SECTION- B2.14

CABLE CONTAINMENT

2.14.1 PREAMBLE

A. Work: under this section consists of Supply, Installation, Testing, Commissioning and setting of the complete cable containment system. A complete system shall comprise
   a. Conduits, back boxes, pull boxes, draw wires, and all accessories
   b. Trunking
   c. Perforated Cable Tray
   d. Ladders along
   e. Hangers, supports and accessories.

B. Ensure all equipment and systems are to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.
C. The Contractor shall install cable containment systems strictly in line with manufacturers recommendations and shall ensure all works are in line with recommended EMC mitigation measures in IEC 61000-5 (Installation and mitigation guidelines).

2.14.2 SUMMARY

A. Scope of work: Design, Fabrication, Delivery to Site and Installation of wiring facilities systems include conduits, cable trays, cable ladder and Trunking system, associated fittings and accessories complete as specified in the schedule of requirement meeting the intents of the Tender. This specification shall be used in conjunction with all drawings, Schedule of requirement and BOQ attached.
B. All cables running above the suspended false ceiling, columns, or on surface shall be supported by proper clamps, on cable tray or cable ladder system. No free hanging of cable is allowed.
C. The cable routes shown in the drawings shall be used as a guide only. The cable routes may be physically examined and coordinated with other services before undertaking the installation work in hand.
D. Uncoordinated and inaccessible routes after other services are installed, shall be relocated at the expense of the Contractor.
E. All conduits, trunking, cable trays and cable ladders shall be earthed in accordance to IS: 3043.
F. Codes & standards
   1. The earthing & bonding system shall be designed and executed in accordance with the latest applicable sections of the IEC/BS/IS codes. Since IS Standards are originated from IEC standards, technical requirements listed in the latest IEC standards supersedes IS standards requirements which do not cover them:

IS:9537 (Part-II)/ CEE 24 & IEC 60695-2-1:1991	Steel Conduit and Fitting Accessories
IS-9537/1984 (Part-III)/ CEE 26	PVC Conduit and Fitting Accessories
ISO 9000, ISO 9001, ISO 9002 or Equivalent	Cable Tray
ISO 9000, ISO 9001, ISO 9002 or Equivalent IS Standard.	Cable Ladder
IS 14927, IEC 61084.	Cable Trunking and Ducting Systems for Electrical Installations
IS: 14772	General Requirements for Enclosures for Accessories for Household and Similar Fixed Electrical Installations
IS 3837	Accessories for rigid steel conduits for electrical wiring
IS 3043	Earthing
IS 2629	Recommended Practice for Hot-Dip Galvanizing of Iron and Steel
IS 4759	Hot-dip zinc coatings on structural steel and other allied products
IS 2633	Methods for testing uniformity of coating of zinc coated articles

IS 6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles
IS 2062	Hot Rolled Medium and High Tensile Structural Steel
IS 1079	Hot Rolled Carbon Steel Sheet and Strip

2. The complete wiring facility system shall conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in the specification and drawings, whichever is the more stringent and acceptable to the Lodha Representative.

3. In the adoption of standards and requirements, the contractor shall take the following precedence:

a. Lodha Representative decision;
b. Local codes of practice;
c. Drawings;
d. Specification;
e. International standards and requirements

2.14.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of conduit, cable trays & trunking indicated.
B. Shop Drawings: For each type of conduit work, cable tray routing & trunking work.
C. Show fabrication and installation details of conduit, cable trays & trunking including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
    1. Seismic-Restraint Details: Signed and sealed by a qualified professional, licensed in the state where Project is located, shall be responsible for their preparation.
    2. Design Calculations: Calculate requirements for selecting seismic restraints.
    3. Detail fabrication, including anchorages and attachments to structure and to support cable trays.
D. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled conduit, cable tray & trunking layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
    1. Vertical and horizontal offsets and transitions.
    2. Clearances for access above and to side of conduit, cable trays & trunking.
    3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
E. All technical submissions shall be approved by th**e** Lodha Representative prior to the respective stages of construction.
    1. Routing of installation
    2. Sample of proprietary factory-made accessories, elbows, risers, reducers, tees, crosses, etc.
F. Field quality-control reports.
G. Operation and Maintenance Data: For conduit, cable trays & trunking to include in emergency, operation, and maintenance manuals.

2.14.4 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to those noted in Section G.

2.14.5 TECHNICAL REQUIREMENT

2.14.5.1 STEEL CONDUIT AND ACCESSORIES

A. Steel Conduit:
   1. All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and 14 (2 mm) gauge for sizes above 32mm.
   2. Both inner and outer surfaces shall be smooth without burrs, dents and kinks.
   3. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout.
   4. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle.
   5. Conduit shall conform to specifications and the capacity of conduits shall be in accordance with the standards
   6. The minimum size of the conduit shall be 19/20mm diameter.
   7. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit is used.

B. Fittings:
   1. Samples of conduit fittings shall be submitted for approval prior to use on work.
   2. Fittings shall be those intended for use with screwed conduits. However, bends, elbows and tees shall not be installed.
   3. Boxes and cover plates installed outdoors shall have fixing lugs exterior to the box so that fixing screws do not enter the box interior.

C. Circular Boxes:
   1. Circular boxes shall be of malleable cast iron, galvanized and of standard pattern with spout(s). When used for connecting lengths of conduits, circular boxes shall be provided with cover plates of similar make that are complete with brass fixing screws.

D. Rectangular Boxes
   1. Rectangular boxes (adaptable boxes) shall be of mild steel not less than 2.3 mm gauge and galvanized. When used as junction boxes, lids of the same gauge with brass fixing screws shall be used.

E. Boxes for Accessories
   1. Boxes for accessories shall be suitable for surface mounting or recessed mounting according to the requirements. Surface mounted boxes and accessories shall be metal clad pattern. Recessed boxes and accessories shall be complete with insulated molded type cover plates.

F. Covers
   1. All covers for boxes, etc shall be made of galvanized steel of 1.2mm thickness.

2.14.5.2 PVC Conduit and Accessories

A. PVC Conduit
   1. All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit .
   2. All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces.
   3. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be of M.S. or otherwise mentioned.
   4. Conduit shall be terminated with adopter/PVC glands as required.

B. PVC Conduit Accessories
   1. Accessories used for conduit wiring shall be of an approved type.
   2. All accessories used shall be of standard white or black color, identical to conduit used.
   3. Plain conduits should be jointed by slip type of couplers with manufacturer's standard sealing cement.
   4. All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and male bushes screwed.
   5. PVC-switch and socket boxes with round knockouts are to be used. The colors of these boxes and the conduits shall be the same.
   6. Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.
   7. Samples of accessories shall be submitted for approval prior to installation.
   8. All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

2.14.5.3 CABLE TRAYS

A. Cable trays and accessories shall be manufactured to comply with the specifications of Indian Standards. Cable trays and accessories shall be fabricated using mild steel sheets and hot dip galvanized in accordance with B.S.729 after fabrication. All bolts, nuts and washers shall also be galvanized. The zinc coating shall be uniform, smooth and free from imperfections such as flux & ash, black spots, blisters etc. Cable trays and accessories shall undergo a process of degreasing, pickling in acid & cold rinsing prior to galvanization. Cable trays shall be of the following type :
   a. Ladder type with rungs
   b. Perforated type.
   c.

B. Perforated cable trays shall be generally of channel type and the perforations shall be 10x30 mm oval holes. Perforated cable trays shall also be galvanized. Galvanizing shall be in accordance with that specified above for ladder type cable tray. Ladder type cable trays shall be made from 2mm thick sheet formed in `C' section of 75mm height and inward flanges of 15mm as side runners and 40mm wide x 10mm high rungs (`C' shaped) from a 1.5mm thick sheet. Perforations as mentioned above shall be provided in the width of the rungs. Pitch of the rungs shall not exceed 250 mm centre to centre. Rungs shall be tack welded to the side members. The thickness of sheet steel for perforated trays shall be 1.6 mm and they shall be of the formed channel shape. Cable trays shall be of following dimensions:

   a. Section Length 2500 mm
   b. Width 150/300/450/600 mm
   c. Flange of perforated tray 25 mm
   d. Following accessories and hardware, as required, shall be supplied with cable trays:

      1. Coupler plates
      2. 900 bends Horizontal and Vertical
      3. Tees
      4. Reducers
      5. 4-way cross
      6. Fasteners (Hardware)

C. For all containment up to and Including 300mm, Thickness of Material to be 1.6mm and Trays above 300mm Thickness of material to be 2mm.

D. The zinc coating thickness for cable trays shall be minimum 65 microns. The cable trays ranging from 450mm to 1200mm, the zinc coating thickness for cable trays shall be minimum 65 microns & the cable trays ranging from 150mm to 300mm, the zinc coating thickness for cable trays shall be minimum 46 microns.

2.14.5.4 TRUNKING

A. Unless noted otherwise, trunking and accessories shall be manufactured to comply with the specifications of Indian Standards. Cable/Wire trunking is proposed to be installed concealed under the floor finish or hung from ceiling. Trunking shall be fabricated from 1.6mm thick GI sheet. Overall sizes of trunking and compartments to be provided in each shall be as follows:

Overall Trunking Size (mm)	No. of compartments & size (mm)
1. 200 x 38	1 x 100 + 1 x 50 + 1 x 50
2. 175 x 38	1 x 75 + 1 x 50 + 1 x 50
3. 100 x 38	1 x 50 + 1 x 50
4. 100 x 38	1 x 50 + 1 x 25 + 1 x 25

B. Trunking shall be complete with partition plates and covers. Trunking of each size shall be supplied with following accessories:
   1. 4 way junction boxes with removable covers
   2. Vertical access boxes
   3. Couplers
   4. End caps.

   Any other accessories, if required, for satisfactory installation shall also be included as part of supply. Trunkings shall be supplied in standard length of 3 meters.

C. For all containment ≥ 600mm web height should be 75mm and all containment <600mm web height should be 50mm

D. For all containment up to and Including 300mm , Thickness of Material to be 1.6mm and Trays above 300mm Thickness of material to be 2mm.

2.14.5.5 FLUSH SCREED TRUNKING

A. Type: For installation in floor screed, laid on unfinished concrete floor, secured and grouted flush with screed.
B. Material: 3.0m lengths of 2 mm thick (14 gage) galvanized sheet steel, protected by corrosion resistant coating on inside and outside surfaces. 3 compartments, as required, are to be as shown on the Drawings. Dimensions are to be as indicated. Covers to be minimum 2 mm thick. Galvanizing to be at least 270 gms/m^2.
C. Openings: Ducts are to have 32 mm (1-1/4 inch) openings spaced at 600 mm (24 inch) with screw plugs for receiving initial or future installation of outlet boxes. Screw plugs are to be replaced by brass ferrules, inserted and securely fastened by crimping tool, for installation of pedestal type outlet boxes.
D. Fittings: Ducts are to be supplied with approved standard manufacturer's fittings, couplings, adjustable duct supports, duct to conduit adapters, horizontal 45 and 90 degree bends, vertical 90 degree bends, terminal bushings to cabinets, cross-under, offsets, plugs, ferrules and complete set of tools for installation and maintenance after installation.
E. Junction Boxes: Flush, galvanized sheet steel or die-cast metal protected by corrosion resistant coating and suitable for double or triple duct systems, as required, and shown on the Drawings. Openings are to be provided for ducts and conduits. Interior of boxes is to be partitioned for 2 or 3 services; completely isolating each duct system and providing straight cross-junctions. Leveling and anchoring of boxes is to be by adjusting screws at 4 corners. Flush cover plates are to form smooth surface with flooring.
F. Flush Outlet Boxes: Factory designed, with accessories necessary to accommodate specific outlets shown on the Drawings or cable outlets as required for signal or control services, with cord-grip nipples.
G. Supports are to be capable of adjustment for height and arranged for maintenance of alignment and spacing of raceways during concreting.
H. Recessed Service Fittings: Modular fittings that match with preset inserts and include covers/ receptacles, outlets and associated device plates to provide service indicated at each location. Covers are to be flush with floor and have a recess to match floor finish and level with the area. Boxes' covers are to be firmly held in place and non-rocking. Coordinate with architectural designs and materials approved for finishes and for electrical devices. Internally mounted receptacle/outlets are to be as shown on the Drawings.

2.14.5.6 SUPPORT, ANCHORAGE & ATTACHEMENT COMPONENTS

A. Steel Slotted Support Systems: Factory-fabricated components for field assembly.
   1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to IS Standards.
   2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied.
   3. Painted Coatings: Manufacturer's standard painted coating applied.
   4. Channel Dimensions: Selected for applicable load criteria.

B. Non metallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches.
C. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
D. Rated Strength: Selected to suit applicable load criteria.
E. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
F. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armoured electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.
G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
3. Hilti Inc.
4. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
5. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18
6. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
7. Toggle Bolts: All-steel springhead type.
8. Hanger Rods: Threaded steel.

2.14.6 EXCECUTION

2.14.6.1 CONDUIT INSTALLATION

A. LAYOUT:

1. Where conduits are run embedded in slab, the contractor shall agree all routing, spacing and installation details with the Structural Engineer prior to submission of shop drawings. Installation at site shall follow agreed layout exactly.
2. The conduit layout and conduit routes shall be submitted for approval. Allowance for adjustments due to site conditions shall be made at no extra cost.
3. Conduit routes shall be chosen for easy, straight runs with minimum bends and crossings. Generally they shall follow the structure of building, running at right angles or in parallel to floors and ceilings. Conduits shall be kept within 300 mm of floors and ceilings when running parallel to them.
4. Outlet boxes for housing accessories shall be used as draw boxes. The total number of draw boxes shall be kept to a minimum and shall be provided so that conduit runs do not exceed 12 m or have more than two right angle bends.
5. All conduits shall be kept clear of gas and water pipes. In particular, conduits shall be at least 150 mm away from gas pipes. Where proximity to these pipes is unavoidable, they shall be effectively segregated e.g. using rubber or other insulating material to prevent appreciable voltage differences at possible points of contact. Segregation from extra low voltage circuits and telecommunication circuits shall also apply unless these are wired to the same voltage requirements as lighting and power circuits.
6. Conduits from different distribution boards shall not be connected to the same junction box. Each run of conduit shall be assembled complete with draw-in-wires.

B. JOINTS AND TERMINATIONS:

1. Electrical and mechanical continuity shall be maintained throughout all conduit joints and terminations. Conduit threads shall be thoroughly cleaned and tightly screwed. The conduit system shall be watertight after installation.
2. Conduits shall be connected using couples or via boxes. With a coupler, the ends of the conduit shall butt close together and the running coupler is screwed tightly on and tightened by a locknut.
3. Conduits terminating into boxes provided with spouts shall be threaded so that there are no exposed threads. For boxes with no spouts, the termination shall be made using a brass bush and a coupler. The conduit is pushed through the knockout or drilled entry and the bush is screwed tightly onto its end. The coupler is screwed to butt firmly against the exterior wall of the box.
4. Where conduits are not jointed or terminated in boxes, they shall be terminated in a screwed brass bush.
5. In all joints and terminations, conduit threads shall not be exposed. Where this cannot be avoided as in a running coupler, the exposed threads shall be coated with red lead paint to seal against the ingress of water.

6. Where noted on the Contract documents conduits are to be installed with expansion joints across building expansion line joints.
7. Additional Supports for expansion joints shall be provided by the contractor as per OEM recommendations.
8. At each expansion joint a suitable flexible connector is to be provided across joints to allow for expansion/contraction of at the joint. Only OEM approved jointing to be used. Contractor is deemed to have included for the same.

C. BENDS:

1. Conduits shall only be bent cold with an approved type of bending block or bending machine, without altering the dimensions of their sections.
2. All conduit bends shall be such as to permit compliance to the requirements for bends in cables to as stated in the respective codes as specified above.
3. Bends shall be made with as large a radius as the position of the conduit within the building permits. Where the bend is more than 90 degree, circular or rectangular junction boxes are to be used for connecting conduits.

D. CABLING:

1. The conduit system must be installed free of obstructions and sharp corners before any cables are drawn in. Conduits shall be thoroughly swabbed to remove moisture and dirt immediately prior to the drawing in of cables.
2. Cables shall be drawn without crossing each other and shall not be pulled against the walls of the draw boxes. Slack cables shall left in all draw boxes.
3. Cables shall be continuous throughout conduit lengths and no joints are permitted. There shall be no kink in cables, neither any cut, abrasion or chink in the cable insulation.
4. The same conduit shall carry the lead and return conductors bunched together. However, the same conduit shall not house cables from different distribution boards.
5. Cables for power and lighting circuits and extra low voltage systems shall not be drawn into the same conduit. Lighting and power circuits shall run in separate conduits except, where an adapter box is employed as final distribution point, a number of final circuits are grouped together in larger conduits between the distribution board and the adapter box provided that all final circuits in one conduit are of the same phase. In the case of three phase circuits, all three phases including neutral, if any, shall be drawn into the same conduit.
6. Conduits shall not constitute the earth continuity path for the electrical circuit. A separate circuit protective conductor shall be installed within the conduit. The whole conduit system shall be effectively earthed.
7. Flexible conduits shall have a separate earthing conductor installed within the tubing and connected at conduit ends. Flexible conduits in general shall not be used for more than 3m length.
8. Maximum number of PVC insulated 650/1100 V grade/copper conductor cable that can be taken in Rigid Metallic or Rigid Non metallic conduit shall be as per relevant code.

E. ACCESS AND DRAINAGE

1. The conduit system shall be rewirable, that is, draw boxes must be accessible for the purpose. Where boxes are concealed, their covers shall be flushed with the finished surface.
2. The need for accessibility notwithstanding, the conduit system shall be protected against the ingress of water and impurities. When installed, conduits shall be kept dry and free of debris with approved pipe plugs or caps. Such plugging is especially essential prior to pouring concrete for concealed installation. As for boxes, they shall be covered by steel plates prior to concreting.
3. When installed outdoor, and in situations liable to condensation of moisture, conduits shall be arranged to be self draining, so that water may drain to low points which are fitted with a drain plug. Conduits laid under concrete floors shall have watertight floor-traps of approved detail for access of these drainage points.

4. Conduits run on surfaces other than structural steel members shall be secured using galvanized space bar saddles and brass fixing screws. Spacing of saddles shall not exceed 1.2 m for conduit sizes up to and including 25 mm and 1.8 m for sizes 32 mm and above.
5. Conduits run on structural steel shall be secured using girder clips or an approved clamp. These conduits and those run in the vicinity of structural steel shall be bonded to the steelwork using an efficient and permanent metallic connection. The conduits shall not in any way be under mechanical stress.
6. All conduit boxes except loop-in patterns shall be fixed direct to the building structure in addition to the support provided by the conduits.
7. Conduits terminating into surface boxes shall be secured by a minimum of 3 saddles at not less than 32 mm, 150 mm and 300 mm respectively from the box.
8. Conduits shall be painted with an approved paint to blend with visual environment. A zinc rich undercoat shall be provided before painting the final coat.

2.14.6.2 CABLE TRAY

A. Cable tray shall be perforated type and construction with minimum 2.0 mm hot dipped galvanized mild steel for outdoor damp condition and heavy-duty hot dipped galvanized hot rolled mild steel for indoors. All cable trays shall be installed in a straight run parallel to walls where possible.

B. Cable trays shall be supported by electro-galvanized 'U' channel with galvanized threaded rod for indoor suspended tray and hot-dipped galvanized for area subject to weather.

C. All hangers shall be installed at 1 meter interval and shall be applied primer and painted to match with the surrounding building finish approved by the Lodha Representative-in-charge.

D. The cable trays those are exposed to the weather, a hot-dip galvanized cover of 1.5mm gauge steel, flush fixing type with gasket, shall be installed on top of the tray.

E. Depending on the size of cable trays spare space of 25% shall be maintained for future expansion.

F. Copper earth link bar shall be fixed at every joint of the cable tray run.

2.14.6.3 CABLE LADDER

A. All cable ladders and accessories installed indoors shall be heavy-duty hot dipped galvanized hot rolled mild steel. All cable ladders installed outdoors shall be heavy-duty hot dipped galvanized hot rolled mild steel. Thickness of the mild steel shall not be less than 2 mm.

B. Cable ladder shall have a 150 mm high longitudinal side member for ladders width of 800 mm or above and 120 mm high longitudinal side member for ladder width less than 800 mm.

C. The rugs shall be at least 50 mm wide, with slots of 25 mm x 10 mm at 25 mm intervals covering the length of the rugs. The rugs shall be space at 300 mm apart along straight lengths of the ladder.

D. All nuts, bolts and washers for clips and brackets shall be zinc plated. Each cable ladder shall be in standard manufacturer's length and supplied complete with coupling sets consisting of fishplates, spine bolts, and nuts and locking washers.

E. The complete cable ladder installation shall be provided with all necessary proprietary factory-made elbows, risers, reducers, tees, crosses, drop-outs, etc. and any site fabricated items will not be permitted.

F. Separate flexible earth continuity connectors of at least 16mm2 copper jumpers shall be installed between the ladder sections.

G. All cables ladders shall be supported from the ceiling concrete slab, steel structures or sidewalls using a frame system, with overhead hangers, support channels, hanger rods or angle brackets, beam clams and ceiling brackets.

H. Fixings and supports shall be installed at regular intervals not exceeding 1000 mm and 150 mm from all bends, tees, inter-sections and risers.

I. When cable ladder is refined to install across structure expansion joints, the ladder shall be in two sections between supports installed on either side of the expansion joint.

J. The ladder sections shall than be jointed with expansion joint fishplates, bolts, nuts and washers install in elongated holes permitting a lengthwise movement of 25 mm from the initial fastening position.

K. For cable ladder that are exposed to the weather, hot-dip galvanized cover of 1.5mm gauge steel, flush fixing type with gasket, shall be installed on top of the ladder.

L. Copper earth link bar shall be fixed at every joint of the cable ladder run.

2.14.6.4 CABLES TRUNKING

A. All trunking shall have removable lids extending over their entire lengths. Lids shall be fixed at interval not exceeding 1 meter by means of brass steel screws which and protected against corrosion by a finish of zinc coating or equivalent to zinc coating.

B. Factory-made bends, joints, elbow, riser, tee, reducer and accessories with same material shall be provided throughout the installation for trunking.

C. Trunking space factor shall be in compliance with latest IS standards.

D. Copper earth link bar shall be fixed at every joint of the cable trunking run.

E. For connection detail from embedded conduit to trunking, contractor to refer to the standard detail sheet.

Note: All items mentioned in this section shall be manufactured to comply with the specifications of Indian Standards.

2.14.6.5 UNDERSCRED RACEWAY/TRUNKING

A. Install under floor raceways as indicated on the Drawings, in compliance with the Specifications and according to manufacturer's written instructions.

B. Spare capacity of 40 percent to be provided for all under floor raceways.

C. Install raceways aligned and leveled and, unless otherwise indicated, parallel or perpendicular to building walls.

D. Arrange supports to attain proper elevation, alignment, and spacing of raceways. Install supports securely at ends and at intervals not to exceed 1500 mm to prevent movement during concrete pour.

E. Seal raceways, cells, and inserts to prevent water, concrete, or foreign matter from entering raceways before and during pouring slab or placing fill. Provide tape or sealing compound at joints as recommended by raceway manufacturer.

F. Remove burrs, sharp edges, dents, and mechanical defects.

G. Cap or plug boxes, openings, and open raceway ends.

H. Junction Boxes: Install tops level and flush with finished floor. Install blank closure plates or plugs to close unused junction-box openings. Install boxes in place with grout to prevent movement during construction. Install supports, couplings and locking and grounding devices with screws tightened in accordance with raceway manufacturer's torque values. Remove burs, which may cause damage to insulation. Place top covers in inverted position to prevent damage to surface of cover.

I. Install devices and service fittings at points of use indicated. Cut, hole saw, and drill slab and raceways to allow wiring installation.

J. Install markers at each cell to identify service. Install markers flush at screed line before pouring slab or placing fill. Extend marker with grommeted screw when floor covering is placed. Do not extend through carpet. Install markers at inserts adjacent to junction boxes, on both sides of permanent walls, and at end of each raceway run. Use slotted-head screw to identify electrical power and Phillips-head screw to identify telephone/low current systems.

K. Installation to be inspected and certified by manufacturer/supplier/authorized representative.

2.14.6.6 PROTECTION

A. Protect installed conduit, cable trays & trunking.

B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

C. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

D. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction.

2.14.6.7 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Fabrication at site shall be permitted for the support & assemblies.

B. If required prior information & approval shall be taken from Lodha.

2.14.6.8 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

2.14.7 QUALITY ASSURANCE

A. Source Limitations: Obtain conduit, cable trays & trunking components through one source from a single manufacturer.
B. Electrical Components, Devices, and Accessories: Listed and labelled as per IS 732 1989 (reaffirmed 2005), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with IS 732 / NBC.

2.14.8 COMMON WORK RESULTS FOR ELECTRICAL

A. SLEEVES FOR RACEWAYS AND CABLES

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, galvanized steel, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
3. Sleeves for Rectangular Openings: Galvanized sheet steel.

B. SLEEVE SEALS

1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
2. Basis-of-Design Product: Subject to compliance with requirements.
3. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Carbon steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

C. GROUT

1. Non metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, non metallic aggregate grout, noncorrosive, non staining, mixed with water to consistency suitable for application.

2.14.9 FIELD QUALITY CONTROL

A. After installing conduit, cable trays, trunking and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

B. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in conduit cable tray, trunking. Vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.

C. Verify that the number, size, and voltage of cables in conduit, cable tray, and trunking do not exceed that permitted by NBC/NEC. Verify that communication or data-processing circuits are separated from power circuits by barriers.

D. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.

E. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.

F. Visually inspect each conduit, cable tray, trunking joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.

G. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

H. Perform visual and mechanical checks for adequacy of conduit, cable tray, trunking grounding; verify that all takeoff raceways are bonded to conduit cable tray & trunking.

END OF SECTION B 2.14