Construction of Office Building for Amaravati Local Head Office and Other Outfits at Amaravati, Andhra Pradesh in EPC Mode.

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TENDER DOCUMENT

Tender No.: SBI/AMR/P&E/2025-26/10/20

Name of the work: - Construction of Office Building for Amaravati Local Head Office and other Outfits at Amaravati, Andhra Pradesh in EPC Mode.

Part- E

Technical Specifications

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TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS (GENERAL)

CHAPTER -A

BRIEF OF REQUIREMENT OF THE WORK:

1. Introduction:

The scope of work relates to Construction of office building for Amaravati Local Head Office and other outfits at Amaravati,India in EPC Mode. The work is to be executed Design, Engineering, Procurement & Construction (EPC) basis as laid down in the Master Plan, Concept plans, Design Brief Report and tender drawings including Operation & Maintenance of buildings/services after completion and handing over in phases and up to the expiry of the defect liability period of complete project.

The scope of work shall also include Electrical works, Mechanical works, Electronic works, Plumbing, Sanitary, Sewerage, Storm water drainage, & Fire-Fighting works etc. including maintenance during defect liability period including & preparation of all detailed drawings, obtaining approval from all local authorities, electrical inspector, water, sewer, drainage, electricity connection from local bodies, permission / approval for tree replantation etc. to be executed as integral part of the project. As CLIENT, SBI aims at getting IGBC Platinum & Net Zero Building Certification (Energy) prospective bidders are required to provide adequate documentation & all other requirements relevant to enable CLIENT/SBI in achieving these objectives as referred above. The following are the salient features of the Works:

a. Foundations & other works like underground water tanks.
b. Retaining wall
c. Sub structure RCC framed structure
d. Super structure RCC Framed structure with brick filler walls
e. Water proofing treatment works
f. UPVC door and windows, etc.
g. Façade System (Energy Efficient Performance Envelope), Zinc Sheet cladding, Aluminium Louvers, Structural glazing work, Texture paint, (columns, mouldings, cornices, wall cladding) etc.
h. Anti-termite chemical treatment
i. Internal and External water supply, Sewerage, Storm water drainage
j. Infrastructure Development I.e. Roads, Parking, Pathways etc.
k. Electrical Installation (External)
l. Fire Fighting System
m. HT Installation, Substation
n. Lifts
o. Fire Alarm
p. GwTP, WTP, STP, R.O System

q. Signages

r. Landscape & Horticulture Works, Hard Landscaping in Courtyards, water bodies etc.

s. Boundary wall with Entry/Exit gates and S ecurity cabins, etc.

t. Boom Barriers

2. General

i. The work shall in general confirm to the **Latest CPWD Specifications** (corrected up to the last date of submission/uploading of bid) as mentioned in Schedule 'F' of the General Conditions of Contract (GCC). Work under this Contract shall consist of furnishing all labour, materials, equipment, tools & plants and appliances necessary and required.

ii. Wherever CPWD Specifications are silent, the latest BIS Codes/Specifications, National Building Code-2016, Manufacturers Specifications, Sound Engineering practices or well-established local construction practices as decided by the SBI/PMC in-charge shall be followed

iii. These Technical Specifications are to be read with the Technical Specifications mentioned in Schedule–F of the General Conditions of Contract. In case of any discrepancy, these technical specifications shall prevail.

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

v. Regarding testing of civil & electrical & other materials, the testing of materials shall be conducted in Govt. Laboratory/ Govt. Engineering Colleges/ IITs/ NITs/NABL/BIS approved laboratory or from the laboratory approved by SBI / PMC / Engineer in charge. The charges of testing of materials in approved laboratory shall be borne by the Contractor.

vi. No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The Contractor shall be fully responsible for any damage to the SBI/Govt. Property/ any other adjacent properties and work for which the payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The Contractor shall be fully responsible for safety and security of his Labour, materials, T&P, Machinery brought to the site by him.

The Contractor shall comply with the Safety procedures, norms and guidelines (as applicable) as outlined in the document Part 7 Constructional practices and Safety- 2016, National Building code of India, Bureau of Indian Standards. A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to causalities. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.

vii. The Contractor shall ensure the following activities for construction workers safety, among other measures:

a. Guarding all parts of dangerous machinery.

b. Precautionary signs for working on machinery

c. Maintaining hoists and lifts, lifting machines, chains, ropes, and other lifting tackles in good condition.

d. Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.

e. Ensuring that walking surfaces or boards at height are of sound construction and are provided with Safety rails or belts.

f. Provide personal protective equipment (PPE); helmets etc.

g. Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.

h. Provide sufficient and suitable light for working during night time.

viii. The Contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The Contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labeled in both Hindi and English with suitable symbols. All wastes to be properly segregate and disposed off as per Govt Norms.

ix. Contractor should spray curing water on concrete structure and shall not allow free flow of water. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them. Contractor shall do water ponding on all sunken slabs using cement and sand mortar.

x. Water used for construction and curing purposes shall conform to the requirements specified in the relevant BIS standards (IS 456:2000 – Clause 5.4 and IS 3025 series for water testing). The water shall be clean and free from deleterious materials such as salts, oils, acids, alkalis, organic matter, or any other impurities that may adversely affect the designed quality, strength, or durability of concrete and reinforcement.

xi. The Contractor shall remove from site all rubbish and debris generated by the Works and keep Works clean and tidy throughout the Contract Period. All the serviceable and non-serviceable (malba) material shall be segregated and stored separately. Malba, rubbish & other waste materials shall be disposed off as directed/ approved by Engineer in Charge and necessary documentations shall be submitted to SBI / PMC / Engineer in charge. In this regard directives of National Green Tribunal or any other authority shall be a binding on Contractor.

xii. In the event any technical specification related to the scope of work is not explicitly provided in the tender documents but is reasonably expected to be part of the work, the EPC contractor shall adopt **CPWD specifications**, **prevailing market standards**, and **relevant IS codes**. Such assumed specifications must be clearly indicated in the proposal and submitted for approval to the Employer/PMC prior to execution. Unless specifically excluded in the tender, any essential item shall be deemed to be included within the contractor’s scope and quoted price.

xiii. **Approved Makes**:

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

Brands and makes specified in the list of approved makes are indicative in nature and serve to establish the minimum desired standards for quality and performance. As the project is targeted for **IGBC Platinum and Net Zero - Energy certification**, where specific green-compliant products are not explicitly listed, the **EPC contractor shall assume high-performance, premium-grade, or top-rated brands** conforming to relevant sustainability standards while quoting. Final selection of all **finishes, materials, and equipment** shall be subject to **review and approval by SBI/PMC**

xiv. **Method Statement**:

The Contractor shall submit a 'Methods statement' for each important activity for the approval of the SBI / PMC / Engineer in charge soon after the award of work to him. The 'Methods statement' is a statement by which the construction procedures for any activity of construction are formulated and stated in chronological order. The 'Methods statement', should have a description of the item with elaborate procedures in steps to implement the same, the specifications of the materials involved, their testing and acceptance criteria, equipment to be used, Precautions to be taken, etc.

3. Setting Out

i. The Contractor shall carry out survey of the whole work area, setting out the layout of building in consultation with the SBI / PMC / Engineer in charge & proceed further. Any discrepancy between the Approved Architectural drawings and actual layout at site shall be brought to the notice of the SBI / PMC / Engineer in charge. It shall be responsibility of the Contractor to ensure correct setting out of alignment. Total station survey instruments only shall be used for layout, fixing boundaries, and Centrelines, etc.

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

iii. If at any time, any error appears due to grades, lines, levels and benchmarks during the progress of the work, the Contractor shall, rectify such error, if so required, to the satisfaction of the SBI / PMC / Engineer in charge.

iv. Though the site levels are indicated in the drawings the Contractor shall ascertain and confirm the site levels with respect to benchmark from the concerned authorities. The Contractor shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of work. These benchmarks shall be got checked by the PMC/Engineer in charge or his authorized representatives. The work at different stages shall be checked with reference to bench marks maintained for the said purpose.

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

vi. The Contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the Contractor to the entire satisfaction of the SBI / PMC / Engineer in charge.

vii. The Contractor(s) shall carry out soil/geotechnical investigation and should satisfy himself about complete characteristics of soil and other parameters at site. The details w.r.t soil strata, bearing capacity etc. given in the DBR are indicative and no claim on the alleged inadequacy or incorrectness of the soil data supplied by the department shall be entertained. The intending Contractor shall conduct soil investigations on their own, and shall be responsible for the adequacy of the design.

4. Coordinated Drawings

i. Before taking up the work, the Contractor shall prepare shop drawings for the works listed below for various civil and electrical & other services showing details of lay out in plan including sections & elevations & large-scale details and Contractor shall plan and mobilize his resources as per these drawings and as per actual site conditions to facilitate convenient execution, installation as well as maintenance of these items.

ii. Shop Drawings:

The scope of work, technical specifications and drawings together shall be considered as a tender requirement and the work shall be carried out as per Good for Construction (GFC) drawings, prepared & submitted by the Contractor and duly approved by SBI / PMC / Engineer in charge. The Contractor shall study the GFC drawings and taking into account actual site conditions and selected material and requirements, shall prepare shop drawings as fully coordinated drawings. Such drawings shall be prepared for the works, not limited to the following works:

a. Aluminium works & Structural glazing.
b. Expansion joint work
c. Stone cladding work
d. Zinc sheet cladding work
e. Suspended ceiling work, coordinated with all ceiling related services.
f. Marble, granite, vitreous, ceramic, tile work, terrazzo, engineered wood, carpet
g. Acoustical materials (ceiling & wall)
h. Boom Barriers
i. All Electrical work
j. All Sanitary work
k. Lifts
l. Horticulture
m. Electric Sub-station
n. STP, WTP & GwTP
o. Fire Alarm system
p. Pumps&Solar panels.
q. Signage

The shop drawings shall be prepared and submitted for approval well in advance to achieve the milestones provided.

iii. Within the time frame agreed with the SBI / PMC / Engineer in charge, the Contractor shall prepare shop drawings using latest version of Auto CAD. Shop drawings shall show all layouts, details in plans & sections showing all connections, junctions, bends, supports, clearances. Fixing arrangements with dimensions' room, etc. shall be prepared by the Contractor on Auto-CAD based on the architectural drawings and site measurements. All measurable items quantities shall be mentioned on each shop drawing being submitted for approval by the Contractor. 3 sets of shop drawings (soft copy also) shall be submitted for approval and Seven sets of final shop drawings after approval by SBI / PMC / Engineer in charge shall be submitted by the Contractor along with the soft copy. The shop drawings shall be prepared as per agreed schedule.

iv. Technical submittals of manufacturer's catalogues and technical data shall be submitted for approval. The Contractor shall designate an Engineer responsible for issue and preparation of shop drawings and control of GFC drawings.

5. Scale of Amenities: -

The doors and windows/flooring shall be provided as per the requirements indicated in the finishing schedules/tender drawings/ CPWD Norms for commercial buildings and technical specifications. In case of variance, the decision of SBI / PMC / Engineer in charge shall prevail.

CHAPTER B

TECHNICAL SPECIFICATIONS – CIVIL WORKS

1 GENERAL

1.1. The work shall be carried out in accordance with the Design Basis Report, Architectural drawings and structural drawings (proof checked/vetted by the approved Institute) and approved by the SBI / PMC / Engineer in charge. The Technical Specifications are to be read with and in general confirming to the Latest CPWD Specifications.

1.2. Contractor(s) shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings. On completion of work, the Contractor(s) shall submit required number of prints of “as built” drawings to the SBI / PMC / Engineer in charge.

1.3. Before commencement of any item of work the Contractor shall correlate all the relevant Architectural and Structural Drawings, and Specifications etc. and satisfy himself that the information available is complete and unambiguous. The Contractor alone shall be responsible for any loss or damage occurring by the commencement of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.

1.4. The Contractor (s) should engage approved, licensed plumbers for the work and get the materials (fixtures/fittings) tested, by the municipal Body /Corporation authorities wherever required, at his own cost. The Contractor(s) shall submit for the approval of the SBI / PMC / Engineer in charge, the name of the plumbing Contractor proposed to be engaged by him.

1.5. The Contractor shall give performance test of the entire installation(s) as per the specifications in the presence of the SBI / PMC / Engineer in charge or his authorized representative before the work is finally accepted and nothing extra what-so-ever shall be payable to the Contractor for the test.

1.6. The work of services will be executed simultaneously. The Contractor shall minimize the scope of making recesses, holes, opening etc. as the same shall be planned in advance and necessary grooves/niches shall be provided in shuttering of RCC.

1.7. Sample of building materials, fittings and other articles required for execution of work shall be got approved from the SBI / PMC / Engineer in charge before use in the work. The quality of samples brought by the Contractor shall be judged by standards laid down in the relevant CPWD/ BIS specifications. All materials and articles brought by the Contractor to the site for use shall confirm to the samples approved by the SBI / PMC / Engineer in charge which shall be preserved till the completion of the work.

1.8. BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the SBI / PMC / Engineer in charge besides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the Contractor shall, if required, by the SBI / PMC / Engineer in charge, furnish manufacturer’s test certificate or test certificate from approved testing laboratory to establish that the material / procured by the Contractor for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.

1.9. The Contractor shall procure the required materials in advance so that there is sufficient time to testing of the materials and clearance of the same before use in the work. The Contractor shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimensions as may be necessary for execution of work.

1.10. Contractor shall submit "Quality Assurance" plan (QAP) as referred under Clause 22 of GCC, PART-B, of Tender document:

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

1.12. In case the make or brand of any item, fitting, fixture, finish, equipment or material is not specifically mentioned in the tender documents, the Contractor shall propose makes of only premium, reputed, and ISI/ASTM/BS/EN certified brands, subject to prior approval of the SBI/ Engineer-in-Charge/PMC. Under no circumstances shall substandard, unbranded, or locally fabricated items be used. The cost for such premium items shall be deemed included in the quoted contract price and no extra claim shall be entertained on this account. In case of discrepancies in specifications of any items within this document, the premium specification shall prevail.

2 CHECK-LIST FOR EXECUTION OF WORK:

i. As and when any important item is taken up for execution, the Contractor shall submit the specifications and develop a Checklist and Pour card. This sample Checklist should be got approved from the SBI / PMC / Engineer in charge and should be used at site. This check list should be shown to the SBI / PMC / Engineer in charge or his Authorized representative during inspection. This procedure is to be followed for all hidden items, CC/RCC work, Steel- reinforcement, shuttering, Cast-in-situ mosaic flooring, Doors & Windows, Plumbing, including Water supply pipe lines, Roof treatment, Earth filling etc.

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

3 EARTH WORK:

3.1 Site Clearance

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one meter above ground level and rubbish removed /disposed off by the Contractor at his own cost to the place as directed by SBI / PMC / Engineer in charge and/or permitted by the local authority after obtaining written permission of the Engineer – in- charge, the contractor shall dispose of othr materials off site and no payment will be made by the SBI for disposal of this rubbish. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is lower, and the holes or hollows filled up with the earth, rammed and levelled.

3.2 Excavation

Excavations shall be prepared with shallow side slopes to minimise the risk of slope failure. Where this is not possible and the depth exceeds 0.6m then the trench slopes must be stabilised. Prior to man entry into the excavation the Contractor must ensure the excavation is stable. Further checks should be made following periods of rainfall or when excessive loadings occur within close proximity to the excavation.

No excavated material shall be placed, even temporarily, nearer than three metres to the outer edge of an excavation.

3.3 Setting Out and Making Profiles

The Contractor shall erect masonry or concrete pillars at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with GPS or any other permanent bench mark approved by SBI. Necessary profiles with pegs, bamboos and strings shall be made to how the correct formation levels before the work is started.

3.4 Earth Work

i. Earth work, by mechanical and manual means in Excavation for Foundation, Basement, Roads, Footpaths, Drains and Trenches etc. in all kind of soil/strata/ordinary rock/ hard rock as per terrains and drawings. Boring for pile (if required) as per structural drawings. In case of very hard rock where excavation using machinery is not possible or taking lot of time, hydraulic splitters or chemical can be used for rock fragmentation for which nothing extra shall be paid.

ii. For all excavation operations executed manually or by mechanical means, irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract. The excavated earth shall be put to use in the areas related to the work and thereafter the extra earth shall be used in filling up the low-lying areas of the total plot, at his own cost. If there is any surplus excavated earth thereafter, the same shall be disposed off by the Contractor at his own cost to the place as directed by SBI / PMC / Engineer in charge and/or permitted by the local authority after obtaining written permission of the Engineer – in- charge and no payment will be made by the SBI for disposal of this excavated earth.

iii. Filling in foundation with available excavated moorum/earth (excluding rock) in trenches, plinth, sides of foundations, roads, drains and footpaths etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering. Additional moorum/earth, if required for the filling, for the work shall be procured from outside of the campus at his own cost. Only moorum/earth shall be used for plinth filling. Filling in plinth shall be in layers and consolidated with water and compacted with pneumatic rammers, to achieve 90% relative density on testing. One test is to be carried out for 1000 sqm. of compacted area or as specified in CPWD specifications.

iv. Any other excavation or filling required at open areas other than building like landscaping, horticultural works, road works etc. for completion of work as per approved drawings shall be in the scope of work.

v. Black cotton soil (if present) shall be removed at all places where permanent structure will be constructed.

vi. The Contractor shall make, at his own cost, all necessary arrangements for maintaining water level low enough in the area where works are under execution, so as not to cause any harm to the works or problems in carrying out with the execution and the rates for all items of work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains subsoil water table being high or due to any other cause whatsoever. The Contractor shall make necessary provision of pumping, dredging, and bailing out water coming from all the above sources and excavation and other works shall be kept free of water by providing suitable system approved by the SBI / PMC / Engineer in charge.

vii. Any other type of earthwork not specifically mentioned herein up to the completion of project shall be in the scope of work.

viii. Handling of C&D Waste: -The debris / building rubbish waste and the like (Construction & Demolition waste commonly known as C & D waste) generated from the work, should be taken out to be disposed it off the campus in a legal and environmental friendly way to the “declared dumping/Land fill sites” where the facility of re-cycling of C&D waste are available. The documentary proof with respect to disposal of all C&D waste generated out of work shall be submitted to SBI / PMC / Engineer in charge on weekly basis.

3.5 Shoring

The Contractor shall be responsible for the design of shoring for the proper retaining of the sides of trenches, pits etc with due consideration to any traffic or other superimposed loads. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. Any shoring shall be removed after the items for which it is required are completed. Should slips occur, the slipped material shall be removed and slope dressed to a modified stable slope.

3.6 Dewatering

The Tenderer shall keep excavations clear of water. Contracter to dispose off discharged water and sludge away from site in proper manner without affecting the adjacent properties.

3.7 Clean Up

Upon completion of the work in this section, all rubbish and debris shall be removed from the site. All construction equipment and implements shall be removed and the entire area shall be left in a neat, clean and acceptable condition.

3.8 Disposal of Excavated Material

Materials suitable for re-use obtained from the excavation shall be properly stored in a convenient place that will not obstruct the free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. The stacking height of the stored material shall not exceed 3 meters. Materials shall be used to the extent required to completely backfill excavations to the finished ground level.

Surplus and unsuitable materials shall be disposed of off-site.

3.9 Excavation Dewatering

Continuous operation of dewatering systems shall be required to complete all portions of the works where dewatering is necessary to prevent inflow and collection of surface water or groundwater, or to protect adjacent properties or constructions from damage resulting from a rise or fall in groundwater levels.

Dewatering systems shall effectively intercept and remove water from the strata and thus enable the excavations to be kept dry when necessary.

The Contractors shall provide and operate all pumps, engines and machinery necessary to keep excavations clear of water. The pumping shall be continued until after the execution of any portion of the work and continued afterwards as necessary.

3.10 Anti-termite treatment:

Both the Pre and Post construction Anti-termite treatment shall be got done through approved specialized agencies only with prior approval of the SBI / PMC / Engineer in charge or his representative. During the execution of work, if any damage shall occur to the treatment already done, either due to rain or any other circumstances, the same shall be rectified and made good to the entire satisfaction of the SBI or his representative by the Contractor at his costs and risks.

The Contractor shall submit a guarantee bond for the anti-termite work executed under the contract in the specified format.

Supplying, Diluting and Injecting chemical (as per I.S.6313 (Part-II) for anti-termite treatment and creating a chemical barrier for termite as per cpwd specification and as per direction of EIC.

- Treatment of soil under floors above sand filling using chemical emulsion by flooding @ 15 litre per sqm.
- Along external wall for 3m width using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300 mm including excavation channel along the wall & rodding etc. complete.
- Along the expansion joints, surrounding of pipes & fittings and conduits @ 20litre per building.
- The Chemicals of PCI / Pecopp / Godrej Hi-Care /M Con shall be used in this work.

PLAIN CEMENT CONCRETE (PCC), REINFORCED CEMENT CONCRETE WORK (RCC) AND DAMP PROOF CONCRETE (DPC):

4.1 Stone Aggregate:

Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source (Quarries to be approved by the SBI / PMC / Engineer in charge) and shall confirm to relevant provision in the Latest CPWD Specifications for works.

4.2 Sand

Sand to be used for the work shall be of as specified in CPWD Specifications 2019. Sand shall be obtained from the source to be got approved by the SBI / PMC / Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the SBI / PMC / Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of sand is available the sand will be sieved for use in finishing work as directed by the SBI / PMC / Engineer in charge in order to obtain smooth surface and nothing extra will be paid on this account.

4.3 Cement

i. The Contractor shall procure 43 grade Ordinary Portland cement confirming to IS 8112 / Portland Pozzolana Cement confirming to IS 1489 (Part I) as required in the work, from manufacturers as per list of approved makes or from any other reputed cement manufacturer having a production capacity not less than one million tons per annum, in case the cement is not available from manufacturers as per list of approved makes. The bidders may also submit a list of names of cement manufacturers which they propose to use in the work. The bid accepting authority reserves right to accept or reject name(s) of cement manufacturer(s) which the bidder proposes to use in the work.

ii. The supply of cement shall be taken in 50 kg. bags/silos bearing manufacturer's name and ISI marking. Samples of cement arranged by the Contractor shall be taken by the SBI / PMC / Engineer in charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the Contractor does not confirm to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the Contractor at his own cost within a week's time of written order from the SBI/PMC in-charge to do so. Supply of cement shall be taken in 50-kg bags bearing manufacturer's name, or his registered trademarks if any and grade and type of cement as well as ISI marking. The packing of the cement bags shall be as per CPWD specifications 2009.

iii. The cement shall be brought at site in bulk supply of approximately 50 tons or more as decided by the PMC/Engineer in charge. The cement godown of adequate capacity to store the cement shall be constructed by the Contractor at site of work.

iv. The cement godown shall always be accessible for the SBI / PMC / Engineer in charge or his representative.

v. The cement shall be got tested by the SBI / PMC / Engineer in charge and shall be used on the work only after satisfactory test results have been received. The Contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the Contractor/Department in the manner indicated below:

   a. By the Contractor, if the results show that the cement does not confirm to relevant BIS codes.

   b. By the Department, if the results show that the cement confirms to relevant BIS codes.

vi. The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in Clause 38 of the GCC and shall be governed by conditions laid therein. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment shall be made.

vii. The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the SBI/PMC in charge.

viii. The damaged cement shall be removed from the site immediately by the Contractor on receipt of a notice in writing from the PMC/Engineer in charge. If he does not do so within 3 days of receipt of such notice, the PMC/Engineer in charge shall get it removed at the cost of the Contractor.

4.4 Fly-ash

Fly-ash confirming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2 and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However, this shall not override the provisions of the respective items.

4.5 Centering Shuttering and Scaffolding:

All Scaffolding centering for RCC shall be properly designed system and brought to site in sufficient quantity well in advance so that the progress of the work is not hampered for non-availability of the same.

4.6 SHUTTERING / FORM WORK: -

The work shall be done in accordance with CPWD Specifications - 2009 - Vol.I & Vol. II with upto date correction slips. Steel shuttering and 12 mm thick BWP grade film faced plywood shuttering to be used in the work by contractor as per direction of engineer in charge. All shuttering brought at site should be new/fresh when used for the first time and should not be allowed more than permissible repetition or quality of surface of shuttering become uneven which ever is earlier.

- Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work and Props of steel shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers.
- Form work including centering, shuttering, propping, staging shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 meters, the prop may be provided in multi-stages. It is important to note here that Designing of formwork/shuttering as per CPWD specifications/relevant IS codes for RCC work i.e column/wall/beam/slab at all heights and level as shown in GFC drawing is the responsibility of contractor and if any mishap happens during execution of RCC work due to design/workmanship fault etc, then it will be the sole responsibility of Contractor.

4.6.1 Workmanship:

Contractor shall account for all material and labour etc. to achieve the required finishes to the satisfaction of the SBI / PMC / Engineer in charge:

- The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shuttering plates in the requisite quantity before assembly of steel reinforcement.
- The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd or equivalent.
- Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter

  a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.

  b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.
- Form shall be so constructed as to be removable in sections in the desired sequence**,** without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.
- Shuttering surface before concreting should be free from any defect/ deposits and fully cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

- Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the E-I-C, so as to offset the subsequent deflection, for cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the SBI / PMC / Engineer in charge.
- Erection of form work may be from pre-moulded, pre-fabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting. The tie rods shall be terminated at least 40mm inside the finished surface.
- Joints shall be water-tight and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
- Pre-fabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For this double wedge shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
- Pre-fabricated or on site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.
- In repeated use, panels shall be clearly marked for using at defined locations

Formwork for exposed concrete surfaces: -

- Where it is specifically shown on the GFC drawings to have Expose concrete finish or original fair face finish of concrete surface without any rendering of plastering, 12 mm thick BWP grade type 3 film faced plywood of CSFF designation confirming to IS: 4990 for form finished/ fair faced concrete surface as per acceptance criteria where ever required as per the Architectural GFC drawing. The BWP type 3 ply to be used can have maximum 3 repeatation only.
- The forms shall be constructed so as to produce a uniform and consistent texture and pattern on the face of the concrete. The formwork shall be placed so that all horizontals are constructed of lumber and are not paneled and the formwork joints shall be staggered.
- To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Whenever possible, joints between sheets shall be arranged to coincide with architectural feature, sills, window heads or change in direction of surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be approved between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.
- Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicate top of pour) at horizontal constructions joints, unless the use of groove strips is specified on the drawings. The reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupt irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

- For fair faced concrete, the position of through bolts will be restricted and generally as indicated on the drawings.
- Plywood used in the formwork for obtaining exposed surfaces shall be got approved from Engineer-in-Charge on each use. However, no forms will be allowed for reuse if it is doubtful to produce desired texture of exposed concrete.
- Cement of only approved shade shall be used preferably of single lot to achieve integrity of texture.

4.7 Reinforcement:

i. The contractor shall procure TMT bars of Fe550D grade from primary producers such as SAIL, Tata Steel Ltd., RINL. The TMT bars procured from primary producers shall conform to manufacture's specifications/ BIS specifications.

ii. The specifications of TMT bars procured from primary producers shall meet the provisions of IS 1786: 2008 pertaining Fe 550D grade of steel as specified in the tender.

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

iv. Samples shall also be taken and got tested by the Engineer -in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications as defined, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineer-in-Charge to do so. Else the department shall remove it and recover double the cost of removal from the contractor.

v. The steel reinforcement bars shall be brought to the site in bulk supply of 20 tonnes or more, or as decided by the Engineer -in-charge.

vi. The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

vii. Coating of aqueous exhibitor.

viii. For physical and chemical test, specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

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

The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor/ Department in the manner indicated below:

(i) By the contractor if the results show that steel does not conform to relevant BIS

Codes.

(ii) By the Department if the results show that steel confirms to relevant BIS Codes.

i. The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations recovery at the rate so prescribed shall be made. In case of excess consumption, no adjustment shall to be made.

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

iii. For the purpose of payment, the actual weight of steel reinforcement / structural steel sections/ plates / bolts and nuts shall be measured as below:

(i) *Unit weight for reinforcement bars:* The actual weight per meter of the reinforcement of various diameters shall be measured for three random samples collected (for each diameter of steel reinforcement) from each lot of particular diameter of steel reinforcement brought to the site for use in the work. For this, each sample (one sample consisting of three specimens) for each diameter of steel reinforcement shall be cut to require lengths and weighed and average weight calculated and recorded. The average weight for each type of steel section and steel reinforcement of each diameter shall be taken as the actual weight per metre for that steel section and that diameter of steel reinforcement.

(ii) In case actual unit weight is less than standard unit weights mentioned in CPWD specifications 2009 Volume 1, but within variation, in such cases payment shall be made on the basis of actual unit weight. However, if actual unit weight is more than standard unit weights mentioned in CPWD specifications 2009 Volume 1, then payment shall be made on the basis of standard unit weight in such cases. In such case nothing extra shall be paid for difference in actual weight and standard weight approval. The RCC work should commence only after getting the BBS approved and signing of pour card by Engineer-in-charge.

(iii) Contractor to submit Bar Bending Schedule (BBS) for reinforcement steel work for

(iv) The work shall be carried out as per the CPWD specifications.

4.8 Concrete Work

All concrete work will be strictly done by automatic computerized batching plant of suitable capacity installed at site or RMC as per approval of SBI / PMC/Engineer in charge. No concrete work will be permitted without automatic batching plant unless specifically approved in writing by SBI/ PMC/Engineer in charge.

4.9 Transportation, Placing and Compaction of Concrete

i. Transportation of the mix concrete shall be done through Transit Mixers and concrete pumped through suitable concrete pumps and pipes arrangement and vibrated by vibration machines, materials lifts shall also be provided at site as and where required.

ii. Mixed concrete from the batching plant shall be transported to the point of placement by transit mixers or through concrete pumps or steel closed bottom buckets capable of carrying 6 cum concrete. In case the concrete is proposed to be transported by transit mixer, the mixer speed shall not be less than 4 rev/ min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum as 70 m / minute at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev / min. nor more than 6 rev / min. of the drum. The number of revolutions of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev / min. and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirements shall confirm to IS: 5892.

iii. In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar / thick cement slurry through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the lineis liable to cause a plug. The operator shall ensure that some concrete is always there in the pump-receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents.

iv. Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe. Grading of aggregate shall be continuous and shall have sufficient ultra-fine materials (materials finer than 0.25mm). Proportion of fine aggregates passing through 0.25mm shall be between15 & 30% and that passing through 0.125 mm sieve shall not be less than 5% of the total volume of aggregate. When pumping long distances and through hot weather, set- retarding admixtures may be used. Admixtures to improve workability can be added. Suitability of concrete shall be through pumping shall be verified by trial mixes and by performing pumping tests.

4.10 Damp Proof Course

Damp proof course shall be with 50 mm thick cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 12.5mm nominal size) mixed with approved water proofing compound painted at top with a coat of residual petroleum bitumen of grade VG-10 of approved quality at 1.7 kg/sqm.

4.11 Plain Cement Concrete (PCC)/ Lean Concrete

i. Lean Concrete of required thickness under foundation, plinth, footpath, ramp, and any other place as required of M-10 grade (design mix) shall be provided and laid in position ready mixed or site batched design mix cement concrete using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana/Ordinary Portland /Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads.

ii. Lean Concrete of M-10 grade or as specified Grade (design mix) as specified above shall be executed on ground and above all floor below flooring to accommodate ducts/ Raceways etc. required for laying LAN cables, wires etc. with thickness of PCC as per actual requirement to accommodate all ducts, wiring, LAN cables, Raceways etc.

iii. In case of small quantity, 1:3:6 (1 Cement: 3 coarse sand (zone-III): 6 graded stone aggregate 20/40 mm nominal size derived from natural sources) or 1:4:8 (1 Cement: 4 coarse sand (zone-III): 8 graded stone aggregate 40 mm nominal size derived from natural sources) as per CPWD specifications may be done with prior approval of SBI / PMC / Engineer in charge.

4.12 RCC Work (Concrete Mix Design)

GENERAL: -

The RCC work shall be done with RMC of Design Mix Concrete, unless otherwise specified in the nomenclature of items, wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Ready Mix Concrete shall be as per IS: 4926 and as per CPWD Specification and guide lines. For the nominal mix in RCC, CPWD specification shall be followed. The Design

Mix Concrete will be designed based on the principles given in IS: 456, 10262 and SP 23. The contractor shall carry out design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The cement shall be actually weighed as presumption of each bag having 50 kg shall not be allowed. In case of use of admixture, the mix shall be designed with these ingredients as well. The specification mentioned herein below shall be followed for Design Mix Concrete.

Scope of RCC Work

Reinforced Cement Concrete (RCC) shall be used extensively throughout the project for the following structural components:

Basements

RCC shall be used for basement retaining walls, basement floor slabs, and basement columns. The design shall consider hydrostatic pressure and provide adequate waterproofing treatment.

Retaining Walls

All peripheral and internal retaining walls shall be constructed in RCC as per structural design to resist lateral earth pressure and ensure long-term stability.

Ramps

RCC shall be used for vehicular and pedestrian access ramps, including sloped slabs, side walls, and parapets, designed for applicable live load and gradient as per standards.

Substructure

RCC shall be used for all substructure elements, including:

- Footings and pile caps
- Columns and pedestals below plinth level
- Plinth beams and tie beams

Superstructure

RCC construction shall be adopted for:

- Columns, beams, slabs, and shear walls above the plinth level
- Cantilevers, balconies, and lintels
- Staircases and landings

Miscellaneous RCC Works

- Water tanks (UG & OH), lift pits, sump tanks
- Core walls, duct slabs, and other service-related RCC structures
- Boundary walls and parapet walls wherever applicable.

All RCC works shall conform to the latest IS codes and relevant BIS standards, ensuring high quality, durability, and compliance with the approved structural drawings and design parameters.

INGREDIENTS

i) Coarse Aggregate: - As per CPWD Specifications

ii) Fine Aggregate: - As per CPWD Specifications.

iii) Water: - As per requirements laid down in IS 456-2000 and CPWD specifications.

iv) Cement: Cement arranged by the contractor will be PPC (in bags) conforming to IS: 1489: Part-I.

4.13 Admixture: - Admixtures shall not be used without approval of Engineer-in-Charge. Wherever required, admixtures of approved quality shall be mixed with concrete to achieve the desired workability within specified water cement ratio. The admixture shall conform to IS: 9103. The chloride content in the admixture shall satisfy the requirement of BS: 5075. The total amount of chlorides in the admixture mixed concrete shall also satisfy the requirements of IS: 456-2000

4.14 The contractor shall not be paid anything extra for admixture required for achieving desired workability without any change in specified water cement ratio for RCC / CC work.

4.15 Grade of concrete: - The characteristic compressive strength of various grades of concrete shall be given as below: -

Sl. No	Grade Designation	Compressive strength on 15cm cubes min 7 days (N/mm2)	Specified characteristic compressive strength at 28 days (N/mm2)	Minimum cement content * (Kg per cum)	Maximum water cement ratio
(i)	M-30	As per Design	30	350	0.45

4.16 The Concrete mix will be designed for minimum workability as specified in para 7 of IS–456-2000

4.17 Workability of concrete (unless otherwise specified elsewhere or as decided by engineer in charge.

Placing Conditions	**Degree of Workability**	**Slump**
(1)	(2)	(3)
Lightly reinforced sections in slabs, beams, walls, columns	Low	25-75
Heavily reinforced section in slabs, beams, walls, columns.	Medium	50-100
Pumped concrete	Medium	75-100

4.18 The recommended values of slump for various members to confirm IS 456

4.19 In the designation of concrete mix letter M refers to the mix and the number to the specified characteristic compressive strength of 15 cm – Cube at 28 days expressed in N/mm2. It is specifically highlighted that in addition to above requirement the maximum cement concrete (PPC i/c flyash) for any grade shall not exceed 430 kg/cum.

a. The concrete design mix with or without admixture will be carried out by the contractor as per direction of Engineer-In-Charge.

b. The various ingredients for mix design/laboratory tests shall be sent to the lab / test houses through the Engineer-In-Charge of the project and got it tested in approved laboratories as may be decided by the Engineer-in-charge immediately after award of work and the samples of such aggregate sent shall be preserved at site by the department. The admixture if used by contractor shall be at his own cost without any extra payment.

c. *Note: The Cement content means PP Cement including fly ash added during production of PPC at the cement plant/factory.

d. The contractor shall submit the mix design report from any of approved laboratories for approval of Engineer in charge within 30 days from the date of issue of letter of acceptance of the bid. No concreting shall be done until the mix design is approved.

e. In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted in approved by Engineer-In-Charge shall be submitted by the contractor as per the direction of the Engineer in charge.

4.20 APPROVAL OF DESIGN MIX

(i) The mix design for a specified grade of concrete shall be done for a target mean compressive strength Tck = Fck + 1.65s

Where Fck = Characteristic Compressive Strength at 28 days

S = Standard deviation which depends on degree of quality control.

(ii) The degree of quality control for this work is “good” for which the standard deviation (s) obtained for different grades of concrete shall be as per IS relevant IS Standards/ Codes.

(iii) Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days.

4.21 CHARGES FOR DESIGN MIX

(i) All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the contractor.

4.22 DESIGN MIX CONCRETE FROM FULLY AUTOMATIC COMPUTERISED CONCRETE BATCHING AND MIXING PLANT

(i) **Proportioning Concrete**

In proportioning cement concrete, the quantity of both cement and aggregates shall be determined by weight. The cement shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. The amount of mixing water shall be adjusted to compensate for moisture content in both coarse and fine aggregates. The moisture content of aggregates shall be determined in accordance with IS : 2386 (Part III). Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weight of aggregates due to variation in moisture content.

(ii) **Production of Concrete**

The concrete shall be RMC. produced in a central batching and mixing plant with, computerized printing for contents and admixture dosage. The batching plant shall be fully automatic. Automatic batcher shall be charged by devices which, when actuated by a Single starter switch will automatically start the weighing operation of each material and stop automatically, when the designated weight of each material has been reached. The batching plant shall have automatic arrangement for dispensing the admixture and shall also be capable of discharging water in more than one stage. A print out from the batching plant for every lot shall be submitted. A batching plant essentially shall consist of the following components: Separate storage bins for different sizes of aggregates, silo for cement; and water storage tank.

a. Batching equipment.
b. Mixers.
c. Control panels.
d. Mechanical material feeding and elevating arrangements.
e. The Contractor shall arrange for inspection of automatic batching plant within seven days of

issue of letter of award to facilitate inspection and approval of same by Engineer-In-Charge. Nothing extra will be paid for this.

(iii) The compartments of storage bins for aggregates shall be approximately of equal size. The cement compartment shall be centrally located in the batching plant. It shall be watertight and provided with necessary air vent, aeration fittings for proper flow of cement & emergency cement cut off gate. The aggregate and sand shall be charged by power operated centrally revolving chute. The entire plant from mixer floor upward shall be enclosed and insulated. The batch bins shall be constructed so as to by self-cleansing during drawdown. The batch bins shall in general conform to the requirements of IS :4925.

(iv) The batching equipment shall be capable of determining and controlling the prescribed amounts of various constituent materials for concrete accurately i.e. water, cement, sand, individual size of coarse aggregates etc. The accuracy of the measuring devices shall fall within the following limits.

Measurement of Cement	±2% of the quantity of cement in each
Measurement of Water	±3% of the quantity of water in each batch
Measurement of Aggregate	±3% of the quantity of aggregate in each
Measurement of Admixture	±3% of the quantity of admixture in each

4.23 Mixing Concrete

The mixer in the batching plant shall be so arranged that mixing action in the mixers can be observed from the operator's station. The mixer shall be equipped with a mechanically or electrically operated timing, signaling and metering device which will indicate and assure completion of the required mixing period. The mixer shall have all other components as specified in IS: 4925.

4.24 Transportation, Placing and Compaction of Concrete

(i) Mixed concrete from the batching plant shall be transported to the point of placement by transit mixers or through concrete pumps or steel closed bottom buckets capable of carrying 6 cum concrete. In case the concrete is proposed to be transported by transit mixer, the mixer speed shall not be less than 4 rev/ min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum as 70 m / minute at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev / min. nor more than 6 rev / min. of the drum. The number of revolutions of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev / min. and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirements shall conform to IS : 5892.

(ii) In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar / thick cement slurry through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the line is liable to cause a plug. The operator shall ensure that some concrete is always there in the pump-receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents.

(iii) Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe. Grading of aggregate shall be continuous and shall have sufficient ultra fine materials (materials finer than 0.25mm). Proportion of fine aggregates passing through 0.25mm shall be between15 & 30% and that passing through 0.125 mm sieve shall not be less than 5% of the total volume of aggregate. When pumping long distances and through hot weather, set- retarding admixtures may be used. Admixtures to improve workability can be added. Suitability of concrete shall be through pumping shall be verified by trial mixes and by performing pumping tests.

4.25 Preparation of mixes as per approved design mix and conducting confirmatory test at field lab.

(i) The contractor shall make the cubes of trial mixes as per approved Mix design at site laboratory for all grades, in presence of Engineer in charge using sample of approved materials proposed to be used in the work prior to commencement of concreting and get them tested in his presence to his entire satisfaction for 7 days and 28 days. Test cubes shall be taken from trial mixes as follows.

For each mix, a set of six cubes shall be made from each of the three consecutive batches. Three cubes from each set of six shall be tested at age of 7 days and remaining three cubes at age of 28 days. The cubes shall be made, cured, transported and tested strictly in accordance with specifications. The average strength of nine cubes at age of 28 days shall exceed the specified target mean strength for which design mix has been approved, the evaluation of test results will be done as per IS: 456-2000.

4.26 WORK STRENGTH TEST SPECIMEN

Work strength test shall be conducted in accordance with IS: 516 on random sampling. Each test shall be conducted on six specimens, three of which shall be tested at 7 days and remaining three at 28 days. Additional samples shall be prepared, if required, as per direction of Engineer in charge for testing samples cured by accelerated method as described in IS: 9103.

TEST RESULTS OF SAMPLE

The test results of the sample shall be the average of the strength of three specimens. The individual variation shall not be more than + - 15 percent of the average. If more, the test results of the sample are invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in the laboratory of Government Engineering colleges, or in any other approved laboratory as directed by the Engineer-in-charge.

4.27 STANDARD FOR ACCEPTANCE

i) Standard of acceptance shall be same as specified in clause 16 of IS 456-2000.

ii) In order to keep the floor finish as per direction of Engineer-in-charge and as per Architectural drawings and to provide required thickness of the flooring as per specification, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the contractor.

4.28 Ultrasonic Pulse Velocity Method of Test for RCC

i) The underlying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity and uniformly is good. The consistency of the concrete as regards its general quality gets established. In case of poorer quality lower velocities are obtained. If there are cracks, voids or flaws inside the concrete which come in the way of transmission of pulse, lower velocities are obtained.

ii) The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation etc. indicative of the level of workmanship employed, can thus be assessed using the guidance given in table below, which have been evolved for characterizing the quality concrete in structure in term of the ultrasonic pulse velocity.

Velocity criterion for Concrete Quality Grading.

Sl. No.	Pulse velocity by Cross Probing (km/sec)	Concrete Quality Grading
1	Above 4.5	Excellent
2	4.5 to 3.5	Good
3	3.5 to 3.0	Medium
4	Below 3.0	Doubtful

Note: In Case of "doubtful" quality it may be necessary to carry further tests.

iii) Pulse velocity method of test of concrete is to be conducted for CPWD works as a routine test. The acceptance criteria as per the above table will be applicable which is as per IS 13311 (part-1): 1992. From the above "Good" and "Excellent" grading is acceptable and below these grading the concrete will not be acceptable.

iv) 5% of the total number of RCC members in each category i.e. beam, column, slab and footing may be tested by UPV test method for establishing quality of concrete. It is suggested that test be conducted on RCC beam near joint with column, on RCC column near joint with beam, on RCC footings and rafts. On RCC rafts a suitable grid can be worked out for determining number of tests. In addition, doubtful areas such as honeycombed locations, locations, where continuous seepage is observed, construction joints and visible loose pockets will also be tested.

v) The test results are to be examined in view of the above acceptance criteria "Good" and "Excellent" and wherever concrete is found with less than required quality as per acceptance criteria, repairs to concrete will be made. Honeycombed areas and loose pockets will be repaired by grouting using Portland Cement Mortar/Polymer Modifies Cement Mortar /Epoxy Mortar, etc. after chipping loose concrete in appropriate manner. In areas where concrete is found below acceptance criteria and defects are not apparently visible on surface ,injecting approved grout in appropriate proportion using epoxy grout /acrylic Polymer modified cements slurry made with shrinkage compensating cement / plain cement slurry etc will be resorted to for repairs.(refer relevant chapters from CPWD Hand Book on Repairs and Rehabilitation of RCC Buildings).Repair to concrete will be done till satisfactory results are obtained as per the acceptance criteria by retesting of the repaired area. If satisfactory results are not obtained dismantling and relaying of concrete will be done.

4.29 PRECAST REINFORCED CONCRETE

i. General Requirements - Precast reinforced concrete units such as columns, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms/ moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. The contractor may precast the units on cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in form. Each unit shall be cast in one operation.

ii. Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honey combing.

iii. Precast articles shall have a dense surface finish showing no coarse aggregate and shall have not cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angle of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogeneous appearance.

iv. The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

v. Curing - After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

vi. The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

vii. Marking - Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

viii. The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

ix. Marking - Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

x. Precast units shall be stored, transported and placed in position in such as manner that they will not be overstressed or damaged.

4.30 Cover/Spacer Block

The Contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Spacer blocks shall be cast well in advance with approved proprietary pre-packed free flowing mortars of high early strength and same colour as surrounding concrete, Pre-cast cement mortar/concrete blocks/blocks of polymer shall not be used as spacer blocks unless specially approved by the PMC/Engineer in charge.

5 MASONRY WORK

Masonry work shall be carried out in confirmity of Latest CPWD Specifications for works.

5.1 BRICK WORK:

i. Class of Bricks to be used in construction, Grade of Cement Mortar shall be as specified in DBR, PART-D and shall be carried out in confirmity of Latest CPWD Specifications for works.

ii. Autoclave Aerated Concrete Block Masonry works:

a. The Autoclave Aerated Concrete block masonry work shall be as per tender drawing and in compliance with latest CPWD specifications and IS codes.

iii. Brick work in foundation and plinth Non modular well burnt clay brick class designation 150 as per relavent IS code in foundation in cement mortar 1:6 (1 Cement: 6 Coarse sand)

6 FINISHING:

Plastering, Painting, Polishing/ Varnishing to be carried out as per latest CPWD Specifications and as specified in DBR, PART-D (C. Design Basis Report- Civil Works) and finsishing schedule/tender drawings.

a) TheworkshallbedoneinaccordancewithCPWDSpecifications-2019 Vol.I to Vol.II with up to date correction slips and the manufacturer's specifications where CPWD specifications are not available.
b) The quantity of paint required as per the theoretical consumption including wastages, if any, shall be procured from the approved manufacturer or his authorized dealers and deposited with the representative of the Engineer-in-Charge at site.
c) The paint shall be obtained in smaller packing (around 20 litre).
d) The paint shall be kept in the joint custody of the Department and the Contractor and day-to-day account of receipt and issue shall be maintained. However, the safe custody and watch and ward shall remain to be the responsibility of the Contractor. Nothing extra shall be payable on this account.
e) The name of the manufacturer, manufacturer's product identification, manufacturer's mixing instructions, warnings and instructions for handling and application, toxicity and date of manufacturing and shelf life shall be clearly and legibly mentioned on the labels of each container. These details shall be kept in record. The material shall be consumed in the order of material brought to site, first come first consume basis. The Contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the various characteristics of the materials as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.
f) Empty containers of the paints shall not be removed from site till the completion of the work unless otherwise permitted and shall be removed only with the permission of the Engineer-in-Charge or his authorized representative at site of work.
g) All arrangements for measuring, dosing etc. At site shall be made by the Contractor. Nothing extra shall be payable on this account.
h) The Contractor shall apply samples of each kind of paint for the approval of shade and colour as per the directions of the Engineer-in-Charge before procuring the paint in mass.
i) All incidental charges of cartage, storage, wastage, safe custody, scaffolding, cost of samples and mock ups etc. Shall be borne by the Contractor and no claim, whatsoever, shall be entertained on this account.
j) For the item of Epoxy paint, it is clarified that the surface for painting shall be prepared by shot blasting. The metal surface shall be cleaned off any rust using sand/emery paper and also by mechanical brush/power tool cleaning using grinder as required as per the manufacturer's specifications etc. The sand blasting as such is not required to be carried out on the surface. However, the epoxy primer shall be applied immediately after the surface preparation.
k) For the item of melamine polish, the item includes all the sand papering required to be carried out and wiped properly for cleaning all the loose dust particles. Necessary masking tapes are to be provided where different finishing work is to be carried out, so that the

melamine polish does not spread to the other surfaces. Care should be taken while removing the masking tape, so that the surface is not damaged. Cost of melamine polish includes the cost of providing and removing the masking tapes wherever required. The surface shall be sand papered using emery paper no.180,320 and 400 as required. Any staining required shall be carried out by applying Apcolite Wood Stain or equivalent, to achieve the required colour and shade as directed by the Engineer-in-Charge.The item of melamine polish is deemed to include cost of such staining. Where French spirit polish is to be carried out the rate is inclusive of cost of staining and wood filler (Apcolite wood filler of Asian Paints or Asian NCCl ear Wood filler or equivalent of other brands ICI and Pidilite Industries) if required. Nothing extra shall be payable on this account.

QUALITY ASSURANCE

For Quality Assurance the Contractor shall ensure that color and texture of finish coats, shall match the approved sample. Also,

i) Color of priming coat shall be lighter than body coat.

ii) Color of body coat shall be lighter than finish coat.

iii) Color prime and body coats as required so as not to show through the finish coat and to mask surface imperfections.

iv) Before starting application of each type of paint, the Contractor shall apply the paint to a specimen area, not to exceed 10 square meter and get finish and texture approved and shall use it as a sample for the remainder of the work.

6.1 Antibacterial Paint

i. The Antibacterial Paint shall be able to provide anti-Microbial Protection:

ii. The scope of work includes providing & applying approved makes anti- Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respect & as directed by PMC/Engineer in charge. Following are the desired characteristic of the paint:

a. The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.

b. The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.

c. The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

7 DOOR & WINDOWS

The doors and windows shall be provided as per the requirements indicated in the PART-D, Design Basis Report and the respective schedules appended to the Design Basis Report, Finishing Schedule appended with DBR & relevant Tender Drawings. Door & Windows shall be carried out in confirmity of Latest CPWD Specifications for works.

However, the typical specifications for the various types of Doors and Windows shall be as under:

7.1 Wooden:

7.1.1 **Wood:**

a. Timber shall be Forest Stewardship council (FSC) certified wood and it shall be seasoned and preservative treated.

b. The moisture contents of the wood used in the work shall not be more than that stipulated in the relevant clause of Latest CPWD Specifications for works. Kiln seasoning and preservative treatment of wood, if required, shall be done by the Contractor. In all other respects the wood used in the work shall confirm to the provision in latest CPWD specification for works.

c. The sample of species to be used shall be deposited by the Contractor with the SBI/PMC in charge before commencement of the work. The Contractor shall produce cash voucher and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them failing which it would not be so accepted as kiln seasoned.

7.1.2 **Glazing**: -

The glazing shall be as per CPWD specifications keeping into consideration the size of opening or panels of the glass or as specified.

7.1.3 **Pre-laminated Particle Board: -**

The pre-laminated particle board shall be off min. 12mm thick and shall be as per CPWD specifications keeping into consideration the size of the opening or as per tender drawings.

7.1.4 **Shutters-Wooden-Flush**: -

a. Factory made shutters, confirming to IS 2202 (Part –I) 1977, shall be obtained from factories to be approved by the PMC / Engineer – in - charge and. The Contractor shall inform well in advance to the Engineer – in – charge the name address of the factory from where the Contractor intends to get the shutters manufactured.

b. The Contractor will place order for manufacture of shutters only after written approval of PMC / Engineer – in – charge in this regard is obtained. The Contractor is bound to abide by the decision of the PMC / Engineer – in-charge. In case the factory already proposed by the Contractor is not found competent to manufacture quality shutters, the Contractor shall propose another name of another factory from the approved list for the approval of Engineer – in – charge.

c. The Contractor will also arrange stage wise inspection of the shutters at factory with the Engineer in charge or his subordinate authorized representatives. Contractor will have no claim, if the shutters brought at site are rejected by the Engineer in charge in part or in full lot due to bad workmanship / quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the Contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the Engineer in charge or his authorized representatives.

d. The shutters shall be both side laminated with 1mm thick decorative laminated sheet of required make & shade (Factory pressed) or without lamination i.e commercial veneered or decorative veneered as per the finishing schedule & tender drawings appended to the tender document.

7.1.5 **Hardware**

a. All hardware for doors and windows shall be of Stainless Steel or as specified. All hardware shall be installed using routers and counter sunk screws. Panic hardware will be provided in all staircase and fire escape doors. Drawer slides with steel roller ball-bearings and drawer locking system with master keying option is to be provided for all built in cabinetry work and drawer units.

b. The Contractor shall procure all the hardware and the fixing shall be done in the best workmanship like manner and in accordance with that employed for fixing hardware.

7.2. UPVC -General

The scope of work includes the design, fabrication, supply, and installation at site of all types of uPVC (unplasticized Polyvinyl Chloride) windows, doors, and ventilators in accordance with the approved architectural drawings and technical specifications.

The supply and erection shall include all necessary components such as frames, sashes, glazing beads, hinges, locking mechanisms, handles, reinforcement profiles (GI/steel), gaskets, drainage holes, mosquito mesh shutters (if specified), and all associated hardware and accessories, whether or not specifically mentioned, but required to complete the work in all respects.

All uPVC units shall be factory-fabricated to fit the finished clear openings at site. The contractor shall verify all dimensions at site prior to fabrication. All works shall be carried out as per the drawings and to the satisfaction of the Engineer-in-Charge.

Materials

i. UPVC profiles shall be extruded from unplasticized polyvinyl chloride resin, with additives for UV resistance, impact resistance, and weather resistance. The profiles shall comply with ISO 12608-1 (uPVC Profiles for Windows and Doors – Classification, Requirements and Test Methods) and IS: 1661/IS: 14856/IS: 16061 or equivalent standards.

ii. The uPVC compound used for the profiles shall be lead-free and RoHS compliant. The formulation shall ensure long-term color stability, impact resistance, and dimensional stability under varying weather conditions.

iv. The minimum wall thickness of outer walls of profiles shall not be less than 2.5 mm, unless otherwise specified, and shall conform to Class B or Class A as per relevant standards.

v. All reinforcements used inside uPVC profiles shall be galvanized steel of minimum thickness 1.2 mm (for windows) and 1.5 mm (for doors), factory-fitted within profiles and properly fixed.

Finishing

i. Profiles shall have smooth and glossy surfaces free from defects.

ii. uPVC profiles shall be available in standard white, off-white, or laminated color finishes (wood-grain, anthracite grey, etc.) as per the architectural design. The lamination or foil finish shall be UV resistant and conform to quality standards.

iii. Any surface lamination or finish shall meet relevant standards and shall be accompanied by a manufacturer’s test certificate.

Fabrication

i. Before commencement of fabrication, detailed shop drawings shall be submitted for approval, showing window/door details including profiles, reinforcements, opening types, locking arrangements, gaskets, joints, fixing methods, etc.

ii. All corners shall be fusion-welded for airtight joints. Mullions and transoms shall be reinforced and securely connected.

iii. All frames and sashes shall be reinforced internally with galvanized steel sections, properly anchored with screws as per manufacturer’s guidelines.

iv. All fabricated components shall be dimensionally accurate, square, and free of twist or deformation. Profiles shall be cut with precision machines and fabricated in clean, dust-free environment.

v. All joints shall be watertight and airtight. Provision shall be made for drainage holes with appropriate end caps or weep hole covers.

vi. The frames shall be fixed to the structure using anchor fasteners, screws, and silicone sealant or PU foam as required, ensuring firm installation and thermal insulation. Fixing shall be done using appropriate brackets, fasteners, and chemical sealants.

vii. Before fixing at site, all materials shall be adequately protected with masking film/tape to avoid scratches or surface damage. The protective tape shall be removed only after final cleaning and handing over.

Glazing

i. Glazing shall be carried out using toughened or laminated float glass of approved make and thickness as per DBR, PART-D, or tender drawings. The glass shall be fitted using appropriate glazing beads and EPDM gaskets to ensure vibration-free, leakproof fit.

ii. All glass edges shall be polished or chamfered before fixing. Double glazing units (DGUs) shall be used wherever specified.

iii. All glass must conform to IS 2553 (Part 1): 2018 and relevant standards.

Hardware

i. All hardware (hinges, handles, locks, friction stay arms, etc.) shall be of uPVC-compatible material such as stainless steel (SS 316), aluminium alloy, or powder-coated zinc alloy of approved make.

ii. All exposed hardware shall be corrosion-resistant and shall conform to ISO 9227 (Salt Spray Test), tested for minimum 500 hours of corrosion resistance.

iii. Multipoint locking systems shall be provided for doors and casement windows. Sliding windows shall be fitted with suitable interlock systems, bearing rollers, and handles as per operational requirement.

Fly Proof Mesh

Fly proof stainless steel mesh made of SS grade 316 shall be provided in sliding/mosquito shutter frames, as specified in tender drawings. The mesh shall have an aperture of 1.4 mm × 1.4 mm and wire thickness not less than 0.50 mm. The mesh shall be fixed using EPDM gaskets or bead system, with provision for easy cleaning or replacement.

Grills (if specified)

In windows/doors where security grills are required, uPVC-compatible powder-coated aluminium or galvanized iron grills of approved pattern and finish shall be fixed using stainless steel screws at 200 mm c/c. All cut-outs for hardware operation and mesh fitting shall be neatly finished and aligned with architectural drawings.

Quality Assurance & Testing

i. All uPVC profiles and components shall be accompanied by manufacturer's test certificates conforming to applicable standards.

ii. Site installation and fabrication shall be checked and certified by the Engineer-in-Charge.

iii. The complete installation shall be water tested (for joints/seals) and air infiltration tested.

iv. All works shall conform to CPWD norms.

7.3. WPC DOORS

General

i. The WPC (Wood Plastic Composite) door shutters shall be made of a solid extruded core composed of wood fiber (or sawdust), thermoplastic polymer (PVC/PE/PP), and additives including stabilizers, lubricants, and colorants. The material shall be factory-made, homogenous, termite-proof, waterproof, corrosion-resistant, and suitable for both wet and dry areas. All WPC doors shall comply with relevant standards and be approved by the Engineer-in-Charge.

ii. WPC doors shall be free from warping, delamination, swelling, or rotting under humid and wet conditions and shall be suitable for use in bathrooms, kitchens, or general-purpose internal applications. The Contractor shall submit product brochures, test certificates, and samples for approval before procurement and installation.

Material Standards and Composition

i. The WPC door shutters shall be manufactured using virgin or partially recycled wood fibers (or other cellulosic material) and thermoplastic resins (PVC or equivalent), with necessary additives.

ii. The WPC material must conform to ISO 16616:2015 – Plastics — Wood-plastic recycled composites (WPRC) and IS 4020 (Parts 1 to 16) for flush door testing standards.

iii. The density of the WPC door shall not be less than 600 kg/m³, and the material shall be free from voids, blowholes, or internal defects. It shall meet Class 1 fire retardant classification, wherever specified.

iv. The door core shall be solid, homogeneous, and without hollow sections unless otherwise specified. Profiles or designs, if any, shall be factory-molded.

iv. Manufacturer's test certificate must to be included

Sizes and Thickness

i. The standard door thickness shall be as per design or drawings.
ii. Door heights and widths shall conform to finished clear openings as per site measurement and drawings.
iii. Any variation in size for toilet, shaft, or service area doors shall be accommodated as per architectural drawings.

Finishing and Lamination

i. WPC door shutters shall be provided either plain (ready-to-paint), pre-laminated with PVC/laminate film, wood-grain textured, or factory finished with heat-pressed decorative laminated sheet, depending on the finish schedule and tender drawings.

ii. Laminated or pre-finished surfaces must be UV-resistant and scratch-resistant. Decorative laminates shall comply with IS 2046:1995 (or equivalent ISO standard).

iii. Edges of the door shall be banded with matching WPC strips or edge bands using hot melt adhesive. Alternatively, edges may be integral if door is single-piece molded.

Fabrication and Installation

i. Fabrication shall be done in factory-controlled environment. Doors shall be properly cut, machined, and edge-finished before dispatch to the site.

ii. All hardware cutouts shall be made using precision routers to avoid cracking. Pilot holes must be drilled before fixing screws to avoid splitting.

iii. Site installation shall be carried out using stainless steel screws and compatible sealants or PU foam. Hinges, locks, and other hardware must be compatible with the screw-holding capacity of WPC material.

iv. The Contractor shall ensure proper fitting and alignment of shutter within the frame and maintain uniform gaps for expansion and ease of movement. Gaps shall be sealed using weather-strips if specified.

Frames (if included)

i. WPC frames, if used, shall be of matching composition and color, with density not less than 650 kg/m³, and shall have provision for receiving screws and hinges.

ii. Frames shall be fixed using SS holdfasts, anchor bolts, and filled with PU foam. All frame-to-masonry joints shall be sealed with silicone sealant.

Hardware

i. All hardware used shall be of stainless steel (SS 316), compatible with WPC material. Hinges, locks, handles, tower bolts, and door closers shall be of heavy-duty type and approved make.

ii. All fasteners shall be fixed with pre-drilled pilot holes. Screws used shall be corrosion-resistant and counter-sunk neatly.

Quality Control and Testing

i. Each batch of WPC doors shall be accompanied by factory test certificates confirming physical and mechanical properties as per ISO and IS standards.

ii. The Engineer-in-Charge reserves the right to get any door sample tested in an approved laboratory. All defective doors shall be removed from site at the Contractor's cost.

iii. Tolerance in dimensions shall be as per IS 4020 / ISO 16929 (or equivalent for flat panels).

7.4 Aluminium Works

a. General

i. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium glazed doors, windows and ventilators in accordance with the drawings and specifications.

ii. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

iii. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

b. Materials: -

i. The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.

ii. The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.

iii. The IS specifications are to be strictly adhered.

iv. The extruder using recycled materials may be preferred.

v. The alloy of extruded aluminum should be BS or IS 733, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

c. Finishing**:**

i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.

ii. The polyester powder coating/powder coating, as required, as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.

iii. The polyester powder coated/powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

d. Fabrication**:**

i. Before commencing the fabrication, the Contractor shall submit to the PMC / Engineer – in - charge for their approval detailed shop drawings, based on the approved Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements. Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc. shall be as per architectural drawings or as approved by the Engineer – in - charge.

ii. A sample of finished door / windows/ ventilator railing etc. shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating / Powder coating shall be as specified in the item specifications.

iv. All materials shall confirm to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the Engineer – in - charge shall be final and binding on the Contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.

e. Glazing**:**

The glazing shall be as specified in DBR, PART-D & tender drawings or as per CPWD specifications keeping into consideration the size of opening or panels of the glass.

f. Hardware:

All hardware for doors and windows shall be of Powder coated aluminum or as specified in DBR / tender drawings

g. Fly proof SS wire mesh: Fly proof stainless steel grade 316 wire gauge mesh to be provided in windows and Main Doors entrance doors as specified in Finishing schedule/ tender drawings shall with average width of aperture 1.4 mm in both directions with wire of dia. 0.50 mm all complete

h. Aluminum Grills: Powder Coated Aluminium grill (minimum 50 micron) of approved design/pattern, with approved standard section shall be fixed to the window frame / Door Frame with stainless steel screws @ 200 mm centre to centre, including cutting the grill to proper opening size for fixing and operation of handles and fixing approved aluminium standard section around the opening, all complete as per requirement as specified in Finishing schedule/ tender drawings and direction of PMC/Engineer in charge.

7.5 Fire Check Doors: -

i) SCOPE

This specification covers the design, supply of materials, Manufacture and installation of factory made special type of approved make steel fire doors of 2 Hrs rating.

ii) CODES AND STANDARDS

All standards, specifications, acts, and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

List of certain important Indian Standards, Acts and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per but not limited to the list given below:

IS : 277	Galvanised steel sheet (plain and corrugated)
IS : 3614(Part-2) 1992	Metallic and non-metallic fire check doors – Resistance test and Part – 2 performance criteria.

iii) <u>GENERAL</u>

Test Report of the Prototype: The door frames and shutters shall be fabricated from approved manufacturers with materials and specifications identical to those for the prototype test report in accordance with IS:3614 (Part-2) 1992 for prescribed fire rating either by CBRI Roorkee shall be submitted to the Engineer-in-charge, and execution of the work shall commence only after obtaining his approval in writing. The test report shall include the information prescribed in clause 10 of IS:3614(Part2) 1992.

Testing: The Engineer-in-charge may select, out of the fire door and shutter, assembalies brought at site, random samples for testing either at CBRI Roorkee or at the Quality Marking Centre for Engineering Goods, Department of Industries, Bahadurgarh Harayana. The contractor shall make all arrangement for testing of the sample as per IS: 3614(Part2) 1992 and submit the test result to Engineer-in-charge. In case the test result is satisfactory testing charges (which includes the cost of sample and transportation) shall be paid by Engineer- in-charge. If the test result indicates that the fire door assembly does not conform to the requirement of IS:3614 (Part2) 1992for FD/60/120/180, the entire lot of the material shall be rejected. In later case, no testing charges shall be paid.

The Contractor shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities which cover the major requirements only. Anything called for in the tender documents shall be considered as applicable to the items of work concerned. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.
All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to.

All fittings shall be of high quality and as specified and as per approval.

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

Any approval, instructions, permission, checking, review, etc., whatsoever by the Engineer-in-charge shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship, etc.

The fire check doors shall satisfy:

a. Stability: The fire check door should not collapse during the rated period of fire under the specified fire conditions. The fire check doors provide safe access to the escape route in the building namely protected corridors and staircase.

b. Integrity: The fire check door should not allow the passage of hot gases or the flames through the rebate or the gap between the door frame and shutters for the duration of its fire rating.

c. Insulation: The mean temperature of the fire door on the unexposed side should not exceed 140 degrees C above ambient temperature for the duration of its fire rating. The fire/smoke check door assembly being offered shall be as prototype tested by CBRI, Roorkee or any other approved laboratory for the prescribed fire rating as per BS:476 part20/22, IS:3614 part-II. A test report from CBRI Roorkee shall be submitted for approval before executing the work. The fire/smoke check doors should also have Tarriff Advisory Committee approval as admissible. The tenderer shall employ specialized agency or manufacturer of the fire check door assembly having their own manufacturing facility and such agency shall be got approved by the Engineer-in-charge. Door frame and shutter shall in general be fabricated as per the nomenclature of the item of the work and recommendations of the specialized agencies as approved by the Engineer-in-charge.

d. Fire check doors shall be 2 hour or as specified fire rated and sh all satisfy the three performance criteria of stability, integrity and insulation as per BS:476 part20/22, IS:3614 part-II.

e. One door assembly shall be got tested from CBRI Roorkee or any other test laboratory approved by Engineer- in-charge as per the nomenclature of the item for the same.

f. The tenderer shall be responsible for obtaining ‘No Objection Clearance’ from local fire authority for the executed work.

g. Guarantee Bond: The work shall be guaranteed for a period of five years from the date of N.O.C. issued by the local fire authority. The security deposit against this item of work shall be in addition to the security deposit mentioned in Schedule-F. The contractor shall execute the necessary guarantee bond against any structural defect, faulty materials, workmanship and defective finish. In addition, 5% (five percent) of the cost of this item of work shall be retained as security deposit and the amount so withheld would be released after five years from the date of completion of the entire work under the agreement, if performance of the work is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor along with any incidental repairs to the structure, flooring, finishing, fixtures and any other related damaged work within fifteen days of receipt of intimation of such defects in the work. If the defects pointed out are not attended to within the specified period, the same shall be got done from another agency at the risk and cost of the contractor and the cost of the attending such repairs shall be deducted from any dues payable to the contractor. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer-in-charge in the prescribed proforma.

7.6 Fire Check Glazed Doors & Windows: -

7.6.1 Composition of the Doors & Windows

All materials, items, hardware etc. shall be subjected to approval by Engineer-In-Charge. Necessary documentation/ test certificates shall be furnished by the Contractor for such approval. FCD & FCW shall be fabricated only after approval of materials etc, by Engineer-In-Charge.

Each FCD & FCW shall be provided with a small metal identification plate in suitable location indicating Fire rating, name of the Manufacturer, date of installation and approval of approved test house.

Each vision panel shall carry a stamp of the manufacturer.
Unless otherwise mentioned elsewhere, all FCD & FCW shall be of two hours (120 Mins.) and all door integrity and thermal insulation). For glazed fire rated door it should exhibit integrity , stability and radiation control for 120 mins and insulation for the first 30 mins. The glazed fire doors shall be manufactured as per the nomenclature of the item an as per the manufacturers specification as per the best engineering practice and as per the drawing and direction of Engineer-in-charge.

The glass panels shall be double glazed with thickness as specified clear, interlayered, 120 min. rated, non wired toughened glass of approved make complies to BS476 Part22 or (EN-1634-1:1999). The glass shall be complied to Class 1B1 Category of Impact Resistance to EN:12600 safety Glazing Material. The system should be tested as per EN:1364 Part-1-1999 or equivalent standard.

7.7 Fire Check Glazed Partition: -

Fire Check Glazed Partition with galvanized steel frame 120-minute fire rated – fully glazed non load bearing fixed partition shall be of proprietary design of the manufacturers as per the valid fire test certificate from /EN/BS from National or international test lab. Frames and glass panels shall be as per the nomenclature of the item.

7.7.1 **INSTALLATION**

Shop drawings of the doors, windows and partitions in accordance to the prototype profiles used to obtain fire test certificate by approved national or international test house shall be prepared and submitted for approval by the Engineer-In-Charge. The shop drawings shall include all details of construction, anchoring, connections, fastenings etc. Any suitable modification in fittings, fixtures as required for project specific installations shall have to be incorporated in door profile and approval obtained prior to the installation of the door.

i. Vision Panel: -

The Fire Rated Glass shall be minimum 11 mm thick interlayered , 120 minutes fire Rated (EW120, EI 15 minutes) Non Wired, Toughened Interlayered Glass of approved make which can also withstand thermal shock upto 800 degree centigrade shall be used as a glazing (Vision Panel Top/side fixed glazing) and is to be fixed in between the glass beading by using ceramic fiber in accordance with BS: 476 Part 22/ EN 1363 EN 1364 for stability and integrity of size 300 mm x 500mm (Clear vision) and the manufacturer should have tested the glass of similar or bigger size with any type of door framing from CBRI Roorkee . The Location of the Fr Glass will be as per the directions of PMC/Engineer in charge.

ii. Finish: -

The door frame and door shutter shall be finished with minimum two or more coats of thermo setting acrylic paint for scratch resistance and durability on hard wooden surface (@3.5 sq.mtr. per ltr., per coat) including preparation of base surface as per recommendation of manufacturer to make the surface fire retardant. The paint shall be of approved brand and quality.

iii. Ironmongry Hinges: -

Fire rated SS Ball Bearing Hinges with SS Screws (4 Nos per panel)

b. Metal Fire Doors & Frames: - These shall confirm to CPWD specifications.

i. DoorFrames**:** -

Door frame shall be double rebate profile of requisite sections made out of 1.60mm (16gauge) minimum thick galvanized steel sheet. NDRF requisite size Frames shall be Butt jointed and field assembled with self-bolted. The frames should be finished with Thermosetting Powder Coating in desired RAL Shade. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate bracket and anchor fasteners for installation on a finished plastered masonry wall opening. The frame shall be fixed with 8 nos. suitable size metal dash fasteners of approved brand and manufacture as per direction of PMC/Engineer in charge.

ii. Door Shutter: -

The Door Shutter shall be of requisite thickness fire resistant door shutters of 120 minutes fire rating confirming to IS:3614 (Part-II), tested and certified as per laboratory approved by PMC/Engineer in charge, with suitable mounting on door frame, consisting of vertical styles, lock rail, top rail 100 mm wide, bottom rail 200 mm wide, made out of 16 SWG G.I. sheet (zinc coating not less than 120 gm/m2) duly filled FR insulation material and fixing with necessary stainless steel ball bearing hinges of approved make, including applying a coat of approved fire resistant primer etc. all complete as per direction of PMC/Engineer in charge

iii. Vision Panel: -

The Fire Rated Glass shall be minimum 11 mm thick interlayerd , 120 minutes fire Rated (EW120, EI 15 minutes) Non Wired, Toughened Interlayered Glass of approved make which can also withstand thermal shock upto 800 degree centigrade shall be used as a glazing (Vision Panel Top/side fixed glazing) and is to be fixed in between the glass beading by using ceramic fiber in accordance with BS: 476 Part 22/

EN 1363 EN 1364 for stability and integrity of size 300 mm x 500mm (Clear vision) and the manufacturer should have tested the glass of similar or bigger size with any type of door framing from CBRI Roorkee . The Location of the Fire Glass will be as per the directions of PMC/Engineer in charge.

iv. Finish: -

The door frame and door shutter shall be finished with minimum two or more coats of thermosetting acrylic paint for scratch resistance and durability on hard wooden surface (@3.5 sq.mtr. per ltr., per coat) including preparation of base xsurface as per recommendation of manufacturer to make the surface fire retardant. The paint shall be of approved brand and quality.

v. Ironmongry Hinges: -

SS Ball Bearing Hinges of size 100 x 75 x 3mm complete with SS Screws of BB1953 Becker F.S / 3090F DORMA / 8011008 GEZE Make (4 Nos per panel) or equivalent approved by SBI/PMC in charge

c. **Fire Resistant Glazed Doors, Windows & Partitions:**

i. General

The Fire Resistant Glazed Doors (hereinafter termed as FRGD), Fire resistant Glazed windows (hereinafter termed as FRGW) and Fire Resistant Glazed Partition (hereinafter termed as FRGP) shall not collapse during the rated period of fire under the specified fire conditions and shall provide safe access to the escape route.

ii. Codes & Specifications

All materials, items, hardware etc. shall be subjected to approval by SBI/PMC in charge Necessary documentation/ test certificates shall be furnished by the Contractor from the manufacturer before supply of material for approval by PMC/Engineer in charge. Each Door/Window and Partition shall be provided with a small metal identification plate in suitable location indicating Fire rating, name of the Manufacturer, date of installation and details of approved test house. Each Glazing pane shall carry a permanent stamp of the manufacturer.

The complete assembly of the doors i.e. frame, shutter, vision glass and hardware shall have fire rating as required and shall confirm to:

			Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware - Part 1: Fire resistance test for door and shutter assemblies and openable windows
			Fire resistance tests for non-load bearing elements –Part 1: Walls
			Determination of luminous and solar characteristics of glazing.

		Glass in Buildings – Pendulum test – Impact test and classification for flat glass

iii. Testing& Certification

The FRGD, FRGW & FRGP shall be supplemented with appropriate certification by fire test lab, for applicable or higher dimension with complete description of the architectural components and hardware for FRGD, FRGW and FRGP for which the approval is given. Along with the material tests, the complete system along with the framing shall be tested in accordance with the criteria of EN1634-1 for door/ window and EN1364-1 for partition. The installation of the fire rated system shall confirm to requirement of test evidence. The choice of hardware and/or glazed accessories shall be as per test evidence.

iv. Frame for Fire Resistant Glazed Door / Windows

Frame for Door/Window of 120 min fire rating shall be made of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m²) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m³. The frame will have a provision of G.I. Anchor fasteners 14 nos (5 each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge. (Cost of SS ball bearing hinges is excluded).

v. Frame for Fire Resistant Glazed Partitions

Frame for non-load bearing fixed fire resistant glazed Partition for 120 min Fire Rating shall be made out to a profile of dimension 60mm x 70 mm of 1.6 mm thick galvanised steel sheet as per test evidence suitable for fixing fire rated glass for 120 min of both integrity & radiation control (EW120) & minimum 15 min of insulation (EI15).The profile has to be fixed to the supporting construction by means of anchor fasteners of size M10 x 80, every 150 mm from the edges and every 500 mm (approx) c/c. The frame shall be filled with mineral wool insulation of density min 96kg/m³. and finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge.

vi. Shutter for Fire Resistant Doors/Windows

Glazed fire resistant door shutters 60 mm thick of 120 min Fire Rating shall be confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by PMC/Engineer in charge, with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m²) duly filled mineral wool insulation having density min 96 kg/m³ and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc all complete as per direction of PMC/Engineer in charge.

vii. Fire Resistant Glass for Doors/Windows and Partitions

Glazing to be fixed in fire resistant doors/window shutters and fixed Partitions with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant primer/powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc complete in all respect as per direction of PMC/Engineer in charge. The glass should be clear, toughened, interlayered, non- wired fire resistant having 11 mm minimum thickness of approved brand with 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 15 min of insulation (EI15) and having a sound reduction of more than 35dB and LT of 85%. Glass shall be compliant to class 2B2/1B1 category of Impact Resistance as per EN 12600. The glass should be manufactured in UL & TUV audited Facility and including UL-EU Certification. The maximum glazing size cannot be more than 1100 mm x 2200 mm (w x h) or 2.42 sq mts in total area. The test report for the complete system (Glazed Door or Partition) will be considered valid only if it contains the stamp and signature of the authorized signatory from the glass manufacturer.

The complete assembly shall satisfy the given criteria of fire resistance - stability, fire integrity, radiation control and insulation as per above mentioned rating required.

viii. Vision Panel for Fire Door Specifications for glass for Vision panels for Fire Rated Door shall be as per para iv above. The size of glass to be used for vision panels shall be as per tender drawings.

d. Fire Doors Fittings

All work is to be carried out in accordance with relevant IS Code and specification for Fire Door & fitting as per IS: 3614 (Part I) – 1966 and direction of Engineer in charge. Door shall be fixed with fire rated hinges 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 316 and in satin stainless steel, as per EN 1935, CE Marked.

i. Mortice Lock: 2 hrs., fire rated mortice lock with lever handle tested in accordance with BS: 476 Part 22. A minimum one-year warrantee shall be provided. Mortice sash lock with internal thumb turn and external key operation with lever handles shall be provided.

ii. Flush Bolts (For Double Door): - 300mm concealed extended lever action flush bolts satin finish, fixed to top and bottom of the inactive blade shall be provided.

iii. Automatic Door Closer: - Dual adjustable speed automatic door closer with rack and pinion method, in confirmance with BS:476 Part 22 (for fire rating) and BS EN1154 shall be provided. The door closer shall have minimum of one-year warrantee.

iv. Pull Handle: 300mm long stainless steel grade 316 D type pull handle shall be fixed with necessary screws etc. complete. A minimum one-year warrantee for the product shall be provided.

v. Fire Rated Panic exit device: - It shall be suitable for door weights up to 120kgs. The Panic bar as per door leaf (SINGLE LEAF/DOUBLE LEAF) shall consist of Main Panic Latch component, End Component, Push bar, Striker Kit, end caps in Silver finish. Complete set with screws & fixing accessories, External trim, having fire rated door closer TS 71/68 rack and pinion door closer EN size 3/4, with std. arm and with two independent closing valves and latching speed adjustable by arm. Full plastic cover. Silver finish. As per EN 1154 life cycle 500,000 with seals and door stopper. The device shall be complete in all respect and fixed as recommended by the manufacturers. A minimum one-year warrantee for the product shall be provided.

vi. Smoke Seals: - Heavy duty smoke seals for smoke check doors shall be provided.

vii. Acoustic Seals: - Acoustic seals of appropriate design duly fixed in shutter as well as door frame shall be provided.

e. **Detail of Fire rated Door/Window/Partition**

i. Door frames and leaf: 1.6 mm thick GI sheet.

ii. Glazing bead: 1.6 mm thick GI sheet.

iii. Stiffeners: 1.6 mm thick GI sheet.

iv. Glass: Clear toughened interlayer fire rated glass.

v. Beading screw: M4x35 mm @ 150mm (approx.) C/C.

vi. SS ball bearing butt hinges 100x89x3 mm.

vii. Ceramic wool infill (Density – 96 kg/m3)

f. Deliverables by the Contractor

Following documentation/ drawings shall be furnished along with the Doors/ window/ partition.

1) Prototype Test Certificate by national/international test house

2) Shop drawings

3) Specification/ Manufacturer's literature, Test certificates and other documentation for materials and items intended to be used.

4) Certificate indicating that design and installation of Doors and hardware confirms to norm laid down by approved national/international test house.

5) Test report to be attested by Fire rated glass manufacturer.

6) The Fire rated glass applicator has to be approved by Fire rated Glass Manufacturer has to submit the approved applicator certificate.

7.8 Automatic Sliding Door Operator

Providing and fixing automatic bi-parting sliding doors with 12mm clear toughened glass shutter.

Automatic sliding door operator shall be as per approved dwg., Compliant with European standards and produced according to the guidelines for power-operated windows, doors and gates, BGR 232, the UVV and the VDE regulations. TÜV design tested, tested according to the low voltage guidelines, fulfils DIN 18650 standards for Pedestrian Safety, TUV Design Tested for Durability of 1 Million Cycles. The track profile should be separate from the main profile for enabling reduction in vibration insulation. Operator length = 6250 mm, Maximum clear passage opening width = 3000 mm, maximum clear passage height = 2500 mm, includes microprocessor controlled drive unit, with self-learning mechanism, program selector with knob, motion detector (eagle 6 radars, 02 nos), mechanical components, toothed belt, cover profile, floor guide for frameless glass (02 nos), glass clamping rail (02 nos), safety device-light barrier (01 pair). Body finish: standard silver anodised operator profile, electromechanical lock with 12 mm plain toughened frameless glass for complete elevation - 2 moving panels. UPS of 750 VA shall be provided, which will give power backup of 20 min. Only & if the duration of power cut to the operator is more than 30 min, then separate arrangement needs to be done for the same as automatic operator requires uninterrupted stabilized power supply. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge / architect consultant.

7.9 Glazed Partitions

Supply and Fixing of Full Height Demountable Glass partition including doors with 10mm Toughened Glass using Frame profiles 100 x 25 mm up to a height of maximum 4m or as per drawing using minimum 20-micron matt finished Anodized Aluminum in required color & shade. The Fixed glass to be fixed using base profiles 100 x 25 mm at Top & Bottom & support profile 100 x 25 mm at sides. The profile size to be 100x25MM to be fixed on to the floor/wall/ ceiling as per the architect design. Over panel Profile of 100 x 50 mm to be used for Over panel, H Junction profile to be used at all Glass to Glass vertical joints, 90 Deg L Junction Profiles and T Junction profiles necessary as per design. End Profile 100 x 25 mm to be used for Open glass edges and all around the door frame with seals and Over Panel End profile including filling the joints if required with Silicon sealant structural grade and weathering grade of Dow corning - USA or "GE Silicon - USA" or "WACKER -

Germany"., complete as per detailed drawings & approved shop drawings. (The contractor must provide detailed shop drawings of individual profiles and also details of any other profiles that may be used clearly indicating all dimensions.) The Profile shall be matt natural anodized, the Profile Manufacturer to supply all the necessary clips, seals and fixing accessories for the system. All Profiles to be with 2 mm Gauge thickness.

7.10 Glass Block

Glass Blocks (transparent / colour) of approved make of size 190mm x 190mmx 80mm (approximate weight 2.0-2.5 kg per block) with 10 mm joint to achieve a 200 mm module with mortar grout of white cement and marble powder in proportion of 1: 2 respectively including 6mm dia steel reinforcement bars to be laid in horizontal and vertical joints as per manufacturers specification.

Glass block panels shall be supported on all sides by fabricated powder coated (minimum thickness of powder coating 60 micron) aluminium frames of nominal dimension 80mm x 40mm x 2mm size, and block should rest on top of the cement mortar 1:3 (1 cement: 3 sand). Aluminium frames shall not be load-bearing and shall be fixed to the surrounding structure.

The joints between the blocks to be sealed with transparent / colour Silicone Gel sealant of approved make complete as per manufacturer specification, as per drawing and instructions of the Architect.

Location: Glass block shall be provided at various location & levels as per GFC architectural drawing. (Basic cost of Glass block excluding GST should not be less than Rs. 160/-).

7.11 Hardware for Glazed Partition single or double leaf doors

Providing & fixing Dorma or approved equivalent make stainless steel grade 316 patch fitting in frameless glass single or double leaf door shutters which include Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate and 'H' shape pull handle (450 mm x 25 mm) SS 316 grade and floor spring with adjustable spring strength, suitable for door leaf weight upto 120 kgs, max leaf width 1100mm and Tested for durability of 500,000 cycles & other accessories including the cost of screw & all other incidentals complete as per detailed drawings & approved shop drawings.

7.12 Frame Less Door

Providing & fixing manual frameless double leaf glass doors with 12 mm clear toughened glass and S/S patch fitting (PT standard) of grade 316: such as Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate & stainless steel grade 316 handles 38 mm dia and 600 mm long or as approved by the Engineer in charge and floor spring conforming to DIN EN1154 with adjustable spring strength EN (1-4) and Tested for durability of 500,000 cycles. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge.

7.13 Glazing with Patch Fittings

a. General

i. The Contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.

b. The scope of work shall include:

i. Design, preparation of shop drawings, calculations, engineering data and test reports.

ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.

iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed Architectural mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, fire-safety etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and ear thing of all metal cladding elements.

x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.

xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. Submittals

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings

d. Fabrication and installation details, including followings

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

e. Sample for verification, for each type of exposed finish required for

i. Metal finish: 150mm long section of patch fittings, rails and other items.

ii. Glass: 150mm square, showing exposed edge finish.

f. Materials

i. **Glass**

- Glass shall be as specified in drawing or as per design requirement. It shall be hard coated reflective bronze and heat strengthened glass. It shall be of approved make.
- In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

ii. **Components**

- Patch fittings: Stainless steel clad aluminium
- Floating Transom Bar: Steel cladded in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.
- Rails: Stainless steel clad aluminium.
- Accessory Fittings: Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.
- Anchors and fastenings: Concealed
- Weather stripping: Sweep type

iii. **Hardware**

- Hardware should be heavy duty in matching finish

- Concealed Floor Closer and Top Pivots
- Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
- Swing: Double acting; Positive dead stop, concealed with hold open angle Delayed action closing
- Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
- Push-pull set: Stainless steel finish
- Lock set of approved make.

g. **Fabrication**

i. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tampering glass. Fully temper glass using horizontal (roller- hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.

ii. Factory assembled components and factory installed hardware to greatest extent possible.

h. **Execution**

i. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.

ii. Install all glass system and associated components according to manufacturer's written instructions.

iii. Set units in level and plumb.

iv. Maintain uniform clearances between adjacent components.

v. Lubricate hardware and other moving parts according to manufacturer's written instructions.

vi. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

i. **Cleaning**

i. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

ii. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.

iii. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.

iv. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.

v. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.

vi. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer – in - charge.

vii. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.

viii. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.

ix. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.

x. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.

j. **Performance Guarantee:**
The Contractor shall offer a minimum of 10-year Performance Warranty for the entire installation carried out.

8 EXTERNAL FAÇADE WORKS:

8.4 Structural Glazing System

<u>Scope of Work</u>

The Contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazingsystem to the proposed building, all in confirmity with the Design Basis Report & Drawings as given. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:

- Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.
- All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
- All thermal insulation associated with the system. All fire protection associated with the system.
- All copings, end closure and metal cladding to complete the system.
- All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
- Isolation of dissimilar metals and moving parts.
- Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.

▪ **The Contractor shall also be responsible for providing the followings:**

- Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.
- Scheduling and Monitoring of the Work.
- Mock-ups, samples and test units.
- Performance testing of the structural glazing framing and glazing assembly.
- Co-ordination with work of other trades.
- Protection.
- All final exterior and interior cleaning and finishing of the structural glazing System
- As-built record drawings and photographs.

- Guarantees and Warranties.
- All hoisting, staging and temporary services.
- Conceptualising and design of a suitable maintenance system for structural glazing.
- The water tightness and structural stability of the whole structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.
- The structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

a. <u>Building Regulations</u>

- Structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.
- All structural glazing, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:

i. Design load and deflection.

ii. Structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm maximum whichever is less.

iii. Structural performance of all parts of structural glazing system shall confirm to relevant IS codes, wind load as per IS-875 and seismic loads as per IS- 1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.

iv. **Design Wind Loading**

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified. The design loads shall be considering Important building with life expectancy of 100 years, local external co-eeficients & internal co-efficient in accordance with codal requirement.

b. <u>Pre Execution Requirements</u>

i. <u>Design Proposals</u>

The Contractor shall propose the final design in such a way that all basic functional and architectural requirements in line with the Master Plan, Concept Plans & Design Basis Report are fulfilled and get the same approved by SBI. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work

including:

- Request details as indicated on the tender drawings.
- Metal quality, finishes and thickness.
- Glass quality, coating and thickness and proposed manufacturer's brand names.
- Sections of the mullion and transom together with structural calculations.
- Arrangement and jointing of components.
- Field connections especially mullion to mullion and transom to mullion. Fixing and anchorage system of typical wall unit together with structural calculations.
- Drainage system and provision in respect of water leakage in the curtain wall/structural glazing system.
- Provisions for thermal movements.
- Sealant and sealing method.
- Glazing method.
- Wind load and seismic load and any other specific load considered in the design.
- Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.
- The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.
- Any parts of the curtain wall/structural glazing, when completed, shall be within the following tolerances:
- Deviation from plumb, level or dimensioned angle must not exceed 3mm per
- 3.5m of length of any member, or 6mm in any total run in any line.
- Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle, must not exceed 9mm total at any location.
- Change in deviation must not exceed 3mm for any 3.5m run in any direction.

ii. Samples

The Contractor shall also submit samples of mullion and transom sections in lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

iii. Preliminary Programme

The tenderer shall also submit a preliminary programme of the contract works showing the various stages of design sampling, testing, fabrication, delivery and installation of the works.

iv. Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.

v. The Contractor/Sub-Contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.

vi. During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the SBI.

c. <u>Execution- Performance Testing</u>

The performance tests are to be conducted on the structural glazing system, if the area of the structural glazing system exceeds 2500 Sqm from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science and Technology, India. The decision of the PMC/Engineer in charge about the necessity of testing of shall be final and binding.

d. <u>General Requirements</u>

- o Mock-up units shall be constructed by the Contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.
- o After approval of structural calculations and shop drawings for the structural glazing, one (1) Test Unit for performance testing of the structural glazing shall be constructed by the Contractor at a laboratory approved by the Department.
- o Erect mock-up under manufacturer's/installer's direct supervision and employ workmen as they would be employed during the actual erection at the job site.
- o Test procedures test schedules and test locations shall be submitted to SBI/PMC in-charge for approval before testing.
- o Prior to fabrication of Test Units, the Contractor shall submit shop drawings and calculations of the Test Unit for the PMC/Engineer in charge's approval.
- o Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

ii. <u>Test of Wind Pressure</u>

o The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the 'Pressure Chamber' at which the Test Unit is fixed.

o The static wind pressure shall be applied design requirement (minimum 1.5 Kpa) at maximum wind pressure. The variation of dynamic pressure shall be of any approximate sine-curve-line.

o Deflection on each observational points of the Test Unit shall be observed and recorded under the Static pressure as described above.

o Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

o The deflection on the main structural parts in these conditions shall not exceed:

- 1/175 of the span between supports or 20mm, whichever is the lesser for vertical elements.
- 1/250 of the span between supports for horizontal elements.
- The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

Test of Lateral Deflection per Floor Height

▪Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

▪The deflection of every + 2.5mm shall be increased upto + 13mmm on the Test Unit (Static Deflection Test).

▪The dynamic deflection shall be applied upto + 13mm.

▪The variation of dynamic deflection shall be of an approximate sine-curve-line, one period of 3 seconds.

▪The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

▪Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection Test of Water-tightness.

▪Water shall be sprinkled to the Test Unit under the wind pressure. Pressure shall not be applied to the Test Unit.

▪The volume of the sprinkling water in one minute shall be 5 litres/m2 min. (0.1 gal/ sq.ft.).

▪All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

▪Hold the test 2 times, in sequence as described below, confirming to the above mentioned conditions.

▪Install the test unit.

▪Hold 1st water-tightness test.

▪Hold test of wind pressure as described above. Hold 2nd water-tightness test.

Lateral deflection test.

▪Water leakage at all parts of the Test Unit shall not be observed inside during the 1st water- tightness test.

iii. Test Report

The Contractor is required to submit five (5) copies of test reports to the PMC/Engineer in charge.

iv. Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the SBI.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratory till it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the SBI.

v. Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for PMC/Engineer in charge`s approval.

vi. Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the PMC/Engineer in charge.

vii. Contractor's Representatives

Full time attendance by Approved Representatives of the Contractor & SubContractor associated with the erection of curtain wall/structural glazingshall be provided for the erection of the Test Unit and for all testing of the Test Unit.

i. Performance Guarantee

The tenderer shall provide a performance guarantee as specified in the Specific Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period to start from the date of completion of the project.

8.5 External Texture Paint

The paint shall be (Texured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint/100% premium acrylic emulsion paint) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fornight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in- Charge.

The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Finishing walls with ready mixed Premium acrylic emulsion paint (Company Depot Tinted) having VOC less than 50 gm/litre and UV resistance as per IS 15489:2004, Alkali & fungal resistance, dirt resistance exterior paint of required shade with silicon additives. 1.5MM - 1.8 MM Providing and laying weather and Ultra voilet Resistant, Water Repellent, Dust, Dirt and Stain Resistant, Fungus and Algae Resistant natural none pigmented crushed granite Chips (100% natural crushed Granite chips/powder) of approved make with final coat of texture with stone chips (attainable thickness: 0.70 to 0.90mm to offer grooved finish) applied with Spray over a coat of texture without chips (attainable thickness: 0.50 to 0.70mm to offer smooth surface as base coat) over a repair check with exterior grade cement mixed with acrylic primer over a coat of acrylic primer tinted in approved shade water in the ratio of 1:1 complete as approved by PMC/Engineer in charge.

Finally, two coat of water base acrylic protection coat applied with roller and brush to make surface streak resistance.

8.6 Stone work-

8.6.1 Dry cladding: -

The dry cladding shall be laid as per design with white sandstone 30mm thick gang saw cut stone with (machine cut edges) of uniform colour in sizes as approved by SBI/PMC in charge and in accordance with CPWD Specifications, including SS grade 316 or as specified, metal cramps, pins, dowels, ledges and supports, as per design and requirements. The support structure shall be designed by the Contractor and approved by the SBI/PMC in charge Horizontal & vertical joints shall be filled with weather sealant mixed with pigment of matching shade. Groove width, if provided/ required, shall be uniform and in plumb of vertical surface.

The Contractor shall get this work executed through a specialized agency. The Contractor shall submit the credential of the specialized agency well in advance for verification and only after written approval of PMC/Engineer in charge can the agency be deployed for this work. The Contractor shall furnish a legal guarantee bond for ten years in prescribed proforma certifying that all the defects noticed during this period shall be rectified and made good to the satisfaction of PMC/Engineer in charge.

Wherever the stone slab dry cladding is provided exposed to environment, exposed surface and edge surfaces of the stone slabs shall be treated to make the surfaces hydrophobic by applying water repellant / hydrophobic clear coating of water soluble siliconate based impregnating agent of approved make. The formulation shall be prepared and applied as per the manufacturer's recommendations. Before applying the formulation, the surface preparation shall be done as per the manufacturer's recommendations. The surface shall be cleaned using water and the formulation shall be applied on the damp surface.

It shall be applied before installation of stone on vertical surface has been completed and after necessary surface preparation.

8.7 Aluminium Louvers system

Aluminium 50 BD Ventilated Façade / Louver System

Panel dimensions: 50mm wide x 100mm depth x 0.5mm thick, Panel length up to 5mtrs. Coil coated on a continuous paint line double baked. Roll formed from enamelled corrosion resistance Aluminium Alloy AA3005 / AA5050. Back cover matching panel length with end caps. Mounted in a module of 175mm on a mullion profile grooved by Locking Clip and Pop Rivet, Slotted Fastening Profile fixed at 200mm from panel ends and 1200mm centre to centre across panel span. Slotted Fastening Profile fixed to suitable sub-structure. Chromatised for maximum bond between metal and paint enamelled twice under high temperature. One side with full primer and finish coat (exterior), the other side with a primer coat (inner side), Green-pro certification for LEED certification by Indian Green Building Council (IGBC), ISO 9001:2015 Quality Management System Certification In-house Powder Coating line with Nano technology & catalytic converter in India Five (5) times cleaning process with Nano Technology for better adhesion and corrosion protection.

9 RAILING, GRILL WORK AND FENCING:

Railing, Grill & Fencing shall be as specified in the PART-D, Design Basis Report/Finshing Schedule or as specified in the Tender drawings. The work to be carried out as per latest CPWD Specifications. Brief Technical specifications of these works are as given below:

9.4 Grill Work:

a. MS Grills shall be provided in the windows made out of mild steel sections or as specified in the tender drawings.

b. All steel grills shall be according to the detailed drawings and shall confirm to Latest CPWD Specifications.

c. On MS grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer and finished with two or more coats of low VOC synthetic enamel pain of approved make and shade/ powder coating as specified.

9.5 Railing:

The scope of the work includes preparation of the shop drawings (based on the tender / architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.

a. <u>MS Railing</u>: To be provided as per CPWD specifications as specified in tender drawings and DBR including painting & primier coat complete.

b. <u>Stainless Steel Railing</u>

i. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the PMC/Engineer in charge.

ii. The Contractor shall submit shop drawings, for approval of the SBI/PMC in charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.

iii. The Contractor shall procure and submit to the PMC/Engineer in charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of PMC/Engineer in charge / SBI. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/Engineer in charge / SBI. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/Engineer in charge. Nothing extra shall be payable on this account.

iv. The stainless steel shall be of grade 316 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

v. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.

vi. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.

vii. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

viii. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

ix. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

x. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of PMC/Engineer in charge.

10 STRUCTURAL STEEL

a. General

i. This specification covers the fabrication and transportation to site and erection on prepared foundations and structural steel work consisting of beams, columns, purlins, vertical trusses, bracings, shear connections etc.

ii. Fabrication, erection and approval of steel structures shall be in compliance with General Specifications mentioned in CPWD specifications with up to date correction slips and IS: 800 – 2007. For the guidance on general fabrication and erection of structural steel work, Chapter 11 of IS: 800 (1984) must be followed. As far as safety is concerned guidance could be obtained from Indian safety code for structural steelwork IS: 7205(1974). Before the commencement of the erection, all the erection equipment tools, shackles, ropes etc. should be tested for their load carrying capacity. Such tests if needed may be repeated at intermediate stages also.

iii. Providing shop primer coat for steel structures. Grouting of holding-down bolt pockets and below base plates where required.

b. Scope

The fabrication and erection of the steel work consists of accomplishing of all jobs here- in enumerated including providing all labour, tools and plant all materials and consumables such as welding electrodes, bolts and nuts, oxygen and acetylene gases, oils for cleaning etc. of approved quality as per relevant IS. The work shall be executed according to the drawings, specifications, relevant codes etc. in an expeditious and workman like manner, as detailed in the specifications and the relevant Indian Standard Codes and Standard Practice and to the complete satisfaction of the PMC/Engineer in charge.

c. Fabrication Drawings

i. The Contractor shall prepare all fabrication and erection drawings on the basis of approved design drawings and shall submit the same in triplicate to the SBI/PMC in charge for review, PMC/Engineer in charge shall review and comment, if any, on the same. Such review, if any, by the PMC/Engineer in charge, does not relieve the Contractor of any of his required guarantees and responsibilities. The Contractor shall however be responsible to fabricate the structural strictly confirming to specifications and reviewed drawings.

ii. Fabrication drawings shall include but not limited to the following:

- Member sizes and details
- Types and dimensions of welds and bolts
- Shapes and sizes of edge preparation for welding
- Details of shop and field joints included in assemblies.
- Quality of structural steels, welding electrodes, bolts, nuts and washers etc. to be used.
- Erection assemblies, identifying all transportable parts and sub-assemblies, associated with special erection instructions, if required.
- Calculations where asked for approval.

iii. Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Where asked for calculations for the merit shall also be submitted for approval.PMC/Engineer in charge review shall not absolve the Contractor of his responsibility for the correctness of dimensions, adequacy of details and connections. One copy will be returned reviewed with or without comments to the Contractor for necessary action. In the former case further three copies of amended drawings shall be submitted by the Contractor for final review.

iv. The Contractor shall supply three prints each of the final reviewed drawings to the PMC/Engineer in charge within a week since final review.

v. If any modification is necessary in the approved drawing during the course of execution of the job, revised fabrication drawings will be prepared by the Contractor, incorporating the changes and the revised fabrication drawings shall be duly got reviewed as per the above Clauses.

d. Materials

i. Rolled Sections

Structural steel will generally be of standard quality confirming to IS: 226/IS: 2062. Whenever welded construction is specified plates of more than 20 mm thickness will generally confirm to IS: 2062.

ii. Welding Materials

Welding electrodes shall confirm to IS: 814 and approval of welding procedures shall be as per IS: 823.

iii. Bolts, Nuts & Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 Kg/mm2 and minimum elongation of 23% on a gauge length of 5.65 (A- Original cross sectional area of the gauge length). Washers shall be as per IS: 2016.

iv. All materials shall confirm to their respective specifications. The use of equivalent or higher grade or alternate materials will be considered only in very special cases subject to the approval of the PMC/Engineer in charge in writing.

v. Receipt & Storing of Materials

- Steel materials supplied by the Contractor must be marked for identification and each lot should be accompanied by manufacturer's quality certificate, confirming chemical analysis and mechanical characteristics.
- All steel parts furnished by supplier shall be checked, sorted out, straightened, and arranged by grades and qualities in stores.
- Structural with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards or as directed by the chief PMC/Engineer in charge.
- Welding wire and electrodes shall be stored separately by qualities and lots inside a dry and enclosed room, in compliance with IS: 816 - 1969 and as per instructions given by the PMC/Engineer in charge. Electrodes shall be perfectly dry and drawn from an electrode even, if required.

vi. Checking of quality bolts of any kind as well as storage of same shall be made confirming to relevant standards.

- Each lot of electrodes, bolts, nuts, etc. shall be accompanied by manufacturer's test certificate.
- The Contractor may use alternative materials as compared to design specification only with the written approval of the PMC/Engineer in charge.

Material Tests

- The Contractor shall be required to produce manufacturer's quality certificates for the materials supplied by the Contractor. Notwithstanding the manufacturer's certificates, the PMC/Engineer in charge may ask for testing of materials in approved test houses. The test results shall satisfy the requirements of the relevant Indian Standards.

- Whenever quality certificates are missing or incomplete or when material quality differs from standard specifications the Contractor shall conduct all appropriate tests as directed by the PMC/Engineer in charge at no extra cost.
- Materials for which test certificates are not available or for which test results do not tally with relevant standard specifications, shall not be used.

vii. Fabrication

The Contractor will submit the credential with full particulars about work completed by fabricator to be deployed for this work for approval of PMC/Engineer in charge. After written approval is communicated in respect of fabricator, then only the jobs should be asigned to him. Fabrication shall be in accordance with IS: 800 Section V in addition to the following:

- Fabrication shall be done as per approved fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.
- Any defective material used shall be replaced by the Contractor at his own expense, care being taken to prevent any damage to the structure during removal.
- All the fabricated and delivered items shall be suitably packed to be protected from any damage during transportation and handling. Any damage caused at any time shall be made good by the Contractor at his own cost.
- Any faulty fabrication pointed out at any stage of work shall be made good by the Contractor at his own cost.

a. Preparation of Materials

Prior to release for fabrication, all rolled sections warped beyond allowable limit shall be pressed or rolled straight and freed from twists, taking care that an uniform pressure is applied. Minor warping, corrugations etc. in rolled sections shall be rectified by cold working. The sections shall be straightened by hot working where the PMC/Engineer in charge so direct and shall cooled slowly after straightening. Warped members like plates and flats may be used as such only if wave like deformation does not exceed L/1000 but limited to 10 mm (L- Length). Surface of members that are to be jointed by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

b. Marking

Marking of members shall be made on horizontal pads, of an appropriate racks or supports in order to ensure horizontal and straight placement of such members. Marking accuracy shall be at least + 1 mm.

c. Cutting

Members shall be cut mechanically (by saw or shear or by oxyacetylene flame). All sharp, rough, or broken edges, and all edges of joints which are subjected to tensile or oscillating stresses, shall be ground. No electric metal arc cutting shall be allowed. All edges cut by oxyacetylene process shall be cleaned of impurities prior to assembly. Cutting tolerances shall be as follows:

a) For members connected at both ends + 1 mm.

b) Elsewhere + 3 mm.

The edge preparation for welding of members more than 12 mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough. Edge preparation shall be as per IS: 823 - 1964.

d. Drilling

Bolts holes shall be drilled. Drilling shall be made to the diameter specified in drawings. No enlarging of holes filling, by mandrolling or oxyacetylene flame shall be allowed. Allowed variations for holes (out-of-roundness, eccentricity, plumb-line deviation) shall be as per IS: 800.

- Maximum deviation for spacing of two holes on the same axis shall be + 1 mm.
- Two perpendicular diameters of any oval hole shall not differ by more than 1 mm.

e. Drilling faults in holes may be rectified by reaming the holes to the next upper diameter, provided that spacing of new hole centres and distance of hole centres to the edges of members are not less than allowed and that the increase of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the number of faulty holes does not exceed 15% of the total number of holes for one joint.

f. Welding**:**

i) Preparation of Members for Welding

- All welding in mild steel work shall be done with electrodes and / or by methods recommended by the suppliers of the metals being welded in accordance with corresponding Indian Standards. Type, *size* and spacing of welds, shall be as specified. All welding consumables shall be in accordance with the I.S. standards.
- Welds behind finished mild steel surfaces shall be so done as to eliminate distortion and / or discoloration on the finished side.
- Weld spatter and welding oxides on finished surfaces shall be removed by descaling and / or grinding. Plug, puddle or spot welding shall not be permitted. If weld beads are visible on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.
- Structural welds shall be made by certified welders and shall confirm to
  I.S. code. The welds shall be tested by the Contractor to ensure quality and integrity of the structural welds. However, welding tests shall be carried out as below: and the Contractor shall maintain records for Visual testing – 100 % of the welds for size and quality. Fillet weld testing- 30 % of the welds for MPI or Dye penetration test
- Dirt grease, lubricant, or other organic material shall be removed by vapor degreasing or suitable solvent.
- Joints rejected because of welding defects may be repaired only by re welding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be allowed.

ii) Assembly of structural members

Assembly of structural members shall be made with proper jigs and fixtures to ensure correct positioning of members (angles, axes nodes etc.) Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or filled over the length of the affected area, deep enough to remove faults completely. Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint. Generally, no special edge preparation shall be required for members under 8 mm thick. Edge preparation (beveling) denotes cutting of the same so as to result in V, X K or U seam shapes as per **IS: 823**. The members to be assembled shall be clean and dry on the welding edges. Under no circumstances shall wet, greasy, rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter likely to get in to the gaps between members to be welded. Before assembly the edges to be welded as well as adjacent areas extending for at least 20 mm shall be cleaned (until metallic polish is achieved). When assembling members, proper care shall be taken of welding shrinkage and distortions, as the drawing dimensions' cover finished dimensions of the structure. The elements shall be got checked and approved by the SBI/PMC in charge or their authorized representative before assembly. The permissible tolerances for assembly of members preparatory to welding shall be as per IS: 823. After the assembly has been checked, temporary tack welding in position shall be done by electric welding; keeping in view finished dimensions of the structure.

iii) Welding procedures

Welding shall be carried out only by fully trained and experienced welders as tested and approved by the PMC/Engineer in charge. Any test carried out either by the PMC/Engineer in charge or their representative or the inspectors shall constitute a right by them for such tests and the cost involved thereon shall be borne by the Contractor himself. Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall be commensurate with the quality of welding required on this job as judged by the PMC/Engineer in charge. The steel structures shall be automatically, semi-automatically or manually welded as per direction of PMC/Engineer in charge. Welding shall begin only after the checks mentioned in Clause herein have been carried out. The welder shall mark with his identification mark on each element welded by him. When welding is carried out in open air, steps shall be taken to protect the face of welding against wind or rain. The electrodes, wire and parts being welded shall be dry. Before beginning the welding operation, each joint shall be checked to ensure that the parts to be welded are clean and root gaps provided as per IS: 823. For continuing the welding of seems discontinued due to some reason, the end of the discontinued seem shall be melted in order to obtain a good continuity. Before resuming the welding operation, the groove as well as the adjacent parts shall be well cleaned for a length of approx. 50 mm. For single butt welds (in V, 1/2 V or U) and double butt welds (in K, double U etc.) the re-welding of the root is mandatory but only the metal deposit on the root has been cleaned by back gouging or chipping. The welding seams shall be left to cool slowly. The Contractor shall not be allowed to cool the welds quickly by any other method. For multi-layer welding, before welding the following layer, the formerly welded layer shall be cleaned metal bright by light chipping and wire brushing. Backing strips shall not be allowed. The order and method of welding shall be so that -

- No unacceptable deformation appears in the welded parts.
- Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of PMC/Engineer in charge.

iv) Weld Inspection

The weld seams shall satisfy the following:

- shall correspond to design shapes and dimensions.
- shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough

surfaces, burns, blow holes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made as shown in Annexure-B. The mechanical characteristics of the welded joints shall be as in IS: 823.

v) Preparation of Members for Bolting

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending. Before assembly, all sharp edges, shavings, rust dirt, etc. shall be removed. Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the co-axiality of the holes. The members shall be finally bolted after the deviations have been corrected, after which there shall not be gaps. Before assembly, the members shall be checked and got approved by the PMC/Engineer in charge. The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8 mm whichever is less. If the difference is larger, it shall be corrected by grinding or filling. Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled. As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

vi) Bolting up

Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained. The bolts shall be tightened starting from the centre of joint towards the edge.

vii) Planing of Ends

Planing of ends of members like column ends shall be done by grinding when so specified in the design. Planning of butt welded members shall be done after these have been assembled, the spare edges shall be removed with grinding machines or files. The following tolerances shall be permitted on member that has been planed.

- On the length of the member having both ends planed, maximum + 2 mm with respect to design.
- Level differences of planed surfaces, maximum 0.3 mm.
- Deviation between planed surface and member's axis maximum 1/1500.

viii) Holes for Field Joints

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies. When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by the PMC/Engineer in charge. For bolted steel structures, trial assembly in shop is mandatory. The tolerance for spacing of holes shall be + 1 mm.

ix) Marking for Identification

All elements and members prior to dispatch from the fabrication yard for erection shall be shop marked. The members shall be visibly marked with a weather proof light coloured paint. The size and thickness of the numbers shall be chosen as to facilitate the identification of members. For the small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle, while the crates shall be marked directly. Each bundle or crate shall be packed with members for one and the same assembly; in the same bundle or crate, general utility members such as bolts, quests etc. may be packed. List of materials showing weight, quality and dimension of contents shall be placed in the crates.

The members shall be marked with a durable paint, in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection. All members shall be marked in the shop before inspection and acceptance. When the member is being painted, the marking area shall not be painted but bordered with white paint. The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

x) Shop Test Pre-assembly

For steel structures that have the same type of welding the shop test pre- assembly shall be performed on one out of every 10 member's minimum. For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in confirmity with previous Clause.

g. Shop Inspection and Approval

i) General

The PMC/Engineer in charge or their representative shall have free access at all responsible times to the Contractor's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications. Technical approval of the steel structure in the shop by the PMC/Engineer in charge is mandatory. The Contractor shall not limit the number and kinds of tests, final as well as intermediate once, or extra tests required by the PMC/Engineer in charge. The Contractor shall furnish necessary tools, gauges, instruments etc. and technical non-technical personnel for shop tests by the PMC/Engineer in charge, free of cost.

ii) Shop Acceptance

The PMC/Engineer in charge shall inspect and approve at the following stages:

- The following approvals may be given in shop:
  - Intermediate approvals of work that cannot be inspected later.
  - Partial approvals
  - Final approvals
- Intermediate approval of work shall be given when a part of the work is preformed later:
  - Cannot be inspected later
  - Inspection would be difficult to perform and results would not be satisfactory.
- Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes:
  - Approval of materials
  - Approval of field joints
  - Approval of parts with planed surfaces
  - Test erection
  - Approval of members
  - Approval of markings
  - Inspections and approvals of special features, like Rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as all former approvals, shall be taken in to consideration.

iii) Final approval in the Shop

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation, or stored.

The final approval comprises of:

- Partial approvals
- Approval of shop primer coat
- Approval of mode of loading and transport

- Approval of storage (for materials stored)

h. Painting and Delivery

i) Preparation of parts for shop painting:

Painting shall consist of providing at least one coat of red oxide zinc chromate primer to steel members before dispatch from shop. Primer coat shall not be applied unless:

- Surface have been wire brushed, cleaned of dust, oil, rust or sand blasted as per the requirement and direction of PMC/Engineer in charge etc.
- Erection gaps between members, spots that cannot be painted or where moisture or other aggressive agents may penetrate, have been filled with an approved type of oil and putty.
- The surface to be painted is completely dry.
- The parts where water of aggressive agents may collect (during transportation, storage, erection and operation) are filled with putty and provided with holes for drainage of water.
- Members and parts have been inspected and accepted
- Welds have been accepted.

The following are not to be painted or protected by any other product:

- Surface which are in the vicinity of joints to be welded at site.
- Surfaces bearing markings
- Other surfaces indicated in the design.

The following shall be given a coat of hot oil or any approved resistant lubricant only.

- Planed surfaces
- Holes for links

The surfaces that are to be embedded or in contact with the concrete shall be given a coat of cement wash. The surfaces which are in contact with the ground, gravel or brick work and subject to moisture shall be given bituminous coat. The other surfaces shall be given a primer coating. Special attention shall be given to locations not easily accessible, where water can collect and which after assembly and erection cannot be inspected, painted and maintained. Holes shall be provided for water drainage and in accessible box type sections shall be hermetically sealed by welds.

The Contractor shall paint further coats of red-oxide after erection and placing in position of the steel structures as directed by the SBI/PMC in charge.

ii) Packing, transportation, delivery:

After final shop acceptance and marking, the item shall be packed and loaded for transportation. Packing must be adequate to protect item against warping during loading and unloading. Proper lifting devices shall be used for loading, in order to protect items against warping. Slender projecting parts shall be braced with additional steel bars, before loading, for protection against warping during transportation. Loading and transportation shall be done in compliance with transportation rules. If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by the PMC/Engineer in charge. Items must be carefully loaded on platforms of transportation means to prevent warping, bending or falling during transportation. The small parts such as fish-plates, quests etc. shall be securely tied with wire to their respective parts. Bolts, nuts and washers shall be packed and transported in crates. The parts shall be delivered in the order stipulated by the PMC/Engineer in charge and shall be accompanied by document showing:

- Quality and quantity of structure or members
- Position of member in the structure
- Particulars of structure

- Identification number job symbol.

i. Field Erection

- The erection work shall be permitted only after the foundation or other structure over which the steel work will be erected is approved and is ready for erection.
- The Contractor shall satisfy himself about the levels, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the Contractor on his expense.
- Any faulty erection done by the Contractor shall be made good at his own cost.
- Approval by the PMC/Engineer in charge or their representatives at any stage of work does not relieve the Contractor of any of his required guarantees of the contract.
- Storage and preparation of parts prior to erection

The storage place for steel parts shall be prepared in advance and got approved by the PMC/Engineer in charge before the steel structures start arriving from the hop. A platform shall be provided by the Contractor near the erection site for preliminary erection work. The Contractor shall make the following verifications upon receipt of material at site.

- o For quality certificates regarding materials and workmanship according to these general specifications and drawings.
- o Whether parts received are complete without defects due to transportation, loading and unloading and defects, if any, are well within the admissible limit.

For the above work sufficient space must be allotted in the storage area which will be arranged by the Contractor without any extra cost to the department. Steps shall be taken to prevent warping of items during unloading. The parts shall be unloaded, stored and stored so as to be easily identified. The parts shall be stored according to construction symbol and markings so that these may be taken out in order or erection. The parts shall be at least 150 mm clear from ground on wooden or steel blocks for protection against direct contact with ground and to permit drainage of water. If rectification of members like straightening etc. are required, these shall be done in a special place allotted which shall be adequately equipped. The parts shall be clean when delivered for erection.

j. Erection & Tolerances

Erection in general shall be carried out as required and approved by the PMC/Engineer in charge. Positioning and levelling of the structure, alignment and plumbing of the stanchion and fixing every member of the structure shall be in accordance with the relevant drawings and to the complete satisfaction of the PMC/Engineer in charge.

The following checks and inspection shall be carried out before during and after erection.

- o damage during transportation
- o accuracy of alignment of structures
- o erection according to drawings and specifications
- o progress and workmanship.

There may be any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the PMC/Engineer in charge shall be informed immediately. Minor rectifications in foundations, orientation of bolts holes etc. shall be carried out as part of the work, at no extra cost. The various parts of the steel structure shall be so erected so to ensure stability against inherent weight, wind and erection stresses. The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by the PMC/Engineer in charge. The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces tapered washers shall be used.

k. Final acceptance and handing over the structure

(i) At acceptance, the Contractor shall submit the following documents:

- Shop and erection drawings – four sets soft copy and hard copies 4 copies of each of the following:
- Shop acceptance documents quality certificate for structurals, plates, etc. (electrodes, welding wire, bolts, nuts, washers etc.)
- List of certified welders who worked on erection of structures.
- Acceptance and intermediate control procedure of erection operations.

(ii) Approval by the PMC/Engineer in charge at any stage of work does not relieve the Contractor of any of his required guarantees of the contract.

l. Grouting of Pockets

(i) Grouting of pockets and under base plates will be done only after the steel work has been levelled and plumbed and the bases of stranchions are supported by steel shims. The space below the base plate and pockets shall be thoroughly cleaned.

(ii) The mortar used for grouting shall not be leaner than 1:2 (1 cement: 2 sand) (grade 300 in case of concrete) or as is specified and shall be mixed to the minimum consistency required. It shall be poured under suitable head and tamped until the space has been completely filled.

m. Tolerances allowed in the erection of building without cranes

The maximum tolerances for line and level of the steel work shall be + 3.00 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 M. section of height and not more than 7.0 mm per 30
M. section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

n. Contractor to submit shop drawing for all structural steel work for approval. The work at site should commence only after getting the shop approved.

o. Contractor to get erection scheme approved before commencement of erection of trusses.

11 FLOORING:

The flooring in the building shall be as per the approved finishing schedule appended in DBR, PART-D/ Tender drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.

a. In order to keep the floor finish as per direction of PMC/Engineer in charge and as per Finishing Schedule/ Architectural drawings and to provide required thickness of the flooring as per specification, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering and casting. Alternatively, for maintaining the floor finish, grading with cement concrete with nominal mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 10mm nominal size) shall be provided.

b. Wherever Vitrified Tile flooring is done, it shall be with 1st Quality multi-grade/multi- range tiles.

c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

d. Protective layer to be provided of all types of flooring.

e. The grouting of the joints shall be with white cement and matching pigment.

f. The edges of steps in the staircases, counters, kitchen platform, window sills, facias and similar location shall be edge moulded as required.

11.4 Minimum Bed mortars for various types of flooring

11.4.1 Chequered tiles/stone flooring/kota stone flooring/granite flooring/ Ceramic glazed floor tile flooring/vitrified flooring - 20mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand). Anti Acid Tiles- 10 mm thick epoxy resin based adhesive.

11.4.2 For dado, skirting and risers of steps in Chequered tiles/stone /kota stone /granite / Ceramic glazed floor tile /vitrified tiles- 12mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand).

11.4.3 The vertical facia and drops shall be finished with epoxy resin based adhesive.

11.5 Cement Plaster Skirting

18mm thick Cement plaster skirting up to 30 cm height, with cement mortar 1:3 (1cement: 3 coarse sand), finished with a floating coat of neat cement.

11.6 Granite

The granite stonework shall, in general, be carried out as per the CPWD Specifications and relevant specification for marble flooring, skirting, dado and tread/risers of steps under Flooring Sub Head of the CPWD Specifications shall prevail. Granite stone slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified, as per the PMC/Engineer in charge architectural drawings and as directed by the PMC/Engineer in charge. Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the PMC/Engineer in charge may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost. Nothing extra shall be payable on this account.

Before execution of the granite stone work, the Contractor shall submit for the approval of the PMC/Engineer in charge, the samples with following details:

a) Three representative samples for each type of granite stone specified.

b) Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c) Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d) Company profile of Suppliers.

The decision of the PMC/Engineer in charge as regards the approval of the samples for the various types of the granite stones shall be final and binding on the Contractor.

The entire supply for each type of granite stone slab shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the PMC/Engineer in charge, shall not be used in the work and shall be removed and replaced by the Contractor.

The stone work may be required to be carried out in patterns, design and / or in combination with granite stones of different colour and shade with or without borders and in combination of different stone slabs / ceramic tiles for which nothing extra shall be payable. The stones shall be provided in sizes and shapes as per the approved PMC/Engineer in charge architectural drawings and wastages and incidental costs, if any, shall be deemed to be covered in the cost of the relevant items. Nothing extra shall be payable on this account.

The following tolerances shall be allowed in the dimension of granite stone slab:

Slabs: **Tolerance**

a). Length ± 1mm

b). Width ± 1mm

c). Thickness - 1mm

d). Angularity at corners ± 0.25%

The stones slabs not meeting the above tolerance limits shall be rejected and not permitted to be used in the work. Nothing extra shall be payable on this account.

Stones slabs shall have uniform thicknesses with-in the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work.

For the steps (risers and treads) in the linear profile, the granite stone shall be provided in single pieces up to 2.0m, unless otherwise specifically permitted by the SBI/PMC in charge Wherever grooves are required to be provided the same is to be done, the joints shall be provided.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the PMC/Engineer in charge.

The granite stone slab shall be fixed over low level storage cabinets using necessary adhesive as per the manufacturer's specification. The stone shall have uniform thickness and shall be provided in sizes as per architectural drawings. The stone slab shall have uniformly levelled surface after fixing. All the joints shall be finished smoothly in a workmanlike manner.

The granite work shall be adequately protected by a layer of Plaster of Paris, which shall be maintained throughout and removed just before handing over of the works.

11.7 DOUBLE CHARGE VITRIFIED TILE FLOORING

1. Material - The tiles shall be of approved make and shall conform to table 12 of IS 15622. (Tiles with water absorption E d" 0.08 per cent Group B) and the joint thickness in flooring shall not be more than 1mm.. The tiles shall be tested as per IS 13630.The size and thickness shall be as per IS 15622.

2. Preparation of Surface and Laying - Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it. Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off.

3. Pointing and Finishing - The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of

tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

a. Epoxy Flooring

Epoxy floor coating with a three component solvent base, epoxy resin coating system of approved brand and manufacturer including applying two coats to achieve a total dry film thickness of 90 microns to provide a hard wearing, easily cleaned, attractive floor coating in areas where high resistance to chemical attack is required making sure the time between two coats is 6-24 hrs @ 20degree celsius and 4-16 hours at 35 degree celsius as per manufacturer specifications. (Must satisfy requirements classified under BS 6319) in approved color on Concrete VDF floor / IPS floor. Surface preparation should be done mechanically with Diamond Grinder or scarifier complete as per manufacturers Specification

b. Tactile Flooring

Fully vitrified unglazed porcelain tile of size 300x300x10mm specially designed to assist the visually impaired- ‘foot Braille’ of approved colour. Confirmance with RNIB, DETR & ADA. Very dense, durable and abrasion resistant, high chemical and stain resistant with high strength and durability. Fade proof with low water absorption (below 0.5%) and excellent slip resistance, laid on 20mm thick base of cement mortar 1:4 (1 cement: 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. complete as per direction of PMC/Engineer in charge.

c. Flooring for SERVER/ Fire Control

False Flooring: False Flooring shall be provided in Server and sub-server Room. Height of false flooring shall be as per functional requirement to be approved PMC/Engineer in charge and shall be done as per following specifications.

Providing and fixing removable raised/false access flooring with system and its components of approved make for different plenum height with possible height adjustment up 2to 50 mm, comprising of modular load bearing floor panels supported on G.I. rectangular stinger frame work and G.I. Pedestal etc. all complete, as per the architectural drawings, as specified and as directed by PMC/Engineer in charge consisting of: (a) Providing at required spacing to form modular framework, pedestals made out of GI tube of thickness minimum 2 mm and 25 mm outer diameter, fully welded on to the G.I. Base plate of size 100mm x 100mm x 3mm at the bottom of the pedestal tube, G.I. pedestal head of size 75mmx75mmx3.5 mm welded with GI fully threaded stud 16mm outer diameter with two GI Check nuts screwed on the stud for level adjustment up to 50mm, locking and stabilizing the pedestal head in position at the required level. The pedestals shall be fixed to the subfloor (base) through base plate using epoxy-based adhesive of approved make or the machine screw with rawl plug. (b) Stringers system in all steel construction hot dipped galvanized of rectangular size 570x20x30x0.80mm thick having holes at both ends for securing the stringers on to the pedestal head using fully threaded screws ensuring maximum lateral stability in all directions, the grid formed by the pedestal and stringer assembly shall receive the floor panel, this system shall provide adequate solid, rigid support for access floor panel, the system shall provide a minimum clear uninterrupted clearance between the bottom of the floor for electrical conduits and wiring etc. all complete as per the architectural drawings, as specified and as directed by the SBI/PMC in charge(c) Providing and fixing Access Floor panel of 600x600x32 mm medium grade Filled Steel anti static high pressure Lamination of 800H grade (FS800H). Access Floor panel shall be steel welded construction with an enclosed bottom pan with uniform pattern of 64 hemispherical cones. The top and bottom plates of Steel Gauges: top 0.6 mm and bottom 0.7 mm fused spot welded together (minimum 64 welds in each dome and 20 welds along each flange). The panel should be Corrosion resistant epoxy coated for lifetime rust protection and cavity formed by the top and bottom plate is filled with Pyro grip noncombustible Portland cementitious core mixed with lightweight foaming compound. The access floor shall be factory finished with Anti-static High Pressure laminate with Non Warp technology upto 1mm thickness for superior adhesion and Surface flatness within 0.75mm. The panel is to withstand a Concentrated Load of 363 kgs applied on area 25mm x 25mm without collapse in the Centre of the panel which is placed on four steel blocks. The panel will withstand and Uniformly Distributed Load (UDL) minimum 1250 kg/sqm and an impact load of 50kg all complete as per the approved manufacturers specification and as per the direction of PMC/Engineer in charge. All specification must be printed on the side of the panel to ensure the quality of the product

Carpet Flooring

Providing and laying minimum 4 mm flocked type textile carpet covering Made up of Nylon and treated with Stain smart soil protection, built in antimicrobial treatment, 6.6 face fibre (approx 80 million fibers/ sq.mtr/ 70 million fiber/sq. yd) in roll. Carpet roll shall beprovided with PVC free Soft back Wellbac function / cushion backing. Carpet roll shall meet ARR – severe rating as CRI TM.

101. Pattern & color shall be as per decision of Engineer in charge. Carpets to be CRI green label certified for IGBC Platinum & Net Zero Building Certification (Energy) Certification. Rate shall be inclusive of installation by using low VOC content adhesive or approved make and covering with protective sheet till instructed to remove by the Engineer In charge.

Yarn Type (Nylon 6.6)

Texture (Multi-level pattern cut & loop pile /Textured /Tip Shear construction)

Secondary Backing (Environmental Friendly & 100% PVC Free with 80+% recycled content and NSF 140 Gold Rating)

Yarn Weight (32-34 oz/yd2) Carpet Gauge (1/8" to 1/11") Stitches/ inch (10 to 13)

Warranty: The Contractor shall submit Life Time or 10 years Comprehensive Warranty (whichever is greater).

Density (8000-8700 oz/ cubic yard)

Total Thickness (i/c roll, backing, etc) (8.1-10.0 mm) Anti-Static Property (Less than 3.5 Kv)

Stain & Soil Resistant (Commercial Anti-Soil /Soil Protection and Anti Stain property with lifetime warranty)

Anti-Microbial Treatment (Commercial Anti-Microbial Treatment with lifetime warranty) Adhesive Quality (Water Resistant, Low VOC, Non Staining & Mildew Resistant) Smoke Density (Less than 450 as per ASTM E662)

Radiant Panel Test (Class 1 as per ASTM E648) Minimum Width (2 mtr)

Appearance Retention Rating (Commercial Severe Use) Supplied carpets to have the following warranties.

Warranties:

10 years Antimicrobial Protection 10-year Face Fiber Wear 10 years

Antistatic 10 years Color Pattern Permanency 10 years Floor

Compatibility

10 years Floor Release

10 years Delamination of Backing 10-year Moisture Resistance 10 years Dimensional Stability 10-year Tuft Bind

10 years Edge Ravel Flammability

12 FALSE CEILING

a. General: -

Work shall in general be carried out as per the CPWD specification. Modular and acoustical false ceiling shall be provided and installed in all areas. All ceilings in the office areas, pantry and all service areas shall be openable, where provided in drawing and nothing extra shall be payable for provision for access panels.

The false ceiling material shall be of Gyp board, metal, acoustic modular tiles or calcium ***silicate*** mineral fibre ceiling tiles. The technical assistance and guidance is to be taken from the respective approved manufacturers and work shall be done strictly according to the manufacturers specifications and manuals. Material from original source shall only be used.
A sample of each finish shall be got approved before proceeding for bulk production. Galvanized Iron / Aluminium grid framing shall be erected as per recommendation of the manufacturer specification and approval of CPWD. No sagging, unleveled stretch of work or chipped tiles shall be accepted. Contractor shall take full responsibility for its firmness with the structure.

The false ceiling comprises of Gypsum board, Calcium Silicate and Metallic Tiles. The Gypsum board false ceiling is to be in different shapes. Such as Vaults, Coffers, cove’s and Plain in unison with Acoustical Ceiling Tiles and Metallic Tiles Ceiling. The technical assistance and guidance is to be taken from manufacturers and work has to be done according to the manufacturer’s specifications and manuals. A sample of each finish shall be got approved before proceeding for bulk production. GI framing shall be erected as per recommendation of the manufacturer specification and approval of the Engineer-in-charge. The main contractor shall engage specialized agency and submit its credentials to Engineer-in-charge for approval. The criteria for setting the terms and conditions shall be broadly in line with CPWD criteria for similar works. The work shall be taken up only when specialized agency is approved in writing by Engineer-in-charge. False ceiling work shall be carried out in accordance with the actual site conditions at different /split-levels. Any sagging, unleveled stretch of work shall be redone /replaced and made good, at no extra charge, to the satisfaction of Engineer-in-charge. No compensation shall be paid on account of provision /coverage of openings for lighting fixtures, air-conditioning ducts and the likes as detailed in drawings and /or directed.

12.1 Gypsum Board Single Layer False Ceiling

Providing and fixing 12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095 false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the Engineer in Charge including final finishing and painting as per GFC drawing.

12.2 Gypsum Board Double Layer False Ceiling

a. Material : Gypsum board Plain 12.5 mm thick which have gray face paper and brown reverse side paper suitable for most applications where Normal fire, Structural and Acoustic levels are specified. Applicable standard of the boards should be IS 2095 (Part 1):2011 (BIS Certified) and should have thermal conductivity and thermal resistance of 0.16 and 0.078 (w/mºK).The boards should have Taper edge along length of board and Square edge along width of board. Flexural breaking load of Gypsum board as per IS 2095 (Part 1):2011 is 180 N in Transverse Direction and 500 N in Longitudinal Direction. Ceiling is in 2 layers with staggered joints.

b. Frame work : - Providing and fixing of frame work made of special/seratted sections, power pressed from M.S. sheets and galvanized with zinc coating of minimum120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 900 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 900 mm centre to centre to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction Perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of double layer of 12.5mm tapered edge Gypsum board Plain (conforming to IS 2095-Part 1:2011, BIS Certified board) is then screw fixed to ceiling section with 25mm drywall screws for first layer and 35 mm drywall screws for second layer at 230mm centres on ceiling section & 150mm at periphery of ceiling including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer’s specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed (if any additional members required at cutouts shall be provided free of cost) all complete as per drawings, specification and direction of the Engineer in Charge including painting as per GFC drawing.

12.3 Eco Friendly Light Weight Calcium Silicate regular edge False Ceiling Tiles.

Materials

I. Frame:

The frame work shall consist of G.I. ' T ' Sections for Main runners / Cross runners of size & thickness specified in the item with galvanization of 120 gsm(minimum),and perimeter wall angle of 0.45mm (minimum)thick gauge having equal flanges of size 24mm made from precoated G.I. Coil length of 3.0/3.60M.fixed to the wall with the help of rawl plugs at 450mm centre to centre with 35x8mm long dry wall wooden screws with virgin plastic rawl plugs@ 230mm interval .The frame work shall be executed in a manner so as to form a grid of 600mm x 600mm as specified in the item. The frame work shall be suspended from ceiling by L shape adjuster hangers made of G.I. Of size 85x 25x2mm having die cut slit for sliding into main T section, also having Precut hole so as the 6mm fully threaded MS rod goes through it and pierces into M 6 dash fasteners of 6 mm dia 40mm long, fixed to the slab and then tightened with check nuts, subsequently the bottom of 6 mm rod will be tightened with check nuts, for adjusting the line & level.

II. Ceiling Tiles:

Ceiling Tiles shall be of 15 mm thick densified edges, semi perforated / fully perforated or with design/ texture as mentioned in item, eco friendly light weight calcium silicate false ceiling tiles and made from hydrated calcium silicate, reinforcing fibres, natural fillers free from formaldehyde and other harmful materials, & shall not contain any toxic ingredients. shall have 52% recycled material, including 23% fly ash.

The tile shall be of size 595 x 595mm having densified reinforced edges of 15 mm thickness all around with the body and 450kg/m3 at the edges. The tiles shall be primer coated on both sides and the fair surface shall be having a factory finish in two coats of white dispersion type solvent free paint.

The tiles should be characterized with 100% relative humidity resistance, non combustiblity as per BS 476 Part IV, thermal conductivity of $\leq$0.043 w/m^{0}kc as per ECBC Code-2007, light reflectance> 85%, and Noise Reduction Coefficient (NRC) of 0.50 for Spintone / Cosmos /Fine Fissured and NRC of 0.15 for Hexa/Quadra, and NRC of 0.65 to 0.75 for Globe fully perforated tiles, as per IS-8225-1987. Sound attenuation STA- 32 dB. The tiles should weigh approx 5.0--5.5 kg/m2.

III. Suspension Material:

G.I. Fully threaded galvanized rod of 6 mm dia. Having hot dip coating of zinc 80g/ Sqm., and tensile strength of 344--413 MPa. The rod should be used in conjunction with L- adjuster, bent at 90^0, and check nuts, so as to ensure that there is no disengagement, both at the bottom of rod and at the top portion which is tightened to M- 6 metal dash fastener, suitably drilled into the slab.

IV. Fixing of frame and tiles.

The main runner of size 38mmx24mmx0.33mm thickness 3.00m/3.60m length spaced at 1200 mm centres, shall be securely suspended with G.I. Fully threaded rod of 6 mm dia. with L- type adjusters of 85x25x2mm made from G.I Sheet. The rod is to be be suspended from the soffit at 1200 mm centre to centre with the aid of M6 dash fasteners, suitably drilled into the slab. The last hanger at the end of each main runner should not be greater than 600mm from the adjacent wall. Then flush fitting cross tees of size 32mmx24mmx0.33mmthickness & 1.20m length are to be inserted in the main tees at 600mm centres at right angles to the main tees to form a grid of 600mm x 1200mm modules Shorter cross tees of 32mmx24mmx0.33mm thickness & 600mm length are then to be centrally inserted in between the longer cross tees in direction parallel to the main tee so as to form a grid of module frame system shall rest on periphery walls/ partition on the wall angle of section 24x24x 0.45 mm thick made from G.I coil length 3.0m/3.60m,.The entire grid system shall be designed to bear a distributed load of minimum 15kg/Sqm. The ceiling tile shall be placed over the GI T-section frame directory and not to be glued or cemented.

V. PRECAUTIONS: -

a) All wet trades such as plastering, conduting, and painting etc. be completed prior to start of false ceiling works.

b) Air Conditioning duct work is to be completed, preferably even before the suspension of the grid sections.

c) Electrical chasing or drawing lines & cables, etc. are to be in place before start of false ceiling works.

d) No unauthorized weight is put on false ceiling. Lighting fixtures, diffusers are to be suspended independently with proper chains/ wire & dash fasteners as directed by Engineer in Charge.
e) The area is dry, prior to ceiling installation work.

13 WATER PROOFING

The work shall be got executed as per CPWD Specifications and as per the manufacturer's specification through specialized agency as approved by the Engineer-in-Charge.

The contractor shall furnish the following particulars immediately after the issue of letter of acceptance by the SBI/ PMC.

i. The name of the specialized firm.
ii. The trade names of the product, which would be used.
iii. List of works where the treatment has been used.
iv. Quantity of chlorides and sulphides used in the product.

13.1 Water Proofing of terrace/ Sunken Portion Area/UG tank.

GENERAL

All the water proofing treatment shall be got executed through the specialized agencies. The specialized agencies shall be got approved from the Chief Engineer. The contractor shall furnish the following particulars immediately after the issue of letter of acceptance by the Department.

a) The name of the specialized firm.
b) The trade names of the product, which would be used.
c) List of works where the treatment has been used.
d) Quantity of chlorides and sulphides used in the product.

The water proofing treatment for the U.G. sump, terrace tank etc. shall be tested by filling the tanks completely with potable water and observing for leakage for minimum 72 hours. All the arrangements for testing including supplying water, closing all the outlets temporaily and restoring after the test etc. shall be made by the contractor at his own cost. The contractors at his own cost rectify any leakage noticed.

The specialist agency for waterproofing shall also grout the Nothing extra shall be payable on this account.

The water proofing treatment over the terrace slab, in the sunk / depressed slabs shall be tested by poding water as specified for curing as well as observing for leakage for minimum 2 weeks. All the arrangements for testing including supplying water, making temporary bunds using mortar, removing bunds after testing etc. shall be made by the contractor at his own cost. The contractor at his own cost shall rectify any leakage noticed. Nothing extra shall be payable on this account.

13.2 Water proofing treatment for the basement walls and rafts.

i. The water proofing items shall be got executed through one of the approved agencies as per the list of approved agencies attached with the tender. The integral cement based water proofing treatment shall be as per the item description and as directed by Engineer-in-Charge.

ii. The specialist agency for water proofing work shall provide necessary sleeves made out of G.I pipes / M.S. puddle flanges (payment for which shall be made under relevant item) in the water proofing treatment at base and the raft for release of uplift pressure till the pressure is taken by the rock anchors and the dead weight of the building. The necessary provisions shall be made for filling these sleeves with cement concrete of same grade and then pressure grouting these holes with polymer modified cement slurry using aluminum nipples etc. at a later date. However, the agency shall ensure complete watertight ness of the raft and the water proofing treatment below raft. Junctions of the rock anchors with the concrete of the basement raft. Nothing extra shall be payable on this account and shall not be measured separately for payment.

iii. The specialist agency for water proofing work shall also grout the junctions of the various service lines entering or coming out through the basement wall. Nothing extra shall be payable on this account and shall not be measured separately for payment.

iv. The reinforced cement concrete provided in the base and walls of under ground tanks shall be admixed with water proofing compound confirming to IS 2645. The guarantee for the water proofing treatment shall include dismantling and relaying the Reinforced cement concrete, if required for rectifying any defect in the water proofing treatment. Nothing extra shall be payable on this account and shall not be measured separately for payment.

v. Layout and Design: The layout and design of Pile foundation shall be as per structural design / drawing to be supplied by the Engineer-in-Charge. The structural drawing shall be properly correlated with the architectural drawing of the work before actual execution. The discrepancy if any, thus notice shall be brought to the notice of Engineer-in-Charge for necessary correction.

vi. The work shall be in general carried out in accordance with CPWD specifications with up-to-date correction slips. However, if the said specifications differ from those detailed in the specifications of the particular item in the schedule of quantities attached or from the particular specifications given here under the later shall prevail.

vii. The water proofing compound used in integral water proofing treatment shall satisfy all the performance requirements indicated in IS: m 2645 and shall be got tested before its use. The compound shall be used @ 2% by weight of cement used or as recommended by the manufacturer.

viii. Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approved of the Engineer-in-Charge in writing. Materials shall be kept under double lock and key and proper account of the water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

13.3 GUARANTEE FOR WATER PROOFING TREATMENT

i. The contractor shall be fully responsible for and shall guarantee proper performance of the entire waterproofing system for a period of 10(Ten) years from the final completion of works. In addition, specific 10 years written guarantee (to be furnished in anon-judicial stamp paper of value not less than Rs.100/-) in approved proforma shall be submitted for the performance of the system, before final payment and shall not in anyway limit any other rights the Employer may have under the contract. Guarantee for waterproofing shall comprises of all the items described above in particular specification.

ii. All water-proofing work shall be carried out through approved specialist agency as per method of working approved by the Engineer-in-charge. However, the Contractors shall be solely responsible for water proofing treatment until the expiry of the above guarantee period.

iii. Ten years guarantee in prescribed proforma attached shall be given by the contractor for the waterproofing treatment. In addition, 10%(ten per cent) of the cost of these items of water proofing under this subhead shall be retained as guarantee to watch the performance of the work executed. However, half of this amount(withheld) would be released after five years from the date of completion of the work, if the performance of the water proofing works is satisfactory. The remaining with held amount shall be released after completion of ten years from the date of completion of work, if the performance of the waterproofing work is satisfactory. If any defect is noticed during the guarantee period, it should be rectified by the contractor within seven days of issuing of notice by the Engineer-in-Charge and, if not attended to, the same shall be got done through other agency at the risk and cost of the contractor and recovery shall be effected from the amount retained towards guarantee. In any case, the contractor and the specialist agency, during the guarantee period, shall inspect and examine the treatment once in every year and make good any defect observed and confirm the same in writing. The security deposit can be released in full, if bank guarantee of equivalent amount, valid for the duration of guarantee period, is produced and deposited with the Department.

13.4 Curing

Provide protection against extreme weather conditions such as heavy rain or freezing conditions during the setting period. Curing is not normally required except during hot, low humidity weather. In these conditions a light mist of water approximately 24 hours after the repair is completed will help to ensure a controlled cure. In extreme dry heat, water misting may be required more frequently.

14 ROOFING

The Roofing Work shall be as appended in DBR, PART-D/ tender drawings and as per latest CPWD specifications or manufactures specifications.

14.1 Polycarbonate Sheet Roofing

a. The polycarbonate sheet roofing shall be of approved make and shall confirm to manufacture's specifications. The material procured shall be free of any defects and damage to the edges, surface etc. The Contractor shall ensure that the material is procured and delivered at installation site without any damage.

b. Adequate care shall be taken for protection of the material before installation as well as afterwards till handing over the building for occupation. The Contractor shall ensure careful handling and storage and prevent any rough handling, to prevent any edge or surface damage. Any panel with edge damaged or damage to the finish etc. shall not be allowed to be used in the work and shall be replaced by the Contractor at his own cost. The Contractor shall procure the material including providing for wastages, damages etc. in one lot so as not have any color and shade variation. Atleast one sample of the polycarbonate sheets brought by the Contractor to the site of work shall be tested. The test shall be got done at reputed independent laboratory as approved by the PMC/Engineer in charge. However, the Contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the polycarbonate sheets as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.

c. The polycarbonate sheet shall be multi-wall (twin wall) section with thickness of the sheet not less than 16mm and the thickness of the walls on the two external faces not less than 0.8mm each. The sheet shall be extruded from polycarbonate material and shall have homogeneous composition of the material. The sheet shall have co- extruded UV protective layer. The sheet shall be fixed with the face treated for UV resistance, upward/exposed to sunlight. The weight of the sheets shall not be less than 2.7 Kg per sq.m. Light transmission shall be minimum 35% or as per manufacturers specifications. The sheets shall be obtained with closed edges. The sheet shall be bent (if required) to the require profile as per the architectural drawings but with radius not less than 175 times the thickness of the sheet. The sheet shall be fixed in a manner that the cells are parallel to the span of the shed.

d. The polycarbonate sheets shall be of colour and shade as approved by the SBI/PMC in-charge.

e. The physical and the chemical characteristics of the polycarbonate sheets shall be as per the manufacturer's specifications and shall confirm to the ASTM standards. The sheets shall confirm to BS 476 part 7 for the fire rating. The Contractor shall submit written guarantee to the PMC/Engineer in charge for the polycarbonate sheets procured and provided by him against any defects like peeling, breakage, fading of color/ discoloration, cracking, leakage through the roofing loss of strength etc. for a period of ten years after the date of completion of the work. The Contractor shall obtain similar back-to-back guarantee from the manufacturer.

f. The polycarbonate sheets shall be used in one piece along the span of the temporary sheds. The width of the sheet across the span of the shed shall not be more than 700mm. The polycarbonate sheets shall be bent to required profile (linear or curvilinear) as per the architectural drawings and fixed in position, to the structural steel framework, using self-driving self-tapping screws with EPDM washers etc. The sheets shall be secured to the structural steel framework so as to withstand all the design dead, live, wind, other accidental loads etc. and shall be fixed in a workmanlike manner. It shall not have any sag. Therefore, the fabrication work shall be got done through experienced & reputed fabricator, to be got approved from the PMC/Engineer in charge. The Contractor shall submit to the PMC/Engineer in charge the shop drawings giving fixing details for the polycarbonate sheets in roofing and also quality assurance and methodology statement for the item. The polycarbonate sheets shall be jointed along the length of the shed using aluminum top & bottom pressure plates having required profiles for fixing the EPDM gaskets, screws, washers etc. The aluminum pressure plates shall be color anodized or powder coated to the require shade. The joints in the sheet shall be provided only on the RHS steel sections of the framework and shall not be permitted elsewhere. The joint width of about 3-4 mm may be provided between the sheets at the junction for thermal expansion. The EPDM gaskets of the required profiles shall than be fixed in the grooves in the aluminum pressure plates on either side of the joint in the polycarbonate sheet. The bottom aluminum plate shall be fixed to the structural steel framework using self-driving self- tapping screws; washers etc. (one screw fixed to each sheet) and the screws fixed @300 mm center to center along the span of the shed.

g. The EPDM gaskets of the required profile shall be fixed in the grooves in the aluminum pressure plate on either side of the joint in the polycarbonate sheet. The top aluminum pressure plate shall than be fixed securely to the bottom aluminum plate using countersunk self-driving self-tapping screws, EPDM washers etc. All the screws shall be concealed using structural silicone sealant DC 995 of Dow Corning or equivalent approved brand. Also, wherever required (especially at the joint in the EPDM gasket etc.) the junction of the polycarbonate sheet and the sides of the pressure plates on both sides shall be sealed using structural silicone sealant DC 995 of Dow Corning or equivalent brand as approved. The item includes cost of all the operations and all inputs of the materials including Polycarbonate sheet, EPDM gaskets, anodized aluminum capping, anodized aluminum edge capping to the sheet with U-shaped EPDM gasket, all structure silicone sealant, self-driving self-tapping screws with EPDM washers, nuts, bolts, washers etc. and the like, labor, T & P, all the incidental charges, wastages etc. involved in the work. The Contractor shall maintain the roofing scratch and damage free till the handling over the building for occupation, at his own cost. Tolerance shall be as per manufacturers specifications

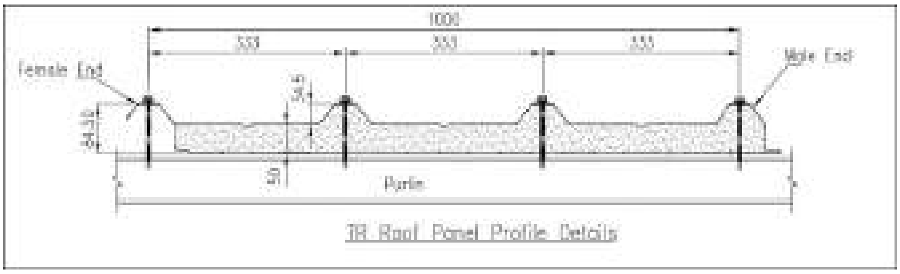
h. The polycarbonate sheets shall be obtained with protective films on both sides. Care shall be taken while fixing to fix the sheets with UV protected side exposed to outside. The sheet shall be stored in a manner not to expose to direct sunlight. The sheet shall be cut to the required size or drilled using the toothed blade/machine. After fixing the protective film shall be removed and the sheets cleaned using non-alkaline based detergent and abrasive equipments or solvents be avoided. The silicones, gaskets, tapes etc. shall be compatible with the polycarbonate sheet.

i. For joining the sheets, at least one complete channel width of each sheet shall be secured per sheet within the joining profile. Since thermal coefficient of expansion of the sheets is different from the RHS steel frames, suitable provision shall be made for accommodating differential expansions. Also any rigid jointing agent that may prevent thermal movements shall not be used. The required section aluminum profiles (upper central profile, lower central profile and top profile) for fixing the polycarbonate sheet to the structural framework as well as for joining the sheet shall be as per the manufacturer's specifications. The top capping profile shall be snap fit to the upper central profile, The EPDM gaskets and the screws shall be provided as per the manufacturer's specifications.

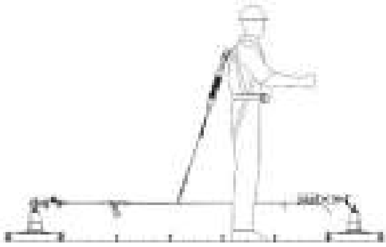
j. The Gaskets shall be extruded micro wave/ steam cured EPDM/ silicone of approved quality compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets, which are UV resistant. They shall not degenerate/discolor or/each on exposure to weather/ rain/pollutants etc.

14.2 Puff Insulated Roofing: -

Approved make Puff Insulated roofing sheet 40 mm thick with 38 mm High Rib, Double skin sandwiched between Pre painted Gallvalume (PPGL) sheet having outer skin 0.47mm thick Pre-coated GL Sky Blue or as approved colour Sheet with depth of crest- 30-40mm, pitch 195-200mm trapezoidal colour coated sheet & inner skin 0.47 mm thick Pre-coated GL White Sheet & minimum 40+30 mm thick layer of rigid CFC free polyurethane foam of density of 40±2 kg/m3 as insulation and PPGI sheet shall have minimum coating of 4-5 micron epoxy primer and 25 micron polyester top coat on the finish surface and 7- 8 micron primer alkyl base on reverse complete with Skirt Flashing, Corner Flashing and Rain Gutter 1.6 mm Thick G.I. Sheet.



Supply and fixing "SELF SUPPORTED" SECRET FIX STANDING ROOFING SYSTEM IN 0.9 mm THICK AA 3004 ALUMINIUM ALLOY. The general roof-construction shall comprise from bottom to top: Steel liner – 28-32/200-250 Galvalume steel liner sheet (GSM 150) 550 MPa, 0.5 mm TCT 1000 mm total cover width 35mm deep ribs spanning up to 1300 mm centres (multiple spans). The finish to the exposed surface of the liner will be polyester coating with film thickness of 23µm +/- 2 µm. (2) Second Layer - Single layer of scrim reinforced polyethylene or Aluminium foil in 150 g/m2 water vapour resistance. The VCL shall be of 200 Microns thickness. (3) Third Layer - Insulation – One layer of Rockwool/ Glasswool insulation of 100 mm thickness each minimum 60 kg/m³ rockwool /24 Kg/m3 (glasswool) density with thermal conductivity of K=0.035 W/mk at 20 degrees Celsius when tested to ASTM C518. (5) Fourth Layer - Aluminium Halters of suitable height with thermal barrier pads to be fixed to the purlins with SS 316 screws only. (6) Fifth Layer – Aluminium Straight profile sheeting manufactured from aluminium self-supported standing seam roof system from aluminium alloy AA 3004 H44 (AlMn1Mg1) as specified in BS EN 1396: 2007 minimum material thickness of 0.9 mm and PVDF2 finish (standard colours) on the exposed surface. The profiled roof panel should have 3Nos of Mini ribs for extra strength Accessories, Fasteners. The material properties shall be as follows: Ultimate tensile strength: minimum 200 N/mm2, 0.2% Proof Stress: min 185 N/mm2, Modulus of elasticity: 70,000 N/mm2. Sheets are to be laid to meet the requirements of the building geometry and fixed on Aluminium Halters. Halters to be fixed to the top hat/purlins with SS 316 screws All installation is to be carried out by approved trained roofing installer. The roofing system provider should have both Factory Mutual & UL Certification. The Roofing system provider should have Thomas Bell Wright International Consultants certificate against the testing done for Water leakage (Static & Dynamic) and Air Infiltration test as per ASTM E 283-04, ASTM E330-02 (2010), ASTM E331-00, AAMA 501.1.05, AAMA 501.2-09. The system supplier is not eligible to take up the Roofing installation work as this being contractual work. The installation team shall be fully trained and approved by the supplier.



Aluminium Flashing 0.9 mm thick: Flashings manufactured from aluminium alloy as specified in BS EN 1396: 2007 minimum material thickness of 0.9 mm and Fluorocarbon PVDF finish on the exposed surface. The flashing shall be of same colour as of roof. Girth – 400mm to 570mm.

Gutter: Providing and fixing of 2 mm thick Aluminium gutter with double side vulcanised rubber Expansion joints at every 8m length. Necessary down take spout with diameter upto 150 mm at required intervals & other accessories like Cover plate, end caps and welding at joints. The Girth of gutter would be upto 1200mm.The gutter will be insulated with 100mmthk mineral wool of 60Kg/mt3 density and liner/ panel rib, Z-girt, VCL at the bottom.

Supply &Fixing of **Fall Arrest System** as per EN 795 Class C: 2012. The system will be capable of taking load of minimum 4 users simultaneous. Systems Specifications: b. Systems Type & Length- FAS safety System- on 400 mm roof sheets. c. Systems Certification- EN 795 Class C Approved d. Testing has been done with 300 Kg weights to prove CFP's compliance for 4 simultaneous users. e. 1000 hours of corrosion testing in Salt spray test as per EN 795C. f. Material- SS 316, Steel Zinc Coated, stainless steel/Aluminium for Cast components and 5083/5084 treated aluminium alloys. g. Product marking complies to EN 795 h. CE certificate mark and EC declaration of confirmity i. The FAS system should have been tested for minimum 4 users with post spaced at minimum 11.00m.

Supply & Fixing of **Walkways System** with all required accessories. The system specification of Walkways is as mentioned below: i) FRP Gratings
- FRP Pultruded Grating is made up of a mixture of Resin, Roving, woven matt, Pigment, surface veil etc. It consists of 'I' Section 38 mm Height with Bearing Bar C/c 40mm & Cross Bar of 12mm Dia Round Bar C/c 150mm. The FRP gratings fulfil the load and deflection conditions as p er EN-516. Width of Walkway--- 500 mm Walkways System Accessories: ii) Seam Halters made of Aluminium Alloy Temper mill finished and will be as per BS EN 755-2 specifications iii) Aluminium L- Angle of thickness 4mm thick made of Aluminium Alloy 6063/T6 Temper mill finished and will be as per BS EN 755-2 specifications. iv) Fasteners used are of Stainless-Steel Grade 316.

Supplying & fixing of **STEP Walkway system** in which the complete system shall be planned, designed and fixed at site to cater all along the roof periphery like exhaust fan, louvers, skylights and gutters of the roof etc., complete all, as per the direction of SBI/PMC in charge. The specification of the system is as mentioned below: Steps the Adjustable steps are made in uncoated cast aluminum Brackets Aluminum alloy, with Nut & Bolts of Stainless Steel 316 of sufficient size. Size of Steps 460 x 250mm and thickness of aluminum tread is minimum 4mm. Minimum 3 steps per running meter. With Angle Adjustment 0 – 45 degrees and shall be of aluminum alloy.

Seam clamp for facilitating installation of solar panels:

Providing and fixing non penetrative aluminium seam clamps over the roof (solar panel framework is extra) for facilitating installation of solar panels.

14.3 Titanium Zinc Standing Seam Roofing System (Non-Insulated):

General Specifications:

Providing and fixing of 25/430 titanium zinc double lock standing seam roofing system (thickness: 0.7mm) with crest height of 25 mm thick consisting of fixing clips made of Stainless steel to connect the zinc panel to the hat section. Comprising of the following layers.

The roof system shall comprise of the following described from top to bottom:

Top Layer:
Zinc titanium standing seam profiled panels 25 /430 (25 mm seam height & 430 mm panel width) manufactured from zinc titanium alloy in pre-weathered equivalent finish in 0.80 mm BMT thickness. Pre-weathered zinc titanium with a matte subtle brushed surface in a natural medium-grey colour. The uniform medium-grey surface of Zinc originates after a chemical surface treatment following the rolling process. An organic temporary coating is applied to prevent fingerprints during installation and to optimize machine processing. An organic temporary coating shall be provided from the original sheeting manufacturer. No

Permanent coating or lacquer layer should be applied as a top coat. The material properties shall be as follows: Ultimate tensile strength:

minimum 150 N/mm2,0.2% Proof Stress: min 110 N/mm2. Panels shall be fixed to the substructure using Stainless Steel clips fixing & sliding clips of suitable height. The zinc roofing sheets shall be as per EN 988 standards. The zinc roofing sheets shall have a protective coating at the underside of the sheet of minimum 12 microns. Zinc manufacturer must have supplied to public projects in India atleasst 6000sqmt.

Second Layer: Anti abrasive breathable membrane laid at the underside of zinc panels. Anti-Abrasive membrane to be laid underneath the roofing bullnose sheets. High Density polyethylene underlay membrane of 0.6 mm with Studs of 8.0 mm spaced at 19.5mm. Membrane shall have compression resistance of 200 kN/m². It shall have stud free lateral edge of 100 mm for overlap of membrane. It should be chemically and electrically neutral, resistant to mould and chemical aggressions.

Third Layer: 1.5 mm thick GI strips to place at distance of 430 mm for fixing of clips.

Fourth Layer: 0.47mm TCT steel sheets profile.
Item includes Designing, Supplying, installation and fixing of profiled zinc panels including stainless steel screws as required for the project.

Mechanical Properties of Titanium Zinc Cladding sheets:
(I) Density: 7.2kg/dm3
(2) Thermal expansion coefficient: 0.022 mm/m x ºC
(3) Melting point: 420 ºC
(4) Re-crystallization point: 300 ºC
(5) Yield strength elasticity (Rp 0,2)- min. 110 N/mm2
(6) Tensile strength (Rm)- min. 150N/mm2

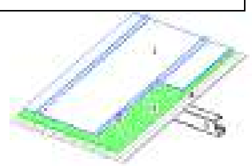
(7) Chemical composition

PRODUCT REQUIREMENT	TITANIUM ZINC
Zinc	Zn 99,995%
Copper	Cu 0,08 - 0,17%
Titanium	Ti 0,07 - 0,12%
Aluminum	Al < 0,015%

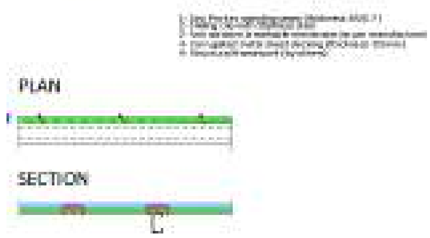
Size tolerances for standard products

PRODUCT REQUIREMENT	TITANIUM ZINC
Sheet and coil thickness	+- 0,025 mm
Sheet and coil width	+ 2/-0 mm
Sheet length	+ 2/-0 mm

1-Ti-zinc standing seam system pane 430mm width and 25 mm seam height with .7mm thickness.
Sliding and Fixed clips
GI Strip



4 Anti Abrasive Membane
5. GI sheet .47 mm
6. Purlins by other or Main Civil Contractor with spacing 1200mm.
Purlins to be provided at a spacing of 1000-1200 mm centre to centre maximum by main Contractor for fixing



of titanium zinc roofing system.Compatibility between materials

Acceptable contact materials include:

(I) Lead
(II) Aluminum
(III) Galvanized Steel
(IV) Stainless Steel
(V) Timber such as pine, spruce, poplar and Scots pine

Unacceptable contact materials include:

(I) Copper
(II) Steel (Non-galvanized)
(III) Plywood or chipboard
(IV) Bituminous felt
(V) Concrete or reinforced concrete
(VI) Timber such as larch, Douglas fir, chestnut, oak, red cedar and white cedar.

ZINC SHEETING TOLERANCES (TO EN988)

Thickness	+- 0.03 mm
Width	0 to +2 mm
Length	0 to +10 mm
Flatness of Sheeting	≤ 2 mm (Refer Omega rule)

Zinc Titanium Material Specifications:

Physical characteristics of pre-weathered ZINC Titanium roofing bullnose sheets:

(I) Density: 7.2kg/m3
(II) Thermal expansion coefficient: 0.022 mm/m x ºC
(III) Melting point: 420 ºC
(IV) Re-crystallization point: 300 ºC
(V) Heat conductivity: 110 W/ (m.K)
(VI) Electrical conductivity: 17Ms/m

Light Grey Pre- Weathered Titanium Zinc consists of rolled zinc alloyed with copper and titanium that complies with European standard EN 988 and the surface of which has a pre-weathering treatment upon which a transparent primer is applied, followed by a coating. This treatment consists of chemically converting the upper crystalline structure of the metal that transforms zinc into zinc phosphate. It gives rolled zinc a bright grey aspect, similar in color to the patina that forms on natural zinc after several months of exposure to the atmosphere. As an indication, the average characteristics of this conversion coating are as follows:

Compatibility between materials

Acceptable contact materials include:

(I) Lead
(II) Aluminium
(III) Galvanized Steel
(IV) Stainless Steel
(V) Timber such as pine, spruce, poplar and Scots pine

Unacceptable contact materials include:

(I) Copper
(II) Steel (Non-galvanized)
(III) Plywood or chipboard
(IV) Bituminous felt
(V) Concrete or reinforced concrete
(VI) Timber such as larch, Douglas fir, chestnut, oak, red cedar and white cedar.

Transportation and storage

The zinc sheets shall be transported and stored in dry conditions and in a constant temperature. Item includes supplying, installation and fixing of profiled zinc sheeting including cost of system accessories insulation, Aluminum Foil vapor barrier, liner sheet, gutters, flashing, capping, trims, fasteners, gaskets, brackets, screws, rivets, sealants, , all machineries, etc complete. The above work is to be carried out by a specialized agency approved by the PMC/Engineer in charge.

Standing seam panels

The zinc roofing bullnose sheets shall be installed with a - locked standing seam. The height of the standing seam shall be a minimum of 25mm in order to ensure perfect water tightness. The transversal junctions will depend on the slope. The minimum slope shall be ≥ 3º (or 5%).

Fixing clips for standing seam panels

The roof cladding system shall meet loading requirements in confirmity with minimum pullout strength of 50daN for each of the fixing clips (fixed and sliding), provided that the entire support transmits the cumulated load of all fixing clips to the structure. For this purpose, the support shall rest on at least 3 bearing elements.

The fixing of the roof sheets shall be done with fixed and sliding clips. These clips have a dual function of ensuring the mechanical resistance of the entire cladding and roofing bullnose area; and allowing free expansion of the cladding and roofing bullnose material. Fixed clips shall be stainless steel with a thickness of not less than 0.5mm. The clips shall be pre-punched with counter-sunk holes for attachment and designed to withstand negative load requirements.

The Sliding clips shall be stainless steel with a thickness of not less than 0.6mm for fixed base and not less than 0.4mm thick for the sliding part. The sliding clip base shall incorporate a 70mm long slot to allow permits movement. The clips shall be pre-punched with counter-sunk holes for attachment and designed to withstand negative load requirements.

The fixing to the support shall be done with stainless steel clips, with minimum pull-out strength of 50daN for each of the fixing clips (fixed and sliding).

Particular care shall be given to the calculations of the number of fixing clips per zinc panel with respect to weather and site conditions, and exposure of wind indifferent parts of the cladding and roofing bull nose area.

Particular care shall also be given to allow the bottom end of the zinc panels to dilate freely. Whenever necessary, the soldering works should be in accordance to the manufacturer’s recommendations (either chemically with stripping products or mechanically.

Transversal junctions for standing seam panels

When the length of the roof slope exceeds the maximum recommended length, it is necessary to join the sheets using transverse junctions to suit the pitch of the roof. These include: Step (or drip): for pitches of 3° (5%) or more.

The step height will be a minimum of 8 cm for standing seam.

Double welt: for pitches of 11° (20%) or more

The double welt can be used for pitches of 11° and above. The minimum length of the overlap is 200 mm with a securing clip at the top. The dimensions can vary due to the projected expansion and/or contraction based on the conditions at the time of installation. Depending on climatic conditions such as wind and rain, the overlap should be increased. The fixed clip should be soldered onto the zinc sheet, not fastened to it.

Single welt: for pitches > 25° (47%) or more

The single welt or single lock cross-welt with an overlap of 50mm can be adopted for pitches greater than 25° (42%) in the standing seam technique.

Soldering

Soldering for Zinc: ASTM B 32, contains 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

Details at Flashing, Capping and Fascia

a. Flashing and Capping

Flashing and capping to the roof will be manufactured from the same quality grade and finish of material as the roofing bullnose elements.

Supply & fixing of 0.8 mm zinc flashing of Maximum Girth 250 mm in the same finish as the roof finish for eaves, gables, ridges, fascia, gutters, etc. as required for site detailing

- Supply & fixing of 0.8 mm zinc flashing of Maximum Girth 500 mm in the same finish as the roof finish for Skylight with soldering, silicone etc. as required for site detailing
- Supply and Fixing of 1.0 mm thick Galvanized Stiffeners maximum girth of 250 mm.

The Flashings for eaves / gutters to be profiled as per the Details Provided by Manufacturers. The flashing needs to be installed along with GI stiffener of 1 mm thick wherever recommended by the manufactures.

All Zinc Flashings and GI Stiffener for flashing shall be measured and invoiced on per Running Meter Basis. Pre-Qualification Criteria for Zinc Titanium roofing bullnose& cladding Item:

Specialized Agency for Zinc Titanium Installation:

The main Contractor shall submit the names of specialized successfully carried out similar nature:

The Specialized Agency must be trained by the Zinc Titanium Manufacturer for installation of zinc titanium roofing bullnose& façade works. Certificate of Training must be submitted by the specialized agency for zinc titanium roofing bullnose and façade. Specialized agency must have Order copy of past executed govt. jobs in titanium- zinc of similar quantity.

Zinc Titanium Supplier**:**

The principal material supplier must have necessary machines, tools, design team in India to profile the Zinc panels to support the Contractor.

Zinc Titanium Supplier:

The zinc titanium material supplier must have presence in India and must have supplied material to Public Buildings in India– Airport / Heliport / NBCC / PWD / CPWD etc. with tools and machinery for profiling of zinc.

MEASUREMENTS:

The area for roof sheeting shall be calculated by measuring actual length X breadth of roof sheeting o site up to two decimal places. Flashings for eaves, gables, ridges shall be charged extra on linear meter basis.

Protection of material

The zinc roofing sheets shall come with a proprietary protective film on the topside to protect it against damage and defect during transportation and storage. The protective film should be removed promptly after installation since the film is not UV resistant and residues of the adhesives may remain on the metal. The protective film shall be removed no later than six weeks from the date of installation.

15 GLASS:

a. All glassand glazing material shall be verified and coordinate with the applicable Performance requirement.

b. All glass shall be cut to required size and ready for glazing. All glass shall be accurate sizes with clear undamaged edges and surfaces which are not disfigured. Any panel which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense.

c. Glass shall confirm to the quality, thickness and dimensional requirement specified in US Federal specifications DD – G0415C.

d. Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm with in 260mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripple shall be consistent and is acceptable to PMC/Engineer in charge. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional and surface compression shall be in the range of 320-450 Kg/cm^2. All glass shall be delivered to site with the manufacturer's label of identification attached.

e. The glass glazed panel / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirement of local building codes.

f. Glass shall be free from defect or impurities detrimental to its performance. Defects such as bubbles, waves, spots scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles delaminating of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass should be consistent in colour.

g. Double glazed units shall be procured only from approved manufacturer. Quality control tests shall be performed for mixing, curing, adhesion and dew point. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.

h. All glass breakage caused by the Contractor or his sub-Contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

16 PANELLING

The Panelling work shall be as per Finishing Schedule as appended in DBR, PART-D/ tender drawings and as per latest CPWD specifications or manufactures specifications**.**

16.1 Wooden Panelling

Providing and Fixing Channeled Wooden perforated panels of width 128mm, thickness of 6mm and length 2440 mm or as required by the PMC/Engineer in charge, made of a high density particle board substrate with a laminated facing as per the approved shade/ species & finish and a melamine balancing layer on the reverse side. The boards shall have a special perforation pattern where the visible surface has a (“Helmholtz” fluted perforation of 2mm width and 14mm of visible panel / 4mm width and 28mm visible panel) each. The panels shall provide a minimum sag resistance of RH90 and a fire rating class of 1 as per Part 7 of BS 476. The edges of the panels shall be “tongue-and-grooved” to receive special clips for installation. The back of the perforated panel shall have sound absorbing non-woven acoustical fleece. The panels shall be mounted on special aluminium splines using clips approved by the PMC/Engineer in charge.

16.1.1 **Installation**:

Install wooden battens (provided by others) of section 50mmx50mm or as approved by the SBI on the solid wall horizontally using screws and plugs at spacing of 600mm centre-to-centre. Screw the aluminium extruded keel for channelled wood(GTPT001) over the lowest and second wooden batten at an on-center distance of 600mm. Install the first set of wooden panels by inserting the clips for border channelled wood(GTPT002) and insert the groove of the panel into the projecting flange of the aluminium clip. Continue installing rows of panels by inserting the tongue into the groove of the earlier inserted panel and progressively installing clips for inside channelled wood (GTPT003) into the next keel till the actual height is achieved. Use clips for border channelled wood(GTPT002) to finish off the installation. Finish off the edges using wooden moulding of matching colour.

16.2 ACOUSTICAL WALL PANELLING

16.2.1 Providing and supplying Acoustical Wall Panelling of Slats made of pinewood E1 grade fiberboard, Melamine laminated finish, groove perforated slats L16-2 - (2mm Slats @16mm pitch) / L32-2 - (2mm grooves @ 32mm centers) / L64-2 - (2mm grooves @ 64mm centers), backlined with black acoustical fleece, tongue-groove edge for a seamless look, of size 75/150x2440mm with min 15mm thick having base density 800Kg/m3, weight 12Kgs/m2 installed by using GI strut system. The GI strut system includes two layers of GI Cross channel (CC50) having thickness 0.45mm, length 3600mm, knurled web 40mm, depth 50mm and equal flanges 15mm is fastened vertically/horizontally at every 600mm centers. Aluminium core cross channel (CC18) having thickness 0.5mm, length 2400mm, web 15mm & 27mm, depth 18mm and flanges of 7mm with suitable edge & centre brackets is then fixed perpendicular to the CC50 with the help of fasteners at every 400mm centers. Slats of size 75/150x2430mmx16mm in then fixed perpendicular to CC18 with suitable edge & centre brackets. Contractor to provide expansion joints of 3mm at every 5mtrs bothways. Panels shall be backlined with acoustical infill of Synth PF 5x50mm thick adhered to the wall using Stick 7 adhesive.

Technical Parameters:

- Core Variants - Pinewood E1 Fibreboard
- Fire – Class 1 & P
- Acoustics – NRC upto 0.75
- Climate (OC RH) – 50, 70
- Light reflectance – 75% (beech haya)
- Green (RC %) – 25
- Hygiene (VoC, Clean room) – Low, Class 1
- Strength, Load capacity (Kg) - Ball-Impact

16.2.2 Providing and supplying Acoustical Wall Panelling of Hush burled square edge, FR grade fabric (colour choice) wrapped glassfibre core panel of size 600x1200x25mm having density 100-120Kgs/m3, weight 3.0kg/m2 installed by using impaling clip Impaling clips are attached directly to the wall/frame work with the points extending outward. The spikes are tipped with Stick S7 adhesive. Then the panels are positioned and pressed into place

Technical Parameters

- Core - Glassfibre
- Fire – Class 1 & P
- Acoustics – NRC up to 0.9
- Climate (OC RH) – 40, 90
- Termite resistance – Yes
- Light reflectance – Colour dependent
- Green (RC %) – 25
- Hygiene (VoC, Clean room) – Low, Class 3

16.2.3 Providing and supplying Acoustical Wall Panelling with square edges made of fibre glass substrate 25mm thick and wrapped on the front side with an acoustically transparent and fire-resistant fabric with an option of colours as per the choice of the PMC/Engineer in charge of size 2100x600 or 600x600 mm providing a minimum sound absorption level of 0.90 NRC to be affixed to wall using Wall panel impellers and construction adhesives as per the instructions laid down by the manufacturer.

16.2.4Installation of wall panel impellers of adequate quantity as specified by the manufacturer shall be fixed to the wall surface using self-tapping screws. Silica based construction adhesive shall be dabbed on to the projecting elements (spikes) of the impellers. wall panels shall be pierced through the spikes of the impellers ensuring the line and level of the panels are maintained.

17 EXPANSION JOINT/SEISMIC JOINT

Gap of the expansion joints shall be provided as proposed in the structural design of the building. Specifications of the Expansion joints shall be as per DBR, PART-D and as per CPWD Specifications. Brief specifications are given below:

17.1 **Floor Joints:** Expansion joint system related with floor location as per drawings and direction of PMC/Engineer in charge. The joints system will be of extruded aluminium base members, self-aligning/self-centring arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor /floor to wall expansion control system for various vertical location in load application areas that accommodates multi directional seismic movement without stress to its components. System shall consist of metal profiles with a universal aluminium base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projected movement and loading requirements and secured to base members by utilizing manufacturer’s pre-engineered self-Centring arrangement that freely rotates/moves in all directions. The Self- centring arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminium extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement all as per the manufactures design and as approved by PMC/Engineer in charge. (Material shallconfirmtoASTM6063)

17.2 **Wall Joints:** Expansion joint system related with wall joint (internal/external) location as per drawings and direction of SBI/PMC in charge. The joints shall be of extruded aluminium base members, self- aligning / centring arrangement and support plates as per ASTM B221- 02. The material shall be such that it provides an Expansion Joints System suitable for vertical wall to wall/wall to corner application, both new and existing construction in office Buildings& complexes with no slipping down tendency amongst the components of the Joint System. The Joint System shall utilize lightweight aluminium profiles exhibiting minimal exposed aluminium surfaces mechanically snap locking the multi cellular to facilitate movement. (Material shall confirm ASTM6063)

17.3 **Roof Joints:** Expansion joint system of approved make and manufactures for various roof locations as per approved drawings and direction of SBI/PMC in charge. The joints shall be of extruded aluminium base members with, self- aligning and self-centring arrangement support plates asper ASTM B221-02. The system shall be such that it provides watertight roof to roof/roof to corner joint cover expansion control system that is capable of accommodating multi directional seismic movement without stress to its components. System shall consist of metal profile that incorporates universal aluminium base member designed to accommodate various project conditions and roof treatments. The cover plate shall be designed of width and thickness required to satisfy movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self- centring arrangement that freely rotates/moves in all directions. The Self centring arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminium extrusion cavity to allow freedom of movement and flexure

In all directions including vertical displacement. The Joint System shall resist damage or deterioration from the impact of falling ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement. (Material shall confirm to ASTM6063.

a. The treatment of Seismic / mechanical expansion joints shall be carried out strictly as per the specifications mentioned herein. In the absence of specifications of any material, relevant I.S. specifications shall be followed and in case any material is not covered up in the specifications; PMC/Engineer in charge's instructions shall be followed. No deviation shall be permissible unless specifically approved by the PMC/Engineer in charge.

b. The work shall be carried out as per CPWD specifications and directions of PMC/Engineer in charge.

c. The work shall be carried out as per site requirement. The Contractor shall submit detailed drawing/shop drawing for each type of joint within three days from the date of award and shall be got approved from PMC/Engineer in charge before execution of the work.

d. The Contractor shall make minor modification in the samples as per site requirement with the approval of PMC/Engineer in charge if required and nothing extra shall be paid for this modification.

e. The Contractor shall submit the test reports of the product of the manufacturers.

 Signature of the Bidder with Seal

f. Manufactures: - All seismic/mechanical expansion joints shall be designed and manufactured by the approved manufacturers.

g. Guarantee: - All the joints shall be guaranteed at least for the period of 5years when installed by the certified applicator in the prescribed performa.

h. Installation: - Installation shall be in strict accordance with manufacture's technical specifications, details and installation instructions. The work shall be carried out through the specialized agencies as approved by the PMC/Engineer in charge.

i. Protection: - The system and its component should be protected during construction and after work is complete, the exposed surface and adjacent areas should be cleaned by suitable cleaner to the satisfaction of PMC/Engineer in charge.

j. Sample for joints: -The agency shall supply sample of minimum one-meter length of all types of expansion joints and the same shall be fixed at site at appropriate location and the same shall be approved by the competent authority which shall be duly intimated by Engineer–in–Charge. The agency shall place the order for procurement of mechanical expansion joint from the parent company for supply only after obtaining approval from PMC/Engineer in charge.

k. Materials: -

   i. EPDM (Ethylene Propylene Dinine membrane) water resistant membrane shall be as per manufacturers specifications and shall be of best quality. The EPDM membrane shall be pasted with approved adhesive to the surface.

   ii. S.S. screw shall be of canon or equivalent make approved by PMC/Engineer in charge.

   iii. Aluminum sheet shall be of approved make and shall generally confirm to IS: 737-1986. The powder coating on aluminum sheet shall be 50-60 microns. The slots on the aluminum sheet shall be made by lath machine with smooth and uniform finish.

l. For any discrepancy in item and corresponding drawing, the decision of SBI/PMC in-charge shall be final and nothing extra shall be paid on that account.

18 BUMPER GUARD STRETCHER GUARD CRASH RAIL SYSTEM & WALL GUARD

The scope of work includes providing & fixing Bumper Guard / Stretcher Guard Crash Rail System of approved make consisting of continuous aluminum retainer, impact absorbing strip (B-ABS), adjustable end cap / corner joint, adjustable adaptor plate and high impact vinyl acrylic cover of desired shade to withstand impact and providing a cushioned surface with its integrated rubberized absorber complete as per manufacturer's specifications.

- The Bumper Guard / Stretcher Guard Crash Rail System shall be able to protect walls that are susceptible to trolley traffic, preventing unsightly scuffs and costly damage.
- This system shall be so designed to withstand impact and provides a cushioned surface with its integrated rubberized absorber, making it ideal for areas like high traffic corridors, loading bays and light cargo lifts.
- Bumper Guard shall be manufactured from specially developed vinyl acrylic materials and has the following qualities:

a. Able to withstand high impact and abrasion

b. Weather resistant and fire retardant

c. Textured to provide an anti- slip surface

- Fittings and anchorages that can withstand corrosion when exposed to normal environmental conditions
- Easy to install and maintain

18.1 **Wall Crash Guard:** Corridors, Lobbies, Ramps of all the floors shall be provided with Wall Crash Guard as per approved drawings with following specifications.

Supply and fixing of CRUSH Rail of approved make having lead free vinyl snap on cover, PVC Holder and bumper of 2mm thickness each. Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T5 aluminum having high impact resistance with size 157(+/-2) mm x 25(+/-2) mm with rail offset of 76mm along with continuous outside corner. The rigid vinyl profile shall resist an impact of minimum 30.4ft-Ibs/inch as per ASTM D-25690b. The finished surface shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTM D-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/Engineer in charge.

18.2 **Column & Wall Corners Guard:** All corners of walls and columns at corridors, lobbies and all inside area of all the floors shall be provided with Column & Wall Corner Guard up to a minimum height of 1.5m as per approved drawings with following specifications.

Supply and fixing of corner guard of approved make and model Corner Guard having lead free vinyl snap on cover with PVC End Capsandbumperof2mmthicknesseach.Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T6 aluminum having high impact resistance with size 52mm x52 mm. The rigid vinyl profile shall resist an impact of minimum 30.4ft lbs/inch as per ASTM D-25690b and shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTMD-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/Engineer in charge.

19 ROADS, PATHWAYS

The campus roads are to be constructed with filling of earth, preparation of sub-grade, sub- base WBM/WMM/GBS as specified and finished with minmimum Grade M40 RCC 200mm thick and as per IRC code with Vacuum Dewatered concrete. All the main RCC roads are to be constructed as per road section drawings and as per IRC code and CPWD Specifications. Following are the types of roads are proposed: -

(i) Vacum Dewatered RCC Road as shown in drawing.

(ii) For pedestrian movement and parking areas, paver blocks/ Grass-Crete blocks/Chequered CC tiles shall be used, as required.

(iii) Kerb stones: All roads edges shall be provided with kerb stones.

(iv) Adequate no. of hume pipes (RCC Pipes) of suitable dia. shall be laid across the roads/pathways etc. for crossing of cables, pipe etc. as per requirements.

All ramps for handicapped/disabled persons are to be provided as per norms for all buildings. Foothpaths with above specifications are also to be provided for all SS points of the buildings

Painting and marking of the roads, parking, cycle tracks footpaths and handicapped ramps are to completed as per standard road signs & specifications.

a) Parking

(i) Provision for parking spaces has been made on the basis of "Equivalent car space" (ECS) as laid down under "Building Bye Laws" of Andhra Pradesh.

(ii) Parking space has been planned with adequate vehicular access to a street and the area of drives, aisles and such other provisions required for adequate manoeuvring of vehicles shall be exclusive of the parking space.

b) Grass Pavers

The grass pavers shall be of size 300mm x 300mm and thickness of 70 mm should be prefab factory made cement concrete interlocking grass pavers of M-30 mix, suitably reinforced and manufactured in joint less moulds on vibrator table finished smooth as per required shape size and pattern and colour. To be laid over 50mm thk. sandbed on top of consolidated earth after proper levelling and dressing of ground surface to the requisite slopes complete in all respects as per directions and instructions of Engineer in charge.

c) Interlocking Pavers

The Interlocking pavers shall be of required size and thickness 80 mm factory made cement concrete interlocking pavers in cement concrete of mix M-30 manufactured in joint less moulds on vibrator table finished smooth as per required shape size and pattern and colour. To be laid over 50mm thk. sandbed on top of consolidated earth after proper levelling and dressing of ground surface to the requisite slopes complete in all respects as per CPWD Specifications & directions and instructions of Engineer in charge.

20 ACOUSTIC CEILING SPECIFICATIONS

Acoustical infill Ceiling Tiles of 595x1195x20/25mm, Square edge of approved make, The Ceiling Tiles to be magnesite-bonded pinewood fibre core pigmented with volume density 400Kgs/m3, weight 8/10kg/m2 and shall be suspended by using 0.3mm thick metal grid system as per manufacturer specification all complete as directed by SBI/PMC in charge.

Technical Parameters

Fire (Class) – 1 & P

• Acoustics – NRC 0.87 (For 15mm thk C50 Mounting)

• Thermal conductivity (W/mk)– 0.08

• Climate (°C, RH) – 50, 90

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• Light reflectance (%) – Low light reflectivity

• Green (VoC, RC %) – Low, 30

20.1 Wooden Slat Acoustical ceiling

Supply & installation of Slats made of pinewood E1 grade fiberboard, melamine laminated finish, 3mm perforated slats backlined with Soundtexblack acoustical fleece, tongue-groove edge for a seamless look, FR Grade, size 128x2440x16mm, volume density of base board 700Kg/m3, weight 10.5Kgs/m2 (L32), installed by using Anutone Strut ceiling suspension system.

The channel ceiling framework system shall include Wall channel, fully knurled, sectional thickness 0.55mm, length 3600mm, unequal flanges of 20 & 30mm and web of 25mm, fixed along the perimeters of the wall with nylon sleeves and suitable fasteners at every 300mm centers. Then suspend Main channels, fully knurled, sectional thickness 0.8mm, length 3600mm, equal flanges of 15mm and web 45mm from the soffit at 1200mm centers with struts, fully knurled, Suspender angle with sectional thickness 0.55mm, unequal flanges of 25 & 10mm. Cross channel, fully knurled, sectional thickness 0.55mm, length 3600mm, web 35mm, depth of 20mm and equal flanges 15mm is fastened to the channel perpendicularly at 600mm centers. Aluminium core cross channel, thickness 0.5mm, length 2400mm, web 15mm & 27mm, depth 18mm and flanges of 7mm with suitable edge &centre brackets is then fixed perpendicular to the Cross channel with the help of fasteners at every 400mm centers. The Slats size 128x 2440x16mm is then fixed perpendicular to the channel with suitable edge & centre brackets. Contractor to provide expansion joints of 3mm at every 4.88m length wise and 4.992m width wise. Cove area to be considered in LM and to be paid as per actuals.

The system is backlined with acoustical lining complying to the following parameters. Fire (Class) – 1 & P (For FR grade), Acoustics – NRC 0.77(E300* Mounting), Thermal conductivity (W/mk)– na, Climate (°C, RH) – 50, 70, Light reflectance (%) – 75 (Maple Arce), Green (VOC, RC %) – Low, 25.

20.2 Core ceiling

Supply and Installation of square edge, magnesite bonded, 2mm wide pinewood fibre core panels, Green Pro certified, core pigmented ceiling tile of size 600x1200x15mm having volume density 400Kgs/m3, weight 8kg/m2 suspended using 0.3mm thick metal framwork system.
The channel ceiling framework system shall include channel, fully knurled, sectional thickness 0.55mm, length 3600mm, unequal flanges of 20 & 30mm and web of 25mm, fixed along the perimeters of the wall with nylon sleeves and suitable fasteners at every 300mm centers. Then suspend channel, fully knurled, sectional thickness 0.8mm, length 3600mm, equal flanges of 15mm and web 45mm from the soffit at 1200mm centers with channels, fully knurled, Suspender angle with sectional thickness 0.55mm, unequal flanges of 25 &10mm such that the channel rests on the channel. The channel fully knurled, sectional thickness 0.55mm, length 3600mm, knurled web 50mm, depth 25mm and equal flanges 15mm is fastened to the channel perpendicularly at 600mm centers and inserted inside the channel at the perimeter. The channel, square edges panels shall be then screwed on CC25 backed with Synth pf 10*50.
Technical Parameters
• Fire (Class) – 1 & P
• Acoustics – NRC 0.9 (For E600 Mounting)
• Thermal conductivity (W/mk)– 0.07
• Climate (°C, RH) – 50, 95
• Light reflectance (%) – na

• Green (VoC, RC %) – Low, 30

20.3 Cloud Concave or Convex suspended ceiling

Supply and installation of Clouds Nubby Melange Concave or Convex of size 1200*600mm ,40mm thk, which are having glassfibre core, colour textured finish and are fully encapsulated Panels are having volume density 120kgs/m3 and weight 4.8kg/m2.

Each Cloud is provided with 4 sets of accessories containing Corkscrew, levelling hook and hanger wires. Corkscrew to be rotated and anchored at back of each panel at four points to hold the panel stable. Supplied hanger wires to be first dropped from the beam/slab/truss to desired height with suitable anchor bolts and S hook. Clouds Nubby Melange concave / convex of size 1200*600 are then suspended using spring hooks and hanger wires and levelled into position with levelling clips. (Anchor bolts and S hook not by vendor).

Technical Parameters

"Fire (Class) – 1 & P, Acoustics – NRC 0.7 (For J Mounting), Thermal conductivity (W/mk)– 0.07, Climate (°C, RH) – 40, 95, Light reflectance (%) –Colour dependant, Green (VoC, RC %) – Low, 35".

21 DRY STONE PITCHING

Stones: These shall be clean, hard stones, free from decay and weathering. They shall be in block and hammer dressed on all sides. The size of the pitching stones shall be approximately 22.5 cm.in depth and not less than 15 cm. in any other direction.

Preparation of surface: The sides and bottom of earth work to be pitched, shall be brought to the required slope and gradient and shall be compacted to a firm and even surface.

Pitching: Pitching shall be of 22.5 depth unless specified otherwise. Profiles shall be put up by means of pegs and strings or by placing stones, at intervals of not more than 15 cm. Stones shall then be laid closely in position in between the profile and firmly embedded with joints staggered and with exposed faces true to line, gradient and in uniform slope throughout.

Cross bands of approximately 22.5 cm. width through bond stones equal to the full depth of pitching shall be provided at an interval of approximately 3 metres centre to centre both longitudinally and transversely.

The interestices between adjacent stones shall be filled in with stones of proper size, well driven in with crow bars to ensure tight packing and complete filling of all interstices. Such filling shall be carried on simultaneously with the placing in position of the large stones and shall in no case be permitted to fall behind. Final wedging shall be done with the largest sized chip practicable, each chip being well driven home with a hammer so that no chip is possible of being picked up or removed by hand.

22 G.I. BARBED WIRE FENCING WITH ANGLE IRON POSTS

Materials: G.I. Barbed wire shall be as per IS 278 and angle iron shall be as per CPWD Specification Vol. The angle shall be of size 40 × 40 × 6 mm or as specified in the tender drawings.

Spacing of Posts and Struts: The spacing of posts shall be 3.00 m centre to centre, unless otherwise specified or as directed by the PMC/ Engineer in charge to suit the dimensions of the area to be fenced. Every 15th, last but one end posts and corner post shall be strutted on both sides and end post on one side only.

Fixing of Posts and Struts Pits 45 x 45 cm and 75 cm deep or as directed shall first be excavated true to line and level to receive the posts. In the case of struts, pits 70 x 45 x 75 cm deep or as directed shall be excavated to suit the inclination of the strut so that it is surrounded by concrete by not less than 15 cm at any point.

The pits shall be filled with a layer of 15 cm thick cement concrete 1:2:4 (1 cement: 2 fine sand:

4 graded stone aggregate 20 nominal size). The posts and struts shall then be placed in the pits, the posts projecting as per specified height above ground, true to line and position. The cement concrete

1:2:4 shall be filled in upto 15 cm for posts and 25 cm for struts below ground level at the base of the concrete so that the posts are embedded in the cement concrete block of size 45 x 45 x 60 cm and strut in block of size 70 x 45 x 50 cm. The concrete in foundations shall be watered for at least 7 days to ensure proper curing. The remaining portions of pits shall be filled up with excavated earth and the surplus earth disposed off as directed by the PMC/Engineer in charge and site cleared.

The angle iron post at bottom shall be split and banded at right angle in opposite direction for 10 cm length to get proper grip.

Fixing G.I. Barbed Wire: The barbed wire shall be stretched and fixed in specified number of rows and two diagonals. The bottom row should be 14 cm above ground and the rest at specified spacing. The diagonal shall be stretched between adjacent posts from the top wire of one post to the bottom wire of 2nd post. The diagonal wire will be interring woven with horizontal wires by fixing the odd rows of wires first, then the diagonal cross wires and lastly even rows of wires. The barbed wire shall be held by tearing the

holes of 10 mm dia in the post and tied with G.I. wire, turn buckles and straining bolts shall be used at the end post. The Barbed Wire shall be Weighing 9.38 kg /100 m (minimum).

23 SIGNAGE & ASSOCIATED WORKS

a. The scope of the work includes preparation of the Architectural Drawings/ shop drawings based on details given in the tender drawings and as directed by SBI/PMC in charge. Fabrication, supply, installation and protection of the Signages shall be carried based on approved shop drawings.

b. The item of work for the respective signage shall be confirming to Specifications/ tender drawings and shall cover all operations, fabrications and their installations and materials required for finished product.

c. The signage work shall be got executed through specialized fabricator having experience of similar works. The EPC Contractor shall submit the credentials of such fabricator for the approval of the PMC/Engineer in charge.

d. The EPC Contractor shall submit the Design, Size and installation procedure along with samples to PMC/Engineer in charge for approval. Approved samples will be kept at site till the whole work is completed. PMC/Engineer in charge has right to modify the design of the approved samples and Contractor is bound to follow these written instructions / changes in design/ size etc. from PMC/Engineer in charge.

e. The typical patterns shown in the drawings are only indicative. The Contractor shall submit shop drawings, for approval of the PMC/Engineer in charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including location, etc. shall be shown in the shop drawings.

f. The Contractor shall submit to the PMC/Engineer in charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of PMC/Engineer in charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/Engineer in charge. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/Engineer in charge. Nothing extra shall be payable on this account.

g. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

h. The signages shall be fixed with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.

i. The entire work shall be carried out to the satisfaction of PMC/Engineer in charge. The Pictures shown for Internal Signages are for reference. The shape & Size of the Signages shall be as per the reference pictures. All the Internal Signages should Bilingual (English/Hindi). The colour of the print to be finalized after having a careful study of the Building Interior which shall be constant in all the buildings. The content of the Signages will be as per Architectural Plans.

j. The fabricator will keep a liberty to choose any one of the items between "IF, IG, IV, IX and IY", wherever they are mentioned/marked without hanging The text height which shall be constant. For Example, if at any particular location "IG" is marked, but the content gets fitted in "IY", the fabricator shall use "IY"in that location instead of using "IG". Similarly, if at any particular location "IX" is marked, but the content doesn't get fitted in "IX" with the standard font size used everywhere, but gets fitted in "IV", the fabricator shall use "IV" in that location instead of using "IX

k. Way finding & Fire Exit signages suspended from Ceiling on corridors and other locations shall have content on both the two sides of the Signage for giving directions as per site requirement.

l. General Specifications of various types of Signages are given below: -

24 SAMPLES OF MATERIALS:

a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the Contractor for approval from the SBI/PMC in charge of work in writing before placing orders for the entire quantity required for completion of work. Samples approved by the EIC shall be kept in Sample Room under the charge of PMC/Engineer in charge and shall retain till completion of work.

b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the SBI/PMC in charge shall be prepared by the Contractor to the satisfaction of SBI/PMC in charge and got approved from him in writing before the commencement of these items for the entire work.

c. The requirements for preparation of samples shall be observed and fulfilled by the Contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

25 IGBC REQUIREMENTS:

The Contractor shall procure materials considering their recycled content to ensure compliance with IGBC requirements, as specified in the Special Conditions of Contract (SCC) and other relevant documents.

26 **VARIATION IN CONSUMPTION OF MATERIALS**:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

27 MISCELLANEOUS:

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as “First Quality” by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the Contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

28 TESTS:

Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. These tests shall be got done from laboratories approved by SBI/PMC in charge. or the laboratory set up by the Contractor at site as per directions of SBI/PMC in charge.

CHAPTER C

TECHNICAL SPECIFICATIONS PLUMBING & SANITARY WORKS

1. Scope of work

The work shall in general confirm to the Latest CPWD Specifications for works as mentioned in Schedule 'F' of the GCC. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the general arrangement (GA) plumbing drawings. Tender drawings w.r.t plumbing & sanitary works are for reference and are indicative in nature only.

2. Plumbing Fixtures

2.1. General

i. Work under this Part shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required for the work.

ii. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following: -

a. Sanitary fixtures

b. Chromium plated fittings

c. Porcelain or stainless-steel sinks

d. Accessories e.g. towel rods, toilet paper holders, soap dish etc.

e. Whether specifically mentioned or not, the installation of the fixtures, appliances and accessories shall be provided with all fixing devices, nuts, bolts, screws, hangers, fasteners as required.

f. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

iii. All sanitary fixtures, CP Fittings and CP/SS accessories shall be as per manufacturers' standards / CPWD Specifications.

iv. All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically mentioned in Specifications or shown on the GA drawings and will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.

v. Wall caps shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pass through them. These wall caps shall be chromium plated brass snugly fittings and shall be large enough to cover the puncture properly and shall confirm to IS: 4291.

vi. Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Iron screws rust will not be permitted.

vii. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

viii. Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble core seal and edges.

2.2. Water Closets

i. European W.C. shall be any one of the following types:

a. Wall hung wash down or

b. single or double siphon type

ii. Each W.C. set shall be provided with an approved type of matching plastic seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.

iii. The seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

iv. The edge between the fixture and the wall shall be sealed with approved type of poly- sulphide sealant.

2.3. Health faucet/spray

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as directed by the SBI/PMC in charge.

2.4. Wash Basins

i. Wash basins shall wall mounted type or for under over/counter installation as specified.

ii. Wash Basins shall be white glazed vitreous chinaware of size, shape and type as specified in the Indicative list of item.

iii. Each basin shall be supported on MS galvanized brackets and the basin securely fixed to wall or under/above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

iv. Each basin shall be provided with 32 mm dia. C.P. waste with overflow/ pop-up or standard waste with rubber plug and chain, 32 mm dia. C.P. brass bottle trap with CP pipe to wall and flange.

v. Each basin shall be provided with a single tap a hot & cold Brass CP mixer with or without pop up waste fittings, 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.

vi. The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant

vii. Washbasins shall be fixed at proper heights as per NBC or as directed by SBI/PMC in charge.

viii. Each basin shall be provided with auto closing pillar cock or as specified in the Indicative list of items.

ix. Each washbasin connection (separately for hot and cold) shall be provided with angle valves with CP wall flange and CP connecting pipe and of required length.

x. Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by EIC.

2.5. Sinks

i. Sinks for kitchens, pantries, and designated utility rooms the Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the Indicative list of items.

ii. Each sink shall be supported by MS galvanized brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

iii. Stainless steel sinks shall be provided with 40 mm dia. C.P. basket waste with plug (as supplied by manufacturer), 40 mm dia. C.P. brass “P” trap with CP pipe to wall and flange.

iv. Each sink shall be provided with hot & cold brass CP mixer with approved type of a neck spout or individual taps as directed by the PMC/Engineer in charge.

2.6. <u>Shower set</u>

i. Shower set shall comprise of hot & cold water mixer, C.P. shower arm with wall flange and shower head adjustable type.

ii. Mixer shall be exposed type, single lever, concealed stop cocks with diverter and spout as selected by the PMC/Engineer in charge.

2.7. <u>Accessories</u>

i. Types of typical Accessories:

a. Towel rails

b. Towel rings

c. Coat hooks

d. Soap dispensers

e. Soap dishes

ii. Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good.

iii. Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

2.8. <u>Toilet for Disabled</u>

(i) Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the SBI/PMC in charge.

(ii) Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by the SBI/PMC in charge

Soils, Waste, Vent & Rainwater Pipes & Fittings

2.9. <u>Scope of work</u>

i. Work shall consist of furnishing all labour, materials, equipment’s and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as per requirement.

ii. Without restricting to the generality of the foregoing, the system shall include the following: -

a. Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.

b. CI Hub less soil, waste & Vent pipe and uPVC rainwater pipes.

c. Connection of all pipes to sewer lines at ground floor levels.

d. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/Khurras.

e. Testing of all pipe lines.

2.10. General requirements

i. All materials shall be new of the best quality confirming to specifications and subject to the approval of PMC/Engineer in charge.

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

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

iv. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

v. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

2.11. Piping System

a. Soil, Waste & Vent Pipes

i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: having separate pipes for waste for kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains and approved by PMC/Engineer in charge.

ii. All waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.

iii. Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly where feasible and shown on the drawings.

b. Rainwater Pipes

i. All terraces shall be drained by providing down-takes rainwater pipes.

ii. Rainwater pipes are separate and independent and are to be connected to the storm water drainage system.

iii. Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water gratingss.

iv. Any dry weather flow from waste appliances, AHU's pump rooms, shall not be connected to the sewerage system.

c. Balcony/Planter drainage

All balconies, terraces, planters and other formal landscape areas will be drained by vertical down take pipes.

d. Hubbless centrifugally cast (Span) iron pipes epoxy coated in sides and outside as per IS code 15905. & fittings (for Soil, waste, anti-siphon age pipes)

e. uPVC pipes & fittings (For Rain Water Pipes etc.)

i. Where specified, Polythene pipes shall be uPVC pipes confirming to I.S: 4985- 2000, 6kg /cm^2.

ii. The details of the nominal outer diameter, weight and working pressure shall be as per the standards, for the respective pressure rating.

iii. Polythene pipes may be cold bending to a radius of not less than eight times of their external diameter. Pipes bent for smaller radius may be made by hot bending.

iv. Fittings used for Polythene pipes shall be compression moulded fittings matching to the above specifications.

f. Jointing

i. All Polythene pipes shall be Drip seal/Sealant/Ring Fit and jointed as per manufacturer's specifications and relevant I.S codes.

ii. All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.

g. Fittings

i. Fittings shall confirm to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

ii. Fittings shall be of the required degree of curvature with or without access door.

iii. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

h. Fixing

i. All vertical pipes shall be fixed by structural support clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

ii. Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps (Clevis clamps) of required shape & design or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

iii. Contractor shall provide all sleeves, openings, hangers, inserts during the construction. All damages shall be made good to restore the surfaces.

2.12. Traps

a. Floor traps

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

b. Urinal traps

Urinal traps shall be of CI, deep seal with an effective seal of 50 mm as given in Indicative list of items. and set in cement concrete block specified in Para above without extra charge.

c. Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting of P.P. pipe without, with one, two or three inlet sockets on side to connect the waste pipe. Joint between waste and hopper inlet socket shall be Ring fit / Drip Seal. Inlet shall be connected to a P.P P or S trap. Floor trap inlet fitting and the traps shall be set in cement concrete blocks.

d. PP Floor trap

PP Floor trap has unique feature such as an air tight baffle construction and the incorporation of seals. The trap can be applied directly within the soil & waste system design.

Important aspects in the designing process are: -

· Knockout prevention

· Seals.

· Absorb/correct installation mistakes

· Durability

· Resistant to difficult installation circumstances

e. Gratings for traps

Floor and urinal traps shall be provided with 100-150mm square or round C.P. / Stainless steel grating / PTMT, with rim of approved design and shape.

f. Jointing

Soil, waste, vent and anti-siphonage pipes shall be jointed with Ring fit joint as per design. The following minimum procedures shall be complied with while making the pipe joints: -

i. Ensure that the pipes are clean internally and undamaged.
ii. The pipes shall be cut square with sharp tools.
iii. The cut ends of the pipes shall be filed/ reamed and finished smooth.
iv. Any deformed ends shall be re-rounded.
v. It shall be ensured that the pipe ends shall enter the fittings and sockets to full depth of the jointing area.
vi. The pipe work shall be assembled in a manner such that it does not entail making of joints in restricted locations.
vii. The jointing surfaces shall be cleaned to remove any coatings etc.

g. Floor Trap Inlet/ Inlet Fitting:

Traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a P.P. inlet fitting without or with one or two or three inlet sockets to receive the waste pipe. Joint between P.P. waste pipe and inlet socket shall be Ring fit / Solvent joint. Inlet fitting shall be connected to a P.P. ‘P’ or ‘S’ trap with at least 50mm seal. Floor trap inlet fitting and the traps shall be set in cement concrete blocks/and supports as required for Floor trap.

2.13. Cleanout Plugs

a. Cleanout Plug on soil pipes

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, “Ys” and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be Drip seal caulked to the drain pipes.

b. Cleanout Plug on Drainage Pipes

i. Cleanout plugs shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the PMC/Engineer in charge. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. Cleanout Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

ii. Cleanout Plug at Ceiling Pipes: - Cleanouts provided at ceiling level pipe shall be fixed to a P.P. pipe. The cleanout doors shall be of Polypropylene, gasket etc.

2.14. Waste pipe from appliances

a. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of Polypropylene pipe as shown on the drawings.

b. All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per good engineering practice approved by the PMC/Engineer in charge.

c. Polypropylene pipes

Waste pipes from appliances shall be Polypropylene pipe confirming to EN:12056 and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All P.P. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

2.15. Polypropylene pipes for drainage

a. All drainage lines passing under building, in exposed position above ground e.g. basement ceiling etc. shall be Polypropylene pipes.

b. Polypropylene pipes shall be confirming to EN: 12056. Quality certificates shall be furnished.

c. Fittings

Fittings used for Polypropylene drainage pipe shall confirm to EN: 12056. Wherever possible, junction from branch pipes shall be made by a Y- tee.

d. Joints

Joints between pipes shall be made with pre-moulded rubber ring joints (Tyton Joints) supplied by the manufacturer to ensure compatibility and water tightness.

2.16. Encasing pipe in Cement Concrete

Polypropylene soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand:4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. inclusive of pillars, supports, shuttering and centring.

2.17. Cutting and making good

a. Pipes shall be fixed and tested as building proceeds.

b. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or brick work in cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

2.18. Testing

(i) Water Test

a. Testing procedure specified below apply to all soil, waste and vent pipes.

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

c. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.

d. Testing soil, waste and rainwater pipes

(i)Apart from factory test all The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the SBI/PMC in charge. After installation all connections from fixtures, vertical stacks and horizontal drains including Polypropylene pipes shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

i. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open an observe for leakages. Rectify or replace defective sections.

ii. After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.

iii. Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of PMC/Engineer in charge and signed by both.

(ii) Smoke Test

Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under: Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the SBI/PMC in charge.

Water Supply Systems

2.19. Scope of work

Without restricting to the generality, the water supply system shall include the following: -

i. Rising main from water supply pumps to all overhead tanks.

ii. Distribution system from overhead tank to all fixtures and appliances for cold & hot water.

iii. Insulation to hot water pipes within toilets.

iv. Connections to all plumbing fixtures, and appliances.

2.20. General requirements

a. All materials shall be new of the best quality confirming to specifications. All works executed shall be to the satisfaction of the PMC/Engineer in charge.

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

c. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

d. As far as possible all bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 25 mm dia. Bends and elbows may be used for pipe dia. greater than 32 mm.

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

f. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the PMC/Engineer in charge.

g. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

2.21. Water Supply System

a. Contractor should study the site plan and water supply system diagram for overviews of the system.

b. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Indicative list of item.

c. Without restricting to the generality of the foregoing, the water supply system shall include the following: -

(i) Internal and External water supply system and making connection from external sources for all buildings etc.

(ii) Drinking water supply system

(iii) Pipe protection and painting.

(iv) Control valves, masonry chambers and other appurtenances.

(v) Connections to all toilets, storage tanks and appliances.

(vi) Excavation and refilling of pipe trenches, wherever required.

(vii) Trenches for taking pipe lines for these services.

d. Source

i. Water supply will be acquired from New Bore wells.

ii. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tanks.

e. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

2.22. General Requirements

(a) All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the SBI/PMC in charge / Owner.

(b) Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

(c) Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

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

(e) Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

(f) Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

2.23. Pipes & Fittings

In the water supply system Galvanized Iron Pipes/ CPVC Pipes/ SS Pipes / UPVC Pipes / Ductile Iron Pipes shall be provided as per approved designs.

i. CPVC pipes shall be used in the internal concealed water supply if specified in the contract. The CPVC pipes shall be confirming to I.S. 15778-2007and/or ASTMF- 441 Schedule 40 of Class specified and having thermal stability for hot & cold-water supply and shall be heavy class. These may require to be connected to the existing/ new GI pipes. The pipe and fitting approved make solvent shall be used as per approved manufacture specification.

ii. UPVC Pipes shall be used in the external water supply, weather concealed or exposed as per approved design. These shall confirm to I.S. 1239 of Class specified and shall be heavy class. These may require to be connected to the existing/ new UPVC/ DI Pipes. The pipe and fitting approved make, solvent etc., as required shall be used as per approved manufacture specification.

2.23.1. Galvanized Iron Pipes

(i) Pipe and fittings shall be joined with screwed joints; after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

(ii) Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply. (Use of red and white lead sutli will not be permitted for screwed joints)

(iii) Fittings shall be malleable iron galvanized of approved make. Each fitting shall have manufacturer’s trade mark stamped on it. Fittings for CPVC pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall confirm to I.S. 1879-(Section I to X).

(iv) All pipes shall be fixed in accordance with approved layout and alignment. Care shall be taken to avoid air pockets. G.I. pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as per approved drawings.

2.23.2. Ductile Iron Pipes

(i) Pipe and fittings shall be joined with spigot and socket joints or flanged joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

(ii) Fittings shall be ductile iron of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for CPVC pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall confirm to I.S. 8329.

(iii) All pipes shall be fixed in accordance with approved layout and alignment. Care shall be taken to avoid air pockets. Pipes may be run as per approved drawings.

2.23.3. Chlorinated Polyvinyl Chloride (CPVC) pipes and fittings

(i) CPVC pipes of specified dia. nominal bore shall confirm to I.S. 15778 – 2007 and ASTMF-441 Schedule 40. The pipe fittings, clamps, etc. required for specified dia. bore pipes shall be of best quality and make as approved by the SBI/PMC in charge Chlorinated Polyvinyl Chloride (CPVC) pipes shall be as per ASTMF-441 Schedule 40 and having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.

a) 15mm

b) 20mm

c) 25mm

d) 32mm

e) 40mm

f) 50mm

g) 65 mm;

(ii) Workmanship: - Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint. Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket. Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket. After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up. An even bead of cement should be evident around the joint and if this bead is not continuing remake the joint to avoid potential leaks.

When making a transition connection to metal threads, special Brass / plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torqued Hard tight puts one half turn should be adequate.

(iii) Pipe and fittings shall be joined with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.

(iv) Fittings shall be CPVC of approved make. Each fitting shall have manufacturer’s trade mark stamped on it. Fittings for CPVC pipe shall include couplings, bends tees, reducers, nipples, union and bushes and shall be of best make as approved by the PMC/Engineer in charge.

(v) Only CPVC solvent cement confirming to ASTMF 493 should be used for joining pipe with fittings and valves. The cement solvent should be used within 30 days after opening the company’s seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used.

(vi) For Horizontal runs, support should be given at 3 foot (90 cm) intervals for diameters of one inch and below and at 4 foot (m) intervals for larger sizes. Hangers should not have rough or sharp edges which come in contact with the tubing.

(vii) All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. CPVC pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

2.23.4. PVC (Sch40) Pipes & Fittings for water distribution Network

(i) The rigid PVC (Polyvinyl Chloride) compound used in the manufacture of pipes and fittings is Type 1, i.e. Grade 1 PVC 1120 as identified in ASTM D 1784. The compound contains specified amounts of pigment, stabilizers and other additives to facilitate extrusion.

(ii) The system is made as per ASTM (American Society for Testing of Materials) standards. The Pipes are made as per ASTM D 1785 and Fittings are made as per ASTM D 2466 (for SCH 40 Fittings). The pipes are plain ended in lengths of 3 meters in SCH 40 pressure classes.

(iii) PRESSURE RATING – PVC SCHEDULE 40

Norm Size (mm)	Max. Work Pre. at 23°C (kg/cm2)
15	42.19
20	33.75
25	31.64
32	26.01
40	23.20
50	19.69
65	21.09
80	18.28
100	15.47
150	12.66

(iv) Cut pipe square. As joints are sealed at the base of the fitting socket. An angled cut result in joint failure. Acceptable tools include miter saw, mechanical cut off saw or wheel cutter. Wheel type cutters must employ a blade designed for plastics.

(v) Remove all burrs from inside and outside of pipe with a knife-edge, file, or deburring tool. Chamfer(bevel) the end of the pipe 10° - 15°.

(vi) Remove surface dirt, grease, or moisture with a clean dry cloth.

(vii) With light pressure, pipe should go one third to one half of the way into the fitting socket. Pipes and fittings that are too tight or too loose should not be used.

(viii) Use an applicator that is one half the pipe diameter. Too large an applicator will force excessive cement into the inside of small diameter fittings. Too small an applicator will not apply sufficient cement to large diameter systems.

(ix) Apply a full even layer of cement to the outside of a pipe and medium layer of cement to the inside of a fitting.

(x) Assemble pipe and fitting socket till it contacts socket bottom. Give pipe a quarter turn. Hold pipe and fitting together until the pipe does not back out. Remove excessive cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter.

(xi) Pressure Testing

a. Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.

b. The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction, change in size and at dead ends.

c. Refer tables given for initial set & cure times before pressure testing.

d. The piping system should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 1 foot per second.

e. All trapped air must be slowly released. Vents must be provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is extremely dangerous and it must be slowly and completely vented prior to testing.

f. The piping system can be pressurized to 125% of its designed working pressure. However, care must be taken to ensure the pressure does not exceed the working pressure of the lowest rated component in the system (valves, unions, flanges, threaded parts etc.)

g. The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure.

2.23.5. <u>Clamps</u>

(i) G.I/CPVC/SS pipes / D.I. Pipes in the shaft and other locations shall be supported by clamps of design approved by PMC/Engineer in charge. Pipes in wall chases shall be anchored by hooks. Pipes at ceiling level shall be supported on structural clamps.

(ii) Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the PMC/Engineer in charge

2.23.6. Unions

Contractor shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop clock, or check valve and go on straight runs as necessary at appropriate locations as required and /or direct by PMC/Engineer in charge.

2.23.7. Flanges

(i) Flanged connections shall be provided on pipes 65 mm and above as required or where shown on the drawings generally as follows:

a. On straight runs not exceeding 30 m, near bends and at connections to main branch lines.

b. On all valves ends

c. On equipment /pump connections as necessary and required or as directed by Engineer – in - charge.

(ii) Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall confirm to match the specification for C.I. sluice valve to I.S. 780 and C.I. butterfly valve to IS: 13095.

2.23.8. Trenches

(i) All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows: -

Dia. of pipe	Width of trench	Depth of trench
15 mm to 50 mm	30 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

(ii) Sand filling

All D.I. / G.I. pipes in trenches shall be protected with fine sand 15 cm all around before filling in the trenches.

2.23.9. Painting

All pipes above ground shall be painted with one coat Zinc with each coating and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by PMC/Engineer in charge.

2.23.10. Pipe protection

(i) All G.I. pipes in chase or below floor shall be protected against corrosion by the application of two coats of bitumen paint covered with bitumen tape and a final coat of bitumen paint before covering up the pipe.

(ii) All D.I. / G.I. / CPVC water supply pipes below ground shall be protected against corrosion by applying one layer of 4 mm thick multilayer anticorrosive polymeric mix tape applied over a coat of primer as per recommendations of the manufacturers. (Pypkote)

2.23.11. Insulation

Hot water pipes within a toilet /kitchen, shaft and terrace from hot water header shall be insulated with **nitrle rubber insulation on hot water supply o**f required size as per specifications.

(i) Materials**: .**

Insulation material for Pipe insulation shall be Closed Cell Elastomeric Nitrile Rubber or closed cell cross linked polyethylene foam. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.038 W/moK or 0.0313 Kcal / Mhr oC or 0.212 BTU / (Hr-ft2-oF/inch) at an average temperature of 30oC. The product shall have temperature range of –40 oC to 105oC. Density of material shall not be less than 0.06 gm/cm3. The insulation shall have fire performance such that it passes minimum CLASS 1 as per BS476 part 7 for surface spread of flame. Water vapour permeability shall not exceed 0.024 per m inch (3 x 10-14 Kgs / m.sec.Pa).

(ii) Workmanship**:**

Insulating material in tube form shall be sleeved on the pipes. On existing piping, slit opened tube from insulating material shall be placed over the pipe and adhesive (as recommended by the manufacturer) shall be applied as suggested by the manufacturer. Adhesive must be allowed to tack dry and then press surface firmly together starting from butt end and working towards center.

All insulation work shall be carried out by skilled workmen specially trained in this kind of work. All insulated pipes shall be labelled (HWS / HWR / HWRR) and provided with 300 mm wide band of paint along circumference at every 1200 mm for colour coding. Direction of fluid shall also be marked. All painting shall be as per relevant BIS codes.

2.24. **Valves**

i. Ball valves

Providing and fixing ball valve (Gunmetal) of approved quality, High or low pressure, with plastic floats as per drawings/CPWD specifications and directions of Engineer-in-charge.

Valves below 50 mm dia. shall be screwed type ball valves with stainless steel balls spindle Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying couplings and steel handles to B.S. 5351**.**

ii. Butterfly Valve

(i) The Butterfly valve shall be of best quality as per CPWD specification with hand lever operation. Operating pressure not less than 16 Kg/Sq.cm (PN 16). The Butterfly valve shall confirm to IS:13095.

(ii) Valves 50 mm dia. and above shall be cast iron butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both directions. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick. P.N
1.6. Butterfly valve shall be of best quality confirming to IS: 13095.

(iii) The butterfly valve shall be installed with rubber gasket, flanges, nuts, bolts, washers & painting complete as required as approved by the SBI/PMC in charge and as per CPWD specifications. The Butterfly Valve shall be complete with bolts, nuts, washers and neoprene gaskets as per manufacturers specifications.

iii. Non return valve (swing check type) shall be provided through which flow can occur in one direction only, It shall be single door swing check type of best quality confirming to IS: 5312.P. N1.6

iv. Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and double washers of correct length.

v. Sluice valve shall be of approved makes confirming to I.S.:780 of class as specified.

2.25. **Storage Tanks**

2.25.1. Overhead Tanks

Overhead water storage tanks for water supply shall be reinforced cement concrete/PVC, as per design approved by the PMC/Engineer in charge.

2.25.2. Tank connection and accessories

(i) Contractor shall provide the following to each tanks:

a. Inlet and outlet connections to pumps, equipment and main pipe lines.

b. Tank overflows with mosquito proof gratings

c. Scour drain and valve as per drawings

d. Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.

(ii) Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing Contractor shall provide necessary G.I. sleeves and co-operate with the Contractor to ensure that the work is successfully executed.

2.26. **Testing**

a. All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg /cm^2 whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop & withstand for 8 hrs.

b. A test register shall be maintained and all entries shall be counter-signed by Contractor(s) in the presence of PMC/Engineer in charge.

c. In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

d. After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

2.27. **P.P. soil, waste water and ventilating pipes & Fittings: -**

2.27.1. **Pipes**

(i) The specified size of P.P. soil or waste pipe shall confirm EN 12056. The soil, waste water and ventilating pipes shall be of the following Normal size (A) 110mm. dia. (B) 160 mm. dia., unless otherwise required as per design.

(ii) Workmanship:

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively, plastic clamps of suitable designs shall be preferred. Jointing for P.P. pipes shall be made by means of 'O' rubber ring.

All soil pipes shall be carried up above the roof and shall have a wire balloon guard or a cowl.

The ventilating pipe or shaft shall be carried out to a height of at least one meter above the outer covering of the roof of the building.

The P.P. pipes shall be fixed with M. S. clamps and stays. The clamp shall be made from 1.5 mm. thick M. S. flat or 3 mm. width band to the required shape and size to fit tightly on the sockets when tightened with screw blots. It shall be formed of two semicircular pieces with flanged ends on both sides; with holes to fit in the screw bolts and nut 40 mm. dia. M. S. Bars. One end of the stay shall be bent to from a hook to be fixed with clamps by means of bolts and the other end shall be bent for embedding in wall in cement concrete block of size 200 mm. x 100 mm. x 100 mm. in 1:2:4 mix. The concrete shall be finished to match the surrounding surfaces.

The connection between the main pipe and branch pipes shall be made by using branches and bends with access doors for cleaning.

The waste from lavatories, kitchens basins, sinks, baths and other floor traps shall be separately connected to respective stacks of upper floors. The waste stack of lavatories shall be connected directly to main hole while the waste slack of other shall be separately discharged over gully trap.

2.27.2. P.P. P trap:

(i) The P.P. P trap shall confirm to EN 12056. The SS hinged grating shall be of best quality. P.P. P trap shall be of the 110 mm nominal diameter or as per design of self-cleaning design with hinged grating including cost of cutting and making good the walls and floors.

(ii) Workmanship:

The P Trap with 110 mm. dia. inlet and 110 mm. dia. outlet shall be fixed as per drawing or as directed. The P trap shall be jointed with P.P. pipe, 110 mm. dia. with solvent cement joints.

2.27.3. PP Floor Drain: -

(i) The PP Fittings shall confirm to EN: 12056. The PP Floor Drain shall be of the of 110 x 50 mm size or as per design including cost of cutting and making good the floors.

(ii) Workmanship: - The Floor drain shall be made out of PP elbow of 110mm x 110 mm and 110 mm x 50 mm reducer size with setting in 1:2:4 mix cement concrete block or clamping to the wall or suspending with the ceiling including cutting and making good the walls and floors wherever required. The Floor drain shall be jointed with pipe with solvent cement joints.

2.27.4. PP soil, waste water and ventilating pipes: -

The specified size of PP soil or waste pipe shall confirm EN: 12056. The PP soil, waste water and ventilating pipes shall be of the following normal size (A) 40 mm. dia. (B) 50 mm. dia.(C) 63 mm. dia.

(i) Workmanship:

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively, plastic clamps of suitable designs shall be preferred. Jointing for PP pipes shall be made by means of ‘O’ rubber ring.

The waste from lavatories, kitchens basins, sinks, baths and other floor traps shall be separately connected to respective stacks of upper floors. The waste stack of lavatories shall be connected directly to main hole while the waste slack of other shall be separately discharged over gully trap.

2.27.5. PP Clean out Plug: -

(i) The PP Fittings shall confirm to EN:12056. The PP Clean out Plug shall be of nominal size (A) 110 mm. dia.(B) 160 mm. dia.

(ii) Workmanship: - The Clean Out plug shall be made out of PP coupler with access door of suitable size. The Clean out Plug shall be jointed with pipe with ‘O’ rubber ring.

2.28. CP Materials: -

2.28.1. CP Brass Angle Valve: -

(i) The C. P. brass Angle Valve shall be 15/20mm dia. of best quality as approved by the SBI/PMC in charge. The Angle Valve shall confirm to I.S. 8931-1993. The CP brass Angle Valve shall be with PVC flexible connections 1.5m long or as per requirement of standard design and of approved make.

(ii) Workmanship: - The C.P. brass Angle Valve shall be fixed as directed to 15/20 mm. dia. CPVC. at one end and PVC flexible connection with brass check nut on the other end.

2.28.2. CP Brass wall mixer: -

(i) The Wall Mixer shall confirm to I.S. 8931-1993. The CP Brass wall mixer shall be with provision of overhead shower with 115mm long bend pipes on upper side with connecting legs and wall flanges with all accessories as required and making good the walls wherever required. The C. P. brass Wall Mixer shall be 15mm dia. of best quality as approved by the SBI/PMC in charge.

(ii) Workmanship: - The C.P. brass wall Mixer shall be fixed as directed to 15 mm. dia. CPVC. at the inlet.

2.28.3. C. P. brass towel rail: -

(i) The C. P. brass towel rail, 600mm long and 20 mm dia, shall be of best quality as approved by the SBI/PMC in chargeThe brackets shall be of C. P. brass. The rail shall confirm to I.S. 1068-1958. The C. P. brass towel rail complete with C.
P. brass brackets shall be fixed to wooden plugs and C. P. brass screws.

(ii) Workmanship: The brackets of the towel rail shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand). The towel rail shall be fixed as and where directed.

2.28.4. CP Brass Soap Dish: -

(i) The C. P. brass Soap Dish shall be of best quality as approved by the

SBI/PMC in charge. The CP Brass Soap Dish complete with C. P. brass brackets shall be fixed to wooden plugs with and C. P. brass screws.

(ii) Workmanship: - The C.P. brass Soap Dish shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand). The towel rail shall be fixed as and where directed.

2.28.5. CP Brass Liquid Soap Dispenser: -

(i) Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to body with concealed locking arrangement, opened only be key provided. Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with 1 litre capacity polyethylene container. The valve shall operate with less than 2.27 Kg (5 lbs) of force. CP Brass Liquid Soap Dispenser complete with C. P. brass brackets shall be fixed to wooden plugs with and C. P. brass screws.

(ii) Workmanship: - The C.P. brass Liquid Soap Dispenser shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand).

2.28.6. 32 mm dia. C.P. brass waste coupling for sink

(i) The 32 mm dia. C.P. brass waste trap and unions shall be of best quality and make as approved by the PMC/Engineer in charge.

(ii) Workmanship: - C. P. brass waste trap and union shall be connected to 32 mm. dia. waste pipe which shall be suitably bent towards the wall and which shall discharge into drain through a floor trap. The C. P. brass waste trap shall be provided for wash basin or sink as the case may be.

2.28.7. CP Brass Sink mixer

(i) The C. P. brass Sink Mixer shall be 15mm dia. of best quality as approved by the SBI/PMC in charge The CP Brass Sink mixer shall be with casted swinging spout with all accessories as required and making good the walls wherever required.

(ii) Workmanship: - The C.P. brass sink mixer shall be fixed as directed to 15 mm. dia. CPVC. Pipe at one end.

2.28.8. Fully automatic "NO TOUCH" durable & shock proof hand drier: -

(i) The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position. The hand drier shall be fully hygienic, rated for continuous repeat use (CRU). The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds. The hand drier shall be of wall mounting type suitable for 230 V, single phase, 50 Hz, AC power supply. It shall be fully automatic "NO TOUCH" durable & shock proof hand drier of approved make & manufacture suitable to operate on
220 volts, single phase 50 hz, A.C. power supply, 1500 Watt and directly plugged to power point complete in ABS plastic body having drying time 20-30 seconds complete as per direction of Engineer in Charge.

(ii) Workmanship: - The Hand Drier shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand). The towel rail shall be fixed as and where directed.

2.28.9. Health faucet with regulator

(i) The Health Faucet shall be 15mm dia. of best quality as approved by the

PMC/Engineer in charge. The Health faucet shall be with regulator with flexible pipe 1 m long, wall hooked complete as required.

(ii) Workmanship: - The Health Faucet shall be fixed as directed to 15 mm. dia. CPVC. Pipe at one end, as and where directed.

2.28.10. Hand rail and grab bar

(i) The C. P. brass hand rail shall be 600 x 20 mm. of best quality as approved by the SBI/PMC in chargeThe brackets shall be of C. P. brass. The rail shall confirm to I.S. 1068-1958. hand rail size 600X100mm and grab bar 350mm long to mounted on the track (vertically and laterally) for handicap toilet complete as required.

(ii) Workmanship: The brackets of the hand rail shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand), as and where directed.

2.28.11. CP Brass Robe Hook

(i) The C. P. brass Robe Hook shall be of best quality as approved by the SBI/PMC in-charge. The CP Brass Robe Hook shall be complete with C.P brass brackets fixed to wooden plugs with and C. P. brass screws.

(ii) Workmanship: - The C.P. brass Robe Hook shall be fixed by means of C.P. brass to screws wooden plugs finely embedded in the wall with C.M. 1: 3 (1 cement: 3 coarse sand), as and where directed.

2.29. Other Materials

2.29.1. S.S. hinged grating

(i) The 100 mm. dia. SS hinged gratings for Floor trap shall be of best quality and make as approved. The frame of the grating shall be minimum 6mm thick. The S.S. hinged grating, 6mm thick with frame shall be of approved make including setting in floor with cement mortar 1:3. Mix.

(ii) Workmanship: The SS grating shall be provided to P trap as the case may be in best workman like manner.

2.29.2. Nitrle rubber insulation on hot water supply

(i) Insulation material for Pipe insulation shall be Closed Cell Elastomeric Nitrile Rubber or closed cell cross linked polyethylene foam. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.038 W/moK or 0.0313 Kcal / Mhr oC or 0.212 BTU / (Hr-ft2-oF/inch) at an average temperature of 30oC. The product shall have temperature range of –40 oC to 105oC. Density of material shall not be less than 0.06 gm/cm3. The insulation shall have fire performance such that it passes minimum CLASS 1 as per BS476 part 7 for surface spread of flame. Water vapour permeability shall not exceed 0.024 per inch (3 x 10-14 Kgs / m.sec.Pa). The nitrle rubber insulation shall be on hot water supply of the following size as per specifications. (A) 15 mm; (B) 20 MM; (C) 25 mm; (D) 32 mm; (E) 40 mm; (F) 50 mm; (G) 65 mm; (H) 80 mm.

(ii) Workmanship:

Insulating material in tube form shall be sleeved on the pipes. On existing piping, slit opened tube from insulating material shall be placed over the pipe and adhesive (as recommended by the manufacturer) shall be applied as suggested by the manufacturer. Adhesive must be allowed to tack dry and then press surface firmly together starting from butt end and working towards centre.

All insulation work shall be carried out by skilled workmen specially trained in this kind of work. All insulated pipes shall be labelled (HWS / HWR /

HWRR) and provided with 300 mm wide band of paint along circumference at every 1200 mm for colour coding. Direction of fluid shall also be marked. All painting shall be as per relevant BIS codes.

2.29.3. MS pipe puddle flanges

Providing and fixing for water tanks MS pipe puddle flanges of required size with 6mm thick MS plate of required size properly fixed in RCC walls of water tanks, including necessary welding of pipe with MS plate & reinforcement as per drawings and directions of Engineer-in-charge.

2.29.4. UPVC Rain Water pipes

(i) The specified size of uPVC Spigot and socket soil or waste pipe shall confirm IS 4985 – 2000 the UPVC Rain Water pipes shall be of the following normal size

(A) 160 mm. dia.

(B) 200 mm. dia.

(ii) Workmanship:

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively, plastic clamps of suitable designs shall be preferred. Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line.

The waste from lavatories, kitchens basins, sinks, baths and other floor traps shall be separately connected to respective stacks of upper floors. The waste stack of lavatories shall be connected directly to main hole while the waste slack of other shall be separately discharged over gully trap.

2.29.5. Cast Iron grating

(i) The 225 x 225 mm. Cast Iron gratings for Floor trap shall be of best quality and make as approved. The Cast Iron grating, with frame shall be of an approved make including setting in floor with cement mortar 1:3.

(ii) Workmanship: The grating shall be provided to Rain Water Pipes as the case may be in best workman like manner.

2.29.6. MS grating

(i) MS grating consisting of ISI marked MS frame made of angle size 25mm x 25mm x 4mm thick. The removable cover shall be made out of ISI marked MS angle size 25mm x 25mm x 4mm thick having vertically welded transverse members made out of MS flats of size 25mm x 5mm thick at a spacing of 25mm centre to centre. The MS grating, with frame shall be of an approved make including setting in floor with cement mortar 1:3.

(ii) The grating to be fixed on brick / concrete with 2 nos hold fasts of size 100mm x 25mm x 4mm thick to be embedded with cement concrete block of size 150mm x 100mm x 100mm of mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) on each face of wall including painting with two coats of synthetic enamel paint over a coat of primer complete as per direction of engineer - in - charge.

2.29.7. Reinforced Concrete Light Duty Non-Pressure Pipes

(i) The reinforced concrete light duly non -pressure pipes of specified diameter shall confirm to I.S. 458-1971. The laying to level or slopes and jointing reinforced concrete light duty non-pressure pipes I.S. class N.P. 2 of the 200mm internal diameters shall be with collars and butt-ends prepared for collar joints incl. testing of joints etc. complete

(ii) Laying:

The pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Where necessary pipe shall be laid in straight lines or with easy curves and true to line and gradient as specified. The laying of pipe shall proceed upgrade of a slope. In the pipe with loose collars, the collars shall be slipped on before the next pipe is laid.

In case where the foundation conditions are unusual such as the proximity of trees or holes, under existing or proposed around in 150 mm. thick cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm. nominal size) or compacted sand or gravel.

In case where the natural foundation is inadequate the pipe shall be laid either in concrete cradle, supported on proper foundation or on any other suitably designed structure. If concrete bedding is used, the depth of concrete below bottom of the pipe shall be at least ¼th of the internal diameter of the pipe subject to a minimum of 100 mm. and maximum 300 mm. The concrete shall be extended upto the sides of the pipe at least a distance of ¼ th of the outside diameter for pipes 300 mm. and over in diameter.

The pipes shall be laid in the concrete bedding before the concrete has set. Pipe laid in trenched in earth shall be bedded evenly and firmly and as far as upto the haunches of the pipe as to safely transmit the load expected from the back fill through the pipe to the bed. This shall be done cither bye excavating the bottom of the trenches to fit the curve of the pipe or by compacting the earth under round curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(iii) Jointing:

The joints shall be done by slipping the collar over and clear of the end of the pipe. The recess of the end of the pipe shall be filled with jute threading dipped in hot bitumen. The new pipe shall then be brought forwarded until the bitumen ring in recess of first pipe is set into the recess of the second pipe. This process shall be repeated for two or three pipes which shall then be jacked up so as to thoroughly compress the bitumen. The quantity of jute and bitumen shall be just enough to fill the recess when pressed hard by jacking, care being taken that no offset of the jute braiding shall be visible either outside or inside of pipe. The collar shall then be set up over the joints covering equally both the pipe and leaving an even caulking space all round Cement and sand mortar 1: 1½ shall then be well punched or pressed home with a caulking tool within this caulking space. Care shall be taken that the underside of the joints is properly filled with mortar.

(iv) Curing:

Every joint shall be kept wet for about 10 days for maturing, the section of the pipe line laid and jointed shall be covered immediately to protect from weather effects. Minimum bore of 100 mm. is considered adequate. 2 A2. The joints shall be left exposed for observation.

(v) Testing of joints: The testing of joints shall be done as per relevant specifications.

2.29.8. 455x610 mm rectangular C.I. cover with (Heavy duty)

(i) The cover for the OHT shall be 455x610 mm rectangular C.I. cover with frame (Heavy duty), with weight not less than 15 Kg for frame and 23 Kg for cover confirming to IS:1726 -1991.

(ii) Workmanship: The CI Cover shall be securely placed on the top of the overhead tank as the case may be in best workman like manner.

2.29.9. Grease Trap

(i) The grease trap shall be constructed in brick masonry chamber with three chambers, each of 0.4 M X 0.6 M in plan including constructing baffle wall, stainless steel angles on corners, stainless steel perforated plates with stainless steel lifting handles in each chamber, inlet and outlet fittings, double seal C.I. covers complete as per standard design. The brick masonry water tight grease trap shall be with inside size 2.0m x 1.5m and 1.0m deep including two nos. 60x60 cm. C.I. Cover and frame (double seal weight of cover and frame not less than 75 kg).

(ii) Workmanship:

a. Bed Concrete shall be in 1:4:8 cement concrete 150 mm thick.

b. Brick work shall be with best quality bricks in 1:5 cement mortar. Baffle walls shall be of R.C.C and of size as mentioned in DBR/Drawings. Brick partition constructed of best quality table moulded bricks in cement mortar 1:5 shall be provided for the entire height of chamber. The walls of chamber shall be plastered from inside with 12 mm thick cement plaster 1:3 and finished smooth with a floating coat of neat cement & rough plaster on outside in cement mortar 1:3.

c. Chamber Covers shall be of size and duty as mentioned in DBR/Drawings. Covers shall be of cast iron as per the details given in the drawing and shall be fixed on frame embedded in concrete. C. I steps shall be provided at two corners of the chamber. All Cast Iron and MS items shall be painted with two coats of bitumastic paint.

d. Cast iron Manhole covers and Frame shall confirm to IS: 1726 and the grade and types have been specified in the DBR/Drawings. The cover and frames shall be cleanly cast and they shall be free from air and sand holes and from cold shuts. They shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage, gas inclusion or other causes. Covers shall have a raised chequered design on the top surface to provide an adequate non-slip grip. The sizes of covers specified shall be taken as the clear internal dimensions of the frame. The covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63° C and shall not brittle as to chip off at a temperature of 0° C

2.30. Indicative List of Items

2.30.1. Sanitary Works

(i) Providing & fixing white vitreous china wall hung type European type water closet with C.P. bolts, nuts, C.I. chair or other hanging arrangement, with white solid plastic seat and cover with lid, dual flush PVC expose cistern (4/2 lpf) with Cistern fittings, C.P. brass hinge rubber buffers, with accessories,C.I/M.S. brackets painted with two coats of enamel paint of approved shade over a coat of primer. C.P. brass screws, wooden cleats including cutting and making good the wall and floors wherever required etc. complete in all respect as per direction of Engineers-in-charge.

(ii) Providing and Fixing vitreous china floor mounted (European Type) water closet with 'P" or "S" trap, C.P. bolts, nuts with solid plastic seat & lid, C.P brass hinged rubber buffers with (dual flush 4/2 lpf) cistern with flush pipe, clamp and rubber adapter joint C.P.brass screws and washers complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(iii) Providing and fixing water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast Iron P or S trap, dual flush (4/2 lpf) white P.V.C. flushing cistern of 6 ltr, including flush pipe, with manually controlled device (handle lever) conforming to IS: 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge. White Vitreous china Orissa pattern W.C. pan of size 580x440 mm with integral type foot rests.

(iv) Providing and Fixing White vitreous china Under counter wash basin with C.I. brackets painted white, 15 mm CP Brass auto closing pillar cock of flow less than 3 lpm, 32mm dia. C.P. waste, C.P chain and rubber plug, C.P. connecting pipe to wall and C.P wall flange and rubber adapter for waste connection complete including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(v) Providing and Fixing vitreous china urinal with electrical/battery operated concealed automatic flushing system flow less than 3.0 lpf CP Brass body with C.I. hangers, 15mm dia inlet to built in spreaders with inbuilt waste with C.P flange for urinal complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(vi) Providing and Fixing vitreous china water less urinal with C.I. hangers, 15mm dia inlet to built in spreaders with inbuilt waste with C.P flange, complete including cutting and making good the walls and floors wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(vii) Providing and fixing stone slab with table rubbed, edges rounded and polished, of size 75x50 cm deep and 1.8 cm thick, fixed in urinal partitions by cutting a chase of appropriate width with chase cutter and embedding the stone in the chase with epoxy grout or with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 6 mm nominal size) as per direction of Engineer-in-charge and finished smooth. Granite Stone of approved shade.

(viii) Providing and fixing sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P. brass waste complete, including painting the fittings and brackets, cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(i) White glazed fire clay sink of size 600x450x 250mm

(ix) Providing and Fixing of wall mounted C.P. brass Sink mixer flow less than 6.0 lpm including cutting and making good the walls wherever required complete in all respects as per direction of the Engineer-in-charge

(x) Providing and fixing white vitreous China laboratory sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P brass waste and 40mm C.P. brass trap with necessary C.P. brass unions complete, including painting of fittings and brackets, cutting and making good the wall wherever required etc. complete in all respect as per direction of Engineering-in-charge. Size 600x450x200 mm

(xi) Providing & fixing CP brass elbow action bib cock for lab sink flow less than 6.0 lpm including cutting & making good the walls wherever required complete in all respects as per Engineering-charge.

(xii) Providing and Fixing 15 mm nominal bore CP Brass long body bib cock flow less than 6.0 lpm of approved quality conforming to IS Standards etc. complete in all respect as per direction of Engineering-in-charge.

(xiii) Providing and Fixing C.P. brass towel ring "Round" fixed to PVC cleats with C.P. brass screws including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(xiv) Providing and fixing SS liquid soap dispenser with push lever assembly with soap refill fixed in wall with Screws complete in all respect as per direction of the engineer-in-charge.

(xv) Providing and fixing S.S. body tissue paper dispenser complete including cutting and making good the walls wherever required etc. complete in all respect as per direction of SBI/PMC in charge

(xvi) Providing and fixing CP Brass Bottle Trap of approved quality & make etc. complete in all respect as per direction of Engineering-in-charge.

a) 32 mm dia b) 40 mm dia

(xvii) Providing and fixing C.P. brass angle valve of approved quality conforming to IS:8931 etc. complete in all respect as per direction of Engineering-in-charge. 15mm nominal bore.

(xviii) Providing and Fixing C.P. Brass Toilet paper holder, including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(xix) Providing and fixing Health faucet with 1-metre-long Flexible Tube and CP wall hook with PVC & SS Screws flow less than 6 lpm wherever required complete as directed by the Engineer-in-charge.

(xx) Providing and Fixing two-way bib cock flow less than 6.0 lpm complete, including cutting and making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(xxi) Providing and Fixing Handicapped set including white vitreous china floor mounted European type water closet including dual flush exposed cistern (4/2 lpf) , Flat Back wash basin with one pair of mounting brackets , complete with fittings, seat cover, two no hinged rail 76 cms and five nos of grab bar 60 cms including 15 mm dia autoclosing pillar cock flow less than 3.0 lpm for Handicapped Toilet complete in all respest as per direction of the engineer-in-charge.

(xxii) Providing and fixing C.P cast brass Double coat hook as approved with C.P. brass screws complete as per instructions of the engineer-in-charge.

(xxiii) Providing and Fixing C.P brass Aerosol perfume dispenser, fixed to wooden cleats / Rawl Plug with C.P brass screws, complete wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(xxiv) Providing & fixing CP emergency shower with pull chain connected to water supply pipes including cutting & making good the walls complete in all respects required as per Engineer in-charge.

(xxv) Providing & Fixing CP self-closing eye wash fountain with CP waste, CP chain & rubber plug, CP cast brass bottle trap & CP connecting pipe to wall and CP wall flange & rubber adopter for waste connection complete in all respects including cutting & making good the walls wherever required etc. complete in all respect as per direction of Engineering-in-charge.

(xxvi) Providing and Fixing straight / offset type flexible single body push fit type WC pan connector with factory supplied seal guard with integral Single mould sealing fins made of flexible EVA body, including bush / adaptor for use with C.I. Pipe as supplied with the pan connector etc. complete in all respect as per direction of Engineering-in-charge.

(xxvii) Providing and fixing Stainless Steel Body Auto hand drier to be operated with 220 volts, single phase, with fully hygienic condition, with all accessories including cutting and making good the walls, wherever required etc. complete in all respect as per direction of SBI/PMC in charge.

(xxviii) Providing and Fixing in position storage type Hot Water electrical vertical heaters with copper container, insulation, and stove enameled M.S. jacket, thermostatically controlled immersion heater, with pilot lamp, 15/20mm dia inlet with non-return valve and 15/20mm dia outlet including making connections complete in all respects. (wall mounted with suitable M.S. bolts and nuts)

a) 25 Ltr.

2.30.2. Soil, Waste and Vent Pipes

a. Providing and fixing soil, waste and vent pipes:

100 mm dia Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905.

b. Providing and Fixing M.S. Holder bat clamp (factory manufactured) of approved design to sand cast iron / cast iron (spun) pipes comprising of M.S. flat brackets made of 50x5 mm flat of specified shape, projecting 75 mm outside the wall surface and fixed on wall with 4 Nos, 6 mm diameter expansion hold fasteners including drilling necessary holes in brick wall /CC/RCC surface and the cost of bolts etc.. The pipes shall be fixed to the already fixed brackets with the help of 30 mmx1.60 mm galvanized M.S. flats of specified shape and total length 420 mm and shall be fixed with M.S. nuts, bolts and washers of size 25x6 mm, one bolt on each side of the pipe.

(i) Total bracket length 580 mm of approved shape and design, (for single 100 mm dia pipe)

(ii) Total bracket length 810 mm of approved shape and design, (for single 100 mm dia pipe)

c. Providing and fixing bend of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.

(i) 100 mm dia Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905

d. Providing and fixing plain bend of required degree.

(i) 100 mm dia Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905

e. Providing and fixing single equal plain junction of required degree:

100x100x100 mm Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905.

f. Providing and fixing double equal plain junction of required degree. 100x100x100x100 mm Hubless centrifugally cast (spun) iron pipes epoxy coated inside & outside IS:15905.

g. Providing and fixing door piece, insertion rubber washer 3mm thick, bolts & nuts complete: 100 mm Sand cast iron S&S as per IS – 3989

h. Providing and Fixing 100 mm dia Terminal guard for Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905 100 mm Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905

i. Providing and fixing shielded coupling for Hubless centrifugally cast iron pipe 100 mm dia SS 316 grade coupling with EPDM rubber gasket.

j. Providing and fixing M.S. stays and clamps for sand cast iron hubless pipes of diameter: 100mm

k. Providing and fixing trap of self-cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors :

100 mm inlet and 100 mm outlet

Hubless centrifugally cast (spun) iron epoxy coated inside & outside as per IS:15905

l. Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.

m. Providing and Fixing G.I. Reducing elbow (Floor drain) of 100 x 50 mm in cement concrete 1:2:4 at all levels for floor drains for connection to floor traps in sunken portions, complete as per drawings and as per approval of the engineer-in-charge. 8.2.14 Providing, fixing, testing & Commissioning of PP materials filled low noise level soil, waste and vent pipe with density 1.9 g/cm3 conforming to DIN EN 12056 along with all required fittings like tees, bends, cowls, crosses with or without access doors jointed with approved push fit rubber ring socket joint / solvent cement fixed to walls and ceilings, cutting holes in brickwall wherever required, filling the annular space between pipe & wall/slab/beam with hand mixed concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and making good the floors, beams and walls with cement mortar where required complete of outer diameter.**(For LABS)**

a) 50 MM OD

b) 75 MM OD

c) 110 mm OD

n. Providing and fixing on wall face un plasticized Rigid PVC rain water pipes conforming to IS: 13592 Type A including jointing with seal ring conforming to IS: 5382 leaving 10 mm gap for thermal expansion. (i) Single socketed pipes.

a)75 MM Diameter

b)110 MM Diameter

o. Providing and fixing 100 mm diameter and 60 cm long rain water spout in cement mortar 1:4 (1 cement: 4 fine sand). a) uPVC spout Type A.

p. Providing and fixing on wall face un plasticized - PVC moulded fittings/ accessories for un plasticized Rigid PVC rain water pipes conforming to

IS: 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.

i. Single Push fit coupler

75 mm dia

110 mm dia

ii. Single Tee with door

75x75x75 mm dia

110x110x110 mm dia

iii. Bend 87.5 Deg

75 mm dia

100 mm dia

iv. Shoe (Plain)

75 mm dia

110 mm dia

q. Providing and Fixing of G.I. coated holder bat clamp of approved design to uPVC pipes comprising of G.I. coated holder flat brackets made of 50X5 mm flat of specified shape, projecting 75 mm outside the wall surface and fixed on wall with 2 nos. 6 mm dia. expansion hold fasteners, including drilling necessary holes in brick wall/CC/RCC surface and cost of bolts etc.The pipes shall be fixed to the already fixed brackets with the help of 6 mm dia. galvanised bar of specified shape and of total length 400 mm and shall be fixed with G.I. coated nuts , bolts & washers one bolt on each side of the pipe etc complete in all respect as per direction of Engineering-in-charge. (Rain water pipes)

a) 75 mm dia b) 110 mm dia

r. Providing and Fixing to the inlet mouth of rain water pipe SS 316

grating of following diameter complete in all respects as per direction of the engineer-in-charge.

a) For 75 mm dia.

b) For 100 mm dia.

c) For 150 mm dia.

s. Providing and Fixing G.I. "B" class pipe complete with G.I. Fittings and clamps, including cutting and making good the walls etc. (Internal work)

a)32 mm dia b)40 mm dia c)50 mm dia

t. Painting of G.I. Pipes and fittings with two coats of anti-corrosive bitumastic paint of approved quality.

a)32 mm dia b)40 mm dia c)50 mm dia.

u. Providing and fixing G.I. Inlet fittings with maximum 3 inlets 32,40 & 50 mm size fabricated from 100 mm dia G.I. pipes and welded G.I. sockets, fixed to C.I. Trap with joints and set in cement concrete (1:2:4) complete as directed by Engineer-in-charge.

v. Providing and Fixing SS 316 Grating with frame and SS Screws casted heavy 125 mm dia complete as directed by Engineer-in-charge.

w. Providing and fixing 6 mm dia. G.I. level adjusting hangers (upto

1200mm length), fixed to roof slabs by means of ceiling cleats made out of G.I. flat 40x3mm size 60 mm long and stainless-steel expandable dash fastener of 12.5 mm dia and 50 mm long, complete as per direction of Engineer-in-charge.

x. Preparing the inside surface of core for bore packing by roughening using suitable file to get better adhesion prior to packing works. Cleaning the surface by wire brushing followed water jet to remove any laitance or loose flaky particles. Providing necessary form work for packing the bore using suitable arrangement (depending upon site conditions). Applying a coat of styrene- butadiene based polymer coating using Nitobond SBR to enhance adhesion between the packing material and other surfaces and Application of swellable Supercast SW20 at the middle of over the pipe external side and. Packing the gap using non-shrink cement polymer based grout using Conbextra GP2 upto the surface of the bore whilst the Nitobond SBR is in tacky state completely for 100 mm dia. pipe as per the manufacturer's Instruction and as per direction of the engineer-in-charge.

y. Providing and fixing pre-fab polymer concrete channels conforming to relevant EN standards with V-shaped profile, tounge and groove jointing arrangement, in-built ductile iron edge rail, with in-built slope along the complete length of the channel, and polymer concrete channels to be made of zero water absorbtion, of density being 2.1 - 2.3gm/cm3, with surface roughness of approx 25 µm, with SS grating at the top complete in all respect including all necessary civil and finishing works as required as per site and the instructions of the engineer - in - charge, for following sizes: Size 250 x 385 mm (B x H)

z. Supply and installation of Slot Drain K-100 Brickslot polymer concrete channels having Length of 1000 mm, Width of 130 and depth as per site requirement confirming to Euro Norms DIN EN 1433 of, V-shaped profile, tounge and groove jointing arrangement, inbuild galvanized iron edge rail and a approx weight of 16 kg/unit. These channels have Stainless Steel Slot and confirming to Load Class A15 as per EN DIN 1433. Inspection Unit of 500 mm length ,130mm width and depth as per site requirement is also provided with the unit.

2.30.3 Water Supply (Internal & External around the building)

a.) Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m: All Kinds of Soil Pipes, cables etc, not exceeding 80 mm dia.

b.)Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : All Kinds of Soil Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia.

c.) Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in Charge.

CONCEALED WORK, including cutting chases and making good the wall etc.

a) 15 mm nominal outer dia pipes

b) 20 mm nominal outer dia pipes

c) 25 mm nominal outer dia pipes

d) 32 mm nominal outer dia pipes

e) 40 mm nominal outer dia pipes

f) 50 mm nominal outer dia pipes

f) Providing and fixing Stainless Steel 316 L pipes confirming to EN 10312 complete with Press Type fittings with SC-Contur in accordance with DVGW regulation W534 such as sockets, bends, elbows, tees, reducers, unions, Flanges, clamps/structural steel supports, hangers etc. necessary adapters SS to CP fittings, jointing, sundries, cutting holes in walls/floors/slabs & making good including wraping with polythene sheet tape etc. **(For drinking water purposes):**

a) 15 mm OD

b) 22 mm OD

c) 28 mm OD

d) 35 mm OD

e) 42 mm OD

i) Providing and Laying anti corrosive tape, 100 mm wide and 4 mm thick including an initial coat of primer for preventing the corrosion of buried pipes in trenches, complete in all respects as per the direction of engineer-in-charge.

a) 25 mm dia pipe

b) 32 mm dia pipe

c) 40 mm dia pipe

d) 50 mm dia pipe.

k) Providing and fixing C.I butterfly valve, wafer end type class PN 1.6 as per I.S:13095 or BS:5155, including necessary nuts, bolts, gaskets etc., complete

a) 65 mm dia

b) 80 mm dia

c) 100 mm dia

d) 150 mm dia

l) Constructing masonry chamber 30x30x50 cm with cement based fly ash bricks, inside with brick work in cement mortar 1:4 (1 cement : 4 Coarse sand) for stop cock, with C.I. surface box 100x100x75 mm (inside) with hinged cover fixed in cement concrete slab1:2:4 mix (1 cement: 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) necessary excavation foundation concrete 1:5:10 mix (1 cement : 5 fine sand and 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design. With cement based fly ash bricks of 1st class. Extra depth to be provided as per site condition if required.

m) Constructing brick masonry chamber for underground C.I. inspection chamber and bends with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) C.I. cover with frame (Heavy duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg), R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 Fine sand : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design: Inside dimensions 500x700 mm and 45 cm deep for pipe line with one or two inlets : With cement based fly ash bricks of 1st class.

n) Extra for depth beyond 45 cm of brick masonry chamber:

For 500x700 mm size

With cement based fly ash bricks of 1st class

o) Providing and placing on terrace (at all floor levels) polyethylene water storage tank, IS: 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.

p) Providing and Fixing of double flanged Water Flow Electromagnetic type Meter complete with digital display provision & including Pulse generator and Remote Totalizer complete in all respect as per the technical specifications.

a) 25 mm dia

b) 32 mm dia

c) 40 mm dia

d) 50 mm dia

q) Providing and Fixing Pressure Reducing station for cold water supply comprising of 2 Nos. of brass ball valves on outlet and bye-pass and ball valve with inbuilt strainers and a PRV (Diaphragm type) unit without going pressure gauge with flanged or union connection including safety valve. The complete system is tested to a pressure not less than 15 Kg/Cm2 and suitable to reduce the pressure from 3.5 Kg/Cm2 to 1.0 Kg/Cm2(or as desired at site) including flanges/unions, nuts, bolts and washers complete as required for applications. (Horizontal or vertical as applicable).

a) 25 mm dia

b) 32 mm dia

c) 40 mm dia

d) 50 mm dia

r) Providing & fixing M.S. structural work fabricated from standard section e.g. M.S rounds, angles, channels, plates including cutting to size, drilling, welding fixing and welding to insert plates in RCC structural members as directed by engineer-in-charge including cutting and making good the walls, ceilings and floors.

vi. LAYING AND JOINTING OF SEWER AND DRAIN PIPES AND FITTINGS

a) All the Strom Water Piping shall be RCC NP2/NP3 with bedding and upto hunch level with 1:5:10 (40mm aggregate).

b) All the Sewer external piping shall be of uPVC SN4 with all around concreting with 1:5:10 (40mm aggregate).

(i) UNLOADING:

(a) The pipes shall be unloaded where they are required.

(b) Unloading (except where mechanical handling facilities are available) – pipes weighing upto 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 degrees. 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.

(c) Under no circumstances shall be the pipes be thrown down from the carriers or be dragged or rolled along hard surfaces.

(d) 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.

(ii) **STORING:**

(a) 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 lines run on level ground.

(b) Each stack shall contain pipes of same class and size, consignment or batch number and particulars of the suppliers, wherever possible, shall be marked on the stack.

(c) Storage shall be done on firm, level and clean ground. Wedges shall be provided at the bottom layer to keep the stack stable.

(iii) **CUTTING:**

(a) 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.

(b) 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.

(iv) **TRENCHES:**

(a) The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

(b) The minimum width of the trench should be “D + 400 mm”, where, D is outer diameter of the pipe.

(c) 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 layer.

(d) 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 or provide lean cement concrete as required and specified.

(e) 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.

(f) Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed. The excavated materials shall not be placed within 1 meter 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 that may be re-laid and compacted in the same order to the satisfaction of the PMC/Engineer in charge.

(g) 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.

(h) 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 main cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC/Engineer in charge.

(i) When pipes are laid under road and pavements, subjected to heavy traffic loads, the trench may be covered with RCC slabs of suitable dimensions.

(v) **LAYING:**

(a) The pipes shall be lowered into the trench by means of suitably 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.

(b) 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.

(c) 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.

(vi) **BACK FILLING AND TAMPING:**

(a) 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.

(b) The initial back fill material used shall be free of large stones and dry lumps.

(c) 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.

(d) 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.

(vii) **S. W. GULLY TRAP**

MATERIAL:

Gully traps shall confirm to IS: 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 kg and the frame not less than 2.70 kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

- **EXCAVATION:**

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the PMC/Engineer in charge.

- **FIXING:**

The gully trap be fixed over cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) foundation 650 mm square and 100 mm thick. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes as described above.

- **BRICK MASONRY CHAMBER:**

After fixing and testing gully and branch drain, a brick masonry chamber 300 mm x 300 mm (in side) with bricks in cement mortar 1:5 (1 cement: 5 fine sand) shall be built with a 100 mm brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 10 nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered in side with cement mortar 1:3 (1 cement: 3 sand), finished with a floating coat of neat cement. The corners and bottoms of the chamber shall be rounded off so as to slop towards grating.

C.I. cover with frame 300 mm x 300 mm (inside) size small then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) 40 mm thick and rendered smooth. The finish top of the cover shall be left about 40 mm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

(viii) **REINFORCED CEMENT CONCRETE (RCC) PIPES (NP2 / NP3)**

All NP2 / NP3 RCC pipes shall be spigot and socket end pipes. The ends shall be suitable for rubber ring joints. The pipes shall be ISI marked as per IS: 458:2003. The rubber rings shall confirm to IS 5382.

- **MATERIAL:**

General - The pipes shall be with reinforcement and shall be of the specified class. These shall confirm to IS: 458 amended up to date. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete – The concrete quality shall be as per IS: 456 for at least very severe environmental exposure condition. Concrete used for the manufacture of reinforced concrete pipes shall have minimum cement content of 450 kg/cum and a compressive strength not less than 35 N/sq.mm at 28 days.

Aggregates – The aggregate shall confirm to 3 of IS: 383. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm dia and 10 mm size for pipe dia from 80 to 250 mm.

Reinforcement - The reinforcement shall confirm to mild steel grade 1 or medium tensile steel bars confirming to IS:432 (part 1) or hard drawn steel wire confirming to IS: 432 (part 2) or structural steel (standard quality) bars confirming to IS: 2062. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

JOINTING: SPIGOT AND SOCKET JOINT:

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The jointing of pipe shall be done by rubber ring method. The rubber rings shall confirm to IS: 5382.

A rubber ring shall be placed on the spigot which shall be forced into the socket of pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After days' work any extraneous material shall then be removed from inside of the pipe and the newly made joint shall be cured,

CLASS NP2 – REINFORCED CONCRETE LIGHT DUTY, NON PRESSURE PIPES

Internal Diameter of Pipes Nominal (mm)	Barrel Wall Thickness (mm)
80	25
100	25
150	25
200	25
225	25
250	25
300	30
350	32
400	32
450	35
500	35
600	45
700	50
800	50
900	55
1000	60

- **CLASS NP3 – REINFORCED CONCRETE MEDIUM DUTY, NON PRESSURE PIPES**

Internal Diameter of Pipes (mm)	Barrel Wall Thickness (mm)
150	25
200	30
225	30
250	30
300	40
350	75
400	75
450	75
500	75
600	85
700	85
800	95
900	100
1000	115

1100	115
1200	120
1400	135
1600	140

(ix) **uPVC SN4 Pipe for Sewer Drain**

The specified size of uPVC Spigot and socket soil or waste pipe shall confirm IS: 15328-2000 the UPVC Rain Water pipes shall be of the following normal size

(A) 160 mm. dia.

(B) 200 mm. dia.

(C) 250 mm. dia.

(D) 315 mm. dia.

(x) **Workmanship:**

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring.

(xi) **TRENCHES:**

(i) The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

(ii) Cover shall be measured from top of pipe to the surface of the ground.

(iii) The width of the trench shall be D+400 mm with a minimum of 750 mm. (D= External diameter of pipe). Note: The width should not be more than the mentioned for structural safety of the pipes.

(iv) 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 layer.

(v) 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.

(vi) 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.

(vii) Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed. The excavated materials shall not be placed within 1 meter 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 that may be re-laid and compacted in the same order to the satisfaction of the PMC/Engineer in charge.

(viii) The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after rewatering the trenches.

(ix) 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 main, cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC/Engineer in charge.

(xii) **LAYING:**

Pipes shall be lowered into the trench carefully. Mechanical appliances may be used, where necessary, pipes shall be laid in straight lines or with easy curves and true to line and gradient as specified. Laying of pipes shall proceed upgrade of a slope. In the pipes spigot end socket joints, the socket ends shall have face up stream. In the case of pipes with joints to be made with loose collars the collars shall be slipped on before the next pipe is laid.

The Cement Concrete bedding shall be provided below RCC / uPVC pipes as instruction of PMC/ Engineer in charge.

When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(xiii) **TESTING OF JOINTS:**

- **HYDRAULIC TEST:**

The pipes shall be subjected to a pressure of at least 2.5-meter head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low 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 end 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 fix suitably for observation.

Subsidence of the test water may be done to one or the more of the following causes: -

i) Absorption by pipes and joints;

ii) Sweating of pipes or joints;

iii) Leakage at joints or from defective pipes and

iv) Trapped air.

Allowance shall be made for (i) above by adding water until absorption has ceased after which the proper test should commence if any leakage is visible the defective part of the work should be made good. A slight amount of sweating which is uniform may be over looked but excessive sweating from a particular pipe or joint shall be watched for as taken as indicating a defect to be made good.

RECTIFICATION OF FAULTY JOINTS:

Any joint leaking or sweating shall be rectified or embedded into into 150mm layer of cement concrete (1:2:4) 300mm in length and the section retested.

(xiv) **MANHOLES**

Manholes of different types and sizes specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawing or as directed by the PMC/Engineer in charge. The size specified shall indicate the inside dimensions (between wall faces) of the manholes. The branch sewer should deliver sewage in the manhole in direction of main flow and the junction must be made with case so that flow in the main is not impeded.

No drain from house fitting i.e. gully taps or soil pipes etc. to manholes shall normally exceed a length of 6 meter unless it is unavoidable.

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 45 m for up to 300 mm dia, 75 meter for 350 to 500 mm dia and 90 meter for 600 mm dia and above.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber.

Manholes shall be built to the following specifications: -

a) **<u>Bed concrete:</u>**

The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) The thickness of Bed Concrete shall be 150 mm upto 0.90-meter depth, 200 mm thick for manholes from 0.90 meter to
2.25-meter depth and 30 mm for manholes of above 2.25-meter depth.

b) **<u>Walls:</u>**

The walls of the manholes shall be of brick masonry. The brick masonry shall be with bricks in cement mortar 1:4 (1 cement: 4 coarse sand) of brick work shall be carefully built in English bond. The jointing face of each brick being well buttered with cement mortar before laying so as to ensure a full joint. The thickness of wall shall not be less than 230mm upto 2.25 meter in depth, 345 mm thick for depth 2.25 to 3.0 meter, 460 mm thick for depths 3.0 m to 5.0 meter and 575 mm thick for 5.0 to 8.0-meter depth. For greater depths and for subsoil water conditions the exact thickness of wall shall be governed by the structural design & site conditions.

c) **<u>Plaster:</u>**

The inside of wall shall be plastered by 12 mm thick with cement mortar 1:3 (1 cement
: 3 coarse sand) and finished with a floating coat of neat cement. All angle shall be rounded to 7.5 cm. radius and all rendered internal surfaces shall have impervious finish obtained by using a steel trowel.

Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth upto 30 cm above the highest sub-soil water level with the approval of the PMC/Engineer in charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer’s specifications.

d) **<u>Channels and benching:</u>**

Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel on appropriate shall suitably rounded off in the direction of flow in the main channel shall be given.

The channels and benching shall be done in cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) rising at a slope of 1 in 6 from the edges of channel. The channels of the bottom of the chamber shall be finished with the floating coat of neat cement.

e) <u>Foot Rests:</u>

All manholes deeper than 0.8 m/ UG/OHT/STP Tanks shall be provided with orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910, on 12 mm dia steel bar confirming to IS: 1786, having minimum cross section as 23 mmx25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) complete as per design.

f) <u>Cover slabs:</u>

These shall be of R.C.C. 1:1.5:3 (1 cement: 1.5 coarse sand: 3 graded stone aggregate 20 mm nominal size) 15 cm thick with surface and edge finished fair. Full bearing equal to the width of the wall shall be given to the slab on all sides. The frame of the man hole cover shall be embedded firmly in the R.C.C. slab so that the top of the frame remains flush with the top of the R.C.C. slab. Where the opening of manhole is only 560 mm dia, the MH cover shall be fixed in 150 mm thick PCC (1:2:4).

(xv) **TESTING:**

Manholes shall be tested by filling with water to a depth not exceeding 1.2 meter as directed by the PMC/Engineer in charge.

After completion of the work manhole covers shall be sealed by means of thick grease.

(xvi) **CONNECTION TO EXISTING SEWER:**

The connection to an existing sewer shall, as far as possible, be done at the manholes. Where it is unavoidable to make connection in between two manholes, the work of breaking into the existing sewer and forming the connection shall be carried out under the supervision Administrative Authority.

Breaking of sewer shall be effected by the cautions enlargement of sewer hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be former in such a way so as to constitute a projection into the sewer or to cause any diminutions in its effective size.

(xvii) **DROP CONNECTIONS:**

Where it is uneconomic or impracticable to arrange the connection within 600 mm height above the invert of the manhole, the connection shall be made by constructing a vertical shaft outside the manholes chamber. If the difference in the levels between the incoming drain and the sewer does not exceed 600 mm and there is sufficient room in the manhole, the connection pipe may be directly brought through the manhole wall and the fall accommodated by constructing a ramp in the benching of the manhole.

(xviii) **PRECAST CONCETE MANHOLE COVERS & FRAMES**

Precast reinforced cement concrete manhole covers intended for use in sewerage, drainage and water works shall generally confirm to IS: 12592 - 2002. Detailed specification is as under:

1. GRADES: TYPES & USES

Manhole covers and frames shall be of the following four grades and types:

Grades	Grade Designation	Type / shape of cover
Light Duty	LD – 2.5	Rectangular, Square, Circular
Medium Duty	MD – 10	Rectangular, Circular
Heavy Duty	HD – 20	Circular-Square, Rectangular,
Extra Heavy Duty	EHD – 35	Circular, Square, Rectangular,

2. The different grades and types of manhole covers may be used as follows:

a) LD – 2.5 Rectangular, Square or Circular types:

These are suitable for use within institutional complexes / areas with pedestrian but occasional LMV traffic. These covers may also be used for inspection chambers.

b) MD – 10:

These are suitable for use in service lanes / roads, car parking areas etc.

c) MD – 20:

Suitable for use in institutional/commercial areas / carriage ways with heavy duty vehicular traffic like buses, trucks, etc. for a wheel load between 50 to 100 KN.

d) EHD – 35: Circular, square, or rectangular (scrapper manhole) types -

These are suitable for use on carriage way in commercial industrial / port areas / near warehouses / god owns where frequent loading and unloading of trucks / trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads up to 115 KN, irrespective of the location of the manhole chambers.

3. **MATERIALS:**

(i) Cement:

Cement used for the manufacture of precast concrete manhole covers shall confirm to IS: 269 or 455 or 1489 or 6909 or IS: 8041 or IS: 8043 or IS: 8112.

(ii) Aggregates:

The aggregates used shall be clean and free from deleterious matter and shall confirm to the requirements of IS: 383–1970.The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.

(iii) 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. (IS: 456) The minimum cement content in the concrete shall be 360 kg/m^3 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.

(iv) Reinforcement:

a) The reinforcement steel shall confirm to Grade A of IS: 2062 or IS 432 (Part I) or IS: 432 (Part 2) or IS: 1786 as appropriate.

Reinforcement shall be clean and free from loose mills 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:** In association with in the main steel bars reinforcement steel fibers of appropriate types and forms may also be used as secondary reinforcement (upto 0.5% by volume).

4. SHAPES AND DIMENSIONS:

The shapes of precast concrete manhole covers shall be square, rectangular or circular with in direction of Engineer in charge.

5. LIFTING DEVICE:

The minimum diameter of mild steel rod used as lifting device shall be 10 mm for light and 12 mm for medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by not galvanizing or epoxy coating or any other suitable.

6. FINISHING AND COATING:

To prevent any possible damage from corrosion of steel the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish.

In order to protect the edges of the covers from possible damage at the time of lifting and handling it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2.5 mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anticorrosive paint or coating.

7. PHYSICAL REQUIREMENTS:

a) General:

All units shall be sound and free from cracks and other defects which interface with the proper placing of the unit or impair the strength or performance of the units. Minor chipping at the edge / surface resulting from the customary methods of handling during delivery shall not be deemed for rejecting.

b) Load test:

The breaking load of individual units when tested in accordance with the method described in IS: 12592 shall be not less than the values specified in Table below.

TABLE

Grade of cover	Type	Load in Tones	Diameter of Blocks in mm
EHD – 35	Circular, Square or Rectangular	35	300
HD – 20	Circular, Square or Rectangular	20	300
MD – 10	Circular, or Rectangular	10	300
LD – 2.5	Rectangular, Square or Circular	2.5	300

8. FIXING:

The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry which shall be paid as extra unless specified otherwise.

Drilled Bore Wells

The general character and the scope of work to be carried out under this contract are illustrated in the following specifications. It gives only general guidance as regards design, drilling and construction of tube wells. Before selecting the method of construction to be adopted, the Contractor shall give due consideration to site condition and Geological data of the site. The construction and testing of tube wells shall be as per IS 2800- 1979 (Part 1 and 2) / CPWD Specification. The Contractor shall ensure the required minimum yield. The Indicative Water sample test report is attached for guidance.

(xix) Selection of Site

The total water supply to the campus is to be met from the water supply through tube wells/bore wells only. No local water supply from the Municipal Bodies is available. The bidder shall assess the total water requirement and propose the location of the tube well / bore wells accordingly for the approval of the PMC/Engineer in charge. After conducting the necessary tests, etc., changes, if required, shall be made with the approval of the PMC/Engineer in charge.

(xx) Geological Data

During the drilling operation, Contractor shall collect the samples of different strata from suitable intervals or where change in strata is met with. It shall be carefully examined and analysed and the data shall be preserved carefully and handed over to SBI/PMC in charge. The Contractor shall make one drilling time log during the execution of work for the bore well.

(xxi) Design and lowering of pipe assembly

The length and diameter of the housing pipe shall be selected on the basis of static water level, the drawdown and the discharge expected from the well and the size of the pump to be installed. The size and length of blind pipes and the slotted/ strainer pipes shall be selected according to the expected discharge and the depth of tubewell. The size and distribution of the slots shall be as per IS 8110. After completion of the bore hole the Contractor shall assemble the tube well assembly according to the water bearing strata met during boring, after getting the same approved from the PMC/Engineer in charge and shall lower in to the drilled hole the same keeping the slotted strainer opposite to water bearing strata from which the water is to be extracted. The bail plug shall rest on firm ground. Before the bail plug is lowered, about one metre depth of the bore hole shall be packed with the gravel to avoid sinking of the assembly. In case part of a bore hole is not proposed to be utilized, it shall be filled with gravel before lowering the assembly. The slotted pipe and other pipes shall be provided with proper guides to keep them in the centre of the bore to ensure uniform gravel packing all around.

(xxii) Gravel Packing

All gravel shall consist of hard rounded particles reasonably uniform in diameter and shall be of size, determined after analyzing the character of the water bearing formation tapped. The gravel shroud around the screen shall be uniform. It should be free from dust, dirt and other vegetable matters. Gravel packing once started shall be carried out continuously until it is completed. Pea gravel/Stone Chips shall be thoroughly washed.

(xxiii) Development of Bore well

The well shall be developed either by surging and agitating or by over pumping and back washing with an air lift and high velocity jetting. The tube well shall be developed as per IS 2800 -1979 or latest by air compressor to be arranged by the Contractor as required to obtain the maximum discharge available from the completed tube well. Another acceptable method may also be adopted. This development process shall be continued until the stabilization of sand and gravel particles has taken place. The development shall continue until the gravel should stop sinking, discharge of depression ceases to improve and the sand content is not more than 20 parts per million. A record of the hours of working of Air compressor shall be maintained by SBI/PMC in - Charge which will be signed by the Contractor or his authorized representative. A statement showing the quantity of gravel initially filled in the bore and the quantity added during development should be prepared by the Contractor and got signed by the representative of the PMC/Engineer in charge.

(xxiv) Disinfection

The well shall be disinfected after completion of test for yield. All the exterior parts of the pump coming in contact with the water shall be thoroughly cleaned and dusted with powdered chlorine compound. In fact it shall be disinfected every time a new pump is installed or the one installed is replaced after repairs.

The stock solution of chlorine may be prepared by dissolving fresh chlorinated lime. For obtaining an applied standard concentration of 50 ppm, 1 litre of the stock solution shall be used to treat 300 litres of water.

(xxv) Grouting and Sealing

Grouting and sealing of tubewell may be done, if required depending upon the site conditions and the quality of the discharge of the strata encountered. To ensure that the grout shall be provided a satisfactory seal, it shall be applied in one continuous operation. Sealing of the tube well may be done by grouting the annular space between bore and the housing pipe, with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4: coarse aggregate 20 mm nominal size) to a depth of 5m below the grouted level.

(xxvi) Handing over of the bore well.

The tube well shall be handed over in complete shape. The housing pipe shall be closed by a well cap for the period between the completion of the tube well and the installation of the pump set.

The following information shall be furnished on completion of the tube well:

a) Strata chart of the tube well the different types of soils met with, at different depths.

b) Samples of strata collected, neatly packed and correctly marked in sample bags.

c) Chart of actual pipe assembly lowered indicating the size of pipes, depth ranges, where slotted/ strainer pipes have been used, depth and diameter of housing pipe, reduced level of the top of the housing pipe and the diameter and depth of the bore hole.

d) Position of every joint in the well assembly.

e) Hours of development done by the compressed air, pump sets or by other means.

f) Pumping water level at the developed discharge.

g) Two copies of test certificates of the water samples result from approved testing agency.

h) Results of development along with levels of static subsoil water and depth of draw for steady discharge.

i) Results of mechanical (sieve) analysis of samples of aquifer materials wherever applicable.

j) Yield analysis and recommendation on the safe pumping yield, pump settings and specifications for suitable pumps etc.

k) Verticality tests results to be recorded in accordance with IS:2800-1979

(xxvii) <u>Tube well Data</u>

i. Yield required minimum 80 KLD per tube well considering 10 hrs. operation per day. (Sand free delivery from bore well)

ii. Bore - 450 mm dia.(Minimum)

iii. Approximate depth – 50 meter (Minimum).

iv. Assembly - Blind/ Slotted Pipes – 200 mm dia. (minimum) Upto complete depth.

v. Material – MS Class "C" pipes (Heavy Class) as per CPWD specifications

vi. Verticality – True verticality as per IS – 2800- 1979

vii. Packing – Pea Gravel

viii. Developing – Minimum 100 Hrs or till sand free discharge is obtained.

ix. Water for drilling – Contractor shall make his own arrangement for water required for drilling purposes as well for development purposes.

x. The design for the tube well indicating the depth range of the aquifer zones to be tapped shall be given after a detailed study of the data collected during drilling operations.

(xxviii) All the casings shall be of ERW steel quality confirming to IS specifications and carry manufacturer's certificate. The pipes shall have a wall thickness of not less than 7 mm or as per IS 1239. The slotted pipes must have an effective open area of at least 15% and the slotted size should be 1.6 mm. All pipes shall be painted fresh before lowering. The pipes shall be welded thoroughly all round to prevent leakage and breakage. Centering guides may be used to maintain the verticality of the tube wells which shall be tested in accordance with the norms stipulated in IS 2800.

(xxix) The annular space between the bore well and tube well assembly shall be packed with well-graded pea gravel of good quality, durability and high sphericity.

vii. **Water Supply Pumping System & Allied services**

(i) **Scope of work**

The scope of work shall consist of furnishing all labour, materials, equipment and appliances necessary and required for the satisfactory supply, installation, completion and commissioning of water supply pumping system and allied works as described hereinafter, as specified in the DBR and/or shown on the plumbing drawings and described in the scope of work.

(ii) **The System**

The system described below is for the Contractors bidding for the works to understand the extent and scope of work and the intent in the manner in which the water supply system is planned and shall be executed. This does not form a part of the Contractor's scope of work with respect to the various elements that are described in this paragraph.

a. **Sources of supply**

The external water supply shall be met from Bore wells.

b. Partially Underground water tanks

i. Static fire water storage tanks in compartments. Connections from the tube well water supply lines will be made into these tanks. Water will overflow into the raw water tanks

ii. Raw Water Tank to hold the tube well as well as CWS Supply water will be made to:

1. A set of pumps will be connected to and water filter and chlorination system and the filtered water stored in the Treated Water Tanks (in three compartments. All piping and connections for this system are a part of this contract, if required.
2. Domestic Water Pumping Systems

iii. Water supply to the various buildings will be made from a set of pumping sets to the overhead water and supplementary fire tanks located on the terrace of each building.

2. Rising Mains & level control system

a. Water from the pumps described above will fill each tank by a rising main to each tower.

b. To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.

c. A set of electronic level sensing probes will be installed in each tank. The probes installed in each pumping system will be wired to a central electronic panel which will activate the pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

3. Level Controllers

a. Level controllers shall be electronic magnetic type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications: -

i. Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location

b. Overhead tank level controller cum indicators & motorized butterfly valve

i. Each OHT to be provided with required number of stainless steels electronically operated probes (housed in a stainless-steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. A common multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:

ii. To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.

iii. Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.

iv. Indicate the water level in each OHT in the level indicating panel installed in the pump room

v. Each OHT are also provided with a motorized butterfly valve complete with high- and low-level control switches to control the valve. The level controllers shall be installed in overhead tanks. The level switch will close the valve when water level is high (Top Water Level) in overhead tank and open the valve when overhead water tank level is low (30% of storage capacity). The system should be complete in all respects with accessories, 220 V AC / 24 V DC, IP67 electrical water level control unit, copper control wiring in whether proof casing etcto stop the supply in individual OHT when level reaches a cut off high level.

c. Control & Indicating Panel (For overhead and underground water tanks)

i. A centralized indicating stand–alone wall mounted panel fabricated from 14
g. with seven tank process MS sheet and painted inside and outside with stove enamelled finish with clear vertical panels for each group of buildings & tanks shall indicate water level in each tank by means of digital display unit to indicate water level in each tank in four levels (¼th, ½, ¾ and full). The panel shall be installed on the control console panel located in the pump room or as directed by the PMC/Engineer in charge. The panel shall have:

ii. Digital level indicator panel meter for each water tank.

iii. Etched plate identification plates.

iv. Control cabling from MCC to the panel installed in the control room as directed by the PMC/Engineer in charge.

v. Cabling from PHT sensing probes to the panel

4. **Pressure filters for Water Supply System**, if required.

a. Specification shall apply for water filtration system

i. Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal GI distribution pipe with polypropylene diffusers on top, collector pipes and arms, inlet and outlet header vertical water pressure dished ends complete with initial charge of filter media, G.I. face piping, accessories testing and commissioning complete, Working Pressure 2.4 kg/cm2 (Test pressure 3.75 kg/cm2). Along with bfv & nrv & gauge, prv etc.

ii. Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.

iii. The diameter and height of each vessel shall be as per the design requirement and as per site conditions.

b. Multi-Port Valves

i. Each vessel will be provided with multi-port valves to operate and regulate the normal flow, backwash and rinsing, rapid washing, on the face piping.

ii. Provide suitable sampling cocks to draw water samples for raw water and treated water.

c. Face Piping

i. Each vessel shall be provided with G.I heavy class face piping from the inlet to the outlet. Face piping & fitting shall be G.I heavy class and treaded, weld and flanged joints

ii. All valves shall be butterfly valves as specified in the piping section over 50 mm dia. and for pipe dia. below 50 mm dia. shall be provided with ball valves.

d. Water Filtration Plant (For Domestic Water)

i. Design parameters for the proposed filter shall be as follows:

1. Filter media: - Graded aggregate of required size selected coarse and fine silica sand as per latest water treatment practice. Aggregate and sand to be acid washed and having purity of 99.9%.
2. Depth of filter media: - Approx. 750-900 mm deep (as per manufacturer's design)
3. Back washing: - By air scouring through air blower (approx. 5.1 lpm/m2 of filter surface area and water supply from raw water pumps by reverse flow
4. Output Water Quality for Domestic Filters: To confirm to IS 10500 for the relevant design criteria

e. Chemical Dosing Pumps

i. Pump applications

1. Chlorination of raw water from tube wells,

ii. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.

iii. Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.

f. Air Blower for Back Washing

i. Low pressure air blower with TEFC electrical motor, belt driven or direct drive, all mounted on a common structural based plate with oil and water separator.

ii. Air blowers will be used for back washing operations. The air blower shall be designed for operation of one filter at a time. Blowers will be designed for air flow of approx 5.1 lpm/m2 air capacity at 0.5 kg/cm2 pressure. (This may be modified to suit manufacturer's requirement for filters offered.)

iii. The electrical switchgear shall be included in the respective MCC panel of the system

viii. **Pipes & Fittings**

1. **Headers, piping and connection**s

a. All pipes within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be D.I /
G.I. / CPVC pipes (medium class) and thickness specified. Pipes up to 150 mm dia. shall confirm to I.S. 1239.

b. Pipe 200 mm dia. and above shall be D.I/G.I. tubes to IS 3589. If black pipes are available, they shall be galvanized before use.

c. Fittings for D.I./G.I. pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia. may be shop fabricated but shall be shop galvanized after fabrication.

d. All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with G.I. structural supports from floor or ceiling as required and directed by PMC/Engineer in charge.

2. Jointing

a. D.I./G.I. Pipes (Screwed joints**)**

Pipe shall be provided with metal to metal threaded joints/push on joints etc. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD /ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

b. Flanged joints / Dead Joints

Flanges shall be provided on:

i. Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.

ii. Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia or larger diameter. (When Permitted)

iii. Both end of all suction delivery and other headers.

iv. For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.

v. Flanges shall be as per applicable I.S. with appropriate number of D.I/G.I. nuts and bolts, 3 mm insertion rubber gasket complete.

c. **Unions**

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

d. Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer’s details.

3. **Valves**

a. Sluice valves

i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.

ii. Sluice valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

iii. Sluice valves shall be of approved makes confirming to I.S.780 PN1.6 class

b. Butterfly Valves (PN 1.6 rating)

i. Butterfly Valves shall be used in all other locations as required confirming to IS 13095.PN 1.6

ii. They shall have a cast iron body.

iii. Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.

iv. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.

v. The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

vi. Built in flanged rubber seals.

vii. Actuator to level operated for valves above ground and T Key operated for valves below Ground.

viii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.

c. Non Return Valves (NRV PN 1.6 rating))

i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

ii. NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall confirm relevant IS or match the butterfly valves.PN 1.6

iii. Built in flanges for screwed on flanged connections.

d. Ball Valves

Ball Valves up to 40 mm dia. shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying coupling and steel handles (to B.S. 5351.

4. 'Y' Strainers (PN 1.6 rating)

Provide cast iron 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

ix. **The detailed specifications for all Plant rooms have been mentioned in individual subheads.**

x. **Specifications for Electrical Installation**

1. Electrical Control Panels

a. General

i. All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volts, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts.

ii. The Switch Boards shall comply with the latest edition with up to date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

b. Switch Board Configuration

i. The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipments.

ii. The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

iii. The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

c. **Equipment Specifications**

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

d. **Constructional Features**

i. The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.

ii. The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 54 as specified. All doors and covers shall also be fully gasket with synthetic rubber and shall be lockable.

iii. The Switch Board shall be fabricated with CRCA 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 constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

iv. All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

v. Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of the Switch Boards.

e. Switchboard Dimensional Limitations

i. A base channel 100 mm x 50 mm x 6 mm thick shall be provided at the bottom.

ii. A minimum of 200 mm blank space between the floor of switch board and bottom most units shall be provided.

iii. The overall height of the Switch Board shall be limited to 2300 mm.

iv. The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

f. Switch Board Compartmentalization

i. The Switch Board shall be divided into distinct separate compartments comprising.

ii. A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical bus bars.

iii. Each circuit breaker and MCCB shall be housed in separate compartments enclosed on all sides.

iv. Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.

v. 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, bus bars and connections.

vi. A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

vii. Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.

viii. Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from top.

ix. Adequate and proper support shall be provided in cable compartments to support cables.

g. Switch Board Bus Bars

i. The Bus Bar and interconnections shall be of electrolytic Copper/ Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per sq. mm. and for Aluminium shall be 1 amp per Sq.
mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second.

ii. The bus bars and interconnections shall be insulated with insulation tape/ fibre glass.

iii. The bus bars shall be extensible on either side of the Switch Board.

iv. The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.

v. All bus bars shall be colour coded.

vi. All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

h. Switch Board Interconnections

i. All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.

ii. For unit ratings up to 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

i. Draw out Features

Air Circuit Breakers shall be provided in fully draw out cubicles. 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. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the draw out cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

j. Instrument Accommodation

i. 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 Switch Board.

ii. For MCCB's instruments and indicating lamps can be provided on the compartment doors.

iii. The current transformers for metering and for protection shall be mounted on the solid copper/aluminium bus bars with proper supports.

k. Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

l. Cable Terminations

i. Knockout holes of appropriate size and number shall be provided in the Switch Board in confirmity with the location of incoming and outgoing conduits/cables.

ii. The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear / top of the panel.

iii. The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.

iv. The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100-volt grade aluminium conductor PVC/PVCA cables.

m. Space Heaters

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230-volt switch socket outlet to eliminate condensation.

n. Ventilation Fans

The Switch Board shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 2500 amp and above. The fan shall be interlocked with switchgear operation.

o. Earthing

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the can be tap from main earthing.

p. Sheet Steel Treatment and Painting

i. Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

ii. All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

q. Name Plates and Labels

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

2. Testing

Copies of type test carried out at ACB / MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. PMC/Engineer in charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests as per relevant clause of SCC

3. Testing at Site

a. Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboard at site before energizing the switchboards including but not restricted to the following.

i. Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.

ii. Physical checking and inspections of Inter panel wiring

iii. Checking free movement of ACBs/MCCBs/SFUs

iv. Checking of operation of breakers

v. Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.

vi. Primary & secondary injection tests of relays and CTs.

vii. Checking of Interlocking function.

4. Cables

i. Medium Voltage Cables

a. Medium voltage cables shall be aluminium conductor PVC insulated, PVC sheathed armoured confirming to IS 1554. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 mm^2 shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 mm^2 and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Cores	:	Red and Black
3 Cores	:	Red, Yellow and Blue
3.5/4 Cores	:	Red, Yellow, Blue and Black

b. Current ratings shall be based on the following conditions.

i.	Maximum conductor temperature	70^{O} C
ii.	Ambient air temperature	45^{O} C
iii.	Ground temperature	30^{O} C
iv.	Depth of laying	1000 mm

c. Short circuit rating of cables shall be as specified in IS 1554 Part-I.

d. Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the Contractor shall recheck the sizes before cables are fixed and connected to service.

e. M.V. cables shall be PVC insulated aluminium/copper conductor and armoured cables confirming to IS Codes. Cables shall be armoured and suitable for laying in trenches, duct and on cable trays as required. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and un armoured cables.

ii. On Trays/Walls

a. Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of Cable	Size	Clamping by	Fixing Interval
MV	Up to and including 25 sq mm	Saddles 1 mm thick	45 cms
MV & HV	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cms
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cms

Note: The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

b. Cable trays

i. Cable trays shall be fabricated from sheet G.I of required thickness Cable trays, of sizes as per DBR / drawings shall be of perforated doubled bend and shall be complete with tees, elbows, risers, and all necessary hardware.

ii. Trays shall have suitable strength and rigidity to provide proper support for all the contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with two coats of red oxide zinc chromate primer after proper surface preparation and two finishing coats of synthetic enamel paint of approved make. Cable trays shall have side rails or equivalent structural members.

iii. Cable trays shall be mounted on support structure as specified by means of specified size of threaded rods and suitable fasteners. Spacing of the support structure shall be such that the cable trays shall remain perfectly horizontal without buckling when fully loaded with cable runs. The support structure shall be suspended from ceiling slab or grouted to walls in an approved manner. Width of the horizontal arms of the support structure shall be same as the tray width plus length required for threading /bolting /welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers required. Cable trays shall be bolted/ welded to the support structure. Minimum clearance between the top most tray tier and the ceiling shall be 300 mm. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

Cables shall be fixed to the tray by clamps fabricated from minimum 3 mm thick GI sheets. The cables shall be dressed properly so as to provide minimum one cable diameter clearance between adjacent cables and from tray ends. Cable trays shall be earthed by 2 runs of 25 mm x 3 mm GI strips throughout their lengths.

5. LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, medium voltage cables shall be laid above HT cables. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables at entry points to the building, at specified intervals for cables laid direct in grounds and in locations like manholes, pull pits etc.

6. Drawings

Shop drawings for control panels and wiring of equipment showing the route of conduit cable shall be submitted by the Contractor for approval of PMC/Engineer in charge before starting the fabrication of panel and starting the work. On completion, all details like location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

9.0 Commissioning and Guarantees

a) **Scope of work**

The work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the Contractor under this contract.

b) **General requirements**:

a. Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

b. On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

c) Pre commissioning

a. On completion of the installation of all pumps, piping, valves, pipe connections, electrical wiring, motor control panels and water level controlling devices the Contractor shall proceed as follows: -

i. Testing of M.C.C

ii. Tests to be carried out for motor control centres shall be:

iii. Insulation resistance test with 500-volt megger, before and after high voltage test, on all power and control wiring.

iv. High voltage test sat 2000 volts A.C. for one minute on all power and control wiring.

v. Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and the outgoing terminals with switches and contactors in closed position.

vi. Low Voltage continuity test (6 volts) on all control wiring.

vii. Operation test for all feeders with only control supply made 'on' to ensure correctness of control wiring, operation of the various equipment used such as push buttons, protective devices, indicating lamps and relays etc. All contactors shall be checked and there shall be no chattering.

viii. Earth continuity test with voltage not exceeding 6 volts between various non-current carrying metallic parts of equipment, steel work etc. And the earth bus provided in the MCC.

ix. Operation of all instruments and meters provided on the MCC.

b. Pipe work

i. Check all clamps, supports and hangers provided for the pipes.

ii. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant Part of the specifications. If any leakage is found, rectify the same and retest the pipes.

iii. Check all face piping and valves

iv. check air blower connections

d) Commissioning & testing

a. All pumping sets: -Start the duty pump on manual controls, check its operation and then test run on auto controls. Change over the duty pump and test it in the same manner as the first pump.

b. Test runs the entire system to ensure satisfactory performance.

e) Handing Over

a. All commissioning and testing shall be done by the contactor to the complete satisfaction of the PMC/Engineer in charge and the job handed over to the SBI/PMC in-charge or his authorized representative.

b. Contractor shall also hand over, to the PMC/Engineer in charge, all maintenance & operation manuals, 4 sets of as Built drawings and all other items as per the terms of the contract with soft copy.

f) Guarantees

a. The Contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

b. The form of warranty shall be as approved by the PMC/Engineer in charge.

c. The warranty shall be valid for a period of one year from the after getting virtual completion certificate.

d. The warranty shall expressly include replacement of all defective or under capacity equipment. PMC/Engineer in charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

e. The warranty shall include replacement of any equipment found to have capacity lesser that the rated capacity as accepted in the contract. The replacement equipment shall be approved by the PMC/Engineer in charge.

f. The Contractor shall separately submit with this offer his charges per month for operation of mechanical equipment(s) after commissioning and handing over.

xi. **I.S. Codes**

Following codes and Indian standards shall be applicable as amended up to date-

A. Electrical equipment

1. Marking & arrangement for switch gear bus bars, main connections and auxiliary wiring- I.S. 375
2. Direct acting electrical indicating instruments - I.S.1248
3. Metal enclosed switch gear and control gear - I.S. 3427
4. A.C. Contactors of voltage not exceeding 1000 volts. - I.S. 2959
5. A.C. Motor starters of voltage not exceeding 1000 volts. -I.S. 1822
6. Air breaks isolation for voltages not exceeding 1000 volts. -I.S. 2607
7. Heavy duty air break switches and composite unit of air break switches and fuses for voltage not exceeding 1000 volts. - I.S. 4047
8. PVC insulated cables (for voltage Up to 1100 volts with copper/ aluminium conductors) (Section I & II) -I.S. 694
9. Normal duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts. -I.S. 4064
10. Code of practice for earthing - I.S. 3043
11. Pumps & motors
    a. Centrifugal pumps -I.S. 1520
    b. Electrical Motors - I.S.7538
12. Pipes
    a. G.I. Pipes - I.S. 1239
13. Valves
    a. Butterfly Valves -IS 23339/13095
    b. Slim Type NRV -I.S. 7312
    c. Sluice valve -I.S. 780
14. Vibration Eliminator
15. Water Shock Absorbers
16. Pipe Color Code as per - I.S. 2379-1983.

xii. **Technical Information for Water Supply & Drainage Pumps to be furnished by Bidder:**

i. **Pumps**

a. Make
b. Model
c. Pump Discharge - Max/Min
d. Pump Head Min/Max,
e. Impeller Material
f. Motor HP
   (Specify make, class of insulation & rated voltage ± %)
g. Shaft Seal Type & make

h. Type of Coupling
i. Efficiency of Pump
j. Type of Bearings
k. RPM

ii. Pressure Tanks (Where specified)

a. Make
b. Material of Construction
c. Internal finish
d. External finish
e. Air balloon/ diaphragm
f. specifications

iii. Submersible pumps- Plant Room- Sewage

a. Make
b. Model No.
c. Pump discharge lpm - max / min
d. Pump head min/max,
e. Impeller material
f. Motor HP (Specify make, class of insulation & rated voltage ± %)
g. Shaft seal Type & make
h. Type of coupling
i. Efficiency of pump
j. Type of bearings
k. RPM

iv. Motor Control Centers (Give detail on separate sheets if required)

a. Make
b. Type (floor/wall mounted)
c. Make of switch gear
d. Make of meters
e. Make of accessories
f. Confirm that all switch gear starters match the capacities of pumps offered.

v. Power & control cables

a. Make

vi. Electronic Level controllers

a. Make
b. Model No.

vii. Electronic High Water Alarm

a. Make
b. Model No.

Signature of the Bidder with Seal

viii. Electronic Level Indicator

a. Make
b. Model

ix. Pipes /CPVC

a. Make offered
   i. Heavy Class 150 mm dia. & below
   ii. Heavy Class 200 mm dia. & above
b. CPVC Pipe

x. Butterfly Valves

a. Make
b. Material
c. Test pressure

xi. NRV Slim Type

a. Make
b. Material
c. Test pressure

xii. Vibration eliminators

a. Make
b. Material
c. Test pressure

xiii. Pressure

a. Working pressure
b. Test pressure
c. Filtration/holding Capacity
d. Inlet/outlet sizes

xiv. Painting/coating

a. Inside
b. Outside

xv. Equipment- Air Blower Chlorinato

a. Make
b. Model
c. Pump Discharge -Max/Min
d. Pump Head - Min/Max,
e. Impeller Material
f. Motor HP (Specify make, class of insulation & rated voltage ± %)
g. Shaft Seal
h. Type of Coupling
i. Efficiency of Pump

j. Type of Bearings
k. Speed of Pumps

xvi. Motor control centers

a. Type (floor/wall mounted)
b. Make of switch gear
c. Make of panel meters
d. Confirm that all switch gear starters are of capacities for pumps offered.

xvii. Pipe fitting scheduled.

xviii. P.P. Pipe

xix. RCC Pipe.

xx. uPVC Pipe.

xxi. cPVC Pipe.

xxii. Insulation Material

xxiii. Flow Meter.

xxiv. PRV

xxv. Hydro-pneumatic Pump.

xxvi. Water meter.

CHAPTER D

TECHNICAL SPECIFICATIONS - HORTICULTURE WORKS:

1. Scope of work

The work shall in general confirm to the Latest CPWD Specifications for works. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described in DBR, Tender Drawings.

2. **Excavation**

The top excavated soil shall be collected, stacked, preserved for use in landscaping / horticulture works. Surplus top excavated soil may be given to the nurseries or put to use in other Horticulture works.

3. **GRASSING**

a. **Preparation**

i. During period prior to planting the ground shall be maintained free from weeds.

ii. Grading and final leveling of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These ‘bunds’ shall be level just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that he soil has completely settled.

iii. Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.

b. **SOIL**: The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

c. **SOWING THE GRASS ROOTS:**

i. Grass roots (Cynodon dectylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved beforehand.

ii. The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

iii. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

d. EXECUTION:

i. Small roots shall be debbled about 15 cms apart into the prepared grounds. Dead grass and weeds shall not be planted.

ii. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

iii. All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

e. MAINTENANCE OF LAWN

i. As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the ½ to ¾ of an inch necessary for mature grass.

ii. In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

iii. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the Contractor.

iv. Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the Contractor's expense.

v. The Contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

f. **ROLING**: A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering

g. **EDGING**: The Contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the Contractor.

h. FERTILIZING: The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.

i. WATERING: Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil.

j. WEEDING: Prior to regular mowing the Contractor shall carefully remove rank and unsightly weeds.

4. **MAINTENANCE:** The Contractor shall maintain all planted area within the landscape contract boundaries until the period of one year after the completion of project. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape area neat in appearance.

5. **PRUNING & REPAIRS: U**pon completion of planting work on the landscape all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of

roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the SBI. Pruning cuts shall be painted with recommended paints.

6. DIGGING HOLES FOR PLANTING TREES

In ordinary soil, refilling earth after mixing with manure and Watering.

Holes of circular shape in ordinary soil shall be excavated and excavated soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the site as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the Contractor. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the SBI/PMC in - charge.

7. FLOODING THE GROUND WITH WATER AND MAKING KIARIES

The water for flooding shall be of soft water and free from chemical and good for growing the trees and shrubs etc. Before flooding the kiaries shall be made in required size and shape as per directions of Officer-in-charge. After uprooting weeds from the trenched area and uprooting vegetation, kiaries shall be dismantled.

8. SPECIFICATIONS OF PLANTS

The plants should be as per following specification.

i. The plants should be full of fresh and healthy foliage.
ii. The plants should be free from insect, pest and disease.
iii. Plant should be healthy and vigorous growth
iv. The height of the plants will be measured from top of the pots.
v. The plants should be well settled and should not be newly shifted.
vi. The plants should be true to the variety and named Variety should be tagged.
vii. Moss stick used should be made on plastic pipe.
viii. Moss stick should be straight and properly fixed in the pot.
ix. The rejected plants materials should be removed from the site immediately.
x. Moss stick should be covered with the plants in case of plants supplied with moss stick.
xi. The Plant should be well established and good spread.
xii. Good earth and manure used for filling the pot/poly bag free from any inert material and mixed to proper ratio.
xiii. Pot/ Poly bag used for filling the plants should be proper size good quality not damaged.
xiv. There should be proper drainage in pots for plants.
xv. The flowering plants should also have proper flowering and should be true to the variety.
xvi. All plant should have the tendency of growth and should not be stunted type.
xvii. There should be no stagnation of water in the pots.

9. **NURSERY STOCK:** Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be healed

in as soon as received or otherwise protected from dying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly abeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

10. **PROTECTIVE FENCING**: According to local environment shrubs may have to be protected adequately from vandalism until established.
11. **COMPLETION:** On completion the ground should be formed over and left tidy.

CHAPTER –E

TECHNICAL SPECIFICATIONS – ELECTRICAL & LOW VOLTAGE WORKS

1. GENERAL

Office Block and other ancillary facilities as per architectural plan is proposed to be constructed.

2. SCOPE OF WORK

The scope of work shall cover External Installations for Office as mentioned in Design Base Report (DBR) works complete as required for Electrification of proposed Works**.** It shall cover designing of complete Electrical System for the entire complex, preparation of Shop Drawings, supply of all equipment, material, electrical Fixtures & Accessories required, installation, testing and commissioning of all electrical installations, for obtaining Local body statutory approvals CEA/CEIG/etc, for the project for the following, but not limited to, main items/systems:

2.1 ESS & External Electrical Installation

i. 33 KV/ 0.433 kV Sub-Stations - 1 No. (Office) comprising of but not limited to following:

a. 33 KV VCB HT Panel with Battery Charger etc

b. Space & Metering panel, RMU etc room provision as per NDMC requirement.

c. Oil Type Transformers with OLTC & RTCC Panels

d. Main LT Panels with auto change over facility and electrical interlocking.

e. Automatic Power Factor Correction (APFC) Capacitor Panels with Hybrid Active Harmonic filters to improve Power factor & mitigation of harmonics.

f. Sandwich Bus Ducts from Transformers to LT Panel, LT Panel to Capacitor Panels etc.

g. All Associated Equipment & accessories required

ii. independent 33kV underground interconnecting cable from Ring Main System to 33 KV ESS Substations.

iii. Lightening Protection System & Earthing Network

iv. 33kV HT Power Cables, 1.1 kV LT power cables and Control Cables etc.

v. Solar & Conventional Street Light System

vi. Electrical distribution comprising of feeder cables from ESS (Electrical Substation) to individual block, services, Main panel, Rising Mains etc. Separate distribution shall be provided for Lighting load, Power/AC Load. Separate LT panels at each floor shall be provided for feeding power supply and Mechanical Ventilation Fans.

The Electrical distribution should include the following system also need to be considered for IGBC Platinum & Net Zero Building Certification (Energy) to be provided by EPC agency.

Automatic Common area, Utility Rooms lighting shutoff shall be provided through PIR based occupancy sensors.

All Motors shall be IE-5 as per IGBC Norms

LPD as per ECBC 2007 or Latest shall be maintained.

All Exterior lighting shall be controlled by photo sensor or astronomical time switch. Exit signs shall not exceed 5W per face.

All Motors shall be as per latest ECBC.

33KV/.433 KV receiving Sub-Stations as per site condition

Emergency power supplying distribution system as per NBC-2016 for critical requirement for functioning of fire and life safety system and equipment, shall be planned for efficient and reliable power and control supply to the following systems and equipment where provided.

Application of Fire Survival Cable confirming to IS 17505 (Part-1): 2020			
S No. (1)	System Description (2)	Cable Fire Rating Required (°C) (3)	Time for which System should Withstand (Minutes) (4)
(i)	Fire pumps	FS (950/FWS)	180
(ii)	Pressurization	FS (950/FWS)	180
(iii)	Smoke venting including its ancillary systems, such as dampers and actuators	950	60
(iv)	Fire-fightin shaft (staircase, lift,lift lobby)	FS (950/FWS)	180
(v)	Fireman's lifts (including all lifts)	FS (950/FWS)	180
(vi)	Exit signage lighting	950	120
(vii)	Emergency lighting	950	120
(viii)	Fire alarm system		
(a)	Conventional (zone-based system)	650	60
(b)	Intelligent addressable system	650	60
(ix)	Magnetic door hold-open devices	650	60
(x)	Lighting in fire command center and security room	FS (950/FWS)	180

2.2 SPECIAL CONDITIONS FOR ELECTRICAL SERVICES:

a) GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the Contractor shall be complete in all respects.

b) The Contractor shall obtain all sanctions (electrical loads sanction, approval of drawing / ESS/ D.G.'s / Estimate / Lift / approval of meter & Meter Room etc. from the concerned authorities and permits required for the electrical installation work. The actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the Contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to SBI / PMC / Engineer in charge.

c) The SBI shall have full power regarding the materials or work to be got tested through independent agency at the EPC Contractor's expenses in order to prove their soundness and adequacy. The Contractor will rectify the defects/suggestions pointed out by SBI/ independent agency at his own expenses.

d) The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

2.3 DRAWINGS

i. **Shop Drawings:** The Contractor shall prepare detailed coordinated electrical shop drawing indicating Light Points, Power Points, Cal Bell Points, Ceiling Fan, Exhaust Fan Points, Switch Boards, Distribution Boards (Light, Power & UPS), Lighting Fixtures, Convenience outlets, Single Line Diagram for complete HT/ LT electrical scheme, DG Sets, HT Panel, Transformers, LT Panels, Capacitor Panels, RTCC Panels, PCC Panel, UPS Units, UPS Incoming/ Outgoing panels, Lift Panels, Rising Mains, HT/ LT Cable Schedules, Solar PV System, Earth Pit Layout, Earth Strip routes, HT/ LT Cable Routes, Street Light Layout & Street Cable routes, Schematic Diagrams & Floor wise Shop Drawings for all LV works namely, Telephone, LAN, CCTV, Access Control System, Fire Alarm System, Public Adress System, Information Display System, Boom Barriers, MATV etc. with other relevant services and submit to the SBI for approval or the PMC/Engineer in charge before commencing the work.

GA Drawings, SLD & Control wiring diagrams, Room trench details for all HT & LT Panels, Capacitor Panels, UPS panels, Floor Electrical Panels, Transformers, DG Sets, UPS Units, Rising Mains etc. shall be prepared & submitted. The shop drawings shall indicate all setting out details and physical dimensions of all equipment/items/ components with wiring and cable details, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above-mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings shall not relieve the Contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The recommended location/ position of the all equipment as shown on the layout drawings will be adhered to unless stated otherwise.

ii. **As-Built Drawings:**

On completion of the work and before issue of certificate of virtual completion, the Contractor shall submit to the SBI, required Sets of 'As Built' drawings (in AutoCAD

& PDF format) along with soft copy of the executed works incorporating all such changes and modifications during engineering and execution along with Operation and Maintenance Manuals, Warranty & Guarantee Certificates from Original Equipment Manufacturers (OEM), authorized Suppliers & Vendors, as applicable.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of Transformers, HT/ LT Panels, Feeder Pillars, capacitor control panels etc.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- Layout of cable trays with support and their fixing details.
- Location of all earthing station, route and size of all earthing conductor.\
- Layout and particulars of rising mains with fixing details.

The Contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by Contractor and the choice of selection out of the approved list lies with the SBI. For all non-specified items, approval of the SBI shall be obtained prior to procurement of the same. SBI shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

2.4 MANUFACTURER’S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/ equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers’ instructions should be followed.

2.5 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by SBI’s PMC/Engineer in charge, only the best quality materials and equipment shall be used.

2.6 GENERAL DETAILS

a) Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b) Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

c) Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d) Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specifications / General arrangement, whenever it is not mentioned it shall be as given below:

- Installed out door: IP-65.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

2.7 Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels are to be provided & attached permanently in a conspicuous position to all equipment & items installed in various buildings. A rating plate of non-corrosive material engraved with manufacturer's name, year of manufacture, equipment name, diagram, type or serial number etc. together with details of the loading conditions of equipment. The rating plate of each equipment shall be according to relevant BIS & IEC norms, as applicable.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

2.8 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/ soldering/ brazing material for all copper/ G.I. earthing and essential chemicals etc. which will be required to put the equipment/ scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

2.9 DESIGN IMPROVEMENTS / DEVIATIONS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from SBI will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

3. QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-Contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the Contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.
- Qualification data for bidder's key personnel.
- The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- Control of non-confirming items and system for corrective actions.
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring instruments and field activities.
- System for indication and appraisal of inspection status.
- System for quality audits.
- System for authorizing release of manufactured product to the Purchaser.
- System for maintenance of records.
- System for handling storage and delivery.
- A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

3.1. QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment:

- All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- Welder and welding operator qualification certificates.
- Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- Stress relief time temperature charts/oil impregnation time temperature charts.
- Factory test results for testing required as per applicable codes/ mutually agreed quality plan/ standards referred in the technical specification.
- The quality plan with verification of various SBI inspection points as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

4. INSPECTION, TESTING AND INSPECTION CERTIFICATE

- The SBI/ PMC/ duly authorized representative shall have at all reasonable times free access to the Contractor's/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.
- All equipment being supplied shall confirm to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the SBI the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies.
- The Contractor shall give the SBI thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The SBI, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of SBI and he shall forthwith forward to the SBI duly certified copies of tests in triplicate.
- The SBI shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.

- When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the SBI shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the SBI, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the SBI. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the SBI to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the SBI.
- The Contractor shall arrange all necessary tools and testing facilities for inspection purpose including arrangement of air travel (inland as well as abroad), conveyance, lodging, boarding and other miscellaneous expenses etc. SBI shall depute its inspection engineers (2 or more as decided by SBI) after receipt of inspection call from the Contractor. All such expenses incurred by the Contractor towards inspection of equipment by SBI' inspection engineers shall be borne by the Contractor.
- For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by SBI or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- The inspection by SBI and issue of Inspection Certificate thereon shall in no way absolve the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- The SBI will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material complies with the specifications.
- The SBI reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

5. TESTS

5.1. Charging Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the SBI and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant
I.S. given and shall be included in the Contractor's quality assurance programme.

5.2. Commissioning Tests

- The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

- All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment.

6. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. SBI takes no responsibility of the requirement of any special packaging/transporting arrangement.

7. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

8. FINISHING OF METAL SURFACES

8.1. General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

<u>Priming:</u> Priming is not normally required on good quality concrete substrates. However, absorbent surfaces such as porous concrete, sand/cement and cement boards will require sealing (as per manufacturers specification) to prevent absorption of polyurethane waterproofing.

<u>Cracks:</u> All shrinkage and non-moving structural cracks should be pretreated with not less than a 1.3mm coating of polyurethane extending 75mm either side of the crack. Allow to cure overnight before general application.

<u>Application:</u> Single component pitch modified polyurethane should be applied by brush, trowel, squeegee or airless spray (two coat application for standard grade on vertical surfaces) at a minimum wet film thickness of 1.3mm (1.3 litre/m2).

<u>Flood test:</u> Prior to placement of protection, flood to a minimum depth of 50mm of water for 24 hours. Drains shall be plugged and barriers placed to contain the water.

<u>Curing and protection:</u> Polyurethene membrane waterproofing must be cured for a minimum of 24 hours @ 25°C before placing protection. Where damage to the

membrane is possible (by traffic, backfilling, etc) it should be protected by a cementitious screed or protection boards.

For vertical surface: The entire treatment will be taken upto 30 cm on parapet wall or upto parapet projection as per manufacturer's specification.

If a water test is to be run, the membrane should be fully cured.

8.2. Hot Dip Galvanizing

- The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
    - Coating thickness,
    - Uniformity of zinc,
    - Adhesion test,
    - Mass of zinc coating.
- Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

8.3. Painting

- All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating

shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoved.

- Powder coating/electrostatic painting of approved shade shall be applied.
- The exterior color of the paint shall be as per Shade No. 697 of IS-5 or as approved by PMC/Engineer in charge and inside shall be white or as approved by PMC/Engineer in charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.
- In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for SBI’s review and approval.

9. HANDLING, STORING AND INSTALLATION

- In accordance with the specific installation instructions as shown on manufacturer’s drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer’s Engineer(s) and shall extend full co-operation to them.
- In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer’s drawings or instructions, necessary clarifications shall be obtained from the SBI. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer’s drawings/instructions correctly.
- Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- The Contractor shall submit to the SBI every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- The Contractor shall be fully responsible for the equipment/material until the same is handed over to the SBI in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by SBI, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

- The words ‘erection’ and ‘installation’ used in the specification are synonymous.
- Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

10. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

11. DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

12. DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the SBI/ MoHFW during the period of Contract. The Contractor shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

13. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

14. SAFETY CODES & PRECAUTIONS

The Contractor at his own expenses shall arrange for safety provisions as required to comply with the statuary regulations, ISI recommendations and CPWD codes.

The Contractor shall provide necessary barriers, warnings, signals and other safety measures to avoid accidents. He shall indemnify SBI against any claims arising out of negligence in this respect.

15. REGULATIONS AND STANDARDS

All equipment's their installation, testing and commissioning shall confirm latest CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code 2016, ECBC, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall confirm to the Indian Standards specifications and codes latest as amended. Some of the applicable codes/standards are as under:

a.	CPWD General specifications for electrical works	Part-I (Internal) 2023
b.	CPWD General specifications for electrical works	Part-II (External) 2023

c.	CPWD General specifications for electrical works	Part-III (Lifts & Escalators) 2003 & Bill No 22-HLA of 2020/68/11517b dt 24.08.2020 – The Haryana Lifts and Escalators (Amendment) Bill 2020.
d.	CPWD General specifications for electrical works	Part-IV (Substation) 2013
e.	CPWD General Specifications for Electrical Works	Part V, Wet Riser & Sprinkler System - 2020
f.	CPWD General Specifications for Electrical Works	Part VI, Fire detection and Alarm System- 2018
g.	CPWD General specifications for electrical works	Part VII, (DG Sets) 2013
h.	CPWD General specifications for electrical works	Part VIII, Gas Based Fire Extinguishing System - 2013
i.	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353 -1985
j.	Low voltage switchgear and control gear assemblies	IS/IEC 61439
k.	Specification for low voltage switchgear and control gear assemblies	IS 8623 (Part -2-1993)
l.	Code of practice for selection, Installationand maintenance of switchgear and control gear.	IS 10118 Part – 1 - 4
m.	PVC insulated (heavy duty) electric cables	IS 1554
n.	PVC insulated cables for working voltages up to and including 1100V.	IS 694
o.	Conduit for electrical installations	IS 9537
p.	Accessories for rigid steel conduits for electrical wiring	IS 3837
q.	Boxes for the enclosure of electrical accessories	IS 14772
r.	General and safety requirements for luminaries	IS 1913
s.	Code of practice for earthing	IS 3043
t.	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
u.	Low Voltage switchgear and control gear	IS 13947 Part 1 – 5
v.	Residual current operated Circuit Beakers	IS 12640
w.	Current Transformers	IS 2705
x.	Voltage Transformers	IS 3156

y.	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
z.	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.	IS 13947 & IS 1336
	High-voltage switchgear and control gear - Common specifications	IEC: 62271 - 1
	Measuring relays and protection equipment - Part 24: Common format for transient data exchange (COMTRADE) for power systems.	IEC: 60255
	Current Transformers	IEC: 600441-1
	Voltage Transformers	IEC: 600441-2
	Standard Voltages	IEC: 60038
	Switch gear assemblies including metal enclosed bus.	ANSI IEEE C 37/20

In case of contradiction in specification the priority of the documents shall be CPWD/ IS Specifications, Drawings, Technical Specifications.

16. 33kV/ 0.433 kV SUBSTATIONS

16.1. 33 kV VACUUM CIRCUIT BREAKER (VCB) HT PANEL

16.1.1. GENERAL:

Vacuum Circuit Breaker shall be incorporated in HT Panel boards in required combination of incoming panels, coupler panel, outgoing transformer panels & outgoing feeder panels. VCB's shall confirm to IEC 298 and 694, IS 3427, BS 5227 and VDE 0670, Part 6 as well as the regulations mentioned therein. VCB's shall be indoor type & suitable for operation on 33 kV, 3-Phase, 50 Hz AC supply. Metering and protection in the panels as detailed herein after.

16.1.2. TYPE AND CONSTRUCTION:

- The metal clad panel shall be fully extensible and compartmentalized to give.
  a. Circuit Breaker Compartment
  b. Bus bar Compartment
  c. CT and Cable Compartment
- The compartments shall be safe to touch, and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation of metering and protective equipment shall be provided with panel on the front.
- The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalized aluminum oxide. The contacts shall be of chromium copper and butt shaped.
- Vacuum Circuit Breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage

mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the HT Board.

- It shall be horizontal isolation, horizontal draw out type, fully interlocked, with dust and vermin proof construction, suitable for indoor instillation. The panel shall be supplied with the manufacturer’s test certificates.
- The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphate process and shall then be given powder coating (Electrostatic) paint of manufacturer’s standard shade.
- The switchgear constructions shall be such that breaker operation and internal explosions do not endanger the operating personnel, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0 mm thickness. It shall have a rigid, smooth, leveled, flawless finish.
- Voltage transformer of burden not less than 100 VA and of proper ratio as specified shall be provided. The accuracy class for the VT shall be 0.5 as per is 3156 Part 1 to III for incomer and class I for outgoing panels. The PT shall be of cast epoxy resin construction. It shall be fixed/withdrawable type. HRC fuses circuit Breaker shall be provided on both HV and LV side. Adequate space at the rear of the panel shall be provided for the termination of power & control cables. The panel shall be provided with a suitable terminating arrangement for the termination of cables. Burden of PT should match the requirements of the client.
- The making contact arms (upper & lower) of the circuit breaker shall be encased in poly prolene tubes. Penetration type bushings shall be provided in the bus bars & cable compartment for the fixed contacts.
- Safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of bus bars side and cable side individually.
- Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by 1.5 sq. mm, 1.1 kV grade stranded copper PVC insulated wires. All control device shall be MCB type.
- Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 1100 V grade. The LT control circuit shall be routine tested to withstand 1.5 kV for one minute.
- Busbar compartment shall be provided at the rear. Electrolytic copper bus bars shall be of rectangular cross section and insulated. Bus bars shall be supported

properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Bus bars shall be provided with necessary color coding for phases indication. The bus bars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C.

16.1.3. BUSBAR AND REGULATORS

- All bus bars and jumper connections shall be of electrolytic copper confirming to relevant IS Standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross section shall be uniform throughout the length of switch board.
- Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.
- Bus bar insulators shall be of track-resistance, high strength, and non-hygroscopic, non- combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the bus bars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

- **EARTHING AND PROTECTIVE EARTHING**

  Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting. Earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of bus bars & feeder circuits.

- **METERING AND PROTECTION**

  The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection CT’s shall be of accuracy class 5P 10 of 2705- Part –III- 1992. The metering CTs shall confirm to the metering ratio and accuracy class 0.5 of is 2705-1992 for the incomer and Class I for the outgoing panels. Ammeter and voltmeter to be installed on panel shall be digital type. Voltmeter transformer of burden not less than 100 VA shall be 0.5 as per IS 3156 Part-I to Part- III for incomer and class I for outgoing panels. The PT shall be fixed/withdrawable type. HRC fuses/ MCB shall be provided on both HV and LV side. All meters shall be 96mm squire pattern, flush mounting type necessary selector switches. Necessary lamps of low voltage type with built in resistors shall be provided (maximum wattage
  2.5watt. Burden of CT should match with as per requirements.

- **Metering and Protection to be provided in Panels shall be as detailed below: 33 KV HT Panel for Main Receiving Station:**

800A, 33 kV VCB BREAKER
33 KV/110 Volts, 3 phase PT Class -0.5 accuracy and 100 VA burden with 1 No. Voltmeter (0-33 KV), digital type with built-in selector switch and protection MCBs for HT metering up to 33 KV on Incomer (IS-3156)
Ammeter Digital Type with built-in selector switch.
Microprocessor based relay with O/L, S/C and E/F protection. Relay shall be communicable on modbus protocol of IBMS.
dual core dual ratio 3 CTs of suitable ratio 15 VA burden and accuracy Class- 0.5 for metering and class 5P10 for protection. (IS-2705-1992)
calibrated intelligent multi-function digital panel meter of class 0.5 accuracy with communication interface port RS 485 for giving output on MOD BUS protocol of IBMS for receiving V, A, KVA, KVAh, KW, KWH, Hz, KVAR , PF, MDI individual total harmonic distortion with suitable rating CTs etc complete with wiring connections etc.
R/Y/B phase LED indication lamp
Red - ON, Green - OFF, TRIP, TRIP CIRCUIT HEALTHY, SPRING CHARGE, DC ON (LED TYPE).
Push button for Emergency Tripping with 1 NO + 1 NC contacts & inscription plates.
Trip / Neutral / Close Breaker Control Switch.
Master Trip Relays / Lockout Relays / Anti pumping / Aux. Relays/ Over
current/ Earth Fault/ Phase Sequence Relay for Incoming VCB Feeders as required.
BUS COUPLER- 800 A, 33 kV **VCB BREAKER PANEL with:**
Red - ON, Green - OFF, SPRING CHARGED. Indication LED lamps
Trip / Neutral / Close Breaker control switch.
OUTGOING PANELS – 800 A, 33 KV VCB BREAKER PANEL
Ammeter digital type with built-in selector switch.
Microprocessor based relay with O/L, S/C and E/F protection. Relay shall be communicable on modbus for protocol of IBMS.
dual core 3 CTs of 15VA burden and accuracy Class-1.0 for metering and class 5P10 for protection.
R/Y/B phase LED indication lamp
Red - ON, Green - OFF, TRIP, TRIP CIRCUIT HEALTHY, SPRING CHARGE, DC ON and AC ON. Indication LED lamps
Push button for Emergency Tripping with 1 NO + 1 NC contacts & inscription plates.
Trip / Neutral / Close Breaker control switch.
calibrated intelligent multi-function digital panel meter of class- 1.0 accuracy with communication interface port RS 485 for giving output on BACNET / MOD BUS protocol IBMS for receiving V, A, KVA, KVAh, KW, KWH,F, KVAR & PF etc. complete with wiring.
8 window solid state audio/ Visual Annunciators with Test/ Accept/ Reset push buttons and Electronic Hooter.

Master Trip Relays / Lockout Relays / Anti pumping / Aux. Relays/ Over current/ Earth Fault for Outgoing VCB feeder as required.

The Incoming, Outgoing and Bus Coupler feeders for all 33 KV VCB HT Panels shall be motorized operated controlled and monitored through BMS.

Also Incoming, Outgoing and Bus Coupler for all 33 KV VCB HT Panels shall be operated in Manual Mode.

16.1.4. OPERATING MECHANISM

- Vacuum Circuit Breaker shall be equipped with motorized spring charge. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.
- Interlocking and Safety Arrangement- Vacuum Circuit Breaker shall be provided with the following safety and interlocking arrangements:

i. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is 'On'.

ii. The circuit breaker cannot be switched 'ON' when the carriage is in any position between test & service position.

iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.

iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.

v. The door cannot be closed unless the LV plug has been fitted.

vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.

vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.

viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.

ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

- **Rating:** The rating of the vacuum circuit breaker shall be as below

Rated current 800A for I/C and O/G

Panels Rated Voltage 33 KV

Rated Frequency 50 Hz

Rated Breaking capacity 18.37 kA (350

MVA) Rated making capacity as per relevant

standards.

- **Accessories:** Circuit Breakers shall be provided with the following accessories.

  i. Auxiliary Switch with minimum 5 NO + 5 NC auxiliary contacts.
  ii. Tripping Coil
  iii. Mechanical Operation Counter
  iv. Spring Charging Handle

- **Mounting: -** Vacuum Circuit Breakers shall be mounted as per manufacturer's standard practice.

- **Auxiliary Supply**

  a. The tripping shall be at 24 Volt D.C. through a power pack unit or Battery Charger
  b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser's cable.

16.1.5. TESTS

- **Factory Tests**

  The circuit breakers panel shall be subjected to routine tests at manufacturer's works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

  a. Power frequency voltage test on the main power circuit.
  b. Verification of the correct wiring/Functional Test.
  c. Dielectric test at 1.5kV on the control circuit. Apart from above, the Contractor shall submit the routine test certificates for the following equipment.
     i. Circuit Breakers
     ii. Current Transformers
     iii. iii.Voltage Transformers
  d. Temperature rise test.
  e. Impulse & power frequency voltage test
  f. Short time current test on circuit breaker.

- **Site Test**

  General

  1. Verification for completion of equipment, physical damage/deformities.
  2. Alignment of panel, interconnection of bus bars & tightness of bolts & connection etc.
  3. Interconnection of panel earth busbar with plant earthing grid.
  4. Inter panel wiring between transport sections.
  5. Cleanliness of insulators and general Cleanliness of panel to remove

traces of dust, water etc.

Circuit Breaker & Panel

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
2. Manual/Electrical operations of the breaker and Functional test as per drawings.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

16.2. 33 KV HT CABLES

The quantity of 33 kV (E) HT cable required for the following is included in the scope of works of the DBR.

The size & runs of the HT cables shall be decided as per the Electrical Load requirements and rated short circuit capacity of Substations & HT cable Schedule shall be got approved from SBI/PMC/Engineer in charge. The cable shall be (1W+1S) configuration for each feeder from receiving Station to substation.

16.2.1. Construction

All HT cables shall be of 33 kV grade, armored, aluminum conductor, XLPE insulated, earthed & PVC sheathed. All HT cables shall be manufactured & tested in accordance with relevant IS Code Specifications.

16.2.2. 33 KV CABLE JOINTS/ TERMINATIONS

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations & straight through joints.

16.2.3. INSTALLATION OF CABLES

Cable laying in ground, Cable trays , Ducts or fixing on Wall shall be carried out as per CPWD specifications for Electrical works Part II as amended up to date. Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

16.3. LT PANELS

16.3.1. GENERAL

The scope of supply covers design, fabricate, integrate, pack, dispatch to site along with routine testing as per IEC of Low Voltage Switchgear & Controlgear Assemblies up-to 1000 V (Will be termed as ‘ LT Panel ’ here forth). Main LT Panel, Distribution Boards & Sub Panels shall be factory fabricated by Original Equipment Manufacturer or their authorized system integrators/ channel partners. All LT Panels, Distribution Boards & Sub Distribution Panels shall comply with IEC-61439 & manufactured accordingly. The Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3-

phase, 50 cycles system. All LT Panels shall be designed to accommodate suitable ratings of Incoming Feeders, Outgoing Feeders, Bus Couplers etc. to cater to electrical load requirements of various buildings & facilities. All LT Panels & Sub-Panels shall be BMS compatible and wired accordingly so that all relevant electrical parameters can be communicated to BMS system. All necessary wiring, cabling etc between LT Panels, Sub- Panels etc and BMS shall be carried out as per norms. All Incoming & Outgoing feeders of Main LT Panels located in Substations shall be controlled and monitored through BMS System. Incoming Feeders from Transformers & DG Sets shall also be controlled through ACBs, PLC for auto Load change over.

Degree of protection shall be IP-42 for Indoor & IP-65 for Outdoor Panels. All Outdoor Panels shall be weather proof, Double Door with suitable canopy on top. The short circuit current rating of LT switchgears shall be ≥ 50 kA.

All LT Panels shall be provided with necessary instruments for Monitoring & Metering purpose to meet ECBC & IGBC requirements.

All incoming feeders of LT panels shall have R, Y, B, ON, OFF & Trip LED Type indication lamps. All outgoing feeders of LT panels shall have ON, OFF & Trip LED Type indication lamps.

Multifunction meters with BMS compatibility shall be provided in all incoming feeders of all LT Panels to be installed in Buildings. Suitable digital energy meter with CTs, wiring etc. shall be provided for all outgoing feeders of all LT panels to be installed in buildings.

Main LT Panels in ESS buildings shall have Multifunction meters with BMS compatibility in all Incoming Feeders & all Outgoing Feeders.

Site Conditions: The LT Panel will be located indoors and shall be designed to operate satisfactory at rated load under the service conditions. This equipment will be subject to the ambient temperature conditions at the site as specified in the Project Requirements.

a. Location - Indoor,
b. Altitude above main sea level - < 300M above sea level.
c. Design Ambient Temperature - 40 Deg. C
d. Temperature rise - As per IEC 61439
e. Relative Humidity Max - 95%
f. Relative Humidity Min - 10%
g. Pollution - Up to Degree of pollution-3
h. Application - Indoor

16.3.2. CONSTRUCTION

a) Standards

The equipment covered under this specification shall confirm to the latest revisions of relevant Indian and International Standards some of which are listed below:

IEC 61439 part 1 & 2: Low voltage switchgear and control Gear assemblies

IS 13947	1993	: General requirements of Switchgear and Control Gear for Voltage not exceeding 1000 / 1200V AC
IS 11353	1985	: Guide for uniform system of marking Identification of Busbar and Terminals.
IS 13703	1993	: Low voltage fuses
IS 2705	1992	: Current transformers
IS 694	1990	: PVC insulated cables for voltages including 1100 V with Copper and Aluminum Conductor.
IS 1248	1983	: Direct Acting Electrical Indicating Analog
IS 8623	1993	: Low voltage Switch gear & control gear assemblies
IS 5082		: Electrolytic Aluminum Busbar, Trunking system, Rod tubes sections for Electrical Purposes.
IS 13779	1999	: AC Electric Meters / Static Meters.

b) Main/Sub Panels shall be:

i. Made of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.

ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.

iii. Provide dust and damp protection.

iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.

v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

i. A front-framed structure of rolled/ folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal bus bars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of 100 mm height with folded sheet steel of minimum 2 mm thickness. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350 mm.

Doors and covers shall be of minimum 2 mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main/Sub Panels shall have the clearances more than as given below.

i. Between phases - 32 mm

ii. Between phases and neutral - 26 mm

iii. Between phases and earth - 26 mm

iv. Between neutral and earth - 26 mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply with those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/ covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

16.3.3. METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows: -

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.

vii. Paint shade shall be Pebble (light) grey, shade No RAL 7032 unless otherwise specified.

16.3.4. BUS BARS

The bus bars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The bus bars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of at least 50 kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and Creepage distances shall be provided on the bus bar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Cross-section area/ size of aluminum bus bars shall be designed considering current density as 0.8 Amp per sqmm. Likewise, Cross-section area/ size of copper bus bars shall be designed considering current density as
1.2 Amp per sqmm. The main bus bars shall have continuous current rating throughout the length of Panels. The cross section of neutral bus bars shall be same as that of phase busbar for bus bars of capacity up to 200 Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase bus bars. The busbar system shall consist of main horizontal busbar and auxillary vertical bus bars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main bus bars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars to be colour coded with PVC sleeves.

All MCCBs & ACBs shall be provide with spreader links/terminals or Bus Bar extension pieces for easy termination of cables.

Clamp or screw type control terminal blocks shall be provided for outgoing control cables.

All Round Panels Clearance should be maintained as per Standars

Minimum 20% spare terminals shall be provided for future use. Control terminal block shall be separated from power terminal blocks by means of an insulating barrier.

16.3.5. SWITCHGEARS

Refer 16.4 – LT switchgears

Protection Relays:

Provision of Relays like Surge Protection, Over Load, Short Circuit, Earth Fault, Under Voltage & Reverse Power Etc shall be incorporated in incoming Feeders in addition to the relays already inbuilt in the ACBs as mentioned above.

16.3.6. CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminum/Copper conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom throughout the length and depth of the MDB/SDB. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

16.3.7. Auxiliary wiring and terminals:

Wiring for all controls, protection, metering, signaling etc. inside the switchboard shall be done with 1100 V grey colour PVC insulated FRLSH copper conductors. Minimum size of these conductors shall not be less than 1.5 mm2. However, CT circuit wiring shall be done with 2.5 mm2. Control wiring to components fixed on doors shall be flexible type.

10% spare terminals shall always be available in each terminal block. Control wiring up to these terminal blocks shall be done by supplier.

15% spare feeders of various ratings completely prewired shall be supplied in each MCC.

All conductors should be terminated using compression type cable sockets / lugs at both the ends.

Each control wiring termination shall be identified at both the ends by PVC ferrules. The identification termination numbers should match with those on drawings. Suitable size SP MCB shall be used for tapping power for control circuit wiring.

For all motor starter feeders, provision for control wiring to remote ON/OFF control is to be made. The auxiliary wiring for the same shall be brought up to terminal block in the feeder's cubicle.

16.3.8. LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

16.3.9. TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

16.3.10. INSTALLATION, TESTING AND COMMISSIONING

Installations of LT Panels shall be done as per CPWD norms/Specifications.

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine Meggar test. Checks and tests shall include the following.

a. Operation checks and lubrication of all moving parts.

b. Interlocking function check.

c. Insulation Test: As per CPWD Specifications for Electrical Works Part-I (2013)

d. Trip tests & protection gear test.

16.4. LT SWITCHGEARS

16.4.1. AIR CIRCUIT BREAKERS

- **GENERAL**

Air Circuit Breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall confirm to IS 13947 (Part 2) & IEC 60947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

All electrical panels shall be provided with meters & controls suitable for BMS/SCADA control & meeting requirements of ECBC.

- **TYPE AND CONSTRUCTION**

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically draw out type unless otherwise specified) with horizontal draw out carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly.

There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Inter phase barriers shall be provided to prevent flashover between phases.

- **OPERATING MECHANISM**

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

- **INTERLOCKING AND SAFETY ARRANGEMENT**

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

i. It shall not be possible for breaker to be withdrawn when in "ON" position.

ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii. The breaker shall be capable of being racked into 'testing', 'isolated' and ‘maintenance’ positions and kept locked in any of these positions.

iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

- **RATING**

The rating of the circuit breaker shall be as per the DBR/ drawings. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard. Rated service short Circuit Breaking capacity shall be equal to the Rated Ultimate Short circuit breaking capacity (Icu) and short circuit withstand values (Icw) for 1 sec.

- **RELAYS & ACCESSORIES**

  All ACBs (except bus couplers) shall be provided with micro-controller-based release to offer accurate and versatile protections with complete flexibility and in the following zones:

  - Overload (Phase & Neutral) protection with adjustable time delay.
  - Short time protection with intentional delay.
  - Instantaneous protection.
  - Ground fault protection with intentional time delay.

  The release should provide local LED indication for identification of type of fault, without requiring using external power supply. The release shall meet the EMI / EMC requirements.

  Transformer & DG set Incomer ACB releases shall have LED/LCD display showing all Power & Energy Parameters (I, Imax, %loading, Iavg, V, Freq, PF, W, VAr, VA, Wh, VArh, Vah, MD-Active, MD-Reactive, MD-Apparent, Temperature in each Phase).

  The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation, release shall also be connected to aux. supply for display of parameters during off or lightly loaded conditions.

  The ACB should have breaker control through Modbus Breaker control.

  The breaker shall be fitted with following accessories for control, signal and interlocking.

i. Auxiliary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.

iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.

   a) Kit for test/isolated indication.

   b) Kit for service position indication.

   c) Kit for shutter assembly.

iv. Accessories for following interlocking schemes shall be provided.

   a) Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.

   b) Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.

   c) Lockable trip push button.

- **MOUNTING**

  Circuit Breakers shall be mounted as per manufacturers' standard practice.

- **TESTING**

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

16.4.2. MOULDED CASE CIRCUIT BREAKERS.

- **GENERAL**

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall confirm to IS 13947 (Part 2) & IEC 60947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from 0.4In to 1.0 In.

- **Technical Specifications**

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. All MCCB should be 4 poles type unless stated otherwise.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA.

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

The MCCBs shall be provided with following type of Relays for overload, short circuit & earth fault protection in the LT panels boards.

All incoming ACBs /MCCBs of LT Panel boards shall be with Microprocessor based release having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay.

The outgoing MCCBs shall be with Thermal Magnetic type release for with adjustable Overload and fixed short circuit protections. MCCBs of ratings 250A & above shall be provided with Microprocessor based.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

For Motor application, motor duty type MCCBs shall be selected with reference to Type 2 coordination chart provided by the manufacturer.

- **CONSTRUCTIONS**

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

- **BREAKING CAPACITY**

All MCCB shall be 4 pole type except in the starters where 3 pole type to be

provided. All MCCBs shall have following short circuit current rating/breaking-

(i) MCCB Below 250A in Main LT Panel rating – 50 kA

(ii) MCCB Below 250A in Other Panels rating – 25 kA

(iii) MCCB above 250A - 630A in All Panels rating – 50 kA

The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=Icu).

- **TESTING**

a. Original test certificate of the MCCB as per Indian Standards (IS) 315C- 8370 shall be furnished.

b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

MCB units shall be used up to and including 63 A. MCCB units shall be used above 63 A upto & including 630 A. ACB shall be used for 800 A and above ratings.

16.5. MEASURING INSTRUMENTS, METERING & PROTECTION

16.5.1. GENERAL

Direct reading electrical instruments shall be in confirmity with IS 1248. The accuracy of direct reading shall be 0.5 for voltmeter and 0.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per DBR/Drawings.

16.5.2. DIGITAL AMMETERS

Ammeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

16.5.3. DIGITAL VOLTMETERS

Voltmeters shall be standard digital type. The voltmeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

16.5.4. CURRENT TRANSFORMERS

Current transformers shall be in confirmity with IS: 4201 - 1983 as amended up to date in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring:	Class 0.5 to
1 Protection:	Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50 KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type

16.6. MISCELLANEOUS

- Control switches shall be of the heavy-duty rotary type with escutcheon plates

Signature of the Bidder with Seal

clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

- Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

- Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

16.7. LT CABLES

16.7.1. GENERAL

LT Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications as per given below. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums.

Total number of runs and size of LT power cables shall be designed so that the distribution losses do not exceed 3% of the total power usage in the system as per ECBC norms.

CODES OF PRACTICE GUIDE		
S. NO.	Reference	Description
1	IS 694: 1990 IEC 60227 - 1 to 5: 1979	PVC insulated cables for working voltages up to and including 1100 V
2	IS 694: 2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V: Part general requirements(fourth revision)
3	IS: 7098: 1988 (Part-I)	XLPE insulated (heavy duty) electric cables. For working Voltages up to and including 1100 V (third revision)
4	IS 4288: 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and 1100 V (second revision)

16.7.2. CABLE CONDUCTOR MATERIAL

a) The LT Power cables shall be XLPE insulated, PVC sheathed, copper conductor armoured cable for sizes up to & including 16 sqmm, unless otherwise stated.

b) For LT Power cable sizes above 16 sqmm, cables shall be XLPE insulated, PVC sheathed, Aluminium conductor armoured cables, unless otherwise stated.

c) LT Control cables shall be XLPE insulated PVC sheathed type copper conductor armoured cables, unless otherwise stated.

d) All LT Power & Control cables shall confirm to IS: 7098: 1988 (Part-I) with up to date amendments.

16.7.3. INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of PMC / Engineer in charge. Cable laying shall be carried out strictly as per CPWD specifications.

16.7.4. INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

16.7.5. JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. This apportioning shall be got approved from PMC/Engineer in charge before the cables are cut to lengths.

16.7.6. LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 meter. Cables shall be laid at depth of 0.75 meters below ground level for LT Cables and 1.20 meter below ground level for HT cable. A cushion of sand total of 250 mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3-meter-long loop shall be provided at both ends of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

16.7.7. CABLE ROUTE MARKERS:

Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

16.7.8. PROTECTION OF CABLES:

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Hume Pipes for road crossing of the cables the shall be laid at a depth of 1000 mm.

16.7.9. EXCAVATION & BACK FILL

All excavation (hard rock, soil, cc road, bt road etc,.) and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, sidewalks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the SBI/PMC in - Charge.

16.7.10. LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING

Cable shall be laid on Ladder/perforated HDGI. Cable tray Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

16.7.11. CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hanger racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required. Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

16.7.12. CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

16.7.13. TESTING OF CABLES

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

i. Before laying.

ii. After laying.

iii. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion of cable laying work, the following tests shall be conducted in the presence of the SBI/PMC in Charge.

i. Insulation Resistance Test (Sectional and overall).

ii. Continuity Resistance Test.

iii. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such test

16.8. CABLE TRAY

16.8.1. Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. Ladder type cable trays shall be Hot Dip Galvanized as per IS-2629 latest as amended. Zinc coating/ galvanizing shall be applied uniformly and thickness of zinc coating/ galvanizing shall not be less than 65 microns.

16.8.2. Perforated Type Cable Tray with Cover

I. The cable tray shall be fabricated out of slotted/perforated Hot Dip Galvanized (HDG), M.S. Sheet as double bended channel section. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. All cable trays and its accessories, supporting structures, suspenders etc. shall be Hot Dipped Galvanized only as per relevant IS- Codes. Zinc coating/ galvanizing shall be applied uniformly and thickness of zinc coating/galvanizing shall not be less than 65 microns.

II. Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II - External, 1994 as amended up to date. The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section.

III. Two coupler plates, each of minimum 200 mm length, shall be bolted on each of the two sides of the channel section with 8 mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

IV. The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II - 1994. The sizes shall be specified considering the same.

V. The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100
mm. The overall width of one cable tray shall be limited to 900 mm.

VI. Dimensions of Cable Trays shall be as following:

Sr	Width	Depth	Thickness
1	100 mm to 300 mm	50 mm	2 mm
2	375 mm to 450 mm	62.5 mm	2 mm
3	600 mm to 900 mm	75 mm	3 mm

VII. Factory fabricated bends, reducers, tee/ cross junctions, coupler plates etc. of suitable size shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II-1994 or as amended up to date. The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

VIII. The cable tray shall be suspended from the ceiling slab with the help of 10mm dia, Hot Dip Galvanized (HDG), MS rounds or 25 mm X 5 mm (HDG) flats at specified spacing as per CPWD General Specification of Electrical Work Part II -2023 or as amended up to date. Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50 mm x 50 mm x 5 mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by Client to take the weight of the cable tray with the cables.

IX. The entire cable trays including all accessories like bends, reducers, coupler plates, tee/cross junctions etc and supporting structures like rods, suspenders, angle, channels etc shall be Hot Dip galvanized as per IS-2629 Code latest as amended.

X. The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.The cable trays shall be measured, in case of item rate contracts, on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

16.9. SANDWICH BUS DUCTS/TRUNKING, RISING MAINS

16.9.1. Scope:

These specifications are intended for design, manufacturing, Supply, Installation, testing & commissioning of 3 Phase 3 Wire / 3 Phase 4 Wire (100% Neutral) / 3 Phase 5 Wire Sandwich type Aluminum Busbar Trunking System.

16.9.2. System details:

The Busbar Trunking System shall be suitable for operational Voltage of 415V / 690V / 1000V with supply frequency of 50Hz, minimum insulation voltage of 1100V & impulse withstands voltage of 12 kV.

16.9.3. Standards:

The Busbar Trunking System shall be designed to comply in accordance with the following international standards,

IEC 61439 – Part 1 : Low voltage switchgear & controlgear assembly- General

rules IEC 61439 – Part 6 : Busbar Trunking Systems (busways)

IEC 60529 : Degree of protection

IS 8623 – Part 2 : Specification for Low Voltage Switchgear & Controlgear Assemblies

IS 1893 – Part 1 : Criteria for Earthquake Resistant Design of

Structures IEEE 693:2005 : High Seismic Qualification Level Wherever

required and specified, the Busbar Trunking System shall confirm to

Fire Rating of 600 deg C for 2 Hours.

Busbar Trunking System should also have Seismic Zone-5, Flame Propagation and Fire Resistance certification.

16.9.4. Manufacturer:

The manufacturer must have an established track record in design and manufacture of sandwich busbar trunking system, and must have supplied busbar trunking systems for at least 20 years.

16.9.5. Design & Construction requirements:

- General:

  The Busbar Trunking System shall be of sandwich construction, non-ventilated and natural cooled design. It shall be possible to mount the Busbar Trunking System in any orientation without affecting the current rating.

- Bus bars:
  - The bus bars should be made of high conductivity electrical grade Aluminum with conductivity >60%
  - Purity of Aluminum conductor should not be less than 99.6%
  - Aluminum bus bars should be Tin plated at the joint area
  - Provision for mounting external earth strip to be provided on both side of busduct. 2 Nos. Copper earth strips of appropriate size shall be provided for the complete run of bus bars enclosure.

- Insulation:
  - Each bus bar shall be individually insulated by means of Multi-Layer Class-F Insulation, each layer shall have withstand breakdown voltage of minimum 6 kV.
  - The insulation material used shall be of minimum Class F (155 deg. C)
  - Insulation must be Halogen free & RoHS compliance

- Housing:

  The housing shall be made of minimum 1.6 mm electro-galvanized sheet steel, epoxy powder coated with RAL7032 shade. Enclosure must be dust & vermin proof IP rating of indoor busduct must be IP-54 / IP-55 & Outdoor busduct should be IP- 65 / IP-66 with canopy.

- Joints:
  - The joint design shall have inbuilt provision of absorbing expansion & contraction of 12mm per joint during operation.
  - The joint insulation must be of single piece moulded design of thermoset material for longer life and higher temperature withstand & better insulation property.
  - The joint construction must allow +/- 3mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
  - The joint bolt must be insulated with a bolt insulator. The bolt insulator must be of moulded one piece.
  - The joint design shall have inbuilt provision to prevent excessive insertion of busduct which can damage the bolt insulator.
  - The busbar ends shall not have holes or slots at the joints to avoid reduction in cross section area which will lead to temperature increase. The electrical continuity shall be through pressure plates, achieving a high contact area of joint cross section and expansion capability.
  - It shall be possible to install and remove the joints without disturbing the

adjacent feeder section

- Joint set should have insulators with temperature withstand capacity of class-F

- Plug-in Unit / Tap off units:
  - Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and with drawl. Plug in boxes will be made from 1.6 mm CRCA sheet steel powder coated.
  - Each section of Bus Bar enclosure plugs in ports spread at interval of approximately 600 mm for the insertion of plug in boxes.
  - Inside the plug in Boxes MCCB will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with bus bar trunking so that it cannot be inserted or removed with the plug in box lid open. MCCB will be of 4 pole type. Short circuit breaking capacity of MCCB in Plug in Box should be same as that of bus trunking i.e. 50 KA.
  - When the MCCB in the Plug-in unit is in ‘ON’ position, the operator should not be able to open the door.
  - The design of plug-in units shall be such that, the PE conductor shall be of ‘First-Make’ ‘Last-Break’ type.
  - The Plug-in unit will be suitable for accommodating MCCBs or other accessories, as required. The Plug-in unit should allow the flexibility of accommodating different reputed MCCB makes, to be mutually agreed depending on the tender requirements.
  - Plug-in unit must achieve IP-54 protection
  - Plug-in units should be plug-in type up to 400A & Bolt-on Type from 630A
  - It should be possible to offer Bolt-on Type Tap-off Box for 100A & higher ratings to withstand vibration due to crane movement, heavy machines in industries

- **Routine & Type Tests:**
  - The busduct shall be type tested at a reputed test laboratory (certified by ASTA or ERDA) for the tests as per IEC-61439 Part-1 (Low voltage switchgear & controlgear assembly- General rules) & Part 6 (Bus bar trunking systems & bus ways)
  - Short circuit testing of busduct should be for duration of 1 Sec. Neutral & Earth conductor should also be tested for 60% short circuit rating of phase conductor
  - Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory as per IEC-60529
  - Dielectric test.
  - Busduct should be tested for minimum Seismic Zone-4 & High Seismic Qualification level as per IEEE:693

- **Installation: -**

  The Bus Section shall be joined together with flanges and tie bolts. Bus trunking shall be suspended at a uniform height as per site conditions above floor/Ground level with suitable MS suspenders and MS supports duly Hot dip Galvanised.

16.10. CAPACITOR PANEL & HYBRID HARMONIC FILTER

16.10.1. SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor upto unity from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C. Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement.

Hybrid Harmonic filter shall comprise two separate panels for harmonic correction and power factor improvement. Harmonic compensation shall be done through IGBT based Active Harmonic filter and Power factor correction shall be done through Automatic Power Factor Correction panels with passive detuned filters.

- **RATING**

The rating of Capacitor units shall be as per CPWD specifications for Electrical Works (Part - 4) Substations 2013.

16.10.2. ACTIVE HARMONIC FILTER

- Active Harmonic Filter to mitigate low voltage system harmonics

The Active Harmonic Filter (Type AHF) is intended to remove harmonic distortion from the phase conductors in a 3-phase electrical system resulting in reduced phase current, reduced current distortion and reduced upstream electrical system harmonic voltage distortion.

- Principle of operation

AHF should measure level of harmonics in supply line and eliminate it by generating the counter harmonics. It should employ a DSP which determines the harmonic current amplitude to be injected in the opposite phase angle of each harmonic order.

The active filter shall not only provide harmonic mitigation, but also, power factor correction and load balancing. Harmonic correction, PF correction and Unbalance correction should be able to set with priority and filter should work to employ the priority as per the user settings.

a. The active harmonic filter shall mitigate harmonics from the 2nd harmonic up to the 15th harmonic and limit harmonic distortion at their point of connection to within the harmonic limits specified herein. The active filter shall be connected in parallel (shunt) to the load.

b. The active filter shall be suitable for connection at an electrical distribution panel, transformer secondary or at an individual load.

c. The active filter shall be suitable for connection to a distorted voltage source and its operation shall not be adversely affected by pre-existing voltage distortion.

d. The active filter shall be suitable for operation on an electrical system having a generator as its power source.

e. AHF should have high attenuation up to 96% of individual harmonics

f. AHF shall allow user to select any 10 order of harmonics out off 2nd to 15th harmonics order.

g. It should be possible to use filter for single harmonic elimination

h. PF compensation should be leading as well as lagging

- Following features are essential requirements for the point of reliability

a. For capacities from 100 Amp onwards the filter design should adapt modular construction

b. The display should be Touch screen SVGA display with true RMS readout & FFT analysis. The wave form should be visible on the display.

c. High grade cooling fans shall be used.

d. In case of future repair requirements, the same shall be done through card level replacement and not the whole module

- Electrical Ratings:

a. System Voltage: 433V AC ± 10%, 3ph 4 Wire/3 wire

b. Line voltage tolerance: ±10%

c. System Frequency: 50 Hz

d. Frequency tolerance: 50 Hz ± 5%

e. Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

f. Current transformers shall be with Class 1 or better with 15VA rating.

g. Flexibility to select CT ratio shall be available.

h. Remote indication contacts: 1No. potential free contact.

i. Surge withstand capability per ANSI/IEEE STD C62.41-1991.

j. Should comply with IEC/IEEE 62040 – 2 category C3

- Basic Product Requirements

The active harmonic filter shall meet the following basic requirements: -

1. Active filters shall include input surge suppression.
2. Active filters shall include forced air cooling system.
3. Active filter shall be able to connect in both open loop and closed loop configuration
4. Active filter should have a HMI touch screen display having the functionality of a power analyzer and should display Load side, supply side and filter parameters as mentioned below-

a. Voltage
b. Current
c. Power factor
d. Filter Temperature
e. Voltage and current waveforms
f. Voltage and current Harmonic spectrum
g. Active, Reactive & Apparent Power
h. Alarm indications & log details

5. Active filter shall be isolated from the power supply when powered “off”.
6. IGBT modules shall be self-protected for maximum reliability.
7. Each power module shall have its own independent set of fuses.
8. The response time shall be atleast 1 ms and the correction time shall be 20 to 40 ms
9. AHF shall have inbuild logic to avoid over-loading without tripping.

- Construction:
  1. Constructed on metal panel with minimum IP 42.
  2. Filter shall be suitable for operation within an ambient temperature between 0ºC and 50ºC.
  3. Shall be able to work with higher temperature with automatic de-rating.
  4. Storage temperature shall be from 0ºC to 70ºC.
  5. Active filters shall be suitable for operation in relative humidity up to 95% non- condensing.

16.10.3. SECTION 2 - APFC Panels with passive filters:

Automatic Power Factor Correction panel shall be totally enclosed, metal clad, sheet steel fabricated, fixed feeder type, dust and vermin-proof, free standing, floor mounting type. The enclosure shall be pre-treated as per 11 tanks process and finished with powder coating of shade RAL 7032. The panel shall be factory build to ensure

Step-less Power Factor Correction (for both leading and lagging current), Control response time: 25μs

Harmonics Compensation up to 51st order (2nd priority)

Load Current Balancing in the three phases (3rd priority)

- Proper thermal design, by providing louvers and fans in appropriate location,
- Accurate selection of switchgear, capacitors-reactors and others in the panel.
- Safety during operation, inspection and maintenance

16.10.4. BASIC Design Specifications

An automatic power factor correction relay, microprocessor based, with arrangement for sensing the power factor of the inductive load (maximum 14 channels) and giving signal to the feeders of power capacitors as per the setting of P.F. and electronic circuit to ensure that once a capacitor gets cut off, it is not put on at least for a minute. The relay should automatically manage capacitor banks according to the reactive power required to correct the power factor of the load to the power factor set on the relay. The capacitors must be turned “on” and “off” to correct the power factor of the load to the power factor set on the relay. The relay should have automatic and manual mode of operation with an LED to indicate the operating mode. The auto / manual function makes it possible to turn the capacitor banks “on” and “off” manually regardless of the line value measured.

Rated System Voltage	440 V / 415 V / 380 V / 400 V
Rated Frequency	50 Hz
Short Circuit Rating	> 30 kA
Altitude	1000 m
Duty	Continuous
Ambient temperature	-5° C to 50° C
Power Supply	Three phase, four line
Relay current input	-- / 5A, from CT on line
Signal	
Enclosures	The load bearing structure is made of 2 mm sheet steel
	The front door and partition are made of 1.6 mm sheet steel
	The internal switchgear components are accessible on opening the front door and Capacitors & Reactors shall be accessed through back door
	Ingress protection - IP42
Installation	Indoor, wall mounted (up to 100 kVAr), floor mounted (100 kVAr and above) in a well-ventilated, non-dusty environment, cable entry from bottom
Control	Auto + Manual
Incomer	3 Pole MCCBs up to 630 A (400 kVAr) , 3 Pole ACBs above 630 A (above 400kVAr)

Other important features required are:

- Various system parameter displays on APFC Relay
- Fully automatic / manual setup and operation
- Minimal joining in all the connections to ensure better reliability and lower losses.
- Use of special connecting cables suitable for high temperature withstands.
- Flush mounted meter to indicate line voltage and current.

16.10.5. CAPACITOR BANK:

The capacitor shall comply with the following standards (and their latest amendments): IS 13340-1993, IS 13341-1992, IEC 60831-1+2

Capacitor voltage shall be minimum 480 V when used with 7% reactors.

Capacitors shall be MPP Heavy Duty type/ Gas filled type. The capacitor element used in unit shall have metallized polypropylene film (MPP) having low loss dielectric and impregnated with such impregnate, which shall have high dielectric constant, low viscosity and high chemical stability. The impregnate should be resin filled. The capacitor unit shall have over pressure dis-connector protection. Discharge resistance shall reduce the residual voltage to less than 50 volts within one minute

General specifications:

- 3 phase, delta connected, 50 Hz
- Overvoltage +10% (for 8h / 24h), + 15% (for 30m / 24h), + 20% (5m/24h), +30% (1m/24h)
- Overcurrent: 1.8 x In
- Peak Inrush current withstand: 250 x In
- Total watt-losses: < 0.45 W / kVAr
- 6000 switching operations per year
- IEC 60831

16.10.6. DETUNED FILTER

- Detuned harmonic filter reactors shall be used along with power capacitors to mitigate harmonics amplification and to avoid electrical resonance in LV electrical networks.
- The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin. The insulation shall be Class H.
- The reactors shall be made of high grade aluminum windings, having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60289 / IS 5553.
- The permitted tolerance of inductance is ± 3% of rated inductance value.
- Reactor tuning factor shall be 7 % (189 Hz) and the current rating of the reactor shall include the effects of harmonics and other possible over-currents.
- The limit of linearity of inductance of the filter reactor is: 1.8*In with L=0.95*LN.
- The reactor shall be fitted with a temperature sensitive micro-switch in the center coil (normally open) for connection to trip circuits in case of high operating temperatures.
- Power loss in each reactor shall be less than 5 W/kVAr
- Each reactor shall have routine test certificate for the above tests.
- All the reactor shall be copper wound.

16.10.7. Contactor

- All contactors shall be AC6B duty 3 pole air-break, magnetic, capacitor duty type. The rating of contactor shall be suitably assigned. The contactors shall be so chosen as to withstand inrush current due to parallel switching. Contactor should be with damping resistors to limit capacitor charging current

- The individual capacitor bank/step shall be switched automatically / manually with selector switch as required using magnetic contactors suitable for switching capacitive currents. The contactor coil voltage shall be as specified.
- The minimum life expectancy of the contactor shall be one million switching operations
- Contactor should be with surge suppressor
- Operation voltage up to 690V
- Insulation voltage 1 kV
- Rated impulse withstand up to 8 kV

16.10.8. APFC Controller

The APFC controller should be microprocessor based and should correct power factor with the help of contactors by switching the required no. capacitor banks

The controller should offer power factor correction without any need for manual intervention. The controllers should decide optimum configuration of capacitor banks in order to achieve desired power factor by taking into consideration the kVAr of each step, no of operations, total usage time, re-connection time of each step etc. Besides manual switching of capacitors should also be possible directly through the controller, The APFC controller should have the following basic features

- Backlit LCD display with multiple parameters displayed at the same time
- Auto step programmable
- Capable of measuring VTHD and ITHD values at least up to 15th order
- Automatic CT reversal sensing and correction
- Should be 1A / 5A CT selectable.
- Sensing shall be done at LT as well as HT side of the transformer
- Display of average weekly power factor
- Keypad lock feature to prevent operation by unauthorized persons
- Alarms for under/over compensation, high VTHD/ITHD, over temperature, capacitor failure, capacitor over-current, over/under voltage
- Individual capacitor’s ON/OFF status and capacitor failure indication
- Temperature sensing feature with alarm in case of panel over heating
- Should have RS485 communication protocol.

16.10.9. SWITCHGEAR & PROTECTION:

Suitable capacity duty contactor for each step shall be used and must be capable of capacitor switching duty. Bus bars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100-volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided.

Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

16.10.10. TESTS AT MANUFACTURER'S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor bank's as amended up to date shall be carried out at manufacturer's works and test certificates to be submitted.

TEST AT SITE:

Insulation resistance with 500 V DC Meggar shall be carried out and test results should be recorded.

Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resister shall be tested for its working.

16.10.11. INSTALLATION:

Capacitor bank shall be installed at least 30 cm away from the walls on suitable frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.

Contractor shall also submit four sets of installation and maintenance manual

17. EARTHING & LIGHTENING PROTECTION SYSTEM

Earthing system shall confirm to CPWD General Specifications for Electrical Works (Part I- Internal), 2013. Earthing system shall comprise of suitable nos. of Earthpits with GI & Copper Plate electrodes as per IS-3043 & CPWD specifications.

Neutral Earthing with suitable size Copper strips and Copper plate earthpits for Transformer, DG Sets and other equipment as specified by OEMs shall be provided. earthing of all sus. The body earthing for transformers, DG, HV & MV panels shall be done separately (2 Nos. for Each equipment) and shall also made a common earth bus network.

Like for a single transformer, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing).

17.1. ELECTRODES

The earth electrodes shall be as per CPWD General Specifi cations for Electrical Works (Part I- Internal), 2013.

17.2. LOCATION OF EARTH ELECTRODES

Distance of earth electrode from any building and other earth electrode shall be as per CPWD specification & IS codes. Care shall be taken that the excavation of earth electrode may not affect the column footings or foundation of the building. In such cases electrodes may be farther away from the building. The location of the electrode earth will be a place where the soil has reasonable chance of remaining moist. As far as possible, entrances, pavements and road ways, are to be definitely avoided for locating the earth electrode.

17.3. WATERING ARRANGEMENT

Method of watering arrangement shall comply with CPWD general specifications.

17.4. SIZE OF EARTH LEAD

The recommended sizes of copper earth bus lead in case of Sub-stations shall be in accordance with General Specifications for Electrical Works (Part I-Internal), 2013 amended upto date. The minimum size of earth lead shall be 25 mm x 5 mm copper or equivalent GI strip.

17.5. INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

17.6. TESTING

After installation, the tests as specified in CPWD General Specifications for Electrical Work (Part I-Internal), 2013 shall be carried out and results recorded LIGHTENING PROTECTION SYSTEM

Lightening Protection System shall be provided for all buildings, blocks and facilities constructed under this contract as per IS/IEC-62305:2010 amended up to date and NBC 2016. However, All earth pits shall be GI maintenance free chemical earth pits. Finial shall be of GI material and for earth grid/mesh & downcomers, required size aluminium round conductor shall be used.

18. SAFETY REQUIREMENTS

Safety provisions shall be generally in confirmity with appendices (A) and (C) of CPWD General Specifications of Electrical Works (Part I-Internal), 2013. In particular, following items shall be provided:

(i) Insulation Mats

Insulation mats confirming to IS 15652: 2006 shall be provided in front of of all HT & LT Panels as well as other control equipments as specified.

(ii) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing required materials should be provided in each sub-station.

Signature of the Bidder with Seal

(iii) Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enameled white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

(iv) Fire Extinguishers

Portable CO2 confirming to IS 2878: 1976/ chemical confirming to IS 2171: 1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

(v) Fire Buckets

Fire buckets confirming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

(vi) Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

(vii) Caution Board

Necessary number of caution boards such as “Man on Line” ‘Don’t Switch on’ etc. shall be available in the sub-station.

(viii) Key Board

A keyboard of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas

19. 33KV/0.433 KV OIL TYPE TRANSFORMER (ON LOAD TAP CHANGER WITH RTCC TYPE)

19.1. GENERAL

Power transformers shall be oil-immersed, ONAN (Oil Natural Air Natural) type, equipped with On-Load Tap Changers (OLTC) and Remote Tap Changer Control (RTCC) panels, suitable for outdoor installation. The transformers shall be rated for 33 kV / 433 V, 50 Hz, Dyn11,3-phase operation.

All transformers shall be of ON LOAD TAP CHANGER type, complete with associated RTCC panels and necessary accessories for remote and local operation.

The design, manufacture, testing, and performance of the transformers shall conform to the latest applicable IS/IEC standards, relevant safety codes, and statutory regulations of the region where the transformers are to be installed.

Transformer losses at 50% and 100% loading, as well as percentage impedance, shall comply with the Energy Conservation Building Code (ECBC) 2017, specifically in line with the requirements in Table 7.1 of ECBC-2017, including all up-to-date amendments.

The LT Panel connected to the transformer’s secondary (incoming feeders) shall be provided with metering-class Current Transformers (CTs) and Potential Transformers (PTs) to facilitate periodic monitoring of transformer losses and energy performance over time.

19.2. CODES AND STANDARD

The transformer shall be designed, manufactured, and tested in accordance with the latest revisions of:

- IS 2026 (Power Transformers)
- IS 1180 (Part 1) for Distribution Transformers up to 2500 kVA
- IS 335 (Insulating Oil)
- IEC 60076 and other relevant international standards as applicable.

19.3. SERVICE CONDITION

Location: Outdoor Installation
Ambient Temperature: Up to 50°C
Relative Humidity: Up to 100%
Altitude: Up to 1000 meters above MSL
System Frequency: 50 Hz
System Voltage: 33 kV / 433 V or as specified
Type of System: 3-phase, 3-wire / 4-wire AC system

19.4. RATING AND TYPE

The transformer shall be of oil-immersed, naturally air-cooled (ONAN) type, suitable for outdoor installation. It shall be rated for a capacity as specified (2500KVA/2000kVA), with a primary voltage of 33 kV and a secondary voltage of 433 V, operating at 50 Hz frequency. The transformer shall be three-phase, with a vector group of Dyn11. Provision for voltage regulation shall be made through on-load tap changers (OLTC) & RTCC, with a tapping range of ±5% in steps of 2.5%, as per project requirement.

19.5. WINDING

Windings shall be manufactured using electrolytic grade copper, with proper insulation and layering to ensure mechanical strength and thermal performance. The windings shall be designed to withstand specified short-circuit forces and thermal limits. Coil construction shall ensure uniform distribution of voltage stresses. All windings shall be properly dried and vacuum impregnated to remove moisture content.

19.6. CORE

The transformer core shall be constructed from high-grade, cold-rolled grain-oriented (CRGO) silicon steel laminations of high permeability and low loss. Laminations shall be coated with an inorganic insulating material to minimize eddy current losses. All lamination edges shall be deburred and stress-relieved through annealing to eliminate residual stresses. The core structure and clamping arrangement shall ensure mechanical rigidity, preventing displacement during transport, handling, and under short-circuit conditions. All iron parts, excluding the active core, shall be hot-dip galvanized or painted with high-temperature resistant coatings. Core clamping shall be insulated to prevent local losses and hotspots. The core shall be designed to withstand up to 10% over-fluxing without damage, corresponding to rated voltage conditions. Suitable lifting lugs shall be provided for lifting the entire core-coil assembly during maintenance or inspection.

19.7. INSULATION

Inter-turn and inter-coil insulation shall be designed to ensure uniform distribution of dielectric stress throughout the winding under all operating conditions. The entire winding system shall be insulated using materials conforming to Class 'F' insulation, suitable for high thermal endurance. All insulation components shall be free from defects, moisture, and contaminants, and shall be compatible with insulating oil.

19.8. TEMPERATURE RISE

The temperature rise of the winding shall not exceed 55°C and that of the oil shall not exceed 50°C above an ambient temperature of 50°C, as per IS 2026/IS-1180. Under no condition shall the operating temperature cause deterioration to insulation, core, or any adjacent components. The transformer shall be designed for safe operation under continuous full load without thermal stress to internal components.

19.9. TAP CHANGING:

An On-Load Tap Changer (OLTC) shall be provided on the High Voltage (HV) side, with tap variation from +5% to -15% in steps of 1.25%. The OLTC shall be controlled through an Automatic Voltage Regulator (AVR), complete with stepless automatic control, position indication lights, locking device, and a separate Remote Tap Changer Control (RTCC) panel. The system shall ensure stable output voltage and smooth tap shifting during load operation.

19.10. VECTOR GROUP:

The transformer shall be connected in Dyn11 vector group configuration. This ensures proper phase displacement suitable for parallel operation, suppression of triplen harmonics, and compatibility with distribution networks.

19.11. IMPEDANCE

The percentage impedance of the transformer shall comply with the provisions of IS:1180 / IS:2026, and shall also meet the Energy Conservation Building Code (ECBC-2017) requirements. Typical impedance shall be 4%, unless specified otherwise, to ensure effective fault current limitation and system coordination.

19.12. FLUX DENSITY

The transformer core shall be designed such that the maximum flux density does not exceed 1.6 Tesla at rated voltage and frequency. This shall prevent core saturation during normal operation and reduce magnetization losses, ensuring high efficiency and thermal stability.

19.13. CURRENT DENSITY

The winding conductor shall be sized such that the current density does not exceed 2.2 A/mm² at rated full load conditions. This ensures thermal stability, improved efficiency, and long insulation life under continuous operation.

19.14. COOLING

The transformer shall be cooled by Oil Natural Air Natural (ONAN) method. Heat generated in the core and windings shall be dissipated through circulating mineral insulating oil, which in turn transfers heat to the ambient air via radiators or corrugated panels. The cooling system shall be adequate to maintain operational temperature limits without auxiliary support.

19.15. ENCLOSURE

The transformer shall be provided with an oil-tight mild steel tank enclosure. The enclosure shall be fabricated from high-quality sheet steel with minimum 2 mm thickness, provided with lifting lugs, earthing terminals, and bolted top cover. For outdoor installations, the enclosure shall have a minimum protection of IP65. Adequate provisions for conservator tank, radiators, breather, and cable terminations shall be integrated.

19.16. CABLE TERMINATION

The Low Voltage (LV) side of the oil-immersed transformer shall be suitably designed to receive a Sandwich Bus Duct of required capacity from the top side of the transformer. A suitably sized flange shall be provided on the LT terminal box for connecting the overhead sandwich-type LT bus duct.

The High Voltage (HV) side shall be provided with cable end boxes to accommodate 3-core, 300 sq.mm, 33 kV grade HT XLPE cables with bottom entry arrangement. All cable boxes shall be fabricated with precision bore holes to match the actual size and number of cables as shown in the approved Single Line Diagram (SLD). The design shall ensure proper clearance, ease of connection, and compliance with thermal and electrical safety norms.

19.17. EARTHING

The transformer shall be provided with two main earthing terminals, clearly marked and robustly welded to the tank body. Each terminal shall be capable of connecting directly to the external grounding system using suitable HDGI Flat Body Earthing. A separate Suitable Copper Flat neutral earthing terminal shall be provided on the LV side of the transformer, securely bonded and accessible for maintenance or grounding equipment.

19.18. FITTINGS AND ACCESSORIES

i. Rating and terminal marking plate, indicating transformer details, including tap positions and voltage configuration

ii. Earthing terminals

iii. Neutral earthing terminal on LV side

iv. Marshalling box with internal wiring, terminals, and connections for external temperature scanner

v. PT-100 temperature sensors for oil and winding temperature, connected to the marshalling box

vi. Neutral CT for 2000KVA & 2500 kVA transformers, wired to marshalling box

vii. Limit switches on all hinged and fixed doors, wired up to the marshalling box for interlock safety

viii. HV cable end box on the primary side

ix. LT bus duct termination box (or LT trunking box) on the secondary side

x. Bi-directional rollers for base movement

xi. Inspection windows on the top cover or radiator to view oil level or desiccant condition

xii. Lifting lugs for the transformer body and core-coil assembly

19.19. RTCC PANEL

A Remote Tap Changer Control (RTCC) Panel shall be provided for each OLTC-equipped transformer. The RTCC shall be installed in the substation control room and shall enable remote operation of tap changers. The panel shall be complete with:

Main switch, tap position selector switch, and raise/lower push buttons

Indicators for tap change in progress, tap change complete, and AVR operational status

Lamps for AC supply ON/OFF, and control power ON

AVR relay system for automatic tap change operation

The cubicle-type panel shall be floor-mounted, fabricated from minimum 2 mm thick cold-rolled sheet steel, and structurally reinforced with folded steel channels. The panel shall be fully enclosed, dustproof and vermin-proof, and designed for indoor use. All exterior sheet metal components shall undergo a rigorous seven-tank chemical pre-treatment process, which includes degreasing, rinsing, pickling, phosphating, passivation, and drying. The panel shall be finished with two coats of corrosion-resistant epoxy primer, followed by a final stoved enamel finish in a neutral grey or approved color. All RTCC panels shall be wired with multicore, copper conductor, armoured control cables of suitable size and shall be connected to their respective transformers. Proper terminal blocks and identification ferrules shall be used for ease of maintenance and troubleshooting.

19.20. INSTALLATION OF TRANSFORMER

Installation of the oil-immersed transformer shall be carried out strictly in accordance with the manufacturer’s guidelines, relevant Indian Standards, and/or as directed by the SBI/PMC. All necessary power and control wiring, mechanical connections, and accessories shall be checked, installed, and properly secured to ensure safe and reliable operation of the transformer.

During unloading, the transformer shall not be placed directly on bare ground. It must be rested on wooden sleepers or similar protective supports. On placement over the final foundation or plinth, proper alignment, leveling, and orientation shall be ensured using spirit levels or approved tools to meet precision standards. Foundation bolts and grouting shall be completed prior to commissioning.

Power/control cables emerging from underground ducts shall be brought up using GI conduit pipes of suitable size, and the terminations shall be made inside the transformer’s cable box. These conduit pipes shall be securely clamped and supported and their ends shall be sealed with bitumen compound or equivalent weatherproofing material to avoid water ingress or rodent damage.

In case of detachable-type cable boxes, proper structural supports shall be provided so that the transformer can be removed for servicing without disturbing the cable terminations or associated GI conduits. Sufficient working clearance and accessibility for maintenance shall be maintained as per statutory norms.

19.21. TEST CERTIFICATES.

The supplier shall furnish test certificates in the required number of copies for approval by the consultant/purchaser. These shall include:

- Routine Test Certificates
- Type Test Certificates
- Special Test Certificates (if applicable)
- Certificates for all associated accessories such as CTs, PTs, OLTC, etc.
- All certificates shall conform to IS 11171 / IS 2026 or equivalent IEC standards (IEC 60076 / IEC 726) as applicable.

Signature of the Bidder with Seal

19.22. ROUTINE TESTS

i) The following Routine Tests shall be conducted at the manufacturer’s works on each transformer unit:

ii) Applied Voltage Test

iii) Induced Voltage Test

iv) No-Load Loss and Excitation Current Test

v) Impedance Voltage and Load Loss Test

vi) Winding Resistance Measurement

vii) Voltage Ratio Test

viii) Polarity and Phase Relationship Test

ix) Insulation Resistance Test (Megger Test)

x) Insulation Power Factor (Tan Delta) Test

All results shall be recorded and submitted as part of the QA documentation.

19.23. TYPE TESTS

The vendor shall Perform the following Type Test at Manufacuring Test bed and submit the Test Reports for one of the transformer in Present SBI/PMC:

Heat Run Test (Temperature Rise Test)

Impulse Voltage Withstand Test

Short Circuit Test Report

19.24. FIELD TEST

After successful installation at the site, the transformer shall undergo the following **field tests** to ensure correct installation and readiness for commissioning:

Visual & Construction Inspection

Voltage Ratio Test

Polarity Test

Megger Test (IR values)

Check for tightness of connections, oil level, and physical damages

Functional tests on RTCC, OLTC, and protection relays

A detailed test report shall be prepared and submitted for approval before energizing the transformer.

19.25. ELECTRICAL & PERFORMANCE REQUIREMENT:

a) Transformer shall operate without injurious heating at the rated KVA at any voltage within variation of +/- 10% of the rated voltage of that particular tap.

b) Transformer shall be designed for 110% continuous over fluxing withstand capability.

c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.

d) Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply.

e) Temperature Rise for continuous full load application shall be guided by Maximum temperature rise clause of IS 2026/IS 1180. The temperature rise shall not exceed 45-degree C by thermometer in oil or 50-degree C for winding over an ambient of 45-degree C.

(Please note maximum ambient temperature shall be considered 50-degree C).

19.26. DRAWINGS AND O&M MANUALS:

Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.

a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.

b) Crane requirements for assembly and dismantling of the transformer.

c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for untanking, H.T./L.T. clearances etc.

b) Drawings of Bus duct termination arrangement.

c) HV cable box arrangement & disconnecting chamber GA drawings.

d) Name plate and terminal making and connection diagram.

e) Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.

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19.27. METALLIC CONDUIT FOR SURFACE WIRING SYSTEM.

19.27.1. TYPE AND SIZE OF CONDUIT

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

19.27.2. CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

19.27.3. PROTECTION AGAINST CONDENSATION.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

19.27.4. PROTECTION OF CONDUIT AGAINST RUST.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

19.27.5. PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

19.27.6. SURFACE CONDUIT

Conduit pipes shall be fixed by saddles, secured to suitable approved plugs with screws in an approved manner at an interval of not more than one meter, but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings. Where conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips or clamps as required by SBI/PMC long distance straight run of conduit, inspection type couplers at reasonable intervals shall be provided, or running threads with couplers and jam nuts shall be provided.Fixing Outlet Boxes Only portion of the switch box shall be sunk in the wall, the other portion beingprojected out for suitable entry of conduit pipes into the box.

19.27.7. RECESS PVC CONDUIT

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

19.27.8. METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes up to 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and confirm to grade P-I of IS: 2036-1994.

19.27.9. ERECTION AND EARTHING OF CONDUITS.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of Engineer In Charge for mechanical and electrical continuity throughout and permanently connected to earth confirming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

19.28. NON-METALLIC CONDUIT WIRING SYSTEM

19.28.1. Scope

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recessed types of wiring work.

19.28.2. Application

- Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc. and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.
- Flexible non-metallic conduits shall be used only at terminations, wherever specified.
- **Special Precautions-**

  i. If the pipes are liable to mechanical damages, they should be adequately protected.

ii. Non-metallic conduit shall not be used for the following applications: -

iii. In concealed/inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.

iv. In places where ambient temperature is less than 5 degrees C.

v. For suspension of fluorescent fi ttings and other fi xtures.

vi. In areas exposed to sunlight.

19.28.3. Materials

a) Conduits

- All non-metallic conduit pipes and accessories shall be of suitable material complying with IS 2509: 1973 and IS 3419: 1989 for rigid conduits and IS 9537 (Part 5): 2000 for fl exible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
- 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
- No non-metallic conduit less than 20 mm in diameter shall be used.
- The maximum number of PVC insulated aluminium/copper conductor cables of 650/1100 V grade confirming to IS 694: 1990 that can be drawn in one conduit of various sizes as per CPWD specification. Conduit sizes shall be Selected accordingly.

b) Conduit Accessories

- The conduit wiring system shall be complete in all respect including accessories.
- Rigid conduit accessories shall be normally of grip type.
- Flexible conduit accessories shall be of threaded type.
- 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.
- Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- The minimum width and the thickness of the ordinary clips or girder clips shall be as per CPWD specification
- For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

c) Outlets

- The switch box shall be made of either rigid PVC molding, or mild steel, or cast iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron.
- PVC boxes shall comply with the requirements laid down in IS 14772: 2000. These boxes shall be free from burrs, fi ns and internal roughness.
- 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.
- 3 mm thick phenolic laminated sheet covers for all types of boxes shall be

as per requirements.

19.28.4. Installation

a) Common Aspects for Both Recessed and Surface Conduit Works

- The erection of conduits of each circuit shall be completed before the cables are drawn in.
- Conduit Joints
  - All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fi ttings 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.
  - The PMC/SBI, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc.
- Conduit joints after preparation shall be submitted for inspection before being fixed.
- 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.
  - 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.
  - 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.
- Outlets
  - All switches, plugs, fan regulators etc. shall be fitted in flush pattern.

b) Additional Requirements for Surface Conduit Work

- 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 fi ttings, saddles shall be fi xed at a closer distance from the centre of such fi ttings.
- Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.
- 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 fi xing, suitable clamps with bolts and nuts shall be used.
- If the conduit pipes are liable to mechanical damage, they shall be adequately protected.

19.28.5. Earthing Requirements

- 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).

19.29. SWITCHES.

All 6- and 16-Amp switches & sockets shall be modular type of 240 volts A.C. grade having anti-bacterial & anti-fungal properties. All switches & sockets shall be fixed on modular metal boxes. These devices should be made from treated plastic that contains micro silver ions. These silver ions must act as a barrier against micro-organisms like bacteria & fungi, stopping their growth and spread. The switches & sockets should be tested & validated as per global safety standards and have self-disinfecting surface resulting in 99.9% reduction in bacteria growth. All 6 Amp socket shall be 3 pin type and 16 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 16/6 Amp. All modular switches, sockets, fan regulators, telephone outlets, TV outlet etc. shall be in white/off-white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by PMC/Engineer in charge.

In case of computer power points, Data points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

One modular switch may control maximum one, two or three light points as per requirement and as directed by PMC/Engineer in charge. One light point controlled by 2 switches shall be provided in the staircases as directed by PMC/Engineer in charge. Depending on area of rooms, halls etc. one or more than one switchboard shall be provided as directed by PMC/Engineer in charge. At least one number 6A Socket with Switch shall be provided in each switchboard as directed by PMC/Engineer in charge. Suitable power points and light points shall be provided for urinal sensors and hand dryers in the toilets as directed by PMC/Engineer in charge. At least 10% Light fixtures shall be provided and operated with UPS supply with switches fed from UPS Distribution Boards.

19.29.1. COVER PLATE

All modular switches, sockets, telephone outlets etc. shall be fixed on modular metal boxes with modular base plates and modular cover plates on top.

19.29.2. WALL SOCKET PLATE

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

19.30. WIRING

All PVC insulated copper conductor wires shall confirm to relevant IS Codes. All wires/ cables shall be stranded type irrespective of its size.

All internal wiring shall be carried out with PVC insulated FRLSH, Copper wires of 650/1100 Volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring.

Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral.

Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated FRLSH copper wire for RYB phase wire respectively and black colour PVC insulated FRLSH Copper wire for the neutral wires. Green/Green-Yellow Colour copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications for Electrical works (Part - I) 2013

Maximum number of PVC insulated 650/1100 V grade aluminium/copper conductor cable confirming to IS: 694 – 1990

Conduit size	**20mm**		**25mm**		**32mm**		**40mm**		**50mm**		**60mm**	
Wire size in sq.mm.	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

NOTE:

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed `S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed `B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

19.30.1. JOINTS.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

19.30.2. LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

19.30.3. COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth in case of insulated earth wire.

19.30.4. CLASSIFICATION OF POINTS.

a. General

Classification of Point wiring shall be as per CPWD specification for Electrical Works (Part-I- Internal) 2013.

b. Point Wiring (Modular)

i. Definition of Point Wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

c. Scope of point wiring

Following shall be deemed to be included in point wiring.

1. Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet.
2. The wires used for the point wiring and power wiring shall be of 1100 Volts grade FRLSH (flame Retardant Low Smoke Halogen) Insulated multi stranded copper conductor single core cables.
3. All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
4. Modular switches, modular base plates and modular cover plates over the same. regulators, sockets with Metal boxes etc. in recessed or surface.
5. Outlet boxes, junction boxes, pull-through boxes etc. but excluding

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modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.

6. In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
7. Control modular switch (5/6A) as specified.
8. Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
9. Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
10. Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
11. Protective (loop earthing) conductor as required from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
12. In each Bedroom One Light Point, One Fan shall be in two-Way Control
13. All staircase light points shall be in two-way control
14. Bushed conduit where wiring cables pass through wall etc.
15. Ceiling rose (in the case of pendants except stiff pendants).
16. TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter at every floor. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of PMC / Authority Engineer-in charge.
17. Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired).
18. Back Plate (in the case of stiff pendants).
19. Telephone outlet point wiring shall be terminated in suitable size of G.I. Junction box direct from ELV Shaft to each Point. However, conduit for telephone wiring may be provided through branching by providing suitable size of G.I. box along with suitable tag block at each floor. The inter connections of all junction boxes fixed at all floors shall be done properly making proper distribution system with the prior approval of Engineer-in-charge. Providing incoming television / telephone cables from the site boundary of building is covered in the scope of this bid. However, pipes for laying of these cables shall also be provided by the bidder as per direction of Engineer-in-Charge.

19.30.5. Circuit and Sub Main Wiring

a. Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

b. Sub main Wiring

Sub main wiring shall mean the wiring from one main/distribution switchboard to another.

19.30.6. Power Plug Wiring

a. 6 A Plug Wiring

Wiring for all 6 A Socket Outlets shall be done with 2 X 2.5 sqmm PVC insulated FRLSH copper wire in suitable size MS Conduit (including supplying and fixing PVC Conduit) along with 1 X 1.5 sqmm PVC insulated

FRLSH copper earth wire. Up to 3 points may be connected to one circuit.

b. 16A Power Plug Wiring

Wiring for all 16 A Socket Outlets/Geyser point shall be done with 2X4 sq mm PVC insulated FRLSH copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with the]1 X 2.5 sqmm PVC insulated FRLSH copper earth wire, directly from the MCB- Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 16A power points (other than computer power points).

c. Wiring for 20/25A/32A Metal Clad Socket Outlets

Wiring for all 20/25/32A Metal Clad Socket Outlets shall be done with 2X6 sqmm PVC insulated FRLSH copper wire in suitable size PVC Conduit (including supplying and fixing PVC Conduit) along with 1 X 4.0 sqmm PVC insulated FRLSH copper earth wire directly from the MCB-Distribution Board. Wiring for 20/25/32A Metal Clad Socket outlet shall be done on linear basis i.e. complete wiring directly from MCB-Distribution Board to the socket outlet.

19.30.7. LED Light Fixtures - GENERAL

Indoor & Outdoor type LED Lighting Fixtures shall confirm to following specifications:

LED Light Fixtures - Outdoor

Sl	Criteria	Specification
1	The Luminaire Construction	Single Piece Pressure die cast Aluminium alloy housing for better thermal conductivity. Seperate driver and optical compartment for Thermal isolation. Each LED should be covered with IP-66 or more protected lens. Luminaire with glass/PC/Acrylic cover/diffuser will not be accepted due to accumulation of insects/dust and decrease in light output.
2	Operating Voltage Range	140 - 270 VAC
3	Frequency	50 Hz
4	Power Factor@240 VAC	≥ 0.90
5	Driver	Driver Efficiency ≥85% Driver inbuilt Surge Protection: 2 KV Silicon Potted IP66 Over voltage Protection Short circuit Protection Thermal Protection
6	THD @240 VAC	≤ 10%
7	Ingress Protection	IP-66
8	Impact Resistance	IK-08
9	Colour Temperature	5300 K to 6000 K
10	Color Rendition Index - CRI	≥70
11	System Efficacy	≥110 Lumens per Watt

12	Junction Temperature of LED	≤ 85° Celsius.
13	LED Make	NICHIA/Philips Lumileds/ CREE/ OSRAM/ Samsung/ BridgeLux
14	Operating Temperature Range	0°C to 50°C
15	Average Operating Life	50,000 Hours @ L 70B50
16	Humidity	10 to 90 %

All relevant Test Reports for Light Fixtures from NABL accredited laboratory shall be submitted at site along with Ligh Fitting consignments.

19.30.8. BALLASTS/ Driver

Ballasts/ Driver shall be electronic type and having high power factor type. Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

19.30.9. Standards:

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

Luminaries – General requirement - IS – 10322 (Part-1)

Luminaries – Constructional requirement - IS – 10322 (Part-2)

Luminaries – Screw and Screwless termination - IS – 10322 (Part-3)

Luminaries – Methods of Tests - IS – 10322 (Part-4)

Particular requirement – General purpose Luminaries -IS – 10322 (Part-5/Sec-1)

Particular requirement – Recessed Luminaries - IS – 10322 (Part-5/Sec-2)

Particular requirement – Luminaries for Road and Street lighting - IS – 10322 (Part-5/Sec-3)

Particular requirement – Flood Lighting - IS – 10322 (Part-5/Sec-5)

Emergency lighting units - IS – 9583: 1981 Flame

proof electric lighting fittings - IS – 2206 (Part 1 of 4)

Standard for Eye and Skin / Photobiological Safety - IEC 62471

Standard for Led Drivers - IEC 61347-2-13

The equipment should be compliant to IEC 60598-1, 2, 3, IEC 62031and IEC/PAS 62612 depending on the type of luminaire. In addition to the above luminaire shall adhere to relevant BIS standards IS 15885, 16101, 16102, 16103, 16104, 16105, 16106, 16107 (Part I & II), 16108 as per
the application requirement.

19.30.10. TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In- charge. Stickers are to be placed on each light fixture w.r.t. controlling switch of respective light.

19.30.11. CEILING FANS WITH BRUSH LESS DIRECT CURRENT (BLDC) MOTOR:

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor shall ensure that provision is kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be provided as per CPWD specification.

Contractor shall carry out Supply, Installation, Testing and Commissioning of 1200 mm sweep, BEE 5-Star rated, Ceiling Fan with Brush Less Direct Current (BLDC) Motor, class of insulation: B, 3 nos. blades, 30 cm long down rod, 2 nos. canopies, shackle kit, safety rope, copper winding, Power Factor not less than 0.9, Service Value (CMM/W) minimum 6.85, Air delivery minimum 215 CMM, 350 RPM (tolerance as per IS: 374-2019), THD less than 10%, remote or electronic regulator unit for speed control and all remaining accessories including safety pin, nut bolts, washers, temperature rise - 75 degree C (max.), insulation resistance more than 2 mega ohm, suitable for 230 V, 50 Hz, single phase AC Supply, earthing etc. complete as required.

Ceiling fan shall be Heavy Duty, double ball bearing type and shall confirm to relevant IS Standards. Ceiling Fans shall be White/ Off-white in colour. Ceiling fans shall be provided with electronic regulators with stepped control. Electronic regulator shall be of 2-Modules suitable for 240 Volts AC supply 50HZ AC supply complete with motor, blades, frame, bracket, louver/ shutter etc as required. Philips or Havells or Crompton EXHAUST FANS.

Exhaust fans shall be with double ball bearing and confirming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable for operation on 240 volts’ single phase
A.C supply with BEE 5-star rating & comply to ECBC norms.

20. EXTERNAL STREET LIGHTING SYSTEM:

20.1. Scope of Work:

The scope of works under External Street Lighting System requires illumination of all external areas like streets, roads, ornamentals, boundary walls, parks, gardens, landscaping, porches, building facades, walkways, pathways etc., which shall be illuminated confirming to NBC 2016, ECBC 2017 and CPWD specifications maintaining required Lux levels. Suitable LED fixtures shall only be used with inbuilt harmonic suppression mechanism for external area illumination. Solar and conventional street light poles, bollards, gate lights, post-top lantern etc. shall be used for this purpose keeping in view aesthetical and architectural requirements. The external lighting shall be fed from outdoor type feeder panels and automatically controlled through 24-hour Digital/ Astronomical Timers.

All solar & conventional street light poles of single arm /double arm/triple arm, as required shall be GI Octagonal with heights as per relevant IS Codes, NBC Code & ECBC.

20.2. GENERAL SPECIFICATION FOR HIGH MAST:

i. SCOPE:

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing, forwarding of High Mast. High Mast lighting shall be provided as per specification Type-I, unless stated otherwise, as per direction of PMC/Engineer in charge.

ii. APPLICATION STANDARDS:

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following Indian, International standards and shall confirm to the regulations of the local authorities.

- IS 875 (Part III) 1987 (Code and practices for design loads for structures)
- IS 2062: 2006 (Hot rolled low, medium and high Tensile structural steel)
- BSEN 10025/DIN 17100 (Grades of MS Plates)
- BSEN 60529 (Degree of provided by Enclosures- IP code)
- BS 5135 / AWS (Welding)
- BS EN ISO 1461: 1999 (Galvanizing)
- BS EN 5649-4: 1982 (Lighting columns, Recommendations for surface protection of metal lighting columns)
- TR No. 7 1996 of ILE, UK (Specifications of Masts and foundations)

iii. GENERAL CONSTRUCTIONS:

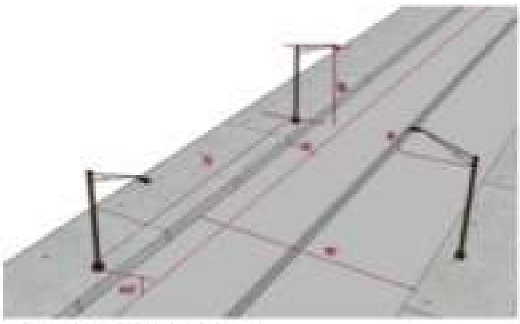
The High Mast shall be designed to withstand the maximum wind speed as per IS: 875. The top loading, i.e. the weight and the area of luminaries are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS: 5649 Part VI – 1982. The Mast shall be designed using limit state principle. The limit states to be considered are: (i) Ultimate and (ii) Serviceability; based on a design wind speed with a return period of 25 years. The total Height of the High Mast, with luminaries mounting carriage cum head frame and luminaries installed all be measured as the vertical distance between the base flange plate and the plane in which the lamps lie in their operating position.

a. STRUCTURE:

The High Mast shall be of continuously tapered, polygonal cross section; ranging from 8 to 20 sided, and shall be based on proven In-Tension design confirming to the standards referred above, to give an assured performance and reliable service. The structure shall be suitable for wind loading as per IS 875 part3 1987.

Typical Calculation of Road Lighting:

- Luminaries are properly selected and mounted on a location most feasible and effective with minimum cost. For a 230 volts system, a voltage drop of 5% is allowed although in extreme cases 15% voltage drop is sometimes tolerated.



Street Lighting Features ([illegible], 1981)
A: Angle of Tilt OR: Outreach S: Spacing
W: Width H: Mounting Height O: Overhang

- **Street illumination level in Lux (E)=(Al x (cu x mf)) / (w x d)**
- E = The illumination in Lux
- w = Width of the roadway
- d = Distance between luminaries
- cu = Coefficient of utilization. Which is dependent on the type of fixture, mounting height, width of roadway and the length of mast arm of outreach?
- **Al = Average lumens, Al = (E x w x d) / Cu x mf**

b. CONSTRUCTION:

The High Mast shall be manufactured using steel plates, confirming to BS-EN 10-025. The high mast shall be manufactured in two sections for 12.5 meters, 16metres and 20metres. In case of 25 meters and 30 meters high mast shall be manufactured in three sections. Each mast section shall be fabricated out of single plate duly folded and welded. The Mast shaft shall have polygonal cross section and shall be continuously tapered with single/Double longitudinal welding. There shall not be any circumferential welding and pole shafts with more than two longitudinal welds shall not be acceptable. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process. No site welding and bolted joints shall be done on the mast. The minimum overlap distance shall be 1.5 times the diameter at penetration. The minimum top diameter and bottom diameter shall be as specified in data sheets and plate thickness shall be as per the structural design requirements. The calculation for civil design and foundation details shall be submitted by the EPC Contractor for approval of PMC/Engineer in charge. The mast shall be provided with fully penetrated flange, which shall be free from any lamination or incursion. The welded connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with supplementary gussets between the bolt- holes to ensure elimination of helical stress concentration.

c. GALVANIZING:

For environmental protection of the mast the entire fabricated mast shall be hot dip galvanized internally and externally as per BS EN ISO 1461 standards with an average coating thickness of minimum 85 micron. The galvanizing shall be done in single dipping only. Double dip-galvanized shafts with overlapping are not acceptable. Further, no post galvanizing painting, touch-up or rectification shall be allowed.

d. DOOR OPENING:

All adequate door opening shall be provided as per the GTP such that the minimum distance from the mast flange plate to the bottom of the door opening shall twice the width of the door opening. The door shall be flushed with the exterior surface. The door opening shall be such that it permits clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch. The door opening shall be complete with a close fitting, vandal resistant, weatherproof door, provided with heavy duty double internal lock with special paddle key. The minimum radius at the corners of openings shall be 20mm. The door opening shall be carefully designed and reinforced with welded steel section, so that the mast section at the base shall be unaffected and undue buckling of the cut portion is prevented.

e. DYNAMIC LOADING FOR THE MAST:

The mast structure shall be suitable to sustain an assumed maximum reaction arising from a wind speed as per IS: 875 (Part-III) 1987 (three second gust) and shall be measured at a height of 10 meters above ground level. The design life of the mast shall be minimum of 25 years.

f. LANTERN CARRIAGE:

i. FABRICATION:

A fabricated raising and lowering type Lantern Carriage cum head frame shall be provided at the top of high mast shaft properly secured for fixing and holding the flood light fittings and control gear boxes. The Lantern Carriage shall be of special design and shall be of steel channel construction. The Lantern Carriage shall be so designed and fabricated to hold the required number of flood light fittings and the control gear boxes, and also have a perfect self-balance. The Lantern Carriage shall be fabricated in two/three halves and joined by bolted flanges with stainless steel bolts and nylon type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage.

The entire Lantern Carriage shall be hot dip galvanized after fabrication. The lantern carriage shall be fabricated out of M.S. channel with suitable reinforcements. Also an certificate to this effect quoting safe working load shall be supplied with each carriage. The carriage shall carry a permanently attached label stating the safe working load. Both the Mast Shaft and Luminaries Mounting Carriage shall be sourced from one manufacturer only so as to ensure compatibility and overall finish of the material.

ii. JUNCTION BOX:

Weather proof junction box, made of Cast Aluminum shall be provided on the Carriage Assembly as required, from which the inter-connections to the designed number of the flood light luminaries and associated control gears fixed on the carriage shall be made.

iii. RAISING AND LOWERING MECHANISM:

For the installation and maintenance of the luminaries and lamps, it will be necessary to lower and raise the Lantern Carriage Assembly. To enable this, a suitable Winch Arrangement shall be provided, with the winch fixed at the base of the mast and the specially designed head frame assembly at the top.

iv. WINCH:

The winch shall be of completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when not in use by gravity activated PAWLS. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be clearly marked on each winch. The gear ratio of the winch shall be calculated considering minimum working load not less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers. The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. It shall be possible to operate the winch manually by a suitable handle and electrically by an external power tool also. It shall be possible to remove the double drum after dismantling, through the door opening provided at the base of the mast. A test certificate shall be furnished by the Contractor from the original equipment manufacturer, for each winch in support of the maximum load operated by the winch.

g. STAINLESS STEEL WIRE ROPES:

The suspension system shall essentially be without any intermediate joint and shall consist of only non-corrodible stainless steel of AISI 316 grade. The stainless steel wire ropes shall be of marine grade 7/19 construction, the central core being of the same material. The overall diameter of the rope shall not be less than 5mm for 12mtr. High mast and 6mm for 16mtr. And 20mtr. High mast. The breaking load of each rope shall not be less than 2350 kg giving a factor of safety of over 5 for the system at full load as per the TR-7 referred to in the beginning of this specification. The end constructions of ropes by compression splices. Continuous lengths of stainless steel wire ropes shall be used in the system and no intermediate joints are acceptable in view of the required safety. No intermediate joints/ terminations, either bolted or else, shall be provided on the wire ropes between winch and lantern carriage. The design of the whole suspension system shall be such that the wire ropes can be removed and replaced from ground level without the necessity of lowering the mast or use of special equipment.

h. ELECTRICAL SYSTEM, CABLE AND CABLE CONNECTIONS:

The control panel at the bottom of the mast shall have facility for terminating up to 1.1kV, 4C x 25 sq. mm, Aluminium conductor, armoured, XLPE incoming cable. The outgoing from this panel shall be the trailing cable, which is terminated at the weather proof junction box provided at the top. This cable shall be minimum 6 cores, 2.5 sq. mm,1100V, electrolytic grade, EPR insulated, copper conductor and PCP sheathed cable to get flexibility and endurance. The connections from the top junction box to the individual luminaries shall be made by using 3 core 4 sq.mm flexible PVC cables of reputed make. The cable shall run via metal ducts or tubes provided in luminary's carriage up to individual luminaries and control gear units. All steel conduits shall be of heavy gauge welded type with hot dipped galvanized finish.

i. LIGHTNING SPIKE:

One number heavy duty hot dip galvanized lightning spike shall be provided for each mast. The lightning spike shall be minimum 1.2 M in length (except for

12.5m where it will be 0.6m) and shall be provided at the centre of the head frame. It shall be bolted solidly to the head frame to get a direct conducting path to the earth the mast. The lightning spike shall not be provided on the lantern carriage under any circumstances in view of safety of the system.

j. AVIATION OBSTRUCTION LIGHTS:

Provision for mounting LED type aviation obstruction lights of reliable design shall be provided on top of each mast for20m high masts only.

a. Dimensions are subjected to tolerance allowed as per IS.

b. Diameter of wire rope may increase to 8 mm wherever qty. of light fittings are more on lantern carriage.

c. Motor can be supplied in single and three phase as per requirement.

20 METER HEIGHT						
S.No	**Description[Lighting Mast]**	**Specification**				
	Type	1	2	3	4	5
1	High mast Height[mtrs] incl.Luminaires Carriage	20	20	20	20	20
1.1	Material Construction	BSEN100025 or Eqiv	BSEN100025 or Eqiv	BSEN100025 or Eqiv	BSEN100025 or Eqiv	BSEN100025 or Eqiv
1.2	Welding	As per IS	As per IS	As per IS	As per IS	As per IS
1.3	No.Of Sides	20	20	20	20	20
2	WIND LOAD DATA taken for this project	as per IS 875	as per IS 875	as per IS 875	as per IS 875	as per IS 875
3	Mast Section Details					
3.1	Top Diameter [In mm]	166	166	206	208	210
3.2	Base Diameter[In mm]	419	419	489	489	518
3.3	Number of Sections[Nos]	2	2	2	2	2
3.4	Top Sections length[mm]xthickness[mm]	10375X3	10375X4	10375X4	10375X4	10375X5
3.5	Middle SectionLength[mm]xthickne ss[mm]	NA	NA	NA	NA	NA
3.6	Bottom Section Length[mm]xthickness[mm]	10375X4	10375X4	10375X4	10375X5	10375X6
3.7	Over lapping [between Sections]	375	375	375	375	375
3.8	Base Flange Diameter[mm]	630	630	730	730	730

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3.9	Base FlangeThickness[mm]	32	32	32	32	32
3.10	P.C.D [mm] x Hole Dimensions [mm]	530	530	630	630	630
3.11	No.Of Bolts[Qty]	12	12	16	16	20
3.12	Foundation bolts Details	1200x24 mm	1200x24 mm	1200x24 mm	1200x24 mm	1200x24 mm
3.13	Metal Treatment Protection for Mast	Galvanised	Galvanised	Galvanised	Galvanised	Galvanised
3.14	Thickness of Galvanisation (min.)	min 65 micron for sheet thickness of 2mm up to 4 mm and 86 Microns for 5 mm and above.				
3.15	Size of opening and door at base	1000mmx300 mm	1000mmx300 mm	1000mmx300 mm	1000mmx300 mm	1000mmx300 mm
3.16	Type of locking arrangement	Anti-Vandalism	Anti-Vandalism	Anti-Vandalism	Anti-Vandalism	Anti-Vandalism
3.17	Size of Anchor Plate & Thickness	630mmx6mm	630mmx6mm	730mmx6mm	730mmx6mm	730mmx6mm
3.18	Details of Template	630mmx6mm	630mmx6mm	730mmx6mm	730mmx6mm	730mmx6mm
4	HEAD FRAME	3-POINT	3-POINT	3-POINT	3-POINT	3-POINT
4.1	Construction	MS.Fabricated				
4.2	Metal Treatment protection for HEAD FRAME	Galvanised				
4.3	Pulley Arrangements (For Steel Wire Rope)	3SETS OF PULLEYS	3SETS OF PULLEYS	3SETS OF PULLEYS	3SETS OF PULLEYS	3SETS OF PULLEYS
4.4	Pulley Arrangements (For Electric Cable)	1 set OF PULLEY	1 set OF PULLEY	1 set OF PULLEY	1 set OF PULLEY	1 set OF PULLEY
5	LANTERN CARRIAGE					
5.1	Matreial of Construction	IS2062	IS2062	IS2062	IS2062	IS2062
5.2	Diameter of Carriage Ring(mm)-1NO	1200	1200	1200	1200	1200
5.3	Construction	M.S fabricated	M.S fabricated	M.S fabricated	M.S fabricated	M.S fabricated
5.4	Number of Joints	3	3	3	3	3
5.5	Buffer arrangements between Carriage & MAST	Will be provided	Will be provided	Will be provided	Will be provided	Will be provided
6	Compensating Disc between L-Ring and DD Ring	PROVIDED	PROVIDED	PROVIDED	PROVIDED	PROVIDED

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7	Safety Locking on both sides at Base of Mast	PROVIDED	PROVIDED	PROVIDED	PROVIDED	PROVIDED
8	Winch	D/Drum, 750 Kg cap	D/Drum, 750 Kg cap	D/Drum, 750 Kg cap	D/Drum, 750 Kg cap	D/Drum, 750 Kg cap
9	Stainless Steel wires diameter	6 mm	6 mm	6 mm	8 mm	6 mm
9.1	Number of Ropes	3	3	3	3	3
9.2	C/disc to D/d.Winch	two[6mm size]	two[6mm size]	two[6mm size]	two[6mm size]	two[6mm size]
9.3	C/disc to Lantern Ring	Three[6mm size]	Three[6mm size]	Three[6mm size]	Three[6mm size]	Three[6mm size]
9.4	Thimbles & Terminals	Provided.	Provided.	Provided.	Provided.	Provided.
9.5	Factor Of Safety	>5	>5	>5	>5	>5
10	POWER TOOL	Gear Ration 53:1	Gear Ration 53:1	Gear Ration 53:1	Gear Ration 53:1	Gear Ration 53:1
10.1	Model	Integral	Integral	Integral	Integral	Integral
10.2	Input Supply	415v,50c/s;3 - ph	415v,50c/s;3 - ph	415v,50c/s;3 - ph	415v,50c/s;3 - ph	415v,50c/s;3 - ph
10.3	WATTAGE	1.5KW	1.5KW	1.5KW	1.5KW	1.5KW
10.4	Num. Of Speeds	Single	Single	Single	Single	Single
10.5	Reversible/Non-reversible	Reversible	Reversible	Reversible	Reversible	Reversible
10.6	Operating Speed	1400 Rpm	1400 Rpm	1400 Rpm	1400 Rpm	1400 Rpm
11	Lightning Arrestor [1.2m Length]	will be provided	will be provided	will be provided	will be provided	will be provided
12	Aviation Obstruction light	Provision for mounting will be provided				

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Note:

a. Dimensions are subjected to tolerance allowed as per IS.

b. Diameter of wire rope may increase to 8mm wherever qty. of light fittings are more on lantern carriage.

c. Motor can be supplied in single and three phase as per requirement.

20.3. Standard Galvanised Octagonal Poles

Octagonal poles shall be designed as per ILE TR7 & BS5649 for structural design & as per IS875 (Part III), 1987 for dynamic loading.

The pole shaft shall be made single piece MS structure continuously tapered having polygonal (8/12 sides) cross section and a single longitudinal welding. The welding will be done as per BS 5135 / IS 9595. No circumferential welding shall be allowed in the pole shaft. The MS shall confirm to BSEN 100025/100027. The structure shall be single hot dip galvanized as per BS 729
/ IS 2629. A suitably designed door shall be provided at approximate 700mm height from the pole base. The door opening will be suitably reinforced for structural strength. The door shall be flushed with pole external surface and shall provide easy access for electrical connections at a maintainable height. A Suitable base flange will be welded and plate reinforcements will be provided between base flange & pole. Foundation accessories will be as per IS 1367.

		POLE DETAILS				FOUNDATION BOLT DETAILS		
POLE DESCRIPTION	HEIGHT	TOP	BOTTOM	THICKNESS	BASE PLATE	LENGTH	NOS	DIA.
	H	TD	BD	T	BP: LXLXT	FL	N	D
3 MTR GI OCTAGONAL POLE	3000	70	130	3	200 X 200X 12	450	4	16
4 MTR GI OCTAGONAL POLE	4000	70	130	3	220 X 220X 12	450	4	20
5 MTR GI OCTAGONAL POLE	5000	70	130	3	200 X 200 X 12	600	4	24
6 MTR GI OCTAGONAL POLE	6000	70	130	3	220X 220 X 16	600	4	24
7 MTR GI OCTAGONAL POLE	7000	70	130	3	220 X 220 X 16	700	4	24
8 MTR GI OCTAGONAL POLE	8000	70	135	3	225 X 225 X 16	750	4	24
9 MTR GI OCTAGONAL POLE	9000	70	155	3	260 X 260 X 16	750	4	24
10 MTR GI OCTAGONAL	10000	70	175	3	275 X 275 X 16	750	4	24

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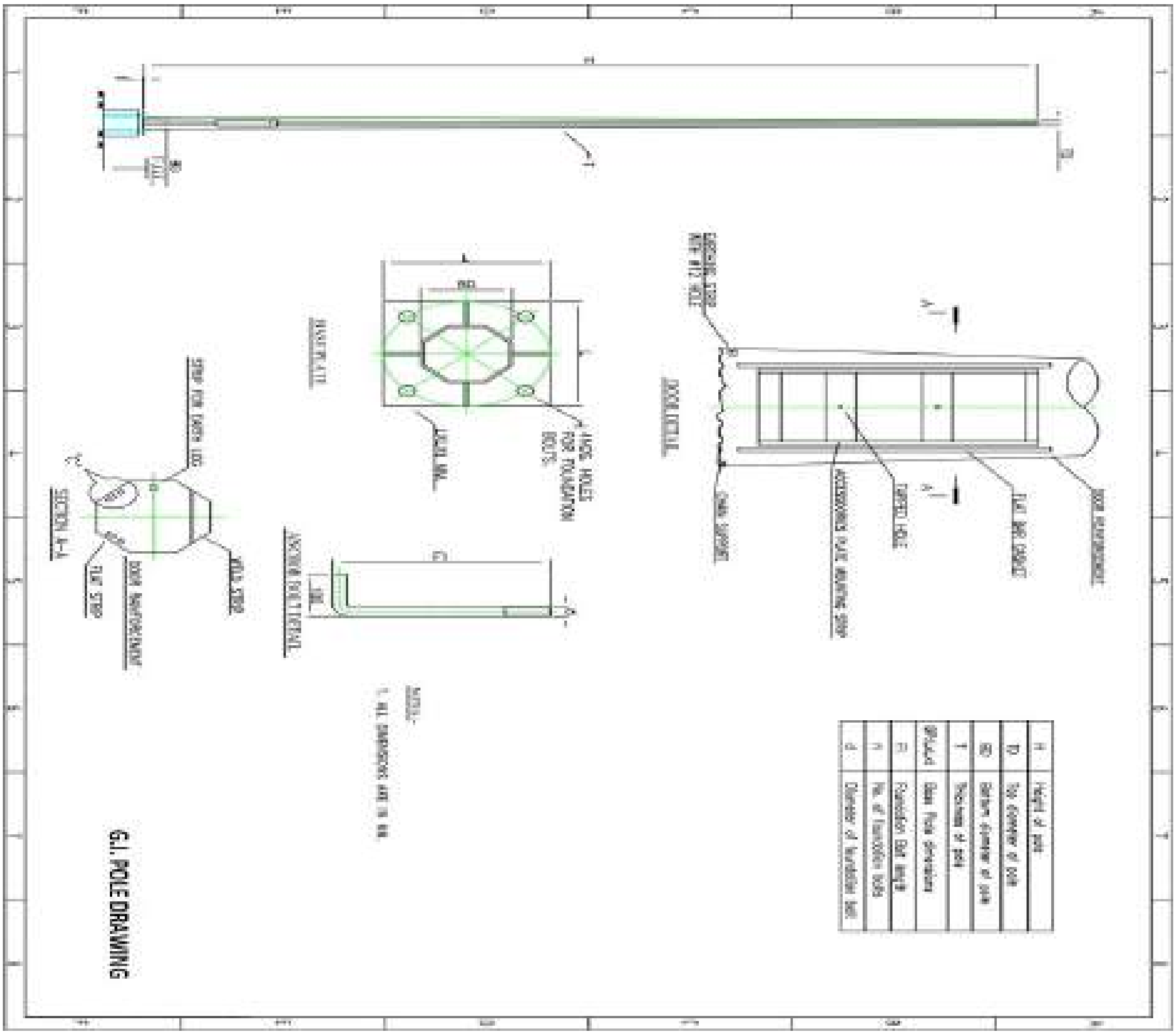
POLE								
11 MTR GI OCTAGONAL POLE	11000	90	210	3	300 X 300 X 20	750	4	24
12 MTR GI OCTAGONAL POLE	12000	90	240	3	320 X 320 X 20	750	4	24

NOTE: ALL DIMENSIONS ARE IN MM.



21. Solar Street Lighting System

21.1. Solar Street Light Poles – All In One Type:

All-In-One' Type integrated Solar Street Light Poles with solar PV modules, GI Octagonal Pole, Height 6M or 7M (as specified in Design basis report), battery with 48 hours back-up, light fixture

 Signature of the bidder with seal

complete may be provided subject to approval of technical specfications by SBI/PMC ‘All-In-One’ Type Solar Street Light poles shall not be hybrid type.

SCOPE & SPECIFICATION FOR ‘ALL IN ONE” INTEGRATED SOLAR STREET LIGHTS (Single Arm- STREET LIGHTS):

The EPC Contractor shall carry out planning, designing, supplying, fixing and installing, testing & commissioning of LED Integrated, Solar Street light 36-40 Watt inbuilt charge controller, with health monitoring system, over charging protection installed on high mast fixing vertically on selected location with following specifications-

(a) LED Luminary-40W, LED-Light Output-25 Lux at 6 metres Height, LED Life Span:> 50,000 hrs. LED Efficiency:>110 lm/W, Operating Voltage 12V DC to 13V DC with necessary accessories.

(b) Solar MONO Panels: 40Wp, Size 1120 X 305 X 140 mm

(c) Battery-LiFePO4, Per fixture Minimum 12.8V,27 Ah, Duty Cycle-12 hours/day, Autonomy 2 days, Ingress Protection IP65 with necessary accessories.

(d) GI Octagonal pole - Mounting Height minimum 6M (or as specified in Design Basis Report/ BoQ), Hot Dip Galvanized with necessary accessories with single decorative arm.

21.2. Façade & Flood Lighting:

EPC Contractor shall carry out Design, Planning, Supply, Installation, Testing and Commissioning of Façade Lighting for the buildings . Luminous efficacy must be more than 110 Lumen/watt or as per OEM standards. Color Rendering Index (CRI) must be more than 70 or as per OEM standards.

21.3. Scope of work for Façade Lighting:

EPC Contractor shall carry out Design, Planning, Supply, Installation, Testing and Commissioning of LED RGB/RGBW flood fighting luminaire for facade lighting with die-cast aluminium housing, powder-coated finish, of 600 Watts or as per OEM design calculations and approved by SBI/PMC in-charge. Luminaire shall be capable of producing dynamic color changing light for with 16 million colors by DMX/Ethernet based control. The beam angle of the fitting shall be narrow, medium, wide or asymmetric as per the requirement. Luminaire shall be complete with driver and capable of operating at line voltage without any separate power supply from 100-270 V AC, having electrical safety class, built-in surge protection of up to 10 kV, 50 Hz with power factor > 0.90. Fixture shall be suitable to operate at an ambient temperature range of -10°C to +50°C and shall be IP-65 and IK-06 rated. Lifetime shall be at least 50,000 burning hours @ L 70 B50 at 50°C. Luminaire shall be confirming to BIS (IS-10322) and shall be complete with all necessary accessories required for proper working of fixture including weather proof connection cables, water proof connectors etc. as required.

21.4. Façade Design Concept:

Façade will allow the building to perform better in terms of energy efficiency & day lighting requirement:

a) Sufficient day light.

b) Energy efficiency with 50,000 burning hours LED life

c) Minimize glare using of direct view luminaire & wall grazing & radiation.

d) Bringing daylight to deeper areas.

e) Using of Narrow beam flood lights for pillars.

f) RGBW linear grazer/linear BAR lights for wall grazing or washing shall be provided.

g) For Building Facia lit up floodlights can be provided minimum of 4 m distance from the object. Glare shield can be proposed in floodlights.

h) IP67/IP68 LED RGBW/ mono color strip to illuminate cove, Edge of Building.

i) Direct View Glare free Linear Bar/ nodes to Illuminate Glass Facades.

J) DMX/RDM based control system for façade can be incorporated.

21.5. FAÇADE DESIGN

Performance Requirements, Design Life and Durability

The Façade Works shall be appropriate & adequate for its intended purpose. The works shall be designed, fabricated and installed to achieve the specified levels of performance throughout the design life in this section, under the general exposure conditions set out in the appendix to BS 7543, subject to any special conditions in this specification:

The Works shall be designed, supplied, installed and warranted by the Contractor to comply with the requirements of this section. The expected life of products used in the Facade shall be confirmed by providing the following information:

i. The economic life of the product/material in the environment in which it shall be used (this is not a warranty or guarantee);

ii. Requisite maintenance procedures which must be followed in order to achieve the economic life of the product/material;

iii. An assurance from the Contractor/manufacturer that the product is suitable for its intended application;

iv. Relevant product data including names of Contractor and manufacturers.

During construction, the PMC/Engineer in charge shall have the absolute right to have any deficient products or materials rectified or replaced at the Contractor's expense in order to achieve the expected life as stated in these documents. The Contractor will under no circumstance enter into a claim or variation for correction of a product or installation by virtue of the product or material being unfit for its intended purpose.

All materials which are exposed to sunlight, including materials exposed through glass, shall not be affected due to exposure to heat or ultraviolet radiation such that the material can no longer perform as intended, for the aforementioned period.

Note: LM 79, LM 80 report and BIS certificate for driver & luminaire shall be provided by the Contractor /vendor along with type test reports.

21.6. Installation

Fixtures shall be installed at mounting heights as detailed on the drawings or as instructed on site by the PMC/Engineer in charge.

Pendent fixtures within the same room or area, shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation. Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation. Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

All light fittings shall be supported with appropriate fixing accessories such as clips, supporting brackets, suspension sets, nuts, washers, screws etc. for their proper installation on different types of ceiling panels. Suspension sets shall be of adjustable type suitable to carry the weight of the lighting fittings unless otherwise stated or indicated on drawings. The suspension sets shall be generally of 900 mm length. Exact lengths required shall be provided to suit the site requirement.

21.7. Testing:

Type Tests:

Type tests shall be carried out to prove confirmation with the requirement of specification and general quality/design features of the unit by the firm on particular models of the luminaire. Necessary type test reports from NABL and ISO accredited Laboratory shall be submitted to SBI.

Acceptance Tests:

These tests shall be carried out in the presence of Client, SBI/ SBI/PMC in charge representatives at the Contractor's premises on random sample drawn from a lot, for the purpose of acceptance. The luminaries shall be selected from the lot at random. Sample size shall be as per mutual agreement between Contractor and the client,SBI/PMC in charge.

21.8. Simulation:

Color Simulation of façade lighting shall be submitted to SBI for approval prior to commencement of Facade Lighting works at site.

21.9. Power cabling for External illumination:

The power shall be fed to Street Light Poles, High Mast Poles, Solar street Light Poles, Bollards, Post Top lanterns, Gate Lights, Façade Lights, walk way lights etc. through suitable size aluminium armored XLPE insulated power cables, laid underground as per CPWD Specifications. Suitable Feeder Pillars shall be provided to feed various circuits of street lights.

21.10. Street Light Pole Height & distance between poles:

Street Light Poles, High Mast Poles, Hybrid Solar street Light Poles, Bollards, Post Top Lanterns of suitable height shall be provided to achieve illumination with required Lux levels in the external areas as per CPWD, NBC 2016 & ECBC norms. Distance between street light poles shall be as per CPWD, NBC 2016 & ECBC norms as applicable.

Inspection: Street Light Poles, High Mast Poles, Hybrid Solar Street Light Poles etc shall be offered for inspection by SBI/PMC at manufacturer's works before final dispatch to site as per terms of the contract.

Drawings: Site Layout drawings and Single Line diagrams shall be prepared and submitted for approval of SBI/PMC by the Contractor for the Street Light Poles, High MasPoles, Hybrid Solar street Light Poles, Bollards, Post Top lanterns, Gate Lights, Façade Lights, Walk Way lights etc. The drawings shall be got approved from SBI/PMC before commencement of works at site.

21.11. Applicable IEC Standards:

i. IEC 61215 latest: Solar Panel
ii. IEC 61347-2-13: LED driver safety
iii. IEC 62384: LED driver performance
iv. CISPR 15: Radio disturbance characteristics
v. IEC 61547: EMC immunity requirements
vi. IEC 60598: General requirements and tests

22. AUTOMATIC TRANSFER SWITCHING EQUIPMENT - ATS

22.1. GENERAL – STANDARDS

a. The ATSE shall comply with IEC 60947-6-1: (Low-voltage switchgear and control gear - Multiple function equipment – Transfer switching equipment) and with IEC 60947-3: (Low-voltage switchgear and control gear – Switches, disconnectors. ATSE shall also confirm to relevant IS Codes, latest as amended.
b. The ATSE product shall have 4-Pole suitable for operation on 415 Volts, 3-phase, 50 Hz supply and must be duly tested in an accredited laboratory.

22.2. PRODUCTS - GENERAL CONSTRUCTION

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22.2.1. The ATSE shall be composed of:

a. An open transition break before make architecture (I – 0 – II), with two back to back, fully rated, IEC 60947-3 compliant, load break switch disconnects, with clear switch position indication (I – 0 – II), on the motorization module.
b. A maintenance free switch design that includes self-cleaning contacts on all poles with fully integrated robust mechanical interlock between both switches.
c. An independent switching mechanism free from external factors during transfer.
d. Mounting lugs fit onto the switches (power section) independent of the motorisation.
e. A wide band (control voltage of 50/60Hz, 166-332V AC) motorization module fit directly to the switching mechanism.
f. An integrated ATS controller with dual power supply (DPS) and 3-phase sensing on both source supplies. ATS shall have Monitoring device and control module - MDCM.
g. An easy to remove motorization & control module with no disturbance to the load. It shall be possible to remove the ATSE motor even while the ATSE is in operation on fully loaded condition.
h. Dual emergency manual operation, with the Manual handle possible to mount directly on the ATSE body. It shall be possible to operate the ATSE in fully loaded condition, in the Manual mode.
i. Padlocking in the zero position with the use of up to 3 X 8 mm padlocks or as per OEM specifications.

22.2.2. The ATSE shall be fully integrated in one device. Besides customer I/O, no additional wiring between functional units other than the power connections and voltage sensing shall be necessary to allow the proper functioning of the ATSE. The fully integrated Controller design will not have any External wiring connection or wiring harness between the ATSE and the Controller.

22.2.3. The ATSE should include dual “Product Available Outputs” (one on the motorisation and one on the ATS controls). The product should analyze / test its condition periodically and communicate through dry contacts to report the ability of the transfer switching equipment to operate.

22.3. DESIGN REQUIREMENTS:

a. For ease of termination and ergonomic placement, complete Line Load side reversibility shall be possible on the ATSE.
b. Dual emergency manual operation shall be provided using an insulated handle directly through the motorisation and on the switch mechanism with the motorisation removed.
c. The ATSE shall have a distinct manual / automatic mode selectable by turning a rotary switch or a removable key switch located on the motorization module. The Auto/Manual selector switch shall be mounted on the ATS body.
d. The neutral pole of the ATSE switches shall be fully rated with left or right configuration.
e. The ATSE shall have no power consumption while in a stable position other than that required for the ATS control unit.
f. ATSE motor operation band shall be a wide band having, operational range 166-332 V AC.
g. The 4-poles shall switch simultaneously with a time gap of less than 1ms to avoid potential floating neutral issues during switching
h. There shall be a fully isolated ZERO position.
i. Settings of various parameters shall be possible via Keypad on the product and also through communication.

22.4. SAFETY REQUIREMENTS & FEATURES:

a. All operating modes shall be inhibited when the product is padlocked.
b. Padlocking shall only be possible with the mode selector switch in manual position.
c. The ATSE should allow manual switching I-0-II at full load without damage to the contacts.
d. There shall be an integrated Watchdog relay to confirm product availability status.
e. Potential free contacts shall be available.

22.5. BASIC OPERATION:

a. The auxiliary power of the ATSE shall be supplied by any one of the available supplies through a built-in dual power supply (DPS).
b. An automatic retransfer function should be included with the facility to inhibit retransfer locally or remotely through dry contacts.
c. The ATSE shall have the facility to inhibit the ATS controller and electrically change the switch state to any position (I – 0 – II) through dedicated inputs and dry contacts.
d. The ATSE shall include a priority input to force the switch to the 0 position and inhibit the automation of the ATS controller.

22.6. ATS CONTROLS

a. The ATSE shall have a fully integrated ATS Controller fixed directly on the motorisation.
b. The controller shall include an LCD display, LED’s and a keypad with front access.
c. Electrical motorised control (position I, O, II) should be available locally through the keypad, remotely through dry contacts and optionally through communication.
d. Main Parameters:
    vii. The ATS controller shall include 3-phase and neutral sensing for the monitoring of voltage and frequency on both source supplies.
    viii. Voltage settings shall be field adjustable in increments of 1%.
    ix. Frequency settings shall be field adjustable in 0.1% increments.
    x. Setting configuration shall be adjustable through software as well as from the keypad.

xi. The ATS Controller shall have phase sequence detection and allow the user to choose the desired sequence (ACB or ABC).

xii. Changeover shall be forbidden if the supply phase sequences are different.

xiii. The ATS Controller is to include an Auto-Configuration function for configuration of the source supply voltage, frequency, phase rotation and neutral position.

xiv. The ATS Controller shall have the possibility to select the network type.

xv. The ATS Controller shall allow the setting of the source priority.

xvi. The ATS controller shall be able to measure phase unbalance.

xvii. The ATS shall include 3-phase current transformer inputs for measurement of voltage, currents, frequency, PF, power (apparent, positive & negative, active and reactive energy). These inputs are to allow for 5A /1A CT configurable in ATS Controller settings.

xviii. The ATS shall have provision to swap the power cables (SWI/SWII SI or SII) so as to facilitate for source power cable inversion in the panel. (Software config)

22.7. COMMUNICATION

a. The ATSE shall have the provision to plug in optional communication module with RS-485 port.

22.8. TIMER SETTINGS:

a. Two adjustable timers of 0 to 60 seconds shall be provided to detect source 1 or source 2 failures, and to override any transient outages of the normal supply. (Source 1 Failure Timer, 1FT and Source 2 Failure Timer, 2FT).

b. A timer of 0 to 60 seconds shall be provided for source 2 available so as to ensure stability of the alternative network before transfer. (Source 2 Available Timer, 2AT).

c. A possibility to stay in switch position I or II shall be provided with an adjustment of 0 to 10 seconds prior to return to the 0 position. (0 Timer, 1OT, 2OT). It must be accessible with parameter RETURN to 0 activated.

Technical specifications of DC Charger		
Parameters	**Characteristic**	**Specification**
Power rating	**Rated Power**	30 kW
	Input voltage	415 Vac (±10%), 50 Hz Three phase
	Number of output	01
	Output current range	65 A Max
	Output Charging Outlet	CCS-2
	Output voltage	500-650 Vdc
User Interface and control	**Display**	7 TFT LCD with touch
	Push Button	Emergency Stop
	User Authorization	RFID + OCPP v1.6
Environment	**Ambient Temperature**	-30ºC to 55ºC
	Storage Temperature	-40ºC to 70ºC
	Altitude	<2000Mtr
	Humidity	<95%,Non condensing
Communication	***External***	*WiFi, BT, LAN, GSM, OCPP 1.6*
	Metering and Billing	*Grid Responsive metering and smart card, QR code scan/OTP/APP Server Based Online Payment*
	Charging Operation	*Swipe Card/ Scan Code/App based authentication*
Protection	***Input/Output protection***	*Over/Under voltage protection, Overload protection, Short circuit protection, Current leakage protection Grounding protection, Surge protection, Over/Under temperature protection*
	Protection level	*IP54*
	Cooling	*Forced Air cooling*
Regulation	***As per***	*IEC 61851-1:2017 , IEC 61851-21-2*
	Safety	*CE*
	Mounting	*Wall mounted*

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d. An adjustable timer of 0 to 60 minutes shall be provided to detect priority network return to normal so as to override any incorrect availability of the normal supply. (Main Return Timer, 1RT, 2RT).
e. Zero position timer, settable up to 20 second
f. An adjustable timer of 0 to 10 minutes shall be provided to allow the generator to cool down after the load retransfer from alternative back to the normal supply. (Cool Down Timer, 2CT accessible in Mains – Gen applications)

22.9. ON LOAD / OFF LOAD TESTS

a. The ATSE shall include for On-Load as well as Off Loads tests associated with Mains – Gen applications. The test will as a minimum start the Genset for a determined period of time. These tests should be operable manually through the keypad, through remote inputs, through MODBUS communication.

22.10. ONLINE MAINTENANCE

a. Replacement of the electrical parts (motorization or ATS controller) shall be possible on-load without removal of or disturbance to the power section and load.
b. Once the motorisation module is removed the transfer switch shall remain functional as an on- load manually operated transfer switch. The switching mechanism shall be independent of the operator switching speed.

22.11. EXECUTION & TESTING:

a. The ATSE shall be declared compliant to the IEC standards listed above by a testing laboratory having delegation or working under contract for certification to UL and IEC standards under the IEC Electro technical Equipment (IECEE) certification body scheme.
b. After installation of the equipment, a test report shall be submitted to client stating that the ATS equipment has been installed and commissioned in accordance with the manufacturer’s instructions.

23. Electrical Vehicle (EV) Charging Station

EPC Contractor shall carry out design, supply, installation, testing & commissioning of Electrical Vehicle (EV) Charging Station as per DBR and technical details as perm norms.

CHAPTER –F

TECHNICAL SPECIFICATIONS – FIRE ALARM SYSTEM

1. FIRE ALARM SYSTEM - GENERAL

a. The specifications includes furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm network equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Network Fire Alarm Control Panels (FACP), Network Reporting Terminals (NRT), Network Liquid Crystal Display (NLCD), auxiliary control devices, annunciators, and wiring as specified herein.

b. The fire alarm system shall comply with requirements of IS:2189:1999 & 1996 NFPA Standard 72 for Protected Premises Signalling Systems except as modified and supplemented by this specification, or the stringent one of the two specification in case of any discrepancy. The system shall be electrically supervised and monitor the integrity of all conductors.

c. Fire Alarm System shall be integrated with P.A. system. A digitized pre-recorded voice message shall notify occupants that a fire condition has been reported. The message shall instruct the occupants with emergency instructions. Emergency manual voice override shall be provided.

d. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing for equivalent European standard EN54.

e. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Alarm Control Room and designated personnel.

f. The FACPs shall be active/interrogative-type systems where each transponder is repetitively scanned, causing a signal to be transmitted to the fire alarm control panel node indicating that the transponder and its associated initiating device and notification appliance circuit wiring is functional. Loss of this signal at the FACP shall result in a trouble indication on both the FACP display and at the network display, as specified hereinafter for the particular input.

g. The system shall be arranged such that not less than 20 percent additional transponders may be inserted into any network communication loop.

h. The installing company shall employ technicians on site to guide the labours and to ensure the systems integrity.

1.1. SCOPE:

a. A new network intelligent reporting, microprocessor controlled fire detection and shall be compatible with PA system emergency voice alarm communication network shall be installed in accordance with the specifications and drawings.

b. **Basic Performance:**

i. Alarm and trouble signals from the FACP, NRT, and NLCD network nodes shall be digitally encoded by listed electronic devices onto a NFPA Style 9 looped multiplex communication system.

ii. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 6 (Class A) Signaling Line Circuits (SLC).

iii. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D). Connected by the SLC.

iv. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z). Connected by the SLC.

v. Power for initiating devices and notification appliances must be from the main fire alarm control panel, the transponder to which they are connected or to a Field Charging Power Supply (FCPS).

vi. A single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

vii. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

viii. Digitized electronic signals shall employ check digits or multiple polling.

ix. Transponder devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.

x. F.A. System shall be integrated with P.A system & Car Calling system so that it can be used for Emergency evacuation under fire condition.

1.2. SUBMITTALS

A. General:

All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the Contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment. Two copies of all submittals shall be submitted to the PMC/Engineer in charge/Engineer for review.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show equipment layout and main control panel, module layout, configurations and terminations.

C. Manuals:

Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets.

Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

Provide a clear and concise description of operation, which gives the information required to properly operate the equipment and system.

Approvals will be based on complete submissions of manuals together with shop drawings.

D. Software Modifications

Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 2 hours.

Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power- down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer and trained on network applications. Include names and addresses in the certification.

1.3. APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. The fire alarm system shall comply with requirements of NFPA 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

B. Underwriters Laboratories Inc. (UL) - USA: / EN - 54

C. NBC - 2016 (Part-4)

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.4. APPROVALS/ GOVERNING SPECIFICATIONS:

A. Detectors/ Devices:

(a) Heat Detectors shall confirm to IS-2175 - 1988 or BS-5445 (EN 54) Part 5– 1977(VdS/LPCB approved) or NFPA72 (UL/ULC/FM approved) amended upto date.

(b) Smoke Detectors shall confirm to IS-11360-1985 or BS 5446 Part I-1977 & Part VII – 1985 (VdS/LPCB approved) or NFPA72 (UL/ULC/FM approved) amended upto date.

(c) For other detectors/devices relevant IS or BS (EN 54) (VdS/LPCB approved) or NFPA 72 (UL/ULC/FM approved) amended upto date

B. **Fire Alarm Control Panel:** FACP shall meet the following requirements to assure the integrity and reliability of the system. The FACP shall have proper listing and / or approval from the following recognized agencies:

(I) National Fire Protection Association (NFPA)-USA: This will cover the following approval:

(a) UL (Under writers Laboratories Inc.)

(b) ULC (Under writers Laboratories Canada)

(c) FM (Factory Mutual)

(d) CSFM (California State Fire Marshal)

(II) EN 54 (European): This will cover the following approval:

(a) LPCB (Loss Prevention Council Board)

(b) VDS (Vertauen Durch Sicherheit)

(c) BRE

Fire Alarm Control Panel (FACP) shall be NFPA/EN listed independently and as per relevant IS Code and CPWD specifications.

B. The fire alarm control panel, network interface and all transponders shall meet the modular labeling requirements of Underwriters Laboratories, Inc. Each subassembly, including all printed circuits, shall include the appropriate UL modular label. Systems which do not include modular labels, which may require return to the manufacturer for system upgrades, and are not acceptable.

1.5. EQUIPMENT AND MATERIAL:

1.5.1. GENERAL

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

1.5.2. WIRE& Cable

Fire Survival Cable: For the detector and sounders proposed to fixed on false ceiling/surface, the wiring shall be done with Fire Survival Cable capable of withstanding temperature up to 950 degree C for 20 minutes and 650 degree C for the 180 minutes. The fire survival cable shall be laid on surface with proper saddle etc. ar per requirement & in cable tray above false ceiling. The cables may be armoured/unarmoured as per the location of use.

1.6. FIRE ALARM CONTROL PANELS AND FIRE CONTROL ROOM:

The Fire Alarm Control Panel shall be as per IS: 2189 (latest amended). Each network FACP shall contain a microprocessor-based central processing unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable detectors, addressable modules, Panel modules including initiating circuit, control circuits, transponders, local and remote operator terminals, printers, annunciators, emergency voice communication systems, and other system controlled devices.

Each FACP on the network shall perform the following functions:

1. It shall Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

2. It shall supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

3. It shall detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode sha ll treat the corresponding SLC loop control modules and associated detection as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

4. It shall visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

5. When a any of the following condition is detected and reported by one of the system initiating devices or appliances:

   i. Fire Alarm Conduits

   ii. Trouble Confirmation

   iii. Supervisory Card

   iv. Security Alarm

   v. Pre Alarm

Then the following functions shall immediately occur:

a. The FACP alarm LED on the FACP shall flash.

b. A local piezo-electric indication for the event signal for the event in the FACP shall sound a distinctive Signal.

c. The 640-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.

d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.

e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

General FACP Configuration & Operation

Each FACP node shall include a full featured operator interface control and annunciation panel which shall include a backlit Liquid Crystal Display (LCD), individual, color coded system status LEDs, and an alpha-numeric keypad for field programming and control of the node.

f. All programming or editing of the existing programming in the system shall be achieved without special equipment or interrupting the alarm monitoring functions of the fire alarm control panel.

g. FACP nodes shall be designed so that it permits continued local operation of remote transponders under both normal and abnormal network communication loop conditions. This shall be obtained by having transponders operate as local control panels upon loss of network communication.

h. FACP nodes shall be modular in construction to allow ease of servicing. Each CPU and transponder shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems which require use of external programmers or change of EPROMs are not acceptable.

i. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients including RFI and EMI.

j. Each transponder and peripheral device connected to the FACP node CPU shall be continuously scanned for proper operation. Data transmissions between network nodes, FACP CPUs, transponders, and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques. Failure of any transponder or peripheral device to respond to an interrogation shall be annunciated as a trouble condition.

The FACP shall be able to provide the following software and hardware features:

1. Pre- Signal and Positive Alarm Sequence: The system shall provide means to cause pre- alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-Second time period for acknowledge an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local remote outputs shall automatically immediately.

2. Smoke Detector Pre-Alarm indication at control panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values abovethe programmed setting. Two levels of Pre-Alarm indication shall be available at the control.

i) Alert: It shall be possible to set individual smoke detectors for pre-programmed pre- alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

ii) Action: if programmed for action and the detector reaches a level exceeding the pre- programmed level, the control panel shall indicate an action condition, Sounder bases installed with either heart or smoke detectors shall automatically activate on action Pre- Alarm level, with general evacuation on alarm level.

3. The system shall be integrated with P.A. System Car Calling system for Emergency evacuation under fire.

4. Each FACP node shall be capable of providing the following features:

a) Block Acknowledge for Trouble Conditions.

b) Rate Charger Control

c) Control-By-Time (Delay, Pulse, time of day, etc.)

d) Automatic Day/Night Sensitivity Adjust (high/low)

e) Device Blink Control (turn of detector LED strobe)

f) Environmental Drift Compensation (selectable ON or OFF)

g) Smoke Detector Pre-alarm Indication at Control Panel

h) NFPA 72 Smoke Detector Sensitivity Test

i) System Status Reports

j) Alarm Verification, by device, with tally

k) Multiple Printer Interface

l) Multiple CRT Display Interface

m) Non-Fire Alarm Module Reporting

n) Automatic NFPA 72 Detector Test

o) Programmable Trouble Reminder

p) Upload/Download System Database to BMS

q) One-Man Walk Test

r) Smoke Detector Maintenance Alert

s) Security Monitor Points

t) Alpha-numeric Pager Interface

u) On-line or Off-line programming

The configuration features & peripherals of FACP shall be given below:

Doc1	**Standard Data Sheet**
Item	Floor Fire Alarm Panel
Purpose	Automatic fire detection and alarm
Interconnection	Peer to peer networked floor Panels

Type	Solid state micro-processor based analogue addressable
Loop capacity	Loop cards as per floor requirement
Compatibility	Photo electric smoke sensors Loop isolators Loop sounders Loop manual call points Loop input monitoring cards RS 485 cards for networking & RS 232 cards for printer & CRT Convention devises
No of devices	Each loop shall be able to cater to minimum as per IS or manufacturer standard
Operation Voltage	15 V to 28 V DC, 3 amps
Input Voltage	230 V AC, 1-Ph, 50 Hz, 0.75 amps.
Standby battery charging	28 V DC, 1.5 A
Wiring/ Cabling	2 core 1.5 mm2, copper, PVC insulated, twisted, screened wires in concealed conduits wherever available & in other places by fire survival cables for notification loop, sounder loop, RS 232 & RS485 communication
Loop wire monitoring	Open circuit
	Short circuit
	Earth Leakage
	Device removed
	Wrong Device
Communication	To remote repeater panel through proprietary protocol over RS 485 link
Outputs	2 X programmable sounders on panel 1 X Fire Contact 1 X Fault Contact
Printer	24 character built in printer

Communication port	RS 485
	RS 232
Selectable Features	Common sounders coincidence alarm RMC Fire
	RMC Fault Zone walk test Control Output
	Output delay Alarm counter Alarm Counter
	Alarm verification Sounder silence
Dialing Time	4 second per loop for 127 devices, 3 second per loop for MCPs
Software	Firmware Field configuration programmable
Memory	EPROM non volatile for 600 event memory storage
Configuration	Power supply module
	CPU
	memory extension module
	memory buffer module
	printer interface module
	LCD ineterface module
	relay driver module
	1 no. 80 column external printer
	1 no. menu driven membrance switch keyboard
	1 set control switches
	1 set operator push buttons
	Loop cards
	Remote terminal unit connection port

	LCD display & driver module
Connectivity	To proprietary protocol compatible to analogue addressable detectors of type
LCD display	Alpha numeric LCD auto back lit with occurrence of event or manual override
Display Format	Alarm/pre-alarm/fault/isolation
	Alarm & event acknowledge
	Commands/report/programming
	Time/day/date
Power supply	SMPS
Back up/ standby power supply	As per IS-2189
Power pack	SMF lead acid / Ni-Cd 24 V DC 30 AH or as per OEM standards
Test features	Panel self test
	LCD Test
	Fault Test
	Detector Test
	Battery Fault
	Internal Hooter Test
	External hooter Test
Control facility	Scroll/next
	Alarm silence
	Fault silence
	Lamp evacuate
	System reset
	LCD back Lighting
	Trouble Silence
Indications	System normal
	Priority 1 Alarm

	Priority 2 Alarm
	Fault
	Alarm Silence
	Power ON
	Battery ON
Event report	Type
	Address
	Location
	Time/day/date
	Date
	Time
Zone recording	In order of occurrence regradless of alarm priority
	Print Interrupt of occurrence of fresh event & on its record resume print
Testing facility	Possible with digital and analogue input and output digital simulation from panel through software
	Under maintenance mode testing possible with balance system in normal operation
Fire pattern	No alarm issue for short duration
	Quick response for fast smoke build up
	Early detection and suitable modification for of alarm level for dirt accumulation
	Programmed output actuation
	Access protection through 4 levels of pass words
	Hardware security lock
	Detector sensitivity adjustment and display of set value
	Disable/isolate detectors/ interface units
	Single button operation front panels keys
Software facility	Individual detector
	Sensitivity setting

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	Trending
	Adjustable dual alarm thresholds
	Pre alert warning
	Cross zoning
	Alarm verifications
	Input/ output assignment
	Event history indexing
Local Sounder	Yes
Panel Sounder output	1 no. rated for 1 Amp.
Surge withstand	As per IEEE 472 for mains, input/ output/loops, 7 kv discharge on panel electronics except LCD display
Ambient	From (-) 5 deg. C to (+) 45 deg C Max.
Humidity	15% to 95% non condensing
Mounting	Wall / Floor
Enclosure	1.6 mm sheet steel, dust and vermin proof to IP-55
Enclosure treatment & painting	Degreased, de-rusted, pickled, rinsed, phosphattized, putty finished. Double primer and final epoxy painted FIRE RED shade
Front doors	Hinged and lockable with transparent visor for viewing LEDs etc.
Cable Entry	From both top & bottom, through 2 mm thick removable gland plate

Network Repeater Panel (NRP)

- A network control annunciator shall be provided to display all system intelligent points. The NRP shall be capable of displaying all information for all possible points on the network.
- Network display devices which are only capable of displaying a subset of network points shall not be suitable substitutes.
- The NRP shall include a minimum of 640-character / minimum 4 " (inch), backlit by a long life, solid state LCD display. It shall also include a keypad. Additionally, the network display shall include ten soft-keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.
- The network control annunciator shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of events by type.

- The NRP shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a back box designed for this use.
- The NRP shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events, and CPU Failure.
- The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.
- The NRP shall allow editing of labels for all points within the network; control on/off of outputs; enable/disable of all network points; alter detector sensitivity; clear detector verification counters for any analog addressable detector within the network; clear any history log within the network; change the Time/Date settings; initiate a Walk Test.

The configuration, features & peripherals of the Repeater panel shall be given below:

Doc 2	**STANDARD DATA SHEET**
Item	Network Repeater Panel
Purpose	Repeat indication
Compatibility	With networked analogue addressable floor fire alarm panel through proprietary communication protocol
Type	Solid state micro-processor based
Communication	By 2 core RS 485 twisted pair screened with networked floor fire alarm analogue addressable panels
Distance maximum	Up to 2 Km from nearest networked floor addressable fire alarm panel. Connection to system by tee off / spur / daisy chained
Power Supply	From power supply unit or from nearest floor addressable fire alarm panel.
Operating Voltage	15 V to 28 V DC
Monitoring	Panel power disconnection
	Floor / Loop / Zone indication LEDs (50 nos)
	Select keys for point addresses in display zone
	Fire
	Fault
	Disabled
	Accept / Reset / Silence / Sound alarm
	Control key for current Fire / Fault / Disabled status
Power consumption	100 mA mains fail state
	250 mA nominal
	350 mA max. draw
LCD display	Back lit, Alphanumeric, 4 line 160 character display
Data interface	RS 485 serial bus driver board
Mounting	Suitable for both surface & recess mounting
Enclosure	1.8 mm sheet steel, dust and vermin proof
	Hinged lockable double door
Ambient	From (-) 5 deg C to (+) 450 deg C Max

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Humidity	15 % to 95 % non condensing
Paint	Degreased, de - rusted, pickled, rinsed, phosphatized expoxy painted in FIRE RED paint
Local sounder	Yes

1.7. Water flow Indicators:

Water flow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.

Water flow Switches shall have an alarm transmission delay time, which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.

All water flow switches shall come from a single manufacturer and series.

Water flow switches shall be provided and connected under this section but installed by the mechanical Contractor.

Where possible, locate water flow switches a minimum of one (1) foot from a fitting, which changes the direction of the flow and a minimum of three (3) feet from a valve.

1.8. Sprinkler and Standpipe Valve Supervisory Switches:

Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.

The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 25 mm conduit entrance and incorporate the necessary facilities for attachment to the valves.

The switch housing shall be finished in red baked enamel.

The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

Valve supervisory switches shall be provided and connected under this section and installed by mechanical Contractor.

1.9. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

Combo Zone: - A special type code shall be available to allow water flow and supervisory devices to share a common addressable module. Water flow devices shall be wired in parallel, supervisory devices in series.

1.10. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

1.10.1. DETECTORS& ADDRESSABLE DEVICES

The addressable detector and devices shall comply to the below mentioned specifications. The addressing of detectors and devices shall be of rotary type electronic addressing shall not be acceptable.

I. Intelligent Laser Photo Smoke Detector

a) The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

b) The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.

c) The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.

d) The laser detector shall not require expensive conduit, special fittings or PVC pipe.

e) The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.

f) The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.

g) The laser photo detector shall include two bi-color LEDs that flash green in normal operation and turn on steady red in alarm.

II. Intelligent Multi Criteria Acclimating Detector

a) The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

b) The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

c) The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

III. Intelligent Thermal Detectors

Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

IV. Intelligent Photoelectric Smoke Detector

The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

V. Intelligent Multi Sensor Intelliquad Detector (CO, IR, Smoke & Heat)

a) The intelligent multi sensor Intelliquad detector shall be an addressable device that is designed to monitor a minimum of photoelectric, thermal technologies, carbon monoxide & infrared in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

b) The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, parking etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

c) The intelligent multi sensor detection device shall include the ability to combine the all of four signals in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

VI. Intelligent Duct Smoke Detector

a) The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

b) When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

a) Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

b) If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

c) The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

d) The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

e) The isolator module shall not consume any detector or device address from the loop capacity.

VII. Addressable Control Relay Module

Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or
1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

VIII. Addressable Control Module

a) Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered polarized audio/visual notification appliances.

b) The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.

c) Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.

d) The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

IX. Manual Pull Stations

The fire alarm station shall be of polycarbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering.

X. Programmable Electronic Exit Point Sounders With Strobe Light

a) Shall follow NFPA 72 2007 edition recommendation.

b) Electronic sounders shall operate on 24 VDC nominal.

c) Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.

d) Shall be capable to broadcast pre programmed Voice Message also

e) Shall be flush or surface mounted as shown on plans.

f) Shall produce broad band directional sound with 20 Hz to 20 Khz frequency band to guide occupants to safe exists even in complete darkness.

g) Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

h) The maximum pulse duration shall be 2/10 of one second.

i) Strobe intensity shall meet the requirements of UL 1971.

j) The flash rate shall meet the requirements of UL 1971.

k) Field Wiring Terminal Blocks

l) For ease of service all panel I/O wiring terminal blocks shall be removable, plug- in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

1.11. TEST

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

a. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
b. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
c. Verify activation of all flow switches.
d. Open initiating device circuits and verify that the trouble signal actuates.
e. Open signaling line circuits and verify that the trouble signal actuates.
f. Open and short notification appliance circuits and verify that trouble signal actuates.
g. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
h. Ground initiating device circuits and verify response of trouble signals.
i. Ground signaling line circuits and verify response of trouble signals.
j. Ground notification appliance circuits and verifies response of trouble signals.
k. Check alert tone and prerecorded voice message to all alarm notification devices.
l. Check installation, supervision & operation of all intelligent smoke detectors using walk test.
m. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
n. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

1.12. FINAL INSPECTION:

At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

1.13. INSTRUCTION & SEQUENCE OF OPERATION:

Instruction shall be required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided. The Contractor and/or the systems manufacturer's representatives shall provide a typed written "Sequence of Operation."

BOOM BARRIER
Boom Barrier Specification

1. General

The boom barrier shall be an electromechanical system designed for regulating vehicle entry and exit. It shall be suitable for outdoor installation and function reliably under Indian environmental conditions (temperature, humidity, dust).

2. Technical Specifications

Parameter	Specification
Type	Electromechanical Boom Barrier
Boom Length	4 to 6 meters (as per site requirement)
Boom Arm Type	Octagonal / Rectangular Aluminium with Reflective Stickers
Duty Cycle	100% Continuous Operation (Heavy Duty)
Operating Voltage	230V ±10%, 50Hz Single Phase AC
Motor Type	DC Brushless Motor / AC Induction Motor
Opening/Closing Time	Adjustable, typically 1.5 to 6 seconds
Cabinet Material	Powder-coated Mild Steel or Stainless Steel (SS 316 optional)
Control Panel	Microprocessor-based controller with inbuilt logic
Manual Operation	Manual override in case of power failure
Operating Temperature	-10°C to +60°C
IP Protection	IP54 or higher
Safety Sensors	Optical/Infrared loop detectors and anti-crush safety sensors
Remote Operation	Wired push button, Remote control, RFID/Access card optional
Boom Arm Reflectors	Retro-reflective stickers or LED light strip
Mounting Base	Bolted to RCC pedestal (RCC base to be constructed by vendor)

Compliance Standards

IS 9000 (Basic Environmental Testing Procedures for Electronic Components)

IS 13947 (Low-voltage switchgear and control gear)

IP Rating as per IS/IEC 60529 (Minimum IP54)

Electrical components shall conform to IS 732 (Code of Practice for Electrical Wiring)

Safety compliance: CE / UL / equivalent preferred

Installation & Commissioning

Vendor shall supply, install, test, and commission the boom barrier system at the designated location.

Civil foundation works shall be carried out as per approved shop drawings.

Signature of the bidder with seal