7.7 Cable Duct

Cable duct works shall include laying of ducts for the cables of Power Supply, Signal and Telecommunication (hereinafter called Communication), and LCX (for train radio). The Works include procurement, transportation, unloading, and installation, removal for material, carrying out of inspections and testing, and responding to any unnatural occurrences.

7.7.1 Construction

a) Cable duct for Power Supply, Signal and Telecommunication

Cable duct for Power Supply, Signal and Telecommunication shall be as per the Drawings, and concrete shall conform to Clause 4 and Sub-Clause 7.2 if not in contravention to the following provisions:

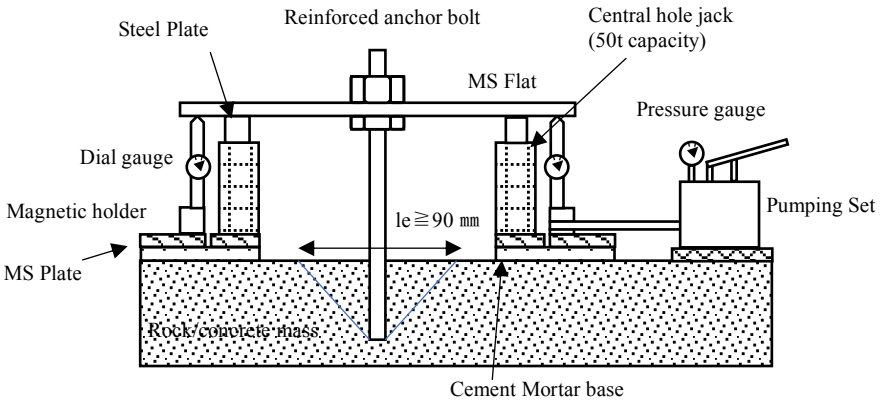
(i) Cement shall be Ordinary Portland cement of 43/53 grade conforming to IS: 269.

(ii) The reinforcement shall be steel conforming to Clause 3 of this Division.

(iii) Cable duct shall be manufactured as per the Drawings and the Method Statement.

(iv) Bolt-insert shall be Ceramic or Polyamide type to avoid bolt seizure and shall be embedded in trough. The anchor to fix the bottom shall be grouted with suitable epoxy as per the Drawing. Bolt shall be of stainless steel as per Japanese Standards SUS: 304 or its equivalent Indian Standard and shall be durable for repetitive use tested under the condition conforming to JIS: B 1056 or its equivalent Indian Standard. Bolt tip shall be coated with suitable epoxy as per the Drawings to prevent loosening and is to be enclosed in fastening. Bolt fastening torque shall correspond to the diameter of bolt, and carefully managed. Bolt-insert of Power-supply/Communication Cable-Duct shall have pull-out strength of at least 4kN each.

(v) Non-destructive test for Bolt-inserts: Pull out strength test for Bolt-inserts of the cable duct shall conform to Sub-Clause 7.7.2. (a)(iv) of this Division and in Figure 2 below.



Note: 'le'= Range where reaction force should not be applied

Figure 2: Non-destructive test for Bolt-inserts

b) Cable duct for LCX at Shaft-1

(i) In the case of LCX cable duct at Shaft-1, as the duct shall not have metal reinforcement so as not to affect radio wave transmission, the concrete shall be Glass fibre Reinforced Concrete (GRC) and the fibre used shall be alkali-resistance glass fibre. The cement used shall not have a chloride ion content of more than 0.30 kg/m3.

(ii) The pull-out strength of the bolt-insert for the LCX cable ducts shall be at least 3kN/bolt.

(iii) The LCX cable duct shall have radio wave transmission range for VHF band (30MHz~300MHz) and for UHF band (300MHz~3GHz). The transmission is influenced by rainwater/moisture content in the cable duct and appropriate measures shall be taken to mitigate the risk of moisture ingress, as per the approved method statement.

(iv) GRC material: The alkali-resistance glass fibre used in LCX cable ducts, shall be in lengths of 13-19 mm, with diameter in the range of 18 μm ± 2 μm, shall be clean and without any cracks; shall be dry having water-content less than 0.5%; and shall have a zirconia content of not less than 16.0%. The Contractor shall submit the material certificate from the Manufacturer to the Engineer for approval.

(v) The shape and dimensions of cable duct for LCX are as shown in Figure.3 as below:

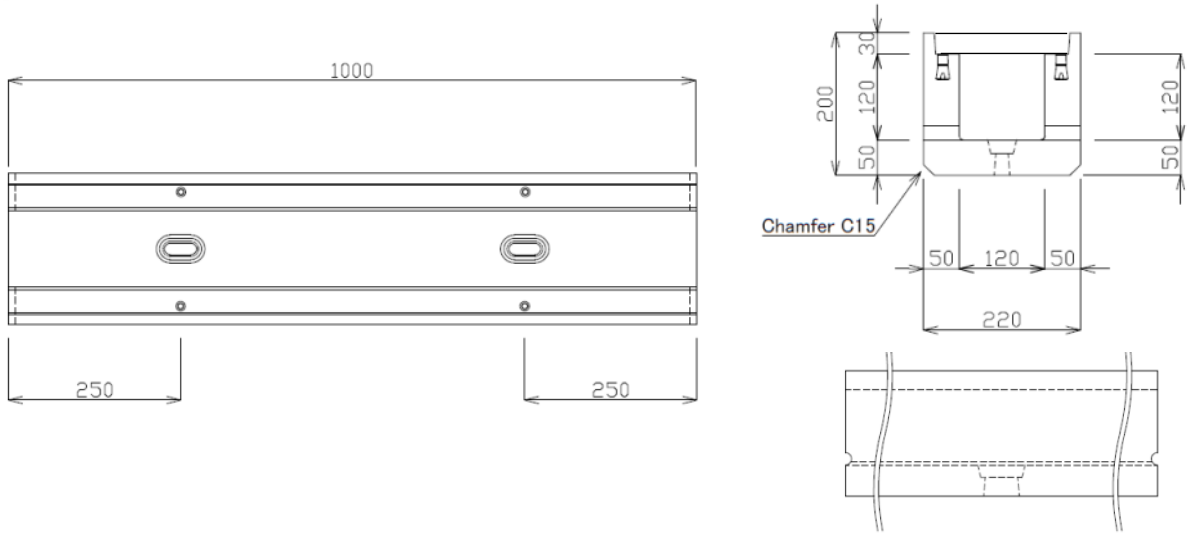


Figure 3: Shapes and dimension of Cable Duct for LCX at shaft 1

7.7.2 Testing and Acceptance

a) Cable duct for Power Supply, Signal and Telecommunication

(i) 10,000 cable-duct panels/pieces or their fraction are taken as one lot, and inspection carried out for each lot. Quantity of one lot may change according to production.

(ii) Visual inspection test: Cable duct shall not have any defects like cracks, chippings, distortions. Visual Inspection test shall be carried out for all cable ducts at the time of formwork stripping. In case one sample does not pass and if rectification is possible, re-inspection shall be done after rectification. If it cannot be rectified, the sample shall be rejected.

(iii) Dimensions of cable duct shall be within a tolerance of 3 mm. The shape and dimensions of each of main body and cover types of ducts shall be examined, taking two sets of main body and cover randomly for each lot. If both sets for one lot are not passed, all quantity of one lot shall be inspected.

(iv) Bending strength test for cable duct & Pull-out strength test for its Bolt-insert:

1) Two sets of main body and cover for each distinct type of shape, dimension, of ducts shall be picked up randomly for each lot, and the tests as below shall be carried out. If both sets for one lot do not pass, re-inspection shall be carried out. Re-inspection shall be carried out for four sets of main body and cover which are randomly picked up from one lot. In case all four samples pass the test, their lot shall be

passed except for the not passed samples from the original test. Even if one of the four samples does not pass, their lot shall be rejected.

2) Method: Bending strength test for cable duct shall conform to JIS A 5372 or its equivalent Indian Standards. Pull-out strength test for Bolt-insert of the cable-duct shall be as per relevant Indian Standards. The testing shall be done for every two samples per one lot.

3) Test results shall satisfy the requirements stated in the Method Statement.

b) Cable duct for LCX

(i) Duct Strength Test

The Contractor shall refer to Figure 4 shown below for testing method of the strength of the cable duct. It shall not break or crack when 0.5 KN/0.5 m is added with a line load from the side of the straight duct. Additionally, in order to balance the product, a spacer may be placed in the gap between the testing machine and the duct.

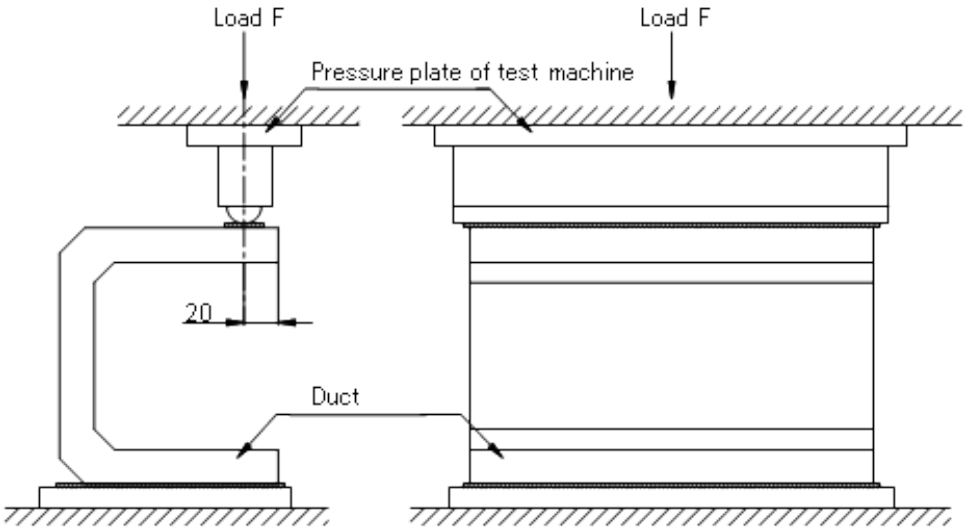


Figure 4: Test Method of the Duct Strength

(ii) Lid Strength Test

The Contractor shall refer to Figure 5 for the lid for the testing method of strength of the cable duct. A line load is applied to the centre of the upper part of the lid of the straight pipe, and the duct cover shall not get damaged or have cracks under a load of 2.0 KN / 0.5 m. The line load may be added with the lid on the duct.

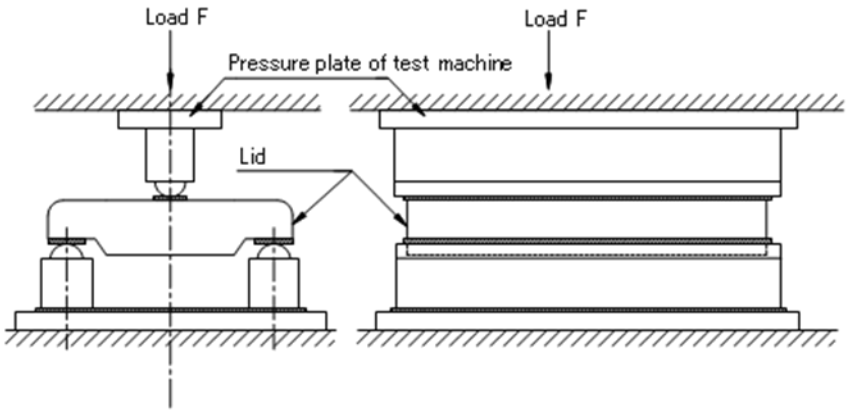


Figure 5: Test Method of the Lid Strength

(iii) Compressive Strength Test of Duct Material

Duct shall be tested according to JIS K 7181 or ISO 604 and shall have a strength of 24 N/mm^2 or more.

(iv) Vibration Resistance Test

There shall be no abnormality such as cracks and lid detachment after the vibration test in accordance with the JIS E 3014 (2 type).

(v) Impact Resistance Test

The Impact test carried out on cable duct specimen in accordance with standard IEC 62262. Impact grade of IK 10 shall be achieved during the test.

(vi) Radio Wave Transmission Test

Using the LCX cable (LCX C 486 W) of length 50 m or more, the coupling loss and transmission loss shall be measured, in case of the cable is laid inside / outside the duct. Radio Frequency shall be set at 420 MHz. The coupling loss shall be measured with a dipole antenna at a height of 1.5 m from the LCX cable. At the time of measurement, the height of the cable inside and outside the duct shall be equal from the ground. The difference between the measurement value of coupling loss in the duct and outside the duct shall be 4 dB or less, the difference of measurement value of transmission loss shall be 6 dB/km or less.

(vii) Acceptance

1) Appearance

Visual inspection shall be carried out for all pieces of cable duct and those that conform to the provisions described in Clause 7.7.2 shall be accepted.

2) Shape and Dimensions

For the inspection of shape and dimensions, two pieces are extracted

arbitrarily from one lot, and if both pieces conform to the provision described in Figure 3 of Clause 7.7.1, the lot is accepted. When even one piece does not fit in this inspection, the whole lot shall require to be inspected.

3) Duct Strength and Lid Strength

Two (02) pieces are pulled out at random from one lot, and the tests are carried out. If both conform to the required performance, the lot is passed and if the two are not compatible, the lot is rejected.

During this inspection, if only one of the two does not conform to the regulations, four more are extracted from the lot, and if all four conform to the regulations, the lot is accepted except for the first rejected item. When even one piece does not fit, the lot is rejected.

7.7.3 Marking

The following particulars shall be marked for the cable duct:

a) Type (Code name) Example: cable duct for Power Supply.

b) Manufacturer`s name or its Abbreviation.

c) Date of manufacture.

7.7.4 Installation

a) Cable duct shall be installed as per the Drawings and the approved Method Statement.

b) No difference in level and gap between power supply and communication ducts is allowed, as the top surface is used for maintenance passage. Where necessary, the cable duct shall have gradient as that of the permissible bending angle which shall be less than 30^{o} for power supply and communication duct, and 4^{o} for LCX duct.

c) The positioning of water drainage points for power supply and communication duct shall ensure that water does not collect in cable ducts.

d) The covers shall be placed without bolting and the bolts shall be handed over as instructed by the Engineer, so that the bolting is done after cable laying in the ducts.

7.7.5 Inspection

Inspection shall be carried out for the installed cable duct system and checked for adequacy as per the Drawings.