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(Reaffirmed 1997)

भारतीय मानक

पूर्व ढलित फेरो सीमेंट के 10 000 लिटर क्षमता वाली पानी की टंकी – विशिष्टि

Indian Standard

PRECAST FERROCEMENT WATER TANKS UP TO 10 000 LITRES CAPACITY — SPECIFICATION

UDC 628·134 (666·982·2)

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

Ferrocement is a versatile structural material possessing unique properties of strength and serviceability. It is made with closely-knit wire mesh, mild steel reinforcing bars and rich cement sand mortar. The materials required for making it, namely, cement, sand, wire mesh and steel skeletal bars are easily available in most places. It is possible to fabricate in ferrocement, a variety of structures which are thin, light, durable and possessing high degree of impermeability. Ferrocement can be easily moulded into any shape. The several applications of this material include storage structures, septic tanks, bio-gas plant digesters, pontoons, boats, roofs, wall panels, manhole covers, drainage and irrigation units, shuttering for concrete construction, etc.

Ferrocement water tanks exhibit a high degree of impermeability. They are ideally suited for residential and community uses. Construction of precast water tanks with ferrocement is an advantage where a large number of tanks have to be built because of the speed in erection and less requirement of skilled labour at site.

The composition of the committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PRECAST FERROCEMENT WATER TANKS UP TO 10 000 LITRES CAPACITY — SPECIFICATION

1 SCOPE

This standard covers the requirements of precast ferrocement water tanks of capacity 270 to 10 000 litres.

NOTES

1 The capacity of tank means the net capacity which is the volume of the actual usable water confined between the levels of the centres of the overflow and outlet sockets. Gross capacity of a tank shall be taken as the total storage capacity including the dead storage and free board.

2 The following net capacities are recommended for different uses:

Uses	*Net Capacity* litres
Domestic use	270, 540, 750 and 1 250
Industrial and community use	1 250, 2 500, 5 000, 7 500 and 10 000

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 SHAPE AND DIMENSIONS

3.1 Shape

Ferrocement water tanks are generally made in square, rectangular and circular shapes. Compared to square and rectangular tanks, circular tanks consume lesser quantity of materials and have no sharp corners. For simplicity of construction the tanks are generally constructed flat bottomed. However, for relatively large circular tanks of diameter exceeding 2·0 m, a shallow spherical dome may be provided for the base or alternatively, suitable fillets may be provided at the junction of bottom slab and vertical wall.

3.2 Dimensions

Dimensions of ferrocement water tanks shall be calculated depending upon their capacities. For cylindrical tanks, height to diameter ratio of 1·0 is generally recommended. For rectangular tanks, length to breadth ratio should generally be kept 1·5 whereas the height to length and breadth ratio should generally be 0·5 to 1·5. If the length of any side exceeds 1·5 m, it is desirable to provide stiffeners in the side walls at spacing not exceeding 1·5 m.

3.2.1 A free board of at least 75 mm shall be provided.

3.3 Tolerances

The tolerances on specified dimensions shall be as follows:

a) Length, breadth, height and diameter up to 1 m; and	± 5 mm
Length, breadth, height and diameter above 1 m	± 10 mm
b) Thickness	± 2 mm

4 MATERIALS

4.1 Cement

The cement used shall conform to IS 269 : 1989 or IS 1489 (Parts 1 and 2) : 1976 or IS 455 : 1989.

4.2 Sand

Only sieved sand conforming to grading zone II of IS 383 : 1970 shall be used, but the maximum particle size shall be less than 1·18 mm. The sand shall be clean, inert and free from organic matter. Silt and clay content shall be less than 3·0 percent.

4.3 Water

Water used shall conform to the requirements specified in IS 456 : 1978.

4.4 Skeletal Steel

Mild steel bars conforming to IS 432 (Part 1) : 1982 or hard-drawn steel wire conforming to IS 432 (Part 2) : 1982 or hard-drawn steel wire fabric conforming to IS 1566 : 1982 shall be used as skeletal steel to provide framework of the structure for laying the mesh layers. Normally the diameter of skeletal steel should be from 3 mm to 10 mm.

4.4.1 All reinforcement shall be free from loose mill scales, loose rust and coats of paints, oil, mud or other coatings which may destory

or reduce bond. A slight film of rust shall not be regarded as harmful but the steel shall not be visibly pitted by rust.

4.5 Reinforcement

Mild steel wire conforming to IS 280 : 1978 shall be used in the manufacture of wire mesh. The mesh shall have hexagonal, rectangular or square openings. It shall be woven or welded. The wires shall be galvanized before weaving. Aperture size of 6 mm to 20 mm and wire diameter of 0·56 mm to 1·25 mm are recommended. In case of welded wire mesh the diameter of wire shall be not less than 1 mm.

4.5.1 In case galvanized wire mesh is used with mild steel bars/wires, chromium trioxide at the rate of 200 to 300 ppm of water should be added to the water used for mortar preparation.

4.6 Admixture

Admixtures may be used in ferrocement for reducing water-cement ratio without affecting the workability and for gaining in strength and durability. Such admixture shall conform to IS 9103 : 1979. Admixtures shall be used with the approval of the engineer-in-charge. Integral cement waterproofing compound, when used, shall conform to IS 2645 : 1975.

5 DESIGN

5.1 Mortar

The minimum compressive strength of cement mortar cubes having area of face equal to 50 cm^2 shall be 25 N/mm^2. The recommended mix proportion is 1 part of cement to 1 5 to 2·5 parts of sand by mass. Water-cement ratio should be 0·35 to 0·45.

5.2 The tensile stress in reinforcement under service condition shall not exceed 200 N/mm^2.

5.3 Ferrocement shall be treated as a composite material for calculation of strength of sections. The principles of reinforced concrete may also be used for calculation of flexural strength. Effective area of steel in the direction of principal tension shall be calculated for hexagonal wire mesh.

5.4 The minimum cross-sectional area of main reinforcement in any one of the two principal directions shall not be less than 1·0 percent of the gross cross-sectional area of the element.

5.5 Laps in wire mesh, where provided, shall be not less than 100 mm.

5.6 The skeletal steel shall be spaced at not more than 300 mm centre to centre in both directions. Laps in bars where, provided, shall be not less than 150 mm. The skeletal steel may not be necessary in case of mechanized or semi-mechanized casting processes.

5.7 The minimu mwall thickness shall be 12 mm for tanks up to 2 000 litres capacity in case of mechanized or semi-mechanized casting and 15 mm for tanks up to 1 000 litres capacity when hand cast. For larger capacity tanks the wall thickness may be 20 mm to 40 mm depending on capacity.

5.8 The minimum thickness of the lid/cover slab shall in no case be less than 15 mm.

5.9 In case the bottom slab thickness exceeds 30 mm, the slab may be cast in ferrocement only. However, an intermediate plain concrete layer using graded coarse aggregate of nominal maximum size 6·3 mm may be introduced between the wire mesh layers to achieve the design thickness without excessive use of cement. In case of composite slab, the minimum thickness of top as well as bottom layer of ferrocement shall not be less than 8 mm.

5.10 The minimum clear cover to reinforcement shall be 4 mm.

6 CONSTRUCTION

6.1 Hand Casting

6.1.1 Skeletal steel cage shall be made according to the shape of the tanks. One or more layers of wire mesh shall then be tied by binding wire to the skeletal steel cage on either side according to the design requirement.

6.1.2 Fittings, such as scour, inlet, outlet and overflow pipe, etc, shall be fixed in correct positions before casting. These fittings normally consist of G. I. sockets/nipples of 15 mm to 40 mm diameter. Each insert will have two anchor bars of 6 mm diameter with a length of 100 mm to 150 mm welded to it as shown in Fig. 1. The inserts are placed in position by manually displacing the mesh wires at the time of casting such that the anchor bars are in contact with the innermost mesh layer to which they are tied as shown in Fig. 2.

6.1.3 Placing of scour shall be so arranged in level with the bottom slab so that cleaning of the tank is made easy. Inlet pipe shall be placed at least 25 mm above the overflow fixture. Placing of outlet pipe shall be such that there

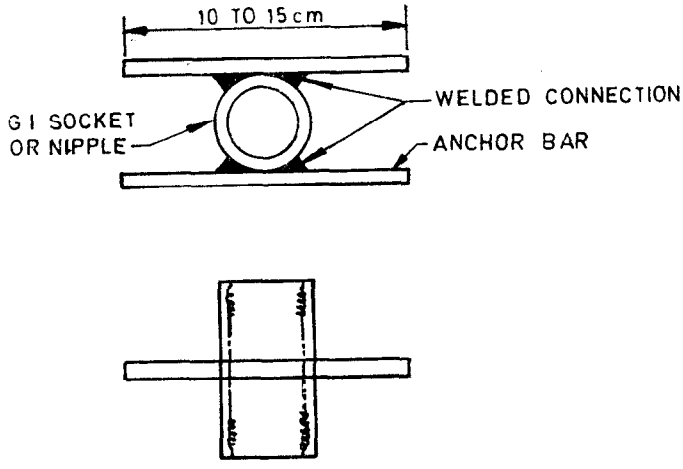
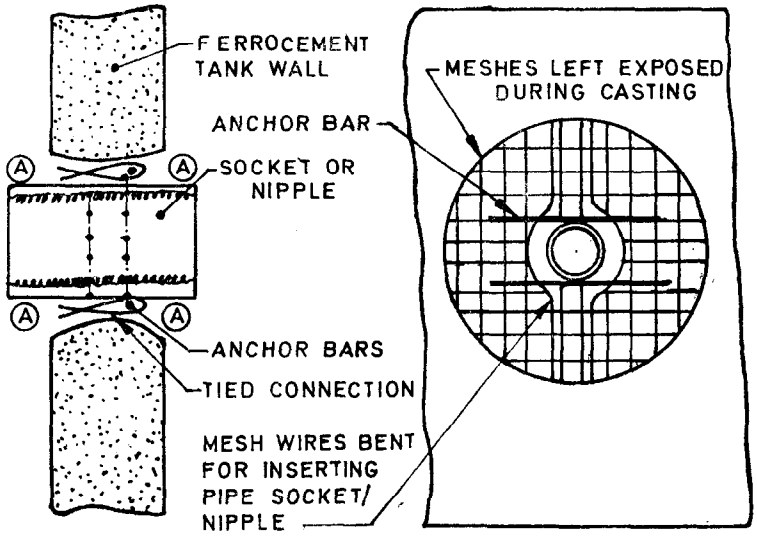


FIG. 1 INSERT WITH ANCHOR BAR



(A) Mortar to be applied after fixing the insert.

FIG. 2 FIXING OF AN INSERT

is always a dead storage of 50 mm water from the bottom of the tank. Overflow pipe with a non-corrosive mosquito-proof strainer shall be fixed with respect to the free board allowed in the design.

6.1.4 *Casting Platform*

Separate shuttering is not necessary while casting the tank since the cage is already made to the required shape. But, to begin with a casting of base slab, a plain and level platform is essential. Before casting of the tank the casting platform shall be coated with mould oil or covered with a plastic film.

6.1.5 Cement and sand shall be mixed dry in the desired proportion. Water is then added to the dry mixed mortar. The reinforcement cage shall be placed on a level platform with debonding media. The bottom slab of required thickness shall then be cast. In the second stage, the vertical walls shall be plastered with the cement mortar. A piece of plywood or galvanized iron sheet may be used as a back up and the mortar shall be forced into the cage from one side, and finished to the required thickness by following the same process from either side. A rough hard-core is thus made. Both inside and outside surfaces shall be rendered smooth after the initial setting of the

mortar. Extra care shall be taken in finishing the area around the pipe fixtures.

Cover slab shall be cast separately on a level platform and finished smooth. Cover shall be provided with a manhole opening of 500 or 600 mm depending on the capacity and requirement of the purchaser. Suitable matching lid shall be provided to cover the manhole opening according to mutual agreement between the purchaser and the manufacturer. Locking arrangement, if required, may also be provided by mutual agreement between the purchaser and the manufacturer.

For mass production of tanks, mechanical methods may be adopted for application of mortar instead of hand application.

6.2 Mechanized or Semi-Mechanized Casting

Mechanized or semi-mechanized casting processes may also be used for casting of ferrocement tanks in full or in segments. Vertical segments are assembled at site by overlapping the projected reinforcement and plastering the joints. The tempformer system and masonry moulds casting methods may also be used.

6.3 Curing and Transportation

Curing of the tank shall be done by using continuous water spray for 7 days followed by keeping it filled to the brim with water, with all openings plugged, for another 7 days. The tanks shall be protected from direct sunlight and wind. The units shall be ready for transportation after the curing period.

6.4 Finish

Each unit shall have no honeycombing and crevices likely to assist in the disintegration of mortar or rusting of reinforcement. The cover slab and lid shall be such that when positioned on the tank, no external dirt or water shall enter the tank and contaminate the water inside.

6.5 Painting

The interior surface of water tanks shall be painted using paint conforming to IS 9862 : 1981. The exterior surface of water tanks may be painted with cement paint conforming to IS 5410 : 1969.

7 TESTS

7.1 Strength of Mortar

Cubes of size 70·6 mm when tested according to the method given in IS 4031 (Part 6) : 1988 shall be not less than 25 N/mm^2.

During manufacture, tests on mortar cubes shall be carried out regularly. The manufacturer shall supply, when required to do so by the purchaser or his representative, the results of compressive tests of mortar cubes made from mortar used for the tanks. The manufacturer shall supply cubes for test purposes required by the purchaser.

7.2 Water Tightness Test

When filled with water, the external faces of the tanks shall show no sign of leakage and sweating and remain apparently dry over the period of observation of seven days after allowing a seven-day period for absorption of water after filling. This test shall be done before painting the interior of the tanks.

7.2.1 In case any leakage is observed during the test, a retest may be made, if agreed to by the purchaser, after necessary rectification by exposing the wire mesh at the desired locations and using the same mortar as used in the manufacture of the tank.

8 SAMPLING

8.1 Scale of Sampling

8.1.1 *Lot*

In a single consignment, all units of the same type, same dimensions and made from similar raw materials, not exceeding 500 units shall be grouped together to constitute a lot.

8.1.2 For ascertaining the conformity of the tanks in a lot to the requirements of this specification, samples shall be tested from each lot separately.

8.1.3 The number of units to be selected from a lot for checking dimensions and finish shall depend upon the size of the lot and shall be in accordance with Table 1.

8.1.3.1 The units in the sample shall be selected from the lot at random. In order to ensure the randomness of selection, all the units in the lot may be first arranged in an orderly manner. Starting from any unit in the lot, every rth unit may be included in the sample, r being integral part of the N/n, N being the number of units in the lot and n the sample size.

Table 1 Scale of Sampling and Criteria for Conformity

(*Clauses* 8.1.3 *and* 8.3.1.1)

Number of Units in the Lot	Requirements of Dimensions and Finish	
	Sample Size	Permissible Number
(*N*)	(*n*)	of Defectives
(1)	(2)	(3)
Up to 50	8	0
51 to 100	13	1
101 to 300	20	2
301 to 500	32	3

8.2 Number of Tests

8.2.1 All the units selected according to **8.1.3** shall be examined for dimensions and finish.

8.2.2 All the units in a lot shall be tested for water tightness.

8.3 Criteria for Conformity

8.3.1 The lot shall be declared as conforming to the requirements of this specification if **8.3.1.1** and **8.3.1.2** are satisfied.

8.3.1.1 The number of units which do not satisfy the requirements of both dimensions and finish shall not exceed the corresponding permissible number of defectives given in col 3 of Table 1.

8.3.1.2 All the units tested for water tightness satisfy the requirements of the test (*see* **7.2**).

9 MARKING

9.1 Each water tank shall be clearly and indelibly marked with the following particulars;

a) Indication of the source of manufacture,

b) Month and year of manufacture, and

c) Capacity.

9.1.1 Each water tank may also be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
269 : 1989	33 Grade ordinary Portland cement (*fourth revision*)
280 : 1978	Mild steel wire for general engineering purposes (*third revision*)
383 : 1970	Coarse and fine aggregates from natural sources for concrete (*second revision*)
432 (Part 1) : 1982	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part 1 Mild steel and medium tensile steel bars (*third revision*)
(Part 2) : 1982	Part 2 Hard-drawn steel wire (*third revision*)
455 : 1989	Portland slag cement (*third revision*)
456 : 1978	Code of practice for plain and reinforced concrete (*second revision*)
1489 (Part 1) : 1991	Portland pozzolana cement : Part 1 Fly ash based (*third revision*)
1489 (Part 2) : 1991	Portland pozzolana cement : Part 2 calcined clay based (*third revision*)
1566 : 1982	Hard-drawn steel wire fabric for concrete reinforcement (*second revision*)
2645 : 1975	Integral cement water proofing compounds (*first revision*)
4031 (Part 6) : 1988	Methods of physical tests for hydraulic cement : Part 6 Determination of compressive strength of hydraulic cement (other than masonry cement) (*first revision*)
5410 : 1969	Cement paint, colour as required
9103 : 1979	Admixtures for concrete
9862 : 1981	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting

ANNEX B

COMPOSITION OF THE TECHNICAL COMMITTEE

Cement and Concrete Sectional Committee, CED 2

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