suitable identification shall be provided to indicate the run of underground pipe wherever the route of underground pipe cannot be ascertained from the location of yard hydrant/isolating valves.

(xiii) It shall be made sure that proper noiseless circulation is achieved in the system. If proper circulation is not achieved due to air-bound connections, the contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification, including the tearing up and refinishing of floors, walls, etc. as required.

7.14 FLUSHING ARRANGEMENT

Flushing connections with isolation valves should be provided at suitable locations in the firewater ring main.

7.15 PRESSURE TESTING

(a) All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kgf/sq.cm for a period not less than 24 hours. While Hydro Testing, inclusion of cut-off valves in the mains to be tested can be avoided. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge.

(b) Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

(c) System may be tested in sections and such sections shall be securely capped.

(d) Pressure gauges may be capped off during pressure testing of the installation.

7.16 PIPE SUPPORTS

For installing pipes vertically or horizontally inside the building standard pipe supports of reputed make shall be used. Following supports shall be used.

(i) Split pipe support clamps with rubber lining for vertical, horizontal and roof hanging.

(ii) Clevis Hangers for horizontal supports to adjust varying heights.

(iii) Sprinkler Hangers for horizontal supports for pipes from 15 mm dia to 150 mm dia. Fastners and fully threaded rods shall be used for installing the pipe supports. The sizes of pipe supports and installation shall be in accordance with manufacturer's recommendations. Some of the typical supports are shown in the Figure-9. For pipes of size 100 mm and above, with the prior approval of Engineer-in- Charge, 'U' clamp with dash fastener may be used for supporting horizontal pipe from ceiling.

7.17 MEASUREMENT

Measurements of plumbing work shall be on following basis:-

(a) Piping shall be measured along the centre line of installed pipes including all pipe fittings and accessories but excluding valves and other terms for which quantities are specifically indicated in the schedule of work. No separate payment shall be made for fittings and accessories.

(b) The rates for piping work shall include all wastage allowances, flanges pipe supports, hangers, excavation, refilling, testing, nuts and check nuts, vibration isolators, suspension where specified or required, and any other item required to complete the piping installation. None of these items will be separately measured and paid.

FIREFIGHTING ACCESSORIES

8.1 SCOPE

This chapter covers landing valves, first aid hose reels, hose pipes, branch pipes etc., which are vital tools for firefighting.

8.2 LANDING VALVE

Landing valves are provided in the system for connection of hose pipes for discharging water for fighting fire by fire brigade or trained personnel.

8.2.1 The landing valves shall be as per IS: 5290

8.2.2 Material of construction

(i) Body, outlet and cap etc. : stainless steel

(ii) Spindle : stainless steel

(iii) Hand wheel : stainless steel

8.2.3 The water discharge shall be not less than 900 lpm for single head valves at 7 kgf/cm^2 pressure.

8.2.4 Installation

8.2.4.1 The landing valve shall be fitted to a T-connection of the riser at the landing in such a way that the valve is in the center of the internal hydrant opening and at a height of 900 mm from floor level.

8.2.4.2 The valve base shall be vertical and the valve facing outside. There should be no hindrance in operation of the handle.

8.3 FIRST AID HOSE REEL

First Aid Hose Reel is meant for delivering small quantity of water in early stage of fire and can be operated even by untrained personnel, and thus provides a most effective firefighting facility. It shall consist of 20 mm (nominal internal) diameter hose tubing length wrapped around a reel with water inlet pipe, stop valve and shut-off nozzle. The entire assembly is

mounted on a wall bracket and can swing 180 degrees. The water inlet shall be connected directly to the riser/down-comer mains by means of 37 mm socket and valve. The hose tube can be pulled out easily for the purpose of discharge of water on fire.

8.3.1 First aid hose reel shall be as per IS-884. The coupling, branch pipe and nozzle shall be as per IS:8090.

8.3.2 Material of Construction -

(i)	Hub and sides	: Aluminum Alloy / Mild steel / Aluminum sheets.
(ii)	Wall Bracket	: Mild steel.
(iii)	Hose tube (20 mm) (nominal internal dia)	:Thermoplastic (Textile Reinforced) Type-2 as per IS-12585
(iv)	Nozzle with branch Pipe	: Brass
(v)	Stop Valve(Ball Valve)	: Gun metal

Normally M S construction is used. Other material may be used in areas having corrosive atmosphere.

8.3.3 The water flow rate shall be not less than 24 lpm and the range of jet shall be not less than 6m.

8.3.4 Installation

8.3.4.1 First aid hose reels are installed with internal hydrant (Para 2.4.1.7.) space for which is provided as per Para 3.2.4. Where space is not provided, first aid hose reel shall be installed in suitable size MS cabinet made from 2 mm thick sheet with glass door. The cabinet shall be painted red as per Para 1.13. The size of the cabinet shall be such that there is no obstruction in swinging the hose reel. The location of cabinet shall be such that it does not form an obstruction in passage/escape route.

8.3.4.2 The length of hose tube shall be such that the nozzle of the hose can be taken into every room and within a range of 6 m from any part of the room.

8.3.4.3 There shall be no obstruction in swinging the hose reel and should be installed above landing valve where provided.

8.3.4.4 The inlet valve shall be at 900 mm above floor level.

8.3.4.5 Hose reel bracket should be firmly grouted on the wall with the help of rawl bolts.

8.4 FIRE HOSE DELIVERY COUPLING, BRANCH PIPE AND NOZZLES:-

8.4.1 These are important accessories used for firefighting operations.

8.4.2 Material of Construction

8.4.2.3 Stainless Steel

8.4.3 Delivery Hose Couplings

8.4.3.1 The delivery hose couplings consist of male half coupling and female half coupling. Grooves are provided on outer side on both coupling for binding hose pipes with wires. In female coupling spring loaded cam tooth is provided for holding male half coupling in position. Male half coupling and female half coupling are provided on both sides (i.e. on one side male and on other side female) of hose pipes. Two or more pipes can be joined together with the help of these couplings instantaneously.

8.4.3.2 **Sizes**:- size 63 mm to be used.

8.4.4 **Branch Pipe and Nozzle** :- Branch Pipes with nozzle are mounted at the end of hose pipe. Branch pipe is properly finished and free from sharp edges. During operation, a fireman has to hold the branch pipe. One end of branch pipe is fixed with hose coupling and the other end is threaded to fit the nozzle. Nozzle is tapered pipe with one end threaded internally which is fixed on branch pipe. The size of other end i.e. nozzle shall be 20 mm (nominal internal diameter). Spare Branch pipes and nozzles to the extent of 10 percent of the above requirements, with a minimum of two sets, shall always be kept readily available in fire control room/pump room.

8.5 FIRE SERVICE INLET AND FIRE SERVICE CONNECTION

8.5.1 These are provided for connection of fire service hose pipes for either directly pressurizing the system with their pumps or filling water in the tank from a distance. In the first case non-return valve with butterfly valve shall be provided for holding water pressure. Fire service inlet shall be provided with each wet riser/down comer and the ring main. These shall be as per IS: 904.

8.6 HOSE PIPES

8.6.1 Hose pipes shall be rubber lined woven jacketed and 63 mm in diameter. They shall conform to Type A (Re-inforced rubber lined) of IS: 636. They shall be flexible and capable of being rolled. Length of hose pipe will be 15 m.

8.6.2 The hose pipe shall be complete with male and female coupling at the ends .Besides keeping hose pipe with internal hydrant and yard hydrant, spare hose pipes to the extent of 10 percent of the above requirements, with a minimum quantity of 30 m shall always be kept readily available in fire control room/pump room.Such spare hose shall be in 15 m lengths, readily attached to couplings.

AUTOMATIC SPRINKLER SYSTEM

9.1 SCOPE

This chapter covers the general requirement of selection, design, installation, testing, commissioning and maintenance of automatic sprinkler system for firefighting in buildings used for other than industrial, storage purpose, hotels and mercantile buildings.

9.1.1 References: For additional information regarding definitions, planning, design, hydraulic calculations, tables etc. following documents are to be referred to:

(i) IS: 15105: - Design and Installation and Maintenance of Fixed Automatic Sprinkler Fire Extinguishing Systems- Code of Practice (First Revision).

(ii) IS: 9972: - Specification for Automatic Sprinkler Heads for Fire Protection Service (First Revision).

9.2 INTRODUCTION

In automatic sprinkler system, sprinkler heads are provided throughout the areas to be protected at specified locations such as roof or ceiling, walls, between racks, below obstructions and fitted with water supply lines permanently charged with water under specified pressure. The sprinklers operate at pre-determined temperature to discharge water over the affected area below and provide an adequate distribution of water to control or extinguish fire. Only those sprinklers which are in the vicinity of fire that is those become sufficiently heated operate. Operation of sprinkler results in flow of water which initiates fire alarm. Thus sprinklers perform two functions i.e. first to detect fire and then to provide an adequate distribution of water to control or extinguish it. Water distribution from ceiling level, cools down the hot gas which forms beneath the ceiling of enclosure in which fire is developing. This will prevent spread of fire to adjoining areas and contain damage to limited area. It should not be assumed that the provision of sprinkler system entirely obviates the need for other means of fighting fire and it is important to consider the fire precaution in the premises as a whole. The system shall be installed only where there is no danger of freezing of water in the pipes at any time.

9.4 PLANNING

9.4.1 Automatic sprinklers shall be installed wherever required in terms of Part-4, Vol-1 of NBC 2016 (amended up to date). These requirements for installation of automatic sprinkle system have been reproduced in Automatic Sprinklers shall also be installed in false ceiling voids exceeding 800 mm in height. Ramps at all levels shall also be protected with sprinklers Pressure in the sprinkler installation piping shall not exceed 7 bar and pressure at the most remote sprinkler at any level shall not be less than 0.5 bar and also not more than 5 bar.

9.4.2 Extent of Sprinkler Protection: -

Sprinklers shall be provided, but for following exceptions:

(a) Areas, rooms or places where the water discharged from a sprinkler may pose a fire or explosion or toxic hazard. In such areas alternative arrangement shall be made.

(b) Stairs, spaces below stair headings (but not rooms above a stair) and lift wells. Any part of the building not provided with sprinkler protection shall be fire separated by walls. Fire doors not less than 1 hour in fire resistance shall be provided in the opening of such walls.

(c) Wash rooms, toilets and WCs (but not cloak rooms) of area less than 5m2. If area of these rooms exceed 5m2, these shall be provided with sprinkler protection unless fire separated by walls and all openings in the walls are protected.

(d) Sprinklers shall not be required in electrical equipment rooms where all of the following conditions are met:

i) The room is dedicated to electrical equipment only.

ii) Only dry-type electrical equipment is used.

iii)Equipment is installed in a 120 minutes fire-rated enclosure including protection for penetration in walls.

iv)Cable coating is done in trays or trenches to prevent flame spread.

v) Storage is not permitted in the room.

In addition, for firefighting provisions to be provided for Substation/Transformers, Electrical MV main distribution panel and lift panel *Clause 3.4.6.3 and 3.4.6.4, Page-22-23 of NBC 2016, Vol-1, Part-4 may be referred to.* (*see* Appendix-G)

9.4.3 The area to be protected by sprinkler is divided in to various zones. For detecting operation of sprinkler in a zone, flow switches are provided which are wired to an annunciation panel installed in the Fire Control Room. In the event of operation of sprinkler(s) in an affected area. The annunciation panel will give audio-visual alarm and indicate the affected zone. This arrangement will be independent of fire alarm system.

9.4.4 Design, Density and Assumed Maximum Area of Operation (AMAO):- This is different for different hazards classified in Para 9.3. For moderate hazard, water discharge shall be at least 5 litre/min/m^2 over an assumed area of operation covering 360 m^2.

9.4.5 Sprinkler Spacing, Arrangement, Distribution and Locations:- Sprinkler heads may be installed on ceiling and or side walls. For selection of number of sprinkler and their location in a given area, following factors shall be considered:

(i)	Maximum Area Coverage per Sprinkler	
	(a) Ceiling sprinkler	$12\ m^2$
	(b) Side wall sprinkler :	
	• Combustible ceiling	$7.5\ m^2$
	• Non-Combustible ceiling	$9\ m^2$
(ii)	Maximum Distance between Sprinklers	
	(a) Ceiling sprinkler	3.5 m
	(b) Side wall sprinkler	
	• Combustible ceiling	2.7 m
	• Non-combustible ceiling	3 m
(iii)	Minimum Distance between Sprinklers (for Ceiling as well as Sidewall sprinklers)	1.8 m

Note: In case of intermediate ceiling suspended sprinklers protecting commodities in racks, distance lower than 1.8 m may be considered if necessary.

(iv) Maximum distance of sprinklers it shall not exceed from end walls : half of the allowable (for ceiling & sidewall sprinklers) distance between sprinklers Note: For ceiling sprinklers:

a) where the external walls are combustible or built with metallic or otherwise or open sided; and in case of open joisted ceilings or where the roof has the rafters exposed, the distance between the boundary and the sprinklers shall not exceed 1.5m.

b) Distance shall be measured perpendicular to the wall.

(v) Sprinklers shall not be located at a distance less than 100 mm from the wall (for ceiling sprinklers). Sprinklers shall not be located at a distance less than 100 mm from the end wall (for sidewall sprinklers)

While designing sprinklers installation, the recommendation of sprinkler manufacturer shall be considered. Typical layout of side wall sprinklers has been shown in Figure 14.

9.4.6 Spacing below Sprinkler Heads: - Clear minimum space of 0.5 m shall be maintained below the deflector of sprinkler head.

9.4.7 Ceiling Sprinkler deflector location and orientation in relation to building structure:

***9.4.7.1 Roofs and ceilings*:**

For conventional and spray type of sprinklers, the sprinklers shall be installed in such a way that the deflectors are at distances below ceilings as shown in Table9.1.

Table 9.1 Sprinkler Location Below Ceilings

[Clause 9.4.7.1]

S. No.	Type of ceiling	Distance below ceilings (in mm)		
		Minimum	Maximum	Preferred
(1)	(2)	(3)	(4)	(5)
i)	Combustible, asbestos cement sheets, wired glass and other types of frangible	75	300	150
ii)	Combustible with exposed rafters and/or open joists	75	150	-
iii)	Non combustible - either plane or arched or sloping	75	450	300

9.4.8 Sidewall Sprinkler Deflector Location and Orientation in relation to building structure:

i) Distance between sprinklers and the ceiling shall not exceed 150 mm. If specifically approved for use and listed so, the distances between ceilings and the sprinklers can be increased up to 450 mm.

ii) Vertical side wall sprinkler deflectors shall be located not more than 150 mm or less than 100 mm from the wall from which they are projecting.

iii) Sprinklers shall be so located to minimize obstructions (to discharge) either on parallel or perpendicular sides thereof. If required, additional sprinklers shall be provided to obviate the obstructions.

iv) Sidewall Sprinkler Obstruction: Sprinklers shall be located at least 1.2 m away from any lighting, fan and similar fixtures either in front of or on the same wall where the sprinklers are mounted. For any obstruction (to discharge) including lighting, fan and the like beyond 1.2 m, distances A and B (as indicated in Fig. 9.2 and 9.3) shall be maintained as per the Tables 9.2 and 9.3 given below. In case these distances can not be maintained, the sprinkler shall not be allowed at such location. (See Fig. 9.2 and 9.3).

v) Clearance between the top of storage if any to the deflector shall not be less than 450 mm.

vi) Side wall sprinklers in rooms shall neither be installed above the grills of air conditioner nor within 450 mm thereof on the same wall.

Table 9.2 Sidewall Sprinkler Location in Relation to Obstructions
(lighting, fan and similar fixtures) **-Facing across the wall** (*see* Fig. 9.2)(*Clause* 9.4.8 iv)

S. No.	Distance (A) between Sprinklers and the Obstruction on Side (mm)	Maximum allowable Distance (B) between Deflector above bottom of Obstruction when Sprinkler can be allowed (mm)
(1)	(2)	(3)
a)	Up to 1200	Not allowed
b)	More than 1200 but less than 1500	25
c)	More than 1500 but less than 1650	50
d)	More than 1650 but less than 1800	80
e)	More than 1800 but less than 1950	100
f)	More than 1950 but less than 2100	150
g)	More than 2100 but less than 2250	180
h)	More than 2250 but less than 2400	230
i)	More than 2400 but less than 2550	280
j)	More than 2550	350

Table 9.3 Sidewall Sprinkler Location in Relation to Obstructions (lighting, fan and similar fixtures)-**Along the same wall** (*see* Fig. 9.3) (*Clause* 9.4.8 iv)

S. No.	**Distance (A) Between Sprinklers and the Obstruction on Side (mm)**	**Maximum allowable Distance (B) between Deflector above bottom of Obstruction when Sprinkler can be allowed (mm)**
(1)	(2)	(3)
a)	100 to 150	25
b)	More than 150 but less than 300	50
c)	More than 300 but less than 450	80
d)	More than 450 but less than 600	115
e)	More than 600 but less than 750	150
f)	More than 750 but less than 900	180
g)	More than 900 but less than 1050	200
h)	More than 1050 but less than 1200	230
i)	More than 1200 but less than 1350	250
j)	More than 1350 but less than 1500	300
k)	More than 1500 but less than 1650	330
l)	More than 1650 but less than 1800	350
m)	More than 1800 but less than 1950	380
n)	More than 1950 but less than 2100	430
o)	More than 2100 but less than 2250	450

vii) Horizontal sidewall sprinkler shall be located not more than 100 mm and are allowed to be located with their deflectors less than 100 mm from the wall on which they are mounted.

viii) Deflectors of the sprinklers shall be aligned parallel to the ceilings or roofs.

ix) When installed under a sloped ceiling (1 in 6), sidewall sprinklers shall be located at the high point of slope and positioned so as to discharge down the slope.

x) Where verticle side of a beam/projection from a wall is used for installing a sidewall sprinkler, additional sprinklers shall be installed below the soffit if the width of beam or projection from the wall exceeds 200 mm.

xi) When soffits used are within 200 mm in width or projection from the wall, additional sprinklers shall not be required subject to the deflector of the sprinklers falling within prescribed distance as contained in 9.4.8 (ii), (vi) & (vii) above.

9.4.9 Concealed Spaces:-

9.4.9.1 If the height of the concealed space at roof and floor is not greater than 0.8m, the spaces shall be sprinkler protected only if they contain combustible materials or are constructed with combustible materials. Electrical cables with voltage less than 250 V, single phase, with a maximum of 15 cables per tray, are allowed.

9.4.9.2 Spaces between roofs and ceiling more than 0.8 m deep shall be sprinkler protected as follows:-

(i) Concealed spaces less than $5m^2$ in area shall not require sprinkler protection.

(ii) Sprinkler heads shall be provided considering the space as any other area in the building.

(iii) Sprinkler heads may be connected individually with the range/distribution pipes below, which shall be sized by taking the room and concealed space sprinklers cumulatively.

(iv) Sprinkler heads for concealed space and for the room may be connected with separate range/distribution pipes connected, with common feed pipe. The common feed pipes shall be not less than 65 mm diameter.

9.4.10 Obstruction below Sprinklers:- Sprinklers shall be fitted under the following types of obstruction which are either:

(a) more than 0.8 m wide and less than 150 mm from the adjacent walls or partitions

(b) more than 1 m wide.

9.4.11 Pipe Sizing and Design: - Sprinkler heads located as per Para 9.4.5 to 9.4.10 shall be connected with pipe lines permanently charged with water. Depending upon location of sprinkler heads and site conditions, sprinkler heads may be connected with range and distribution pipes. A number Of The pipes connecting the sprinkler heads are to be sized depending upon number of sprinkler heads and arrangement of their connection. Main elements of a sprinkler installation are shown in Various pipes connecting the sprinkler headsare termed as below:

(a) Range Pipe

(b) Distribution Pipe

(c) Main Distribution Pipe

(d) Riser

Sizes of pipes are to be calculated from various tables and hydraulic calculations given in IS: 15105. Pipe sizes shall be determined using one of the following methods:

a) **Pre-calculated system:** applicable only where light and ordinary occupancies where the aggregate floor plate area (in one or more floors combined) is 5000 m2 or less (except where gridded or looped layouts are used). Pre-calculated pipework is applicable only to the extensions of old pre- calculated systems.

b) **Fully calculated system**: applicable for

i) Light and ordinary occupancies where the aggregate floor plate area (in one or more floors combined) exceeds 5000 m^2.

ii) High hazard occupancies,

iii) Storage occupancies, and

iv) All occupancies where conventional and special sprinklers are used like ESFR, LD, EC, intermediate, etc.

Some guidelines relating to pre-calculated system are given below:

a) Pipe less than 25 mm diameter is not to be used.

b) There shall not be more than 6(Six) sprinklers in any range.

c) Range and distribution pipe nominal sizes shall be selected from Table 9.4 and Table 9.5 respectively.

TABLE 9.4

RANGE PIPE NOMINAL SIZES FOR VARIOUS PIPE LAYOUTS IN MODERATE/ORDINARY HAZARD INSTALLATIONS

	Range Pipe Layout	Pipe Nominal Bore (mm)	Maximum Number of Sprinklers to be fed by Pipe of size listed
	(1)	(2)	(3)
(a)	(1) Range(s) at remote end of each distribution pipe spur in end feed layout:		
	(i) Last two ranges in two end-side layout	25	1
		32	2
	(ii) Last three ranges in three end-side layout	25	2
		32	3
	Last range in all other layouts.	25	2
		32	3
		40	4
	All other ranges in case of 1(i), 1(ii) & (2) above	25	3

TABLE 9.5

DISTRIBUTION PIPE NOMINAL SIZE IN MODERATE/ORDINARY HAZARD INSTALLATIONS AND MAXIMUM NUMBER OF SPRINKLERS

Distribution Pipes	Type of Layout	Distribution Pipe Nominal (mm)	Maximum Number of Sprinklers to be fed by Pipe size listed
(1)	(2)	(3)	(4)
(a) At extremities of the installation	Two end side layouts	32	2
		40	4
		50	8
		65	16
(b) Last three ranges	All other layouts	32	3
		40	6
		50	9
		65	18
(c) Between design points and the Installation	All	To be calculated as per **10.4.4** (b) of IS 15105	

Typical pipe sizes for sprinkler installation have been shown in Figure-13.

9.4.12 Components of sprinkler system:- Following types of valves are used in the installations:

(a) Stop Valves

(b) Test Valves

(c) Drain Valves

(d) Flushing Valves

(e) Check Valves

(f) Installation Control Valves

(g) Pre action valves

(h) Subsidiary valves

The location of above valves shall be as under:

9.4.12.1 **Test Valve**. - For testing hydraulic alarm or electric alarm by drawing water from downstream side, test valve shall be connected with downstream of the water flow alarm.

9.4.12.2 **Drain Valve:** - For drainage of system, drain valve 50 mm diameter shall be provided down stream of Installation Control Valve or any subsidiary stop valve.

A common valve can perform the functions of test and drain. The outlet shall be connected with a 50 mm diameter G.I. drain pipe along with riser pipes as shown in figure No. 3 and 4.

9.4.12.3 **Flushing Valve:-** If the water used for sprinkler is not potable, flushing valves shall be provided at the end of a distribution pipe. The valve size shall be same as distribution pipe. Valve outlet shall be fitted with a brass plug and extended to not more than 3 m above floor.

9.4.12.4 **Check Valve:-** Check valve shall be provided where more than one water supply is available and same shall be fitted on each water supply pipe.

9.4.12.5 **Subsidiary Stop Valve:-** Subsidiary stop valve which shall be of the same diameter as the pipe line in which they are fitted shall be provided to control water supply to sprinklers of highly sensitive areas like computer rooms.

9.4.12.6 Installation Control Valve (ICV)**: -** A sprinkler installation shall be fitted with a suitable Installation Control Valve to control the water supply to the installation. The valve set shall comprise of:

(a) a main stop valve.

(b) an alarm valve.

(c) a water motor alarm.

The alarm valve shall be fitted immediately downstream of the main stop valve of each building/block and before any connection is taken off to supply any part of the installation. The Installation Control Valve shall be placed externally in the vicinity of the main entrance of the building protected at an easily accessible place so that the alarm bell sound is heard by the inhabitants/passer-by. The valve shall be secured open by a pad locked or rivetted strap and protected against impact damage. If there are genuine constraints in locating the Installation Control Valveoutside the buildings, this may be located inside the building in the vicinity of main entrance (subject to approval of authorities concerned). Installation Control Valve in such cases, shall be located away from any exposure to damage and personnel shall be normally available in the vicinity of the location to get alerted by alarm operation. Also, electrically operated sirens interfaced with the opening of the alarm valve of ICV, shall be provided outside the building. In no case, Installation Control Valve shall be provided inside basement or inside pump room.

A plan of the risk with the position of Installation Control Valve shall be placed in a conspicuous location. A location plate shall be fixed near the Installation Control Valve bearing the following words in raised letters:

SPRINKLER

ALARM

VALVE

9.4.12.7 **Water motor alarm**: Water motor alarm shall be provided very close to the alarm valve. Strainer shall be fitted between the alarm valve and the motor nozzle connection. The water outlet shall be positioned so that any flow of water can be seen. The alarm device shall provide audibility level of 85 dB above the back ground noise Ievel

9.4.12.8 **Pressure Gauges: -** Pressure gauges shall be provided immediately above and below each alarm valve.

Stop cock shall be provided before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS: 3624.

9.5 SPRINKLERS TYPE

Sprinklers shall be as per IS: 9972 and following types:

9.5.1 According to type of discharge *(Refer Figure - 15):*

a) Conventional pattern

b) Spray pattern

c) Side wall pattern

9.5.2 According to mounting pattern:

a) Pendent sprinkler

b) Up right sprinkler

c) Horizontal sprinkler

d) Ceiling sprinkler

9.5.3 According to Release Mechanism:

a) Fusible element sprinkler

b) Glass bulb sprinkler

9.5.4 According to Orifice Size:

a) 10mm

b) 15 mm

c) 20mm

d) 25 mm

9.5.5 According to Temperature Rating:

Sprinkler shall have one of the following temperature rating and shall be correspondingly color coded:

(a) Fusible Link Type

Temp. Rating °C	Color Code
68/74	Natural
93/100	White
141	Blue
182	Yellow
227	Red

(b) Glass Bulb Type

Temp. Rating	Color of bulb Liquid
57	Orange
68	Red
79	Yellow
93	Green
141	Blue
182	Mauve
204/260	Black

9.6 SELECTION OF TEMPERATURE RATING

Temperature rating of a sprinkler should not be less than 30° C more than the highest anticipated temperature of the location of installation. Under glazed roofs or where there are roof sheets of PVC or similar plastic material, sprinkler shall be rated 73° C to 100°

C.

9.7 SELECTION OF ORIFICE SIZE

In moderate hazard applications, sprinklers of orifice size 15 mm shall be used.

Table-9.6 Types of sprinkler			
S. No.	**HAZARD CLASS**	**SPRINKLE R**	**NOMINAL ORIFICE NOT LESS THAN MM**
(1)	(2)	(3)	(4)
i)	Light	Standard, Spray, Flush, Sidewall types	10-15
ii)	Ordinary	All except sidewall types	15
iii)	High	Standard, spray pattern only	15-25
iv)	Storage	Standard, spray pattern only	15-25

9.8 SIZE OF INSTALLATIONS

The protected floor area to be controlled by any one Installation Control Valve shall not exceed 12000 m^2. As far as possible one area shall be controlled by one Installation Control Valve. If the area is quite large, more than one Installation Control Valve should be planned. Details of area controlled by an Installation Control valve shall be exhibited near it. If there are more than one block in a campus, each block shall be provided with different Installation Control valve.

9.9 PROTECTION OF SPRINKLERS

Any sprinkler installed in a position of risk or accidental damage shall be fitted with a metal guard suitable for sprinkler service.

9.10 WATER SUPPLY ARRANGEMENT FOR SPRINKLER

9.10.1 Pump- Details of pumps to be installed for sprinkler installation are given in Appendix-A. For large installations, separate jockey pump shall be provided for sprinkler system. All pumps shall have common discharge header. If two electrical pumps are to be provided one non-return valve shall be provided in the header such that sprinkler pump will not feed other system.

9.10.2 Water Storage Tank- The water storage tank shall be combined for other firefighting system and sprinkler installation and the capacity shall be as given in Appendix 'A'.

9.11 SPRINKLER ANNUNCIATION PANEL AND ALARM

Electrically operated alarm shall be provided for indication of operation of sprinkler in an area. Water flow switches shall be installed in main distribution pipes which shall be wired to sprinkler annunciation panel. In the event of operation of a sprinkler, the flow switch will operate and give signal to the annunciation panel to indicate operation of sprinkler in the area. This will initiate an electrically operated alarm. The system shall be independent of fire alarm system and compatible with BMS. Necessary potential free contacts for use in BMS should be provided.

9.11.1 Construction Details

(i) The Panel shall be fabricated out of not less than 2 mm thick MS sheet and powder coated after 7 tank treatment process and shall be totally enclosed dust damp and vermin proof. Suitable knockout shall be provided for the entry of cables. The panel shall be designed such that the equipment for power supply, battery charging are housed in independent compartments. Sealed maintenance free batteries shall also be accommodated inside the panel.

(ii) Indicating lamps control switches, buttons and fuses shall be suitably located in the front and properly labeled.

(iii) The indicating lamps shall be LED type of following colors. The flow switch operation conditions shall be indicated by twin lamps.

- (a) Red to indicate flow switch operation.
- (b) Amber to indicate fault condition.
- (c) Green to indicate healthy condition.

(iv) The test buttons to test the indication lamps shall be provided.

(v) The panel control shall be microprocessor type.

(vi) The primary function of the panel shall be to respond automatically to the operation of one or more flow switches to give alarm and to indicate area/areas where the device has activated. The operation of one or more flow switches shall result in simultaneous alarm given by the following:-

- (a) External alarm hooter(s) (provided outside the building to be protected).
- (b) A visible indication on panel.

(c) Audible alarm on panel itself (common for all zones)

(vii) The panel shall indicate the fault within the system and immediate fault warning shall be given by an audible and visible signal on the panel in case of open circuit, short circuit and earth fault in cable between flow switch and annunciation panel.

(viii) The panel shall be complete with mimic diagram for the areas covered by different flow switches. The layout of mimic diagram shall be got approved from Engineer- in-Charge.

(ix) Battery backup with trickle cum boost charger shall be provided for operation of the system. Indication of mains failure and the state of charge of the batteries shall be provided. The batteries shall be sealed maintenance free. The capacity of the battery shall be 12 Volt, 2 Nos. 24 Ah each. All standard accessories shall be provided.

9.12 INSTALLATION

The installation shall be carried out as per Chapter 7 and 11. Following additional points are to be taken care for sprinkler installations:

9.12.1 For fixing sprinkler heads, 15 mm diameter M.S. Socket is to be welded to range pipes at the locations as per drawings. Dead plug shall be fixed in the socket.

9.12.2 If sprinkler head is to be provided away from range pipe, M.S. Pipe nipple of suitable size be used to extend the sprinkler head and socket is welded at desired location.

9.12.3 After completion of work in sections, pressure testing at 7.5 kgf/cm^2 pressure shall be carried out for 24 hrs.

9.12.4 After completion of the entire work, pressure testing of entire pipe work shall be carried out for 24 hrs. at a pressure of 7.5 kgf/cm^2. The drop of pressure up to 0.5 kgf/cm^2 shall be accepted.

9.12.5 The lines shall be flushed before completion of building work so that any foreign matter which might have entered the system is taken out. The pressurization pump (Jockey Pump) be operated and valves opened at different locations.

9.12.6 During occupation of the building, sprinkler heads shall be provided in place of dead plugs. Teflon tape shall be used on threaded portion. The sprinkler heads shall be properly tightened in the socket.

9.12.7 When all sprinklers heads are installed, pressure is built up in the system by pressurization pump slowly and in case no leak is found, desired pressure is developed and maintained. In case any leak is detected, the same shall be attended before pressurizing the system further.

9.13 COMMISSIONING

As soon as the work is complete, the system shall be commissioned and made available for use in accordance with Para 11.6.

9.14 Spare Sprinklers to be Kept in Stock :

A stock of spare sprinklers shall be maintained in the premises so that prompt replacement is possible after the operation/damage of sprinkler heads. The spares shall be kept in an easily accessible location under conditions where the temperature does not exceed 38°C. The guidelines as in Table 9.7 shall be followed in respect of stocking spare sprinkler heads. Spanners or wrenches for the sprinklers shall also be kept along with the spare sprinklers in readiness.

Table 9.7

Guidelines for stocking spare sprinkler			
S. No.	HAZARD CLASS	All state capitals and within 200Km thereof	Other locations
(1)	(2)	(3)	(4)
i)	Light	5 sprinklers of each type	15
ii)	Moderate/Ordinary	15 sprinklers of each type	25
iii)	High & storage	30 sprinklers of each type	50
Note- When there is more than one installation within a complex, the above quantity shall also be increased in proportion. Each type of sprinkler used in the installation such as conventional or spray or ceiling/flush or sidewall sprinklers and appropriate temperatures shall be stocked as per the above requirements.			

ELECTRICAL WORK

10.1 SCOPE

This chapter covers the requirements for the electrical worms associated with firefighting installations, namely, motors, switch boards, power cabling, control wiring, earthing and remote control-cum-indicating panels.

10.2 GENERAL

(i) Unless otherwise specified in the tender specifications, all equipment and materials for electrical works shall be suitable for operations on 415 V / 240 V + 10% (3 phase/single phase), 50 Hz AC system.

(ii) All electrical works shall be carried out complying Central Electricity Authority (Measures Relating To Safety and Electric Supply) Regulations, 2010 and NEC 2011, as amended up to date.

(iii) All parts of electrical works shall be carried out as per appropriate CPWD General Specifications for Electrical works, namely, Part I (Internal) 2013, Part II (External) 1994 work, and Part IV (Sub-station)- 2013 all as amended up to date.

(iv) All materials and components used shall conform to the relevant IS specifications amended to date.

10.3 POWER SUPPLY

Power supply to following systems and equipment, where provided, shall be from normal and emergency (standby generator) power sources with change over facility:

a) Fire pumps
b) Pressurization and smoke venting; including its ancillary systems such as dampers and actuators.
c) Terrace pump
d) Fireman's lifts (including all lifts).
e) Exit signage lighting.
f) Emergency lighting.
g) Fire alarm system.
h) Public address (PA) system (relating to emergency voice evacuation and annunciation).
i) Magnetic door hold open devices.
j) Lighting in fire command center and security room.

The generator shall be capable of taking starting current of all the fire and life safety systems and equipment as above. Where parallel HV/LV supply from separate substation fed from different grid is provided with appropriate transformer for emergency, the provision of generator may be waived in consultation with the Authority.

The electric supply to the pumping set(s) shall be entirely independent of all other equipment in the premises that is even when the power throughout the entire premises is switched off, the supply to the pump shall continue to be available un-interrupted. This can be achieved by taking the connection for the pump(s) from the incoming side of the main L.T. breaker. In case, where parallel HV/LV supply from a separate substation fed from different grid is provided with appropriate transformer for emergency connected to a common bus bar, the connection may be taken through the bus bars.

The power supply to the panel/distribution board of these fire and life safety systems shall be through fire proof enclosures or circuit integrity cables or through alternate route in the adjoining fire compartment to ensure supply of power is reliable to these systems and equipment. It shall be ensured that the cabling from the adjoining fire compartment is protected within the compartment of vulnerability. The location of the panel/distribution board feeding the fire and life safety system shall be in fire safe zone ensuring supply of power to these systems.

Circuits of such emergency system shall be protected at origin by an automatic circuit breaker so set as to permit the motor to be overloaded during an emergency to the maximum limit permissible by the manufacturer. Further, the no volt coil/the under voltage release of that circuit breaker shall be removed. Master switches controlling essential service circuits shall be clearly labeled.

10.3.1 Independent supply shall be provided for water supply pumps if installed in the same pump house.

10.3.2 If the fire pump house is away from the sub-station building, the route of the cable shall not pass under the building or permanent structure. Cable shall be laid along the route which is safe from fire.

10.3.3 Sufficient spare power shall always be available to drive pumping sets at all times throughout the year. Suitable capacity ACBs/SDFUs shall be provided in the electrical panel for extending supplies to fire pumps. Such switches shall be suitably marked "FIRE SWITCH" and shall not be switched-off without permission/intimation to appropriate authority. Incase any maintenance/repair work is to be carried out on the electrical panel where from supplies to fire pumps have been extended, alternative arrangement shall be made to ensure that power supply to fire pumps continue to be available for operation any time.

10.4 MOTORS

The motors shall be squirrel cage AC induction type. The motors shall be suitable for continuous duty and rating necessary to drive the pump at 150 percent of its rated discharge with at least 65 percent rated head. The motor shall be totally enclosed fan cooled type confirming to protection clause IP21 of IS: 4691. The class of insulation shall be 'F'. The synchronous speed shall be 1500/3000 rpm as per requirement of the pump. The motor shall conform to IS:325.

10.5 MOTOR STARTER

(i) The motor starter shall conform to IS: 1822 "Motor starters of voltage not exceeding 1000 volts" and shall be air insulated and suitable for 415 V, ±10%, 50 Hz, 3 phase AC supply and shall be integrated in the panel.

(ii) Starter for the motor shall be direct on line (D.O.L) for motors up to and including 7.5 H.P. rating and automatic star-delta type for motors of higher ratings unless otherwise specified in the tender specifications. However, for main Fire Pump & Sprinkler Pump Soft Starters may be used.

(iii) Each starter shall be provided with the following protections: -

(a) Thermal overload on all the three phases with adjustable settings,

(b) Independent single phase preventer. (Current sensing type).

(iv) Adequate number of extra NO/NC contacts for interlocks, indicating lamps,remote operation etc. shall be provided on the starter/ contactor.

(v) Under voltage/No volt trip shall not be provided.

10.6 SWITCH BOARDS

(i) The main switch board shall be floor mounted, free standing or wall mounted cubical type and shall be factory built fabricated by one of the approved switch board manufacturer. The board shall be fabricated from 2.0 mm thick CRCA sheet and powder coated after 7 tank treatment process. The board shall be fabricated with IP 42 degree of protection. It shall be suitable for termination of the incoming cable(s) from bottom.

(ii) The capacity of switch gear shall be suitable for the requirements of motor fed/ controlled. Starting currents shall be duly considered.

(iii) Switch fuse units shall be used up to and including 32 A and SDFU shall be used for 63 A and above. ACB shall be used for 630 A and above ratings.

(iv) All Switch fuse units/SDFUs shall be of AC 23 duty as per IS: 4064-1978 as amended up to date. They shall be complete with suitable HRC cartridge type fuses.

(v) Switch boards shall house starters for motors with independent current sensing type single phase preventor for each starter.

(vi) Volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided. Ammeter with CTs, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a class index not higher than 1.0. The instruments and accessories shall be provided whether or not specifically indicated in the tender specifications.

(vii) The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer-in-charge.

(viii) Switchboards shall be fabricated as per specifications indicated in sub-para above.

(ix) The layout shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit.

(x) Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.

(xi) Where terminations are done on the bus bars by drilling holes therein, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping.

(xii) Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switchboard.

(xiii) Identification labels shall be provided against each switchgear and starter compartment, using plastic/aluminum engraved labels.

(xiv) Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.

10.7 SYSTEM CONTROLLER

For controlling operation of pumps as per Para 2.4.1.14 and indicating fault, system controller shall be provided. The system controller shall consist of relays, timer, contactors etc. and shall be designed to operate the fire pumps with interlocking and fault indication as described in Para 2.4.1.15. Annunciation window shall be provided to indicate following faults:

(i) Low water level in UG tank

(ii) Low water level in terrace tank.

(iii) Main pump failed to start.

(iv) Main pump failed during operation.

(v) Diesel pump failed to start.

(vi) Diesel pump failed during operation

(vii) Supply to Main Pump failed

(viii) Supply to Pressurization Pump failed

(ix) Supply to Terrace Pump failed.

Suitable sensors, differential pressure switches, monitors shall be provided at respective locations. The control system shall be operational on 12 Volt/24 Volt DC starting batteries of engine. Battery chargers shall be provided to ensure that the batteries remain charged. Batteries shall be sealed maintenance free type.

10.8 REMOTE INDICATING PANEL

(i) The remote indicating panel shall be provided in the fire control room. This panel shall have necessary status indication of all electric motors.

(ii) Back indication to show the status of operation of all the motors, pressure in the system, water level in underground and overhead tank etc. shall be provided.

(iii) Panel shall be fabricated from not less than 1.6 mm thick CRCA sheet and powder coated after 7 tank treatment process. The panel shall be dust, damp and vermin proof. This shall be of wall mounting type. This shall be complete with necessary termination arrangements, multicore cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

10.9 POWER CABLING

(i) Unless otherwise specified, the power cables shall be XLPE insulated, PVC outer sheathed aluminum conductor, armoured cables 1100 V grade. The power cables shall be of 2 core for single phase, 4 core for sizes up to and including 25 sq.mm for 3 phase and 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Alternatively, XLPE/PVC insulated copper cable (single core/multicore armoured/un-armoured) of grade 1100 V shall be used. **For main power cable(s)** from LT Room to Fire Pumps Panel, if the cable(s) is taken in cable trench duly filled with sand & with proper distancing from other cables within the cable trench, or in fire rated shaft, then the cable(s) of above type be used. However, if the cable(s) is likely to be exposed to fire, then fire survival cable(s) shall be used.

(ii) Power cables shall be of sizes to meet the starting and running current of motors fed and shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling.

(iii) Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls. Cable ducts shall not be provided in pump rooms. Cable trays shall be of perforated steel sheet with adequate structural strength and rigidity. Necessary supports and suspenders for cable trays shall be provided by the contractor as required.

10.10 CONTROL WIRING

(i) Control wiring shall be done using ISI marked PVC insulated and PVC sheathed, 2.5 sq.mm, 250 V grade, armoured multi-core copper conductor cable. The control cable shall also be laid in the same manner as power cable.

(ii) The number and size of the control cables shall be such as to suit the control system design adopted by the contractor.

(iii) Runs of control wires within the-switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.

(iv) Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

10.11 EARTHING

(i) Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.

(ii) The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 2013.

(iii) Metallic body of all motors, medium voltage equipment and switch boards shall be connected by two separate and distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment, or switch board to another.

(iv) The size of earth conductors for body earthing of equipment shall be 2 Nos. 6 mm dia copper wire/2 Nos. 25 x 3 mm G.I. strip

(v) Armoring of cables shall be connected to the body of the equipment/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC/XLPE cables.

10.12 PAINTING

All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work.

INSTALLATION, TESTING AND COMMISSIONING

11.1 SCOPE

This chapter covers the requirement of Installation, testing and commissioning of firefighting system.

11.2 PREPARATION AND APPROVAL OF DRAWING

On award of the work, the contractor has to prepare working drawings as per Para 1.17.2 and submit to the Engineer-in-charge for approval. The work is to be executed as per approved drawings. The stage of approval of drawings is therefore very important. All drawings should be carefully and critically examined before approval. The requirements of various components of firefighting system have been described in previous chapters dealing with the components. However, generally following points are to be taken care while examining and approving the drawings.

11.2.1 Site survey should be carried out in detail.

11.2.2 In addition to building plans, layout plan along with landscape plan/horticulture plan and other services plans should be consulted while deciding route of underground pipes from pump house and around the building.

11.2.3 As far as possible, underground pipe are not to be laid under road, pavement, building and long open spaces. The locations along road, foot path in earth may be preferred.

11.2.4 The location of yard hydrants, fire service inlet and fire service connection are to be decided based on consideration of Para 2.4.1.8 to Para 2.4.1.10. However necessary adjustments are to be made so that these components do not become hindrance in vehicular movement and entrance to the building. Requirement of other building services are also to be given due consideration. Symmetry should be maintained for aesthetic considerations.

11.2.5 Pipe sizes are to be decided in accordance with provision of Para 2.4.1.2 and 4.5.4.

11.2.6 **Pump House**:-The layout of equipment in pump house is very important from operation and maintenance considerations. The requirement of pumps and engine have been described in Chapter 5 and 6. In case other equipment i.e.water supply pumps etc. are to be installed in the same pump house, sufficient space shall be left for them as well. The dimensioned foundation drawing of pumps should be available for marking in the pump room layout. The layout is to be prepared in such a way that it should be possible to maintain any equipment without disturbing the adjoining equipment. Electrical panels are to be installed at a location which is easily accessible near the entrance to the pump house and there should be no possibility of water dripping over or near the electrical panel. Typical layout of fire pump house is shown in Figure -10.

11.2.7 **Terrace Pumps:-** The location of pumps and terrace pipe may be decided keeping in view location of terrace tanks for firefighting and other services. The pipe line should not cause undue hindrance for movement of maintenance personnel at the terrace.

11.2.8 **Electrical Panel** :- Complete wiring drawing, layout etc. are to be examined to ensure that provisions of agreement are incorporated in the drawing. Sizes of various panel and mounting arrangement may be decided keeping in view ease of operation and aesthetic consideration as well.

11.3 INSTALLATION:-

The requirements of installation of various components have been described in previous chapters. However, following precautions are to be taken during execution of the work.

11.3.1 The pump and motor/engine are to be perfectly aligned on the base plate so that there is no vibration during operation. All nuts, bolts, washers shall be of adequate size and galvanized.

11.3.2 The pipe supports should be decided in a way that the weight of pipes and valves are not transferred to the pumps and supports do not cause hindrance in movement inside the pump house. As far as possible, floor supports may be provided in pump house.

11.3.3 All valves shall be installed at a height and in a position that their operation by right hand is conveniently possible.

11.3.4 All pressure gauges should be installed so that the dial is vertical and is visible while entering the pump house.

11.3.5 Electrical panels should not be installed at floor level. The panels shall be sufficiently raised above ground level. If panels are to be mounted on wall, an angle iron frame shall be provided so that at least 75 mm space is leftbehind the panels. The panels shall be easily approachable.

11.3.6 Cable trays are to be used for laying of power and control cable inside pump house. No cable is to be laid at floor level/in trench. Cable tray layout should give neat appearance. All cable tray shall be adequately supported from the ceiling/floor.

11.3.7 Drain pump shall be installed in the sump provided as per Para 3.2.2 (viii).The pump shall operate automatically for which water level sensor shall be provided.

11.3.8 In no case any structural member i.e. RCC wall, column, beam and floor are to be damaged during installation. Mechanical fasteners are to be used for grouting support. U.G. tank wall is not to be used for any support. No pipe/cable is to cross the pump house below ground level. Openings above ground level are only to be used for this purpose.

11.3.9 The engine installation work shall be carried out in accordance with the requirement of engine manufacturer and be got approved by the manufacturer or their authorized service center. The exhaust pipe should be suitably extended outside the pump house so that smoke does not effect nearby structure. Fuel tank shall be properly supported and located in a way that the same does not cause hindrance in movement in the pump house.

11.3.10 While excavating for laying of external pipes, suitable sign board/ barricading shall be provided to ensure that no person falls in the trench.

11.3.11 The width and depth of trench shall be adequate for laying the pipe 1m below ground level.

11.3.12 No earth or any other matter is to be allowed to enter the pipes. The ends shall be kept closed always.

11.3.13 The anticorrosive treatment is to be applied on the entire length laid underground in accordance with Para 7.5. The treatment is not to be damaged.

11.3.14 Pressure testing is to be carried out in sections before filling the earth back in the trench.

11.3.15 The earth filling is to be done in layers of 20 cm each and properly rammed so as to avoid possibility of settlement. Surplus earth/malba shall be removed from the site by the contractor.

11.3.16 Where pipes crossing road likely to have heavy traffic, additional protection over pipe shall be provided to ensure that pipe is not damaged. However, semi-circular RCC Pipes shall be provided over cast iron pipes at road crossings.

11.3.17 External hydrants and fire service connection/ inlet shall be located parallel to the nearby road/ foot path so as to give proper appearance. Foundation shall be raised from below ground level and shall be properly plastered in plumb. The hydrants shall be facing the road/ approach. There shall be no obstruction in approaching the hydrants for operation.

11.3.18 Risers shall be parallel to the wall and in plumb. Adequate supports shall be provided from the wall. Opening around the pipe in slab shall be filled with CC and finished with plaster.

11.3.19 Internal hydrant shall be provided in the center and facing outside for ease of operation. Sufficient space shall be provided around the handle for operation. There shall be no hindrance in moving the first aid hose reel.

11.3.20 Terrace pipes shall be supported on CC pedestals of adequate height. The pipe route shall be such as no hindrance is created in movement at the terrace. Pipes shall be sufficiently raised above terrace. It is to be ensured that water proofing is not damaged during laying of pipes.

11.4 TESTING

11.4.1 Initial Testing

11.4.1.1 During laying of pipes, the same shall be subjected to 10 kgf/cm^2 hydraulic pressure for a period of 24 hours, in sections.

11.4.1.2 After completion of the work, all vaIves/ fittings shall be installed in position and entire system shall be tested for 24 hours at a pressure of 10 kgf/ cm^2. The drop of pressure up to 0.5 kgf/cm^2 shall be accepted.

11.4.2 Final Testing

11.4.2.1 After completion, all operation checks as per Para 2.4.1.14 shall be carried out for automatic operation of the systems. For this purpose, landing valves may be opened at different locations. The exercise shall be repeated couple of times to ensure trouble free operation of the system.

11.4.2.2 ***Flow Test***: - The design flow of pumps shall be checked. The pump shall be operated after opening a number of landing valves at different locations. Design pressure is to be maintained in the pump house. Water discharge is to be measured by drop in level in UG tank for a certain period. All pumps shall be tested one by one. The flow rate shall be not less than as specified while maintaining the design pressure in pump house.

11.5 INSPECTION BY LOCAL FIRE OFFICER

After completion of the work and testing to the entire satisfaction of Engineer- in- Charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower during testing. The observations of Chief Fire Officer shall be part of the agreement. These shall be attended by the contractor. Nothing extra shall be paid for testing as above.

11.6 COMMISSIONING

11.6.1 Flushing the System:

Before commissioning, the entire system shall be flushed to ensure that any earth/ foreign matters which might have entered during installation are taken out. For this, pump may be operated and valves opened at different locations.

11.6.2 As soon as the work is complete, the system shall be commissioned and made available for use. Requirement of firefighting installations is equally important during occupation of the building. If the building is to be occupied in part, firefighting system of building completed shall be commissioned by isolating the system of under construction portion of the building.

11.6.3 The firefighting system shall be maintained and manned from the very first day of its commissioning.

11.6.4 Any defects noticed during the warranty period shall be promptly attended by the contractor and availability of the system at all time is to be ensured.

SECTION – 2-FIRE ALAM SYSTEM

MANUAL CALL BOXES

1 Scope

This section covers the requirements of manual call boxes used in fire alarm system.

2 Constructional requirements:

(i) The call box shall be of 1.5mm thick welded sheet steel or 3mm thick cast aluminium. The front face shall have a glass area designed to break by a steady application of pressure or by impact. Suitable arrangement like scratching by a diamond bit shall be incorporated in the frangible element so that when it breaks upon application of pressure by a finger, it does not hurt the finger.

(ii) The frangible element shall keep a push button pressed inside such that in the event of breaking of the frangible element, the push button is released to actuate an alarm in the control panel. The push button shall be partly depressed so as not to hinder breaking of the frangible element.

(iii) The call box shall have suitable knock out for termination of a 20mm conduit. This shall also have suitable provision for being fixed on surface or semi recessed in wall.

(iv) Where sheet steel is used for call box, this shall be thoroughly cleaned off dust, dirt, grease and rust if any and two coats of anti rust primer shall be given both inside and outside followed by two coat of synthetic enamel paint in signal red colour or expoxy or powder coated after seven tank process.

(v) In the case cast aluminium body for a call box, the surface shall be neatly finished with red colour paint as in (iv) above.

(vi) The words 'FIRE' shall be printed on the front of the call box in face of window.

(vii) The glass surface shall be minimum 30 sqcm in area and glass thickness shall not exceed 2 mm.

2.3 Installation requirement:-

(i) Manual call boxes shall be installed at a height of l400mm above the floor level.

(ii) They shall be installed at easily accessible, well illuminated and conspicuous position, preferably in a contrasting background so that they are easily noticed from either direction. They should be semi-recessed so as to project minimum 10mm from wall surface.

(iii) They shall be installed free from obstructions and shall not themselves obstruct exit way.

(iv) It shall be located on escape routes at (inside or outside) each floor to escape stair preferably near entry to staircases at various level.

(v) It shall be located such a way that, no person in the premises needs to travel more than

30 meters to reach a manual call point to give an alarm.

(vi) Where necessary, the travel distance may be reduced to less than 30 meters e.g. where there is difficulty in access or in potentially dangerous risk areas.

2.4 Functional requirement:

Once the glass is broken the alarm shall sound on the floor as well as on control panel.

Automatic Fire Detectors

3.1 Scope:-

This-section covers the requirements of Automatic Fire Detectors of various types used in Automatic Fire Alarm System.

3.2 Choice of Fire Detectors :-

3.2.1 The Fire detectors are designed to detect one or more of following three characteristics of a fire:

(a) Smoke

(b) Heat

Detectors as specified in the boq and drawings to be followed.

CONTROL AND INDICATING PANELS & PA SYSTEM

4.1 SCOPE:

This section covers the requirements of the various Control and indicating panels used in

Fire Alarm System and Public Address System.

4.2 Type of control and indicating panels:

Following are the types of control indicating panels in a FAS/AFAS. These shall be provided as specified in the schedule of work.

(i) Main control and indicating panel (C & I Panel) including Public Address System.

(ii) Sector Panel.

(iii) Zonal Panel.

(iv) Repeater Panel.

4.3 Functional requirements:

4.3.1 General:

The trigger devices shall be connected to the respective zonal panels. Where the zoning design in any work provides of areas as sector and further sub-division as zones, the trigger devices shall be connected to the sector panels, since no zonal panel is required in such a case. The sector/zonal panels shall in turn be connected to the C&I Panel. The C&I panel shall provide necessary audio-visual alarm and actuate the sounders. This shall also initiate signals for any other operation specified in tender specification. Electric power supply to the entire FAS/ AFAS shall be fed through this panel.

4.3.2 C & I Panel including Public Address System

(i) All the sectors/zones connected to this panel shall be continuously monitored.

(ii) Audio-visual alarm shall be provided in this panel to show the ZONE affected by fault in its wiring system or by fire. Such an alarm should be separate for fault and fire conditions. (See also 4.4.2)

(iii) This shall be complete with necessary circuitry for providing power supply to the entire FAS/AFAS drawing power from the mains/standby battery.

(iv) This shall transmit to its repeater panel if any, signal of alarm of fault and of fire.

(v) This shall be so designed that the audio alarm activation and silencing shall be as indicated in Section-5 (Part-A).

(vi) Public Address System shall be provided to enable transmission of announcements and instructions to the occupants in each zone in the event of a fire.

(vii) Fire alarm sounders in the premises shall be designed to function as loud speakers for the purpose. The microphone, necessary amplification equipment and control switches shall be provided as a part of the C&I panel.

(viii) The power rating and frequency response shall be as per the requirement of the individual installation.

4.3.3 Sector/zonal Panel:

(i) A sector panel shall be provided where there is more than one zone in a floor under the control of a C&I panel, and zonal panel is not required in that floor. A zonal panel shall be provided where there is only one zone in that floor.

(ii) The sector/Zonal panel shall provide visual indication of the ZONE where a fault or fire has occurred. (See also 4.4.3) Audio alarm in this panel shall be provided, where specified in tender specifications.

(iii) This panels shall transmit to the C&I panel, alarm signals from any of the trigger devices and the wiring connected to it.

4.3.4 Spot Indicator:

This shall provide only a visual indication whenever any of the detectors connected to it triggers a fire alarm.

4.3.5 Repeater panel:

A repeater panel where provided shall duplicate the alarm indications (audio as well as visual) of the C&I Panel.

4.4 Constructional requirements:

4.4.1 General design & fabrication:

(i) The various control and indicating panels shall be totally enclosed, dust and vermin proof and shall be suitable for the environmental conditions at the site of their installation.

(ii) These shall be fabricated out of sheet steel of 1.6mm thickness and designed for wall or floor mounting. They shall be front openable type with hinged cover and lock.

(iii) The C & I Panel shall be designed such that the equipment for power supply, battery charging and P.A system for FAS/AFAS are housed in independent compartments. Maintenance free batteries shall however not be accommodated inside the panel to avoid problems due to corrosion.

(iv) Suitable knock outs shall be provided for the entry of cables and wiring into the panels.

(v) The panels after fabrication shall be cleaned to remove any dust/dirt/grease/rust and phosphated. After two coats of anti-rust primer, the panels shall be finished with powder coating of fire red colour.

(vi) All components and their wiring shall be arranged so as to be conveniently attended to from the front of the panels.

(vii) All indicating lamps, control switches and buttons and fuses shall be located in the front of the panels. These shall be suitable and unambiguously labeled.

(viii) The indicating lamps should consist of LED confirming to relevant Indian standards, connected in parallel, of following colours:

(a) Red to indicate FIRE condition - Two LED

(b) Amber to indicate FAULT condition - only one LED i.e. for open & short circuit separately.

(c) Green to indicate HEALTHY condition.

(ix) Test buttons to test the indicating lamps shall be provided.

(x) All control and indicating panels can be of either electro-mechanical type or of electronic type.

(xi) Any printed circuit boards (PCBs) used in the panels shall be plug in type. The PCBs shall be suitably protected against atmospheric corrosion.

(xii) If required, the panel should have additional capacity to operate auxiliary equipment like fire dampers, fire closers, ventilation and/or pressurizing fans, smoke exhaust fans etc.

4.4.2 C & I Panels.

(i) Audio-visual indication shall be provided in this panel for the following:

(a) Fire in any zone

(b) Fault in any zone including fault in wiring to the sector/zonal panels and removal of any fire detector/disconnection of leads to detectors.

(c) Fault in this panel itself.

(d) Mains supply failure.

(e) Low battery voltage.

(f) A.C. Fuse blowout.

(g) D.C. fuse blow out.

(ii) Only visual indication shall be provided in this panel for the following:

(a) A.C. Power ON/OFF.

(b) Stand by battery supply ON/OFF.

(c) Battery charger ON/OFF.

(d) Isolation of zone for testing purposes as per (iii) below.

(e) Operation if silencing switch, when there is no alarm condition.

(f) P.A. system ON.

(iii) Facility shall be provided to test the zones individually by simulating fault or fire condition. Each zone shall be capable of isolation for maintenance or test purposes leaving the remaining zones in healthy condition so that fire detection in those zones is not affected. Visual indication of such isolation shall be available on the panel.

(iv) This panel shall also be provided with the following:

(a) Necessary test switches for testing of circuits and C&I panel.

(b) Panel sounder and silencing switch.

(c) Switches to operate the fire alarm sounders zone wise and also collectively at all zones.

(d) Changeover switch to P.A. System.

(e) P.A. System equipment and panel microphone.

(f) Voltmeters with protective fuses for both A.C. and D.C. Supplies.

(g) Battery charger ammeter.

(v) On clearance of a fault or a fire condition, as the case may be the system shall reset automatically.

(vi) Where specified, the following provisions shall be incorporated in the design of the C&I panel:

(a) Provision for automatic connection to Fire Brigade through external public telephone lines.

(b) Provision for operation in conjunction with other Gas based Suppression System.

4.4.3 Sector/Zonal Panel:

(i) This panel shall provide visual indication for the following:

(a) System ON and healthy.

(b) Fault in any zone connected to this panel.

(c) Fire in any zone connected to this panel with double lamp arrangement.

(d) Isolation of a zone for testing purposes from C&I panel.

(ii) Test switch shall be provided to test the lamps on this panel.

(iii) Where audio alarm is specified in tender specifications in any work in this panel, panel sounder and its silencing switch shall be provided.

(iv) The power supply to operate this panel shall be drawn from the C&I panel.

4.4.4 Spot indicator:

(i) The indication given out by these indicators shall be conspicuous under fire conditions.

In case of recessed type, the design shall be such that the indicators are spotted easily.

(ii) The cover of the spot indicators may be screwed type or snap-in-type.

4.4.5 Repeater Panel:

(i) All indications, both visual and audio as shown on the C&I panel shall be indicated in the repeater panel, where provided.

(ii) The power supply to operate the repeater panel shall be drawn from the C&I panel.

4.5 Installation requirements:

4.5.1 Location:

(i) No control and indicating panel shall be located outside the building room in severe environmental conditions, unless precaution against the effects of the same have been taken.

(ii) These panels shall not be provided inside any enclosed space and preferably be located somewhere on the ground floor / in fire control room.

(iii) The C&I panel shall be conspicuously located so as to be visible without effort on entering a building.

(iv) The sector/zonal panel shall be located in a conspicuous location at the entrance to a sector/zone, such as a lift lobby or a staircase lobby. This panel shall be in a common lobby or a corridor, which can be approached without passing through an occupied area.

(v) The repeater panel should be provided near the main entrance so that maintenance staff notices the fault condition or isolation if any for rectification.

4.5.2 Installation of control and indicating panels:

(i) The control and indicating panels shall be installed at the locations decided in conformity with 4.5.1 above and shown in the drawings approved by the department. Mimic diagram shall be installed by the side of the C&I panel so as to be integral part of the same.

(ii) Depending on the size and design of these panels, they may be either wall mounting or floor mounting type. Installation shall be done using necessary foundation bolts etc.

(iii) Any supports required for large panels shall be of sufficient strength so that installation is rigid and sturdy.

(iv) Necessary provisions shall be made for conveniently receiving conduits or cables as the case may be.

(v) The panels shall be so installed that all the indicator lamps are easily visible and the switches in the panels are within easy reach for operation.

(vi) A free working space of at least 1 meter shall be available in front of the panels.

4.5.3 Installation of spot indicators:

(i) Spot indicators shall be installed on wall such that its top is at door level and by the side of the entrance to the respective premises.

(ii) Spot indicators for detectors installed over a false ceiling in a corridor shall be installed directly under the false ceiling.

(iii) Spot indicators for detectors installed under a false floor, shall be installed at a height of 1 meter above false floor level. Additionally, a marking or an arrow pointing downwards shall be made by the side of the spot indicator.

(iv) The installation shall be such that the visual indication from the spot indicators are conspicuous and that the affected area is spotted without difficulty.

4.5.4 Silencing of Fire Alarm:

The alarm should operate until silenced manually. The alarm should not be silenced automatically.

5. SOUNDERS AND SILENCING SWITCHES

5.1 SCOPE

This section covers the requirements of sounders and silencing switches used in fire Alarm

System/Automatic Fire Alarm System.

5.2 Type of Sounders:

Sounders in a FAS/AFAS shall be of the following types:

(i) Panel sounders.

(ii) Fire alarm sounders. These in turn comprise of low intensity and high intensity Sounders. These shall be provided as specified in the schedule of work. The sounders for fire alarm should be electronic hooters/horns/electric bell.

5.3 Functional requirements:

(i) Panel sounder shall be provided in C&I Panels, sector/zonal panel specified and repeater panel if any so as to draw attention of the care taking personnel in a building to a fault in the FAS/AFAS wiring and a fire condition in the protected premises.

(ii) Fire alarm sounder of low intensity type shall be installed to signal to the occupants of the building to evacuate in the event of a fire.

(iii) Fire alarm sounders of high intensity type shall be installed to draw the attention of the fire fighting personnel toward the main entrance of the premises where a fire has erupted.

(iv) Fire alarm sounders shall not be used for any purpose other than for fire operations.

(v) Silencing facility shall be provided, only for panel sounders and not for fire alarm sounders.

5.4 Operation of sounders and silencing:

(i) (a) Panel sounders shall be actuated from the respective panels except in repeater panel, in which this shall be actuated from the C&I Panels.

(b) Fire alarm sounders shall be actuated from the C&I Panel.

(c) The operation of sounders shall be independent of operation of any indication like lamps or flags in the panels.

(ii) The panel sounders in the respective panels shall be actuated automatically as soon as fire alarm signal is initiated from any trigger device connected to them. These shall be sounded when there is a fault alarm signal within their areas of control.

(iii) A silencing switch shall be provided in C&I Panel. Operation of this switch shall mute the audio output from the panel sounder in this panel and in its repeater panel, if any. Silencing switch shall also be provided in repeater panel which when actuated shall mute the audio output in the panel only. Silencing switch shall be provided in sector/zonal panels which may be specified to have audio indication in particular works, to mute the output of the same.

(iv) Fire alarm sounders in a zone affected by a fire shall be actuated automatically as soon as fire alarm signal in initiated from any trigger device in that zone. All other fire alarm sounders shall be actuated only manually from the C&I Panel, individual zone- wise and collectively for the entire installation. (Automatic operation of all the sounders in a building immediately after a fire alarm signal is initiated is likely to create panic). Such a manual operation of Fire alarm sounders be done after operating the silencing switch for the sounder in the C&I Panel, within a preset time.

5.5 Specification requirements:

5.5.1 Sounders:

(i) Hooter shall be provided for both panel sounders and fire alarm sounders.

Bell may be provided as low intensity fire alarm sounders, only where so specified.

(ii) The frequency of sound from sounders shall lie in the 500-1000 Hz band. The sound level shall be at least 65dB(A)or 5 dB (A) above any other noise likely persists for a period longer than 30 second at any part of the building. Sounders with a level greater than 120 DB(A) shall not be provided.

(iii) The sound shall be continuous although the frequencies and amplitude may vary and of the same characteristics from the fire alarm sounders in a building. Coded fire alarm signaling from sounders shall not be provided which may cause hearing damage.

(iv) 'Fault alarm' and 'Fire alarm' in a panel sounder shall be distinctly different.

5.6 Silencing switches:

(i) Silencing switch shall be in the form of a switch or push button.

(ii) This shall be located on the panel whose panel sounder is to be silenced.

(iii) Operation of a silencing switch shall not affect any visual indication nor the output of fire alarm sounders in the building.

(iv) Operation of a silencing switch shall not prevent the receipt of alarm from any sector/zone as the case may be, not already in an alarm condition.

5.7 Installation requirements:

(i) Low intensity fire alarm sounders may be installed on surface of ceiling, suspended from ceiling or recessed in flush with the ceiling, depending on the construction of the sounder and ceiling height.

(ii) These shall be installed at a height not lower than 2.4m except when recessed in a false ceiling of lower height. In such cases the sounders shall be recessed at false ceiling level.

(iii) When installed flush with a false ceiling these shall match the ceiling surface.

Necessary provisions for frame work to accommodate the sounders shall be made in the ceiling in advance.

(iv) High intensity sounders shall be mounted on substantial supports. Provisions for terminating the electrical wiring cables shall be such as not to permit entry of rain water through the wiring conduits or cable runs.

MIMIC DIAGRAM

6.1 SCOPE:

This section covers the requirements of mimic diagram to be provided as part of a Fire Alarm system/Automatic Fire Alarm System.

6.2 Mimic Diagram.

(i) A clear indication of the locations of all the ZONES shall be provided in mimic diagram.

(ii) Mimic diagram shall be provided near Main Control Panel and near repeater panels. (iii) A topographical representation of the premises shall be provided in the mimic diagram for the purpose.

(iv) The construction shall be in a metal frame work wall mounted, with a facia of transparent acrylic sheet with lighted and labeled (or engraved) indications.

(v) The location shall be well lighted so that the mimic diagram is conveniently readable.

7. POWER SUPPLY EQUIPMENT AND WIRING

7.1 SCOPE:

This section covers the requirements of power supply equipment for the Fire Alarm System/Automatic Fire Alarm System and the wiring for the system.

7.2 Main Supply

Power supply at 230 V 50 Hz, A C. single phase shall be provided terminating directly into the incoming switch of the C & I panel. Earth wire shall be provided with the power supply. Rectification of the input AC supply into DC and further stabilization of the voltage as may be necessary shall from part of the FAS equipment.

7.3 Standby battery supply

7.3.1 Standby battery shall be provided with C&I Panel.

7.3.2 Battery supply shall be arranged to automatically feed the FAS/Automatic Fire Alarm System in the event of variation of input A.C. voltage beyond preset values on high and low sides.

7.3.3 The battery shall be sealed maintenance free lead acid type or any other rechargeable type. The nominal voltage shall be as suitable for the FAS/AFAS The capacity of the battery Shall be such that it should capable of maintaining the system in normal operation for a Period of not less than 24 Hours after failure of normal supply.

7.3.4 Installation

Battery shall be located in a well ventilated space close to the C & I Panel, so as to be conveniently maintained. This shall be installed in a non corrosive enclosure, such as of wood, PVC or steel coated with epoxy paint

7.4 Battery Charger

7.4.1 The battery shall be provided with a matching battery charger which shall form part of the C&I Panel. The battery shall be in continuous trickle/boost charge.

7.4.2 The charging rate shall be such that after re-charging for a period of 8 hours, the battery shall be capable of feeding load for the capacity specified in the schedule of work.

7.4.3 The charger shall be complete with necessary voltmeter, ammeter, indicating lamps, fuses, etc.

7.5 Wiring for FAS/AFAS

7.5.1 Circuit Design:

(i) The design of the System wiring shall match the manufacturer system design.

7.5.2 Wiring/Cables:

(i) The PVC insulated FRLS copper conductor cable having a minimum 1.5 mm2 cross sectional area confirming to IS-694 to be used.

(ii) Armoured XLPE cables confirming to IS 7098 Part-1, 1988 with upto date amendments shall be used for connection with control panels & other areas wherever required.

(iii) Wiring shall be laid in metallic/rigid conduit.

(iv) Cables connected to detectors should be given 'S' loops on both the sides of the detectors which should be properly clamped to the ceiling. Loop should also be left, where wire/cables connect to sounders & all other accessories in the system. Appropriate glands should be provided where the cables enters the junctions box.

(v) Only 'red colour' wire should be used for laying in conduit.

(vi) No over head lines should be used to connect different building.

(vii) All the wires should be tagged for proper identification, should be identified by ferrules at junction & cable by colour bands at every 3 meters distance.

(viii) Multi-core cables and flexible cords shall not be used.

7.5.3 Installation requirement:

(i) The electrical work connected with a FAS/ AFAS shall be carried out in conformity with CPWD General Specification for electrical work Part-I (Internal) 2013 and Part-II (External) 1994 both amended up to date.

(ii) FAS/AFAS wiring shall be exclusive to the FAS/AFAS and be physically separated from wiring for any other service in the building.

(iii) To minimize possible disruption due to fire or other cause, fire alarm circuits should be separated as much as possible from each other. Where practicable, the different fire alarm circuits shall be run through different routes.

(iv) The metal body of all control and indicating panels shall be loop earthed using 2.5 sqmm copper wire and bonded to the earthing system in the building.

A.MEP-TENDER SPECIFICATION

Scope of works

1. Providing new Electrical wiring , conduiting ,DBs, switch Boards, LED / Electrical fittings, LED light driver, TPN Tap off boxes, Cable trays etc. as per the schedule/ BOQ.
2. Providing new Main MV panels, DG synchronizing panels , Sub Panels , terminations etc. as per the schedule/BOQ.
3. Providing New DG set , shifting of old DG sets with panels , housing of DG sets, Exhaust pipes with insulation, foundations , earthing of DGs etc. as per the schedule/BOQ
4. Providing new UPS systems with batteries as per the schedule/BOQ.
5. Providing and terminations of cables, Earthing and commissioning of the entire work as per the schedule / BOQ
6. Providing new HVAC items including AC outdoor and indoor units, ventilation fans, ducting, copper piping, copper piping and duct thermal insulation ,duct acoustic insulation, control wiring, wired and wireless controllers ,raise ways/duct /shaft etc. for routing the same as per the schedule/BOQ
7. Providing new ELV system with telephone, DATA sockets, Data and telephone cabling and conduiting ,Telephone units, EPABX,OFC cabling, Network switches, Network racks, cable trays for ELV,CCTV cameras, CCTV NVR, Wifi access points and wireless controllers, SFP modules, Patch panels and patch cables, and related items as per the schedule / BOQ
8. Providing new ELV-Audio/Video system with LED wall screen ,Amplifiers, Mixers, Speakers, Interactive LED screens,Microphone,All in one video conferencing equipment, cabling ,conduiting , network racks ,LED TVs and related items as per the schedule / BOQ

9. Providing new Fire Fighting items with Electrical Fire pumps, Fire pump with Diesel engine,Air vessel,Pressure gauges,Flow switches,MS piping,Valves,Hydrant valves, yard hydrants,Branch pipes,Non percolated RRL hoses,Hose reels, Hose cabins,Sprinklers, smoke and heat detectors,air release valves,fire brigade connection ,Tank filling unit,Pipe supports ,Electrical wiring and conduiting for FAS and PA system,Manual call points,Fire alarm sounder, talk back unit system,Fire alarm panels ,PA speaker system with mic and amplifier,Fire extinguishers and signages as per the schedule / BOQ
10. Dismantling and removing the old existing Electrical wiring/Distribution items, Panels ,Electrical fittings, Switch Board,DB's , cables , ELV items, Old lightning arrestor strips/Mast , Fire Fighting items,AC systems etc. for enabling the proposed new work installation.

SPECIFICATION FOR ELECTRICAL WORKS

ELECTRIC POWER DISTRIBUTION AND WIRING

1 System of Distribution and Wiring

1.1 The wiring shall be done from a distribution system through main and/or branch distribution boards. The system design and location of boards will be properly worked out.

1.2 Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker. Each outgoing circuit shall be controlled by a circuit breaker.

1.3 Only MCCB/MCB type main and branch distribution boards shall be used. HRC/ Rewireable type fuses shall not be used.

1.4 Three phase DBs shall not be used for final circuit distribution as far as possible.

1.5 'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light/power wiring shall be separate.

1.6 Essential/non-essential/UPS distribution each will have a completely independent and separate distribution system starting from the main, switchboard up to final wiring for each system. As for example, conduit carrying non-essential wiring shall not have essential or UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed.

1.7 Generally, no switchboard will have more than one source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.

1.8 Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.

2. Electrical Load balancing

2.1 Balancing of 3-phase circuit shall be done.

2.2 Power and light MCB distribution boards in office building should be of same size irrespective of number of circuits as far as possible in order to get aesthetic look. And the electrical load in light Power and UPS DBs to be balanced properly.

3.1 Wiring

All flexible copper wires used shall have Class 2 copper conductor satisfying the resistance requirements of NEC 2023 Part 1 Section 17, Annex B.

3.1.1 Submain & Circuit Wiring

(a) Submain Wiring: Submain wiring shall mean the wiring from one main/distribution switchboard to another.

(b) Circuit Wiring: Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts

3.1.2 Scope

Following shall be deemed to be included in wiring:

(a) 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.

(b) All fixing accessories such as clips, screws, Phil plug, rawl plug etc. as required.

(c) Metal switch boxes for control switches, regulators, sockets etc, recessed with modular base and cover plates

(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switchboards for loose wires/conduit terminations.

(e) Control switch or MCB, as specified.

(f) 3 pin or 6 pin sockets, ceiling rose or connector as required. (2 pin and 5 pin socket outlets shall not be permitted.)

(g) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

(h)Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

Note: In areas where false ceiling are provided, termination of wires should be at the fittings/Junction boxes. Flexible metallic conduits helically wound in galvanized steel from ceiling junction box to the fittings shall be provided duly coupled at both ends with GI couplers. This shall be included within the scope of point wiring.

(i) Interconnecting wiring between switches within the switch box on the same circuit.

(j) PVC conduit glands/ double check nuts at conduit terminations.

(k) Wire termination lugs at all terminations.

(l) Terminal blocks at switch boards and junction boxes.

(m) Dismantling of old Wiring items, fan, light fittings, Switch Boards, DB's, old Earthing/ lightning protection strips etc. as per requirements and direction of Engineer in Charge.

3.2 Wiring System

3.2.1 Wiring shall be done only by the looping system. Phase/live conductors shall be looped at the switch box. For point wiring, neutral wire/earth wire looping for the 1st point shall be done in the switch box; and neutral/earth looping of subsequent points will be made from point outlets.

3.2.2 In wiring, no joints in wiring will be permitted anywhere, except in switch box or point outlets, where joining of wires will be allowed with use of suitable connector.

3.2.3 The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.

3.2.4 Light, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'power' circuits. 5A/6A socket outlets shall also be wired in the power circuit in office buildings.

3.2.5 Colour Coding of Wiring:

Following colour coding shall be followed in wiring:

Phase : Red/Yellow/Blue.(Three phase wiring) Live : Red (Single phase wiring)

Neutral : Black

Earth : Yellow/Green.

3.2.6 Termination of Circuit into Switchboard

Circuit will consist of phase/neutral/earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner:

Phase wire terminated in phase connector. Neutral wire terminated in neutral connector. Earth wire terminated in earth connector.

The switchboard will have phase, neutral and earth terminal connector blocks to receive phase/neutral/ earth wire.

3.3 Run of Wiring

3.3.1 The type of wiring shall be namely, surface conduit/recessed conduit, steel/PVC, channel.

3.3.2 Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.

3.3.3 Above false ceiling, Wiring will be done in recessed conduit or surface steel conduit.

3.3.4 In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don't present a shabby look. Such boxes can be provided 5 mm above plaster level, and they can be covered with plaster of Paris/Wall putty with marking of junction boxes.

3.3.5 Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminium/PVC channels duly covered by a false ceiling, so that subsequently such service can be maintained and additional cables can be provided.

3.3.6 Generally, conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance.Alternatively floor trunking (raceways) / false flooring can be provided.

3.4 Passing through Walls or Floors

3.4.1 When wiring cables are to pass through a wall, these shall be taken through a protection (steel/ PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either porcelain, PVC or other approved material.

3.4.2 All floor openings for carrying any wiring shall be suitably sealed after installation.

3.5 Joints in Wiring

3.5.1 No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/ or protective conductors in wiring shall be permitted.

3.5.2 There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

3.5.3 Termination of multi stranded conductors shall be done using suitable crimping type thimbles.

3.6 Ratings of Outlets

(to be adopted for design).

3.6.1 LED fittings shall be used in the buildings and the rated capacity shall be as per actuals subject to “each circuit shall not have more than 800 W connected load or more than 20 points whichever is less”.

3.6.2 Conventional Ceiling fans shall be rated at 60W and BLDC fans shall be rated as per the actuals. Exhaust fans, shall be rated according to their capacity. Control gear losses shall also be considered as applicable.

3.6.3 6A and 16A socket outlet points shall be rated at 100W and 1000W respectively, unless the actual values of loads are specified.

3.7 Capacity of Circuits

3.7.1 Lighting circuit shall feed light/fan/call bell points. Each circuit shall not have more than 800 W connected load or more than 20 points whichever is less as because of introduction of LED lights, load on lighting circuit gets reduced drastically.

3.7.2 Power circuit in non-residential building will have only one outlet per circuit. However in non- residential building for computer points 3 nos. 6A outlet sockets can be feed through power circuit.

3.7.3 Each power circuit in a building can feed following outlets:

(a) Not more than 2 Nos. 16A outlets.

(b) Not more than 3 Nos. 6A outlets.

(c) Not more than 1 No.16A and 2 Nos. 6A outlets.

(d) Independent circuit each to feed Geyser, AC Outlet

3.7.4 Load more than 1 KW shall be controlled by suitably rated MCB and cable size shall be decided as per calculations.

3.8 Socket Outlets

3.8.1 Socket outlets modular type shall be 6A 3 pin, or 16/6 Amp 6 pin. 5 pin socket outlets will not be permitted.

The third pin shall be connected to earth through protective earthing conductor. 2 pin or 5 pin sockets shall not be permitted to be used.

3.8.2 Conductors connecting electrical appliances with socket outlets shall be of flexible type with a protective earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.

3.8.3 Sockets for the power outlets of rating above 1KW shall be of suitable rating modular switch/ socket configuration with controlling MCB.

3.8.4 Where specified, shutter type (interlocking type) of sockets shall be used.

3.8.5 Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on the 'live' side of the line.

3.8.6 6A and 16A socket outlets shall be installed at the following positions, unless otherwise specified.

(a) Non-residential buildings –

(i) 6A socket outlet: 110 cm above floor level.

(ii) 16A socket outlet: 23 cm/ 110 cm above floor level.

(b) Pantry:

6A/ 16A socket outlet – 23 cm above working platform and away from the likely positions of stove and sink.

(c) Bathroom:

6A socket outlet: Socket outlet for portable appliances like hair dryer, shaver etc. to be provided adjacent to wash basin/ mirror at 110 cm height above floor level.

For Geyser:

16A MCB/16 A modular switch in modular switch box arrangement be provided in bathroom at 110 cm height, adjacent to switchboard (for light and exhaust fan) with socket outlet at minimum 2mt. height from floor level and at least 60 cm. away from shower head adjacent to geyser (within 30 cm).

OR

16A MCB in modular box arrangement be provided in bathroom at 110 cm height at suitable location near door, with socket outlet at minimum 2mt. height from floor level and at least 60 cm. away from shower head adjacent to geyser (within 30 cm).

3.8.7 Unless and otherwise specified, the control switches for the 6A and 16A socket outlets shall be kept along with the socket outlets.

3.9 Cables

3.9.1 Copper conductor cable only will be used for submain/ circuit/ point wiring.

3.9.2 Minimum size of wiring:

Light Wiring	:	1.5 sq.mm.
Power Wiring	:	4.0sq.mm/ 2.5 sq mm.
Power circuit rated	:	More than 1 KW, Size as per calculation.

3.9.3 Insulation : Copper conductor cable shall be PVC insulated conforming to BIS Specification

3.9.4 Multi stranded : Cables are permitted to be used. However, proper termination on the ends with lugs/ thimbles should be used.

3.10 Flexible Cable

3.10.1 Conductor of flexible cables shall be of copper. The cross-sectional area of conductor for flexible cable shall be as per design.

3.10.2 Only 3 core flexible cables shall be used for connecting single-phase appliances.

3.10.3 Unless the flexible cables are mechanically protected by armour, or tough rubber, or PVC sheath, these shall not be used in places where they are liable to mechanical damage.

3.10.4 Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit/metallic casing and capping.

3.11 Wiring Accessories

3.11.1 **Control Switches for Point**

(a) Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be 'On' when the knob is down.

(b) (i) Modular type switches and sockets should be used.

(ii)Modular type switches and sockets to be provided for buildings i.e. in all types of remaining non-residential buildings & as may be decided by the Architect/ user department.

(c) It is recommended to provide MCB in Modular type boxes with controlling MCB for, geysers etc. The location of the controlling MCB and related socket should can be at separate location depending upon type of gadget. For example, in case of geyser/ the socket can be near the geyser/ indoor split unit and switch/ controlling MCB can be at different location at approachable height.

3.11.2 **Specification of Modular Switches and socket**

The modular switch shall be as per following/ have features mentioned below: -

- Suitable for 240V, AC, with normal gap constructions, Flush type, Screw type terminal, IP20
- Current carrying plastic parts of Nylon (PA6) with glass fibers up to 16A
- Non-Flammable insulating parts & very high Insulating resistance after Humidity test.
- Marked with IS 3854:1997
- Snap fit with Modular Plates very easy to install
- Arrow marking for correct orientation with plate.
- Double rocker mechanism to prevent visible spark.
- Bimetal Silver contact tips for less spark & longer life.
- Fire retardant and UV stabilized.

The modular sockets shall be as per following/ have features mentioned below:-

- 240V, AC, Flush type, Screw type terminal, Shuttered.
- Polycarbonate material thickness ~1.5 mm to 2.5 mm
- Non-Flammable insulating parts & very high Insulating resistance after Humidity

test.

- 6A, 6/16A Socket market with ISI, as per IS1293:2019
- Snap fit with Modular Plates easy to install
- Brass current carrying parts.
- Fire retardant and UV stabilized.

3.11.3 **Switch Box**

(a) Switch box shall be hot dip galvanized, factory fabricated, suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other than modular switches/ sockets). Switch box shall be of SS.

(b) Switch box also can be of non-metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.

3.11.4 **Ceiling Rose**

(a) A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.

(b) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

(c) A ceiling rose shall not embody fuse terminal as an integral part of it.

3.11.5 **Lamp Holders**

(a) Lamp holders may be batten, angle, pendant or bracket holder type as required. The holder shall be made of brass/ ABS Plastic material/ Bakelite (ISI marked) and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.

(b) Lamp holders for use on brackets and all those for use with flexible pendant shall be provided with cord grips.

(c) All lamp holders shall be provided with shade carriers.

(d) Where centre contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the 'middle wire', or the neutral conductor of the circuit.

3.11.6 **Fittings**

(a) Types: The type of fittings shall be as specified in tender documents. The fitting proposed shall be compliant to the related Bureau of Indian Standards (BIS) as applicable, including LED fittings.

(b) Indoor Type Fittings

(i) Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permit looping back.

(ii) Wires used within prewired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built-in-terminal block, ceiling rose or connector, as required.

(iii) LED driver used in fittings to be with inbuilt P.F correction

(iv) Fittings shall be installed such that the lamp is at a height of 2.4m above floor level, unless otherwise directed by the Engineer-in-charge.

(v) Fittings made of CRCA shall be phosphatized and powder/epoxy painted. For coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel etc. should be used.

(c) Outdoor Fittings

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of minimum IP 65, for reducing recurring maintenance cost and improved performance. Where ever required IP 66 fittings also can be provided for reducing maintenance frequency and cost.

Other fittings, which are not available with tested IP 65/54 protection, can be properly fabricated with weatherproof features, proper gasketing etc. As far as possible corrosion free material like cast aluminium, stainless steel, engineering plastics may be used for fabrication of such fittings, to prolong life of such fittings. There should not be any exposed wiring in such outdoor fittings.

3.12 Attachment of Fittings and Accessories

3.12.1 Conduit Wiring System

(a) All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch/regulator boxes. Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes. The fan regulators may also be fixed on outlet boxes, if so directed by the Engineer-in-charge.

(b) Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases. (use Stainless Steel Screws for corridor , stairs case and outside fittings)

(c) The switch box/regulator box shall normally be mounted with their bottom at 1.1 m from floor level, unless otherwise directed by the Engineer-in-charge.

3.12.2 **Fixing to Walls and Ceiling**

(a) Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.

(b) Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

3.12.3 **Exhaust Fans**

(a) Exhaust fans shall conform to relevant Indian Standards.

(b) Exhaust fans shall be erected at the places indicated by the Engineer-in- charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to the original finish of the wall. The exhaust fan shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.

(c) Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.

(d) Installation of exhaust fans in kitchens, dark rooms and such other special locations need careful consideration; any special provisions needed shall be specified.

3.12.4 **Regulators**

The exhaust fans shall be connected to earth by protective conductor.

3.13 Marking of Switch Boards

3.13.1 **Schematic Diagram**

First a comprehensive schematic diagram for each building is to be prepared, starting from Main LT Panel, rising main, submain boards, DBs, etc. and the manner in which they are connected. This will include essential, non-essential and UPS systems. Sizes of interconnecting main/submain cables shall be indicated.

3.13.2 **Marking of each Main Board**

Each main board/submain board shall be marked indicating rating of each incoming/ outgoing switch and the details of load/area it feeds. Detail/size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

3.13.3**Marking of Distribution Board**

Each Distribution Board shall be marked indicating detail of incoming switch (Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds. Suitable marking sticker will be suitably fixed to indicate such details.

3.13.4 **Marking of Power/Light/UPS DBs**

Power/light/UPS DBs shall be marked 'PDB' and 'LDB' and 'UDB' respectively.

3.13.5 **Marking for Non-essential/Essential/UPS/Switch Boards**

Each switchboard shall be marked essential/non-essential/UPS to indicate the nature of such switchboards.

3.13.6 **Marking of Main Earthing Terminal**

Main Earthing terminals in main/submain switchboard shall be permanently marked, as "Safety Earth – Don't Remove".

3.14 LT Distribution Switchgear

Only following type switchboards will be used:

3.14.1 Main/Submain switchboard of cubicle type.

3.14.2 DBs shall have incoming and outgoing terminal blocks with factory pre-wiring up to outgoing terminal blocks having phase/neutral/Earth terminal block for each circuit. This is to minimize chance of loose wiring which is a potential fire hazard. Conventional DBs of reputed makes with factory fabricated loose wire box with terminal blocks can also be used with the approval of technical sanctioning authority/NIT authority in addition to pre wired DBs.

Also specially designed switchboards can be used with detailed specification and fabrication drawings approved by the technical sanctioning authority.

3.15 Location of Switchboards

3.15.1 Switchboards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.

3.15.2 Switchboard shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.

3.15.3 Switchboards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of launderings or in the bath rooms, toilets, or kitchen.

3.15.4 It is preferable to locate floor main boards in rising main shafts of adequate size, with steel doors (having ventilation) or in suitable room.

3.15.5 Similarly, DBs can be in suitable niches in corridor walls having doors.

3.15.6 Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unaesthetic.

3.15.7 The main switchboard, which receives power to the building, should be invariably located in a switch room, having round the clock access, for emergency attendance to the switchboard(MSB).

3.16.1 **Stair Case Lighting**

Stair case lighting is to be treated as an extension of street lighting, for security and convenience of the residents. LED light fitting for staircase lighting may be provided to reduce load. Incandescent stair case lighting and bulk head fittings should not be provided, in view of excessive energy consumption and low burning hours.

3.16.2 **Emergency Electric Supply**

For ensuring essential water supply and security lighting, a D.G. set to be provided to take care of water supply pump set, sewerage pump set, street lighting and essential load requirement of the buildings as detailed in the BOQ.

3.16.3 **Corrosion Free Fittings**

Coastal areas and humid areas like toilet are subject to corrosion, which substantially reduces the useful life of such fittings, besides giving an ugly look on account of rusting.

Therefore, for coastal areas, and other humid areas corrosion free type of fittings (like aluminium, stainless steel, engineering plastic) should be used, for ensuring long life of such fittings and to achieve life cycle economy, after taking into account recurring expenditure on account of painting of fittings.

4. Telephone Wiring

Telephone wiring is to be provided. Such telephone wiring to be brought to a tag- block at a suitable point in ground floor EPBAX ROOM. Provisions shall be kept for suitable entry-pipe for laying incoming telephone cable. Necessary Krone boxes with terminals shall be provided in each floor as per the requirements and capacity. The telephone cabls shall be laid along the existing ducts / through the proposed trays near to the outside staircase. The number of telephone points shall be as per scale of amenities/as per the employees requirements.

NON-METALLIC CONDUIT WIRING SYSTEM

5.1 Application

5.1.1 **Recessed conduit**

Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places where recessed work may not be possible to be done. The type of work shall be as specified in individual works.

5.1.2 **Flexible non-metallic conduits**

Flexible non-metallic conduits shall be used only at terminations, wherever specified.

5.1.3 **Special Precautions**

(a) If the pipes are liable to mechanical damages, they should be adequately protected.

(b) Non-metallic conduit shall not be used for the following applications: -

(i) In concealed/inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.

(ii) In places where ambient temperature is less than 5 degrees C.

(iii) For suspension of fluorescent fittings and other fixtures.

(iv) In areas exposed to sunlight.

5.2 Materials

5.2.1 Conduits

(a) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 9537 (Part 3): 1983 (Reaffirmed 2017) and IS 3419:1988 (Reaffirmed 2017) for rigid conduits and IS 9537 (Part 5):2000 (Reaffirmed 2020) for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.

(b) The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in table below.

Dimensional Details of Rigid Non-metallic Conduits

[Clause 5.2.1(ii)]

(All dimensions in mm)

S. No.	Nominal Outside Diamet	Maximum Outside Diameter	Minimum Inside Diameter(in mm)	Maximum Permissible Eccentricity (in mm)	Minimum Permissible Ovality (in mm)
1.	20	20 + 0.3	17.2	0.2	0.5
2.	25	25 + 0.3	21.6	0.2	0.5
3.	32	32 + 0.3	28.2	0.2	0.5
4.	40	40 + 0.3	35.8	0.2	0.5
5.	50	50 + 0.3	45.0	0.4	0.6

(c) Wiring Capacity

The maximum number of PVC insulated aluminium/copper conductor cables of 1100 V grade conforming to IS 694: 2018 that can be drawn in one conduit of various sizes shall be selected accordingly.

5.3.2 Conduit Accessories

(a) The conduit wiring system shall be complete in all respect including accessories.

(b) Rigid conduit accessories shall be normally of grip type.

(c) Flexible conduit accessories shall be of threaded type.

(d) Bends, couplers etc. shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type of works.

(e) Saddles for fixing conduits shall be heavy gauge metallic type with base.

(f) For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

(h) All accessories of non-metallic conduit like junction box, bend etc. shall be ISI marked only (IS 3419:1988 (Reaffirmed 2017) for non metalic rigid conduits and BIS 3837:1976, Reaffirmed 2006, Accessories for Rigid non metallic Conduit).

5.3.3 **Outlets**

(a) PVC boxes shall comply with the requirements laid down in IS 14772: 2020. These boxes shall be free from burrs, fins and internal roughness.

(b) The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 m.

(c) The modular switch boxes shall be of required number of modules, made of SS sheet compliant to relevant BIS.

5.4 Installation

5.4.1 Common Aspects for Both Recessed and Surface Conduit Works

(a) The erection of conduits of each circuit shall be completed before the cables are drawn in.

(b) Conduit Joints

   (i) All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.

   (ii) The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

(c) Bends in Conduit

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

(ii) Radius of bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

(iii) Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

(d) Outlets

All switches, plugs, fan regulators etc. shall be fitted in flush pattern.

(e) Painting

After installation, all accessible surfaces of metallic accessories shall be painted in compliance with clauses under Chapter 15 "Painting".

5.4.2 **Additional Requirements for Surface Conduit Work**

(a) Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base, secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings. Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.

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

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

5.4.3 **Earthing Requirements**

(a) A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and/or earth terminal blocks at the DBs.

Gas or water pipe shall not be used as protective conductors (earth medium).

6 Mandatory test:

This Mandatory Test is applicable for original works only (original Works means all new constructions, item preparation, additions and alterations, special repairs to newly purchased or previously abandoned buildings or structures, including re-modelling or replacement).

The Acceptance Test as mentioned in IS 9537- Part 3: 1983 (Reaffirmed 2017) shall constitute the mandatory test for non-metallic rigid conduit :

(a) Dimension Test

(b) Bending Test

(c) Compression Test

(d) Resistance to Heat test

(e) Resistance to Burning Test

(f) Electrical Characteristics Test

POWER SWITCHGEAR AND CONTROL GEAR ASSEMBLIES (LT PANELS), D.B.

7.1 Requirements

(a) For each equipment, required IP rating and short circuit rating capacity will be specified. Governing BIS/ IEC also will be specified.

(b) All the equipment will be factory fabricated in an approved factory having modern fabrication and testing process. It shall have seven tank pre-treatment process comprising of degreasing, rinsing, de- rusting, rinsing, phosphatising, rinsing and passivation followed by powder coat painting having a paint thickness of 80 microns or as specified. The powder paint will be subjected to oven-heated process. All panels will be provided with suitable gasket to make it dust/ vermin proof.

7.1.1 **Power switchgear and control gear assemblies (LT Panels)**

It is combination of one or more low-voltage switching devices together with associated control, measuring, signaling, protective, regulating equipment, with all the internal electrical and mechanical interconnections and structural parts. This clause of specification is applicable to

PSC- ASSEMBLIES for which the rated voltage does not exceed 1000 V in case of a.c.

(a) This section covers the detail requirements for Design, Manufacturing, Testing and Verification at works of the L.T. Panel made out of CRCA/GI Zinc Coated sheet steel indoor type, floor mounted, free standing, totally enclosed, extensible type, air insulated type for use on 415 Volts, 3 phase with neutral, 50 cycles/sec system. The LT panel construction performance, testing and verification shall conform to

(a) IS/IEC 61439-1: 2011 (Low-Voltage Switchgear and Control gear Assemblies – Part 1 General Rules),

b) IS/IEC 61439-2: 2011 (Low-voltage switchgear and control gear assemblies – Part 2: Power switchgear and control gear assemblies.

The equipment shall be designed to conform to the requirements of:

Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.

(i) Air circuit breakers/ molded case circuit breaker IS:60947 (Part-II) & IEC 60947(2)

(ii) Fuse switch and switch fuse units IS: 13947 (Part-3) & IEC 947 (3).

(iii) HRC fuse links	IS: 13703
(iv) Current Transformers	IS :2705
(v) Voltage Transformers	IS :3156
(vi) Indicating Instruments	IS: 1248
(vii) Integrating Instruments	IS : 722
(viii) Control Switches & Push Buttons	IS : 6875
(ix) Auxiliary Contactors	IS: 13947 (Part-4/Sec.-I) & IEC 947 (4/1)
(x) Relays	IS: 3231

(b) The panel shall be compartmentalized type having space and arrangement for incoming cable/ bus ducting, incoming switchgear/ switchgears, bus coupler, insulated and properly supported compartmentalized bus bars, outgoing compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, inter-connection between bus bars and switchgear with auxiliary bus bars/ insulated conductors/ strips etc. Also, the panel will be provided with necessary instrumentation like CTs, PTs, Ammeters, Voltmeters, phase indicating lamps, other required instruments, wiring, fuses etc.

(c) It shall be fabricated out of CRCA sheet not less than 2.0 mm thick for load bearing members/ GI 275GSM Zinc coated metal. and 1.6 mm for doors of LT panels. General constructions shall employ the principle of compartmentalization and segregation of each circuit. Unless otherwise approved, incomer and bus section panels shall be separate and independent and shall not be mixed with sections required for feeders. Operating handle of the highest unit shall be at a height not more than 1.7 mt. Overall height of the board shall not exceed 2.3 metre.

(d) **Arrangement for Incoming/Outgoing Cable Termination**

Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size. Removable gland plate to be provided for each cable entry. Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed. From each outgoing switch, insulated strip/ conductor of suitable size to be provided up to suitable terminal block, which will receive incoming/ outgoing cable termination. It is desirable that cables are not terminated directly to switchgear, but terminated through proper terminal blocks.

(e) **Specification of Cable Terminal Block**

Terminal block of reputed make shall be used. The housing material shall be polyamide having unbreakable and fire-retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail' type. Screws shall be self-captive type. No protection cover is required, and the block should be touch proof.

(f) **Bus bars/ Supports/ Clearances**

The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys. For bus bar material, ratings, current density, insulation, supports, bus bar clearances and joints.

(g) **Earthing**

Protective earthing conductor shall be sized according to to IS/IEC 61439-1 : 2011 and IS/IEC 61439-2 : 2011. Earth busbars shall be fixed in the panel connected to incoming protective earth conductors. 2 no's of busbar and connections are recommended. Door earthing required.

(h) **Commissioning**

After erection, the LT panel will be commissioned after:

- Tightening of all nuts and bolts.
- Closing any left-out holes to ensure the entire panel is insect proof.
- Megger testing.
- Earth testing.

(i) The enclosures shall be designed to take care of normal stress as well as abnormal electro mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained. Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions. The design should have undergone Internal Arc tests for different types of feeders.

(j) For operator safety IP2 X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

(k) Switchboard shall have finger touch proof design with rear Terminals for MCCB feeders. Rear stud terminals shall be used directly on MCCB to avoid any direct touch in the front.

7.1.2 **Switchboard Configuration**

(a) The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MPCB, MCB’s and other equipment as called for in the schedule of quantities.

(b) The MCCBs shall be arranged in multi-tier formation. The incoming Air Circuit Breakers shall be arranged in Single tier formation only but Double tier formation to facilitate operation and maintenance may be used for outgoing air circuit breakers only.

(c) The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

7.2.3 **Constructional Features**

(a) The Switchboards shall be metal clad totally enclosed, floor mounted free-standing type of modular bolted type extensible design suitable for indoor mounting. Switchboard shall have a double front door arrangement to avoid unauthorized access. Suitable locking arrangement has to be considered.

(b) Switchboards construction shall employ the principle of compactization and segregation for each circuit.

(c) Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified.

(d) Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

(e) Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

(f) The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

(g) Metal based Polyurethane gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide required degree of protection as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

(h) Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.

(i) Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contract with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

(j) Switchboard panels and cubicles shall be fabricated with CRCA/GI Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness as per manufacturer standard. Joints of any kind in sheet metal shall be bolted construction.

(k) All panels and covers shall be properly fitted. The holes in the panel shall be correctly positioned.

(l) Switchboard shall be provided with “Danger Notice Plate” conforming to relevant Indian

Standards.

(m) Panel shall be tested for Seismic withstand of Zone-IV as per IEEE/IEC/BIS.

7.2.4 **Switchboard Dimensional Limitations**

(a) The overall height of the switchboard shall be limited to 2450 mm or less as per manufacturer's standards for all the Bus bar ratings and type of switchboards.

(b) The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

(c) Other dimensional limits if any are specified separately.

7.2.5 **Switchboard Compartmentalization**

(a) For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable alleys.

(b) All feeders having ACB & MCCB shall have rear or front terminal cable connection as specified in the tender / as per requirements of site.

(c) The main board shall be with Form 4b Construction. Form 4b Construction has provisions for Separation of busbars from all functional units, Separation of all functional units from one another, Separation of terminals for external conductors associated with a functional unit from the terminals of any other functional unit and the bus bars, Separation of the external conductors from the busbars, Separation of the external conductors associated with a functional unit from other functional units and their terminals, External conductors need not be separated from each other and Terminals not in same compartment as associated functional unit as per IEC 61439-2.

(d) Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be at least IP 2X.

(e) Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.

(f) For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

(g) Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only.

(h) A suitable wire way with cover shall be provided to take interconnecting control wiring between vertical sections.

(i) Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

7.2.6 **Switchboard Bus Bars**

(a) Busbars shall be made of high conductivity, 99.9% purity, high strength tinned copper of ETP grade Bus bars shall be of rectangular cross sections, suitable capacity for 1.2 A /Sq mm current for phase and Neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

(b) The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alley on either side in which the circuit could be arranged with front access for cable entrances.

(c) The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of 110^{O} C at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities. The material and the spacing of the Busbar supports should be same as per the type tested assembly & supplied by OEM with valid test reports.

(d) Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper.

(e) Clearances

The minimum clearances to be maintained for enclosed indoor air insulated bus bars for medium voltage applications shall be as per IEC guidelines

7.2.7 **Switchboard Interconnection**

(a) All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

(b) For unit ratings up to 100 amps, PVC insulated 105 deg withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 100 amps.

(c) All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Suitable grade nuts and bolts shall be used for busbar connections.

7.2.8 **Draw out Features**

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

7.2.9 **Instrument Accommodation**

(a) All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96sq.mm conforming to class 1.0 or as specified to IS 1248 for accuracy.

(b) Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

(c) For MCCBs, instruments and indicating lamps can be provided on the compartment doors.

(d) The current transformers for metering and for protection shall be mounted on the solid copper/aluminum busbars with proper supports.

7.2.10 **Wiring**

All wiring for relays and meters shall be with PVC insulated copper conductor FRLSH wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall use at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

7.2.11 **Space Heaters –if required**

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5O deg C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

7.2.12 **Earthing**

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

7.2.13 **Sheet Steel Treatment and Painting**

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

7.2.14 **Name Plates and Labels**

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

TABLE 7.3

[Clause 7.4.3.1 (g)]

A: Earth Continuity Strip for Protective Earthing

S. No.	Type of Installation	Earth Electrode	Earth Strip from Earth Electrode to Earth Bus and Loop Earthing of
1.	Indoor sub-station with HT panel, Transformer capacity up to 1600 KVA, LT panel, Generating set.	Copper Plate	25 x 5 mm Copper Strip
2.	T Indoor sub-station with generator	Copper	25 x 5 mm Copper Strip
3.	LT switch room having Main LT Switch Board	Copper Plate	20 x 3 mm Copper Strip

B: Neutral Earthing of Generators

S.No.	Equipment	Earth Electrode	Earth Strip from Earth Station to Neutral
1.	Generating set of all capacity	Copper plate	25 x 5 mm Copper strip

EARTHING

8.1 All connections including the protective bonding connections to Main earthing terminal shall be marked “SAFETY EARTH – DO NOT DISCONNECT”.

8.2 Testing

The integrity of safety by “Protective equipotential Bonding and Automatic Disconnection of supply” is ensured by testing

- Efficiency of Automatic disconnection.
- Main and Supplementary Equipotential Bonding.

Efficiency of Automatic Disconnection of supply is tested by measuring fault loop impedance, calculating fault current and comparing with the disconnection time of the respective protective device. While measuring fault loop impedance, attention is required for the following

- Fault loop impedance shall be measured at the final end of the circuit
- Along with fault loop impedance, short circuit loop impedance for current carrying conductors is also a good practice.
- Verifications recommended in IS732 / NEC (SP30: National Electrical code of India) also shall be carried out.

MEDIUM VOLTAGE CABLING AND WIRING SYSTEM

9.1 Scope

Supply, installation, storing, laying, fixing, jointing, terminating, testing and commissioning of Medium Voltage XLPE insulated PVC sheathed Armoured aluminium conductor cables of reputed make laid in built up trenches, directly buried underground, on cable trays, in pipes, clamped directly to wall conforming to IS 1554 (L), Part - I and specifications given below.

The Main and subwiring UG cables shall be laid through the existing Duct/ Shaft / raise ways available near to the lift structure through cable trays / clamping along wall etc. as per the requirements.

9.2 Type

a. Medium voltage cables shall be aluminium conductor, XLPE insulated, PVC sheathed and steel wire flat armoured or steel tape armoured construction. The cable shall be have stranded, sector shaped aluminium conductors for cables of 50 sq.mm size and above b.

b. The cables shall be rated for a voltage of 1100 volts.

9.3 Core identifications cores shall be provided with the following colour scheme of PVC insulation.

a. Core Red/Black/Yellow/Blue

b. Core Red and Black

c. Core red, yellow and blue

d. 3 1/2 or 4 core, red yellow, blue and black

9.4 Inspection

All cables shall be inspected upon receipt at site and checked for any damage during transit and shall be supplied with complete manufacturer's test certificates. At any cost the cables shall not be accepted without test certificate.

9.5 Storing

All the cables shall be supplied in drums. On receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position.

9.6 Joints in Cables

9.6.1 The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. The apportioning shall be got approved by the Architect before the cables are cut to lengths.

9.6.2 Where joints are unavoidable, the location of such joints shall be got approved and marking shall be done with suitable tags.

9.6.3 Jointing boxes for cables

Cable joint boxes shall be of appropriate size, suitable for XLPE insulated armoured cables of particular voltage rating.

9.7 Jointing Cables

9.7.1 All cables be jointed colour to colour, tested for continuity and insulation resistance before jointing. The seals of cables must not be removed until preparation for jointed are completed. Joints shall be commenced and finished on the same day. During the time of joining the cables, sufficient protection from the weather shall be ensured. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped by with epoxy compound so as to ensure that the box is properly filled.

9.7.2 Cable terminations

Cable termination shall be done in cable terminal box with suitable lug/sockets using cable glands and the cable ends sealed with sealing compound.

9.7.3 Bonding of cables

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable due to vibrations. The glands shall be fixed to the lead sheath by means of either a `Plumbing joint or a cone of approved material, capable of being compressed into lead sheath. The gland or cone shall be capable of effecting a good electrical bond between both the armouring of the cable, and the casing.

9.8 Laying of cables

Cables shall be laid as per the specifications given below:-

9.8.1 Cables in outdoor trenches

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 750mm, below the final ground level. The width of the trenches shall not be less than 300mmThe trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping may be done to avoid caving - in of trench walls. Where ever trench has been taken in the existing paved tiles, Concrete surfaces etc. after the laying the cables the tiles etc. shall be relayed as per original condition.

The floor of the trench shall be rammed level. The cables shall be laid in trenches over rollers placed inside the trench.

The cable drums shall be laid unrolled in the direction of the arrow marked on the drum for unrolling.

Wherever, cables are bent, minimum bending radius shall not be less than 12 times the diameter of the cable. After the cable is laid and straightened, it shall be covered with 80mm thick layer of sand. The cable shall then be lifted and placed over the sand cushion. Over this, a course of cable protection tiles or burnt brick shall be provided to cover the cables by 50mm on either side. Trench shall be backfilled with earth and consolidated. Cables shall be laid in GI pipes at all road crossings and in GI pipe at the wall entries. Cable route markers to be provided as per standards.

9.9 Testing of Cables

Tests shall be conducted for insulation between phases and between phase and earth for each length of cables, before and after jointing. As such all phase cables may be checked before being laid for above tests. On completion of cable laying work, the following tests shall be conducted in the presence of the Consultant/Owner's representatives.

a. Insulation Resistance Test (Sectional and overall)

b. Continuity resistance test

c. Sheathing continuity test.

d. Earth test

All tests shall be carried out in accordance with relevant standard code of practice and Electricity Rules. The contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Architect/PMC/Consultant.

LIGHT FITTINGS AND ACCESSORIES

10.1 Erection, testing, commissioning of light fittings and accessories conforming to relevant IS standards and specifications.

10.2 Standards

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

Electric lighting fittings : (The current mandatory BIS standard for general luminaires is typically : **IS 10322 (Part 1):** Luminaire - General Requirements and Tests.) **IS 10322 (Part 5/Sec 9): 2017**.– IS 10322 (Part 5/Sec 5): 2013 IS 10322 (Part 5/Sec 3): 2012Bayonet lamp holders - IS – 1258 **,** IS 10322 (Part 1): Luminaires - General Requirements and Tests

10.3 Lighting Fittings General Requirements

10.3.1 Fittings shall be designed for continuous trouble free operation under any atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather and rain proof.

10.3.2 Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps / Drives etc.

10.3.3 All fittings shall be supplied complete with lamps. Outdoor type fittings shall be provided with weather proof boxes.

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

10.3.5 All hard-wares used in the fitting shall be suitably plated or anodized and passivated for use in industrial plants.

10.3.6 All metal or metal enclosed parts of housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

10.3.7 Painting / Finish

All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp edges, and burrs.

10.3.8 The housing shall be stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign or cracking or flaking when bent through 90^0 over 12mm dia mandrel.

10.3.9 Decorative type fittings

Decorative LED fittings shall be provided with mounting/housing channel cum reflectors or CRCA sheet steel, stove enameled diffusers or louvers shall be translucent white .

10.3.10 Accessories for light fittings Reflectors

The reflectors shall be made of CRCA sheet steel/aluminium/silvered glass/chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/vitreous enameled/epoxy coating finish for the reflectors shall be as specified. The reflectors shall be free from scratches blisters and shall a smooth and glossy surface with optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

10.3.11 Lamp/ holders

Lamp holders shall have low contact resistance, shall be resistant to wear. They shall hold lamps in position under normal conditions of shock and vibration prevalent in an industrial atmosphere.

10.3.12 Lamps

a. Lamps shall be of LED type as specified in BOQ. LED lamps shall be "day light colour" type unless otherwise specified and shall be provided features to avoid blackening of lamp ends.

b. Lamps shall be capable of withstanding vibrations prevalent in an office atmosphere and connections at lend in wires

DG TECHNICAL PARAMETERS OF THE EQUIPMENT

11.1 The tentative technical parameters of Equipment's are furnished as below. The Tenderer should furnish the values of these parameters in their offer clearly.

S.No	Description	Parameters
4.1.1	Prime Power KVA Rating of DG Set at site altitude, air intake temperature of 40 degree Centigrade and average relative humidity of 98% at 0.8 lagging load power factor. (As per Clause 13.3.2 of ISO 8528-1 (1993-E))	250 KVA
4.1.2	Prime Rating at rated rpm (as per ISO 8528) in KW	200 KW
4.1.2	Frequency	50 Hz
4.1.3	Power Factor	0.8Lagging
4.1.4	Voltage	415 V, 3Phase
4.1.5	Fuel Tank Capacity	600 liters (approx.)
4.1.6	Electrical Battery starting voltage	24 Volts/12VDC
4.1.7	Insulation Class of alternator	H Class
4.1.9	Alternator Efficiency (at 100 % load)0.8 pf	94.3%
4.1.10	Short time overload capacity without exceeding temperature rise limits specified in BS:2613 or BS:5000 when corrected/ connected to ambient temperature at site.	10% for 1 hr in 12 hrs of Operation
4.1.11	Maximum Noise Level with the Acoustic enclosure	As per CPCB's latest norms. Prescribed limits.
4.1.12	Compliance to emission standards for Diesel Engine exhaust.	As per Central Pollution Control Board (CPCB)'s – IV latest provision/limits.

Note : No deviation in above parameters is permitted.

11.2 DIESEL ENGINE

11.2.1 The diesel engine shall be of outdoor type, multi cylinder, 4 stroke cycle, radiator water cooled, totally enclosed, prime duty, direct fuel injection, turbocharged Compression ignition, complete with its self-contained lubricating system, electric Battery start, directly coupled to alternator, mounted on a common base frame through flexible coupling. The engine shall be suitable for 10% overload for one hour in every 12 hours continuous running. The diesel engine shall be of suitable capacity and rating as per ISO:8528 and shall be capable of delivering prime power as perISO:8528 at ISO reference conditions.

11.2.2 The lube oil system shall be provided with engine driven lube oil pump

11.2.3 Engine and alternator shall be mounted on MS base frame structure on a common bed plate together with all auxiliaries to ensure perfect alignment of engine and alternator with minimum vibrations. The bed plate shall be suitable for installation on suitable anti vibration mounting system. The base frame shall be given anti rust treatment and shall be painted with one coat of primer and two coats of heat-resistant paint. Engine and alternator alignment shall be ensured as per relevant standards.

11.2.4 Anti vibration mounts will be provided with proper spacing such that the static and dynamic load of DG Set is uniformly distributed on the foundation.

11.2.5 The engine shall be radiator water cooled. Supply and installation of all items associated with engine cooling system shall be in the scope of Vendor

11.2.6 Engine Control Panel comprising of the following:

(a) Lubricating oil pressure gauge

(b) Battery Volt meter

(c) Coolant water temperature gauge

(d) Battery charging ammeter

(e) RPM/indicator

(f) On / Off remote start key

11.2.7 Safety equipment's for engine comprising of the following:

(a) Over Speed tripping cum indication

(b) Low lube oil pressure trip cum indication

(c) High water temperature trip cum indication

(d) Fuel level indication

11.2.8 Engine Speed Governor

Engine shall be supplied with inbuilt electronic governor to maintain engine speeds within the rated speed under varying load conditions

11.3 ALTERNATOR

11.4 The alternator shall be suitable for 250 KVA, 415 Volt, 3 Phase, 4 wire, 50HZ AC system, working at 1500 r.p.m., 0.8 lagging Power Factor, Self ventilated, Screen protected and dripproof, Salient pole,Brush less and Revolving field type, Self excited and Self regulating type and shall conform to IS: 4722/IEC: 34 or BS: 5000. It shall be directly coupled with engine by means of flexible coupling. The alternator shall be provided with Automatic Voltage Regulator (AVR) and can deliver rated output at the conditions mentioned in Leading parameters at clause 4.1.

Technical Particulars of Alternator:

(a) Type: PMG

(b) Voltage Regulation: +1.0 % of rated voltage from no load to full load

(c) Enclosure: IP-23

(d) Insulation: Class "H"

(e) Permissible over load: 10% for one hour in 12 hours of duration.

11.4.2 The main alternator winding and exciter winding shall be Class H insulated. The enclosure is drip proof and screen protected IP-23. The exciter shall be capable of forcing the field for 3 seconds in the event of short circuit fault at generator terminal. It will have in built protection for over voltage and rate of rise of voltage. All parameters shall be conforming to ISO 8528.

11.4.3 Performance: Voltage dip shall not exceed 20% of the rated voltage for any step load or transient load as per ISO 8528 (Part-1). The winding shall not develop hot spots exceeding safe limits due to imbalance of 20% between any two phases from no load to full load.

The generator shall preferably be capable of withstanding a current equal to 1.5times the rated current for a period of not more than 15 seconds as required vide clause 14.1.1 of IS 4722:1992.

The performance characteristics of the alternator shall be as below:

(a) Efficiency at full load 0.8 P.F : Not less than 93.5%

(b) Total distortion factor : Less than 3 %

(c) (i) 10% overload : One hour in every 12 hrs of continuous use.

(ii) 50% overload :15 seconds.

11.4.4 Terminal Boxes: Terminal boxes shall be suitable for U.G. cables. The Terminal box shall be suitable to withstand the mechanical and thermal stresses Developed due to any short circuit at the terminals.

11.4.5 Earth Terminals: 2 Nos. earth terminals on opposite side with vibration proof Connections, non-ferrous hardware etc. shall be provided.

11.4.6 Space Heaters: Alternator may be provided with suitable space heaters as per Manufacturers standard to maintain the winding temperature automatically such that it does not absorb moisture during long idle periods. The heater terminals shall be brought to a separate terminal box suitable for 230 V AC supply and a permanent caution notice shall be displayed.

11.4.7 Most of load fed by the alternator are non-linear industrial loads with heavy harmonics. Alternator shall be capable of handling these loads safely without any change in Performance.

11.5 AUTOMATIC VOLTAGE REGULATOR

The automatic voltage regulator (AVR) shall be electronic and manual control, capable of automatic voltage regulation within +/- 1.0 % all load between no load to full load and power factor 0.8 to unity.

11.6 AMF CONTROL PANEL

11.6.1 The AMF control panel shall be made of 2.0 mm thick CRCA sheet steel and shall be indoor type, floor mounted, dust and vermin proof. The panel shall have door sat the front and back for proper maintenance with suitable lock and key arrangement. The panel shall have steel channel fabricated kick –plate and bolted type cable gland plate fitted at the bottom. All the joints shall have proper gaskets. Panel for DG Set shall be modular type independent panel. Control supply wiring from DG Panel to AMF Control Panel shall be done by Firm.

The Panel shall comprise of

(a) 4 Pole, MCCB of 400 Ampere, 415 volt, 3 phase rating and associated control and protection system. The control panel will have COPPER bus bars of Suitable size.

(b) Combined meter i.e., Multifunctional meter with RS-232 port for measuring Voltage, Frequency, KWhr, PF, KW, etc.

(c) Equipment and components necessary for testing generating set's healthiness with test mode and with load on mains.

(d) Necessary instruments and accessories such as voltmeter, power factor meter, KW meter, KWH meter, Ammeter, Frequency meter etc. in one energy Analyzer unit with selector switch to obtain the reading of desired parameters.

(e) Necessary engine/ generating set shut down devices due to faults /abnormalities.

(f) Analogue/Digital Ammeters with selector switch.

(f) DC Ammeter and Voltmeter

(g) Battery Charger

(h) Indication lamps/ Selector switches for Voltmeter and ammeter (DC and AC) (j) Hour meter

(i) Auxiliary relay for monitoring engine parameters and to generate alarm trip Signal with necessary visual audio alarm.

(j) Potential free contacts for remote indication of Alarm / trip conditions.

(m) Provision for Engine start / stop from remote location

(k) All control circuits shall be controlled through a separate MCB.

(l) AMF Control System for auto start/stop.

The temperature indicator for Alternator winding & bearing shall be through RTD.

11.6.2 The AMF operation shall automatically start normally within 10 seconds after interruption of mains supply. Also DG set shall automatically stop within 3minutes after changeover from DG set to main supply. However, it should positively start within 3 attempts hence starting time should not exceed 30-40seconds in normal condition. The AMF panel shall also be capable of starting DG set in the event of voltage below the specified values. The AMF panel shall include the following:-

(a) Status indicating load on mains, load on DG set and DG set failed to start.

(b) DC control relay and timer for start/stop/three attempt start feature

(c) Voltage Sensing Unit with Time Relay:

AMF panel shall be provided with this sensing unit with adjustable settings, which should ensure that AMF does not come into operation in the event of voltage variation of limited duration.

(d) Provision should be made to operate the DG sets both in auto mode and manual mode.

(e) Battery charger working on mains supply.

11.6.3 System Operation: The above mentioned facilities provided shall afford the following operational requirements.

11.6.3.1 Auto Mode:

(a) A line voltage monitor shall monitor supply voltage on each phase. When the mains supply voltage fails completely or falls below set value (variablebetween80 to 95% of the normal value) on any phase, the monitor module shall initiate start- up of diesel engine. To avoid initiation due to momentary disturbance, a time delay adjustment between 0 to 5 second shall be incorporated in start-up initiation.

(b) A three attempt starting facility shall be provided 6 seconds ON, 5 seconds OFF,6 seconds ON, 5 seconds OFF, 6 seconds ON, if at the end of the third attempt, the engine does not start, it shall be locked out of start, a master timer shall be provided for this function. Suitable adjustment timers be incorporated which will make it feasible to vary independently ON-OFF setting periods from 1-10seconds. If alternator does not build up voltage after the first or second start as may be, further starting attempt will not be made until the starting facility is reset.

(c) Once the alternator has built up voltage, the alternator circuit breaker shall Close connecting the load to the alternator. The load is now supplied by the alternator.

(d) When the main supply is restored and is healthy as sensed by the line voltage monitor setting, both for under voltage and unbalance, the system shall be monitored by a suitable timer which can be set between 1 minute to 10 minutes for the load to be transferred automatically to main supply.

(e) The diesel alternator set reverts to standby for next operation as per (a), (b) and (c) above.

11.6.3.2. Manual Mode:

(a) In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button.

(b) Three attempt starting facility shall be operative for the start-up function.

(c) Alternator circuit breakers close and trip operations shall also be through Operator only by pressing the appropriate button on the panel and closure shall be feasible only after alternator has built up full voltage. If the load is already on ‘mains’, pressure on ‘close’ button shall be ineffective.

(d) Engine shut down, otherwise due to faults, shall be manual by pressing a ‘stop’ button.

11.6.3.3. Test Mode:

(a) When under 'test' mode pressing of 'test' button shall complete the start up sequence simulation and start the engine. The simulation will be that of mains failure. Sequence 1(a) and (b) shall be completed.

(b) Engine shall build up voltage but the set shall not take load by closing of alternator circuit breaker. When the load is on the mains, monitoring of performance for voltage/ frequency etc. shall be feasible without supply to load.

(c) If during test mode, the power supply has failed, the load shall automatically Get transferred to alternator. Bringing the mode selector to auto position shall shut down the set as per sequence of4.6.3.1(d) provided main supply is ON. If the mains supply is not available at that time, the alternator shall take load as in (c) above.

11.7 SWITCH GEAR SECTION (MCCB)

11.7.1 Switch Gear Section for DG set shall consists of 01 No. each DG Set, 4 Pole, 400 Ampere, 415 volt, 3 phase rating, communicable type MCCB with microprocessor based overload, delayed short circuit, short circuit protections. MCCB and associated control and protection system shall be provided, for DG Set out put to AMF control panel. MCCB shall have adequate breaking capacity to clear dead short circuit fault current at the output of MCCB.

11.8 ACOUSTIC ENCLOSURE

The Diesel Generator (DG) Set integrated acoustic enclosure shall be soundproof and weatherproof/weather-resistant, and shall conform to statutory Government noise level norms suitable for outdoor installation as per latest regulatory bodies norms. The enclosure shall be fabricated from 1.6 mm thick CRCA (Cold Rolled Close Annealed) steel sheets.

The salient features of the acoustic enclosure shall be as follows:

(a) The enclosure shall be modular in construction with the provision to assemble and dismantle easily at site. The DG set, Batteries etc. shall be completely installed (Ready to use type) inside the enclosure

(b) The sheet metal components shall undergo a minimum nine-tank chemical pre-treatment process (degreasing, phosphating, rinsing, etc.)before powder coating.

(c) The enclosure shall be powder coated (inside and outside) with a pure polyester or epoxy-polyester based powder. All nuts and bolts/external hardware shall be made from stainless steel.

(d) The doors shall be gasketed with high quality EPDN gaskets to prevent leakage of sound

(e) The door handles shall be lockable type fitted with heavy-duty corrosion-resistant locks.

(f) Sound proofing of the enclosure shall be done with high quality Rock wool/Mineral wool/Resin bonded fiber wool conforming to relevant IS/IS 8183 and the same shall be further covered with fiberglass tissue and perforated sheet.

(g) Specially designed, acoustically lined **baffle-type attenuators** shall be provided to control sound at air entry and exit points.

(h) Adequate cooling and combustion air flow shall be provided. The design shall meet the total air requirement. If required, an auxiliary blower fan shall be provided to meet the total air requirement.

(i) The internal enclosure temperature rise shall not exceed 7°C above the maximum rated ambient temperature of 40 deg C at full load.

(j) There shall be a provisionfor an external, clearly marked Emergency Stop (E-Stop) button accessible from outside the enclosure.

(k) Enclosure shall have LED lighting arrangement with at least 2 Nos. of suitable power (20 W LED) fittings along with MCB complete in all respect.

(l) | Noise Level shall not exceed 75 dB(A) at a distance of 1 meter (measured in free field conditions) or as per the strictest statutory local pollution control board norms.

(m)Door hinges shall be made heavy-duty, anti-corrosive stainless steel (SS) or a special alloy.

(n) Viewing window shall be fitted with toughened glass instead of acrylic sheet.

(o) Acoustic enclosure shall have certified, integrated heavy-duty lifting points/facility for safe and ease handling.

(p) The construction should be such that it prevents entry of rain water splashing into the enclosure and allows free & quick flow of rain water to the ground in the event of heavy rain.

(q) The acoustic enclosure should be suitable for U.G cable connection. Such arrangements on acoustic enclosure should be water proof & dust-proof conforming to IP-65 protection.

(r) If an auxiliary forced ventilation system is provided, it shall consist of suitably sized axial flow fans complete with necessary motors and an automatic control system. The control system shall be interlocked with the DG set and incorporate a timer for post-cooling operation (set to stop 5 minutes after DG set shutdown)

(s) The canopy should be provided with high enclosure temperature safety device. The canopy shall be provided with a high enclosure temperature sensor interlocked with the DG set control panel to initiate shutdown and/or alarm in case of overheating. Specified the device type (sensor) and its function (interlock/shutdown/alarm).

(t) Acoustic enclosures are supplied with built in Anti Vibration Mountings (AVMs). The DG set base frame shall be supplied with built-in Anti-Vibration Mountings (AVMs) between the engine/alternator and the base frame. AVMs are typically placed under the skid/base frame, not the enclosure structure itself, to absorb engine vibrations.

(u) The acoustic enclosure placement should be such that there is no restriction in front of air inlet and outlet from canopy. The manufacturer shall clearly specify the minimum installation clearance requirements to ensure unrestricted airflow in front of the air inlet and outlet apertures.

11.9 EMISSION RELATED PARAMETERS

Emission of the exhaust gas should be in accordance with the norms of Central Pollution Control Board as applicable at the time of supply with CPCB IV +

11.10 ANTI VIBRATION MOUNTING AND BASE FRAME

The Engine and Alternator shall be close-coupled, flange-mounted, and permanently aligned on a robust, common fabricated structural steel base frame (skid) constructed from heavy-duty ISMC sections or equivalent. The base frame shall be designed to limit deflection to maintain alignment during lifting, transport, and operation. It shall incorporate certified lifting points and provisions for foundation anchoring/grouting.

11.11 CABLING

11.11.1 All cabling between the alternator and the control panel is included in the scope of

Vendor.

11.11.2 Suitable cable entry adopter boxes are to be fabricated and fitted to the alternator.

11.11.3 Control cables between all instrumentation and control panels is included in the Scope of Vendor.

11.11.4 Control cables shall be copper conductor of not less than 2.5 sq mm, PVC insulated 1100 V grade with proper shielding as required & suitable colour coding should be followed. Terminal blocks of robust type and generally not less than 15 Amps capacity,250/500 V grade for DC up to 100 V and 1100 volts grade for AC and rest of the junction shall be employed in such a manner so that they are freely accessible for maintenance. All ends shall be identified with ferrules at the ends.

11.11.5 All power cabling between the alternator and AMF control panel is also included in the scope of Vendor

11.12 BATTERY AND BATTERY CHARGERS

11.12.1 The battery shall be sealed maintenance free lead acid type, heavy-duty motive power/traction with a minimum capacity of 150 Ah, 24 V, DC, sufficient for three consecutive starts without recharging. Battery shall be supplied with suitable structural steel stand with wooden base and rubber-mat.

11.12.2Battery charger shall have boost and trickles charging features with built in voltage regulators

11.12.3 Battery charger shall be suitable for operation on 230V AC, 50Hz supply with voltage variation of + / - 10% Ripple content of the charger DC outlet shall be limited to +/-2%.

11.12.4 Battery shall be conforming to IS 1652.

11.12.5 Battery charger with suitable auto manual selection shall be provided for charging battery from mains when DG is not running. Suitable capacity dynamo shall be provided for charging the batteries when DG is in operation

11.12.6 A separate voltmeter and ammeter shall be provided for monitoring battery voltage and current.

11.12.7 Connections between the battery charger & batteries shall be provided with suitable copper leads with lugs etc.

11.13 INDICATION LAMPS

(a)The alarm shall be DC hooter with audible control, fixed on the AMF panel.

(b)Accept' and 'Reset' pushbuttons shall be provided to accept the alarm and to reset the system after fault has been cleared.

(c)All Indication lamps shall be LED type rated suitably for control and power voltage.

(d) Pushbutton for testing all lamps.

(e) Status indication:

(f)Mains healthy

(g)Load on Mains

(h)DG set running

(i)Load on DG

(j)Alarms with warning lamps only.

(k)Low Fuel Level (Lamp indication shall not be reset unless fuel is filled)

(l)Low battery voltage.

(m) Battery charger failure.

11.14 PROTECTION

(a) High water Temperature.

(b) Low Lube oil Pressure.

(c) Emergency stop push button to stop the DG in case emergency in auto and manual modes.

(d) Engine over speed shut down.

(e) KW over load.

(f) Unbalance Load.

(g) Under/Over Frequency.

(h) Under/Over Voltage.

(i) Earth fault,

(j) Short circuit

11.15 POTENTIAL FREE CONTACTS FOR REMOTE TELEMETRY OF FOLLOWING SIGNALS

(a) Mains Failure

(b) DG fail to start

(c) Low fuel level.

(d) High water temperature

(e) Low lube oil pressure.

(f) DG set running.

11.16 PIPING

11.16.1 The material of construction for interconnecting pipes, pipe fittings, exhausts pipes, Bolts and nuts shall be as per relevant standards and suitable to withstand the temperature of the gas/liquid within the pipes and the environmental conditions. Exhaust pipes shall be cladded with rockwool insulation density not less than 120 Kg/m3 for 50mm thickness sand covered with 22G aluminium sheet.

11.16.2 The piping shall include necessary flexible pieces in the exhaust, fuel, lube oil and Waterlines as are necessary in view of the vibration isolation requirement in the installation. The pipe work shall be inclusive of all fittings and accessories required such as bends, reducers, elbows, flanges, flexible connections, necessary hardware etc. The installation shall cover clamps, supports, hangers etc. as are necessary for completing the work. However, the work shall be sectionalized with flanged connections as are necessary for easy isolation for purposes for maintenance of unit.

12-LIST OF SPECIFICATIONS FOR ELECTRICAL INSTALLATION WORK

The following specifications will apply under all circumstances to the equipment to be supplied and installed against this contracts and it is to be ensured that the Contractor shall obtain for himself at his own expense and on his own responsibility all the information which may be necessary for the purpose of submitting the tender and for entering into a contract keeping in view the specifications of installation and inspection of site etc.

IS 613 : 2000	Copper Rods and Bars for Electrical Purposes - Specification
IS 1248 : Part 1 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and

	their Accessories - Specification - Part : 1 Definitions and General Requirements
IS 1248 : Part 2 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 2 : Special Requirements for Ammeters and Voltmeters
IS 1248 : Part 3 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 3 : Special Requirements for Wattmeters and Varmeters
IS 1248 : Part 4 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 4 : Special Requirements for Frequency Meters
IS 1248 : Part 5 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 5 : Special Requirements for Phase Meters, Power Factor Meters and Synchroscopes
IS 1248 : Part 6 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 6 : Special Requirements for Ohmmeters (Impedance Meters) and Conductance Meters
IS 1248 : Part 7 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories - Part 7 : Special Requirements for Multi-Function Instruments
IS 1248 : Part 8 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 8 : Special Requirements for Accessories
IS 1248 : Part 9 : 2003	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 9 : Test Methods
IS 1271 : 1985	Thermal evaluation and classification of electrical insulation
IS 1646 : 1997	Code of practice for fire safety of buildings (general): Electrical installations
IS 1885 : Part 9 : 1992	Electrotechnical Vocabulary: Part 9 Electrical relays
IS 1897 : 1983	Copper strip for electrical purposes

IS 2419 : 1979	Dimensions for panel mounted indicating and recording electrical instruments
IS 2448 : Part 1 : 1963	Adhesive insulating tapes for electrical purposes: Part 1 Tapes with cotton textile substrates
IS 2464 : 1963	Built-up mica for electrical purposes
IS 3024 : 1997	Grain orinted electrical steel sheets and strips
IS 3231 : Part 1.2,3 : Sec 1 : 1986	Specification for Electrical Relays for Power System Protection Part 1 : General Requirements Section 1 : Contact Performance
IS 3480 : 1966	Flexible steel conduits for electrical wiring
IS 3837 : 1976	Accessories for rigid steel conduits for electrical wiring
IS 3842 : Part 12 : 1976	Application guide for electrical relays for ac systems: Part 12 Differential relays for Distribution transformers
IS 4483 : Part 1 : 1968	Preferred panel cutout dimensions for electrical relays: Part 1 Flush mounting IDMTL relays
IS 4648 : 1968	Guide for Electrical Layout in Residential Buildings
IS 5216 : Part I : 1982	Recommendations on Safety Procedures and Practices in Electrical Work - Part I : General
IS 9537 : Part 1 : 1980	Conduits for electrical installations: Part 1 General requirements
IS 9537 : Part 2 : 1981	Conduits for electrical installations: Part 2 Rigid steel conduits (superseding IS:1653)
IS 9537 : Part 3 : 1983	Conduits for electrical installations: Part 3 Rigid plain conduits of insulating materials (superseding IS:2509)
IS 9537 : Part 4 : 1983	Specification for Conduits for Electrical Installations - Part 4 : Pliable Self-recovering Conduits of Insulating Materials
IS 9537 : Part 5 : 2000	Conduits for Electrical Installations - Part 5 : Pliable Conduits of Insulating Material
IS 9537 : Part 6 : 2000	Conduits for Electrical Installations - Specification - Part 6 : Pliable

	Conduits of Metal or Composite Materials
IS 9537 : Part 8 : 2003	Conduits for Electrical Installations - Specification - Part 8 : Rigid Non-Threadable Conduits of Aluminium Alloy
IS 10381 : 1982	Terms (and their Hindi equivalents) commonly used for name plates and similar data of electrical power equipment
IS 11005 : 1984	Dust tight ignition proof enclosures of electrical equipment
IS 14927 : Part 1 : 2001	Cable Trunking and Ducting Systems for Electrical Installations : Part 1 General Requirements
IS 14927 : Part 2 : 2001	Cable Trunking and Ducting Systems for Electrical Installations : Part 2 Cable Trunking and Ducting Systems Intended for Mounting on Walls or Ceiling
IS 14930 : Part 1 : 2001	Conduit Systems for Electrical Installations - Part 1 : General Requirements
IS 14930 : Part 2 : 2001	Conduit Systems for Electrical Installations - Part 2 : Particular Requirements - Conduit Systems Burried Underground
SP 30 : 1985	Special Publication - National Electrical Code
IS 2516 - (L) PART I & II Section - I	LT air circuit breakers
IS 4064 (L)	Fuse switch units and switch fuse units
IS 2208 (L)	H R C fuse links
IS 2675 (L)	Distribution Boards
IS 2147	Enclosures for low voltage switch gears
IS 2418 (L)	Tabular Fluorescent lamps
IS 415 (L)	Tungsten filament lamps
IS 374 (L)	Ceiling fan
IS 1947 (L)	Flood light

IS 1771 (L)	Industrial light fittings
IS 3553 (L)	Water proof electrical fittings
IS 5133 (L)	Steel boxes for enclosure of electrical accessories
IS 2667 (L)	Fittings for rigid steel conduit:
IS 653 (L)	Mild steel conduit for Electrical wiring
IS 3837 (L)	Accessories for rigid steel conduit for electrical wiring
IS 4615 (L)	Switch socket outlets
IS 1293 (L)	Three pin plug & socket outlet
IS 3854 (L)	Switches for domestic and similar purposes
IS 2268 (L)	Call bell and buzzers
IS 3043 (L)	Earthing
IS 3072 (L)	Switch gear
IS 2309 (L)	Lighting protection
IS 7098 (L)	HT cable
IS 1886 (L)	Power Distribution transformer
IS 2705 (L)	Current Distribution transformer
IS 2516 Part I & II / Sector I (L)	MCCB
IS 2959 (L)	Auxiliary contacts
IS 2834 (L)	Power factor correction capacitors
IS 9357 (L) Part 1,2,3 & 4	PVC/ Metal conduiting
IS 2544 (L)	Bus bar support insulators
IS 375: 1963	Marking and arrangement for switchgears bus-bars, main connections and auxiliary wiring (revised) (superseded by IS: 5578 and IS: 11353)
IS 694: 1986	PVC insulated cables for working voltages upto and including 1100 V (third revision) (Amendment 1)

IS 722 (Part 1): 1986	AC electrical meters: Part 1 general requirements and tests (third revision)
IS 732: 1989	Code of practice for electrical wiring installations (third revision)
IS 1336: 1959	Recommendations for the colour of push buttons [superseded by IS: 6875 (Part 2)]
IS 1554 (Part 1): 1988	PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1 100 V (third revision) (Amendment 1)
IS 10118 (Part 1): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 1 General
IS 10118 (Part 2): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 2 Selection
IS 10118 (Part 3): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 3 Installation
IS 10118 (Part 4): 1982	Code of practice for selection installation and maintenance of switchgear and control gear: Part 4 Maintenance
IS 12021: 1987	Control Distribution transformers for switchgear and control gear for voltage not exceeding 1000 V ac (Amendment 1)
IS 12063: 1987	Classification of degrees of protection provided by enclosures of electrical equipment
IS 13234: 1992	Guide for short-circuit current calculations in three-phase as systems (superseding IS 5728)
IS 13947 (Part 1):1993	Low voltage switchgear and control gear: Part 1 General rules (superseding IS 4237)
IS 13947 (Part 2):1993	Low voltage switchgear and control gear: Part 2 Circuit breakers [superseding IS 2516(Part 1 & 2/Sec 1): 1985] (Amendment 1)
IS 13947 (Part 3):1993	Low voltage switchgear and control gear: Part 3 Switches, disconnectors, switch disconnectors and fuse combination units [superseding IS 4064(Part 1 and 2)]

IS 13947 (Part 4/Sec1) : 1993	Low voltage switchgear and control gear: Part 4 Contractors and motor starters, Sec 1 Electromechanical contactors and motor starters [superseding IS 2959 & IS 8544(All parts)] (Amendment 1)
IS 13947 (Part 5/Sec1) : 1993	Low voltage switchgear and control gear: Part 5 Control circuit devices and switching elements, Sec 1 Electromechanical control circuit devices [superseding IS 6875(All Parts)] (Amendment 1)
IS 14415: 1997	Volt-ampere hour meters for restricted power factor range [superseding IS 722(Part 5) 1980]

- IS-694 PVC insulated cables for working voltage up to 1100V
- IS-732 Code of practice for electrical wiring installation
- IS-900 Code of practice for installation and maintenance of induction motors
- IS-1248 Electrical measuring meters: Part 1,2,3,4,5,6,7,8,9
- IS-1255 Code of practice for installation and maintenance of power cables including and up to 33 kV rating
- IS-1258 Bayonet lamp holder
- IS-1293 Three pin plugs and socket outlets
- IS-1554 (Part-1) Specification for PVC insulated (heavy duty) electric cables for working voltage up to and including 1100V
- IS-1554 (Part-2) Specification for PVC insulated (heavy duty) electric cables for working voltage from 3.3 to 11 KV
- IS-1646 Electrical installation fire safety of buildings (general) Code of practice
- IS-1777 Industrial luminaire with metal reflectors
- IS-1885 Glossary of items for electrical cables and conductors
- IS-1944 Part 1 &2 Code of practice for lighting of public through fares
- IS-2026 (Part 1 to 4) Specification for power Distribution transformers
- IS-2071 (Part1 to 3) Method of high voltage testing
- IS-2147 Degree of protection provided by enclosures for low voltage switchgears and control gears.

- IS-2148 Specification for double compression cable glands
- IS-2206 Part 1 & 2 – Specification for flameproof light fittings
- IS-2268 Electric call bells and buzzers
- IS-2309 Protection of building and allied structure against lightning.
- IS-2440 Guide for day lighting of building
- IS-2544 Porcelain post insulators for systems with nominal voltages greater than 1000V
- IS-2551 Danger notice board
- IS-2667 Fittings rigid steel conduits for electrical wiring
- IS-2705 (Parts 1 to 4) Specification for Current Distribution transformer
- IS-3043 Code of practice for earthing
- IS-3419 Fittings for rigid non-metallic conduits
- IS-3427 Metal enclosed switchgear and control gear for voltages above 1000V but not exceeding 11000V
- IS-3480 Flexible steel conduits for electrical wiring
- IS-3636(Part 1 & 2) Code of practice for interior illumination
- IS-3837 Accessories for rigid steel conduits for electrical wiring
- IS-3854 Switches for domestic and similar purpose
- IS-3961(Parts 2,3 & 5) Current ratings for cables
- IS-4004 Application guide for surge arrestors for AC system
- IS-4012 Specification for dust proof electric light fittings
- IS-4013 Specification for dust tight electric light fittings
- IS-4160 Interlocking switch socket outlets
- IS-4615 Switch socket outlets (non-interlocking type)
- IS-5133 (part 1) Boxes for enclosure of electrical accessories Part-1 : Steel & cast iron boxes
- IS – 5077 Decorative lighting outfits
- IS-5216 (Part 1&2) Recommendation on safety procedures and practices in electrical works

- IS-5578 &11353 Marking and arrangement of bus bars
- -IS-5819 Recommended short circuit rating of high voltage PVC cables
- IS-5987 Code of practice for selection of switches
- IS - 6616 Ballast for HP MV lamps
- IS-7098 (part2) Cross-linked Polyethylene (XLPE) insulated PVC sheathed cables For working voltages from 3.3 KV up to and including 33 KV
- IS-7987 Guide for selection of HT AC circuit breakers
- IS-8623 (Part1,2&3) Specification for Low voltage switchgear and control gear assemblies
- IS-8828 Circuit breakers for household applications – MCB IS-9537(Part 1 &2) Rigid steel conduits
- IS-9537 (Part 3) PVC rigid conduits
- IS- 9900 (Part-1) High pressure mercury vapour lamps
- IS-10028 (Part 1,2&3) Code of practice for selection, installation and maintenance of Distribution transformer
- IS-10118 (Part 1,2,3&4) Code of practice for selection, installation and maintenance of switchgear and control gear
- IS – 10322 (Part-1) Luminaries – General requirement
- IS – 10322 (Part-2) Luminaries – Constructional requirement
- IS- 10810 Methods of test for cables
- IS-11171 Specification for dry type Distribution transformer
- IS-12360 Voltage bands for electrical installation including preferred voltages and frequency
- IS-12640 Specification for RCCB
- IS-12729 Switchgear and control gear for voltage exceeding 1000V
- IS-12943 Specification single compression cable gland
- IS – 13021 (Part-1) Electronic Ballasts for fluorescent lamps – General & Safety requirement

- IS – 13021 (Part-2) Electronic Ballasts for fluorescent lamps – Performance requirement
- IS – 13021 (Part-3) Luminaries – Screw and Screw less termination
- IS – 10322 (Part-4) Luminaries – Methods of Tests
- IS- 10322 (Part-5/Sec-1) Particular requirement – General purpose Luminaries
- IS-10322 (Part-5/Sec-2) Particular requirement – Recessed Luminaries
- IS-13118 Specification for high voltage AC circuit breakers
- IS-13703 Specification for low voltage fuses upto 1000V
- IS-13947 (Part 1,23) Specification for low voltage switchgear and control gear
- IS-15652-2006 Specification for rubber mats for electrical purposes
- IS : 1651 & 1652 Stationary cells and batteries lead acid type.

  Note: Latest edition of above mentioned codes shall be referred and contractor shall ensure that all the items supplied and Installation meets the latest revised standards/ Norms as notified by the applicable regulatory/Govt. agencies.

HVAC TECHNICAL SPECIFICATION

1.0 GENERAL SPECIFICATION

The specifications given hereunder relate to the supply, installation, testing and commissioning of HVAC system using Variable Refrigerant Flow (VRF) system and shall be read in conjunction with the appropriate International & Indian Standard Specifications.

2.0 Site

A comfort air conditioning system using variable refrigerant flow (VRF) system has been designed for CoPA building.

3.0 Scope of Work

The scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under the contract in every respect in conformity with the contract documents and with the directions of and to the satisfaction of the Engineer-in-charge. The Contractor shall furnish all labour, materials and equipment (except those to be supplied by the Owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of complete HVAC system as described in the specifications and as shown on the drawings. This also includes all materials, equipment, appliances and incidental work not specifically mentioned herein or noted on the drawings or documents as being furnished or installed, but which are necessary and customary to make a complete installation.

4.0 Noise Level

Noise level in conditioned spaces due to all refrigeration and air conditioning equipment shall not exceed 48 dB at 125 Hz when measured at any point in occupied spaces less than 150 cm above floor level and not closer than 150 cm from any supply air register or 60 cm from any return air grille.

5.0 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 Consultants.

b.The system after commissioning shall be handed over to the Owners and thereafter they will monitor the performance for standard designed 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 Owners/ Architects.

6.0 Schedule and Manner of Operations

Time being the essence of this contract, the Contractor will be expected to furnish all labor 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

Consultants/Architects/Owners.

7.0 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 tender's guidance.

8.0 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 the complete HVAC system at site.

(b) Any compensation towards damage/loss of property/material/equipment or to any person working at site shall be borne by the Contractor as per standard terms of contract.

(c) No escalation/ change of prices would be admissible under any circumstances.

9.0 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.

10.0 Design Drawings

The drawings prepared by the Consultants 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. They should get OEM approval prior to finalization of the drawings. He shall check the drawings of other trades to verify space for his installation. The Contractor shall examine all relevant architectural, structural, plumbing, electrical and other services layout drawings before preparing the shop drawings for this installation, and report to the Consultants any discrepancy and obtain clarifications. Any changes found necessary for co-ordination and installation of this work with other services and trades shall be made with prior approval of the Architects/Consultants and Project Managers without any additional cost to the Owner.

11.0 Shop Drawings

(a) Within seven days after the award of the Contract, the contractor shall furnish for the approval of the Architect/Consultants , 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 Architect/ Consultant. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all equipment, 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 Architect/Consultants make any amendment 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 Architect/Consultant, the Contractor shall submit a further six sets of shop drawings for the exclusive use of and retention by the Architect/Consultant. 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 Architects/ Consultants 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 any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract. again after the removal of the defects and shall be commissioned only after approval by competent inspecting authority or the Consultants and the Owner. All tests shall be carried out in the presence of the Consultants and Owner‟s representative.

12.0 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 all the expenses in connection with the same.

13.0 Completion Documents

a. 5 copies of operation manuals/catalogues of all standard equipment to be furnished by the contractor immediately after commissioning of plant.

b. 5 copies of write up on preventive maintenance, trouble shooting and operating instructions of the system along with the as-built drawings to be supplied by the Contractor at time of commissioning.

c. 5 sets of catalogues of all equipment such as outdoor units, indoor units, split packages, centrifugal fan sections, electrical components etc.

14.0 Completion Drawings

The Contractor shall submit five sets cloth mounted drawings showing all details of the installation including the equipment layout, size & routing of duct work, refrigerant piping, run of cable and any other information required by the Consultants.

15.0 Technical Submittals

The successful tenderer after award of work shall furnish submittals for various items incorporating complete technical details for the approval of the Consultants. The submittals for items mentioned in the tender document but not restricted to the following:

a. VRF System

c. Copper pipes

e. Grilles & diffusers.

f. Insulation material.

16.0 Maintenance during Liability Period

Defects liability period shall commence from the date of virtual completion upon fulfillment of the procedure laid down in the relevant clause mentioned above. Contractor shall include incidental expenses towards necessary maintenance during defects liability period by deputing a skilled technician once in every week. The scope of such maintenance work to include:

a. Wet Cleaning of indoor unit filters and fresh air intake filters.

b. Checking of fan belts, pulleys etc.

c. Dry Cleaning of electrical components using air blower

TECHNICAL SPECIFICATIONS

1.0 Equipment

1.1 Air-cooled Variable Refrigerant Flow System

1.1.1Scope

The scope of this section comprises of supply, installation, testing and commissioning of self-contained air cooled split type variable refrigerant flow packages each comprising of an outdoor and multiple indoor ductable/non ductable units conforming to these specifications and in accordance with the requirement of drawings and schedule of quantities.

1.1.2Outdoor Unit

Outdoor unit shall be factory assembled, good for outdoor installation, constructed out of heavy gauge MS panels with weather proof painting. The units shall be factory wired with necessary controls duly tested prior to dispatch conforming to the following specifications.

(a) All outdoor units shall consist of minimum two scroll compressors, preferably one with inverter drive, capable to operate even when one compressor is unserviceable.

(b) Outdoor units above 16 HP shall consist of minimum two separate inverter driven compressors.

(c) The units shall be provided with duty cycling arrangement for multiple inverter compressors.

(d) The outdoor unit shall be modular in design to facilitate installation one after another close to each other. Preference would be given to compact units having smaller footprint.

(e) Outdoor units should be rugged of anti-corrosion design.

(f) The outdoor unit shall comprise of sub cooling feature to effectively use the entire coil surface through proper circuit/bridge in order to prevent flushing of refrigerant owing to large length of piping.

(g) The condensing unit shall be provided with state-of-the-art microprocessor based control panel.

The outdoor unit shall be provided with Aero spiral design fan exhibiting low noise level characteristics complete with aero fitting grille to facilitate spiral discharge of airflow to effect reduction in pressure losses. The fan should be capable to respond to external static pressure of 5mm. The condensing unit shall be designed to facilitate fail safe operation when connected to multiple indoor units. Following safety devices shall be integral part of the outdoor unit:

- High pressure switch
- Fan drive overload protection switch
- Fusible plug

Overload relay including overload protection for inverter driven compressor.

1.1.2.1 Scroll Compressor

The scroll compressor shall be an industrial quality rugged, cast iron, direct hermatic compressor with scroll plates, suction & discharge service valves. The compressor shall be complete with straight suction tube, centrifugal oil pump, oil charging valve, oil level sight glass, crank case heater and check valve on the scroll discharge port. The compressor shall be complete with the provision of two-point lubrication for each motor bearing. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.The compressor shall be capable of functioning with inverter control as well. The inverter driven compressor shall preferably be with reluctance DC inverter for higher efficiency and reliability.

1.1.2.2 Condenser

Condenser shall be air-cooled type, suitable for outdoor installation and shall be suitable for operating at 46 deg C db and 24 deg C wb temperatures. Condenser shall be in copper tube & aluminium fin construction. Condenser coil shall be of minimum 4 rows deep and the fin spacing shall not exceed 2mm. The maximum face velocity across the coil shall not exceed 215 MPM. The condenser frame shall be constructed from heavy duty galvanized steel. The condenser fan/s shall be of propeller type with 900 RPM variable voltage electric motor complete with IP-55 protection. Motor shall be speed controlled to ensure a stable operation or varying ambient, by a factory fitted direct acting head pressure activated variable speed drive. The condenser shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessories necessary with the equipment supplied.

1.1.3Anti-Corrosion Protective Treatment Associated with Condensing Units, Piping, Joints and U bends & Refrigerant Piping between Outdoor and Indoor Units.

All interconnecting piping, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air pollution. Two coats of protective coating shall be applied. Each coat shall have dry film thickness of 35 micron or more.

The coating shall be strong, flexible and durable. It shall have good adhesive and abrasion resistance. It shall be resistant to moisture, UV, acid, alkali and other chemicals and capable of functioning between -250 C and 1500 C.

1.3 Refrigerant Piping (VRF)

The copper refrigerant piping shall be carried out neatly to connect outdoor and group of indoor units and shall run along with wires/cables. The refrigerant piping shall be carried out using hard drawn copper pipes & readymade copper fittings for pipe diameter exceeding 19mm. Piping less than 19mm shall be carried out using soft seamless copper pipes. Joints shall be affected by soldering/brazing process using silver rods. Suitable sleeves shall be provided at all wall crossings as required. The refrigerant circuit shall include liquid line and gas shut-off valves besides solenoid valve at the end of condenser. The refrigerant piping shall be carefully sized with necessary headers and should consist of accessories including Y-joints.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 21Kg/ Sqcm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum equivalent to 700mm Hg and held for another 24 hours prior to commencement of gas charging.All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building element by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The liquid and suction refrigerant lines including all fittings, valves, strainer etc. shall be insulated with 13 mm thick closed cell elastomeric insulation material preferably in tubing form as specified in Schedule of Quantities.

To protect nitrile rubber insulation associated with exposed copper piping from degrading due to ultra violet rays & atmospheric conditions, it shall be covered with polyshield coating. Fiberglass tape shall be helically wrapped & applied with two coats of resin with hardener to give smooth finish.

The recommended wall thickness of copper pipes being used for VRF application using high pressure refrigerant, R 410 a, is as under:

Copper Pipe Outer dia	**Copper tube wall thickness (mm)**
	Minimum requirement
Dia 6.4	0.8
Dia 9.5	0.8
Dia 12.7	0.8
Dia 15.9	1
Dia 19.1	0.8
Dia 22.2	0.8
Dia 25.4	0.88
Dia 28.6	0.99
Dia 31.8	1.10
Dia 34.9	1.21
Dia 38.1	1.32
Dia 41.3	1.43

1.4 Centralized Remote Controller, Touch Screen Type

A multifunctional compact centralized controller shall be provided with the system.

The Graphic Controller must act as an advanced air conditioning management system to facilitate complete control of VRF air conditioning equipment, It should be user friendly through its touch screen, icon display and color LCD display.It shall be able to control up to several groups of indoor units with the following functions: Starting/stopping of Airconditoners as a zone or group or individual unit.Temperature setting for each indoor unit or zone.Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.Monitoring of operation status such as operation mode & temperature setting of individual indoor unit, maintenance information and troubleshooting information.Display of air conditioner operation history.Daily management automation through yearly schedule function with possibility of various schedules.The controller shall comprise of wide screen user friendly color LCD display and can be wired by a non-polar 2 wire transmission cable upto a distance of 1 km away from indoor unit.

1.5.Motors

Fan motor shall be high efficiency EFF-1 suitable for operation on 415 + 10% volts, 50 cycle, 3 phase AC power supply. The motor shall be TEFC, squirrel cage induction type having two speed and IP-55 protection, provided with class „B" insulation, centrifugal fans, whenever used for smoke venting duty, motor shall be with class „H" insulation. Motor name plate horse power shall exceed brake horse power by a minimum of 20%. Motor shall be designed especially for quiet operation and motor speed shall not exceed

1450 rpm. The fan and motor combination selected for the particular required performance shall be energy efficient ensuring lowest noise level. The motor shall be of approved make.

1.6 Drive

Drive to fan shall be provided through belt with adjustable motor sheave and standard belt guard. Belt shall be of the oil resistant type.

1.7 Vibration Isolation

MS base shall be provided for both fan as well as motor, built as an integral part, and shall be mounted on a concrete foundation through vibration isolators of approved make or cushy foot mountings. The concrete foundation shall be at least 15 cm above the finished floor level or as shown in approved for construction shop drawings.

1.8.1 Outdoor Unit

Outdoor unit shall be an air cooled condensing unit suitable for outdoor installation conforming to the following specifications.

1.8.1.1 Unit Base & Casing

Base panel shall be constructed out of fabricated steel structure of adequate size. Casing panels shall be of 1.2 mm thick, welded construction, removable type to provide easy access to equipment and shall be bonderized and painted. Casing shall be complete with discharge outlets, grilles, space for refrigeration equipment, fans, condenser coil etc.

1.8.2 Compressor

1.8.2.1 Scroll Compressor

The scroll compressor shall be an industrial quality rugged, cast iron, direct hermatic compressor with scroll plates, suction & discharge service valves. The compressor shall be complete with straight suction tube, centrifugal oil pump, oil charging valve, oil level sight glass, crank case heater and check valve on the scroll discharge port. The compressor shall be complete with the provision of two-point lubrication for each motor bearing. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

1.8.2.2 Rotary Compressor

The rotary compressor shall be an industrial quality rugged, cast iron, hermatic/ semi hermatic compressor with capacity control side valve , oil sump heater & differential pressure refrigerant oil flow system. The compressor shall be provided with multiple pressure lubricated rolling element bearing group shall support the rotating assembly. Suitable overload protection shall be provided & necessary isolating valves shall be provided at suction & discharge. The compressor shall be fitted with electrically operated oil heaters with built in thermostats. The heaters shall be shall be automatically actuated when the compressor is stopped. Necessary time delay shall be provided for restart of compressor. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

1.8.2.3 Condenser

Condenser shall be air cooled in copper tube & aluminium fins construction. Condensers shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessory necessary with the equipment supplied.

1.8.2.4 Condenser Fan

Fan shall be preferably propeller type suitable for fractional horse power drive with IP-55 protection.

1.8.3 Indoor Unit

The indoor unit shall be basically a fan coil unit suitable for wall, floor and under ceiling installation of various types conforming to the following specifications. Indoor units shall be either ceiling mounted cassette type, wall mounted type, floor mounted type or ceiling mounted ductable type in conformity with the design drawings and schedule of quantities.

Each indoor unit shall consist of PID controller for maintaining design room conditions besides microprocessor based thermostat for cooling. The indoor unit shall also be provided with wired LCD type remote controller which shall memorize the latest malfunction code for ease in maintenance. The controller shall incorporate self diagnostic features. Such remote controllers associated with cassette type and hi-wall type indoor units shall incorporate inbuilt feature to be able to change fan speed and angle of swing flap individually as desired by the user.

The ceiling mounted cassette type indoor units shall comprise of an attractive moulded ABS plastic exterior enclosure provided with four way supply air grilles on the periphery and square return air grill at the centre with filter behind. Each cassette type indoor unit shall consist of high efficiency paddle type condensate water pump to facilitate forced disposal of condensate water and low gas detection system.

The hi-wall indoor units shall be suitable for installation on the wall preferably at lintel level. The specifications shall otherwise be similar to above. Ceiling mounted ductable indoor units shall comprise of high static centrifugal fan, direct driven or belt driven through TEFC squirrel cage induction motor suitable for moderate amount of duct work. The housing shall be of light weight construction fabricated out of powder coated galvanized sheet steel single skin panels, internally insulated with 9mm thick closed cell elastomeric insulation material.

1.8.3.1 Cooling coil

Cooling coil shall be of the fin and tube type, having aluminium fins, firmly bonded to seamless copper tubes. Face and surface areas shall be such as to assure rated capacity and the air velocity across the coil shall not exceed 170 MPM. The coil shall be factory tested under water at 21 Kg/Sqcm air pressure.

1.8.3.2 Fan Section

The fan associated with non ductable indoor units shall be dual suction, aero dynamically designed, multi blade type, statically-dynamically balanced to ensure smooth circulation of air exhibiting lower noise level. The fan shall be direct driven type mounted directly on motor shaft supported from the housing.

Fan associated with ductable indoor unit shall be centrifugal double inlet double width forward curved type, preferably with variable pitch pulleys. The fan housing shall be statically-dynamically balanced at works to ensure noise and vibration free operation.

1.8.3.3 Filters

Filters shall be cleanable, synthetic fibre media of approved make. Velocity through filters shall not exceed 105 MPM and pressure drop across filters shall not exceed 5 mm of WG.

1.8.3.4 Insulation

All indoor unit shall be factory insulated with minimum 9 mm thick closed cell elastomeric insulation material towards thermal/acoustic treatment.

Drain pan shall be insulated with minimum 9mm mm thick closed cell elastomeric insulation material. Fixing of coil section and drain pan shall be done in such a way to avoid direct metal contact with any other un-insulated metal part in order to avoid condensation. Condensate drain piping around the indoor unit shall also be insulated with minimum 9mm thick closed cell elastomeric insulation preferably in tubing form.

1.8.4 Refrigerant Piping (For Split Units)

The copper refrigerant piping shall be carried out neatly to connect outdoor and indoor unit/s and shall run along with wires/cables. The refrigerant piping associated with ductable units shall be carried out using hard drawn copper pipes & ready made copper fittings for pipe diameter exceeding 19mm. Piping less than 19mm shall be carried out using soft seamless copper pipes. Joints shall be affected by soldering/brazing process using silver rods. Suitable sleeves shall be provided at all wall crossings as required. The refrigerant circuit shall include liquid line and gas shut-off valves at the end of condenser.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 21Kg/ Sqcm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum equivalent to 700mm Hg and held for another 24 hours prior to commencement of gas charging.

All refrigerant pipes shall be properly supported and anchored to the buildings structure using steel hangers, anchors, brackets and supports which shall be fixed to the building element by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The liquid and suction refrigerant lines including all fittings, valves, strainer etc. shall be insulated with 13 mm thick closed cell elastomeric insulation material preferably in tubing form as specified in Schedule of Quantities.

To protect nitrile rubber insulation associated with exposed copper piping from degrading due to ultra violet rays & atmospheric conditions, it shall be covered with polyshield coating. Fiberglass tape shall be helically wrapped & applied with two coats of resin with hardener to give smooth finish.

2. Air Distribution

2.1 Scope

The scope of this section comprises of supply, fabrication, installation and testing of all sheet metal ducts and supply, installation, testing and balancing of grilles, registers and diffusers, in accordance with these specifications and the general arrangements shown on various drawings.

2.2 Duct Material

The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277, 1962 (revised) or aluminium sheets conforming to ISS:737-1955, wherever aluminium ducts are specified.

All ducts shall be fabricated from galvanized steel sheets and all ductwork shall conform to SMACNA Standard. Galvanized sheet shall possess light coating of Zinc, generally 120gm/sum of surface area. GI sheets shall be of Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by Owner"s site representative shall be subject to approval and tested for thickness and zinc coating at Contractor"s expense.

2.3 Duct Fabrication

All ducts shall be fabricated and installed in a workman like manner, generally conforming to SMACNA Standards. Round exposed ducts shall be die formed for achieving perfect circle configuration. The plain end of the round duct shall be slipped into the mating round duct with machine pressed flared end and thereafter pop riveted to complete the joint. The sample of round duct shall be displayed at the site prior to procurement for the approval of Consultants and Architects.

a. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

b. All exposed ducts within conditioned spaces shall have only slip joints and no flanged joints. The internal ends of slip joints shall be made in the direction of air flow.

c. Change in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a center line radius equal to one and half times the width of the duct. Air turns shall be installed in all abrupt elbows and shall consist of curved metal blades or vanes, arranged to permit the air to make the turns without appreciable turbulence. GI splitter dampers complete with brass metal lever shall be installed at each bifurcation/trifurcation point of duct for proper flow of air quantity in each duct.

d. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

e. All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed out of 18 gauge galvanized steel sheet, thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary doors as required by the Consultants to give access to all parts of the apparatus. Doors shall not be less than 450mm x 450mm in size. All hardware fittings such as thunder bolts, hinges, handles etc shall be in extruded aluminium construction.

f. In case of grid type false ceiling, the entire diffuser assembly with plenum shall be independently hung from the ceiling through adjustable GI wires and the same shall be connected to the main duct through a flexible round duct.

All ducts shall be fabricated from galvanized steel/ aluminium sheets of the following thickness as indicated below:

TABLE-I

Standard with no intermediate bracing

Rectangular Ducts (GSS)	**Pressure 250 Pa**			**Pressure 500 Pa**		
	Duct Section Length 1.2 m (4 ft)			**Duct Section Length 1.2 m (4 ft)**		
Maximum DuctSize (mm)	Gauge	Joint Type	Bracing Spacing	Gauge	Joint Type	Bracing Spacing
1-550	26	C & SS	Nil	26	C & SS	Nil
551-750	26	C & SS	Nil	26	TDC/TDF/Slipon	Nil
751-900	26	TDC/TDF/Slipon	Nil	24	TDC/TDF/Slipon	Nil
901-1200	24	TDC/TDF/Slipon	Nil	22	TDC/TDF/Slipon	Nil
1201-1300	22	TDC/TDF/Slipon	Nil	20	TDC/TDF/Slipon	Nil
1301-1500	22	TDC/TDF/Slipon	Nil	20	TDC/TDF/Slipon	Nil
1501-1800	22	TDC/TDF/Slipon	Nil	18	TDC/TDF/Slipon	Nil
1801-2100	20	TDC/TDF/Slipon	Nil			
2101-2250	18	TDC/TDF/Slipon	Nil			
2251-2400	18	TDC/TDF/Slipon	Nil			
2401-2700	18	TDC/TDF/Slipon	Nil			

Abbreviations :

. „C" - cleat

. „S" – S cleat

. „SS" - Standing S cleat.

For Aluminium duct material should be one commercial gauge higher with 22 G as minimum.

Fabrication Standards & Equipment

All duct construction and installation shall be in accordance with SMACNA standard. In addition, the ducts shall be factory fabricated with the help of following machines to produce the requisite quality of duct work.

1. Coil (sheet metal in roll form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.

2. All ducts, transformation piece, and fittings to be made on CNC profile cutter for requisite

accuracy of dimensions, location and dimensions of notches at the folding lines.

3. All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

2.4 Duct Construction

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

a.) Ducts so identified on the Drawing shall be acoustically lined and insulated from outside as described in the section “Insulation” and as indicated in schedule of quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gapes.

b.) Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or Snap button as per SMACNA practice to ensure air tightness.

c.) All ducts up to 750 mm width within conditioned spaces have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories including insulation within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint unless and otherwise specified.

d.) All ducts over 750 mm duct size for pressure class 1 “ / 250 Pa (W.G.), and over 550 mm duct size for pressure class 2” / 500 Pa(W.G.) shall have transverse joints as specified in Annexure I.

e.) Changes in dimensions and shapes of ducts shall be gradual (between 1:4 and 1:7) , Air –turns (vanes) shall be installed in all bands and duct collars designed to permit the air to make the turn without appreciated turbulence.

f.) Ducts shall be fabricated as per details on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seam, tees, or angels of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking.

g.) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans shall be constructed of 18 gauge GSS/ 16 gauge aluminium thoroughly stiffened with 25mm x 25mmx3mm galvanized steel angle braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus access doors shall be not less than 45cm x 45 cm in size.

h.) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i,e. towards GS sheet and riveting shall be done from outside.

i.) Self-adhesive Neoprene rubber/ UV resistant PVC lining of 5mm thickness instead of felt shall be used between mating flanges and duct supports for all ducting installation.

j.) Towards fire protection, all kitchen extract ductwork shall be fabricated out of 18 gauge GSS and coated with approved fire retardant paint preferably sprayed at factory prior to dispatch in order to capture the flanges, corners and internal joints.

2.5 Duct Installation

All ducts shall be installed generally as per the drawings and in strict accordance with approved for construction shop drawings prepared by the contractor.

a. The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. This work shall meet with the approval of the Architect/ Consultants in all its parts and details.

b. All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the buildings, whether or not the same are shown on the drawings. Where it becomes necessary to avoid beams or other structural work, plumbing or other pipes, and or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained as approved or directed by the Architect/Consultants.

c. If a duct cannot be run as shown on the drawing, the contractor shall install the duct between the required points by any path available, subject to the approval of the Architect/ Consultants.

d. All duct work shall be independently supported from building elements or as required by the Architect/Consultants. All horizontal ducts shall be rigidly and securely supported, in an approved manner, within hangers formed of wire rope suspension arrangement with hot dipped galvanized (HDG) perforated channel under the ducts. The distance between two successive supports shall not be greater than 2 meter center to center. All vertical duct work shall be supported by structural members at each floor.

e. Ducting on top of the ceiling shall be supported from the slab above, or from beams with the help of adequate strength dash fasteners, after obtaining approval of the Architect/ Consultant. In no case shall a duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

f. All metal work in dead or closed down spaces shall be erected in time to occasion no delay to other contractors in the building.

g. All ducts shall be totally free from vibration under all conditions of operations. Whenever duct work is connected to fans, that may cause vibrations in the duct, ducts shall be provided with two flexible connections located close to the unit in mutually perpendicular directions. Flexible connection shall be constructed of fire resistant flexible double canvas sleeves at least 100mm deep, secured properly and bolted at both ends. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.

h. The two mating flanges of the ducts being joined with each other shall be made air tight by providing 2mm thick foam rubber insertion fixed on both mating flanges by means of good quality adhesive. Rubber strip shall also be provided between bottom surface of duct and angle iron at each duct support to avoid metal to metal contact.

2.6 Volume Control Dampers

a. All dampers shall be multiblade type of robust construction of galvanized steel and tightly fitted. The design, method of handling, and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts and at each supply air collar, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

2.7 Supply Air Diffusers

Diffusers shall be of approved make and of mild steel construction, square in shape with flush fixed pattern or adjustable flow pattern. Diffusers for different spaces shall be selected in consultation with the Consultant.

All supply air diffusers shall be equipped with removable key-operated volume control dampers. Anti-smudge ring may be required in specific applications. The outer shell and diffusing assembly shall be made out of 18 gauge and 24 gauge MS sheet respectively.

2.8 Extruded Aluminium Grilles & Diffusers

2.9 Rectangular/ Square Ceiling Diffusers

Rectangular /square ceiling diffusers shall be fabricated out of extruded aluminium sections powder coated in colour approved by Architects/Consultants. The four directional air flow diffuser shall consist of outer ring fixed to duct collar with concealed screws. Foam gasket shall be provided between outer ring and suspended ceiling.

The central core shall be clip fixed to the outer ring. Opposed blade volume control damper in extruded aluminium construction shall be fixed to the neck of diffuser. The damper shall be adjusted after removing the central core. The diffuser shall be equipped with anti-smudge ring.

In case of grid type false ceiling, the entire diffuser assembly with plenum shall be independently hung from the ceiling through adjustable GI wires and the same shall be connected to the main duct through a flexible round duct.

2.10.1 Plaque Diffuser

The Plaque diffusers shall be constructed out of Extruded Aluminium powder coated sections is designed to integrate with suspended ceiling arrangement preferably grid type.

The diffuser shall consist of a rear pan and a removable heavy gauge front flat panel attached to the rear pan through spring loaded locking posts. The flat panel may be removed whenever need arises to facilitate adjustment of the damper for air balancing.

The front panel shall be aerodynamic in appearance, rigid and preferably in single piece construction and free from any welding or forming blemishes.

The horizontal air discharge pattern shall be 360 0 type. Blank off baffles shall be provided to obtain one, two or three way blow pattern if specifically asked for in the "Schedule of Quantities". Diffusers shall be provided with following accessories:

I. Opposed blade damper

II. Spiggot to facilitate round duct connection at neck.

The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.10.2 Swirl Diffuser

The diffuser face shall consist of fixed radically arranged air control blades. The supply air pattern shall permit specifically arranged internal air guidance elements or guide vanes. Such elements are not required for return/extract versions. Due to the rotary swirling motion of the air discharge, induction of room air occurs very quickly, resulting in decay of supply air velocity and temperature differential.

In order to stabilize horizontal discharge, all sizes must be mounted flushed with the suspended ceiling. The minimum height between floor & the diffuser face should be 2.6 M or less. The face plate shall be square. The supply air versions shall be supplied with top/side entry spigot with lip seals and Volume Control Damper.

The diffuser face shall be fabricated out of 1.2 mm thick galvanized steel sheet, pretreated and powder coated white. The spigot shall also be of 1.2 mm thick galvanized steel sheet & lip seal of soft rubber.

The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.10.3.Multislot Linear Diffuser

Linear ceiling diffuser shall be multislot type. The diffuser shall be fabricated out of extruded aluminium sections. Each slot shall be 19mm wide. Each slot shall be equipped with air flow direction control louver mechanically fixed. Integral sliding type hit & miss type volume control damper in extruded aluminium construction shall be provided for each slot for fine control of air flow in supply air portion only. The damper shall be fabricated out of anodized extruded aluminium sections. Other sections of ceiling diffuser shall be powder coated in color & shade approved by the Consultants/Architects. The linear diffuser shall be fixed in to a plenum chamber with concealed screws. Side end pieces or corner pieces shall be provided if required.

2.10.4 Multi Louvered Grilles

For supply air double louvered grilles in extruded aluminium construction shall be provided with individually adjusted louvers along with volume control damper in extruded aluminium construction. The louvers shall be pivoted in Nylon bushes for smooth operation for return air grilles similar to supply air as described above will be provided but without volume control dampers. These grilles shall be painted as per approved powder coated shade.

2.10.5 Linear Grilles

Linear Grilles shall be fabricated out of extruded aluminium sections. Flanges shall be of 1.3mm thick extruded aluminium. Louvers shall be of extruded aluminium sections 3.7mm thick at the front and 2.2 mm at the rear with 15 degree deflection strong enough to withstand site abuse during installation. The sample of grille shall have to be got approved by the consultants before delivery. The linear grilles shall be provided with removable/fixed internal core. All sections of linear grille shall be powder coated in color/shade approved by the Architects/Consultants. The linear grilles shall be fixed into a plenum chamber having GI spacers with concealed screws. End pieces or corner pieces shall be provided as required.

2.11 Testing And Balancing

After completion of the installation of the complete air distribution system, all ducts shall be tested for air leaks. Before painting the interiors, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

The entire air distribution system shall be balanced using approved anemometer. Air quantities at the fan discharge and at various outlets shall be identical to, or less than 5 percent in excess of, those specified and quoted. Leakage in each air distribution system shall be within 3 percent so that supply air volume at each fan shall be identical to , or no greater than 3 percent in excess of, the total air quantity measured at all supply outlets served by the fan. Branch duct adjustments shall be made by volume or splitter dampers. Dampers shall be permanently marked after air balancing is complete .

restored to their correct position if disturbed at any time. Complete air balance report shall be submitted to the Consultants for scrutiny and approval, and six copies of the approved report shall be provided with completion documents.

3. Insulation

3.1 All chilled water piping/refrigerant piping, chilled water equipment and Duct work shall be insulated in the manner specified hereunder:

Material

Chilled water pipes shall be insulated with closed cell elastomeric insulation of properties as given below:

Average Physical Properties Of Insulation						Test Method
Cell structure	Closed cell					--
Density (gm/cm3)	(0.04 - 0.07)					--
Thermal Conductivity (W/m.K)	Mean Temp.	-20°C	0° C	20°C	40°C	BS 874, Part 2 1986 DIN 52612
	K. Value	0.034	0.035	0.037	0.039	--
Service-Temperature Limit	(-40 ° C to 105° C)					--
Water Vapour Permeability (ì)	Minimum 7,000					DIN 52615
Water Absorption (% by volume)	1.5% Maximum					--
Ozone Resistance	Should be Excellent					--
Flammability	Class1 followed by Class 0					BS-476 Part 7& Part6

No insulation shall be applied on pipes until the pipes are satisfactorily tested, as specified in section “PIPING”.

3.1.1 Application of Insulation

Cold insulation on pipes shall be applied as specified below:

a. Pipes shall be thoroughly cleaned with brush & linen and rendered free from all foreign matter and grease.

b. Apply SR –998 (or equivalent) adhesive on the bare surface of pipes.

c. Closed cell Elastomeric Thermal insulation preferably in tubing form shall be fixed tightly to the surface. All joints to be sealed properly with vapour barrier compound. Condensate drain piping and refrigerant piping shall be insulated in the manner specified above.

All valves, fittings, strainers, etc in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and applied generally in the manner specified above, valves bonnets, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

Exposed CHW pipe insulation shall be provided with necessary treatment as under:

a. Apply two layers of surface coating as under:

I. Apply a coat of composition prepared out of synthetic resin, cristalline silica & ethyl alchohal.

II. Cover the insulated surface with lagging in the form of fire retardant glass fibre cloth, by wrapping it on wet coating.

III. Subsequently, apply a coat of special composition and allow drying.

IV. Apply second coating thereafter achieving sufficient mechanical strength.

3.3 Duct Lining:

3.3.1 Scope

The scope of this section comprises of supply and application of acoustic insulation conforming to following Specifications.

3.3.2 Material

Insulation material shall be processed Elastomeric, nitrile rubber or other approved equal.

Samples of insulation material shall be submitted for approval to the Consultants prior to procurement. The physical properties of material shall be as given hereunder:

Average Physical Properties Of Insulation						**Test Method**
Cell structure	Open cell					--
Density (Kg/CuM)	(140 - 180)					--
Thermal Conductivity (W/mK)	Mean Temp.	-20°C	0° C	20°C	40°C	DIN : EN 12667
	K. Value	0.046	0.047	0.050	0.052	
Service-Temperature Limit	(-20 ° C to 105° C)					--

Ozone Resistance	Should be Excellent	--
Flammability	Class1	BS-476 Part 7 -1997
Tensile Strength	190 K Pa	--
Resistance to chemicals	Organic Solvents	Should be Excellent
	Dilute Inorganic acids	Should be good
	Mineral Oil	Should be good
Health aspects	Dust & Fibre free	--
Water Absorption	Non hygroscopic coating	

3.3.3 Application of Insulation

Acoustic lining of ducts wherever specified shall be applied as under:

a. Clean the internal surface of the duct to make it free from dirt and dust. b. Apply adhesive on the the bare surface of duct.

c. Processed Nitrile rubber foam shall be fixed tightly to the surface, joints sealed properly with tape of same material.

3.4 Duct Insulation

External thermal insulation of ducts shall be carried out with closed cell elastomeric insulation having thermal properties mentioned on first page of insulation sub head and thickness mentioned in schedule of quantities. The contractor shall ensure availability of all accessories as mentioned under appendices for achieving perfect workmanship. Insulation of ducts shall be applied strictly as per the recommendations of manufacturers amended from time to time. However, application procedure shall generally be as given hereunder:

a. Apply SR 998 / equivalent adhesive on the bare surface after vigorously cleaning the duct using fresh linen.

b. Closed cell elastomeric insulation material possessing class "O" properties in specified thickness to be fixed tightly to the surface with joints well butted.

c. Longitudinal as well as vertical joints shall be sealed with the adhesive forming proper bonding.

Circular ducts shall be insulated internally following procedure as mentioned above. In addition, insulated surface shall be secured with circular GI strips spaced at regular intervals. A sample of insulated duct shall be displayed at site and approval sought prior to application.

3.5 Thermal Insulation of ducts exposed to atmosphere:

Duct insulation shall be applied as follows:

a. Apply SR 998 / equivalent adhesive on the bare surface after vigorously cleaning the duct using fresh linen.

b. Closed cell elastomeric insulation material of class “O” properties in specified thickness to be fixed tightly to the surface with joints well butted.

c. Longitudinal as well as vertical joints shall be sealed with the adhesive forming proper bonding and taped over with same material.

d. Apply two layers of surface coating as under:

I. Apply a coat of composition prepared out of synthetic resin, crystalline silica & ethyl alcohol.

II. Cover the insulated surface with lagging in the form of fire retardant glass fibre cloth, by wrapping it on wet coating.

III. Subsequently, apply a coat of special composition and allow drying.

Note: Latest edition of above mentioned codes shall be referred and contractor shall ensure that all the items supplied and Installation meets the latest revised standards/ Norms as notified by the applicable regulatory/Govt. agencies.

D.TECHNICAL SPECIFICATION-ELV/AUDIO VIDEO

1. DATA & TELECOM – PASSIVE CABLING INFRASTRUCTURE – CAT6E CABLE & OFC COMPONENTS

SCOPE OF WORK

- Complete installation and configuration shall be done in accordance with installation practices for a well structured cabling system, using components from a single OEM to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.
- Devices and services that shall run on the passive network shall include, but not limited to, the following:

  a.) Wired LAN access

  b.) Wireless LAN access

  c.) Voice communications –Telephone

  d.) IP-based CCTV/Surveillance Cameras

  e.) Various devices and controllers for AV system

  f.) Video-conferencing equipment
- Cabling installation for data and voice communications shall originate at networking racks and terminate at IOs terminated at specified locations. All cables are should be covered with caseing and capping as per standards.
- Installation, termination and identification of wiring between station outlets and networking distribution rack(s)and networking distribution rack(s) and main rack (s), shall be considered part of the system integrator's work.
- All cables and terminations shall be tested @500 MHz identified, labelled and documented at all locations.
- **The system integrator carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ without any additional cost.**

- System integrator shall provide Ethernet cabling connectivity for all other services, utilities and systems (such as, but not limited to – HVAC, Electrical, Plumbing, Lift Panels and any other such) besides those already forming part of ELV (CCTV, FAS, ACS, Data and Telecom) upto the device location as indicated by the respective utility contractor, e.g., DDCs, PLCs, FRTUs and other such. The respective utility contractor shall indicate the location of their devices and rack where the cabling is to be terminated.
- System integrator shall have complete responsibility to Install and Configure the LAN Switches, WLAN AP's & WLCs, IP Based CCTV/NVRs, EPBAX, VC AV Equipments & other devices as per the requirement of CoPA under the contract as per the ISO 27001:2019 standard

<u>Supported Applications, but not limited to:</u>

- Ethernet Applications – wired Ethernet and wireless as per IEEE 802.11a/b/g/n/ac
- IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
- Telecom – BRI, PRI and Digital Subscriber Loop (DSL) Applications
- Voice, Video and ISDN Applications

<u>References & Standards, but not limited to:</u>

- TIA / EIA
- CPWD
- International Electro technical Commission (IEC)
- European Committee for Electro technical Standardization (CENELEC)
- American National Standards Institute (ANSI)
- Institution of Electrical and Electronics Engineers (IEEE)
- **Wherever there is reference to multiple standards and/codes, the ones most recent and most stringent shall apply.**

It shall be the responsibility of the system integrator and OEM manufacturer to ensure that:

- The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use.
- All Passive Components in the structured cabling distribution network shall meet or exceed the relevant component specification of the EIA/TIA 568-B and EIA/TIA

568-C.2 series and ISO/IEC 11801: 2002 standards; or later version as applicable at the time of installation.

- The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.
- The specifications for items in this section, applies to the following:

a.) F/UTP CAT6Ecable and associated components such as Patch Panels, IOs/RJ45 Jacks, Patch Cords

b.) UTP CAT6E cable and associated components such as Patch Panels, IOs/RJ45 Jacks, Patch Cords

c.) Single-Mode fiber optic cable and associated components such as distribution shelves, LIUs, pigtails and patch cords

d.) Networking Racks – for termination of networking cables

Installation:

·The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows :

Conduit Diameter	**Inch/mm.**	**Max. No. of cables**
1"	25	2 Nos. Of F/UTP CAT6Ecables
1½"	40	4 Nos. Of F/UTP CAT6Ecables

1.1. F/UTP CAT6E CABLING SYSTEM

Description	**Specification**
Following common specifications shall apply to all F/UTP CAT6Estandards based structured cabling components, i.e., Cable, Patch Panel, IOs& Patch Cords. All components of the structured cabling system shall be from the same OEM manufacturer.	

Standards Compliance	F/UTP cabling system, conforming to ANSI/TIA/EIA 568-C.2 CAT6E Cabling system, ISO/IEC 11801 2nd edition, EN-50173-1. The cabling system components must be UL listed or equivalent
Warranty	Performance characteristics shall be provided along with the bids and actual tests conducted at site after installation and commissioning for the following parameters: Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel. 5-years' systems performance guaranty shall be provided and site shall be certified for guarantied performance by the OEM/manufacturer along with actual test results conducted at site. The cable shall be tested for minimum guaranteed performance as per standards at 500MHzoperation minimum.
OEM Requirement	All passive cabling must be from same OEM (UTP, F/UTP and Fiber)
F/UTP CAT6E	
Standards Compliance	As per 1.i) above
Conductors	23 AWG solid bare copper
Construction and mechanical details	Polyethylene insulation, LSZH jacket, each pair to be individually foiled.
Operating temperature	-20 Deg. C to +60 Deg. C
Delay Skew	Not exceeding 45 ns / 100m
Performance Characteristics	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel, to be submitted with
F/UTP CAT6EI/O Jack	
Standards Compliance	As per 1.i) above, UL Listed

Performance Characteristics	ETL Verified 4-Connector Channel to ISO/IEC 11801 AMD 1 Class EA, along with channel illustration, and parts numbers to be submitted along with the bid
F/UTP CAT6EPATCH	
Standards Compliance	As per 1.i) above
Ports	Ports loaded with shuttered or keystone Jacks
Port arrangement	Individually replaceable jacks or keystone
Height	1 U (1.75 inches)
Panel	Fully powder coated
Approvals	UL listed
Termination Pattern	TIA / EIA 568 A and B;
Performance Characteristics	ETL Verified 4-Connector Channel to ISO/IEC 11801 AMD 1 Class EA, along with channel illustration, and parts numbers to be submitted along with the bid
F/UTP CAT6EPATCH CORDS	
Standards Compliance	As per 1.i) above
Conductor	24-26 AWG, multi-stranded copper, UL Listed

Iii	Length	Pre-terminated (Factory Crimped) 1 Meter, 2 Meter, 3 Meter options in different colours
	FACEPLATES	
i	Type	1-port, 2 -port or 4-port, White Face plate
ii	Material	ABS / UL 94 V-0
iii	No. of ports	One/ Two / Four

The containment system for F/UTP CAT6E cabling shall consist of PVC conduits and multi-compartment raceways. PVC conduits shall be dedicated for all IT/ELV related cabling.

Wherever multi-compartment raceways are to be used, the F/UTP cabling for IT/ELV shall be laid in one of the dedicated compartments.

Exposed F/UTP cables in horizontal runs are not acceptable.

F/UTP cables bunched together with electrical distribution cables or other ELV cables such as fire detection, pubic address and IBMS signal/communication cables are not acceptable. Proper earthing/grounding arrangement shall be provided by the ELV System Integrator. Sharp bends such as at 90 degrees are to be avoided – the integrator shall follow OEM guidelines for maintaining bending radii.

OFC CABLING:

Description	**Specification**
OFC	
Type of Cable	Single Mode Optical Fiber Cable (SM-OFC)
Applicable Standard	ITU-T G.652.D (Low Water Peak)
Number of Fibers	12F
Operating Wavelength	1310 nm & 1550 nm
Cable Construction	Loose Tube
Loose Tube Material	PBT (Polybutylene Terephthalate)
Central Strength Member	FRP / Steel Wire
Water Blocking	Jelly filled & water-swellable yarn/tape
Armouring	Armoured (Corrugated Steel Tape or Steel Wire)
Outer Sheath	HDPE, UV resistant, Black
Operating temperature	–40°C to +70°C
Compliance	IEC 60793 / IEC 60794, RoHS

1.2 WALL MOUNTED NETWORKING ENCLOSURES (6U TO 15U USABLE HEIGHTS)

- Construction shall be single section welded robust with ventilation holes on the sides and top & bottom covers with provision to mount 2 fans
- Top/ Bottom covers and side panels shall be of sheet steel, powder coated
- Vertical metric panel mounts and door trims shall be of sheet steel and powder coated
- The top and bottom covers shall be provided with four cut outs on top and bottom cover for cable entry and round cuts shall be edge protected with rubber grommets
- Toughened glass front lockable door
- Wall mounted Networking rack shall be available in various heights
- Cooling shall be achieved with the help of two fans, 90 CFM capacity each, mounted on top
- Power shall be provided in form 19” rack mountable power strip which shall consist of minimum four 5/16A power sockets. Power strip shall be provided with 20A MCB
- Cantilever shelf – at least one front mounting 1U cantilever shelf shall be provided with depth of 250 mm or more
- 1U vertical cable managers on a/r (as required basis) for dressing of cables for 24 ports patch panel, 24 ports switch
- Hardware Pack / Rack mounting accessories and hardware – as required
- Horizontal managers on A/R basis for ensuring neat and aesthetically clean installation
- Cabinet material – cabinet shall be made of 16 Gauge (1.5mm) thick cold rolled steel sheets or thicker
- Finish – cabinet shall be black or grey epoxy powder-coated of durable quality
- Load carrying capacity – min. 25 kg load of equipment should be mountable
- Product must be UL listed and certified for use in Information Technology or Communication Equipment
- EIA standard pattern design with 12-24 tapped holes (EIA-310-E compliant)
- Dimensions – 6U to 15U usable height, 600mm (W), 450mm(D)

2. <u>ACTIVE COMPONENTS - NETWORKING SWITCH SPECIFICATIONS</u>

DESCRIPTION & DESIGN

- Networking infrastructure is a high performance design that factors important parameters such as aggressive use of IT + scalability and reliability.
- Key considerations for network are – gigabit connectivity to each user from the nearest distribution rack to various users/departments/devices in a topology consisting of core switches at central server room followed by the distribution and edge/access switches.
- The network shall have a mix of components for supporting PoE+ as well as non-PoE devices.
- A robust fiber optics based backbone is being provided. It shall be based on ring topology using single mode fiber optics cable. The vendor shall ensure that the networking switches shall be populated with the necessary transceivers for achieving this design objective.
- Several applications are proposed to run on this network – IP-based voice communications supporting voice-data-video, network based cameras and storage, integrated audio-video, video conferencing, interactive learning, integrated building management systems and important services integration such as fire detection.
- The integrators shall propose and supply enterprise class networking switches only.

2.1. SWITCH (MANAGEABLE)

Layer 3, 10/100/1000 Base-Tx Ports, PoE+, plus minimum 2 & maximum 4 dedicated SFP Ports Switch Architecture

- The switch should have 24 10/100/1000 Base-Tx ports <u>4 × 1G SFP /4 × 10G SFP</u>; all ports shall be 802.3at-compliant PoE+ capable, with the switch capable of providing minimum120 Watts of PoE power budget with required SFP Modules & Patch Cables.
- The switch should also support PoE as per802.3 af on all ports.
- Switch should have 10 Base-T/100Base-Tx/1000Base-Tx auto-sensing ports complying to IEEE802.3, IEEE802.3 at, IEEE802.3u and 802.3ab standard, supporting half duplex

mode, full duplex mode and auto-negotiation on each port.

- Switch should have minimum2 & maximum4 dedicated SFP ports.
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate.
- Switch should support both IPv4 and IPv6 – Switch should support features like Neighbour Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS over IPv6
- Switch should have non-blocking switching bandwidth of minimum 24Gbps.
- Switch should have forwarding rate of minimum 14Mpps.
- Switch should have dynamic routing layer 3 features

· Switch should be IPv6-Ready from Day 1

Supported upto to Layer 3 Features

- The Layer 3 switch should support full Layer 3 features like PIM-DM/, PIM-SM, RIPv1/v2, OSPF, PBR, ECMP, BGP and VRRP; it shall be supplied with all requisite licences for implementing Layer 3 capabilities
- The Layer 3 Switch should support for full IPv6 features like RIPng, MLD v1/v2, OSPFv3, VRRPv3 and IPv6 management
- The Distribution switch should support virtualization routing and forwarding
- Inter-VLAN IP routing for full layer 3 routing between two or more VLANs
- IP unicast routing protocols (static, RIPv1/v2 & OSPF)
- Virtual Router Redundancy Protocol (VRRP) as per RFC 3768 or equivalent
- Switch should support IGMP v1/v2/v3 as well as IGMP v1/v2/v3 snooping or Proxy
- Switch should support up to 512 multicast groups/entries
- Inter-VLAN IP routing for full layer 3 routing between two or more VLANs
- The switch should support all Layer-3 functionalities
- Switch should have valid OEM advance hardware & software support for resolving technical issues if any.

Security Features:

- Switch should support MAC Address based Filters / Access Control Lists (ACLs) on all switch ports
- Switch should support Port based Filters / ACLs
- Switch should support RADIUS and TACACS+ for access restriction and authentication
- Secure Shell (SSH) Protocol, HTTP and DoS protection
- IP Route Filtering, ARP spoofing, DHCP snooping
- Switch should support static ARP, Proxy ARP, UDP forwarding and IP source-guard

Management Features

- The switch should support CLI based or Web-based Management, via a console port
- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3
- Switch should support all the standard MIBs (MIB-I& II)
- Switch should support TELNET and SSH Version-2 for Command Line Management
- Switch should support 4 groups of embedded RMON (history, statistics, alarm and events)
- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers
- Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3functions, VLAN, STP, Security, QoS should not require rebooting of the switch
- Switch should have comprehensive debugging features required for software &hardware fault diagnosis
- Switch should support multiple privilege levels to provide different levels of access
- Switch should support SNTP (Network Time Protocol)
- Switch should support FTP/TFTP for software upgrade
- Switch support multiple configuration file & backup configuration file

2.2. WIRELESS LAN INFRASTRUCTURE (CONTROLLER AND ACCESS POINT)

2.2.1. ARCHITECTURE

- ·Wireless deployment should be on a centralized controller-based architecture with the controller in High Availability mode providing seamless scalability

- The architecture should be scalable
- Redundancy should be built in the architecture, i.e., 1+1 controller configuration.
- Redundancy should be built in the architecture where there is no single point of failure
- Solution should support application visibility and control
- Should support Band Steering/Band Select to force clients with dual band support to register to only 5Ghz, thus freeing up capacity in 2.4Ghz
- Supports complete local AAA authentication and including 802.1xas primary or backup to a centralized AAA server
- All AP's & WLC's should have valid licenses from OEM for atleast 5 Years
- It should have Internal Captive Portal including support for external CP
- The WLAN APs must support either internal RADIUS server or external RADIUS servers for user authentication
- Solution should support Campus or Public Cloud mode of management for Management and Control
- Solution should also support Hotspot 2.0 (IEEE 802.11u)
- Should support IEEE 802.1x with multiple EAP types (TLS or EAP/MSCHAP or TTLS or equivalent)
- Wireless system should support IPv6 from Day 1
- Radio Resource Management capabilities for radio self-test and healing shall be supported by the solution
- Wireless solution shall support IEEE 802.1q – VLAN Tagging
- Wireless solution shall support IEEE 802.1p – Layer 2 Traffic Prioritization
- Wireless solution shall support IPv6 Control for an increased wireless device density through control of unnecessary IPv6 traffic on IPv4-only networks
- Solution must have capabilities to set a maximum per-user bandwidth limit on per-SSID basis
- WLC & AP's should have valid OEM advance hardware & software support for resolving technical issues if any.

2.2.2. WIRELESS CONTROLLER

- The controller shall have two 10Gb ports
- The controller shall support 1500 access points without hardware change
- Shall support 1+1 ,N+1 ,N+N redundancy models
- The primary controller should have the capabilities to cater all the APs independently and incase of any failure the secondary/redundant controller should take entire load

WLAN controller management features

- Shall support spectrum analysis from day one - to detect and mitigate non Wi-Fi interference
- Shall support band navigation/band select functionality to enables redirection of 5Ghz clients to 5Ghz radio
- Shall support VLAN pooling which ensures assignment of VLANs to SSID
- Shall support AP grouping to enables an admin to easily apply AP-based or radio-based configurations to all the AP that arein the same group
- Controller/Solution should have basic profiling capabilities
- Controller should support deep packet inspection for all user traffic across Layer 4-7 network to analyses information about applications usage, peak network usage times for all access points from day one in a central and local switching mode

WLAN controller security features

- Shall support integrated system of detection for wireless intrusion from day one
- Controller should support Rogue AP detection and classification and should have WIPs signatures

WLAN controller performance features

- Shall support layer 3 roaming and fast roaming
- Shall support airtime fairness
- Shall support client load balancing based on sessions and traffic load
- Shall support bandwidth limiting per SSID

2.2.3. WIRELESS LAN MANAGEMENT

WMS should support following broad life cycle management features:

i. Configuration and policy management

ii. Performance monitoring

iii. Reporting and analytics

iv. Security monitoring

v. Troubleshooting

WMS should support following key features:

i. Web-Based Interface

ii. Network Discovery

iii. Detailed AP Status

iv. Station Troubleshooting

v. Policy Configuration

vi. Wireless Heat Maps

vii. Security Monitoring

viii. 802.11 Packet Capture

ix. Device Identification

x. Reporting

WMS dashboard should provide real time summary of status and activity based on parameters such as:

i. AP and Radio Status

ii. AP/Radio Throughput

iii. Rogue & Threat Overview

iv. Most Recent Alarms

v. Station Information

- It should be possible to drill down to individual AP station(s) for troubleshooting and proactive station monitoring, alerting on errors, rates, signal levels
- It should be possible to Assign and configure newly discovered Wireless APs with default or pre-selected policies & Configuration templates applied to individual or AP groups

- Solution should support Layer 2 and Layer 3 roaming
- It should be possible to locate function in map showing station location & Use signal from multiple APs for location identification & should also display station/rogue details
- WMS should have ability to display heat maps and clients
- Wireless solution should support techniques for automation of configuration and service provisioning & also simplify adds, moves, and changes of authenticated and authorized network endpoints
- Wireless solution should support complete AAA authentication, including 802.1x,as primary or backup to a centralized AAA server
- WMS Software should be installable on an VM environment or appliance
- WMS should have functionality to generate graphical maps showing wireless coverage heat maps, devices and location
- Solution should support troubleshooting tools, packet capture and reports to resolve connectivity and performance issues
- Solution should allow automated deployment of new software image to one or more APs, or groups of APs for centralized management through controller
- Customizable view listing security events by type, detected by APs, with time detected, mac address of device and SSID
- Web access (https) for configuration, SNMP v1, v2c, v3
- Syslog support for system monitoring

2.2.4. ACCESS POINT

- Dual Radio, with 802.11a/n/ac (5 GHz) and 802.11g/n (2.4 GHz) concurrent operation
- 4X4:3Multiple Input / Multiple Output (MIMO) Wave 2 access point
- Internal/external antennas for 2.4Ghz and 5Ghz operations with one 10/100/1000 Base-Tx auto-sensing (RJ45) PoE+ port
- AP must have two radios (2.4GHz or 5GHz)
- Maximum Associated Users: 240 (120 per radio)

- AP must have two ethernet ports for link aggregation
- Power Supply: via an 802.3at POE+switch port or OEM supplied Power Injector
- Access point should be 802.11ac Wave 2 from day 1
- IEEE 802.3 10-BASE-T, IEEE 802.3u 100BASE-TX, 1000BASE-T, IEEE 802.3ab 1000BASE-T
- AP must include OEM supplied mounting brackets and accessories for various mounting options such as ceiling, wall or rooftop

Security:

- WPA
- IEEE 802.11i WPA2
- RFC 2246 TLS protocol version 2.0
- RFC 3280 Internet X.509 PKI certificate and CRL profile
- RFC 4346 TLS protocol version 1.1/1.0

Encryption:

- WEP – 64 and 128 bit, TKIP-MIC: RC4 40 bit, 104 bit and 128 bit, SSL & TLS: RC4 128-bit
- PHY data rates up to 1.8Gbps per AP
- Support for band steering, client load balancing, LLDP
- Should support 802.1X authentication
- Should support centralized configuration and management and reporting
- Solution should have Bonjour Support for supporting Apple devices
- Should support Wi-Fi Alliance Protected Access 1.0 (WPA) and 2.0 (WPA2)

3. VIDEO SURVEILLANCE SYSTEM

GENERAL

- The Surveillance System components must be TCP/IP based components working on a separate LAN network (LAN).
- Surveillance system must be scalable in terms of equipment (no. of cameras), storage capacity and licenses.

- True open platform functionality is an essential aspect of this specification; cameras from different OEMs must be able to integrate seamlessly with the specified 3rd party VMS software platforms without any loss of features and functionality. Similarly, supplied VMS software platforms must also be able to integrate with a variety of cameras from different manufacturers in future.
- For better saving on storage and bandwidth the compression used shall be H.264 high profile for all types of cameras and devices. H.264 high profile shall be a common requirement for all cameras and devices irrespective of whether mentioned in individual sub-sections or not or if mentioned otherwise.
- All cameras shall be vandal resistant as per IK10 rating.
- **All cameras shall be ONVIF Profile S compliant and must be SQTC certified**
- Cameras shall have a wide dynamic range of between 85 to 95dB (for Fixed Box/CS-Mount and Indoor Dome/Mini-dome models and between 120 to 130dB (for indoor/outdoor PTZ models)for ensuring good image performance in varying light conditions.

3.1. CAMERA GENERAL REQUIREMENTS:

- The camera shall be a Full HD camera supporting triple streaming of codecs; simultaneously generating and transmitting JPEG and two independent H.264High Profile video streams different in resolutions and frame rates.
- The camera shall have a 1/3" type CMOS/CCD/MOS sensor of approx. 2.0 Megapixels and have a True day/night capability.
- The camera shall incorporate a built-in 10X optical, auto-focus zoom lens, and shall have 20X digital zoom capability with 360X total zoom capability.
- The camera shall be able to automatically sequence through the preset positions in programmable sequence, i.e., preset tours.
- The camera shall produce a high quality picture with a minimum illumination of 0.4 lux in color mode or 0.02 lux in B/W mode at F1.6 or better. It shall offer IR cut filter that switches on/off to enhance low-light sensitivity during B/W mode.
- The camera shall be equipped with an intelligent automatic backlight compensation

capability, mask settings and level adjustment capabilities to compensate for backlight by masking out brighter areas.

- The camera shall have feature to transform shadows and dark areas into natural and crisp images in real time.
- The camera shall support automatic tracing white balance adjustment capability.
- The camera shall have light control mode to select the operating environment, i.e., indoor or outdoor.
- The camera shall have a 2D and 3D noise reduction capability for reducing AGC noise to provide clear images without motion blur.
- The network interface shall be an 8-pin RJ-45 connector, 10Base-T/100Base-TX Ethernet. Both IPv6 and IPv4 shall be supported.
- The camera shall support JPEG and H.264 high profile compression. The minimum resolution for each codec shall be 1920x1080.
- The camera shall be capable of generating HTML code for the video image, allowing for easy web page integration.
- The camera shall be capable of supporting up to five (05) users simultaneously over the network.
- The camera shall have the capability to stream JPEG and H.264 high profile video in TCP protocol H.264 in UDP (unicast/multicast) protocol.
- The camera shall incorporate a built-in algorithm for intelligent motion detection capability. The camera shall offer this feature with minimum four configurable areas per scene and ten sensitivity levels adjustments.
- The camera shall have 2-way audio features, i.e., the camera shall have built-in audio input and output jacks and be capable of transmitting and receiving full duplex audio stream on the same Ethernet connection as the video. The audio shall be encoded using the G.726 or equivalent ADPCM standard.
- The camera shall support the following network protocols: TCP/IP, UDP/IP, HTTP, HTTPS, RTSP, RTP, RTP/RTCP, FTP, SMTP, DHCP, DNS, DDNS, NTP, SNMP, UPnP
- The camera shall support HTTPS client authentication.

- The camera shall be compliant with the industry standard ONVIF (Open Network Video Interface Forum) specification with Profile S compliance.
- The camera shall have user configurable port settings.
- The camera shall have an email (SMTP) notification capability and shall support scheduled transfer of image data via FTP to an FTP server.
- The camera shall have privacy zone masking for blocking out unwanted or prohibited areas within the video image to protect privacy.
- The camera software should include IP Setup (including group camera management) program, Firmware Upgrade Tool, Privacy Masking Tool. The software shall be supplied with the camera as a standard accessory.
- The minimum electronic shutter setting shall be 1 second, and a maximum of 1/20,000 sec.
- The camera shall have 4 external I/O Terminals for external control.
- The camera shall be capable of limiting bandwidth from 64 kbps to 8 Mbps in H.264 mode while also being able to operate without bandwidth limitation in JPEG format.
- The camera shall be capable of automatically transmitting alarm images transfer via FTP file transfer and/or e-mail. In addition the network camera shall support scheduled transfer of image information via FTP to an FTP server.
- Terminal inputs, video motion detection alarms, and alarm commands shall be able to trigger actions such as memory recording, FTP file transfer, e-mail notification, alarm indications on web browser, alarm terminal output, and alarm command.

CAMERA LENS SPECIFICATIONS:

- The camera shall have an integrated minimum 10X auto-focus .
- Focal length shall be 4.3 to 129 mm with field of view coverage of 2.4° to 63.5°.
- The aperture range for the lens shall be F1.6 to F4.7.

VIDEO-ELECTRICAL REQUIREMENTS:

- The camera input power shall be PoE+ or optionally AC/DC 24V which shall be included in supply, if necessary.
- Power consumption for the camera shall be 20 watts maximum.

AUDIO REQUIREMENTS:

- ·The camera shall support bi-directional audio, using G.711 (64kbps) and G.726 (32kbps) codecs.
- It shall support audio modes such as - OFF or Mic (Line) input or Audio output or Interactive (Half duplex) or Interactive (Full duplex)
- The camera shall have mini-jack connectors accessible via pigtail to support external microphone and active speakers.

4.LED WALL SCREEN

LED Wall screen supplied and installed to be with the following or better specifications:

LED package-SMD2020 equivalent or better for indoor office use

Resolution- Full HD (1920 pixels wide by 1080 pixels high) or Higher resolution

Refresh rate- 1920Hz to 3840Hz

SMD (Surface Mounted Device) LED Displays-Viewing angle between 120-140 degrees

Brightness – 1000CD

Connectivity- 3 xHDMI/1x Ethernet/ 2xUSB C/1X VGA/Wi Fi/1X DVI-I/ 1X DVI-D

Screen Size- As specified in the boq

Material of the Cabinet: Mild Steel

Aspect Ratio: 16:9

LED Configuration: RGB 3 in 1 SMD

Response Time(milliseconds):2

Frame Frequency (Hz): 50 – 60

Contrast Ratio: 5000:1

Anti-glare-Yes

Fan less operation-yes

Orientation-Landscape

Ethernet-10 / 100 Mbps , 10 / 100 / 1000 Mbps (OPS) × 1

Flicker Free-Yes

Make-As specified in the approved make list

5.INTERACTIVE LED SCREEN

LED Interactive screen supplied and installed to be with the following or higher specification:

Panel Screen size-As specified in the boq

Panel type-IPS

Aspect ratio-16:9

Resolution- Full HD (1920 pixels wide by 1080 pixels high) or Higher resolution

Response time-2 ms

Color depth-10-bit

Orientation-Landscape

Panel brightness -450 nits

Contrast ratio -1200:1

Dynamic contrast ratio-30,000:1

Color gamut-72% NTSC

Anti-glare-Yes

Hardness-9H tempered

Touch screen -Touch technology-Infrared touch

Touch points-20

Touch response time< 4 ms

System Memory | Storage 4GB | 32GB

OS Android- latest or as specified by the OEM

Connectivity 3 xHDMI/1x Ethernet/ 2xUSB C/1x VGA/Wi Fi/1x DVI-I/ 1x DVI-D

3.5 mm Line in (1) Mic × 1

3.5 mm Line out-Earphone × 1

OPS slot (for slot-in PC)-1

S/PDIF out-0 | 1 (optical)

Ethernet-10 / 100 Mbps , 10 / 100 / 1000 Mbps (OPS) × 1

3.5 mm Line in (2)-PC Audio × 1

RS-232-1 | 0

Built-in peripherals

NFC sensor-Yes

Motion sensor-3

Microphone-8 (Max. pickup range 8m)

Speaker-2 × 16 W

Air sensor-TVOC

Subwoofer-1 × 15 W

White boarding- yes

Wireless screen sharing- Insta Share 1

Flicker Free-Yes

Low Blue Light-Yes

Make-As specified in the approved make list

6. AUDIO AMPLIFIERS

Class D amplifier as per the power specified in the boq with internal DSP 96KHz with 10 band PEQ/ LS6/ LS12/ HS6/ HS12/ APF for each in and out, 20 presets, control through USB through computer, XLR input and XLR loop output connector, speakon connectors for speaker output, Power factor correction.

THD< 0.05% in 20Hz to 20KHz, signal to noise ratio > 120 dB, frequency response- 20Hz-20KHz, damping factor > 2000, amplifier input gain selector switches of 0.7/1.0/1.4

Front panel on/ off switch, front to rear airflow, front panel indication with on screen display

Circuit protection- input limiter, short circuit protection, DC protection of output, under & over voltage protection, SOA protection, intelligent mains fuse protection, power stage overload protection, temperature protection for transformer

Output circuitry- Class D - full bandwidth PWM modulator with ultra low distortion

Power supply- Universal & regulated switch mode power supply with Power Factor Correction, Universal Mains, 90-270V AC

Make-As specified in the approved make list

7.LOUDSPEAKER

Speakers as specified in the boq with Full range, 2-Way Passive Loudspeaker. Frequency Range (-10 dB)-46 Hz – 20 kHz, Power capacity – as specified, Sensitivity-96 dB, Maximum Peak SPL-

128dB, Coverage Angle-85° conical, LF Driver - 12-inch with 3-inch Voice Coil, HF Driver- 1-inch Exit, 1.75-inch voice coil, compression driver. Nominal Impedance-8Ω, Input Connections-2 × NL4, 1 × barrier strip, Enclosure-Trapezoidal, plywood, black texture paint finish, Perforated, powder-coated steel grille.

Make-As specified in the approved make list

8.DIGITAL MIXER

16 Channel Touch Screen Digital Mixer as specified in the boq with 7" Diagonal Color TFT Screen, 16 Mic/Line Inputs (4 XLR, 4 XLR/Jack Combo), 2 Stereo Line Inputs (1/4" TRS), Stereo USB / MP3 Playback, 1 x Talkback Input with XLR Connector, 4 Band Parametric EQ, Gate & Compressor Input Processing, Balanced Main LR Output on 2 x XLR (Line Level), 6 x Balanced Aux Outputs on XLR (Line Level), 1 x Stereo TRS Headphone Output, 1 x Stereo TRS Monitor L/R Output, 1/3 Octave Graphic EQ, 6 Band Parametric EQ, Variable High & Low Pass filters, 8-Band Anti-Feedback Filters, Limiter, Delay Output Processing, Stereo mp3 & 22 x 22 Multitrack Recording & Playback direct to hard drive, 8 DCA Groups with Mute, 8 Mute Groups, 4 Simultaneous Effects Processing including Reverb, Echo, Delay, Chorus, Pitch Shift etc.1/3 Octave RTA assignable to channels or user selectable source, 99 User Scenes, 120 Factory Presete, 99 User Presets. External Control using wifi enabled iOS or Android devices, USB Wifi Adapter Included in Package, Selectable 44.1 kHz ot 48 kHz Sampling Frequency , 32 Bit Floating Point Internal Processing, THD <0.005% at +4 dBu, 20 Hz to 20 kHz, Unity Gain, any input to any output, Dynamic Range 105 dB,Crosstalk -80 dB, S/N Ratio -94 dB, Mic Input Gain - 75 dB (60 dB Analog, 15 dB Digital), Maximum Input Level +16 dBu on XLR Mic/Line Inputs, +26 dBu on TRS Mic/Line Inputs, +22 dBu on Stereo Inputs, Maximum Output Level +22 dBu on all line level outputs.48V Phantom Power Individually Switchable on all Mic Inputs.

Make-As specified in the approved make list

9.AUDIO MIC

9.1-Wired mic as per the specification equivalent to below or better:

Capsule Type	Dynamic

Frequency Response	40Hz-16kHz
Sensitivity	-52dB±3dB (0dB=1V/Pa at 1KHz)
Signal to Noise Ratio	>70dB
Output Impedance	600Ω±30% (at 1kHz)
Polar Pattern	Unidirectional, Hyper cardioid
Connection	Wired Phone Jack
Operating Temperature	0°C~40°C

Make-As specified in the approved make list

<u>9.2 -Wireless Mic set complete as per the Specification equivalent to below or better:</u>

Working Frequency		632 - 661.25MHz
Modulation Type		FM
Number of Channels		100
Channel Spacing		250kHz
Dynamic Range		82dB
Maximum Deviation		±45kHz

Frequency Response		120Hz~15KHz (±3dB)
Signal to Noise Ratio		>70dB
Polar Pattern		Unidirectional
Composite Distortion		≤1%
Working Temperature		-10°C ~ +40°C
Package Dimension		As per actual
Gross Weight		5.2Kg
Receiver		Wireless Connector: BNC/50Ω
Receiver		Sensitivity: ≤-95dBm
Receiver		Operating Power: DC12V, 600mA

Make-As specified in the approved make list

10.EPABX-MINI EXCHANGE

Specification equivalent to below or better:

Fully Unified Communication EPABX System

Complete Converge with Voice, with up to 10 Analogue extensions,

Digital Console Rack Mountable Kit

In Built Features: Auto Attended(Voice Response System) Audio Conference Least Call Routing.

Make-As specified in the approved make list

11. Video Conferencing-System

Specification equivalent to below or better:

- All-In-One Video Conference Equipment
- 4K Video Bar
- 20MP Dual Cameras,
- Mic-Built in
- 140° FOV
- Large Room Coverage
- Wireless LAN connectivity
- HDMI In/Out
- USB Connectivity A and C type
- Ethernet connectivity

Make-As specified in the approved make list

Note: Latest edition of above mentioned codes shall be referred and contractor shall ensure that all the items supplied and Installation meets the latest revised standards/ Norms as notified by the applicable regulatory/Govt. agencies.

APPENDIX-1

GUARANTEE PROFORMA

GUARANTEE FOR INSTALLATION

We hereby guarantee the System which we have installed in the

Project described below :

Project :

Location :

Owner :

For a period of 12 Months from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorise the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

WE ALSO HEREBY UNDERTAKE to test the entire installation upon completion and ensure that all units are functioning satisfactorily.

SIGNATURE OF CONTRACTOR

DATE SEAL

APPENDIX-1

GUARANTEE PROFORMA FOR COMPLETE MEP WORK

GUARANTEE FOR INSTALLATION

We hereby guarantee the System which we have installed in the
Project described below :

Project :
Location :
Owner :

For a period of **12 Months** from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorise the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

Special Note 1: For electrical light fittings as mentioned in the boq- 24 Months onsite warranty to be provided .

Special Note 2: For ELV and ELV Audio Video equipments as mentioned in the boq - 60 Months onsite warranty to be provided.

WE ALSO HERE BY UNDERTAKE to test the entire installation upon completion and ensure that all units are functioning satisfactorily.

SIGNATURE OF CONTRACTOR

DATE SEAL

LIST OF APPROVED MAKES

COPA OFFICE BUILDING-APPROVED MAKES FOR MEP		
A.HVAC SYSTEM		
Sl No.	**Description**	**Make**
1	Variable Refrigerant Flow System	Daikin /Mitsubishi heavy/Toshiba
2	Centrifugal Fans	Greenheck/Nicotra/Comefri/ Kruger/ Chaysol
3	Inline Fans	Caryaire/ System air (Sweden)/ Ostberg (Sweden)/ Chaysol(Spain)
4	Propeller Fans	Greenheck/Nicotra/ Alstom/Kruger/ Airflow
5	Axial Flow Fans	Greenheck/Nicotra/ Alstom/Kruger/ Airflow
6	V-Belts	Fenner India/Dunlop/Sanlux
7	Voltage Stabilisers	Vguard/Aulten/Microtek/Luminous
8	Extract Fan Sections	Nicotra/Zeco/ Roots / Edgetech/V-Hitech
9	Strip Heaters	Dasspass or equivalent
10	Airwashers	Ambassador /Roots/ Edgetech
11	Cellulose based Paper fills	Glacier-Cor/Munters/DP engineers
12	Motors	Siemens/Bharat Bijlee/ ABB
13	Air Curtains	Beacon/Thermadyne/Aircon
14	Copper Pipes	OEM approved Make from one of these-Uniflow, Papriwal, Mandev, Mehta Tubes, Kaliraj Impex, or S.K
15	Split Units	Daikin /Mitsubishi heavy/Toshiba
16	Compressor	Daikin /Mitsubishi heavy/Toshiba
Sl No.	**Description**	**Make**
AIR DISTRIBUTION		
1	GS Sheet	SAIL/ ISCO/ TataSteel/ National/Jindal
2	Factory Fabricated Ducts	Rolastar/Zeco/Techno Fabriduct/Ductofab
4	Wire rope suspension arrangement	Gripple/ Ductmate/ Acrefine
5	Pre Filters	Anfilco/Thermadyne/Spectrum/SAGI Cofim
6	Fine Filters/ Hepa Filters/Activated carbon filters	Anfilco/Thermadyne/Spectrum/SAGI Cofim

7	Metallic air Filters	Suvidha/ Zeco/ Edgetech/ Nutech
8	Antivibration canvass sleeve	Suvidha/ Zeco/ Edgetech/ Nutech
9	Extruded Aluminium grilles &diffusers	Dynacraft/Servex/ Air Master/ Precise
10	Plaque Type diffusers	Dynacraft/Servex/ Air Master/Precise
11	Swirl Diffusers	Dynacraft/Trox/ Air Master/Precise
12	Jet Nozzles	Dynacraft/Trox/ Air Master/Precise
13	Air transfer grilles	Dynacraft/Servex/ Air Master/Precise
14	Smoke cum Fire Dampers and actuators	Greenheck/Ruskin/Dynacraft/Servex/Belimo/Joventa / Siemens
15	Sound Attenuators	Intertec (Noida)/Titus/Sound Control
16	Intake Louvers	Dynacraft/Servex/ Air Master/Precise
17	Duct Dampers	Dynacraft/Servex/Easyflow
18	Dash fastners/ suspension accessories with anti-seismic feature	HILTI/Fischer/ Canon
19	Flexible Ducts	Caryaire/ Atco/ Global
20	Fire retardant Flexible connections for ducts at building expansion joints	Resistoflex/Gerb/Easyflex
Sl No.	**Description**	**Make**
INSULATION		
1	Fibre glass	UP Twiga/Owens Corning/Johns Manville/ Knauf Insulation/ CertainTeed
2	RP Tissue	UP Twiga/Owens Corning/Johns Manville/ Knauf Insulation/ CertainTeed
3	Closed/open cell Elastomeric Thermal/Acoustic Insulation	Armaflex/Eurobatex/Aeroflex/K-flex
4	Adhesive for closed cell insulation	Pidilite/Aeroseal Glue/Paramount
5	Expanded polystyrene	Beardsell/Styrene Packing
6	Aluminium Tape	3M/Magic/Nippon/I-Stix

7	Aluminium foil	INDALCO/BALCO/Nippon
8	PUF pipe supports	Malanpur Entech/Bestopuf/Shelko/Bituplus
9	Mo Ply Polyster Membrane	Malanpur Entech/Bestopuf/Shelko/Bituplus
10	External surface treatment of insulated surface to achieve mechanical strength & UV protection	Paramount Polytreat/Polybond/Nippon
B.ELV AND AUDIO VIDEO		
Sl No.	**Description**	**Make**
1	Telephone jack	Legrand/ Schneider/ Wipro
2	Telephone	Panasonic
3	Telephone Wire/cable	Finolex/Havells/Polycab
4	Mini exhange	Matrix, NEC, Panasonic ,Syntel
5	LAN Socket	Legrand/ Schneider/ Wipro
6	CAT 6E / OFC cable	Comsol/Commscope
7	Network Switches	Cisco
8	Network Rack	Legrand/Valrack/Netrack
9	Conduit	Balco/Conseal/Precision
10	Camera	Hikvision-SQTC Certified
12	Wireless Access Point	Cisco
13	Wireless controller	Cisco
14	Small form-Pluggable (SFP)	Cisco
15	LED Wall Screen	Samsung/Sony/LG
16	Amplifier	3DB PRO/Yamaha/Bose
17	Speakers	QSC/Yamaha/Bose
18	Touch Screen Digital Mixer	QSC/Yamaha/Bose
19	Microphone	Norden/Rode/Sennheiser/Shure
20	Interactive LED Display	Samsung/Sony/LG
21	Ceiling Recessed Mic	Collaborate versa pro ct or equivalent
22	Video Conferencing-All-In-One	Polycomm/HP /People Link
23	Wall plate transmitter	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
24	HDMI Receiver	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
25	HDMI Patch Cable	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
26	Speaker Cable	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
27	Microphone Cable	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
28	Audio Stereo / Control Cable	Kramer/Belden/Rode/ Samson/Proel/ Bespeco
C-FIRE PROTECTION SYSTEM		
Sl	**Description**	**Make**

No.		
1	Fire Pump Electric/Diesel	Kirlosker/Wilo Mather and Platt
2	Pressure Gauge	H-Guru / National/Ashcroft/ Emerson
3	Flow switch	H-Guru / National/Ashcroft/ Emerson
4	Pressure switch	Indfoss/Karthar/CRI/Danfoss/Wika
5	Butterfly valve/non-return valve	Karthar/CRI/Ziegler
6	MS Class B/C Pipes	Jindal/TATA/SAIL
7	Hydrant valve	Monsher/Newage/Cease Fire
8	RRL Hose/Branch Pipe	Monsher/Newage/Cease Fire
9	First-aid Hose Reel	Monsher/Newage/Cease Fire
10	Hose Cabinet	Friends/Capital Gains/Ceasefire/ Armor Fire/ GUARDS India/ AAAG
11	Sprinkler	Sharp/Monsher/Kanex /Armor
12	Air Release Valve	Atom/TBS/AVK/BERMAD/ Leader Valves
13	Fire brigade connection	Karthar/CRI/NewAge/Safex/Ceasefire/HD Fire Protect
14	SS Tank Filling Unit	Karthar/CRI/NewAge/Safex/Ceasefire/HD Fire Protect
15	Yard Hydrant	Karthar/CRI/NewAge/Safex/Ceasefire/HD Fire Protect
16	SS Strainer	Karthar/CRI/NewAge/Safex/Ceasefire/HD Fire Protect
17	Flexible pipe for sprinkler	Sharp/Monsher/Kanex /Armor
18	MS Channel support	Hi-Tech or equivalent
19	Manual Call Point	Ravel/Agni/Apollo/Notifier/ Cooper
20	Fire alarm sounder	Ravel/Agni/Apollo/Notifier/ Cooper
21	Smoke/Heat Detector	System senseor/GST/Ravel/Agni/Apollo/Notifier/ Cooper
22	Fire alarm armoured cable	Finolex/RR/Polycab-FRLSH
23	Talk back unit	Ravel/Agni/Apollo/Notifier
24	Speakers	Ahuja/QSC/Yamaha
25	Speaker wiring	Finolex/RR/Polycab
26	Conduit	Balco/Conseal/Precision
27	Mic	Ahuja/QSC/Norden
28	Amplifier	Ahuja/3DB PRO/QSC
29	Fire Extinguisher	Winmex/Saftyone/Ceasefire/Safex Fire Services/ Kanex Fire/NewAge Fire Protection/Safepro
	D-PLUMBING	
Sl No.	**Description**	**Make**
1	Flush tank-Concealed	Gebberit
2	Sanitary Items	Cera
3	CP Fittings	Jaquar
4	PVC pipes & specials	Supreme / Astral/Ashirvad

5	UPVC pipes ASTM SH-40/80, CPVC SDR11	Supreme / Astral/Ashirvad
6	Ball valves	Kirlosker/ZOLOTO/ RB / TBS/Inter valve /SKS
7	Butterfly valves	Kirlosker/ZOLOTO/ RB / TBS/Inter valve /SKS
8	Air relief valve	Kirlosker/ZOLOTO/ RB / TBS/Inter valve /SKS
9	Foot valve, NRV	Kirlosker/ZOLOTO/ RB / TBS/Inter valve /SKS
10	GI clamps, Rails, legs and accesseries	Hi-tech or equivalent
E-ELECTRICAL		
Sl No.	**Description**	**Make**
1	HT & LT Cables (XLPE)	Polycab /Havells/Gloster/Universal/KEI/APAR - FRLS
2	Relay & Controls IS 3231 Sec 2, 3, 4	Prok Devices/ABB/Siemens/Schneider
3	MCCB's/ACB's	ABB/Schneider/Lk/Legrand
4	LT SFU/Switch Disconnector	ABB/Schneider/Lk/Legrand
5	HT cable termination kit[Heat shrinkable type]	Raychem/M-Seal/ Equivalent or Better
6	KWHR, KW Meters/TOD	Lk/Schneider/Genus
7	Current Distribution transformer	Kappa/ Torrid /Equivalent or Better
8	MCB’s, RCCB&RCBO	Legrand /Schneider/Lk
9	Switches & Sockets	Legrand-Myrius or equivalent/better
10	Wires-FRLSH	Finolex/RR Kabel/Havells/Polycab/KEI - FRLSH
11	Cable gland	Dowell’s/ Jainson/HMI
12	PVC Conduits	Balco/Conseal/Precision
13	Fans	Crompton/Havells/Orient
14	Light fixtures/lamps	Philips/Wipro/Havells/LT
15	Exhaust Fans	Almonard/Havells/Crompton
16	Crimping sockets	Dowell’s/ Jainson/HMI
17	HRC Fuse & Fuse Carrier	Seimens/ABB/Schneider
18	Capacitor	Meher/Schneider /Epcos
19	Distribution board	Legrand/Havells/Shneider
20	MDF/IDF boxes	Krone/Havells/Hensel
21	Weather proof polycarbonate boxes	Sintex/ C&S /hensel
22	Contactor	Siemens/L&T/Schneider
23	Panel Indication LED/Pushbutton/ Emergency stop push button	Schneider/Lk/C&S
24	CRCA Sheet Material for Electrical Panel Board	Tata/Jindal/SAIL
25	Multifunction Meters	Conzerv (Schneider) /Secure/C&S

26	Diesel Generator	Kirlosker/Cummins/Greaves Cotton/Powerica (Alternator - CROMPTON GREAVES, STAMFORD, LEROYSOMER, KIRLOSKAR, KEL, BHEL)
27	UPS	APC/Liebhert/GE/Emerson/Eaton
28	UPS Batteries	Amaron/Exide
29	LT Panels	ABB/HESEL/ WAVES/POWER CONTROLS /L&T/ SIEMENS/SCHNEIDER/ IMPERIAL/ CAMEX or CPRI approved make.

3.DRAWINGS

(DRAWING ATTACHED SEPARATELY)