भारतीय मानक

पूर्व ढलित कंकरीट मैनहोल के ढक्कन व फ्रेम — विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

PRECAST CONCRETE MANHOLE COVER AND FRAME — SPECIFICATION

(First Revision)

ICS 91.100.30

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 2002

Price Group 5

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement Matrix Products Sectional Committee had been approved by the Civil Engineering Division Council.

Cast iron manhole covers and frames are prone to pilferage and misuse due to its high resale value. Precast concrete manhole covers and frames which are found to satisfy the general requirements specified in IS 1726 : 1974 'Specification for cast iron manhole covers and frames: Part 1 General requirements (*first revision*)' have proved to be good substitute to cast iron manhole covers and frames. As such, use of such covers and frames is increasing day-by-day.

This standard has been prepared with a view to guiding the manufacture and use of precast reinforced cement concrete manhole covers and frames. This standard covers the requirements of precast concrete manhole covers and frames manufactured using reinforced cement concrete.

The manufacturing process of precast concrete manhole covers and frames is simple and requires only ordinary locally available machinery, such as concrete mixers, vibrators, appropriate moulds, hydraulic jacks, etc. These products can be produced in existing factories producing precast concrete products.

This standard was first published in two parts, namely, Part 1 Covers and Part 2 Frames, brought out in 1988 and 1991 respectively. This revision has been taken up in view of the change in grade and test load of manhole covers and frames in IS 1726 : 1991 'Specification for cast iron manhole covers and frames (*third revision*)', and to incorporate the modifications found necessary in light of the experience gained while using the earlier version of the standard. It was also felt that instead of having two separate standard for manhole covers and frames, requirements of both should be covered in one standard. Accordingly in this revision the requirements of both covers and frames are covered by merging the Part 1 and Part 2 of the erstwhile standard.

The Composition of the Committee responsible for the formulation of this standard is given in Annex D.

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 CONCRETE MANHOLE COVER AND FRAME — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements for precast steel reinforced cement concrete manhole covers and frames intended for use in sewerage and storm water drainage.

2 REFERENCES

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 editions of the standards indicated in Annex A.

3 GRADES AND TYPES

3.1 Manhole covers and frames shall be of the following four grades and types:

Grade	*Grade Designation*	*Type/Shape of Cover*
Light Duty	LD-2.5	Rectangular, Square, Circular
Medium Duty	MD-10	Rectangular, Circular
Heavy Duty	HD-20	Rectangular (Scrapper Manhole), Square, Circular and Lamphole
Extra Heavy Duty	EHD-35	Rectangular (Scrapper Manhole), Square and Circular

3.2 Recommended locations for placement of different grades and types/shapes of manhole covers and frames are as given in **3.2.1** to **3.2.4**.

3.2.1 *LD-2.5 Rectangular, Square or Circular Types*

Suitable for use within residential and institutional complexes/areas with pedestrian but occasional light motor vehicle traffic. These are also used for 'Inspection chambers'.

3.2.2 *MD-10 Circular or Rectangular Types*

Suitable for use in service lanes/roads, on pavements for use under medium duty vehicular traffic including for car parking areas.

3.2.3 *HD-20 Circular, Lamphole, Square or Rectangular (Scrapper Manhole) Types*

Suitable for use in institutional/commercial areas/ carriageways/city trunk roads/bus terminals with heavy duty vehicular traffic of wheel load between 50 to 100 kN, like buses, trucks and parking areas and where the manhole chambers are located in between the pavement and the middle of the road.

3.2.4 *EHD-35 Circular, Square or Rectangular (Scrapper Manhole) Types*

Suitable for use on carriageways in commercial/ industrial/port areas/near warehouses/godowns where frequent loading and unloading of trucks/trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads up to 115 kN irrespective of the location of the manhole chambers.

4 MATERIAL

4.1 Cement

Cement used for the manufacture of precast concrete manhole covers shall conform to IS 269 or IS 455 or IS 1489 (Part 1) or IS 1489 (Part 2) or IS 6909 or IS 8041 or IS 8043 or IS 8112 or IS 12330 or IS 12269.

4.2 Aggregates

The aggregates used shall be well graded. The nominal maximum size of coarse aggregate shall not exceed 20 mm. The aggregates shall be clean and free from deleterious matter and shall conform to the requirements of IS 383.

4.3 Concrete

The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combs, etc (*see* IS 456). The minimum cement content in the concrete shall be 360 kg/m^3, with a maximum water cement ratio of 0.45. Concrete weaker than grade M30 shall not be used. Compaction of concrete shall be done by machine vibration.

4.4 Reinforcement

The reinforcing steel shall conform to Grade A of IS 2062 or IS 432 (Part 1) or IS 432 (Part 2) or IS 1786 as appropriate.

4.4.1 Reinforcement shall be clean and free from loose mill scale, loose rust, mud, oil, grease or any other coating which may reduce or destroy the bond between concrete and steel. A slight film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

4.5 Steel Fibres

The diameter/equivalent diameter of steel fibres where 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 properiety fibres, manufacturer's recommendations shall be taken into account.

4.6 Admixtures

Where admixtures are used, they shall conform to IS 9103.

4.7 Water

The water used shall be free from matter harmful to concrete or reinforcement or matter likely to cause efflorescence in the units and shall conform to the requirements of IS 456.

5 SHAPES AND DIMENSIONS

5.1 Shapes

The precast concrete manhole covers and frames shall be of any shape given in **3.1**.

5.2 Dimensions and Tolerances

The dimensions and tolerances on dimensions of frames shall be as shown in Table 1 but outside dimensions of cover at top shall match with the corresponding frame so that the maximum clearance at top between the frame and the cover all round the periphery is not more than 5 mm and the top surface of the frame and cover is in level within a tolerance of ± 5 mm.

For facility of removing the cover from the frame, suitable taper matching with taper given for the frame shall be provided to the periphery of the cover (*see* Fig. 1).

6 DESIGN

The reinforced concrete manhole cover and frame shall be designed in accordance with the provisions of IS 456. If required by the purchaser, the manufacturer shall furnish the specification and drawings principle given in IS 456 may be followed.

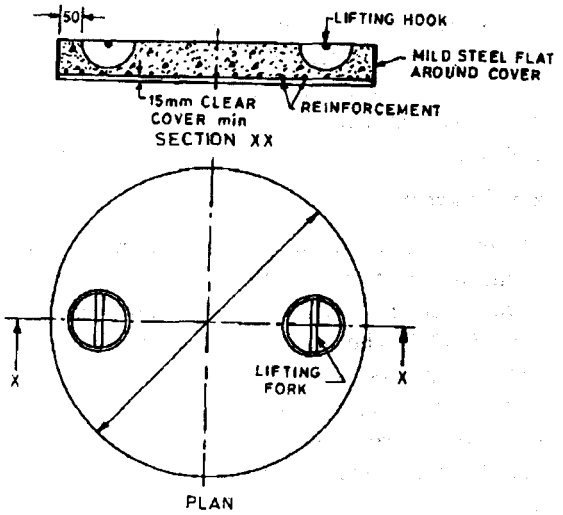
7 MANUFACTURE

7.1 Mixing

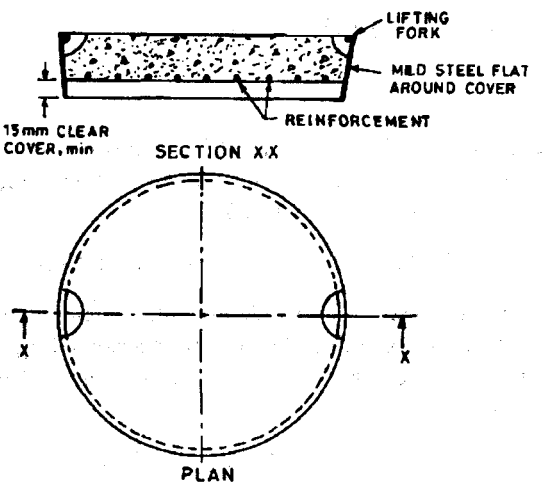
Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. If steel fibres are used in addition to reinforcement, it shall conform to the requirements given in **4.5**.

7.2 Placing and Compaction

The reinforcement shall be placed in proper position in an appropriate mould coated with a thin layer of mould oil in case of frames and within the protective sheet (*see* **7.4.2**) in case of covers. Concrete shall be filled to slightly overfill and compacted by vibration and struck off level with a trowel.



1A



1B

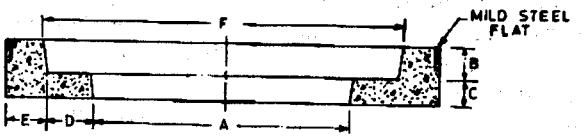
All dimensions in millimetres.

FIG. 1 TYPICAL ILLUSTRATION OF CIRCULAR PRECAST CONCRETE MANHOLE COVER

Table 1 Dimensions of Frame

(*Clause* 5.2)

All dimensions in millimetres.



Grade Designation	Description	Clear Opening in Frame	*B*	*C*	*D*	*E* Min	*F* Min
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LD-2.5	Light Duty Rectangular	450 × 450	50	50	50	50	566
LD-2.5	Light Duty Square	450 × 450	50	50	50	50	566 × 566
		400 × 400	50	50	50	50	516 × 516
LD-2.5	Light Duty Circular	370	50	50	50	50	486
		560	50	50	50	50	676
		500	50	50	50	50	616
		450	50	50	50	50	566
MD-10	Medium Duty Rectangular	450 × 600	70	50	50	50	570 × 720
MD-10	Medium Duty Circular	450	70	50	50	50	570
		500	70	50	50	50	620
		560	70	50	50	50	680
		600	70	50	50	50	720
HD-20	Heavy Duty Rectangular (Scrapper)	900 × 450	90	75	75	75	1 080 × 630
HD-20	Heavy Duty Square	560 × 560	90	75	75	75	740 × 740
HD-20	Heavy Duty Circular	450	90	75	75	75	630
		500	90	75	75	75	680
		560	90	75	75	75	740
		600	90	75	75	75	780
HD-20	Heavy Duty Lamphole	350	90	75	75	75	530
EHD-35	Extra Heavy Duty Rectangular	900 × 560	100	75	75	75	1 078 × 738
EHD-35	Extra Heavy Duty Square	560 × 560	100	75	75	75	738 × 738
EHD-35	Extra Heavy Duty Circular	450	100	75	75	75	628
		500	100	75	75	75	678
		560	100	75	75	75	738
		600	100	75	75	75	778

NOTES

1 Tolerance on *C* shall be ±5 mm, tolerance on *A*, *B*, *D* and *E* shall be $^{+5}_{-0}$ mm.

2 For facility of removing the manhole cover suitable upward taper not more than 5° may be provided to the inner periphery of the frame.

3 If required for the removal of the moulds suitable taper not more than 5° can be given at the lower inner periphery of the frame (*see* figure).

7.2.1 Use of needle vibrators for compacting the wet concrete mix containing fibres is not recommended since the holes left by the vibrator in the wet mix may not close after its removal owing to the interlocking of the fibres with the mix. Compaction by means of shutter or form or table vibrators is recommended. In case of extra heavy duty and heavy duty cover and frame, compaction by means of pressure-cum-vibration technique may also be employed so as to achieve dense and strong concrete.

7.2.2 Clear cover to reinforcement shall be not less than 15 mm.

7.2.3 After demoulding, cover and frame shall be protected until they are sufficiently hardened to permit handling without damage.

7.3 Curing

7.3.1 The hardened concrete manhole cover and frame shall be placed in a curing water tank. The period of curing shall be as given in IS 456.

7.3.2 Steam curing of manhole cover and frames may be adopted instead of method specified in **7.3.1**, followed by normal curing for 7 days provided the requirements of pressure or non-pressure steam curing are fulfilled and the manhole cover and frames meet the requirements specified in this standard.

7.4 Edge Protection and Finishing

7.4.1 *Frame*

The top and inside surface of frames shall be smooth. To prevent the top outer edge from possible damages, it shall be protected by 25 mm × 3 mm mild steel flat as part of the frame. Sufficient number of steel connectors shall be welded to the inner surface of the mild steel flat so as to connect it with the frame reinforcement and these shall be embedded in the concrete during casting. Exposed surface of mild steel flat shall be given suitable treatment with anticorrosive paint or coating.

7.4.2 *Cover*

To prevent any possible damage from corrosion of reinforcing steel, the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish.

In order to protect the edges of the covers from possible damage at the time of lifting and handling, it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2 mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anti-corrosive paint or coating.

7.4.3 Suitable arrangements may be made for fixing the manhole cover and frame in position on the manholes by mutual agreement between the manufacturer and the purchaser.

7.4.4 The manufacture of manhole cover and frame shall be such as to ensure the compatibility of their seatings. For classes HD 20 and HD 35, these seatings shall be manufactured in such a way as to ensure stability and quiteness in use. This may be achieved by grinding the contact surface, if needed.

8 LIFTING HOOKS

The minimum diameter of mild steel rod used as lifting device shall be 12 mm for light and medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by hot dip galvanizing or any other suitable means approved by the purchaser or shall be made of naturally corrosion resistant metal rods.

The lifting arrangement shall be as agreed between the manufacturer and the purchaser. Typical arrangements of lifting devices are shown in Fig. 1A and 1B.

9 PHYSICAL REQUIREMENTS

9.1 General

All the covers and frames shall be sound and free from cracks and other defects which interferes with the proper placing of the unit or impair the strength or performance of the units. Minor chippings resulting from the customary method of handling and transportation shall not be deemed ground for rejection.

9.2 Dimensions

The dimensions of the cover and frame shall be as specified in 5; the overall dimensions of the units shall be measured in accordance with Annex B.

9.3 Load Test

The breaking load of individual units when tested in accordance with the method described in Annex C shall be not less than the values specified in Table 2. Also, the permanent set shall not exceed the requirement given in Annex C.

Table 2 Test Load and Diameter of Block
(*Clauses* 9.3, 12.3 *and* C-1.1)

Grade of Cover	Type	Load	Diameter of Block
		kN	mm
(1)	(2)	(3)	(4)
LD-2.5	Rectangular, square or circular	25	300
MD-10	Rectangular or circular	100	300
HD-20	Rectangular, square or circular	200	300
EHD-35	Rectangular, square or circular	350	300

10 TESTS

Tests shall be conducted on samples of covers and frames selected according to the sampling procedure given in **11**, to ensure conformity with the physical requirements laid down in **9**.

11 SAMPLING AND INSPECTION

11.1 Scale of Sampling

11.1.1 *Lot*

In any consignment, 500 percast concrete manhole covers and frames or a part thereof the same dimensions and belonging to the same batch of manufacture, shall be grouped together to constitute a lot.

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

11.1.3 The number of covers and frames to be selected from the lot shall depend on the size of the lot and shall be according to Table 3.

Table 3 Scale of Sampling and Permissible Number of Defectives

(*Clauses* 11.1.3, 11.4.2 *and* 12.2)

No. of Covers or Frames in the Lot	Dimensional Requirements		Number of Samples for Load Test on Cover Only
	Sample Size	Acceptance Number	
(1)	(2)	(3)	(4)
Up to 100	10	1	2
101 to 200	15	1	3
201 to 300	20	2	4
301 to 500	30	3	5

NOTE — If the number of covers in the lot is 20 or less, the number of samples for load test shall be decided by mutual agreement between the purchaser and the manufacturer.

11.2 Sampling Covers and Frames in Motion

Whenever practicable, samples of covers and frames shall be taken when the units are being moved as in the case of loading, unloading, etc. The batch from where the samples are to be drawn shall be divided into a number of convenient portions such that when one sample is drawn from each of these portions, the minimum number of units specified under **11.1.3**, is provided.

11.3 Sampling Covers and Frames from a Stack

The number of covers and frames required for the test shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

11.4 Number of Tests

11.4.1 All the covers and frames selected according to **11.1.3**, shall be checked for dimensions (*see* **9.2**) and inspected for visual defects (*see* **9.1**).

11.4.2 The number of covers to be subject to load test shall be according to col 4 of Table 3.

12 CRITERIA FOR CONFORMITY

12.1 The lot shall be considered as conforming to the requirements of the specification conditions mentioned in **12.2** and **12.3** are satisfied.

12.2 The number of covers and frames with dimensions outside the tolerance limit and/or with visual defects among those inspected shall be less than or equal to the corresponding acceptance number given in col 3 of Table 3.

12.3 For load test no value shall be less than the load specified in Table 2.

13 MANUFACTURER'S CERTIFICATE

The manufacturer shall satisfy himself that the manhole cover and frame conform to the requirements of this specification, and if requested, shall supply a certificate to this effect to the purchaser or his representative.

14 MARKING

14.1 Following information shall be clearly and permanently marked on top of each manhole cover and frame:

a) Identification of the source of manufacture;
b) Grade designation denoted by LD 2.5/MD 10/HD 20/EHD 35;
c) Any identification mark as required by the purchaser; and
d) Year and month of manufacture of the manhole cover and frame marked at any appropriate location.

14.2 BIS Certification Marking

The manhole cover and frame may also be marked with the Standard Mark.

14.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
269 : 1989	Specification for ordinary Portland cement, 33 grade (*fourth revision*)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (*second revision*)
432	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement:
(Part 1) : 1982	Mild steel and medium tensile steel bar (*third revision*)
(Part 2) : 1982	Hard-drawn steel wire (*third revision*)
455 : 1989	Specification for Portland slag cement (*fourth revision*)
456 : 2000	Code of practice for plain and reinforced concrete (*fourth revision*)
1489	Specification for Portland-pozzolana cement:
(Part 1) : 1991	Flyash based (*third revision*)
(Part 2) : 1991	Calcined clay based (*third revision*)
1786 : 1985	Specification for high strength deformed steel bars and wires for concrete reinforcement (*third revision*)
2062 : 1992	Specification for steel for general structural purposes (*fourth revision*)
6909 : 1990	Specification for supersulphated cement (*first revision*)
8041 : 1990	Specification for rapid hardening Portland cement (*second revision*)
8043 : 1991	Specification for hydrophobic Portland cement (*second revision*)
8112 : 1989	Specification for 43 grade ordinary Portland cement (*first revision*)
9103 : 1999	Specification for admixtures (*first revision*)
12269 : 1987	Specification for 53 grade ordinary Portland cement
12330 : 1988	Specification for sulphate resistance Portland cement

ANNEX B

(*Clause* 9.2)

MEASUREMENT OF DIMENSIONS

B-1 PROCEDURE

B-1.1 Individually measurements of the dimensions of each unit shall be made with a steel scale graduated in 1 mm divisions and shall be read to the nearest division of scale and the average recorded.

B-1.2 Length and diameter shall be measured on the longitudinal centre line of each face, width of square or rectangular manhole covers across the top and bottom bearing at midlength and thickness on both faces at midlength.

B-2 REPORT

The report shall show the average length, width, or diameter and thickness of each specimen.

ANNEX C

(*Clause* 9.3)

METHOD FOR LOAD TEST

C-1 PROCEDURE

C-1.1 A suitable testing arrangement is shown in Fig. 2. The cover shall be supported in a frame which may be standard frame or a specially made testing appliance simulating normal conditions of use. The specified load as given in Table 2 shall be applied without shock through the medium of a bearing block faced with hard rubber or other resilient material. The bearing block shall be of the size specified in Table 2 and shall bear centrally on the cover. The block shall be sufficiently rigid to ensure that the load on the cover is uniformly distributed over the full area of the block.

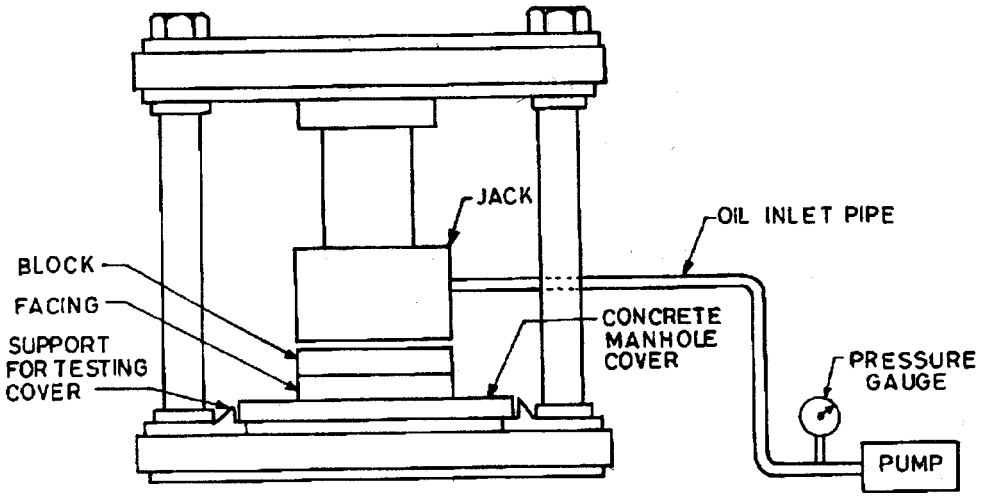


FIG . 2 ARRANGEMENT FOR LOAD TEST OF MANHOLE COVER

C-1.2 All covers shall be submitted to the following tests:

a) Measurement of the permanent set of the cover after the application of 2/3 of the test load.

b) Application of test load.

C-1.2.1 *Measurement of Permanent Set of the Cover After the Application of 2/3 of the Test Load.*

Before the load is applied take an initial reading at the geometric centre of the cover.

The load shall be applied at the rate of approximately 0.6 ± 0.4 N/mm/s up to 2/3 of the test load. The load on the test specimen is then released. This procedure shall be carried out five times. Then take reading at the geometric centre.

The permanent set shall then be determined on the difference of the measured readings before the first and the fifth loading. The permanent set shall not exceed 1/100 times the diameter of the largest circle that can be inscribed in the clear area of the frame as shown in Fig. 3.

C-1.2.2 *Application of the Test Load*

Immediately after the test according to **C-1.2.1**, the test load shall be applied at the same rate given in **C-1.2.1**, the test load shall be applied until it is achieved. The test load to be maintained for 30 ± 2 s. Cover shall not show cracks in the course of the test.

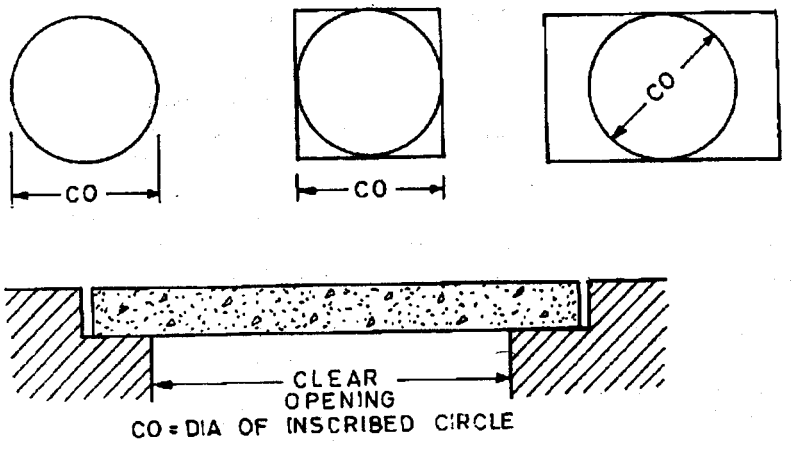


FIG. 3 ILLUSTRATION OF LARGEST INSCRIBED CIRCLE IN CLEAR AREA

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Cement Matrix Products Sectional Committee, CED 53

Organization	*Representative(s)*
Gammon India Ltd, Mumbai	SHRI S. A. REDDI (***Chairman***)
All India Small Scale AC Pressure Pipe Manufacturers' Association, Secunderabad	SHRI N. KISHAN REDDY SHRI P. S. KALANI (*Alternate*)
B.G. Shirke Construction Technology Ltd, Pune	SHRI G. R. BHARITKAR COL D. V. PADSALGIKAR (RETD) (*Alternate*)
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Directorate General of Supplies & Disposals, New Delhi	SHRI S. M. MUNJAL SHRI R. K. AGARWAL (*Alternate*)
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Eternit Everest Ltd, New Delhi	SHRI K. SRIVASTAVA
Fedaration of UP Pipe Manufacturers, Lucknow	SHRI S. P. RASTOGI
Fly Ash Mission, Department of Science and Technology, New Delhi	SHRI VIMAL KUMAR SHRI MUKESH MATHUR (*Alternate*)
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Housing and Urban Development Corporation, New Delhi	SHRI V. SURESH SHRI S. K. TANEJA (*Alternate*)
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National Test House, Kolkata	SHRI D. K. KANUNGO SHRI T. CHOUDHURY (*Alternate*)
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The Indian Hume Pipe Co Ltd, Mumbai	SHRI P. D. KELKAR SHRI P. R. C. NAIR (*Alternate*)
In personal capacity (*F-12, Naraina Vihar, New Delhi 110028*)	SHRI Y. R. TANEJA
BIS Directorate General	SHRI S. K. JAIN, Director & Head (Civ Engg) [Representing Director General (*Ex-officio Member*)]

Member-Secretary
SHRI SANJAY PANT
Deputy Director (Civ Engg), BIS

(Continued on page 9)

(*Continued from page* 8)

Precast Concrete Products Subcommittee, CED 53:3

Organization	*Representive(s)*
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Central Public Works Department, Chandigarh	SUPERINTENDING ENGINEER (Plg & Admn) EXECUTIVE ENGINEER (Plg) (*Alternate*)
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