Indian Standard

PRECAST CONCRETE BOX CULVERT AND U DRAIN SPECIFICATION

1 SCOPE //IRC 122: Guidelines for Construction of Precast Concrete Segmental Box Culverts : Indian Roads Congress : Free Download, Borrow, and Streaming : Internet Archive ,from industry visit (iv) //

This standard covers classification, dimensions, manufacture, physical requirements, sampling criteria of conformity and marking of Precast Concrete Box Culvert and U Drains. Precast concrete box culvert is used for underpasses, service tunnels, subways, bridges, stream culverts, cattle pass and so on. U Drains are mainly used as storm water drains and cable trenches.

2 REFERENCE //precast concrete grating specification //

The Indian Standards listed in Annex A contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMINOLOGY //ASTM C76//

3.1 Culvert – A pipeline intended to convey water under a highway, railroad, canal, or similar facility.

3.2 Monolithic – Cast as one complete piece by a continuous placement of concrete.

4 DIMENSIONS

4.1 Box Culverts and U Drain Shape and Size //From iv, IRC 122 //

Precast Concrete Box Culverts may be made as segmental square box culverts, segmental rectangular box culverts, segmental 'C' section box culverts or any other shapes as per agreement between manufacturer and purchaser. The dimensions of the box section and number of boxes are decided based on the hydraulic design. Additional features can include toe walls, headwalls, wing walls, and watertight joints. Precast Concrete U Drains may be made as segmental U shaped drains with top slab made separately. The most commonly used shapes and size of precast concrete box culverts and U drains are given in Table 1 and Table 2 respectively. Precast concrete box culverts and U Drains with shape and size other than those given in Table 1 and Table 2 may also be manufactured as per agreement between manufacture and purchaser, however the tolerance given in 8.2 shall be applicable to all sizes. The precast box culverts and U Drains shall be placed on plain cement concrete (PCC) of M10 bed of adequate thickness. The PCC bed thickness shall not be less than 100 mm.

Table 1 Dimension of Precast Concrete Box Culverts

(*Clause 4.1*)

Sl No. (1)	**Parameter** (2)	**Dimensions** mm (3)
i)	Length(L)	600,1000,2000,4000
ii)	Width(W)	600,1000,2000,4000
iii)	Thickness(T)	As per design but in no case below 150 mm

Table 2 Dimension of Precast Concrete U Drains

(*Clause 4.1*)

Sl No. (1)	**Parameter** (2)	**Dimensions** mm (3)
i)	Length(L)	300,500,600,1000,1500
ii)	Width(W)	300,500,600,1000,1500
iii)	Thickness(T)	As per design but in no case below 100 mm

5 CLASSIFICATION //from iv //

Based on the method of casting, there are two types of PCBC.They are - dry cast PCBC and wet cast PCBC.They could also be classified based on loading conditions as light duty PCBC,medium duty PCBC and heavy duty PCBC.

Table 3 Types of Precast Concrete Box Culvert

(*Clause 5*)

Sl No. (1)	**Types** (2)	**Minimum Load** (kN/m2) (3)	**Remarks** (4)
i)	Light duty PCBC	20	Suitable for p crossings an drainage app
ii)	Medium duty PCBC	40	Ideal for roa drainage unc traffic.
iii)	Heavy duty PCBC	80	Designed for infrastructure traffic roadw

6 MANUFACTURE AND DESIGN

6.1 Manufacture

6.1.1 Mixture //from iv //

The aggregate shall be sized, graded, proportioned and mixed with such proportions of cementitious materials and water as will produce a thoroughly mixed concrete of such quality that the box culvert and U Drains will conform to the test and design requirements of this specification. All concrete shall have a water cementitious ratio not exceeding 0.4 by weight.

6.1.2 Casting //from iv, IRC 122 //

There are two main methods of casting of PCBC and u drains. These are
i) Dry cast (Machine Made)

ii) Wet Cast

6.1.2.1 Dry cast method

In this method precast segments are cast using mechanized equipment. Form vibrators consolidate zero-slump concrete between core and jacket. Hole formers can be incorporated, or sometimes coring is resorted to as may be needed. The Precast Concrete segment is immediately stripped, and the form is reused. Segments are typically cured in a curing tank, or moisture curing is used.

6.1.2.2 Wet cast method

In this method, the precast concrete segments are typically cast on using an inner and outer form. Forms shall be cleaned of concrete build-up after each use. Block outs/hole formers can easily be incorporated before concreting. The segments are cast using conventional concrete or self-consolidating concrete. Concrete cover shall not be less than that given in **Table 1** and **Table 2**.

Precautions shall be taken to ensure that the reinforcement does not move significantly during the casting operations. IS: 15916:2010 gives various accepted methods of manufacture of precast units. These have been broadly classified as:

a) The 'Stand Method' where the moulds remain stationary at places, when the various processes involved are carried out in a cyclic order at the same place, and
b) The 'Flow Method' where the precast unit under consideration is in movement according to the various processes involved in the work which are carried out in an assembly-line method.

Any method which is suitable to the project and site requirements shall be adopted.

6.1.3 Curing //from iv //

The precast sections shall be cured for a sufficient length of time so that the concrete will develop a specified compressive strength in 28 days or less. The concrete box and u drain shall be cured by steam curing or water curing or membrane curing as specified in IS 456.

6.1.4 Forms //from iv //

The forms used in manufacturing shall be sufficiently rigid and accurate to maintain the box section and u drain dimensions within permissible variations given in 8.2. All casting surfaces shall be of smooth nonporous material.

6.1.5 Handling //from iv //

Handling devices or holes and anchors shall be permitted in each box sections and u drain for the purpose of handling and laying. The handling process encompasses the demoulding of the precast units, their loading and transportation to storage areas, offloading and storage, transfer to site and site erection.

6.2 Design //from iv //

The precast concrete box culvert and U Drains shall be designed in accordance with the provision of IS 456. Placing of reinforcement shall be done in such a way so that the criteria of minimum 25 mm clear cover shall be satisfied for PCBC and U Drains. Positioning of reinforcement shall be assisted by tying or other suitable methods.

7 MATERIALS //precast concrete grating specification, from iv //

The material used shall be as per 7.1 to 7.8

7.1 Cement

Cement complying with any of the following Indian Standards may be used: (industry officials said only opc is currently in use)

a) Ordinary Portland cement conforming to IS 269;
b) Portland slag cement conforming to IS 455;
c)Portland pozzolana cement fly ash based conforming to IS 1489 (Part 1);
d) Portland pozzolana cement, calcined clay based conforming to IS 1489 (Part 2);

7.2 Aggregate //from iv //

Fine and coarse aggregates used in the manufacture of box culverts and u drains shall conform to IS 383.

7.3 Reinforcement //from iv //

Steel for reinforcement of concrete shall be Mild steel and medium tensile steel bars conforming to IS 432 (Part 1); Fe500 Fe550 are commonly used.

7.4 Admixtures //from iv //

Admixtures, if used, shall conform to IS 9103.

7.5 Fibers //precast concrete grating specification , from iv //

Steel and polypropylene fibers are used.The diameter/equivalent diameter of steel fibres if used, shall not be greater than 0.75 mm. The aspect ratio of the fibres (ratio of the length of the fibre to its diameter/equivalent diameter) shall be in the range of 50 to 80. The minimum volume of fibres shall be 0.5 percent of the volume of concrete. In case of propriety fibres, manufacturer's recommendations shall be taken into account.

7.6 Pulverised Fuel Ash //from iv //

Pulverized fuel ash shall conform to IS 3812 (Part 1).

7.7 Water //from iv //

Water shall be clean and free from injurious amounts of deleterious materials. Potable water is generally considered satisfactory for use in concrete.

7.8 GGBFS //from iv //

Ground granulated blast-furnace slag shall conform to IS 16714.

8 REQUIREMENTS

8.1 General //from iv //

All units shall be sound and free of cracks or other defects like honeycombing which interfere with the proper placing of the unit or which impair the strength or performance of the construction. Minor chipping resulting from the customary methods of handling during delivery, shall not be deemed grounds for rejection. Minor cracks are filled with white cement. Units with structural cracks and cracks of dimension greater than 50 mm are rejected.

8.2 Dimensions and Tolerances //from iv //

Dimensional tolerances of the precast units as received on site should comply with those specified in the contract documents. Changes to the dimensions and shapes of units should be identified and assessed with regard to the overall tolerance; and surface finish. Finished segment tolerances should not exceed the following:

Length :	± 5 mm
Breadth :	± 5 mm

Thickness: ± 5 mm

The surface finishes of precast units when received on site should be checked for compliance with the requirements of the contract documents.

8.3 Compressive Strength //precast concrete grating specification, from iv //

The minimum average compressive strength of concrete box culvert and U Drain shall not be less than 20 Mpa or 0.7 times the compressive strength of concrete when tested as per IS 516 (Part 1/Section 1).

8.4 Load Test //from iv //

The minimum load bearing capacity of box culvert when tested as per the procedure given in IS 456, shall not be less than the values specified in Table 4.

Table 4 Load Tests

(*Clause 8.4*)

Sl No. (1)	**Types** (2)	**Minimum Load Bearing Capacity** (kN/m2) (3)
i)	Light duty PCBC	20
ii)	Medium duty PCBC	40
iii)	Heavy duty PCBC	80

8.5 Water Absorption //precast concrete grating specification, from iv //

The average water absorption of three units, when determined in the manner prescribed in IS 12592 shall not be more than 4 percent by mass.

9 SAMPLING AND INSPECTION

9.1 Scale of Sampling

9.1.1 Lot //precast concrete grating specification , from iv //

In any consignment, precast concrete box culverts and U Drains manufactured with same type of raw material and having same dimensions and type shall be grouped together to constitute a lot respectively.

9.1.2 The number of precast concrete box culvert and U Drain to be selected from the lot shall depend on the size of the lot.

9.2 Number of Tests //from iv //

9.2.1 All the box culverts and u drains selected according to 9.1.2, shall be inspected for visual defects (*see* 8.1) and checked for dimensions (*see* 8.2)

10 CRITERIA FOR CONFORMITY //from iv //

Acceptance of any structural defect should be assessed with regard to the causes and the overall structural integrity of the precast units. Dimensional tolerances of the precast units as received on site should comply with those specified in the contract documents. The box sections and u drains should be free of fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint. It should not have damaged ends or honeycombed textures.

10.1 The lot shall be considered as conforming to the requirements of the specification if the conditions mentioned in 10.2 is satisfied.

10.2 For load test, no value shall be less than the load specified in Table 4.

11 MANUFACTURER'S CERTIFICATE //from iv //

The purchaser shall satisfy himself that the box culvert and u drain conform to the requirements of this specification and if requested, the manufacturer shall supply a certificate to this effect to the purchaser or his representative.

12 STORAGE AND TRANSPORTATION

12.1 Storage //from iv //

To store precast concrete box culverts and U drains safely and effectively the storage area should be spacious to accommodate the units safely, allowing room for maneuvering, lifting equipment and transport vehicles. The ground surface must be hard, level, clean, and well-drained to facilitate organized storage and prevent

settlement. Proper stacking is important to prevent damage to the precast segments. Units should be stacked in a manner that avoids twisting or distortion, with supports arranged to evenly distribute weight and minimize the risk of excessive settlement. It's important that these supports do not stain the precast units and are sufficient to transfer the weight to the ground securely. During storage, measures should be taken to protect the units from accidental damage. This includes keeping lifting points well protected and accessible throughout the storage period. This ensures structural integrity as well as safety to workers. By adhering to these guidelines, the storage of precast concrete box culverts and U drains can be managed effectively, safeguarding their quality and ensuring they remain ready for installation without compromising safety or structural integrity.

12.2 Transportation //from iv //

Precast concrete box culverts and U drains are often cast at facilities located some distance away from their intended project sites. Efficient transportation from the casting yard to the construction site is important.Forklift trucks and cranes are used for effective transportation to stack yards. It's crucial that precast units have attained adequate strength before loading for transport to prevent damage. Proper planning ensures that transportation logistics, including route selection and vehicle capacity are managed well. This approach ensures the structural integrity of the units during transit. This ensures that they arrive ready for installation, facilitating smooth execution of the project and minimizing delays.

13 MARKING //from iv //

13.1 Following information shall be clearly and permanently marked on top of box culvert and on side of u drains:
a) Identification of the source of manufacture;
b) Element ID;
c) Date of production or batch number; and
d) Any identification mark as required by the purchaser

13.2 BIS Certification Marking //precast concrete grating specification , from iv //

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark. In any consignment, precast concrete box culvert and u drain manufactured with same type of raw material and having same dimensions and type shall be grouped together to constitute a lot respectively.