Volume III
Employers Requirement and Technical Specifications

A. Scope of works

The works under Contract comprises the construction of proposed skywalk in textile market area on 18.0 m wide salasar hanumar road of approximate length of 2870.0m and it is divided into 3 phases. Phase I is approximately 670.m long connecting ring road & mithi khadi road and Maintenance of Tendered works for Period of Five years

The Work Shall be executed on Prepartion of Working Drawings, Procurement and Construction Basis . Details and drawings given in Tender document is for information purpose only and successful bidder shall undertake confirmatory survey for accuracy and completeness of data. It is in scope of successful Bidder to undertake all Site surveys, Geotechnical investigations, Underground Utility Survey and Scanning of the roads for utility shifting, obtaining all required approvals from the relevant authorities,Carry out Design and Drawings for all the components of the work as per Employers requirement and submit the same to client for review and approval, Prepare Good for Construction Drawings, submit maintenance manual to client for approval before start of Maintenance period.

The successful bidder shall have to prepare and submit 'As Built Drawings' depicting the exact construction carried out on site, in soft and hard copy format.

Statutory and other charges for getting various required approvals shall be in scope of Successful bidder

The scope of work also includes :

1.1 Construction and completion of the following

a. Site clearance, demolition works, earthworks, temporary works,traffic diversion, barricading the construction site, utility shifting and all ancillary works deemed necessary for the carrying out of temporary & permanent construction works.
b. Tree cutting (if any) as indicated in the drawings.

c. All other works and services ancillary or related to the full completion of the Works in accordance with the Employer's requirements

1.2 The Contractor shall ascertain, determine and verify the locations of all utility services by scaning the roads in the vicinity of the Works, and co-ordinate with utility agencies for the diversion of affected services. The Contractor shall support and protect services that need not be diverted or pending diversion and remove all abandoned services. Contractor shall be responsible for , site accesses, temporary drains, earth works, , environmental assessments, necessary safety measures and protection works, sewer lines etc

1.3 The Contractor's responsibility for the design and build works includes the submissions to relevant government authorities / technical departments for obtaining all necessary clearances/approvals.

1.4 The Contractor shall co-ordinate and interfaces his works with that of all other contractors, subcontractors, utility services, statutory authorities, etc. and achieve the completion of the Works to the satisfaction of the Engineer

1.5 The Contractor shall verify the proposed road reserve, cadastral boundary and contract boundary and all dimensions on Site prior to submission of Tender. The Contractor is responsible for clarifying any discrepancy between the Drawings and actual condition on Site.

1.6 The Contractor shall make good all works including road surfaces, drains, concrete slabs, gratings, kerbs, pavements, turfing, railing, fence, boundary wall, etc. affected or damaged during the course of construction, to the satisfaction of the Engineer. The costs of making good all these defects shall be borne solely by the Contractor and deemed included in his Contract Sum

1.7 All works specified shall include the provision of all labour, tools, equipment, material,traffic control, transport and everything else necessary for the satisfactory completion of the Work by the Contractor to the satisfaction of the Engineer.

1.8 Description of the Works involved in this Contract is given in the Specifications for the guidance of the Contractor. The Contractor shall be solely and fully responsible for investigating and ensuring the actual extent and nature of the Works comprised in this Contract prior to submission of his Tender.

1.9 Construction, management and quality of the Works shall comply with the Drawings,Specifications and Employers requirement

B. CONTRACTOR'S OBLIGATION

1.1 SITE RESPONSIBILITY CHART

The Contractor shall submit, within 15 days after the Date of Commencement of the Contract, a site responsibility chart to show the functions and responsibilities of various personnel from the Project Manager to the workmen responsible for executing the Works, as well as the functions and responsibilities of the sub-contractors involved.

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1.2 SETTING OUT AND EXISTING LEVELS

The Contractor shall take levels and set out for the whole of the Works. The information on existing levels as shown on the Drawings is provided in good faith for the general guidance of the Contractor. The Contractor is to note that accuracy of information shown on the Drawings is not guaranteed. The Contractor shall visit the site and carry out field surveys if he considers it necessary to ascertain the full extent of the Works. Within one week after the commencement of the Works, the Contractor shall submit to the Engineer for his verification and endorsement, records of levels of the existing site condition. Similarly, the Contractor shall submit the as-constructed levels of the site to the
Engineer upon completion of the Works. Such records shall be certified and endorsed by a Registered Surveyor engaged by the Contractor at his own cost.

1.3 DESIGN OF WORKS :

The Contractor shall carry out, and be responsible for the design of the Works, including any site surveys, subsoil investigations, materials testing, and all other things necessary for proper planning and design.

With 10 days from Award of work, the Contractor shall start submiting drawings, construction documents, etc., for review and approval by the Employer's Representative. The Contractor will be fully responsible for ensuring that its designs, drawings, and construction documents satisfy all requirements for constructing Works that are complete and fully functional in all respects.
The Contractor shall prepare, and keep up-to-date, a complete set of "as-built" records of the execution of the Works, showing the exact as-built locations, sizes and details of the work as executed. These records shall be kept on the Site and Two sets of such records shall be Submited to Employer.

In addition, the Contractor shall supply to the Employer's Representative as-built drawings of the Works, showing all Works as executed.

1.4 PROGRAMMING & PLANNING

BASELINE PROGRAMME :

1.4.1 Within 15 **days** after the award of the Contract, the Contractor shall submit six (6) hardcopies and one (1) softcopy of a Baseline Programme to the Engineer for his acceptance. The Contractor's project manager shall make a presentation of his proposed programme to the Engineer to demonstrate his understanding of the contract requirements, planning, control, monitoring of works programme and resources of the Works. Upon acceptance of the Baseline Programme by the Engineer, the Contractor shall adhere to it strictly. The Contractor shall ensure that preparation, updating and revision of programme of works are carried out by experienced and qualified personnel. The Baseline Programme shall be developed by the computerised Critical Path Method (CPM) using the Precedence Diagramming Method (PDM). The programming software shall be Primavera Project Planner or Microsoft Project or Open Plan, subject to the Engineer's approval.

1.4.2 Programme Details

The level of programme development, information and detail shall be sufficient to accurately define the Contractor's intentions and sequence of works. The programme shall show every significant activity required for the completion of the Contract that include but not limited to the following:

a. key dates, milestones, interface and handover dates, phased completion and completion of Whole of the Works;

b. Contractor's design including dates for submission to and acceptance by the Engineer;

c. submission and acceptance of road diversion plan, utilities diversion plan, Temporary Works and other works requiring approvals from authorities;

d. procurement of major equipment and material, in particular long lead items and the delivery to site;

e. all on-site works, including preliminary and Temporary Works by the Contractor, his sub-contractors and suppliers;

f. any off-site work such as the production and/or fabrication of any components or materials;

g. the different stages of traffic diversion and specific requirements with regard to traffic aspects as given in this Specification;

h. interface with Utility Agencies and work done by Utility Agencies or the Contractor for diversion;

i. interface with other contracts/contractors; and

j. any outside influence which will or may affect the progress of Works

1.5 SITE MEETINGS

The Contractor shall provide all facilities at the site for the purpose of conducting joint site meetings between the Contractor and the Engineer.The Contractor's key representatives (Project Manager, Construction Managers, Safety and Health Officer, Environmental Control Officer and site engineers, etc.) are required to attend daily pre-work meeting punctually prior to commencement of site activities and submit daily and weekly works programme to the Engineer (or his representatives).

1.6 NOISE CONTROL

The Contractor shall maintain noise levels for construction premises as stipulated under the Environmental Pollution Control (Control of Noise at Construction Site Regulations) (Amended) Regulations latest and subsidiary legislation and any amendments and/or reenactment thereto. All vehicles and mechanical construction plants used for the purpose of the Works shall be fitted with effective exhaust silencers and shall be maintained in good and efficient working order. All compressors shall be sound reduced models fitted with properly lined and sealed acoustic covers which shall be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools shall be fitted with mufflers or silencers of the type recommended by the manufacturer.All construction plants shall, where appropriate, be muffled and the Engineer shall have the authority to instruct the Contractor to shut down any which is not adequately muffled and to remove it from the Site.All machines in intermittent use shall be shut down or throttled down to a minimum in the intervening periods between works. Noise emitting equipment running continuously shall be housed in a suitable acoustic enclosure. Constructional plant shall be maintained in good and workmanlike condition so that extraneous noises from mechanical vibration, creaking and squeaking are reduced

to an acceptable minimum. Percussive methods will not be permitted for breaking concrete. Equipment which breaks concrete or used for bending or such other equipment as is approved by the Engineer shall be used. All pile driving, demolition works etc shall be carried out by a recognised noise reducing system. Rotary drills and busters actuated by hydraulic or electrical power shall, where practicable, be used for excavating hard material. Noisy constructional plant shall be sited as far away as possible from occupied buildings. The use of barriers (noise barriers, site huts, acoustic sheds, screens or partitions) to absorb and or deflect noise away from occupied buildings shall be employed wherever possible. Care shall be taken when loading or unloading vehicles, dismantling scaffolding or moving materials to reduce impact noise. Access to the working areas shall be such as to ensure minimum disturbance to persons in occupied buildings. The Contractor shall not execute any of the works or carry out maintenance of construction plants in such a manner as to cause nuisance unless the work is absolutely necessary to save life or property or for the safety of the works in which case the Contractor shall immediately advise the Engineer. The Contractor shall provide all that is necessary, including competent and qualified personnel and suitable equipment for all the measurements and recordings of the noise levels as and when requested by the Engineer during the Contract duration and submit a detailed report including analysis within two days after the day of measurements to the Engineer.The Contractor shall provide and use construction plant and equipment, which have been specifically designed or modified to reduce the noise of normal operation.All night work after 6pm shall be subject to the approval of the Engineer.

1.7 MAPPING OF EXISTING SERVICES

Prior to commencement of any part of the works under the contract, the Contractor shall locate the exact positions of all existing sewer mains, gas mains, water mains, electrical cables, telecommunication cables and other utility services.

Underground Utility Surveying shall be carried out by the Contractor, using the most advanced technology to get accurate & reliable Underground Utility information. Based on the findings of Underground Utility Surveying, the Contractor shall submit the Utility map and his plan for shifting of same to the Employer and respective Utility services Authorities. The Contrcator shall commence the work of Shifting / Relocation of Utilities only on reveiving approval for same

The Contractor shall take all precautionary measures to prevent damage to the services and minimize all inconvenience to residents, during the cutting of trial trenches.

Where utility services which are in the way of the works are not diverted or not to be diverted, they must be supported and protected during the construction of the works. The Contractor shall submit to the engineer and the relevant utility services authorities, calculations and detailed drawings, for the necessary support and protection of these services.

Any requirement that may be imposed by the utility services authorities in this connection shall be met fully and without compromise.

The Contractor shall note that the employer will not be responsible for any damage of the existing
services caused by the construction works, etc. The Contractor will be liable for any damage to the existing services and carry out the repair works to the satisfaction of the engineer and the appropriate utility services authorities at his own expense.

All relevant utility services authorities shall be kept informed of any changes affecting their services

1.7.1 Diversion and Maintenance of Existing Drains

Upon award of the contract and prior to the commencement of the works, the contractor shall submit to the engineer his proposal for the diversion and maintenance of existing drains for the whole period of construction to the engineer and respective authority for approval.

The contractor shall be responsible for the maintenance of the free flow of the drains at all times. At no time shall the contractor obstruct or reduce the free flow area of the existing canal / drain without the prior approval of the engineer and respective authority.

If, in the opinion of the engineer, the contractor has not carried out or is unable to carry out such maintenance of temporary drain diversion to his satisfaction, the engineer reserves the right to employ others to carry out such works and deduct the cost of all such works from any money due to or to become due to the contractor.

The contractor shall remove all temporary works as soon as these are no longer required and reinstate the siteto its original condition to the satisfaction of the engineer and respective authority.

The contractor shall take all necessary precautions to prevent any damage to the existing culverts and drains. Existing drains/culverts/sumps etc. Made redundant when the new drains / culverts / sumps are completed, shall be completely removed and filled with suitable materials to the satisfactory of the Engineer

1.8 Interface with Government Authorities / Consultants / Contractors / Vendors

Contractor shall Coordinate with Various Government Authorities / Agencies , State Electricity Board, Torrent Power, Gas Authority, , various other Contractors / Vendors engaged by Employer for this Project for finalizing the Drawings, Implementation Schedule,shifting and Alignment of Utilities, for Proper Execution of works. All the Statutory Charges/ Fees. etc required for the same shall be borne by the Contractor.

Interface Matrix is given as a Guideline to the Contractor, However it is in the scope of Contractor to coordinate with all Relevant Authorities for Proper Execution and Completion of Works

INTERFACE MATRIX

Sr.No	Description	Coordination
1	For design & implemention of work as per detail scope as mentioned in Tender document	SMC BRTS & Traffic Cell, Visual Improvement contractor
2	For all Statutory / planning /Designing / Safety / Environmental norms	With Relevant departments. All charges / fees required shall be borne by the Contractor
3	Assessment of Power Requirement, Location and Space required for Supply of Power Equipments.	Torrent Power, DGVCL & relevant SMC department
4	Shifting of Required Utilities	Drainage / Water Department of SMC

1.9 Design and Drawings to be submitted for review and Approval

On Award of work the Contractor shall submit the design and Drawing for review and approval. Drawings mentioned in the list are indicative and for Information. Contractor shall not limit himself to the same but it is in scope of Contractor to submit all required design and drawings for review and approval as per Instruction from Engineer-In-Charge

Sr.No	Documents
1	Geotechnical investigation report
2	Topography Survey Layout
3	Civil / structural design basis report
4	Structural design (calculations) report
5	Proposed Layout for Shifting of Utilities
6	Skywalk Layout with Access point locations
7	Design,Drawings, Sections for Skywalk Including electrical layout, details & structural details
8	Design, Drawings details for Access points Including electrical layout, details & structural details
B	**Typical Detail /shop Drawings**

13	Flooring details
14	shop drawings for Elevators & Escalators
15	Glazing details
16	Railing details
17	Branding & Advertisement boards – Shop Drawings
18	Roof fixing details

C. **Salient Features of Skywalk for Surat Smart city :**

Skywalk layout in Textile Market Area is marked below

For more details of Skywalk & list of the markets covered

Detail of Phasing

1. Phase I – Salasar Hanumar marg from Ring road entrance to Existing Multi level parking behind millennium market

SPECIFICATIONS

1.1. PREAMBLE

This section contains the specifications for proposed work and shall be read in conjunction with the various other sections forming the Contract namely, Instructions to Tenderers, General Conditions, Special Conditions, Bill of Quantities, Drawings and other related documents mentioned in this Tender Document together with any Addendum issued thereto.

A1 : Demolition & other works

Removal of existing street furniture, manhole covers, existing median, exiting signages, trees if any way as per revised ROW, existing structures that obstruct the revised ROW. Item also includes all materials, labour, equipments, dismantaling, transportation & disposing where required etc. complete.

CLEARING AND GRABBING

Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps , roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Site Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer., It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

1 Glass Railing

1.1 General:

1.1.1 Glass component

Transparent tempered laminated sheet glass shall conform to the requirements of IS: 2835. Glass balustrade railing systems shall withstand structural loading as determined by allowable design working stresses of materials based on the following standards.

IS: 5437: IS 5437: Figured rolled and wired glass .

1382: 1981 Glossary of terms related to glass & glassware (first revision)

5437: 1994 Figured, rolled and wired glass – specification

3548: 1988 Indian Standard, Code of practice for glazing in buildings

10439: 1983 Indian Standard, Code of practice for patent glazing

875: 1987 Indian Standard, Code of practice for design loads (other than earthquake) for buildings & structures, part 3: wind loads

2553: 1990 Safety glass – specification (Part 1)

2835: 1987 Specification for flat transparent sheet glass

IS 16231 Code of practice for use of glass in buildings

Builder's hardware for fittings shall be of the best quality from approved manufacturers.

1.1.2 Railing Components:
1. Extruded Aluminum Components: Provide manufacturer's standard extruded aluminum components as follows:
a. Aluminum Base Shoe: 2 inches (51 mm) by 4 inches (102 mm), Alloy 6063-T6.

b. Top Rail: Circular cross section, radius as indicated on the Drawings or, if not indicated, as selected by the Architect from the manufacturer's standards with an open bottom, 2.20 mm wall thickness.
1.1.3 Structural Performance: Provide glass balustrade railing systems capable of withstanding the following structural loads without exceeding allowable design working stress of materials for railings, anchors, and connections:
1.1.3(A) Top Rail: Shall withstand the following loads:
a. Concentrated load of 890 N applied at any point and in any direction.
b. Uniform load of 730 N/m applied horizontally or vertically downward.
c. Concentrated and uniform loads above need not be assumed to act concurrently.
1.1.3(B) Handrails not serving as Top Rails: Shall withstand the following loads:
a. Concentrated load of 890 N applied at any point and in any direction.
b. Uniform load of 730 N/m applied in any direction.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

Infill Area shall withstand the following loads:
Concentrated horizontal load of 222 N applied to 0.09 m2 at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Loads need not be assumed to act concurrently with loads on top rails in determining stress on guard.

1.1.4 Glass Balustrade Railing Systems: Capable of withstanding loads indicated for top rail and infill areas of guardrail systems, with each section of top rails supported by a minimum of three glass panels or by another means so that it remains in place should any one panel fail.

1.1.5 Thermal Movements: Glass balustrade railing systems shall allow for movements resulting from changes in ambient and surface temperatures.

1.1.6 Corrosion Resistance: Separate incompatible materials to prevent galvanic corrosion.

1.2. Submittals:
1.2.1. Product Data:
1. Submit manufacturer's data sheets on each product to be used, including, but not limited to the following:

a. Preparation instructions and recommendations.
b. Storage and handling requirements and recommendations.
c. Installation methods.

2. Submit product data for manufacturer's product lines of glass balustrade railing systems assembled from standard components.

1.2.2. Shop Drawings: Submit shop drawings showing fabrication and installation of glass balustrade railing systems. Include plans, elevations, sections, details, and attachments to other work.

1.2.3 Samples:

1. Color Selection: Submit manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.
2. Finish Selection: Provide sections of railing or flat sheet metal which depict available mechanical surface finishes.
3. Verification Samples: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected. A 150 mm long sections of each different linear railing member, including handrails and top rails.

1.2.4 Quality Control Submittals:

1. Design Data: For installed glass balustrade railing systems indicated to comply with certain design loadings, include structural analysis data signed and sealed by the professional engineer who was responsible for their preparation.
2. Qualification Data: Submit documentation demonstrating capability and experience in performing installations of the same type and scope as specified. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.3. Workmanship

The workmanship and finish of glass work in railings shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled worker for good appearance, efficient and safety. All works shall be executed as per the detailed drawings and/ or as directed by the Engineer. Hand railing shall be of the size and shape with the fixing arrangement as indicated in the drawings. All members of the guide rails shall be straight without any bend unless otherwise indicated in drawings. The right angle shall be checked from the inside surfaces of the respective members. Joints in metal members shall have welded joints which shall be scrubbed and finished to give a smooth surface appearance. The vertical members of the railing shall project below the finished floor level and anchored to structural slab with MS bolts. The panels shall be fixed by providing channel sections on top and bottom of the rails. Glazing bars shall be as detailed in the drawings.

The properties of glass shall be as follows:

(a) Type: laminated tempered glass.

(b) Minimum thickness: 8 mm

(c) Visible light transmittance: %

(d) U-Value (summer): 0.49 Btu/hr.sft.Deg F

(e) Shading coefficient: 0.

1.4 Mock-Ups: Prior to installation of the work, fabricate and erect mock-ups for each type of finish and application required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of work. Locate mock-ups on site in location and of size indicated or, if not indicated, as directed by the Architect. Demonstrate the proposed range of aesthetic effects and workmanship to be expected in the completed work. Obtain the Architect's acceptance of mock-ups before start of final unit of work. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of work.

1. When directed, demolish and remove mock-ups from the Project site.
2. Accepted mock-ups in undisturbed condition at time of Substantial Completion may become part of completed unit of work.

1.5. Measurements

Measurement for railings shall be measured in running meters (RM) correct to two places of decimal. Measurement shall be from out to out of the railing. Rates quoted shall be for all the works including glazing, painting, Builder's hardware of fittings as specifically described in the respective items of work.

Rate shall include the following:

(a) Fixing of Metal members in masonry/ RCC members/ structural steel with screws to meet adequate strength.

(b) Providing temporary supports, etc for fixing of at all levels.

1.6. Extra materials

A. All supplemental materials not expressly specified in this section shall be approved by the Architect prior to installation.

Metals: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

1.6.1 . Aluminum: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy and temper designated below for each aluminum form required.

a. Extruded Bar and Tube: ASTM B221/B221M, Alloy 6063-T5/T52.
b. Extruded Structural Pipe and Tube: ASTM B429/B429M, Alloy 6063-T832.
c. Drawn Seamless Tube: ASTM B210/B210M, Alloy 6063-T832.
d. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
e. Die and Hand Forgings: ASTM B247/B247M, Alloy 6061-T6.
f. Castings: ASTM B26/B26M, Alloy A356-T6.

1.6.2. Brackets, Flanges, and Anchors: Provide cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

a. Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.
b. Provide formed or cast brackets with predrilled hole for exposed bolt anchorage.

c. Provide formed steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

d. Provide brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

1.6.3 Fasteners:

1. Railing Anchors: Select fasteners of type, grade and class required to produce connections suitable for anchoring glass balustrade railing systems to other types of construction indicated and capable of withstanding design loads.
2. Railing Component Anchors: Use fasteners fabricated from same basic metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are standard fastening method for handrail and railing indicated.

b. Provide flat-head machine screws for exposed fasteners, unless otherwise indicated.

3. Cast-in-Place and Post Installed Anchors: Provide anchors of type as indicated in specification, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four items the load imposed when installed in concrete, or as determined by testing in charge of a qualified independent testing agency.

1.7. Fabrications

A. Assemble glass balustrade railing systems in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Fabricate glass balustrade railing systems by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

C. Tempered laminated glass shall be cut to final size and shape before heat treatment; provide for proper edge clearance and bite on glass. Provide thickness indicated on the Drawings, not less than required to support structural loads.

D. Provide inserts and other anchorage devices to connect glass balustrade railing systems to concrete/ masonry or structural steel members. Fabricate anchorage devices capable of withstanding loads imposed by glass balustrade railing systems. Coordinate anchorage devices with supporting structure.

E. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

F. Cut reinforces, drill, and tap components as indicated on the Drawings to receive finish hardware, screws, and similar items.

G. Close exposed ends of railing members with prefabricated end fittings.

1.8. Finishes

1. Appearance of Finished Work:

a. Variations in appearance of abutting or adjacent units are acceptable if they are well within close to range of final samples. Noticeable variations in the same unit are not acceptable.

b. Variations in appearance of other components are acceptable if they are well within the range of final samples and are assembled or installed to minimize contrast.

B. Aluminum Finish:

1. Powder Coat Finish:

Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified. Prepare, pretreat, and apply

manufacturer's standard baked powder coat finish. Comply with coating manufacturer's written instructions for cleaning, surface preparation, pretreatment, and application.
a. Material: Polyester powder coating including, but not limited to, average film thickness. Subject to compliance with requirements, provide one of the following products:

1.9. Installation
1. Fitting: Fit exposed connections together to form tight, hairline joints.
2. Cutting and Placement: Set glass balustrade railing systems accurately in location, alignment, and elevation measured from established lines and levels and free from rack.
a. Do not weld, cut, or abrade coated or finished surfaces of railing components that are intended for field connection by mechanical or other means without further cutting or fitting.
b. Align rails so variations from level or parallel alignment do not exceed 1.5 mm per m.
c. Provide manufacturer's proprietary system to evacuate entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources, in order to prevent water from entering the concrete slab. In lieu of the manufacturer's proprietary system, if acceptable to the Architect, provide another means to evacuate the entrapped water, i.e., a weephole and epoxy fill system ("drill-and-fill").
3. Corrosion Protection: Provide separation as recommended by manufacturer on concealed surfaces of aluminum that will be in contact with concrete, masonry, or dissimilar metals.
4. Adjusting: Adjust glass balustrade railing systems before anchoring to ensure alignment at abutting joint's space at interval indicated, but not less than required to achieve structural loads.
5. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing glass balustrade railing systems and for properly transferring loads to in-place construction.
1.9.1 Non-Welded Railings Connections: Use mechanical joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.
1.9.2 Glass-Supported Metal Railing Installation: Install assembly to comply with railing manufacturer's instructions, to listed tolerances, beginning with attachment of base channel to building structure, followed by insertion and connection of factory-fabricated and assembled glass panels.
1.10. Adjusting and Cleaning
A. **Touch-Up Painting**: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and appoint exposed areas with same material.
B. **Cleaning**: Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.
1.11. Protection
Provide final protection and maintain conditions in a manner acceptable to the Installer that shall ensure that the glass balustrade railing systems shall be without damage at time of substantial.
1.12. Completion
Protect finishes of glass balustrade railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

<u>2 Curtain wall/Structural Glazing</u>
2.1.0 Materials
Extrusions shall be 6063 T6 alloy and temper, formed aluminum components shall be of suitable alloy and strength to suit their purpose and function. Fasteners shall be made of corrosion-resistant and compatible materials and of sufficient size and strength to perform their intended function. Glazing gaskets shall be extruded black, santoprene of durometer appropriate to perform their intended function. Insulated back pans in column or spandrel areas shall be galvanized steel of 20

gauge thickness (or as specified to suit application) and have sealed corners. Insulation shall be AF530 48kg/m in density fibreglass 51mm thick (or as specified to suit application).
Securing of insulation into back-up panel shall be by impaling insulation onto welded pins with retaining discs. Any connections between the back-up panels and framing shall be caulked with high grade butyl sealant.
Selected framing system shall be:
-45 series 1 3/4" (45) wide thermally improved curtain wall framing for sealed unit glazing.
-2500 series 2 1/2" (64) wide thermally improved curtain wall framing for sealed unit glazing
Both systems to offer vented horizontal mullion glazing pockets achieving full rain screen capabilities.

2.2. Fabrication
Construct framing from tubular extruded sections of size and shape as shown on shop drawings. All framing joints shall be accurately cut, machined and sealed to allow neat watertight connections and be designed for shear block joinery with all extrusions. Vertical expansion joints shall be sleeved and sealed at meeting mullion ends. All structural anchors shall have 3 way adjustment with welding completed after curtain wall is aligned. All horizontal members shall be sealed to vertical members to provide individual compartments within the system in accordance with the rain screen principle and must form individually pressure equalized and sealed cells.

2.3. Finish
All exposed surfaces shall be free of scratches and defects. Aluminum extrusions shall be finished as selected by architect.
The surface finishing shall comply below standards
Standard Clear Anodizing: AA-M12C22A31
Standard Bronze Anodizing: AA-M12C22A34
Standard Black Anodizing: AA-M12C22A44
Duracron Acrylic Enamel: AAMA 2603
Duranar Fluoropolymer paint: AAMA 2605

2.4. Installation
Framing shall be installed, glazed and adjusted accordingly to the manufacturer's instructions and approved shop drawings. All items in this section shall be set level, square and plumb and at their correct location and alignment with other work.

2.5. Measurements
Measurement for curtain walls shall be in square meters of glass façade area correct to two places of decimal. Measurement shall be from out to out of the mullions. Rates quoted shall be for all the works including glazing, fixing, Builder’s hardware of fittings as specifically described in the respective items of work.

Rate shall include the following:

(a) Fixing of Metal members in masonry/ RCC members/ structural steel with screws to meet adequate strength.
(b) Providing temporary supports, etc for fixing of at all levels.

2.6. Protection and Cleaning
Framing shall be protected from other building materials during and after installation until acceptance by the General Contractor.

Work included: Furnish materials, labor and equipment for the complete installation of curtain wall as detailed on the drawings and specification including structural support of framing, interior building trims.

Cement Concrete Flooring (IPS)

3.0 Scope of Work

The work covered under this specification consists of providing and laying at all levels and floors, flooring of different types, strictly in accordance with these specifications and relevant drawings.

3.1 Cement Concrete Flooring (Indian Patent Stone)

3.1.1 Materials: The specifications for materials, grading, mixing and the quantity of water to be added shall generally conform to their relevant specifications described under plain and reinforced concrete. The maximum size of coarse aggregate shall be 10 mm. The fine aggregate shall consist of properly graded sand. Concrete shall be mixed preferably by machine, and hand mixing shall be avoided as far as practicable.

3.1.2 Preparation of Base: The base concrete surface shall be thoroughly chipped to remove laitance, caked mortar, loose sand, dirt etc. cleaned with wire brush and washed clean and watered until no more water is absorbed. Where the base concrete has hardened so much that roughening the surface by wire brushes is not possible, the same shall be roughened by chipping or hacking at close intervals. The surface shall be soaked with water for at least 12 hours and surface water removed and dried before laying the topping. Before laying the concrete, cement slurry at 2.00 kg./ sqm. of surface shall be applied for better bond. Concrete flooring shall then be laid in alternate bays in pattern and joints, wide/ flush as per drawing. The edge of each panel into which the floor is divided shall be supported by wooden or metal strips duly oiled to prevent sticking. The panels shall be of uniform size and, unless otherwise specified, no dimension of panel shall exceed 2 m. and the area of a panel shall not be more than 2.00 sqm. However, the exact size of panel shall be decided by the Engineer-in-Charge to suit the size of the room. The joints in the floor finish shall extend through the borders and skirting/dado. The border shall have mitred joints at the corners of the room. Where glass/ aluminum dividing strips are proposed to be provided, the same shall be fixed over thiyyas of cement mortar 1:2 to form panel of size as specified.

The depth and thickness of dividing strips shall be as specified in the item. In the case of flush joints, alternate panels only may be cast on same day. At least 48 hours shall elapse before the concreting of adjacent bay is commenced.

3.1.3 Mixing: The topping concrete shall be of mix of one part of cement, two parts of sand and 4 parts of well graded stone chips of 10 mm. maximum size. The ingredients shall be thoroughly mixed with just sufficient water to the required plasticity, having water cement ratio not more than 0.4.

3.1.4 Laying: Laying of concrete flooring shall comply IS: 2571- code of practice for laying in-situ cement concrete flooring. The free water on the surface of the base shall be removed and a coat of cement slurry to the consistency of thick cream shall be brushed on the surface. On this fresh grouted base, the prepared cement concrete shall be laid immediately after mixing. The concrete shall be spread evenly and laid immediately after mixing. The concrete shall be spread and leveled carefully. The concrete shall be completed and brought to the specified levels by means of a heavy straight edge resting on the side forms and down ahead with a sawing motion in combination with a series of lifts and drops alternatively with small lateral shifts, either mechanically or manually as directed by the Engineer-in-Charge.

While concreting the adjacent bays, care shall be taken to ensure that the edges of the previously laid bays are not broken by carelessness or hand tamping. Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or

removing the concrete and whole surface is again leveled. When the layer is made even, the surface shall be completed by ramming or beating and then screed to a uniform line and level. Before the initial set commences, the surface shall be trowelled to smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly or empty gunny bags spread over the surface of the concrete to absorb excess water coming on top due to floating.

3.1.5 Finishing the Surface: After the concrete has been fully compacted, it shall be finished by trowelling or floating. Finishing operations shall start shortly after the compaction of concrete and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled intermittently at intervals for several times so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon the care with which trowelling is carried out. The object of trowelling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trowelling is very important. Immediately after laying only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to work a layer rich in cement to the surface, some time. After the first trowelling, the duration depending upon the temperature, atmospheric conditions and the rate of setting of cement used, the surface shall be retrowelled many times at intervals to close any pores on the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowelled back into the topping). The final trowelling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface. Trowelling of rich mix of dry cement and fine aggregate on to the surface shall not be permitted. Trowel marks should not be seen on the finished surface.
Where broom finish is specified, after the concrete has been thoroughly compacted, and when most of the surface water has disappeared, the surface shall be given broom finish with an approved type of brass or M.S. fiber. The broom shall be pulled gently over the surface from edge to edge in such a manner that corrugation shall be uniform in width and depth, the depth shall be not more than 1.5 mm. Brooming shall be done when the concrete is in such a condition that the surface will not be torn or unduly roughened by the operation. Coarse or long bristles which cause irregularities or deep corrugation shall be trimmed out. Brooms which are worn or otherwise unsatisfactory shall be discarded. After the concrete in the bays has set, the joints of the panels should be filled with cement cream and neatly floated smooth or jointed. Care should be taken that just the minimum quantity of cream for joint is used and excess spilling over the already finished surface shall be removed when the cream is still green. In case of wide joints the same shall be filled with pigmented cement concrete (1:2:4) using approved pigment and the joint shall be finished in perfectly straight line.

3.1.6 Steel Trowel Finish: Areas where PVC Flooring/ Self leveling Epoxy Flooring are proposed to be used are required to have base concrete finished smooth by steel trowel.
3.1.7 Curing: The completed flooring shall be protected from sun, wind and rain for the first two days and movement of persons over the floor is prohibited during this period. The finished surface shall be covered and cured continuously form the next day after finishing, at least for a period of 7 days. Bunding with murrum for curing is prohibited as it will leave permanent stain on the finished floor. Curing shall be done by spreading sand and kept damp throughout the curing period of seven days minimum. The surface shall be protected from any damage to it whatsoever. The surface shall then be allowed to dry slowly. All corners, junctions of floor with plastered wall surface shall be rounded off when required at no extra cost.
3.1.8 Measurement: The rate for flooring and skirting shall be in square meter of the area covered. The length and width of the flooring shall be measured net between the faces of skirting or dado or

plastered faces of walls which is the proudest. All openings in flooring exceeding 0.1 sqm. in area where flooring is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment. Nothing extra shall be paid for laying the floor at different levels in the same room.
The dimensions shall be measured upto two places of decimals of a meter and area worked out upto two places of decimal of a square meter.

4. KALZIP roofing System
4.1 Materials
Roofing to be made of 0.9mm thick KALZIP roofing system conforming to AA 3004 ALUMINIUM ALLOY, comprising of the following layers:
i.**Exterior Layer** – Top layer –Kalzip 65/400 or Kalzip 50/ 429 as suitable, Straight/Curved profiled sheeting manufactured from Aluminum Alloy Almnlmg1- as specified in BS EN 1396 (comparable AA 3004), minimum material thickness of 0.9 mm and PVDF finish. (RAL 9006 / as per standard color chart of Kalzip as approved by Architect)
The material properties are as follows:-
Ultimate tensile strength: minimum 200 N/mm2
0.2% Proof Stress: minimum 185 N/mm2
Modulus of elasticity:70,000 N/mm2
The panels shall be finished with PVDF.
The fluorocarbon coating (2-coat system) shall consist of:-
First coat -Inhibitive primer, with a dry film thickness averaging 5-7mm
Second coat -Fluorocarbon color coat, with a minimum dry film thickness of 20 microns.
The inner side of the panels shall be finished with primer coating of 5-7 microns Accessories,
Aluminum ST clips – in grade 6061- T6, of suitable height, with spacing as required for the wind loads. Detailed structural calculations shall be provided by the manufacturer for the Clip Pull out force. Each aluminum clip shall come with a 5mm height black polyamide thermal barrier pad. Other relevant accessories like, Ridge closures, gable end channels, tolerance clips, gable end clips, foam fillers etc to be included as appropriate and wherever necessary. Corrugation cavities shall be closed off from the outside and inside of the building to ensure a tight fit leaving no gaps
Item includes Designing, Supplying, installation and fixing of profiled aluminium sheeting including Clips, stainless steel fasteners, thermal barrier pads, inner closure at ridge and eaves with rivets and also providing all machineries (Straight/ Curved profile machine) required for the project.

4.2 Measurement: The rate for roofing shall be in square meter of the area covered. All openings in roofing exceeding 0.1 sqm. in area where flooring is not done shall be deducted and net areas only shall be measured and paid for. Nothing extra shall be paid for installation at different levels in the same space.
The dimensions shall be measured upto two places of decimals of a meter and area worked out upto two places of decimal of a square meter.

5.0 Aluminum Flashing
5.1 Materials: Form flashings, copings and fascias to profiles indicated of 0.9 mm thick prefinished steel or as mentioned in detailed specification to be used.
5.2 Submittal

5.2.1 Product Data:

a. Submit manufacturer's printed product literature including product specifications and technical data sheets for sheet metal flashing fasteners and accessory materials. Include product characteristics, performance criteria, physical size, finish and limitations.

a. Shop Drawings:

a. Submit shop drawings for all sheet metal fabrications.

b. Indicate sheet thickness, flashing dimensions and fastenings. Include anchorage, expansion joints and other provisions for thermal movement.

c. Submit manufacturer's catalogue cut sheets for manufactured items.

b. Samples:

Contractor shall submit 50 x 50 mm samples of each type of sheet metal material, finishes and color.

5.3 Delivery, storage and handling

a. Deliver, store and handle materials in accordance with manufacturer's guide.

b. Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

5.4 Accessories

a. Isolation coating: alkali resistant bituminous paint.

b. Best quality sealant to be used at joints.

c. Cleats of same material to be used. Minimum 50 mm wide temper as sheet metal with thickness same as sheet metal being to be adopted.

d. Fasteners of same material as sheet metal with ring thread flat head roofing nails of length and thickness suitable for metal flashing application to be used.

e. Washers: of same material as sheet metal, 1 mm thick with rubber packings.

f. Touch-up paint: as recommended by prefinished material manufacturer.

5.5 Installation

a. Install sheet metal work in accordance with detail drawings and as per manufacturer's guide.

b. Use concealed fastenings except where approved before installation.

a. Gutters and Downspouts: Install gutters and downspouts as indicated and in accordance with the approved Shop Drawings and pertinent provisions of manufacturer's manual.

b. Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

c. Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.

d. Lock end joints and caulk with sealant.

5.3 Measurements

a. Measurement for Metal flashing shall be measured in running meters (RM) correct to two places of decimal. Measurement shall be from outer edge of the flashing. Rates quoted shall be for all the works including aluminum flashing, sealant, painting and Builder's hardware of fittings as specifically described in the respective items of work and shop drawings.

b. Rate shall include the following:

- Fixing of Metal members to roofing sheets/ structural steel with screws to comply with aesthetics and strength.
- Providing temporary supports, etc for fixing of at all levels.

6. Granite flooring

6.1 Summary

Extent of interior stonework is indicated on Drawings.

Interior stonework includes the following:

1. Granite tile flooring.

6.2 Submittals

A. Product Data: Submit manufacturer's technical data for each type of stone, stonework accessory and other manufactured product required.

B. Samples for Initial Selection: Furnish samples of portions of actual stone, showing manufacturer's full range of standard products, for Architect's selection. Submit 2 or more samples of each selection representing the full range of color and pattern to be expected in installed material.

C. Samples for Verification: Provide a 6-inch by 6-inch sample of each selected color for verification purposes. Select samples to represent the full range of color and pattern to be expected in the finished installation.

6.3 Quality assurance

A. Standards: Comply with referenced ANSI and ASTM materials standards, and with referenced installation methods and materials of referenced Tile Council of America (TCA) Handbook numbers.

Granite shall be hard, sound dense and homogenous in texture with crystalline texture as far as possible. It shall generally be uniform in colour and free from stains, cracks, decay and weathering. Classification for Granite shall be as given below:

Steel Grey Fine, GRN1

Imperial White, GRN2

Ivory Brown, GRN3

6.4 Finishes for Granite Work

The finishes for granite work shall be either mirror polished or flamed as specified or as directed by the Engineer.

6.5 Finishing for Flamed Granite Work

All flamed Granite Work shall be cleaned with a solution of oxalic acid applied at the rate of 33gm/sqm so as to give clear, textured and even surface.

6.6 Waxing

Granite work shall not be wax polished after finishing.

6.7 Dressing of Slabs/ Tiles

Every stone shall be machine cut to the required size and shape. Fine chisel dressing of machine cut surface need not be done provided a straight edge laid anywhere along the machine cut surface is fully in contact with every point on it. The sides and top surface of tiles/ slabs shall be machine rubbed or table rubbed with coarse sand before laying. All angles and edges of the granite tiles/ slabs shall be true, square and free from chippings and the surface shall be true and plane unless otherwise noted as a special case.

The thickness of the tiles shall be 20 mm or as specified in the item description of the Schedule of Quantities. Tolerance of +3 % shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of +2 mm shall be allowed. Granite stone slabs/ tiles and dressing of slabs/ tiles for risers of steps/ dado and skirting shall as specified above except that the thickness of slabs shall be 20 mm or as given in the item description. A tolerance of ± 3 mm shall be allowed, unless otherwise specified in the description of the item. For preparation of surfaces risers of steps/ skirting/ dado, the joints shall be raked out to a depth of atleast 15 mm in masonry walls. In case of concrete walls, the surface

shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced. Where necessary, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of the wall as shown in drawings or as required by the Engineer.

6.8 Laying

Base concrete or the RCC slab on which the slabs/ tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as given in the item description.

The average thickness of the bedding mortar under the tile shall be 30 mm and the thickness at any place under the tile shall be not less than 12 mm.

The granite tiles shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab/ tile, roughly to the average thickness specified in the item. The slab/ tile shall be washed clean before laying. It shall be laid on top of bedding, pressed, tapped with wooden mallet and brought to level with the adjoining slabs/ tiles. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden slightly and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab/ tile already laid shall be buttered with grey or white cement slurry with or without admixture of pigment to match the shade of the granite slabs/ tiles as specified in the item description.

The slab/ tile to be laid shall then be lowered gently back in position and tapped with a wooden mallet till it is properly bedded in level with and close to the adjoining slabs/ tiles with as fine a joint as possible. Subsequent slabs/ tiles shall be laid in the same manner. After each tile has been laid, surplus cement on the surface of the slabs/ tiles shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Engineer.

The slabs/ tiles shall be matched as shown in drawings or as instructed by the Engineer.

Slabs/ tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

The mortar shall be in grey or white cement admixed with or without pigment to match the shade of stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no

place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary MS hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength. for risers of steps and skirting.

The joints shall be as fine as possible. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers/ dado and skirting slab shall be matched as shown in drawings or as instructed by the Engineer.

6.9 Curing and Finishing

Slight unevenness at the meeting edges of slabs/ tiles shall then be removed by hand rubbing by coarse polishing stone or fine chiselling and finished in a manner as specified below:

The day after the slabs/ tiles are laid all joints shall be cleaned of the cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without colour pigment to match the shade of the topping of the wearing layer of the slabs/ tiles. The finished surface shall not sound hollow when tapped with a wooden mallet. No loose tiles shall be accepted. Joints cannot be too wide or too narrow and shall be in straight lines parallel to rectangular walls or as per the layout drawing.

The floor shall be cured for a minimum period of 7 days by keeping it wet.

For risers of steps and skirting, curing and finishing shall be as specified above as far as possible, except that cement slurry with or without pigment shall not be applied on the surface and polishing shall be done only with hand. The face and top of skirting shall be polished. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

6.10 Measurement

Measurement for flooring and dado shall be in sqm correct to two places of decimal. Actual quantity of flooring work as laid shall be measured for payment as per the respective items of work after making deductions for openings, etc. Measurement for skirting shall be in running meters correct to two places of decimal for the specified height as per the item of work.

7.0 Glazed, matt finish, vitrified/ ceramic tile flooring

7.1 Materials

- Ceramic tiles shall be of approved make first quality and shall generally conform to IS: 13712 or IS: 15622. The tiles shall be flat and true to shape and free from blisters, crazing, chips, welts, crawling or other imperfections detracting from their appearance. Dimensional tolerances shall be as specified in IS: 13711.
- Vitrified tiles shall be of approved make first quality and shall generally conform to IS: 13712 or IS: 15622.

7.2 Workmanship

- The size, thickness, color, with or without designs, etc. of the tiles for flooring/ dado/ skirting shall be as specified in the respective items of work.
- The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring/ dado/ skirting. The minimum thickness of bedding mortar shall be 12 mm for flooring and 10 mm for dado/ skirting work.
- The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5.
- Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.
- Colored tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.
- Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings, etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the backing mortar shall be roughened using a wire brush.
- Neat cement slurry using 3.3 kg cement per sqm of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles

shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles.

- For skirting and dado work, the back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1 mm wide. The surface shall be checked frequently to ensure correct level/ required slope. Floor tiles near the walls shall enter skirting/ dado to a minimum depth of 10 mm. Tiles shall not sound hollow when tapped.
- All the joints shall be cleaned of grey cement with wire brush to a depth of atleast 3 mm and all dust, loose mortar, etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.
- Specials consisting of coves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

7.3 Measurement

Measurement for floor tile and dado shall be in sqm correct to two places of decimal. Actual quantity of flooring work as laid shall be measured for payment as per the respective items of work after making deductions for openings, etc. Measurement for skirting shall be in running meters correct to two places of decimal for the specified height as per the item of work.

SPECIFICATIONS OF MATERIALS

M – 1 Water

1.1. Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standard specified in I.S. 456-1978.

1.2. If required by the Engineer-in-Charge it shall be tested by comparison with distilled water Comparison shall be made by means of standard cement tests for soundness time of setting and mortar strength as specified in I.S. 269-1976. Any indication of unsoundness charge in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength, of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3. Water for curing mortar, concrete or masonry should not be too acidic or too alkaline . It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces

1.4. Hard and bitter water shall not be used for curing

1.5. Potable water will generally found suitable for curing mortar or concrete.

M – 2 Lime

2.1. Lime shall be hydraulic lime as per I.S. 712-1973. Necessary tests shall be carried out as per I.S. 6932 (Parts I to X) 1973

2.2. The following field tests for limes are to be earned out:

(1) A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of porous lumps of dirty white colour indicates quick lime, and solid lumps are the un burnt lime stone.

(2) Acid tests for determining the carbonate content in lime Excessive amount of impurities and rough determination of class of lime.

2.3. Storage shall comply with J.S. 712-1973 The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged" in any way shall be rejected and all rejected materials shall be removed from site of work.

2.4. Field testing shall be done according to I.S 1624-1974 to show the acceptability of materials.

M – 3 Cement

3.1. Cement snail be ordinary Portland slag cement as per I.S.269-1976 or Portland slag cement as per I.S. 455-1976

M - 4 White Cement

4.1. The white cement shall conform to IS. 8042-E-1978.,

M – 5 Coloured Cement

5.1. Coloured cement shall be with white of grey Portland cement as specified in the item of the work.

5.2. The pigments used for coloured cement shall be of approved quality and shall not exceed 10% of cement used in the mix. The mixture of pigment add cement shall be properly ground to have a uniform colour and shade. The pigments shall have such properties to provide for durability underexposure to sunlight and weather.

5.3. The pigment shall have the property such that it is neither affected by the cement nor detrimental to it

M - 6 Sand

6.1. Sand shall be natural sand, clean, well graded hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge. The sand shall not contain more contain more than 8 percent of silt as determined by field test, if necessary the sand shall be washed to make it clean.

6.2. Coarse Sand :The fineness modulus of coarse sand shall not be less than 2.5 and shall not exceed 3 0. The sieve analysis of coarse shall be as under.

I.S.Designation	Sieve passing sieve	% by weight Designation	I.S.Sieve % by weight passing Seive
4.75 mm	100	600 micron	30-100
2.36mm	90 to 100	300 micron	50-70
1.18mm	70 to 100	150micron	0-50

6.3. Fine Sand :

The fineness modulus shall not exceed 1.0 The sieve analysis of fine sand shall be as under.

I.S.Designation	Sieve passing sieve	% by weight Designation	I.S.Sieve % by weight passing Seive
4.75 mm	100	600 micron	40-85
2.36mm	100	300 micron	5-50
1.18mm	75 to 100	150micron	0-10

M - 7 Stone Dust

7.1. This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is given as under :

7.2. A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm. mark. The clean water shall be added up to 150 mm mark. The mixture shall be stirred vigorously and the content allowed to settle for 3 hours.

7.3. The height of silt, visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

7.4. The fineness modules of stone dust shall not be less than 1.80

M - 8 Stone Grit

8.1. Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar Grit shall generally be cubical in shape and as far as possible flakey elongated pieces shall be avoided. It shall generally comply whit-the provisions of I.S. 383-1970. Unless special stone of particular quarries is mentioned grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have no deleterious with cement.

8.2. The grit shall conform to the following gradation as per sieve analysis :

I.S.Designation	Sieve passing sieve	% by weight Designation	I.S.Sieve % by weight passing Seive
4.75 mm	100	600 micron	30-100
2.36mm	90 to 100	300 micron	50-70
1.18mm	70 to 100	150micron	0-50

8.3. The crushing strength of grit will be such as to allow the concrete in which ft used to build-up the specified strength of concrete

8.4. The necessary tests for grit shall be carried out as per the requirements of I.S.2386- (parts-l to VIII} 1963r as per instructions of the Engineer-in-charge. The necessity of test will be decided by the Engineer-in-charge.

M - 9 Cinder

9.1. Cinder is will burnt furnace residue which has been fused or sintered into lumps of varying sizes

9.2. Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only It shall be

sound clean and tree from clay dirt, ash or other deleterious matter

9.3. The average grading for cinder aggregates shall be as mentioned below .

I.S. Designation	M - 1 Lime Mortar Percentage by weight Sieve passing	I.S. Designation	Percentage by weight Sieve passing 70
20	100	4.75MM	70
10	86	2.36MM	52

M - 10 Cement Mortar

10.1. Water shall conform to specification M-1, Cement : Cement shall conform to specifications M-3 and Sand : Sand shall conform to M-6

10.2. Proportion of Mix

10.2.1. Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes, the proportion of cement will be by volume on the basis of 50 Kg/Bag of cement being equal to 0.0342 Cu.m. The mortar may be hand mixed of machine mixed as directed.

10.3. Proportion of Mortar :

10.3.1. In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained.

Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to from a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed

10.3.2. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes

M - 11 Stone Coarse Aggregate For Nominal Mix Concrete

11.1. coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar

11.2. The aggregate shall generally be cubical in shape Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below.

However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6- mm. less than the cover whichever is smaller.

I S. Sieve	Percentage passing for single Sized aggregates of Nominal size		
	40 MM	20 MM	16 MM
80 MM	-	-	-
63 MM	100	-	-
40 MM	85-100	100	-
20MM	0.20	85-100	100
16 MM	85-100	-	-
12.5 MM	-	-	-
10 MM	0.50	0.20	0.30
4.75 MM	-	0.50	0.5
2.35 MM	-	-	-

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.

11.3. The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests, indicated in I.S. 383-1970 and 456~197f shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If she aggregates are covered with dust, they shall be washed with water to make them clean.

M - 12 Black Trap or Equivalent Hard Stone Coarse

12.1. Aggregate For Design Mix Concrete . Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

12.2. The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed, from the best, black trap or equivalent hard stones as approved, Aggregate shall have no deleterious with cement

12.3. The necessary tests indicated in I S. 383-1970 and I.S.456-1978 shall have to be carried out to ensure the acceptability of the material.

12.4. If aggregate is covered with dust it shall be washed with water to make it clean.

M - 13 Brick Bats Aggregate

13.1. Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt of any other foreign material. The brick bats shall be of 40 mm - 50 mm. size unless otherwise specified in the item The under burnt of over burnt brick bats shall not be allowed.

13.2. The brick bats shall be measured by suitable boxes or as directed.

M - 14 Bricks

14.1. The bricks shall be hand or machine molded and made from suitable soils and kiln burnt. They shall be free from cracks and flaws and nodules of free lime they shall have smooth rectangular faces with sharp corners and shall be of uniform colour.

The bricks shall be- moulded with a frog of 100 mm. x 40 mm. and 10 mrn. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600 mm.

14.2. The crushing strength of the bricks shall not be less than 35 Kg/Sq. Cm. The average water absorption shall not be more the 20 percent by weight Necessary tests for crushing strength and water absorption etc. shall be carried out as per I.S. 3495 (Part-l to IV) - 1976

M - 15 Structural Steel

15.1. All structural Steel! shall conform to IS. 226-1985: The steel shall be free from the defects mentioned in I.S 226-1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to I.S. 1148-1973. . It shall also comply with relevant part of I.S. 456-1978.

152.2. When the steel is supplied by the Contractor test certificate of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

M - 16 Shuttering

16.1. The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel lining or of steel plates stiffened by steel angles The shuttering shall be supported on battens and beams and props of vertical bullies properly cross braced together so as to make the centering rigid. In places of bullies props, brick pillar of adequate section built in mud mortar may be used

16.2. The form work shall be sufficiently strong and shall have camber so that it assumes correct shape after deposition of the concrete and shall b-j able to resist forces caused by vibration of live load of men working over it and other incidental leads associated with it.

The shuttering shall have smooth and even surface and its joints shall permit leakage of cement grout

16.3. If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work The complete from work shall be got inspected by and got approved form the Engineer-in-charge, before the reinforcement bars are placed in position

16.4. The props shall consist to bullies having 100 mm .minimum diameter measured at mid length and 80 mm. at thin end shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm. thick and minimum bearing area of 0-10 sq m laid on sufficiently hard base.

16.5. Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete

16.6. The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planed on the sides and the surface coming in contact with concrete Wooden form work with metal sheet lining or steel plates .stiffened by steel angles shall be permitted

16.7. As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.

16.8. The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.

16.9. The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250 } or as directed by the Engineer-in-charge so as to offset the subsequent deflection For cantilevers, the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-charge.

M - 17 Paints:

17.1 Enamel paints:

The enamel paint shall satisfy in general requirements in specification of oil paints, Enamel paint shall conform to I.S. 2933-1975.

All the paints shall meet with the following general requirements

(i) Paint shall not show excessive setting in a freshly opened full can and shall easily be ready spread with a paddle to a smooth homogeneous state. The paint shall show no curdling, levering caking or colour separation and shall be free from lumps and skins

(ii) The paint as received shall brush easily, possess good leveling properties and show no running or sagging tendencies

(iii) The paint shall not skin within 48 hours in a three quarters filled closed container

(iv) The paint shall dry to a smooth uniform finish free from roughness, grit unevenness and other imperfections

1. Excavation

1.0. General

1.1. Any soil which generally yields to the application of pickaxes and shovels, phawaras rakes or any such ordinary excavating implement or organic soil, gravel silt, sand turf loam, clay, peat etc., fail under this category

2.0. Clearing the site

2.1. The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials and rubbish of all kind bush wood and trees shall be remove as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m lead. The roots of the trees coming in the sides shall be cut and coated with hot asphalt.

2.2. The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

3.0. Setting out

After clearing the site the centre lines will be given, by the Engineer-in-charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labours materials etc. required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

4.0. Excavation

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately it not specified. The bottom of the excavated area shall be levelled both longitudinally and transversely as directed by removing and

watering as required No. earth filling will be allowed for brining it to level. If by mistake or any excavation is made deeper or wider than, that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

5.0. Disposal of the excavated stuff

5.1. The excavated stuff of the selected type shall be used in filling the trenches and plinth or levelling the ground in layers including ramming and watering etc.

5.2. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 50 M. and all lift.

6.0. Mode of measurements & payment

6.1. The measurement of excavation in trenches for foundation shall be made according to the sections of trenches shown on the drawing or as per sections given by the Engineer-m-charge. No payment shall be made for surplus excavation made in excess of above requirements or due to stopping and sloping back as found necessary on account of conditions of soil and requirements of safety.

6.2. The rate shall be for a unit of one cubic meter

2. Concrete work:

- Providing and laying in foundation and plinth/under floors lime concrete with hard broken aggregate 40 mm. nominal size and 40% mortar comprising of 1 Lime putty : 2 fine sand and curing complete excluding cost of form work.

1.0. Materials

Water shall conform to M-1. Sand shall conform to M-6 Lime shall conform to M-2. Graded aggregate 40 mm nominal size shall conform to M-12

2.1. General

2.1.1. Before staring the concrete the bed of the foundation trenches shall be cleared of all loose materials and watered and rammed as directed.

2.2. Proportion of Mix

2.2.1. The proportion of lime, sand and aggregate shall be specified in the item of the work and shall be measured by volume.

2.2.2. The lime mortar shaft consist of proportion of 1 lime putty : 2 sand by volume. The lime mortar shall be prepared by wet process. Power driven mill shall be used for reparation of lime mortar. The slaked lime shall be placed in the mill in even layer and ground for 180

revolutions with sufficient water. The water shall be added as required during grinding and care shall be taken not to add more water so that it will bring the mixed materials to a consistency of stiff paste, thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

2.2.3. Lime mortar shall be kept, protected from sun and rain till used-up, covering it by tarpaulin or open sheds.

2.2.4. All the lime mortar shall be used as soon as possible after grinding. It should be used on the day on which it is prepared but in no case mortar- made earlier than 36 hours shall be permitted for use.

2.3. Mixing:

2.3.1. The concrete shall be mixed in mechanical mixer. Mixing shall be continued until there is uniform distribution of the materials and the mass is uniform is uniform in colour and consistency but in no case mixing shall be done for less than 2 to 3 minutes.

2.4. Laying & Compacting:

2.4.1. The concrete shall always be used while quite fresh It shall be laid (not thrown) in layers not exceeding 150 mm in thickness and shall be well and quickly rammed with wooden or iron rammers, till the required compaction is achieved. The concrete laid shall not be of too fluid consistency. After it has been mixed no more water shall be added, but the surface during and after compaction shall be kept damp. In laying consecutive layers, the layer cast shall be well watered and made rough before the upper layer is laid. The concrete shall be kept continuously wet for period of 7 days from the date of placing of until it- is built over whichever is more.

2.5. Mode of Measurement & Payment :

2.5.1. The concrete work shall be measured in length, breadth and depth as specified on drawing or as directed, correct up to nearest centimetre and cubical content shall be worked out nearest up to two places of decimals.

2.5.2. The rate shall be for unit of one cubic meter.

Concrete Work

- Providing and laying controlled cement concrete M-250 and curing complete excluding the cost of reinforcement of reinforced concrete work in: (A) Foundations, footings, bases of columns, and the like and mass concrete (B) Walls from, top of foundation level up to floor two level (C) Slabs, landing, shelves, balconies, beams, girders and cantilever up to floor two level (D) Columns, pillars, struts up to floor two level.

1.0. Materials

1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8 Course aggregate shall conform M-12.

2.0. General

2.1. ordinary concrete shall be followed except that the concrete mix shall be designed form preliminary tests. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350 & M-400 with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./Crnt.

2.2. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

Grade of Concrete	compressive strength of 15 cms. cubes in Kg./Cmt. at 28 days, conducted in accordance with I.S. 516-1959. Preliminary test Min	Work test Min.
M-150	200	150
M-200	260	200
M-250	320	250
M-300	380	300
M-350	440	350
M-400	500	400

In all cases, the 28 days compressive strength specified in above be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for purpose as concrete belonging to the lower of the grades between which its strength lies.

3.0. Workmanship

3.1. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work question and can be property compacted with means available except where ft can be shown to the satisfaction of the Engineer-in-charge, that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate shall be controlled by obtaining the coarse aggregates in different sizes and bending them in the right proportions as required. Aggregates of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently

as possible, the frequency for a given job being determined by Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

3.2. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag, a reasonable number of bags shall be weighted separately to check the net weight. Where cement is weighted form bulk stocks at site and not by bags, it shall be weighed separately from the aggregate. Water, shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.

3.3. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates. I.S. 2386 (Part-Ill) shall be referred to. Suitable adjustments shah also be made in the weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 220 kg./M-3 in plain concrete and not less than 250 kg/M-3 in reinforced concrete.

4.0. Mode of measurement & payment

4.1. The rate excludes cost of form work. The rate shall be for a unit of One Kg.

Steel Work

High yield deform bars steel reinforcement for R.C.C. work including bending, binding and placing in position complete up to floor two level.

1.0. Materials

1.1. Cold twisted steel bars (high yield strength deformed bars) shall conform to M.19 Mild steel binding wires shall conform to M-21.

2.0. Workmanship

2.1. The specifications of item No. 5.4.10 shall he followed except that the cold twisted steel ars shrill be used with or without hooks at the ends. Deformed .bars without hooks shall, however, comply with relevant anchorage requirements

3.0. Mode of Measurement & Payment

3.1. The relevant specifications of item No. 5.4.10 shall be followed

3.2. The rate shall be for a unit of One kg

5.4.13. Extra for additional lift of concrete for all R.C.C. work above floor two level excluding cost of reinforcement.

1.0. Materials & Workmanship

The relevant specifications for item No. 5.4.1 shall be followed for the work except that the R.C.C. work shall be done for ground floor i.e. above plinth level to first floor level.

2.0. Mode of Measurement & Payment

2.1. The relevant specifications of item No. 5.4 1 shall be followed except that rate shall be for extra lift above plinth to floor two level over and above the rate of concrete at floor two level.

2.2. The rate shall be for a unit of one cubic meter per floor.

5.4.13.(A) Extra for additional lift of reinforcement steel for all R.C.C. work above floor two level.

1.0. Materials & Workmanship

1.1. The relevant specifications of item No. 5.4.10 as may be applicable, shall be followed except that the work shall be carried out above floor two level for each floor

2.0. Mode of measurement & payment

2.1. The relevant specifications of item No. 5.4.10 o4 5.4.11 as may be applicable shall be followed except that the work shall be carried out above floor tow level.

2.2. The rate shall be for a unit of one kg. per floor Section - 17

Plastering and Paints

10 mm. thick cement plaster in single coat on fair side of brick concrete walls for interior plastering up to floor two level and finished even and smooth in (i) C. M. 1:3.

20 mm. thick cement plaster in single coat on rough side of single or half brick wall for interior plastering up to floor two level, finished even and smooth in cement mortar 1:4 (1 cement : 4 sand).

1.0. Materials

1.1. Water shall conform to M-1. The cement mortar of proportion 1:3 shall conform to M-13.

2.0. Workmanship

2.1. Scaffolding:

Wooden bullies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

2.2. Preparation of back-ground :

2.2.1. The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, fflorescence and other foreign matter by water or by brushing. Smooth surface shall be toughened by wire brushing if it is not hard and by hacking if it is hard. In case of concrete surface, if a chemical retarded has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the readers if left on the surface. Trimming of projections on brick/concrete surfaces where necessary shall be carried out to get an even surface.

2.2.2. Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

2.2.3. The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry, such area shall be moistened again.

2.2.4. For external plaster, the pestering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be-started wherever the building frame and cladding work are ready and the temporary supports of the ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

2:3. Application of plaster:

2.3.1. The plaster about 15x15 cms. shall be first applied horizontally and vertically at not more than 2 meters intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float according as a smooth or a smooth or a sandy granular texture is required Excessive troweling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Hounding or chamfering, corners, arises junctions etc. shall be carried out with proper templates to be size required.

2.3.2. Cement plaster shall be used within half an hour after addition of water. And mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

2.3.3. In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically, when recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the

body of the wall and nearer than 15 cm. to any corners or arises. It shall not be closed on the body of features such as plaster bands and cornices not at the corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

2.3.4. Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging matting or gunny bags oh the outside of the plaster and keeping them wet.

3.0. Mode of measurements & payment

3.1. The rate shall include the cost of all materials, labour and scaffolding etc. involved in the operations described under workmanship.

3.2. All plastering shall be measured in square meters unless otherwise specified. Length breadth or height shall be measured correct to a centimetre.

3.3. Thickness of the plaster shall be exclusive of the thickness of the key i.e. Grooves or open joints in brick work, stone work etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm. at any point on this surface.

3.4. This item includes plastering up to floor two level.

3.5. The measurement of wall plastering shall be taken between the walls or partition (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

3.6. Soffits of stairs shall be measured as plastering on ceilings, following soffits shall be measured separately.

3.7. For jambs, soffits, sills etc. for openings not exceeding 0.5 sq. met each in area for ends of joints beams,posts, girders, steps etc. not exceeding 0.5 sq. mt each in area and for openings exceeding 0.5. sq. mt and not exceeding 3.00 sq. mt. in each area deductions and additions shall be made in the following manners.

(a)No deductions shall be made for ends of joints, beams, posts etc. and openings not exceeding 0.5 sq. mt each and no addition shall be made for reveals, jambs, soffits, sils etc. of these openings, for finish to plaster around ends of joints, beams posts etc.

(b) Deduction for openings exceeding 0.5 sq. mt but not exceeding 3 sq.mt. each shall be made as follows and no addition shall be made for ravels, jambs, soffits, sills etc. of these openings, (i) When both faces of all wall are plastered with same plaster, deduction shall be made for one face only, (ii) When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, window etc. on which width of reveals is less than that on the other side but no

deductions shall be made on the other side. Where width of reveals on both faces of all are equal, deductions of 50% of area of opening on each face shall be made from areas of plaster and / or pointing as the case may be.

3.8. For openings having door frames equal to or projecting beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

3.9. In case of openings of area above 3 sq. mt. each, deduction shall be made for openings but jambs, soffits sand sills shall be measured.

3.10. The rate shall be for a unit of One sq. meter.

Painting Work

Distempering with dry (water bound) Distemper of approved brand and manufacture (two coats) and of required shade on undecorated wall surfaces to give an even shade, over and including a priming coat of white washing after thoroughly brooming the surface free from mortar droppings and other foreign matters.

1.0. Materials

1.1. The dry distemper and primer shall be of approved brand and manufacture. The dry distemper shall be of required colour and shade and the same shall conform to I.S. 427-1965. Writing shall conform to I.S. 63-1964.

2.0. Workmanship

2.1. Scaffolding : Where scaffolding is required it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be distempered. A properly secured strong and well tied suspended platform (Joolas) may be used for distempering. Where ladders are used- pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For distempering to ceiling, proper stage scaffolding shall be erected where necessary.

2.2. Preparation of Surface.

2.2.1. The undecorated surface to be distempered shall be thoroughly brushed free from dust, dirt, grease, mortar, droppings and other foreign matter and sand papered smooth. New plaster surface shall be allowed to dryat least 2 months before application of distemper.

2.2.2. All unnecessary nails shall be removed. Pitting in plaster shall be made good with plaster of Paris mixed with dry distemper of the colour to be used. The surface shall then be rubbed down again with a fine grades andpaper and made smooth. The surface affected by moulds, moss, fang, algae lichens, efflorescence etc. shall be treated in accordance with I.S. 2395 (Part-l) 1966 before applying distemper. Any unevenness shall be made good by applying putty made of plaster of Paris mixed with water on entire surface including filling up the undulations and then sand papering the same after it is dry.

2.3. Priming coat :

2.3.1. A priming coat of whiting shall be applied as per item No. 18.11 over the prepared surface in case of new work on undecorated surface. No coat of white washing with lime shall be used as a priming coat for distemper.

2.3.2. Application of plaster shall be done as under:

The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical stokes shall be applied immediately afterwards. This entire operation will constitute one coat. The

surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper or paint is applied.

2.3.3. Distemper is not recommended to be applied within six months of the completion of wall plaster.

2.4. Proportion of Distemper : The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturers only. Sufficient quantity of distemper required for one day's work shall be prepared.

2.5. Application of Distemper coat :

2.5.1. For undecorated surfaces after the primer coat is dried for at least 48 hours, the surfaces shall be lightly sand papered to make them smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval strokes which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coals to permit proper drying of the proceeding coat. The finished surface shall be even and uniform without patches, brush marks, distemper drops etc.

2.5.2. Sufficient quantity of distemper shall be mixed to finish on room at a time. The application of a coat in each room snail be finished in one operation and no work shall be started in any room which cannot be completed, on the same day.

2.5.3. 15 cm. double bristle distemper brush shall be used. After the day's work, brushes shall be thoroughly washed in hot water with soap solution and hang down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

2.6. Protective Measures : The surfaces of doors, windows, floors, articles of furniture etc. and such other parts of the building as are not to be distempered shall be a plashed form being splashed upon. Such surfaces shall be cleaned of distemper a plashes if any.

3.0. Mode of measurements and payment

3.1. Pruning coal of distemper primer, scraping of surface spoiled by smoke soot, removal of oil and grease spots, treatment for infraction of effloresces, mould moss, fungi, algae and lichens and patch repairs to plaster shall be included in this item for which nothing extra shall be paid.

3.2. AH the work shall be measured net in the decimal system as in places subject to the following limits unless otherwise stated hereinafter:

(a) Dimensions shall be measured to the nearest 0.01 m.

(b) Area in individual items shall be worked out to the nearest 0.01 sq. m. All work shall be measured in sq. meter. No deductions shall be made for ends of joints, beams, posts, etc. of these openings nor for finish around the ends of joints, beams, posts etc.

3.3. Deductions of openings exceeding 0.5 sq.m. but not exceeding 3 sq. m. each shall be made as follows and no addition shall be made for reveal, jambs, soffits etc. of these openings:

(a) When both the faces of wails are provided with the same finish decutions shall be made for one face only.

(b) Wren each face of wail is provided with different finish, deduction shall be made for that of frame for door, windows etc. on which width of reveal is less than that of the other side but no deductions shall be made on the other side. Where the width of reveals on the both the faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of finish.

(c) When only one face of wall is treated and the other face is not treated, full deductions shall be made if the width of the reveal on treated side is less than that on untreated side but if the width of the reveals is equal or more than that of untreated side neither deductions nor additions to be made for reveals, jambs, sills and soffits shall be measured

3.4. In case of openings of area exceeding 3 sq.m. each, deduction shall be made for openings, but jambs, sillsand soffits shall be measured.

3.5. No deductions shall be made for attachments such as casing, conduits, pipes, electric wiring and the like.

3.6. Item includes removing nails, making good holes, cracks, patches with materials similar in composition to the distemper.

3.7. The rate includes cost of all materials, labour, scaffolding, protective measures etc. involved in all the operations described above This shall also include conveyance, delivery, bundling, unloading storing etc.

3.8. The rate shall be for a unit of One sq.

Electrical Specificatiions:

1.1 The total length of the skywalk to be considered for this phase is approximately

670m long stretch with 4 nos. of access points. The electrical scope shall include:

(a) Power Supply Arrangements for Access Points – All access point shall have 415 V LT connection from Torrent Power Limited (TPL) with all necessary Tariff metering equipment & electric supply connection for which necessary liaison shall be done by the CONTRACTOR for all access points of the skywalk for this phase, the charges for the same shall be reimbursed by client.

(b) LV metal enclosed switchgears including Power Distribution Boards (PDB), Main Lighting DBs, Sub Lighting DBs, Receptacle DBs and receptacles for utilities

(c) Complete Elevator System with all necessary equipments and its auxiliaries including drives, power supply as per specification.

(d) Complete Escalator System with all necessary equipments and its auxiliaries including drives, power supply as per specification.

(e) Double Walled Corrugated (DWC) pipe for cabling for incoming Power Supply to access points.

(f) Cabling system consisting of LV grade, XLPE/ PVC insulated, multi-stranded Al/ Cu, GI round wire/ flat strip armoured power & control cables, prefabricated GI ladder/ perforated type cable trays, GI raceways, metallic GI Conduits & associated accessories including support structures.

(g) Earthing system for LV equipments, light fixtures, junction boxes, elevators, escalators and lightning protection system for skywalk and access points.

(h) LED Lighting and Receptacle system for all indoor & outdoor areas controlled by lighting panels and raw power panels installed in respective areas including junction boxes, bill board lighting systems.

(i) Safety Equipments for access points including rubber mats, shock treatment charts, first aid box, fire extinguisher, gloves for electrical rooms separate for all access points.

1.2 Inland and overseas transit insurance, transport, testing at site shall be CONTRACTOR"s scope. Tender BOQ and drawings, if provided, are for reference purposes only which are the minimum requirements; CONTRACTOR shall ensure that design & equipment ratings shall be as per specification requirements.

1.3 The CONTRACTOR shall prepare design calculations based on parameters/ design criteria indicated in the specifications. The CONTRACTOR shall prepare detailed engineering and construction purpose drawings to make his/ her own estimate of ratings & quantities (minimum requirements as per price schedule, technical data sheets, reference electrical Single Line Diagram (SLD) & other relevant details) for entire electrical systems including all items, systems such as equipments, power &

control cables/ cabling system, lighting system, earthing, lightning protection, main & auxiliary power distribution, civil works required for completion of Works.

1.4 CONTRACTOR shall take due care of the site Seismic conditions while designing all equipments/ components used in entire electrical systems covered in this specification. CONTRACTOR shall furnish list of additional design parameters considered in design to fulfil the above requirement.

1.5 Design and detailed engineering of the materials procured by CONTRACTOR is included in scope. CONTRACTOR shall submit each document/ calculations of system which is included in scope to PURCHASER/ Consultant for final review/ approval. All design documents/ calculations prepared by CONTRACTOR shall be duly signed by qualified authorities and stamped. Design documents/ calculations prepared by sub-CONTRACTORs shall be approved by CONTRACTOR and stamped copy of approval along with no-deviation sheet from sub-CONTRACTOR shall be submitted by the CONTRACTOR to PURCHASER/ PURCHASER‟s representative for final review/ approval.

1.6 Expert or manufacturer supervision for sub-CONTRACTOR supplied material shall be provided by CONTRACTOR and shall be included in offer.

1.7 CONTRACTOR shall be solely responsible for any shortages or damages in transit for his supply scope, handling and/ or in storage of any materials and erection of the equipment, supply of erection tools at site. CONTRACTOR shall ensure that it will not affect any activity or project schedule. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the CONTRACTOR.

1.8 CONTRACTOR shall identify activities and mile stones of the work forecasted for next month with optimistic and pessimistic dates of work completion. CONTRACTOR shall prepare program evaluation and review techniques to identify critical path of project and activity sequences. The project schedule shall be prepared and updated fortnightly in MS Project.

1.9 Nothing in this specification shall be constructed to relieve the CONTRACTOR of his/ her responsibilities towards following best engineering practices established in the country.

1.10 Obtaining approvals including load sanction/ release from Local Power Supply Company - Torrent power Limited (TPL) for which necessary liaison shall be done by the CONTRACTOR for all access points of the skywalk for this phase, the charges for the same shall be reimbursed by client;

1.11 No Objection Certificates from GETCO/ GEB, Electrical Inspector (CEIG), Chief Inspector of Lifts and Escalators, relevant Government Agencies, Statutory Authorities, as applicable is included in CONTRACTOR‟s scope.

1.12 Voltage level for supply shall need to be confirmed with TPL by CONTRACTOR before the commencement of design.

1.13 All necessary legal fees required for various applications to TPL/Electrical Inspector (CEIG), relevant Government Agencies, Statutory Authorities shall be paid by the PURCHASER upon production of valid receipts. The TPL deposit required to be paid for Load Release shall also be borne by the PURCHASER.

1.14 The CONTRACTOR‟s scope shall also include measurement of soil resistivity at site by Wenner‟s four electrode method as per IS: 3043 – 1987 (Reaffirmed in 2006 or its latest version) at minimum four locations at site. The earthing system shall be designed for the actual mean soil resistivity value obtained.

1.15 Even if all components of a system included in this specification are not explicitly identified and/ or listed herein, these shall be supplied under this contract to ensure completeness of the system and facilitate proper operation and easy maintenance of the plant. Any and all other works not indicated above but necessary/ required to complete the job in all aspects, are included in the CONTRACTOR‟s scope.

1.16 The CONTRACTOR shall indicate and include start up spares, essential spares, recommended spares and a set of special tools necessary for operation, routine maintenance of equipment supplied for a period of five years.

1.17 Whether specifically called for or not, all accessories required for normal and satisfactory operation (as deemed by the PURCHASER) of the equipment shall be considered to be a part of the CONTRACTOR‟s basic scope of supply and/ or work and no claims whatsoever, for extra payment on these grounds, will be accepted.

1.18 CONTRACTOR should visit site and get himself/ herself ascertained regarding the scope of work for the complete Electrical works before submission of quote/ offer.

1.19 CONTRACTOR‟s scope shall also include all civil works and structural works required for installation of all electrical equipment/ systems such as equipment foundations, indoor & outdoor trenches, equipment support structures and all excavation works including those for lighting, earthing, cabling systems etc.

1.20 It is not the intent to completely specify herein all details of design and construction of the equipment and systems. Nevertheless, the Electrical system shall conform to high standard of engineering, design and workmanship in all respects and shall be

capable of performing satisfactorily in continuous commercial operation under the specified environmental conditions.

1.21 PURCHASER reserves the right to issue addendum to the technical specification to indicate modification/ changes in the requirements, if so required at a later date.

2.0 PROJECT INFORMATION:

2.1 Site/ Environmental Conditions:

- Ambient temperature : 50ºC (site specific)
- Relative Humidity : 5 - 95%
- Area Classification : Non Hazardous
- Seismic Data : As per IS 1893 (latest Issue)

2.2 Nominal System Voltage:

i. Incoming AC power supply voltage to the access points shall be 415V, Since there is space constraints and no space available for substation LT supply is envisaged at each access points which will supply to access points and some lengths of Skywalk.

ii. Voltage level for supply shall need to be confirmed with TPL by CONTRACTOR before the commencement of design.

iii. Power/ Control Supply Distribution Voltage:

(i) LV - 415V, 3 Phase, 4 Wire, 50 Hz, AC

(ii) General Lighting & Space Heating - 240V, 1 Ph, 2 Wire, 50Hz, AC

(iii) Control & Protection - 24/ 30 V or 110V, 2 Wire DC (As applicable)

iv. Voltage Transformer Secondary: 110 V, 3 Ph, 50 Hz, AC

v. Voltage Variation: ± 10%,

vi. Frequency Variation: ± 3% and

vii. Combined Voltage & Frequency Variation: ± 10%

2.3System Earthing:

i. 415 V, 3 ph, AC system : Neutral Solidly Earthed

ii. 240 V, 1 ph, AC system : Neutral Solidly Earthed

3.0 APPLICABLE CODES AND STANDARDS:

3.1 The design, manufacture, installation, testing, commissioning and performance of all the equipment and system shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of his responsibility.

3.2 The design standards described herein are generally in compliance with the Central Electricity Authority Regulations 2010, latest Indian Standards, State Electricity board standards and code of practices already established in the country and IRC guidelines.

4.0 POWER DISTRIBUTION ARRANGEMENT:

4.1 The connected load at individual access points is less than 100 kVA, hence all access point shall have 415 V LT connection from Torrent Power Limited (TPL) with all necessary Tariff metering equipment & electric supply connection for all access points of the skywalk for this phase.

4.2 It is presumed that the power supply to the proposed access points of the skywalk shall be provided from the nearest Torrent Power Limited (TPL) distribution board/box for each access point.

4.3 Tariff metering arrangement as per TPL standards & specifications shall be provided By CONTRACTOR. CONTRACTOR shall make all the above arrangements incase the same are not provided by TPL. The CONTRACTOR shall take necessary confirmation on the same before submission of the Offer/ Bid and include the same in it.

4.4 A Power Distribution Boards (PDB) shall be present in each access point. The PDB shall supply power to Main Lighting DBs, Elevator DB, Escalator DB and Receptacle DBs.

4.5 Main Lighting DBs shall supply power to lighting system of access points and areas of skywalk near its vicinity.

4.6 Sub lighting DBs shall be provided at locations of the skywalk and shall be located at certain locations at Skywalk areas, which shall feed lighting of remaining areas of skywalk not covered by main lighting DBs and for the billboard and signage lighting.

4.7 Elevator DB shall provide power supply for drives for elevator, shaft lighting & shaft sockets and all auxiliary supply for elevators including the power supply and control supply for cars.

4.8 Escalator DB shall provide power supply for drives and power and control supply for escalators.

4.9 Receptacle DBs shall be provided at locations in skywalk to provide power supply to sockets which are available throughout the skywalk at an interval of 20m for specific requirements of advertising/charging etc.

4.10 All the cabling from the PDB to the respective DBs shall be laid on Cable trays.

5.0 DESIGN CRITERIA FOR ELECTRICAL EQUIPMENT/ SYSTEMS:

5.1 GENERAL:

5.1.1 The design criteria, given below has to be followed by the CONTRACTOR for designing/ sizing of electrical equipments covered under CONTRACTOR‟s battery limits; however it is to be noted by the CONTRACTOR that, following this design criteria does not relieve the CONTRACTOR from adherence to the standards, regulatory requirements & best engineering practices.

5.1.2 The electrical system shall be designed to provide

i. Safety to Personnel and equipment during both operation and maintenance

ii. Reliability of Service

iii. Minimal fire risk.

iv. Ease of maintenance and convenience of operation.

v. Protection of all electrical equipment through selective relaying system.

vi. Electrical supply to equipment and machinery within the design operating limits.

vii. Adequate provision for future extension and modification.

viii. Maximum inter-changeability of equipment.

ix. Fail safe feature.

x. Energy efficient equipment/ system such that BEE Rating above 3 stars

xi. Suitability for applicable environmental factors

5.2 ESTIMATION OF LOAD/ MAX DEMAND:

5.2.1 The following considerations are to be followed to arrive at the maximum electrical demand.

5.2.2 Load Factor

i.	Auxiliary load	:	0.9
ii.	Lighting load	:	1.0
iii.	Miscellaneous Power loads	:	0.9

5.2.3 Diversity Factor

i.	Auxiliary load	:	1.0
ii.	Lighting load	:	1.0
iii.	Miscellaneous Power loads	:	0.9

5.2.4 Power factor of Motors : As per the Manufacture‟s Data sheets

5.2.5 Efficiency of Motors : As per the Manufacturer‟s Data sheets

5.2.6 All motors will be highly energy efficient (IE2) type and shall conform to IS: 325.

5.2.7 Motors will be capable of giving rated output without reduction in the expected life span when operated continuously under either of the following supply conditions.

Supply Condition

(a) Variation in supply voltage from rated voltage ±10%

(b) Variation in supply frequency from rated frequency ±5%

(c) Combined voltage and Frequency variation ±10%

5.3 For the per unit calculation purpose, minimum starting current for various types of starter applications shall be considered as following:

(a) DOL Starter – 6 times the rated current.

(b) Star- Delta Starter – 3 times the rated current.

(c) Soft Starter – 3 times the rated current.

5.4 SWITCHGEAR SIZING/ SELECTION:

5.4.1 Switchgear shall be sized/ selected considering the following:

(a) Rating suitable for carrying full load current of the equipment.

(b) Suitability for Short Circuit Rating for 1 sec duration.

(c) Switchgear for motors shall be suitable for motor duty application.

(d) Switchgear for all the motor feeders shall be Type-2 co-ordination.

5.4.2 In-panel de-ration of minimum 20% or as provided in Manufacturer‟s catalogue, whichever is higher shall be considered.

5.5 BUS BAR SIZING:

(a) The CONTRACTOR shall furnish calculations after award of contract, establishing the adequacy of the bus bar sizes to meet the continuous and short time current ratings as calculated.

(b) The bus-bars shall be sized considering the following criteria:

i. Sleeves made of insulating material on all bus bars.

ii. Design ambient temperature 50 deg. C.

iii. Final temperature of the bus-bars complying with requirements of IS 8623 & IEC 60947.

iv. Bus bars being inside the panel; De- ration for enclosure and ventilation.

v. Bus bar suitability for carrying rated current continuously.

vi. Configuration of bus bars and Proximity effect

vii. Bus bars shall withstand the short time rating of the panel for 1 sec duration.

5.6 CABLE SIZING:

5.6.1 The CONTRACTOR shall ensure that cable and wires associated with the power distribution and control systems in all the installations throughout the Works are adequately rated for their use

5.6.2 The following main aspects shall also be considered while deciding the final size of the cables-

(a) Supply voltage and frequency

(b) All cables shall be selected to carry the corresponding full load current under site conditions.

(c) Route length and disposition of cables

(d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).

(e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.

i. Cable from transformer secondary to PCC incomer, fault clearing time shall be 1sec

ii. For Cables emerging from ACB outgoing, fault clearing time shall be considered as 0.16 second (for Tie feeders if any it shall be 0.5 second)

iii. For Cables emerging from MCCB outgoing, fault clearing time shall be considered as 0.01 second

CONTRACTOR to note that, the above fault clearing times are minimum to be considered. Actual fault clearing time shall be considered as per actual relay co-ordination.

5.6.3 Appropriate de-rating factors as per cable manufacturer"s catalogue and enlisted below shall be considered for sizing the cable:

i. Ambient Air Temperature (minimum 50 deg. C).

ii. Ambient ground temperature (minimum 40 deg. C to be considered)

iii. Laid in Air / ducts/ directly in ground etc.

iv. Depth of cable burial (minimum 750 mm for LT and 900 mm/ 1200mm for 11kV/ 33KV HT)

v. Thermal Resistivity of Soil (minimum 150 deg. C Cm/ W to be considered)

vi. No. of cables in a group-touching each other or separated by a distance

vii. No. of cable trays in tier

viii. Any other de-ration factors as applicable & as per Manufacturer"s catalog.

5.6.4 In running condition, cumulative voltage drop (Including HV and LV at 100% rated load) shall not exceed 5% (measured at load end) for the LV loads. The voltage drop at starting (Voltage dip) shall be limited to 15% of the rated voltage.

5.6.5 The LV cables shall be 1.1 kV grade, multi-stranded Copper/ Al conductor, XLPE insulated, colour coded, inner and outer extruded PVC sheathed, galvanized steel round wire/ flat strip armoured cables.

5.6.6 Cables up to & including 4.0 sq.mm shall be Cu multi-stranded conductor with galvanized steel round wire armoured & balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.

5.6.7 Single core cable shall have non magnetic material armouring.

5.6.8 Control cables shall be Cu multi-stranded conductor with galvanized steel round wire/ flat strip armoured. For cables above 7 cores, minimum two spare cores shall be considered.

5.7 ILLUMINATION SYSTEM:

5.7.1 All lighting fixtures for Skywalks, bill boards, advertisements, signage, fixtures on the periphery of access points, electrical room for access points, stair area/ escalator area, lift landing area, and all other areas of access points shall be LED type with suitable driver and heat sink as testified by the type tests mentioned further in the specifications under appropriate clause.

5.7.2 Indoor lighting illumination levels will be as per IS 3646 and where as outdoor lighting illumination level will be as per IS 1944.

5.7.3 The illumination levels to be considered for the design of lighting system for various areas shall be as follows. These are the illumination levels achieved at Work plane. Work plane height shall be considered as 0.76 m from FGL.

5.7.4 The uniformity of 50% shall be maintained for indoor area and skywalk area and while that of 25 to 40% for outdoor area.

S.No.	Area	Illumination Level (Lux) - Average values
i.	Electrical/ Switchgear rooms;	250 Lux
ii.	Entrance Lobby	200 Lux
iii.	Skywalk	150 Lux
iv.	Outdoor areas	20 Lux

5.7.5 Lighting design shall be performed using latest version of DiaLux Software/ Original Equipment Manufacturer (OEM) validated software. The Validation Report

along with software and data files shall be acceptable to PURCHASER/ PURCHASER"s representative.

5.7.6 Various design factors shall be considered as following:

a) Maintenance Factor:

i) Outdoor area & Skywalk area : 0.6 (0.7 for LED)

b) Reflectance Factors:

i) Ceiling : 20%

ii) Floor : 20%

Reflectance from walls shall be ignored for calculation

c) Uniformity (Min. / Avg.) : 50% Minimum

d) Color Temperature of the lamp

i. Access points, Electrical Room : 6500K Minimum & Skywalk

Outdoor Areas 5400K Preferably, but minimum 4000K

5.8 PROVISION OF GENERAL RECEPTACLES AND OTHER SERVICE OUTLETS

5.8.1 General Purpose 6A/16A Switch Socket shall be provided at every 20m throughout the length of Skywalk.

5.8.2 In the Control Room at least one Switch Socket shall be provided. The height of mounting shall be 150mm above the Finished Floor Level.

5.9 EARTHING & LIGHTNING PROTECTION SYSTEM:

5.9.1 The safety earthing and lightning protection system will be generally on the basis of latest versions of the following codes and standards (including their latest editions).

i. IS 3043 -1987 (Reaffirmed in 2006): Code of practice for Safety Earthing

ii. IEEE 80 - 2000.

iii. IS/IEC-62305, 2013: Code of Practice for the protection of buildings and allied structures against lightning.

iv. CEA Regulations - 2010: Measures related to safety & electric supply.

5.9.2 The fault levels considered shall be as follows:

System	Fault level in kA
a) 415V System	As per TPL, min 18.5kA for 1 sec

(*) CONTRACTOR to design on the basis of actual impedance & adequacy calculations for sufficiency of earth conductor size shall be provided.

5.9.3 Following factors shall be considered for sizing the earthing conductor:

Design Ambient Temperature	50°C
Allowable temperature rise for steel welded joints	500°C

Fault clearing time	1 Second
Overall earthing resistance	< 1 Ohm or as per elevator, escalator OEM prescribed value.

5.9.4 Measurement of soil resistivity shall be done using Wenner"s 4 electrode method as described in IS 3043 -1987 (Reaffirmed in 2006) including its latest amendment.

5.9.5 The soil resistivity of the proposed plot area has not yet been measured; the same should be carried out during detailed engineering by successful CONTRACTOR. Test reports shall be certified by Govt. Authorised Laboratory/ Institutes/ Agencies.

5.9.6 After soil resistivity measurement; no. of earth electrodes and no. of test pits shall be finalized based on these design criteria & the requirements specified in earthing requirements.

5.10 DEGREE OF PROTECTION

The enclosures of the control cabinets, junction boxes and Marshalling boxes, panels other than mentioned above etc. to be installed shall provide degree of protection as detailed here under

i. Installed outdoor – IP 65

ii. Installed indoor – IP 54

iii. The degree of protection shall be in accordance with IS 13947 (Part I)/ IEC 947 (Part I)/ IS 2063/ IEC 529

5.11 DRAWINGS/ DOCUMENTS FOR SUBMISION:

5.11.1 After the award of contract, CONTRACTOR has to get approval for the equipment selection along with the approval for sufficiency calculations.

6.0 GENERAL TECHNICAL & PARTICULAR REQUIREMENTS FOR ELECTRICAL, EQUIPMENT/ SYSTEMS:

6.1 LV PANEL BOARDS

6.1.1 <u>GENERAL</u>:

(a) The scope of this specification includes design, engineering, manufacture/ assembly, installation, testing and performance demonstration of the LV Panel boards for various sizes and ratings to be provided for the distribution of the power supply in the Skywalk, Access point & Electrical Room.

(b) The panels include

i. Power distribution board (PDB)

ii. Wall mounted Distribution Board for

(i) Lighting Panels (LP) for lighting fixtures

(ii) Raw Power DB for receptacles (RDB) for sockets present through skywalk

(iii) Sub Lighting Panel for Skywalk, billboard & advertisement lighting

(c) Any other Panels and Distribution Boards if deemed required for the proposed scheme of power distribution for the center may be added appropriately.

(d) Each switchgear shall be complete with all fittings and accessories, drawing details, quantity shall be brought to PURCHASER"s notice at the time of bid submission only.

(e) Protection circuits, control wiring and interlock circuits not specified, but deemed necessary for the safe operation of the system shall be provided without any additional cost to complete the system.

6.1.2 APPLICABLE STANDARDS**:**

The design, manufacture and performance of equipment shall conform to the latest standards specified below. In case of conflict between standards and this specification, this specification shall govern.

Metal enclosed switchgear - General requirements	IS: 3427
Factory Built Assemblies of SWGR and control gear for Voltages up to and including 1000V AC & 1200VAC	IS: 8623 / BS: 5486 / IEC: 439
Air Break Switches	IS: 13947-P3 / BSEN6049 / IEC: 947-3
Miniature Circuit Breakers	IS: 8828 / BSEN: 60898
Low Voltage Fuses	

	IS: 13703 / BS: 1362 / IEC: 269-1
Contactors	IS: 13947/ BSEN: 60947 4 / IEC: 947-1
Starters	IS: 13947/ BSEN60947-4/ IEC: 292-1 to 4
Control Switches & Push buttons	IS: 6857 / BSEN: 60947
Current Transformer	IS: 2705 / BS: 7626
Voltage Transformer	IS: 3156 / BS: 7625 / IEC: 44, 186
Indicating instruments	IS: 1248 / BS: 89 / IEC: 51
Marking and Identification of Conductors and Apparatus Terminals	IS: 11353 / BS: 159
A.C. Electricity Meters	IS: 722, 8530 / BS: 5685 / IEC 145,211
Degree of Protection	IS: 13947 / IEC: 947-P1
Selection installation and maintenance of switchgear and control gear	IS: 10118
Code of practice for phosphating iron and steel	IS: 6005 / BS: 3189
Specification for copper rods and bars for electrical purposes	IS: 613

Control transformers for switchgear and control gear voltage not exceeding 1000V AC	IS: 12021

6.1.3 CONSTRUCTIONAL REQUIREMENTS:

(a) Sheet Metal Works Requirement:

i. Main PDB panel shall be free standing, metal enclosed, single front, compartmentalised fabricated with 2mm CRCA sheet steel for all doors, partitions and covers and 2.5mm CRCA sheet steel for load bearing sections.

ii. All indoor panels shall be minimum IP54 certified.

iii. The gasket shall be suitable to withstand all weathers for long tenure of service.

iv. All hardware shall be HD Galvanized or stainless steel.

v. All panels shall conform to form 4B as per IS 8623: 1993, Part I.

vi. Each door & cover shall have adequate reinforcement of suitable ribs & stiffeners.

vii. All feeders and cable alleys shall have hinged type door with panel locks. All such doors shall open min 105 deg. All bus-bar covers and other panel covers shall be screw fixed. Cable alleys and bus-bar chamber shall have minimum width of 300mm.

viii. All doors shall be with concealed type hinges and captive screws. Rear doors of panels requiring rear access shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.

ix. All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by authorised personnel. Rubber grommets shall be provided at the cable entry.

x. All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor.

xi. All free standing panels shall have uniform height. The operating height of all the panels shall not be less than 300mm and more than 1900mm.

xii. All the panel boards shall have cable entry from bottom. Gland plate (can be Split) of 2mm thick shall be supplied for termination of power, control and instrumentation cables sized as per the required no. of cable and 20% spare space for future addition.

xiii. The exposed bus live parts in the cable alley shall be totally covered against accidental contact by a shroud (and not by sleeve) to protect the workmen working on the switchgear. The protection shall be minimum IP20 inside the entire panel. A protective wire mesh with mesh size conforming to IP20 shall be provided in the busbar chambers to avoid direct contact with the bus while accessing them during maintenance and to make it vermin proof.

xiv. Separate metering compartment for incomer shall be provided for all analogue / digital meters and its accessories like load manager, voltmeter, ammeter, indication lamp, Voltmeter and ammeter selector switch etc. All wiring & MCBs shall be mounted in metering compartment such that meter maintenance is independent of the power compartments.

xv. All fabrication work like cutting, drilling, punching, shearing & welding etc. Related to switch board shall be complete before proceeding to 7 tank process. All interiors and exteriors of switchgear enclosure shall be finished and painted to prevent rusting and corrosion.

xvi. Sheet metal components shall be pre-treated using the seven tank phosphating process consisting of de-greasing, acid pickling, de-rusting, phosphating and passivation including repeated rinsing in between each process. On completion of passivation of the components they shall be preheated and then epoxy powder coated with Siemens grey RAL 7035 shade for exterior as well as interior and Glossy White shade for the gland plates (Inside the panel) and component mounting plate. Thickness of all painting shall be minimum 80 - 100 microns DFT.

(b) Bus-Bars:

i. All bus-bars shall be electrolytic grade Aluminium. CONTRACTOR shall specify the purity and conductivity of the bus bar along with the BID.

ii. All the bus bars shall be sleeved with heat shrinkable Black colour PVC sleeve or better insulation with coloured polyester tapes for phase identification at regular intervals/ locations.

iii. CONTRACTOR shall submit all calculations & documental proof of the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for approval during procurement/ manufacturing.

iv. Main Horizontal bus-bars of PCC above 2000A with Aluminium bars shall be interleaved type if required. Vertical bus-bars shall have S.C. rating same as main bus bar and shall be suitable for all connected load of vertical section.

v. CONTRACTOR shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. CONTRACTOR shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.

vi. Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved TYPE TEST REPORT for short time rating. Joint positions and insulators shall be properly adjusted so that they don"t interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually.

vii. Neutral bus-bars of different panel boards shall be as per the required standard.

viii. All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.

(c) Earthing:

i. Earth bus bars of Aluminium material shall be run all along the panel, extended out at both ends of value equal to the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.

ii. Earthing bus-bar shall be terminated at both ends of the switchgear to suit the connections to PURCHASER"s earthing conductor. The locations where the bus are protruding out of the panel boards, CONTRACTOR shall ensure that proper ingress protections are provided at all such locations.

iii. All doors and detachable components inside the feeder are required to be earthed individually with green (with yellow band) colour PVC insulated multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and are to be looped & connected to horizontal earth bus.

iv. Earthing bus shall be run continuously in panel drawn out suitably considering respective cable entry inside the panel.

(d) Separate Al earth bus shall be provided at each cable alley for all the panels.Power Wiring (Inside The Feeder):

i. All power wiring for rating upto and including 63A shall be carried out with 1.1kV grade coloured HFFR/ FR PVC insulated, coloured for phase identification, multi stranded copper wires duly crimped with ring type lugs.

ii. Power connections for rating above 63A shall be done with AL bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections shall be sufficient enough and profiled suitable for termination of the prescribed number of cables.

(e) Control Wiring (For Panel And Feeders):

i. All panel Control wiring shall be done by 1.1kV grade HFFR/FR PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications. Wires shall be gray coloured with suitable crimpable copper lugs. CT"s & PT"s wiring shall be colour coded for multi-phase identifications (R-Y-B-N).

ii. Panel wiring & cabling shall be cross-ferruled. Ferrules shall be printed type.

(f) Terminals:

i. All the Terminals shall be Polyamide type. Sliding link type CT shorting terminals shall be provided for CT connections & screw / stud type terminals shall be provided for PT connections & other control circuit wiring.

ii. All unused auxiliary contacts of circuit breakers, protection, auxiliary, control relays shall be wired up to terminal block. The terminal blocks shall be located suitably spaced from each other and atleast 200mm from the side/ bottom wall or any adjacent feeder component to provide better convenience for running the wire troughs and termination of the control cables.

iii. All panels shall have Terminal block suitable for connecting minimum 6sq.mm. conductor unless otherwise stated.

iv. 20% extra terminals shall be provided for power as well as control for PURCHASER"s use in each terminal strip/feeder.

6.1.4 GENERAL REQUIREMENTS:

(a) The panel shall be Internal Arc tested in accordance with IEC 61641 for minimum 0.3s.

(b) The panel shall conform to fuse less design except for the semiconductor fuses used for protection of devices and cards and HRC fuses for protection of Control transformers. ACB/ MCCB shall be provided for all outgoing and incoming feeders as per the rating.

(c) DP MCB shall be provided for all control circuits where the fault level is less than 10kA. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB/ SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely.

(d) Where control transformer has been provided, a separate control bus shall be run maintaining adequate clearance of atleast 300mm from the power bus with provision of tapping at each vertical column section. The control bus should be preferably a bus bar with Heat shrinkable sleeve.

(e) Self explanatory Wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the door of each feeder. Drawing set in the panel shall be laminated.

(f) All labels for identification of feeders as well as internal and external components as per legends provided in the approved drawings shall be on white acrylic sheet with black engraving. These labels shall be fixed by screws/rivets and shall not be pasted.

(g) Aluminium etched 415V Caution boards written in three languages (English, Hindi & Gujrati) shall be riveted on the panel on all four sides at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers.

(h) Selector/control switches shall have an 'Off' position. The 'Off' position shall not be wired in any circuit and shall be utilised to disconnect (or bypass) power supply to control circuit for any maintenance work.

(i) All hardware e.g. Nuts, bolts & gasket, anchor fasteners etc, are included in the VENDOR's scope. No separate claim shall be entertained, in this respect. Atleast 10% extra hardware shall be provided for any installation/fixing work. This is to ensure ready availability of hardware in case of loss of some hardware during installation.

(j) Start push button shall be recess type, spring return. Stop push button shall be stay-put lockable type. The pushbuttons shall be dust and vermin tight.

(k) All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals).

(l) No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened.

(m) Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage upto handing-over shall be provided (for safety and ease of maintenance) without any cost implication to the

PURCHASER.

(n) All PVC/engineering plastic based items (including but not limited to conduits, casing-capping, trough, trunk, enclosures, covers, plugs, etc) shall be with FR properties.

(o) Lifting hooks/eyes shall be provided in each shipping section of the equipment and shall be removable type.

(p) The equipment shall be given tropical and fungicidal treatment.

(q) Insulation mat of suitable standard width shall be provided in front of the LV panels.

(r) Atleast one 230V, 1Ph, Space heater shall be provided for each vertical section of the switchboard. Each Space heater shall be provided with an isolating switch, a thermostat and dedicated MCB protection of appropriate rating. Heater shall be mounted at bottom of the panel with cover to avoid accidental contact of heater with skin.

(s) 230V 1Ph, Panel illumination (11W CFL fixture with lamp, limit switch and isolation switch) along with 1 no. 5/15A 5 pin socket with switch shall be provided for each vertical section. Bare holder with open lamp is not acceptable. Interlock with the Door limit switch shall be provided.

6.1.5 <u>EQUIPMENT REQUIREMENT:</u>

(a) Continuous Rating at design ambient temperature as specified elsewhere in the tender; configuration of poles, operation mechanism and short time rating of each Circuit breaker (ACB and MCCB) for the panel along with all the specified releases, switches, push buttons and indication lamps etc shall be as per SLD.

(b) All the Incomer and outgoing feeders of the PDB shall have overload, earth fault and short circuit protection through microprocessor based releases.

(c) Earth fault release for 4 pole breakers microprocessor based release shall be inbuilt in the release. However, for three pole breakers, suitable earth fault module with CT on neutral shall be considered along with shunt trip. These provisions shall not affect the provision of indication lamps or remote communication module.

(d) For Distinct Fault Indication, required voltage supply shall be derived from the existing control supply by VENDOR.

(e) 415V switchgear panels shall have MCCBs upto 400Amp and ACB shall be considered above that.

(f) All ACBs shall be in draw-out modules. ACBs shall be rated for 415 V, 50 Hz, with minimum 6 NO and 6 NC auxiliary contacts rated 10A at 230V. The breaking capacity shall be rated for 1sec for symmetrical short circuit current (Ics = Icu =Icw = 100%).

(g) Air Circuit breakers (ACB) shall be operated by a motor spring charging type of mechanism. The tripping spring shall be charged by the closing action, to enable quick tripping. Closing of the circuit breaker shall automatically initiate recharging of the springs to enable the mechanism to be ready for the next closing stroke. Charging time for the springs shall not exceed 30 seconds. It shall be possible to manually charge the springs in an emergency. Transfer from motor to manual charging shall automatically disconnect the charging motor. The charging mechanism shall be provided with mechanical indicators to show "charged" and "discharged" conditions of the spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker. All operating mechanisms shall be provided with "ON" - "OFF" mechanical indication.

(h) The trip coil and closing coils of ACBs (230 V AC) shall operate satisfactorily under the following conditions of supply voltage.

i. Closing coils 85 % to 110 % of rated voltage

ii. Trip coils- 70 % to 110 % of rated voltage.

(i) All MCCBs shall be rated for 415V, 3 Ph, 50Hz. MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing. The service breaking capacity of all the MCCBs shall be for 1sec for symmetrical short circuit current (ICU =ICW = 100%).

(j) The ACBs & MCCBs shall be suitable for remote communication (SCADA control).

(k) For ACBs, 6NO + 6NC and for MCCBs 2NO + 2NC potential free contacts for PURCHASER‟s use in addition to those required for control and indication shall be provided. If any contact multiplication is done, it should be done by an auxiliary relay and not by contactor.

(l) All the MCCBs shall be of current limiting type and shall provide a cut off in, < 10 ms for prospective currents during faults. Necessary auxiliary contact block for provision of auxiliary contacts is included in scope. The CONTRACTOR shall ensure co-ordination between upstream & down- stream ACB/MCCBs.

(m) All MCCBs shall be provided with rotary handle with door interlock and extension links/ spreaders with proper shrouds.

(n) All protective components esp. ACBs and MCCBs installed in PCC and at Incomer of downstream Panels shall be with Utilisation Category "B" (i.e. offering time discrimination with downstream devices).

(o) Protective releases shall be EMC compliant. The release shall be protected against non-linear loads and shall not cause nuisance tripping due to harmonics.

(p) The motor feeders shall have thermal over load protection (OL) through thermal overload relay, single phase preventer for motors rated upto 15kW in addition to protection of motors for elevators and escalators.

(q) Motor feeders above 15kW and below 100kW shall have thermal over load protection (OL) through thermal overload relay and Motor control Unit with Earth fault protection, Phase current out of balance and Single phase preventers in addition to protection of motors for elevators and escalators.

(r) All instrument transformers shall be cast resin type and shall have insulation of class B or better.

(s) Current transformers shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.

(t) Current transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary duties of the switchgear, as indicated in the Technical Specification. CT core laminations shall be of high grade silicon steel. Identification labels shall be fitted giving type, ratio, rating, output and serial numbers.

(u) It shall be entirely the responsibility of the CONTRACTOR to ensure that characteristics of CTs, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.

(v) Transient Voltage Surge Suppressor (TVSS) shall be provided at the incomer of LV panel before the incoming breaker. TVSS shall be provided suitable for the fault level of the LV panel.

(w) Electrical analogue indicating instruments shall be 96mm square with 240º scale. Taut band type of instruments is preferred. Instrument dials shall be white with black numbers and lettering. Instruments shall have an accuracy of Class 1.0.

(x) Indicating lamps shall be of the Multi chip LED type with low watt consumption. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at 240 V AC. Lamps shall be provided with translucent lamp covers.

(y) "Start" and "Stop" push buttons shall be colored green and red respectively. Stop Push Button shall be lockable stay-put type with Mushroom head.

(z) Multi Function Meter shall display all electrical parameters like (but not limited to) current, voltage, kW, kVA, KVAr, kWH, MD, PF, F, ITHD, VTHD etc. and shall have provision for remote communication with SCADA.

(aa) The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals shall be provided in each cubicle. Ring type lugs suitable for termination of 2.5 sq mm copper wires shall be used.

6.1.6 SPECIFIC REQUIREMENTS OF PDB PANEL:

(a) In the PDB panel, the incomer breakers, if two nos. shall be electro-mechanically interlocked in a scheme such that no two supply source clash with each other.

(b) CONTROL CIRCUIT:

i. Following control voltages shall be provided in all the panels;

ii. All ACB/MCCB tripping- Direct acting releases/ Shunt trip coil 230V AC

iii. All ACB/MCCB closing- 230V AC

iv. All ACB closing motor - 230V AC

v. Indications - 230V AC

vi. Space heater, Panel lamp, Aux Plug-Socket etc. - 230V AC

(c) Control supply for tripping and closing circuit of incomer breaker and outgoing breakers shall be tapped from incoming and outgoing bus respectively.

(d) Control supply for metering of the outgoing feeders shall be tapped from either one point on outgoing bus or from the respective feeders.

(e) Power supply for space heater, panel lamps and spring charging motors shall be tapped from the incomer of the panel.

(f) In location of PDB panel and thus the Electrical Room shall be in concurrence with the Fire Officer‟s requirement of Local Isolation in case of Fire.

6.1.7 SPECIFIC REQUIREMENT OF WALL MOUNTED PANELS

(a) Main Indoor Lighting Panels (MLP) shall be of industrial type, totally sheet steel enclosed of 2mm thick, double door construction, fully dust and vermin proof, wall/column mounting type with a degree of protection of IP – 52. Outdoor panels shall be weather proof type with IP – 54 degree of protection. The boards shall have welded back and sides and hinged door with gasket at the front with door handle and suitable locking device. Detachable cover plates shall be provided at the top and bottom for cable/conduit entry and suitable knock out shall be provided for this purpose. The Lighting panel after fabrication shall be subject to rust removal treatment and provided with epoxy powder coating followed by baking. The board shall have 2 No. earthing terminals suitable for 25mm X 6mm GI flat and mounting arrangement for wall/column mounting. One no. of such MLP shall be present in each access points. MLP shall be Wing Knob – Lockable type/ Pad lockable. The incomer shall be min 32A MCB+RCCB and Outgoing shall be min 12 nos. of 6A SP MCBs as per requirement with 20% spares.

(b) Outdoor Lighting panel (OLP) shall be wall/ structure mounted, 1 phase 230V 50Hz, powder coated double door construction of 2.0 mm thick sheet steel enclosure, conforming to IP52 protection for indoor installation, with DP ELMCB (30mA sensitivity) Incomer, and required Nos. of SP MCBs as outgoings duly wired with copper PVC insulated wires and terminals. All emergency lighting shall be controlled directly from the respective LP. OLP shall be located at every 200m length of skywalk. OLP shall be Wing Knob – Lockable type. The incomer shall be min 32A MCB+RCCB and Outgoing shall be min 12 nos. of 6A SP MCBs as per requirement with 20% spares.

(c) Raw Power Distribution Board (RDB) shall be similar in construction to the LPs. The board shall be 3 phase and neutral, 4wire type. The board shall have current limiting type 3 pole (TP) MCCB with OL/SC/EF release as incoming feeder; adequate nos. of three pole (TP) and single phase (SP) MCB outgoing circuits. RDP shall be located at every 200m length of skywalk. RDB shall be Wing Knob – Lockable type. The incomer shall be min 63A MCB+RCCB and Outgoing shall be min 12 nos. of 32A SP MCBs as per requirement with 20% spares.

(d) Protective knobs of MCBs providing inside the board to show only the operating knobs of MCBs providing outside the cover plate. Adequate space shall be provided within the board to facilitate termination of incoming and outgoing multi core cables. The board shall be factory assembled and wired with HFFR/ FR/ FRLS insulated stranded copper wires. The MCB phase feeders shall be suitable for mounting on the DIN rail provided in the board. Tinned copper bus bar shall be used in the board.

6.2 CABLES

6.2.1 SCOPE

(a) The scope includes Design, engineering, manufacture, Acceptance testing at manufacturer‟s works, packing, forwarding, delivery including transit insurance, unloading at site, handling, assembly, installation, testing, commissioning &

performance demonstration of LV, Control AC & DC Cables of various sizes as required, to be laid buried in ground or RCC trenches/ laid on cable trays in RCC trenches or on wall or structural supports or in specified ducts. Civil work such as excavation, providing sand bedding above and below the cable; laying of Class A Red clay brick/ RCC tile/ semi-circle hume pipe protection; or for mounting structural support for cable trays / supports shall be included in installation CONTRACTOR scope.

(b) Miscellaneous items such as cable dressing accessories like nylon tie, GI clamps, GI cleats, GI Saddle Spacers, cable tags, cable route marker etc. are included in the scope. Removal of empty drums, cartons and making the site normal as instructed by PURCHASER is included in scope.

(c) The construction, performance and testing of cables shall comply with IS 7098 Part II for HT cables, 7098 Part I for LT XLPE cables and IS1554-Part-I for PVC cables.

(d) In general cable installation works shall be carried out in accordance with IS 1255 – 1983, latest version.

(e) Installation of cables at height more than 3 meters if required by Use of metal modular scaffolding / scissor lift & other necessary safety gears arrangements for working at this height are included in the scope of installation CONTRACTOR.

(f) Use of all the personal Safety gears per person required as per standard safety practices prevailing in included in the scope of the CONTRACTOR.

(g) The HV power cables shall conform to Earthed grade (E), three core, multi-stranded, Aluminium conductor, screened by extruded semi-conducting compound, cross-linked poly ethylene (XLPE) insulated, cores screened with non-magnetic metallic tape laid up with inner and outer extruded PVC sheath compound Type-ST2 and galvanised steel strip armouring. The cables shall generally conform to IS 7098-1985(latest version) with relevant parts thereof. The insulation over the individual conductor core will be colour coded.

(h) All Armouring shall confirm to latest version of IS: 3975.

(i) The LV Power cables shall be 1100V grade, multi-stranded, Al / Copper conductor, XLPE insulated, extruded inner & outer PVC sheath compound type ST2 and galvanised steel strip armoured cables.

(j) All the control cables shall be 1100V grade, multi-stranded, Copper conductor, XLPE insulated, extruded inner PVC & outer PVC FRLS sheath compound type ST2 and galvanised steel round wire armoured.

(k) The cable sizes & type shall in general follow the criteria as tabulated below.

SR. NO.	PARAMETER	LT CABLE

1	Application	Control & Power
2	Applicable Standard	IS 7098 -I
3	Voltage Grade	1.1 kV
4	Conductor	Multi strandedCu upto 4sq. mm Multi stranded Al for ≥10 sq. mm
5	Insulation	XLPE
6	Inner Sheath	ST2 extruded PVC
7	Armouring	GI armour for multi-core Al armour for single core
		Up to 10 sq. mm round wire and 16 sq. mm & above - flat strip armouring.
8	Outer Sheath	ST2 extruded PVC
		FRLS PVC Outer sheath for- a) All control Cables b) All cables inside the building area c) All cables in Hazardous area.
9	Cable Laying (Mainly complying with Installation practice as mentioned in IS 1255)	

(l) Inside the electrical switchgear room, cables will be laid in prefabricated HD galvanised Steel cable trays mounted on support structures. All vertical cable trays shall be covered with prefabricated GI covers after proper dressing.

(m) Fire protection sealing (Brick or Mortar) for 4 Hrs fire rating rating shall be provided for cables/ cut outs/ outlets wherever passing through wall/ slabs/ cable trench/ conduits etc.

(n) The Installation CONTRACTOR shall prepare the cable and interconnection schedule for entire electrical system from HV Switchgear/ RMU to tail end of equipment based on equipment drawings and submit the same to Consultant /PURCHASER for review & approval.

(o) Printed ferrule (tubular types) white with black lettering shall be provided. The printing shall be done with the indelible ink.

(p) All wiring shall be with 0.75 kV grade, multi-stranded Cu conductor, PVC FRLS insulated wires.

(q) All cables & wires shall be with multi-stranded conductor irrespective of size.

(r) If required, looping of all RS 485 ports shall be done using 3 core twisted & shielded 1.5 sq. Mm copper cable & shall be terminated at incomer panel.

(s) For control wiring straight + cross ferruling shall be provided, so that identification of wire emergence & destination can be done.

(t) Outdoor cables will be galvanised steel wire / strip armoured. These cables shall generally conform to latest version of Indian Standards.

(u) All control cables shall be with following specific requirements:

i. Copper conductor stranded class 2.

ii. PVC Insulated

iii. Provided with inner extruded PVC and outer PVC FRLS sheath of extruded black PVC compound.

iv. Galvanised steel armouring in the form of GI round wire.

v. Core identification shall be by printed numerals.

vi. The insulation over the individual conductor core will be colour coded.

(v) All the power & control cables used in the Hazardous area shall be with FRLS PVC outer sheath.

(w) Any buried cable crossing a road shall be laid in a Hume / HDPE pipes/Culverts atleast 750mm below the Finished Road Level.

(x) Earthing Cable shall be Single core multi-stranded Cu 1100V grade, XLPE insulated, un-armoured green coloured outer sheath with yellow strips/band cable to be laid in trays, underground, trenches etc. where ever required - for transformer neutral earthing.

(y) All cables shall be terminated at both ends.

(z) For HT cables Raychem make Heat Shrinkable termination kits shall be used for outdoor & indoor terminations/ straight through joints. M-seal push on type terminations may be used for indoor terminations.

(aa) For all HT, LT power and control cables, double compression glands with aluminium lugs for Aluminium cables and tinned Copper lugs for Copper cables shall be used in indoor and outdoor application.

(bb) The termination shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.

(cc) For Underground cables, cable marker shall project 150mm above ground and shall be spaced at an interval of 30 metres, and at every change in direction. They shall be located on both side of road and drain crossings. Top of cable marker/joint marker shall be sloped, to avoid accumulation of water/dust on marker.

(dd) Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossings, on each duct/ conduit entry, and at every ten (10) metres in cable tray runs. Cable tags shall also be provided inside the switchgear, motor control centres, control and relay panels, etc., cable identification is also required where number of cables enter together a gland plate.

(ee) Separate cable trays will be used for control, signalling, Data and supervisory cables. In case separate cable tray provision is not possible, then separation distance of minimum 300mm shall be maintained between power/ control & signal cables. The cables can be segregated using metallic conduits also. Where ever cables with two different voltage classes cross each other, they shall cross each other at 90 degree.

(ff) Cable Lugs

i. Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.

ii. The current rating of the lugs shall be same as that of the respective cable conductors.

iii. Ring type cable terminations shall be used.

iv. Insulated lugs are not acceptable for any cable terminations.

v. Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.

vi. Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.

vii. Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.

viii. Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with „long palm terminals.

ix. All terminations in DBs / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.

x. All earthing terminations shall be with ring type lugs only.

xi. All control & interlock cable terminations shall be with ring type lugs.

xii. Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Al cable terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs)].

xiii. If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

(gg) Cable Glands

i. Double compression type cable glands shall be used for the termination of all the power and control cables. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.

ii. For single core cables, gland shall be with brass ring.

iii. Cable glands shall be with metric threads.

iv. Cable glands shall be conical (& not flange type).

(hh) Where ever applicable, supply & installation provision of bimetallic strip for connection between Al to Cu strip & GI to CU strip shall be the scope of

CONTRACTOR.

(ii) Following colour coding shall be used for the Panel wiring (1.1kV grade Copper conductor):

i. Control circuit wiring minimum 1.5 Sq.mm Grey colour FRLS wire.

ii. CT circuit wiring minimum 2.5 Sq.mm Red, Yellow & Blue colour FRLS wire.

iii. PT circuit wiring minimum 1.5 Sq.mm Red, Yellow & Blue colour FRLS wire.

iv. Power circuit wiring minimum 2.5 Sq. mm Red, Yellow & Blue colour FRLS.

v. Earthing wire – Green/ Green with Yellow colour Band.

(jj) CONTRACTOR has to ensure reference of an arrow and suitable accompanying wording which shall be stencilled on the sides of the drums indicating which way it should be rolled. The number on each drum shall be either branded at the end of the drum or stamped on the metal attached to an end of the drum. The cable shall be placed on the drum in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. The drum shall be securely blocked in position so that the cable will not be displaced during transit.

(kk) It shall be the CONTRACTOR"s responsibility to prepare the drum cutting schedule so that cable wastage is minimum while cutting.

6.3 CABLE TRAYS

(a) The cable trays shall be pre fabricated galvanised steel, perforated or ladder cable trays, suitably supported by primer coated (2 Coats) and epoxy painted (2 Coats) mild steel cable tray supports. Separate cable trays will be used for power, control, signalling and supervisory cables.

(b) All cable trays will be earthed at minimum two places by suitable sized GI flats to main earthing system earth conductor. The cable trays shall also be earthed at a regular interval not more than 10m.

(c) Cable trays of prefabricated perforated and ladder types and associated accessories such as coupler plates, tees, elbow etc. fabricated from 14SWG MS sheet and then hot dip galvanised (2.0 mm thick) sheet steel. 50mm side flanges for perforated tray and 75 side flange (100 mm only for 750mm tray) for ladder tray shall be provided on both sides of the tray. All the cable trays shall be hot dip galvanised (Min. 80 micron thickness) after fabrication.

(d) All the Vertical cable trays shall be provided with covers. All cable trays & covers (only for vertical drops) shall be MS sheet fabricated and then hot dip galvanised with thickness of minimum 70 Micron as per IS 4759:1996. Thickness for Cable tray shall be minimum 2 mm & for covers shall be min. 1.6 mm.

(e) Cable trays shall be in standard length of 2500 mm and clear inside width of trays shall be

i.	Perforated type trays	:	50, 75, 100, 150
ii.	Ladder type trays	:	300, 450, 600, 750

(f) Only Pre-Fabricated bends, joints and reducers shall be used.

(g) Two lengths of Cable trays shall be fixed with twin coupler plates (inner & outer) at each joint. Erection with just one coupler plate shall result in rejection of the entire installation.

(h) Hardware (esp. bolts) for Joining of two lengths of cable trays shall be installed such that, not to damage the cables under any condition.

(i) 2 nos. of earth strips shall run through each cable tray. In case of multi-tier cable trays, 2 nos. of earthing strips shall run only through one of the cable tray. The balance cable trays of the multi-tier cable trays shall be connected with these earth strips at a distance not more than 10 meter. The cable tray earthing shall be interconnected to Main earth grid at least at two places.

(j) The CONTRACTOR shall ensure that, for all vertical drops no cable shall be seen uncovered i.e. all the vertical cable trays shall be covered with cable tray covers.

(k) TESTS

The CONTRACTOR shall conduct the routine tests on each drum length, acceptance and type test on the cables as per applicable standards. Also special tests for critical oxygen index, temperature index values, and acid gas generation, smoke generation, and flammability test, effects of light and water test as specified shall be conducted on specimen, from different batches.

i. Following site test shall be done on MV cable

(i) Very low frequency AC HV test (instead of DC test)

(ii) Insulation resistance including P.I. at rated voltage

(iii) Capacitance and tan delta

(iv) AC leakage current

(v) Partial discharge measurement

(vi) Testing and Commissioning of Cables

(l) Cables shall be checked for insulation resistance before and after jointing. The voltage rating of the Megger for cables of different voltage grades shall be as indicated below.

Voltage Grade	Megger rating
1.1kV	500V

(m) All cables of 1.1 kV grade cables shall be subjected to DC or AC (preferably DC) high voltage test after terminating but before commissioning as per Table 6 in IS: 1255 (Code of practise for Installation & Maintenance of Power Cables up to and including 33kV).

6.4 ELEVATOR

6.4.1 SCOPE

(A) This specification covers the general requirements for traffic study, design, detailed engineering, preparation of construction drawing, manufacture, acceptance testing at manufacturer‟s works, supply, packing, forwarding and delivery from place of storage/ manufacturer‟s works to erection site including transit insurance, unloading, storage at site, assembly, erection, testing, installation, commissioning and performance demonstration of Goods Elevator complete with all devices; power and control panels and civil construction of structural shaft as are necessary to complete the installation of Elevator in accordance with this specification to be installed for Access points of Skywalk.

(B) The scope also covers the provision of hoist ways, pits of specified dimension, floor, wall and ceiling finishes in hoist ways, pits. Lighting as per requirement in hoist ways and pits, ventilation system of machine rooms with suitable exhause fans as per NBC & BIS codes.

(C) It is the sole responsibility of the CONTRACTOR to obtain necessary approvals and obtaining licenses from the local authorities concerned for the installation and operation of the Elevator system, without any additional cost. The CONTRACTOR has to comply with all the points/modification if suggested by Elevator inspecting authority without any extra cost.

(D) CONTRACTOR has to submit the datasheets/ specifications make, model no. / type & other technical details with bids. Before finalization of the make model no., capacity etc. CONTRACTOR has to take prior approval from PURCHASER / consultant.

(E) With the lift the Vendor shall supply a maintenance tool kit which shall be kept in machine room.

6.4.2 CODES AND STANDARDS

(A) The equipment shall fully comply with the requirements of latest editions of enclosed specifications and the latest editions of codes and standards.

(B) Elevator system in general shall comply with IS 14665, IS 15330, IS 8216 & IS 15785 & CEN EN 81-1 (as amended up to date).

(C) In addition to above, Elevators covered by this specification shall be provided, installed, tested, commissioned, certified and approved as per statutory requirements of the Local Elevator Inspectorate

(D) The Elevator installations shall also be governed by the following Acts/Bye-laws/Codes as amended up to date in addition to the codes specified in the tender. Elevator installation shall be in conformity with:

(a) National Building Code of India - 2016

(b) Indian Electricity Act - 1910

(c) Local Lift and Escalator Act

(d) Building Bye-Laws

(e) Local Fire Prevention and Fire Safety Rule.

(f) Central Electricity Authority Regulations – 2010

(E) In the event of any conflict between the codes and standards referred to elsewhere in the specification and the requirement of this specification, the stringent requirement shall govern.

6.4.3 DESIGN FEATURES

(A) The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered

(B) Hoist Machine

(a) Hoisting machine shall be gearless type. Gearless hoisting machine shall be having motor suitable for AC Variable Voltage Variable Frequency (VVVF). The motor shall be designed for lift service and have efficiency class of IE 2 as per IEC 60034.

(b) The motor shall be reversible type particularly designed for elevator service with high starting torque and low starting current. The starting current shall be 1.2 to 1.5 times the rated current. Motor & Drive shall be suitable for 150 starts per hour. The motor and drive shall be designed in such a way as to withstand

occasional overloading above its rated capacity and shall have overload protection.

(c) The motor shall have a good speed regulation under different conditions of load and shall be designed to give a noiseless and vibration-free operation.

(d) The AC VVVF drive system shall control AC voltage and frequency concurrently with the hoist motor regulate the lift"s actual performance to match closely the ideal speed pattern, obtain maximum efficiency of operation and provide a very smooth ride.

(e) Hoisting machine, brake assembly, sheaves aligned properly, along with associated accessories shall be mounted on steel machine frame.

(f) Machine support frame shall be provided at the top of the elevator or mounted on the back of the guide rail at the top landing. The machine shall be located directly above the Elevator. Suitable beams shall be provided for mounting arrangements, if required by the Elevator CONTRACTOR. The brake-release mechanism shall be operable from the last landing without entering into the Elevator. Sound isolating pads below mounting frame shall be provided to reduce the noise levels.

(g) Requirements for permanent lifting hooks hoisting beams and access hatches shall be indicated on the drawings by the Elevator system CONTRACTOR.

(C) Energy Efficiency and Sustainability

(a) When there is no landing call after 90s, the light and the fan inside the car shall be automatically switched off. Car lights and fan shall switch ON automatically before the lift doors start to open or the lift is set in motion.

(b) LED lamps shall be used for all lighting of lifts including shaft lighting.

(c) The total power factor of the drive shall be improved for better energy efficiency.

(d) Gearless type machine shall be used to avoid transmission losses if possible.

(e) The motor shall have efficiency class of IE 2 as per IEC 60034.

(f) The elevator shall have components which are environment friendly.

(g) The elevator installation shall not inject undesirable waveforms into the electric supply & distribution system. The THD produced by the elevator shall not exceed the maximum allowable values as per IEEE. The THD shall be measured when the elevator is operating at no load at its rated speed.

(D) Brake

(a) The electromagnetic brake shall be spring applied and electrically released. It shall come into action after the elevator has come to a complete halt to hold the car in position. The brake shall operate automatically with the safety devices and failure of the mains. It shall be released electrically. It shall be possible to release the brake manually – such release requiring the action of manual force to move the elevator in short stops.

(E) Emergency Cranking

(a) The hoisting machines shall be provided with a set of special tools including a hand crank to allow release of hoist brake and provide for manual movement of the car in case of emergency. These tools shall be hung up on a tool board fitted to a wall in lift well with instructions for their use clearly written on the board both in English and the local language.

(b) An automatic switch shall be provided to interrupt power to the elevator mains. Upon withdrawal of crank and manual resetting of power monitor switch, power shall be restored.

(F) Digital Encoder

(a) Digital encoder shall be provided for each floor to update car position and automatically restore the same after power loss.

(b) In case the shaft size is bigger than required, then Bidder to clearly indicate additional support frame requirement, if any for safe & noise free travel of Elevator in the Elevator shaft.

(G) Speed Governor

(a) Each Elevator shall be provided with speed governor located at top of hoist way. The governor shall actuate a switch when excessive descending speed occurs, disconnecting power to the hoist motor and applying the brake prior to deployment of the safeties.

(H) Control

(a) The elevators shall have state of art microprocessor based AC variable voltage variable frequency (ACVVVF) drive.

(b) Two elevators adjacent to each other in one location shall be provided with Directional Collective/Selective Control for two cars with Group Supervisory Control. The microprocessor-based controller to memorize all car and landing calls, and the system shall answer all registered calls sequentially & preferably in the current direction of movement.

(c) The control system shall regulate dispatching of individual cars and shall provide service to all floors as different traffic conditions arise minimizing

unproductive factors. The system shall respond automatically to UP and DOWN peak, balanced or light traffic etc.

(d) Each of the landing call shall be automatically allocated to the best placed (nearest car travelling in the same direction).Control to be designed such that cars are effectively spaced to give even service.

(e) All cars to be parked at ground floor when there are no unanswered calls.

(f) Complete detail of such features of Controller & its collective selective operation capabilities shall be furnished along with the tender.

(g) Some of the technical parameters required are listed below. Bidder shall categorically confirm their compliance or otherwise in the tender.

Sr. No.	Parameter	Requirement
1.	Starting Current	1.2 – 1.5 time full load running current
2.	Levelling accuracy	± 3 mm
3.	Acceptable Voltage Fluctuation	± 10%
4.	Frequency Variation	± 5%
5.	Rate of acceleration/deceleration	0.6 – 1.5 (Adjustable at

Sr. No.	Parameter	Requirement
	(M/S2)	site)
6.	Maximum jerk (M/S3)	0.7 – 1.5 (Adjustable at site)
7.	Lateral Quaking and maximum vibration in car horizontal/vertical	20 gal / 20 dBA
8.	Maximum noise level in car during travel	48 dBA
9.	Maximum noise level in machine room/machine room less at 1 mtr from machine	62 dBA
10.	Maximum door noise level while closing and opening at a distance of 1 m from car door	52 dBA

(h) The controller shall be wall/floor mounted, vertical, totally enclosed cubicle type with hinged doors on the front & rear to provide easy access to all components in the controller. The enclosure shall be minimum IP 23 protected. The cubicle shall be well ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions in the machine room/shaft. In case found necessary arrangements of suitable heat sinks & ventilation fan shall be provided.

(i) The controller shall operate within the supply voltage variation of plus 10% to minus 10% of the nominal voltage. An inbuilt voltage stabilizer shall be provided in the controller for the purpose.

(j) The controller shall be complete with relay protection against the following:

i. Over current

ii. Under voltage

iii. Single phasing

iv. Phase reversal

v. Earth leakage

vi. Over voltage

(k) The controller shall be designed to cut off the power supply, apply the brake and bring the car to a rest in the event of any of the above failures OR in the event of signal from Fire Detection & Alarm Control Panel.

(l) Elevator controller shall be capable of following –

(i) Potential free contacts for indicating elevator alarm status, trip status and emergency activation switch status.

(ii) It shall accept signal form fire alarm panel

(iii) If any devices of the electro mechanical type are used the same shall be equipped with arc chutes to prolong the life of contacts.

(I) CAR

(a) A car-frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. Safety shall conform to ANSI/ASME/CENEN-81 or local codes if more stringent.

(b) The car platform shall be of stainless steel plate. The entire platform shall rest on rubber pads, so that it will be designed to form an isolating cushion between the car and car frame. Platform deflection shall be limited to maximum 3 mm under maximum normal operating conditions.

(c) The floor shall be recessed by 25 mm to enable PURCHASER to provide floor finish of their choice. The weight to be allowed for flooring shall be 500 kg for goods elevator.

(d) For servicing the car mechanical hatch to be provided as per design of Elevator manufacturer.

(e) Interior of elevators shall be with stainless steel hairline finish grade 304 as indicated in datasheets.

(f) Rear side of car shall be of stainless steel hairline finish Grade 304 with half mirror above the hand rail on the rear side, stainless steel hairline finish Grade 304 handrail shall be provided on one side.

(g) Inner surface of Car door & false ceiling shall be stainless steel hairline finish Grade 304. Louvers from side shall be provided in ceiling as per

PURCHASER"s requirements.

(h) Car Top Station - A car top operating station shall comprise of key operated switch and constant pressure up/down buttons which shall be provided on each Elevator. Car shall respond to up/down command at inspection speed. The elevator CONTRACTOR shall provide LED light fixture for car top station.

(i) A key operated switch shall be provided in the car operating station which, when actuated, shall allow operation from inside car buttons only.

(j) Roller guides of suitable design shall be provided for elevators to ensure safe operation.

(k) Car enclosure shall have integral microphone & calling devise along with necessary LED fixture of PURCHASER"s choice & Ventilation Fan. Car inside illumination shall be 100 Lux average at floor level.

(J) Doors

(a) Car Door

(i) Elevator entrance door shall be centre opening horizontal sliding type doors unless otherwise specified suitable for a clear opening as indicated in technical data sheet. Necessary supporting arrangement & groove shall be provided for holding the doors safely in its position.

(ii) The car entrances for Elevator s shall be protected by automatic power operated, centre opening electronic door detector.

(iii) Elevator entrance doors shall be rated at least for 2 hour fire rating.

(iv) Frames & doors shall be provided by Elevator CONTRACTOR. Frames shall be made up of minimum 2 mm thick & doors shall be sandwich construction and made up of minimum 1.6mm thick stainless steel.

(v) A soft chime shall ring prior to door closing & opening. Door opening time shall be adjustable to 1.5 second ± 1 second.

(vi) The doors shall open automatically while the car is levelling at the respective landing. The doors shall automatically close after a predetermined time interval has elapsed, but the momentary pressure of the “door open” button provided in the car shall reverse the motion and reopen the doors and reset the time interval unless overridden by the electronic door monitor.

(b) Car & Hoist way Door Protection

(i) Infrared light beams shall be provided to act as a safety curtain across the door entrance to monitor the door closing. Only the door at the landing where the car is stopping shall be opened.

(ii) Infrared matrix shall be for the full height of the door.

(iii) This device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing.

(iv) When beams are interrupted during initial door opening door shall remain open for minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, hold time will reduce to 1.0 -1.5 seconds and which shall be adjustable.

(v) The landing doors shall be of the weather proof type when lifts are used in outdoor locations.

(c) Car & Hoist way Door Operation

(i) The equipment shall be complete with electric door operator for opening and closing of Car & Hoist way landing door. The equipment shall consist of a motor on the elevator car to operate the door when the car is stopping at a landing. The car & hoist way doors shall be mechanically connected such that both move simultaneously for opening and closing.

(ii) The car doors & hoist way landing doors open automatically as the car is stopping at a landing. The closing of the car and landing door must occur before the car is set in motion

(iii) In normal condition, Car cannot move when the car or hoist-way door is open.

(iv) Provision of interlock shall be provided for each Elevator entrance to

ensure Elevator operation only when, all doors for that Elevator are secured and shall maintain the doors in their closed position while the Elevator is away from the landing.

(v) It shall not be possible to open the landing door from the landing unless the elevator car is within the particular landing zone

(vi) In the event of interruption of electric power or failure of the door operator, it shall not be possible to open the car door manually from within the car.

(vii) During emergencies, car and hoist-way doors shall be capable of being opened from outside.

(d) Door Hangers and Tracks

(i) The car and the landing doors shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be steel with moulded nylon collar and shall include shielded

ball bearings. Tracks shall be of suitable steel section with smooth surface. The landing doors shall be complete with headers, sills, frames etc. as required.

(e) Cabin Fan:

A Noiseless pressure fan or blower shall be provided in the Elevator cabin with supply grill matching with the interior of the car.

(f) Emergency Lights:

In addition to normal lighting an emergency light unit using sealed Nickel/Cadmium Maintenance free battery power pack with charger and LED lamp to operate automatically and to illuminate the car for minimum 30 minutes in case of power failure shall be provided in each Elevator Car.

(g) Operation Buttons and Indications:

The following operation buttons and indications shall be provided in each elevator/hoist way. The push buttons shall be micro movement, illuminated type. All the buttons shall be Braille compliant.

(h) In each Elevator Car:-

Faceplate shall be constructed of stainless steel, hairline finish Grade 304, flush mounted shall be provided on one side of the door having:-

(i) LED Illuminated push buttons of micro pressure type corresponding to the floors served.

(ii) Door open and door close button.

(iii) Emergency stop button.

(iv) Emergency alarm button connected to bell at ground floor.

(v) Two position key operated switch for „with attendant" and „without attendant" operation.

(vi) Ventilation fan ON/OFF switch with auto OFF when there is no call after 120 seconds.

(vii) Built in intercom of the hands free type as well as space for providing EPABX telephone instrument and 5 pair telephone trailing cable to communicate from car to Central Monitoring Station (at remote location) and vice-versa.

(viii) Dynamic car direction display

(ix) Car position indicator

(x) Audio/Visual overload warning indicator

(xi) Digital voice synthesizer for announcing special messages with background music shall be quoted.

(xii) Non-stop button (Only during attendant mode)

(xiii) For integration with PA system, additional cabling to be provided from Elevator car to the elevator control panel.

(xiv) LED Dot Matrix Display unit.

(xv) At Landings:

Terminal Landings: -

LED illuminated type up down push buttons with travel indication arrow in satin finish stainless steel facia plate.

Digital car position indicator with gong in stainless steel facia plate. Intermediate Landings:-

Two LED illuminated type up down push buttons with travel indication arrow in satin finish stainless steel facia plate.

Digital car position indicator with gong in stainless steel facia plate.

(i) Selection for call button for passenger car shall be as per Architect selection.

(j) All fixtures / Car Operating Panel form and finishes, etc. shall be subject to the Architect‟s and interior designer‟s approval.

(k) An emergency alarm bell including necessary wiring to be provided and connected to a properly marked push button in the car operating panel. The

alarm bell shall be located at the ground floor, at the floor landing outside and adjacent to hoist way OR as asked by PURCHASER. The alarm unit shall be solid-state siren type, operated by Nickel/Cadmium maintenance free batteries to give a siren when the alarm button in the car is pressed momentarily.

(l) Each elevators group shall be enabled for central monitoring panel with LED Dot Matrix screen to indicate position of all elevator cars working in a group. The central monitoring panel shall be integrated with the BMS.

(m) Counter Weight

The counter weight shall be made of cast iron and consist of structural steel frame which shall travel between rigid guides and also shall be capable of withstanding buffer impacts. Suitable metallic counter weight guard of required length shall be provided at the bottom of the hoist way.

(n) Hitches Plates:

Self aligning hitches plates of better roping shall be provided.

(o) Travelling Cables:

Fire proof compound coated travelling cable shall be used and shall conform to IS: 4289 - 1967 with latest amendment.

(p) Guide Rails Shoes:

To prevent car shaking automatic adjustable guide rails shoes should be used.

(q) Reverse Phase Relay:

Reverse phase relays should be provided on the controller which should be designed to protect the Elevator equipment against phase reversal and single phasing and phase failure.

(r) Safety Devices

All safety devices as per local codes/by laws/ statutory requirements and as required by Elevator Inspector, including but not restricted to the following shall be provided

Terminal and Final Limits:

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings, and final limit switches shall be

furnished to automatically cut off power should the car travel beyond the terminal landings.

Interlocking:

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open and also the elevator is overloaded.

Car Safety and Governor:

The car safety shall be provided to stop the car whenever excessive descending speed is attained.

(s) Automatic Rescue Device:

Each elevator shall be provided with an electronic state of art Emergency Battery Drive for automatically rescuing trapped passengers from the elevator during power failure. The rescue device shall automatically bring the elevator car to the nearest landing and open the door so that the trapped persons can walk out of the elevators. The elevators shall resume normal operation on restoration of power supply. For specific requirement please refer technical datasheets.

(t) Emergency Stop Switches:

An emergency stop switch for use by maintenance personal shall be provided in each elevator car.

- Self Levelling:

The elevators shall be provided with self levelling features of ±3mm accuracy.

Levelling device shall be with two way automatic.

(v) Over Load

Elevators shall be fitted with the load weighing feature to illuminate “Over-Load” and defeat the car"s operating circuits when car load reaches 110% or more of rated load.

(w) Elevator shall be capable of operations for the voltage & frequency variation limits as specified above.

(x) Fire Rescue Elevator with fireman switch & automatic retrieval system :

The Elevator shall be operated as fire rescue Elevator.

The Elevator shall have a Fireman switch with glass for access by the Fireman. The operation of this switch shall cancel all calls to this elevator and will stop at the next nearest landing if travelling upwards. The doors will not open at this landing and the elevator will return to the ground floor. In case the elevator is travelling downwards when the fireman‟s switch is operated it will go straight to the ground floor bypassing all calls within route. The emergency stop button inside the car shall be rendered inoperative.

The elevator shall be equipped with automatic elevator retrieval system which shall, upon signal from the central fire alarm system or manually operated key switch, cause all elevators to be dispatched automatically to the ground floor. Elevators shall, open their doors and remain at the ground floor. All floor and car buttons shall be rendered ineffective until the system is manually reset.

The fire Elevator shall be provided with ceiling hatch for use in case of emergency, so that when the car gets stuck up, it shall be easily openable for people to escape.

(K) Earthing

Earthing provisions for all the devices/components & accessories shall be provided by Elevator CONTRACTOR as per relevant standards.

CONTRACTOR will make necessary arrangement for the Earthing electrodes as per standard requirements. Earth strip connection from external earth electrode/earthing system up to the single termination point of Elevator system will be provided by Electrical CONTRACTOR.

(a) Name plate with Serial number of Lift, Year of manufacturing, Capacity etc. as per statutory requirements shall be fitted in car.

(b) A nameplate indicating TAG number shall be provided on control panel, socket, motor, lighting fixture and junction box. Nameplate shall be fixed by screws and shall not be pasted. In case the standard details given above are embossed on the enclosure; the same need not be repeated on the name plate.

(c) Necessary cabling up to Elevator Panel and termination shall be done to integrate with FDAS system.

(d) Minor Civil works such as; making chase, holes, drilling in concrete, sealings, and support structures shall be included in CONTRACTOR‟s scope.

(e) Clear hoist way and pit as required by the elevator vendor, including any civil work within the hoist way required for the machinery will be provided CONTRACTOR in accordance with necessary structural arrangements for installation & operations of the elevators.

(f) Providing all the required machinery, scaffoldings, structural beams, safety equipments etc. required for elevator installation & removal of the same after completion of installation shall be in elevator CONTRACTOR‟s scope.

(g) All the necessary supporting brackets, guide rails etc. required for elevator installation shall be in elevator CONTRACTOR‟s scope.

(h) Entire installation shall conform to the requirements of the lift Inspector and it will be the sole responsibility of CONTRACTOR to obtain approval of the layouts and equipment.

(i) Special tools which will be required for operation and maintenance of the lift shall be supplied to the PURCHASER. The cost for the same shall be considered in commercial offer and mentioned specifically.

(j) The elevator components & accessories such as guide rails, sheaves, elevator & governor ropes etc. shall in general be complying to requirements specified

(k) The CONTRACTOR is responsible for the complete installation and performance of the works within the confines of the Elevator shaft, pit, Elevator cab enclosure and Machine Room.

(l) The CONTRACTOR shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The CONTRACTOR shall appoint one erection engineer and one senior supervisor posted at site on full time basis

(m) For quality control and monitoring of workmanship, CONTRACTOR shall assign at least one full time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

(n) Obtaining all statutory approvals, Elevator operation Licence from local authority as per codes & regulations shall be included CONTRACTOR‟s scope of work.

(o) Erection of equipment shall be carried out without causing any hindrance to the work of other CONTRACTORs.

(p) Bidder to note that, all the necessary accessories for successful supply, installation, testing, commissioning of elevators, whether specifically mentioned in tender or not shall be deemed to be included in Bidder scope.

(L) INSPECTION AND TESTING

(a) PURCHASER/PMC/Consultant shall inspect the lifts at successful bidder"s works. CONTRACTOR shall inform regarding inspection schedule 2 weeks in advance. All type test certificates shall be provided along with the BID and internal test certificates shall be furnished at the time of inspection.

(b) Apart from tests/inspection points agreed in QAP following shall be checked during/post installation of elevators.

(i) Visual inspection for all the components

(ii) Depth of Pit & whether ladder is provided

(iii) Arrangement of lighting in the elevator shaft

(iv) Operational / functional tests for all the inside car, outside car, lobby operated, hoist way machine, COP components & accessories.

(v) Earthing of equipment & connection to main grid

(vi) Pre commissioning Tests

(vii) IR / PI Value of motor & cables

(viii) External cabling & termination of power & control system

(ix) Test for rated power against actual power consumption under full load

(x) Sound level checks

(xi) Safety device & interlock operational checks.

(xii) Controller checks

(xiii) Monitoring at Central monitoring Panel

(c) A contract load test under the supervision of the Local Authority and in the presence of Owner/Engineer shall be carried out before lift is put in regular service. During the test, the breaks, limit switches, buffers, car safety devices shall be caused to function with the contract load in the lift and the operation of various safety devices.

(d) The levelling gear shall be tested on-load and off-load with enclosure of car levelling within limits.

(e) The lifts shall be tested for contract speed with the full contract load.

(f) Any other tests which are required as per I.S. standards and to ensure that the lift equipment complies with the specifications and will give satisfactory operation during service.

(g) Test certificates of bought out components shall be submitted to the Engineer / Owner before dispatch of item.

(h) The Elevator CONTRACTOR shall guarantee the smooth and noiseless performance of the elevators System as per IS-14665 (part 2 \ section 1 &2)

(i) Erection completion certificate to Owner.

(M) DRAWINGS & DOCUMENTS

(a) General arrangement drawing along with, detailed technical data sheets & offered interior finish, component & accessory details shall be provided along with the bid document.

(b) Post award of contract following needs to be provided by elevator CONTRACTOR for PURCHASER/Consultant‟s approval –

(i) Technical Datasheets for Elevators.

(ii) Elevator shaft layout plans & sectional details.

(iii) Structural details, support arrangement in the shaft.

(iv) Lighting & power requirement at elevator shaft.

(v) Car interior detail.

(vi) Wall elevations in lobby & floor lobbies

(vii) GA drawing for Control Panel

(viii) Wiring diagram & schematic diagrams of control panels.

(ix) As Built Drawings & Documents.

(x) Operation & Maintenance Manuals

(N) MAINTENANCE REQUIREMENTS

(a) CONTRACTOR shall arrange for maintenance tools including special tools, if required, for attending to the equipment supplied by them at no extra cost.

(b) CONTRACTOR shall include supply of start-up and essential spares required during maintenance period. CONTRACTOR shall furnish detailed inter-panel wiring diagrams, terminal connection wiring diagram, and detailed component layout drawings to enable maintenance work.

(O) STATUTOARY APPROVALS

(a) The CONTRACTOR shall be responsible for getting approval from Lift inspector/local authorities for the Elevator & electrical installation included in CONTRACTOR"s scope of work.

(b) It shall be full responsibility of the CONTRACTOR to carry out all the necessary documentation, drawings etc. required for obtaining approval from lift inspector.

(c) PURCHASER will pay for statutory fees on production of the duly signed/stamped receipt by Elevator CONTRACTOR.

(P) DATA SHEET:

The Elevator shall have the following minimum features as listed below:

Sl. No.	Item	Specification
1	Type Of Lift	Goods lift.
2	Load / Speed	As per requirement 800 kg (min) /1.00 mtr. per second
3	Drive	Micro processor based VVVF
4	Travel / PIT / Headroom	As per site
5	Number Of Floors	2 (Ground + 1 upper floor only) as per skywalk
6	Floor Display	0,1
7	Number Of Landing Entrances	2 (Ground + 1 upper floor only)
8	Number and Position of Car Entrances	1 (one), in front only

9	Position Of Machinery	Machine room less - gearless
10	Size of Lift Well	As per Layout
11	Lift Car Inside Size	As per design
12	Clear opening of Gates / Doors / Lintel	As per design
13	Type or Design of Lift Car	
14	Car Ceiling Car Floor	Stainless steel (1.5 mm) - SS PVC - Black
15	Car Fittings	LED lights & regular (circular) - fan
16	Type Of Car Front Entrance Protection	Power Operated Centre Opening Sliding Door - Stainless Steel (1.5 mm)
17	Land Entrance Protection (0,1)	Centre Opening Sliding Door - Stainless Steel (1.5 mm) -
18	Landing Door Frame (0,1)	Stainless Steel (1.5 mm) -
19	Finish for ceiling, door, frame, entrance	Hairline Finish
20	Type Of Control System	Microprocessor based simplex selective

		collective control with / without attendant
21	Electric Supply	AC 400/440 volts, 3 phase, 50 cycles
22	Motor power	As per design
23	Intercom Type	2-station intercom
24	Safety Features	AutomaticRescue device, Battery Operated Emergency Light And Alarm Bell, Fireman's Drive & switch, Lift announcement System, Load Weighing Device with Overload Warning Indicator, Vandal Proof S.S. Button With S.S. Cover, Infra Red Door Screen, Floor Annunciator With Music, Full Car Operating Panel – handicap friendly (Braille), 3 Way Intercom, Dot Matrix Led Indicators In Car & Landings, Auto Light & Fan Switch Off.

6.5 ESCALATOR

6.5.1 SCOPE

(A) This specification covers the general requirements for traffic study, design, detailed engineering, preparation of construction drawing, manufacture, acceptance testing at manufacturer"s works, supply, packing, forwarding and delivery from place of storage/ manufacturer"s works to erection site including transit insurance, unloading, storage at site, assembly, erection, testing, installation, commissioning and performance demonstration of Escalators complete with all devices; power and control panels and civil construction of structural shaft as are necessary to complete the installation of Escalators in accordance with this specification to be installed for Access points of Skywalk.

(B) It is the sole responsibility of the CONTRACTOR to obtain necessary approvals and obtaining licenses from the local authorities concerned for the installation and operation of the Elevator system, without any additional cost. The CONTRACTOR

has to comply with all the points/modification if suggested by Elevator inspecting authority without any extra cost.

(C) CONTRACTOR has to submit the datasheets/ specifications make, model no. / type & other technical details with bids. Before finalization of the make model no., capacity etc. CONTRACTOR has to take prior approval from PURCHASER / consultant.

(D) With the escalator the Vendor shall supply a maintenance tool kit which shall be kept in machine room.

6.5.2 CODES AND STANDARDS

(A) The equipment shall fully comply with the requirements of latest editions of enclosed specifications and the latest editions of codes and standards.

(B) The escalator confirms to IS 4591 and EN 115 standard.

(C) In addition to above, Escalator covered by this specification shall be provided, installed, tested, commissioned, certified and approved as per statutory requirements of the Local Escalator Inspectorate.

(D) The Escalator installations shall also be governed by the following Acts/Bye-laws/Codes as amended up to date in addition to the codes specified in the tender. Escalator installation shall be in conformity with:

(a) National Building Code of India - 2016

(b) Indian Electricity Act - 1910

(c) Local Lift and Escalator Act

(d) Building Bye-Laws

(e) Local Fire Prevention and Fire Safety Rule

(f) Central Electricity Authority Regulations – 2010

(E) In the event of any conflict between the codes and standards referred to elsewhere in the specification and the requirement of this specification, the stringent requirement shall govern.

6.5.3 DESIGN FEATURES

(A) The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered

(B) Design

(a) The load profile and detailed traffic analysis shall be done by the CONTRACTOR for selection of the escalator also considering the location, physical requirements, maximum step load, average level of use, minimum safety factor, step width, nominal speed, inclination, travel height, operation mode and type of balustrade as specified in the data sheet provided in this specification and also the safety consideration mentioneds.

(C) Clearance

(a) Adequate clearances between handrail and adjacent surfaces/vertical walls shall be maintained as recommended by the OEM. OEM shall communicate the same during the start of the project and also shall check the escalator drawings.

(b) Head room clearance shall be maintained as per the recommendations from OEM.

(D) Drive

(a) The drive/gear shall have motor suitable for AC Variable Voltage Variable Frequency (VVVF). The motor shall be designed for escalator service and have efficiency class of IE 2 as per IEC 60034.

(b) The motor duty shall be designed in such a way that the min duty shall be 16hrs/day.

(c) The motor shall be reversible type particularly designed for escalator service with recommended starting torque and low starting current. The starting current shall be 1.2 to 1.5 times the rated current. Motor & Drive shall be suitable for 150 starts per hour.

(d) A drive shall not be used for driving more than one escalator.

(f) The driving machine shall be connected to main drive shaft by non- frictional elements such as gear wheels to avoid frictional losses. Safety factors for all driving elements shall be at least 5 for static calculations.

(g) The escalators should not run when there are no passengers to move. The escalator shall be stopped automatically after a sufficient time (at least the anticipated passenger transfer time plus 10 seconds) the passenger has actuated the automatic starting device.

(h) Escalators which start automatically by the passing of a user shall start to move before the person walking reaches the comb intersection line. This can, for instance, be accomplished by light-rays or contact mat.

(E) Energy Efficiency and Sustainability

(a) The escalators should not run when there are no passengers to move. In this stop mode, only the control system and the passenger detection system are kept running.

(b) Another option is to reduce the speed to match the passenger demand, thus reducing energy consumption by the use of variable voltage variable frequency (VVVF) drives, which provide very smooth, almost imperceptible speed transitions.

(c) LED lamps shall be used for all lighting of escalators.

(d) The total power factor of the drive shall be improved for better energy efficiency.

(e) The driving machine shall be connected to main drive shaft by non- frictional elements to avoid frictional losses.

(f) The motor shall have efficiency class of IE 2 as per IEC 60034.

(g) The escalator shall have components which are environment friendly.

(h) The escalator installation shall not inject undesirable waveforms into the electric supply & distribution system. The THD produced by the escalator shall not exceed the maximum allowable values as per IEEE. The THD shall be measured when the escalator is operating at no load at its rated speed.

(F) Brake

(a) The braking system shall bring escalator to rest with uniform deceleration and shall keep it stationary, there shall be no intentional delay in application of breaking system.

(b) There shall be an operational electromechanical/electromagenetic braking system and also an auxiliary braking system

(G) Balustrade

(a) The parts of the balustrade facing the steps shall be smooth. Covers or strips not in the direction of travel shall not project more than 3 mm.

(b) Cover joints in the direction of travel (in particular between the skirting and balustrade interior panelling) shall be arranged and formed in such a manner to eliminate the risk of injury caused by trapping.

(c) Gap between interior panels of the balustrade shall not be wider than 4 mm. The edges shall be rounded off or bevelled. The balustrade interior panelling shall have adequate mechanical strength and rigidity.

(H) Skirting

(a) The skirting shall be vertical, plain and sufficiently rigid. Where the skirting of escalators or moving walks is placed beside the steps and pallets or the belt

the horizontal clearance shall not exceed 4 mm at either side, or 7 mm for the sum of clearances measured at both sides at two directly opposite points.

(b) Where the skirting of moving walks finishes above the pallets or the belt, the clearance shall not exceed 4 mm measured vertically from the tread surface.

(c) Skirt Deflectors shall be designed with rounded edges. Fastening heads and joint connections shall not extend into the path of travel. They shall consist of a rigid and a flexible part (for example, brushes and rubber profiles). They shall have a minimum projection of 33 mm and a maximum of 50 mm from the vertical face of the skirt panels. The terminal end piece shall be tapered to give a flush interface with the skirting. The terminal end piece of any deflector device shall end not less than 50 mm and maximum 150 mm prior to the comb intersection line.

(I) Handrails

(a) Each balustrade shall be provided with a handrail moving, on the top of each balustrade, in the same direction and at the same speed.

(b) The handrails shall be constructed of multi-layered canvas with the exposed surface covered with smooth black abrasion resistant rubber which shall be vulcanised into an endless loop.

(c) Each moving handrail shall extend at normal handrail height not less than 300 mm beyond the line of point of comb plate teeth at the upper and lower landings. Hand or finger guards shall be provided at the points where handrails enter the balustrade.

(J) Landing

(a) The landing area (that is, comb plate and floor plate) of escalator shall have a surface that provides a secure foot hold for a minimum distance of 0.85 m measured from the root of the comb teeth.

(b) The landing plate shall be removable removal type and shall give access to the mechanism for maintenance purpose.

(c) At the upper and lower landing, the steps of the escalator shall be guided in such a way that the front edges of the steps leaving the comb and the rear edges of the steps entering the comb are moving horizontally for a length of at least 0.80 m from comb.

(K) Comb Plate

(a) Comb plate shall be provided at the top and bottom landing /entrance and exit of every escalator and shall be wear resistant aluminium alloy with anti-slip pattern.

(b) The comb plate teeth shall be meshed with and set into the tread surface so that the points of the teeth are always below the upper surface of the treads. The comb plates shall be adjustable horizontally and vertically.

(c) Combs shall be readily removable in case of emergency. Combs shall be easily replaceable.

(L) Notices Near Entrances Of Escalator

The following notices for the user shall be fixed in the vicinity

(a) Small children must be held firmly.

(b) Pets must be carried.

(c) Stand facing the direction of travel; keep feet away from sides.
(d) Hold the handrail.

(e) Transportation of bulky and heavy loads not permitted.

(f) Push chairs/ Shopping Trolleys/ baggage Carts not permitted.

(g) Wheel Chair users not permitted. (Direction to nearest elevator shall be provided).

Whenever possible, these notices shall be given in the form of pictographs.

The minimum size of the pictographs shall be 80 x 80 mm.

(M) Control Station

Position

(a) Control station shall be provided at both the upper and lower landing newel, which shall contain an emergency stop switch, two key operated direction switches, an audio alarm switch and if specified a foot light switch. The station shall be so positioned as to enable any person operating any of the switches to afford a full view of the escalator.

Type of switch

(b) The emergency stop switch shall be push button type with a red button and shall be suitably protected against accidental operation. But the up and down directional starting switch shall be of the key-operated spring off type.

(N) Operating and Safety Devices

(a) Starting Switch

Starting switches shall be of the key-operated type and shall be located within sight of the escalator steps. The starting switch shall be key operated or shall be enclosed in a box provided with a lock and key.

(b) Speed Governor

Speed governor shall be provided which shall operate if the speed of the escalator exceeds 1.2 times the nominal speed. This requirement may not be applied if the design prevents the excessive speed or where a low slip AC squirrel cage induction motor is used and the motor is directly connected to the driving machine.

Escalators and inclined (a > 6°) moving walks shall be equipped in such a way that they stop automatically by the time the steps and pallets or the belt change from the pre-set direction of travel.

(c) Emergency stopping devices

Emergency stop devices shall be placed in conspicuous and easily accessible positions at or near to landings of the escalator.

The Emergency stop shall be mushroom head type red coloured conspicuously marked “STOP SWITCH” and shall be press to lock and key to release type. The E-stop button shall be protected against accidental operation or shall be provided in an unlockable cover which shall be lifted or pushed aside.

For escalators with rise above 12 m, and for passenger conveyors with a length of the treadway of more than 40m, additional emergency stopping devices shall be installed.

(d) Broken step chain device

The broken chain safety device shall be incorporated if there is no separate automatic chain tension monitoring device. It shall operate if the bottom sprocket moves unduly in either direction in the event of either both step chains breaking or becoming unduly lengthened due to wear of the pins, or tension in either chain sagging below a pre-determined value.

If any part of the step is sagging so that meshing of the combs is no longer ensured, the device shall be operated at a sufficient distance before the comb intersection line to ensure that the step which has sagged does not reach the comb intersection line. The control device can be applied at any point of the step.

(e) Broken drive chain device

Where the driving machine is connected to the main drive shaft by a chain, broken chain device shall be provided. The device shall operate for breakage of the chain between the driving machine and the escalator main drive shaft. Auxiliary brake if provided shall also operate.

(f) Broken handrail device

Broken handrail devices shall be situated inside both balustrades at the lower end of the incline, which shall be actuated if either or both handrails break.

(g) Non-reverse device

A non-reversing device shall be arranged to prevent a travelling escalator to slow unduly or attempts to reverse its direction of travel. The escalator shall be stopped once the device is operated and it shall only be started again by the key operated switch.

(h) Operation of the Safety Device

The operation of any one of these safety devices shall cause the electrical supply to the driving motor to be disconnected and the electro-mechanical brake to be operated thus bringing the escalator to rest.

(O) Lighting

(a) Lighting of machine room shall be provided with atleast one light point with LED light fixture and one 16A plug socket with RCCB. The light switch shall be located at entry so that it can be operated without passing over or reaching any part of machinery.

(b) Step threads shall be illuminated throughout their run. The light intensity on the tread surfaces shall not be less than 50 lux. The lights shall be LED type only

(P) Electrical Wiring

(a) Unless specified otherwise, the escalators shall be suitable for 415V and lighting shall be suitable for 240V supply with other parameters as per data sheet provided in this specification.

(b) All electrical wiring and apparatus in connection with the escalator installation, shall conform to the Indian Electricity Rules and to the relevant Indian Standard and also to other regulations, if any, relating to fire insurance of the building in which the escalator is installed

(c) All cables and other wiring and other accessories of escalator installation shall confirm to the relevant Indian Standard for the voltage at which these are intended to be worked.

(d) Electrical conductors shall be encased in rigid conduits, electrical tubings or wireways which shall be securely fastened to the supporting structure.

(e) All electric supply lines and apparatus in the escalator shall be of suitable construction and shall be so installed, protected, worked and maintained that there is no danger to persons from them.

(Q) Earthing

(a) All metal casings or metallic coverings containing or protecting any electric supply line or apparatus shall be efficiently connected with earth.

(b) Earthing provisions for all the devices/components & accessories shall be provided by Escalator CONTRACTOR as per relevant standards.

(c) CONTRACTOR will make necessary arrangement for the Earthing electrodes as per standard requirements. Earth strip connection from external earth electrode/earthing system up to the single termination point of Escalator system will be provided by Electrical CONTRACTOR.

(R) Specific scope and requirements

(a) Name plate with Serial number of Escalator, mode no., Year of manufacturing, and Capacity etc. as per statutory requirements shall be fitted in Escalator.

(b) A nameplate indicating TAG number shall be provided on control panel, socket, motor, lighting fixture and junction box. Nameplate shall be fixed by screws and shall not be pasted. In case the standard details given above are embossed on the enclosure; the same need not be repeated on the name plate.

(c) Minor Civil works such as; making chase, holes, drilling in concrete, sealings, and support structures shall be included in CONTRACTOR‟s scope.

(d) Any civil work shall be done by CONTRACTOR in accordance with necessary structural arrangements for installation & operations of the escalator.

(e) Providing all the required machinery, scaffoldings, structural beams, safety equipments etc. required for escalator installation & removal of the same after completion of installation shall be in elevator CONTRACTOR‟s scope.

(f) All the necessary supporting brackets, guide rails etc. required for escalator installation shall be in escalator CONTRACTOR‟s scope.

(g) Entire installation shall conform to the requirements of the escalator Inspector and it will be the sole responsibility of CONTRACTOR to obtain approval of the layouts and equipment.

(h) Special tools which will be required for operation and maintenance of the escalator shall be supplied to the PURCHASER. The cost for the same shall be considered in commercial offer and mentioned specifically.

(i) The CONTRACTOR is responsible for the complete installation and performance of the works within the confines of the Elevator shaft, pit, Elevator cab enclosure and Machine Room.

(j) The CONTRACTOR shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The CONTRACTOR shall appoint one erection engineer and one senior supervisor posted at site on full time basis

(k) For quality control and monitoring of workmanship, CONTRACTOR shall assign at least one full time engineer who would be exclusively responsible for

ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

(l) Obtaining all statutory approvals, Escalator operation Licence from local authority as per codes & regulations shall be included CONTRACTOR‟s scope of work.

(m) Erection of equipment shall be carried out without causing any hindrance to the work of other CONTRACTORs.

(n) Bidder to note that, all the necessary accessories for successful supply, installation, testing, commissioning of escalators, whether specifically mentioned in tender or not shall be deemed to be included in Bidder scope.

(S) INSPECTION AND TESTING

(a) Each type and size of escalator shall be tested for the rated load that it is designed to carry. Such tests may be made, at the option of the manufacturer, in his plant or in the field on the first escalator of that type and size installed in a building.

(b) PURCHASER/PMC/Consultant shall inspect the escalator at successful bidder‟s works. CONTRACTOR shall inform regarding inspection schedule 2 weeks in advance. All type test certificates shall be provided along with the BID and internal test certificates shall be furnished at the time of inspection.

(c) Where a type and size of escalator has previously been tested and approved in one jurisdiction, certified copies of such test may be accepted in lieu of an actual test at the option of the enforcing authority.

(d) If the rise for a given type and width to be installed is more than 1.5 metres higher than the rise for which that type and width has been tested, a new type test shall be made for the higher rise.

(e) Electrical insulation resistance test shall be performed.

(f) Test shall be performed on drive and motor as per relevant standards.

(g) Escalator operating and safety devices required shall be tested with no-load on the escalator in accordance with the following:

Functional tests shall be done on the following safety devices by operating it by hand for starting switch, speed governor, Emergency stopping devices, Broken step chain device, Broken drive chain device, Broken handrail device, Non-reverse device

(h) In addition to above, Typical Escalator site checklist/ Inspection list of NBC-2016(Annex-A, clause 14.5) and Typical Check List for Functional Tests on Safety Switches and Devices (Annex-B, clause 14.6.4) shall be followed.

(i) Apart from tests/inspection points agreed in QAP following shall be checked during/post installation of elevators.

(i) Visual inspection for all the components

(ii) Arrangement of lighting

(iii) Operational / functional tests for all components & accessories.

(iv) Earthing of equipment & connection to main grid

(v) Pre commissioning Tests

(vi) IR / PI Value of motor & cables

(vii) External cabling & termination of power & control system
(viii) Test for rated power against actual power consumption under full load

(ix) Sound level checks

(x) Safety device & interlock operational checks.

(xi) Controller checks

(xii) Monitoring at Central monitoring Panel

(j) A contract load test under the supervision of the Local Authority and in the presence of Owner/Engineer shall be carried out before escalator is put in regular service. During the test, the brakes, limit switches, buffers, car safety devices shall be caused to function with the contract load in the lift and the operation of various safety devices.

(k) The escalators shall be tested for contract speed with the full contract load.

(l) Any other tests which are required as per I.S. standards and to ensure that the lift equipment complies with the specifications and will give satisfactory operation during service.

(m) Test certificates of bought out components shall be submitted to the Engineer / Owner before dispatch of item.

(n) The following documents shall be provided by the manufacturer:

(i) Stress analysis of the truss or equivalent certificate by a competent person;

(ii) Proof by calculation of sufficient breakage resistance of the parts directly driving the steps, pallets or the belt, for example, step chains, racks;

(iii) Calculation of the stopping distances for loaded moving walks together with adjustment data;

(iv) Test certificate for steps or pallets;

(v) Test certificate for the breaking strength of the belt;

(vi) Test certificate sliding coefficients for skirting;

(vii) Test certificate for anti-slip properties of tread surfaces (steps, pallets, floor and comb plates without combs);

(viii) Test certificate for stopping distances and deceleration values; and

(ix) Test certificate for handrail breaking strength (for public service escalators and public service passenger moving walks).

(o) The Escalator CONTRACTOR shall guarantee the smooth and noiseless performance of the elevators System as per IS-4591 and National Building Code, 2016.

(p) Erection completion certificate to Owner.

(T) DRAWINGS & DOCUMENTS

(b) General arrangement drawing along with, detailed technical data sheets & offered interior finish, component & accessory details shall be provided along with the bid document.

(c) Post award of contract following needs to be provided by elevator

CONTRACTOR for PURCHASER/Consultant"s approval –

(i) Technical Datasheets for Escalator.

(ii) Escalator layout plans & sectional details.
(iii) Structural details, support arrangement.

(iv) Lighting & power requirement.

(v) GA drawing for Control Panel

(vi) Wiring diagram & schematic diagrams of control panels.

(vii) As Built Drawings & Documents.

(viii) Operation & Maintenance Manuals

(U) MAINTENANCE REQUIREMENTS

(a) CONTRACTOR shall arrange for maintenance tools including special tools, if required, for attending to the equipment supplied by them at no extra cost.

(b) CONTRACTOR shall include supply of start-up and essential spares required during maintenance period. CONTRACTOR shall furnish detailed inter-panel wiring diagrams, terminal connection wiring diagram, and detailed component layout drawings to enable maintenance work.

(V) STATUTOARY APPROVALS

(a) The CONTRACTOR shall be responsible for getting approval from Escalator inspector/local authorities for the Escalator & electrical installation included in

CONTRACTOR"s scope of work.

(b) It shall be full responsibility of the CONTRACTOR to carry out all the necessary documentation, drawings etc. required for obtaining approval from lift inspector.

(c) PURCHASER will pay for statutory fees on production of the duly signed/stamped receipt by Escalator CONTRACTOR.

(W) DATA SHEET:

The Escalator shall have the following minimum features as listed below:

Sl. No.	Item	Specification
1	Standards	EN 115, NBC- 2016, As per latest standards

2	Step width (mm)	1000 mm
3	Horizontal steps	Two
4	Vertical rise = h	5000 mm
5	Horizontal span = l	12017 mm
6	Inclination	30-35 degree
7	Speed	0.50 m/s
8	Gear box	Worm gear
9	Motor IP	IP55
10	Starting	VVVF Drive
11	Lighting voltage	240V
12	Frequency	50Hz
13	Power voltage	415V
14	Arrangement	Single
15	Motor power	*kW (As per requirement), IP 55.
16	Deflection of truss:	1/750*L
17	Installation	Indoor
18	Balustrade Profile	Hairline Stainless steel

Sl. No.	Item	Specification
19	Balustrade Panel	12 mm thick, shock resistant stainless steel sandwich panels as they may be susceptible to vandalism.
20	Balustrade Height	1000mm as per design
21	Balustrade material	10mm thick tempered glass
22	Handrail material	Rubber type with cotton sliding
23	Skirting, Inner & Outer Decking,	Hairline Stainless Steel
24	Step & Step Demarcation	Hairline Stainless Steel/ Die cast Aluminium & Yellow demarcation
25	Landing Plate Panel	Etched stainless steel in a single piece for entire landing and thickness shall be designed as per the same. 2 or 3 plates at landing shall not be accepted for safety concerns.
26	Combs	Die Cast Aluminium
27	Duty Cycle	Min 20 Hours/day or as per traffic analysis.
28	Step Chain	Insider Roller Chains
29	Operational Environment	Semi Outdoor

30	Operation Panel	Key switch Up/down & E-stop at both ends
31	Drive	Preferable direct drive
32	Gear & Brake	Worn gear & service brake
33	Controller	Microprocessor with IP 54
34	Track System	As per design
35	Safety Features	The following safety devices/features shall be provided as per model: Broken drive-chain contact, Skirting contact, Handrail entrance contact, Broken step-chain contact, Step sag contact, missing step device, Phase monitor, Zinc steel flying wheel cover, Motor overload and thermal protection contact, Comb contact, Step gap illumination, Maintenance locking device, Alarm buzzer, Motor speed & anti-reversal monitor, Step anti-static brush, Stop button, Step reversing fences, Handrail anti-static roller, Service brake release contact, Landing plate switch/floor plate safety device, Skirting brush, Step anti-up thrust device, Led comb lighting, Auto lubrication system, LED traffic light, Outside truss cladding, Auto-start, Fiber optic skirt monitoring, fall protection barrier
36	Operational Mode	Auto Start

6.6 EARTHING & LIGHTNING PROTECTION SYSTEM:

6.6.1 Scope:

The scope includes collection of data, design of the system as per relevant National/International Standards preparation of layout drawing supply of earthing conductors, earth electrode, earthing strips installation and approval to the satisfaction of electrical inspector under this tender specification.

Earthing system shall be provided to ensure equipment safety, personnel safety and facilitate designed operation of protective switching during earth fault conditions in the associated system.

6.6.2 Codes and Standards:

The general design shall be on the basis of following codes and standards (their latest amendments) in line with design criteria & specification requirements.

i. IS 3043-1987 – Re-affirmed in 2006: Code of practice for Safety Earthing

ii. IS / IEC 62305: Protection against lightning.

iii. IEEE 80 – 2000: IEEE Guide for Safety in Sub-station Earthing.

iv. Central Electricity Authority (CEA) Regulations – 2010

v. IEEE 1100- Electronic earthing.

vi. IEEE – 142: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

6.6.3 The maximum values of earth fault current for the design of the earthing system will be considered based on system requirement as follows:

i. 11 kV or 33 kV systems : 25 kA for 1 sec

ii. 415 V systems : 18.4kA for 1 sec

6.6.4 EARTHING CONDUCTOR LAYOUT

(A) The design basis for designing earthing conductor is indicated under design criteria for electrical system. Earthing system shall be provided for complete Skywalk, electrical room and all electrical equipments as per the latest edition including all official amendments and revisions of IS-3043 and CEA guidelines.

(B) All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be approved by the Engineer's representative & CEIG.

(C) CONTRACTOR has to carry out soil resistivity test at, at least 4 locations for which locations shall be provided by PURCHASER"s representative. Testing to be done at each site.

(D) Soil resistivity shall be carried out by Wenner four electrode method as described in IS 3043. CONTRACTOR has to carry out the test in presence of PURCHASER"s representative & test shall be carried out keeping electrode spacing as 1, 2, 4, 6, 8, 10, 15, 25 M (each, along all 8 directions) as per normal practice and report has to be submitted. Polar curves shall be used for measurement of mean soil resistivity, which shall be used in finding earthing resistance at a particular location. Mean soil resistivity values/ the results/ report shall be certified by Govt. Authorised Labs or agencies.

(E) The CONTRACTOR shall base his earthing calculations on actual measurement carried out as explained above.

(F) Galvanized Iron flat / wire shall be used as earthing conductor. Copper flat / wire shall be used if specifically mentioned.

(G) The underground joints in the system shall be properly welded or brazed and the bolted type connection shall be made with structures/ equipments. Welded and Bolted joints shall be covered with bituminous compound/ tapes as suitable. Welding shall be done as per IS 816.

(H) Earthing conductor shall be protected against mechanical damages considering the installation conditions.

(I) The earthing system shall comprise of earth electrodes, earthing grid or a combination of these in order to obtain the required earth electrode resistance of less than 1 Ohm.

(J) For equipment earthing, two earthing leads will be used if rated voltage of the equipment is 250 Volts & above and one earthing lead will be provided for equipment rated below 250 Volts.

(K) The earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm below FGL.

(L) Earth electrodes shall be of heavy duty galvanized mild steel of not less than 40 mm NB and minimum 3000 mm long. Where multiple rods are used they shall be separated by a distance of not less than 2000mm.

(M) Each earth electrode pipe shall be welded at the top to a mild steel plate to which the earthing strips shall be connected. These connections shall each be housed in individual inspection chamber set which shall project 100 mm above the finished ground level and shall allow disconnection for testing of individual electrodes. The chamber shall be permanently marked `Electrical Earth'.

(N) All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by CEIG.

(O) All civil works, such as excavation, boring, provision of charcoal & salt in adequate quantity, backfilling for the installation of the earth electrodes and the earth pit/ inspection pit shall be in the scope of CONTRACTOR.

(P) After the earth installation has been completed the CONTRACTOR shall demonstrate to the PURCHASER/ PURCHASER"s Representative that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes and test instruments required for the tests shall be provided by the CONTRACTOR.

(Q) Main equi-potential bonding conductors shall be provided to connect the earth electrode system to conductive parts forming the Works.

(R) An independent circuit protective conductor shall be provided for each circuit and may comprise one or any of the following as appropriate:

(a) A separate core within a multicore cable

(b) A separate conductor installed within a conduit or trunking. Steel conduit or trunking shall not be used as a circuit protective conductor.

(c) The metal sheath of an armoured cable. The sheath shall be bonded to the metal work of the apparatus and to the apparatus earth bar, if any.

(d) The copper sheath of a mineral insulated copper sheathed cable

(e) An independent earthing conductor MS or GS run adjacent to the circuit it protects.

(S) The size of the circuit protective conductor shall be calculated in such a manner as not to take into consideration the contribution of any other parallel or fortuitous earth paths.

(T) The armour of the supply cable shall not form the sole means of earthing a switchboard or distribution panel.

6.6.5 Instrumentation Earth:

An instrumentation earth bus shall be provided in each control panel. This shall comprise a GI flat of cross section not less than 25 x 6 mm and length to suit the number of connections. It shall be mounted on at least two insulated supports and be provided with a single earth connection to the control panel electrical power earth.

If due to the physical size of a control panel more than one instrument earth bar is required the additional bar shall be connected again with a single earth connection to the same point as before on the control panel electrical earth bar. In this fashion all instrument earths shall be connected radialy from the same earth point.

All signal cable screens (analogue and digital) shall be terminated on to the instrument earth bar. Signal cable screens shall be earthed at the control panel end only. Screens at the field end shall be tied back and insulated.

Surge Protector Devices (SPDs) associated with the control and instrumentation system shall be earthed to the instrument earth in accordance with the SPD manufacturer‟s recommendations.

6.6.6 Important Instructions for Earthing:

(a) All the earthing material with laying etc. shall be included in the scope.

(b) The entire Skywalk will have an earth grid laid in trenches/ trays/ buried in the ground outside. The main earthing grid shall be embedded at a minimum depth of 600 mm below FGL which shall be connected to earth electrodes.

(c) All interconnections of the earthing grid conductors will have welded type joints except at electrodes with disconnecting facility and at equipment with bolted connections. All indoor earthing grids will be suitably interconnected to the external earthing grid.

(d) Each steel/ RCC column of the skywalk will be interconnected to the floor-earthing grid. Steel columns, steel strips / conduits, cable trays etc. will not be used as earth continuity conductors.

(e) Disconnecting type facility shall be provided between Earthing grid & each earth electrode.

(f) All connection between the conductors shall be welded/ brazed type. Metallic pipe, conduit, structures shall be bonded to lightning protection conductors to prevent the side flashover. But no metallic pipe, conduit, structure shall be used as air termination conductor or down conductor.

(g) The down conductors shall be fixed with embedded brass posts (on concrete columns) with nuts & bolts used for fixing the saddle/ clamp (direct drilling of down comer and fixing with screw shall not be acceptable).

(h) Cleats for „earthing and lightning protection systems‟ shall be of GI.

(i) The lightning protective conductor shall not be connected with the earthing above ground however both the systems shall be interconnected below ground.

(j) The earth pits may require boring & drilling in the soil & the same shall be considered in CONTRACTOR"s scope.

(k) Earth electrode with disconnecting facility shall be provided so that the resistance of the independent earth electrode may be measured.

(l) Internal earth Bus of each panel shall be connected to both ends to the earthing system by means of earthing conductor.

(m) Metallic frames of all current carrying equipment, structures supporting and adjacent to current carrying conductors, lightning protection system conductors, metallic structures, metallic stairs, hand rails, fences shall be connected to a single earthing system. Neutral points of various systems shall be connected to the dedicated treated earth pits and these earth pits shall be interconnected to each other below ground.

(n) All connections in the equipment earth conductors buried in ground (or otherwise) shall be cad welded/ brazed, whereas connection at equipment end shall be of bolted type. All connections shall be of low resistance. All bimetallic connection shall be treated with suitable compound to prevent moisture ingression. For Bimetallic bolted connection, bimetallic washers shall be used. All bolted joints shall have minimum two bolts to ensure proper surface contact. Termination of stranded conductors at earth inserts shall be with ring type/ lugs.

(o) Galvanized conductors shall be touched up with zinc-rich paint where holes are drilled at site for bolting to equipment/structure.

(p) Suitable earth risers approved by the Engineer shall be provided above finished floor/ ground level, if the equipment is not available at the time of laying of the main earth conductor. The minimum length of such risers inside the building shall be 200 mm and outdoor shall be 500 mm above ground level.

(q) Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.

(r) All cable trays will be earthed at minimum two places by suitable sized GI flats to main earthing system earth conductor. The cable trays shall also be earthed at a regular interval of not more than 10 meters by the same size GI flat as run along the tray.

(s) Wherever earthing conductor cross underground service ducts, pipes, trenches, tunnels, etc. or Road, it shall be laid in Hume pipes at minimum 600 mm below them. The earthing conductor shall be re-routed in case it fouls with equipment foundations.

(t) Wherever earthing conductor passes through walls, floors, etc. galvanized conduit / HDPE pipe sleeves shall be provided for the passage of the conductor. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves. The seals, in addition, shall be fire proof if the specifications/project drawings call for the same.

(u) Water stops shall be provided wherever earthing conductor enters the building from outside, below grade level.

(v) Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.

(w) Earthing conductors embedded in the concrete floor of the building shall have at least 50mm concrete cover.

(x) Earthing conductors along their run on columns, walls, etc. shall be fixed by suitable welding or cleating at intervals of 1000mm and 750mm respectively. Earthing cables crossing other metallic structures such as conduits pipelines

etc shall be minimum 300 mm away from such structures. Earthing conductors shall be protected against mechanical damage. All earth lead connections shall be as short and direct as possible and shall be without kink.

(y) The main earth loop in the plot area shall be generally routed along cables. When equipments are located away from main earth loops, suitable sub-loops shall be run up to them for deriving connections for individual equipment. The entire earthing system shall fully comply with the CEA guidelines and requirements.

(z) The CONTRACTOR shall have to carry out any changes as desired by the Electrical inspector or the Engineer in charge, in order to make installation conforming to the CEA guidelines 2010 and IS 3043.

6.6.7 Earthing Pits

(a) Adequate number of earthing pits shall be provided in conjunction with earthing grid for the earthing system. The minimum spacing between two adjacent earthing pits shall not be less than 2000mm and shall be kept 1500 mm away from footings of the structure.

(b) Earthing pits shall be located in ground, which has a reasonable chance of remaining moist. Arrangement comprising of GI pipe with top funnel with wire mesh shall be made to facilitate pouring of water to keep earthing pit wet.

(c) A galvanized iron strip of adequate size (as per calculations) shall be provided from plate electrode to about ground level to facilitate jointing with earth conductors. Each earth electrode ending at the pit shall be connected to suitable linking strips to connect and disconnect the earthing suitably.

(d) Earthing chamber shall be of RCC/ brick chamber of 600 mm x 600 mm, with Hinged cast Iron chequered cover plates. The covers shall have holes for handling. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.

6.6.8 Cable Earthing

Metallic sheaths, screens and armour of all multi-core power/control cables shall be earthed at both equipment and source/switchgear end. Sheath and armour of single core power cables shall be earthed at source/switchgear end only, unless other-wise stated elsewhere.

6.6.9 Lightning Protection:

(e) The lightning protection system need will be established by calculating the risk factor value of each building, structure etc. as per procedure given in IS/IEC 62305-2010 and if found necessary the same shall be provided by the CONTRACTOR.

(f) For Lightning protection of Civil Structures including RCC Buildings, fixing of 25x6 mm GI earth strip to roof as per IS/ IEC std, saddle clamp, down comer connector etc. as required with all hardware shall be in CONTRACTOR"s scope.

(g) Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.

(h) Down conductors shall be cleated on outer side of the building wall at 750 mm interval or welded to outside building columns at 1000 mm interval.

(i) Connection between each down conductor and rod/pipe electrode shall be made via test link.

(j) Lightning conductors shall not pass through or run inside G.I. conduits.

(k) All metallic structures within a vicinity of 2000 mm in air shall be bonded to the conductors of lightning protection system.

(B) Galvanizing:

(a) Wherever galvanizing has been specified, the hot dip process shall be used. The galvanized coating shall be of uniform thickness. Weight of Zinc coatings for various applications shall not be less than those indicated in the standard.

(C) Burrs shall be removed before galvanizing. Any site modification of galvanized parts should be covered well by zinc rich primer and aluminium paint.

(D) CONTRACTOR shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

(E) Drawings/ Documents Required:

(a) The CONTRACTOR shall submit the Earth resistivity measurement Report duly attested.

(b) Earthing calculations based on the above earth resistivity and the calculated or estimated fault level.

(c) The CONTRACTOR should prepare Layout drawings, after award of contract and before commencement of work for PURCHASER‟s approval, showing the location of earthing grid, electrodes, interconnection grids and earthing leads to various equipment, down comers, isolating links etc. should be accompanied by design calculations.

6.7 LIGHTING & RECEPTACLE SYSTEM

6.7.1 The scope of the CONTRACTOR shall include Design, Engineering, manufacture, testing at manufacturer‟s works, supply to site, unloading & handling, cleaning and assembly, installation, commissioning and performance demonstration of the of Illumination system and Receptacle system for skywalks and its access points and its adjoining area within the battery limits.

6.7.2 The lighting system includes luminaires & lamps, lighting panels (LP), Raw power distribution boards (RDB), modular switchboards, Modular and non-metallic industrial Receptacles in access points and electrical room and suitable RCCB in the skywalk area, JBs, cables/wires for lighting/receptacles, conduits, support accessories etc.

6.7.3 The illumination levels to be considered for the design of lighting system for various areas shall be as per the National Lighting Code and BIS standards.

6.7.4 Lighting design shall be performed using latest version of DiaLux Software/ Original Equipment Manufacturer (OEM) validated software. The Validation Report along with software and data files shall be acceptable to PURCHASER/ PURCHASER‟s representative.

6.7.5 The CONTRACTOR shall carry out Lux Level test in each area and submit a report for the same to the PURCHASER as part of the performance demonstration. The same shall be compared with the Guaranteed performance parameters for any deviation and due rectifications.

6.7.6 After completing the erection work, the CONTRACTOR shall carry out various pre commissioning checks and commissioning tests on the distribution boards, light

fittings, sockets and cables and all other items, to ensure that these are fit for energizing and operation on load.

6.7.7 The lighting system will comprise the following:

6.7.8 NORMAL AC LIGHTING –

(a) Main Indoor Lighting Panels (MLP) shall be of industrial type, totally sheet steel enclosed of 2mm thick, double door construction, fully dust and vermin proof, wall/column mounting type with a degree of protection of IP – 52. Outdoor panels shall be weather proof type with IP – 54 degree of protection. The boards shall have welded back and sides and hinged door with gasket at the front with door handle and suitable locking device. Detachable cover plates shall be provided at the top and bottom for cable/conduit entry and suitable knock out shall be provided for this purpose. The Lighting panel after fabrication shall be subject to rust removal treatment and provided with epoxy powder coating followed by baking. The board shall have 2 No. earthing terminals suitable for 25mm X 6mm GI flat and mounting arrangement for wall/column mounting. One no. of such MLP shall be present in each access points. MLP shall be Wing Knob – Lockable type/ Pad lockable. The incomer shall be min 32A MCB+RCCB and Outgoing shall be min 12 nos. of 6A SP MCBs as per requirement with 20% spares.

6.7.9 CRITICAL AC LIGHTING - Emergency Lighting shall be provided for access points at all junctions, exit passages by means of instalite fittings. Critical Lighting shall be designed for around 10 Lux. If the Skywalk is completely covered with no access of external light then the critical lighting by installite fittings shall be provided for the skywalk also.

6.7.10 Recessed type luminaire fixing shall not rely on false ceiling strength alone. The luminaires shall be additionally supported / hung from ceiling/ cable tray supports with a hot-dip galvanised chain/ clutch wires.

6.7.11 The tension of clamps for fixing to ceiling shall be moderate (The ceiling should not be damaged while removing the Luminaire. Nor it should be too loose so as to cause the offset luminaire). The clamps shall also not cause dents on reflector during regular installation & maintenance handling.

6.7.12 Luminaire housing shall be strong enough as not to buckle/ twist while handling (including holding at two ends).

6.7.13 Luminaires shall be suitable for loop-in & loop-out with suitable terminals & twin cable entry size.

6.7.14 The accessories shall be more rigidly mounted to avoid transit damages/ displacement of accessories. If required, separate protection should be provided.

6.7.15 The scope of the CONTRACTOR shall include Supply and installation of luminaires including lamps, lighting panels (LP), switchboards, receptacles & JBs, cables/ wires for lighting/ receptacles, conduits, termination and performance testing etc.

6.7.16 Offers shall include comprehensive technical details of the luminaires which will be supplied by installation CONTRACTOR and the lamps being offered. The details must be

sufficient to take into consideration maximising of energy efficiency and minimising overall skywalk power consumption.

6.7.17 For luminaries (For electrical room & access points etc.), 0.75 kV grade multi stranded Copper conductor FRLS PVC insulated wires of area not less than 2.5 sq

mm (for Ph + N) & 1.5 sq. mm (for E) shall be laid in 25/32 mm dia. black enamelled MS conduit shall be used.

6.7.18 Separate metallic conduits shall be used for wiring of lighting system. Wiring shall be concealed in wall below false ceiling with concealed/surface mounted switch board.

Minor civil work like chasing wall, cut outs for conduit, switch board, LP in wall, entries for tray, conduits etc. is in CONTRACTOR‟s scope.

6.7.19 The BIDDER shall note that any chasing in walls or cut-outs or openings such as fixing of LPs, DBs, switchboards, concealing conduit in wall etc. in walls required shall be made before plastering of brickwork wherever applicable and installation rates quoted shall be inclusive of chasing, cutting & making the plaster as per standard practice/ as instructed

6.7.20 All the cables / wires used for indoor shall be FRLS type only.

6.7.21 Lighting panels shall be provided in various areas and circuit wiring/ cabling to the lighting fixtures shall be made from lighting panels. Lighting panel shall comprise of per phase isolation/ without per phase isolation.

6.7.22 For panels having per phase isolation, 1 no. of FP MCB as incomer, along with 3 nos. of DP RCCB (100mA) & 6/8/12/ 24/ 36 SP MCB outgoings shall be considered for RDB/ ELP/ NLP.

6.7.23 For panels without per phase isolation, 1 no. of FP MCB + FP RCCB (100mA) as incomer & 6/8/12/ 24/ 36 SP MCB outgoings shall be considered for RDB/ NLP/ ELP

6.7.24 For all lighting panels, RCCB sensitivity shall be 30mA.

6.7.25 The lighting panels / receptacle distribution panels shall be minimum IP 54 protected, metal door, wall / column mounted panels

6.7.26 Outdoor Lighting:

6.7.27 Lighting for light fixtures of skywalk & flood light fixtures if any for periphery lighting shall be carried out with cables. The supply of junction boxes, street light poles & structural steel required for mounting fixtures/ LPs etc. are in the scope of

CONTRACTOR.

6.7.28 Outdoor Lighting panel (OLP) shall be wall/ structure mounted, 1 phase 230V 50Hz, powder coated double door construction of 2.0 mm thick sheet steel enclosure, conforming to IP52 protection for indoor installation, with DP ELMCB (30mA sensitivity) Incomer, and required Nos. of SP MCBs as outgoings duly wired with copper PVC insulated wires and terminals. All emergency lighting shall be controlled directly from the respective LP. OLP shall be located at every 200m length of skywalk. OLP shall be Wing Knob – Lockable type. The incomer shall be min 32A MCB+RCCB and Outgoing shall be min 12 nos. of 6A SP MCBs as per requirement with 20% spares. The lighting panel for outdoor lighting shall have a programmable timer for automatic control of lighting along-with contactor & auto/ manual selector switch.

6.7.29 For outdoor lighting/ street lighting, cable installation from OLP to junction box & further wiring /cabling up to fixture mounted on the pole is in CONTRACTOR"s scope.

6.7.30 3Cx2.5Sq.mm copper flexible cables will supply power from lighting distribution board to lighting fixture. Out of the three cores one is phase, one is neutral and the remaining one is earth.

6.7.31 CONTRACTOR"s scope shall also include arrangement for looping in & looping out arrangement of cables/ wires for circuiting, where ever found necessary.

6.7.32 All mounting accessories like base channels, cross angles if required, nuts, bolts etc.

shall be supplied by the Bidder under the scope of this contract.

6.7.33 Boundary lighting shall be provided by the CONTRACTOR with suitable LED light fittings which shall be fixed on supports available without degrading the aesthetics of the area.

6.7.34 Raw Power Distribution Board (RDB):

6.7.35 Raw Power Distribution Board (RDB) shall be similar in construction to the LPs. The board shall be 3 phase and neutral, 4wire type. The board shall have current limiting type 3 pole (TP) MCCB with OL/SC/EF release as incoming feeder; adequate nos. of three pole (TP) and single phase (SP) MCB outgoing circuits. RDP shall be located at every 200m length of skywalk. RDB shall be Wing Knob – Lockable type. The incomer shall be min 63A MCB+RCCB and Outgoing shall be min 12 nos. of 32A SP MCBs as per requirement with 20% spares.

6.7.36 The sockets shall be supplied by means of cable only; there shall be no use of separate wires for cabling of sockets.

6.7.37 Terminal block (TB) shall be suitable for loop in loop out of the 4CX10/16/25 sq. mm Cu conductor, XLPE insulated, GI armoured cables. JB shall have suitable studs for connection of earthing strip of 25 mm x 6 mm size.

6.7.38 3Cx4Sq.mm copper flexible cables will supply power from Receptacle distribution board to receptacle. Out of the three cores one is phase, one is neutral and the remaining one is earth.

6.7.39 The each suspended trunk will carry 3 numbers of 3Cx2.5Sq.mm copper flexible cables for lighting fixture and 2 number of 3Cx4Sq.mm copper flexible for receptacle. This trunk shall be supported at every 1.5m.

6.7.40 Based on the requirement, the lighting fixture can either be bolted to the suspended trunk or it can suspended from the ceiling separately or suspended from the truck.

6.7.41 In case of suspended separately or suspended from the trunk the cable shall run from trunk to fixture through a flexible conduit.

6.7.42 Luminaries shall be with connector (Wago make terminal) for loop in loop out the 3C x 2.5 Sq. mm flexible copper cable.

6.7.43

6.7.44 Point Wiring – Access points & Electrical Room:

(A) For lighting circuits, Point wiring covers the wiring between circuits of the lighting panel to switchboard and then from switchboard to lighting fixtures connected to that circuit of the lighting panel.

(B) For receptacle circuits, point wiring shall cover wiring between circuits of the receptacle DB to receptacles connected to that circuit of the RDB.

(C) Lighting fixtures and ceiling fans/toilet exhaust fans will be grouped on the circuit wherever required. However, separate circuits shall be used for receptacles wiring.

(D) Switchboard shall consist of consisting of piano switches with/without indicator (only receptacle/socket switch shall be with indicator & balance all switches shall be without indicator), white coloured cover plate for modules -as applicable, 1/2 nos.2/3 pin shuttered socket of 6/10/13A and metal flush box/surface mounted box as required.

(E) Point Wiring rate shall include 0.75 kV grade 2.5/1.5 (E) sq mm for lighting points and 4/ 2.5 (E) sq mm for power points, FRLS PVC insulated multi-stranded copper conductor wiring in MS conduit with its complete accessories running concealed/exposed in ceiling and in partition and concealed/exposed on brick wall, earth wire, 25mm MS conduit, clamps, hardware and accessories etc.

(F) Wires of the different phases shall not be laid in the same conduit.

(G) Earthing wire shall be laid along with the Ph and Neutral wires in the same conduit.

(H) Lighting for staircase shall be controlled with flushed modular switch. The conduit for main staircase shall be concealed. Lighting for all staircases shall be with 2 way switch.

(I) The necessary connector if found required for looping of wires from one switchboard to another switchboard shall be included in the scope.

(J) CONTRACTOR shall estimate rate considering span between fixtures referring lighting layouts.

(K) Preparation of conduit layout as per point wiring is included in Installation CONTRACTOR‟s scope.

(L) Wiring shall be done in wire colour codes. Colour code of wire for phases, Neutral and earth shall be separate.

(M) Wherever found necessary blanking plates shall be provided by CONTRACTOR, for which rates shall be included in point wiring.

(N) Bidder shall consider grouping of lighting fixtures, Control schedule, Switch control for light fitting/ceiling fan/exhaust fans as deemed suitable and justify the same.

(O) Time switch: Schneider or equivalent make Digital type Astronomical Timers shall be used for the outgoing feeders of ELDBs & outdoor lighting panel. The time switch shall have remote switching feature. Time switch shall be with A/M/bypass/OFF selection facility (either inbuilt or external through a separate switch).

(P) Casing capping shall be used only in case PURCHASER specifically asks for the same during execution, otherwise metallic conduit & it‟s accessories shall be considered for point wiring.

6.7.45 LUMINAIRES

(A) Light source should be LED of all the luminaires to be used for the lighting of Skywalk, access points, electrical room & all areas (Indoor and Outdoor). Luminaires in all the areas are non – dynamic in nature and should have following product characteristics.

Optical efficacy of luminaire	90lumen/watt.

Driver efficiency	> 85%.
THD	<10%
CCT	6500 K
CRI	> 80

(B) Luminaires to be designed for L70 B50 lifetime performance.

(C) LED make shall be Lumileds / CREE/ Nichia / LG/ OSRAM

(D) Electrical Specifications of LED Driver

1.	Universal Input Voltage	240 V AC ± 5% (140V to 277V Range)
2	Input Frequency	50 Hz ± 3%
3	Surge & Spike Protection	> 3 KV
4	Power Factor	>0.90
5	THD (I)	< 10%
6	Driver Efficiency	> 90%
7	Operating Temperature	0 to 50 Deg C
8	IEC Compliance	Confirming to IEC- 61347-1 & IEC 61347-2-13, IEC 61547, 610-3-2, CISPR-15

(E) Selection of Luminaires – The below indicated luminaires are the minimum requirement and these light fixtures shall be vandal proof confirming to the technical features indicated below or better. All lighting fixtures shall be of LED type only.

(a) Periphery Lighting: Surface mounted, IP65, LED lamp with batten - Luminaire & Lamp shall be Philips make 42W Endural LED lamp with batten. (Lumen output = 3500 Lumen) or Equivalent.

(b) Skywalk, Access point & Electrical room Lighting: Philips make, Luminaire-TCW 450 P 1XTLED 19W, Fixture - Master LED tube 1200mm 20W or Equivalent of suitable wattage of other approved make.

(c) Critical Lighting - LED Down lighter luminaire Wipro make model no. CRDL11R023HP57- Cleanray Halo (18W) with Lumen output/ fixture -1497 or equivalent ma be used or the normal LED lighting can be converted to Emergency lighting by supplying it from EDB.

(d) Signboards for Entry and Exit points - 3W Double sided LED signage with built in battery back-up for 2 hrs. for entry and exit.

(e) Signboards for Stairs & Lifts - 3W Double sided LED lit display with built in battery back-up for 2 hrs. for entry and exit.

(f) Bill Boards – Backlit LED Type with power supplied from RDB with 16A outdoor type socket with flap equivalent legrand make Grey /white adaptor for IP55 Plexo with smoked polycarbonate flap.

6.7.46 PERFORMANCE REQUIREMENTS OF LUMINAIRES:

(A) Luminaries shall be guaranteed against quality (including any component failure and deterioration/appearance of corrosion symptoms. This shall also cover any fading (reduction)/ deterioration of reflector coating). In such case the defective luminaire shall be replaced without any cost. In case identical defects are observed on more than 5% of particular type of luminaire (installed quantity), then the complete lot of supplied/ installed luminaires of similar type shall be replaced free of charge).

(B) Offers shall include comprehensive technical details of the luminaires and the lamps being offered. The details must be sufficient to take in to consideration maximizing of energy efficiency and minimizing overall shop power consumption.

(C) Luminaire housing shall be strong enough as not to buckle/ twist while handling (including holding at two ends).

(D) Outdoor luminaires shall be strong enough to withstand strong winds likely to be witnessed at the location.

(E) Luminaires shall be suitable for loop-in & loop-out with suitable terminals & twin cable entry size.

(F) Lamp life specified by bidder shall be at the end of the 50% failure.

(G) Bidder to provide all the technical details, test certificates, data sheets along with the offered luminaire / lamps.

(H) Losses of all luminaires under the scope of supply shall also be guaranteed.

6.7.47 MAINTENANCE REQUIREMENTS

(A) Bidder shall supply maintenance tools including special tools, if required, for attending to the equipment supplied at no extra cost. As far as practicable, the equipment and accessories shall be so designed that no special tools are necessary for installation and

maintenance of the equipment. However, if special tools are required, the Bidder shall include price of one complete set for each type of equipment

(B) Bidder shall submit an itemised list of spares, for three (3) years trouble free operation, with prices in his offer. The prices quoted for spares shall be furnished with basic price and all applicable taxes / duties separately. No variation will be allowed in this basic price for order placement up to the end of the guarantee period.

6.7.48 STORAGE AT SITE

(A) CONTRACTOR shall indicate the specific requirements, if any for proper storage of the equipment supplied at site.

(B) In general, while shipping the equipment to site, Vendor shall ensure that each assembly or component shall be crated, boxed or otherwise suitably protected against damage or loss during shipment and to facilitate site storage. All openings shall be effectively sealed with temporary closures to prevent entry of dust, dirt, moisture and other foreign matter.

6.8 **SAFETY & MISCELLANEOUS ITEMS FOR EACH ACCESS POINTS:**

Below mentioned items shall also part of Supply & Installation scope of CONTRACTOR which shall be at each access points:

(A) 6 mm thick antiskid insulating rubber mat for LV Panels of adequate length and breadth as per IS 15652 and of reputed make to be spread in front of 415V switch gear panels & power panels etc.

(B) One pair of rubber gloves (minimum).

(C) First aid box with all the standard contents.

(D) First aid chart made of cloth for electrical shock treatment printed in English, Hindi and Gujarati duly framed with front glasses.

(E) 415V Single line diagrams in adequate sizes, Escalator & Elevator Wiring drawings.

(F) Routine maintenance schedule for Low voltage Switchgears, elevators, escalators etc.

(G) Provision of 2 Nos. of CO2 portable type 5 Kg fire extinguishers at electrical room in line with the statutory requirements.

(H) 2 Nos. of 9 litres fire bucket with Sand.

(I) All Junction boxes shall be made of powder coated 1.6mm thick Sheet steel with access on all four sides; mounting arrangement; terminals suitable for 4sqmm loop in- loop out facility.

(J) Maintenance tools as per escalator vendor.

(K) Maintenance tools as per elevator vendor.