भारतीय मानक **IS 18894 : 2024**

Indian Standard

प्रीकास्ट कंक्रीट पेविंग ग्रिड्स और ग्रास पेवर्स — विशिष्टि

Precast Concrete Paving Grids and Grass Pavers — Specification

ICS 93.080.20

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
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September 2024 **Price Group 7**

Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

FOREWORD

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

Concrete paving grids and grass pavers originated from the need to reduce urban heat generated by high concentration of buildings and pavements as well as to assist in storm water drainage arising from impervious pavement surfaces.

Perforated concrete units or paving grids first appeared in 1961 in Stuttgart Germany in a car parking lot. Thereafter, concrete grids were applied in North America as a method for reducing lakeside erosion as well as for ditch liners.

Now precast concrete paving grids and grass pavers are used in India and world over for driveways, car parking areas, shoulders along highways, intersections, emergency fire lanes and for access roads adjacent to buildings.

In the formulation of this standard, assistance has been derived from the following publications:

ASTM C140/C140M-15, 'Standard test methods for sampling and testing concrete masonry units and related units'

ASTM C1319-17, 'Standard specification for concrete grid paving units'

This standard contributes to the United Nations Sustainable Development Goal 9: 'Industry, innovation and infrastructure', particularly its target to develop quality, reliable, sustainable and resilient infrastructure, and also promote inclusive and sustainable industrialization.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

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 : 2022 'Rules for rounding off numerical values (*second revision*)'. 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 PAVING GRIDS AND GRASS PAVERS — SPECIFICATION

1 SCOPE

This standard covers requirements for precast concrete paving grids and grass pavers for use in construction of walkways/footpath, parking areas, soil stabilization, embankments, and revetments.

2 REFERENCES

The 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

For the purpose of this standard, the following definitions shall apply.

3.1 Backing Layer — Layer of concrete on the lower face of a double layer paving grid, made of material same as or different from that used in the wearing layer of the grid.

3.2 Bed Face — The surface of a paving grid which, when paved, comes in direct contact with the bedding material.

3.3 Double Layer — Units which contain a wearing layer as well as a backing layer.

3.4 Grass Paver — Concrete paving grids designed to facilitate the growth of grass, which are laid over gravel, sand and/or topsoil base.

3.5 Paving Grids — Flat concrete lattice with honeycombed cavities within a supporting concrete matrix.

3.6 Thickness — Vertical distance between the upper face and bed face of a paving grid/grass paver.

3.7 Wearing Face — The surface of a paving grid which, when paved, faces the atmosphere and is directly subjected to vehicular or pedestrian traffic.

3.8 Wearing Layer — Layer of concrete or mortar on the upper face of a double layer paving grid, made of material same as or different from that used in the backing layer of the grid.

3.9 Web — The solid sections between openings in a paving grid/grass paver.

4 MATERIALS

4.1 Cement

Cement used in the manufacture of paving grids shall be any of the following:

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);

e) Rapid hardening Portland cement conforming to IS 8041; and

f) Composite cement conforming to IS 16415.

4.2 Mineral Admixtures

Mineral admixtures may be used as a part replacement of ordinary Portland cement in the manufacture of paving grids, provided uniform blending with cement is ensured. They shall be any of the following:

a) Pulverized fuel ash conforming to IS 3812 (Part 1);

b) Pulverized fuel ash conforming to IS 3812 (Part 2);

c) Silica fume conforming to IS 15388;

d) Ground granulated blast furnace slag conforming to IS 16714;

e) Metakaolin conforming to IS 16354; and

f) Rice husk ash conforming to the requirements of IS 456.

4.3 Chemical Admixtures

Chemical admixtures, if used in the manufacture of paving grids, shall conform to IS 9103.

4.4 Aggregates

4.4.1 *Coarse Aggregates*

a) Coarse aggregates shall comply with the requirements of IS 383; and

b) The nominal maximum size of coarse aggregate used in production of paving grids shall be 12.5 mm. However, the nominal maximum size of the coarse aggregate may be increased up to 20 mm in case of single layer paving grids and two-layer paving grids having thickness of backing layer of 80 mm or above.

4.4.2 *Fine Aggregates*

Fine aggregates shall conform to the requirements of IS 383.

4.5 Pigments

4.5.1 Pigments, if used either singly or in combination in the manufacture of paving grids, shall have durable color and free from matters detrimental to concrete. They shall be any of the following:

a) Black or red or brown pigment conforming to IS 44;

b) Green pigment conforming to IS 54;

c) Blue pigment conforming to IS 55 or IS 56 or IS 3574 (Part 2);

d) White pigment conforming to IS 411; and

e) Yellow pigment conforming to IS 3574 (Part 1).

4.5.2 Pigment quantity shall be restricted to a maximum of 9 percent by weight of cement content. The fineness of pigment should be more than the fineness of cement.

4.5.3 The pigments shall not contain zinc compounds or organic dyes. Lead pigments shall not be used.

4.6 Water

Water used in the manufacture of concrete grids for paving shall conform to the requirements of IS 456.

5 MANUFACTURE

5.1 Concrete shall be mixed in a mechanical mixer and mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency. The concrete, so obtained, shall be filled to slightly overfill the suitable moulds, compacted by hydraulic or vibration machine and struck off level with a trowel, if required. The proportioning of the various mix constituents used, mentioned in 4, shall be so carried out as to obtain concrete having zero slump (in case hydraulic machine is used), or slump as low as possible (in case vibration equipment is used) and required compressive strength at 28 days in accordance with this standard.

5.2 The paving grids, on removal from the moulds, shall be kept in moist condition continuously for such a period that would ensure their conformity to the requirements of this standard.

5.3 The paving grids may be manufactured in single layer or two layers. When two-layer paving grids are manufactured, there shall be proper bonding and demarcation between the two layers. There shall be no delamination between the two layers.

6 GENERAL QUALITY AND FINISH

6.1 General Quality

All paving grids and grass pavers shall be sound and free of cracks or other visual defects which interfere with the proper paving of the unit or impair the strength or performance of the pavement paved with the paving grids and grass pavers.

6.2 Visual Inspection

Visual inspection of quality of paving grids and grass pavers shall be carried out in natural daylight, prior to the tests for other properties. The paving grids and grass pavers shall then be laid out on a level floor in any desired paving pattern, approximately covering a square area of 1 m^2. Any visual defects of paving grids and grass pavers, including cracks and flaking, shall be recorded by observing the paved grids and pavers from a distance of approximately 1.2 m from each edge of the paved area.

6.3 Colour and Texture

The colour and texture of the pigmented paving grids and grass pavers shall be as mutually agreed between manufacturer and the purchaser.

7 DIMENSIONS AND TOLERANCES

The paving grids and grass pavers shall comply with the dimensions and tolerance requirements given in Table 1, when tested in accordance with the methods given in Annex B.

8 PHYSICAL REQUIREMENTS

8.1 All units shall be sound and free of cracks or other defects which interfere with the proper placing of the unit or 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. All angles of the units, with exception of angles resulting from the splayed or chamfered faces, shall be true right angles.

8.2 The minimum compressive strength of a sample lot should average 35 MPa with no individual unit less than 30 MPa, when tested in accordance with the methods given in Annex C.

8.3 Their average water absorption of a sample lot should not exceed 6 percent with no individual unit exceeding 7 percent, when tested in accordance with the methods given in Annex D.

8.4 The grid openings shall be designed such that the solid area of the grid is at least 50 percent.

9 SAMPLING

9.1 All concrete paving grids and grass pavers of same size/shape, manufactured under identical condition, from raw material of same source in a week, shall constitute one batch.

9.2 When the product has been submitted to an assessment of conformity by a third party, further testing is not required. In case of dispute between the purchaser and manufacturer, testing may be carried out and required number of blocks shall be sampled from each batch of the consignment of blocks up to a quantity of 6 000 grids.

9.3 When the product has not been submitted to an assessment of conformity by a third party, the required number of paving grids shall be sampled from each batch of the consignment of paving grids up to a quantity of 6 000 grids.

9.4 When the quantity of a partial batch is less than half of the quantities mentioned in **9.2** and **9.3**, that partial batch of the consignment shall be added to the previous full batch.

9.5 The sample of paving grids for inspection and testing shall be chosen from a batch at random. For guidance in procedure of random selection, IS 4905 may be referred.

9.6 The number of paving grids to be sampled from each batch for each test shall be as given in Table 2. If the samples drawn for testing one characteristic can be utilized for testing any other characteristic, without introducing any prejudice in the test results of the latter, it would not be necessary to take fresh samples for the latter characteristics.

Table 1 Dimensions and Tolerances

(*Clause* 7)

Sl No.	Dimensions	Requirements	Tolerances	
			Thickness < 100 mm	Thickness ≥ 100 mm
(1)	(2)	(3)	(4)	(5)
i)	Length *L* mm, *Max*	610	± 2	± 3
ii)	Width *W* mm, *Max*	610	± 2	± 3
iii)	Thickness *T* mm, *Min*	60	± 2	± 3
iv)	Thickness of wearing layer, mm, *Min*	6	–	–
v)	Thickness of web between openings, mm, *Min*	25	–	–

NOTE — For length *L* and width *W*, the difference between the overall dimensions, when measured across the top and bottom bearing surfaces, should not exceed 6 mm.

10 CRITERIA FOR CONFORMITY

10.1 The lot shall be considered as conforming to the requirements of the specification, if the conditions mentioned in 6, 7 and 8 are satisfied.

10.2 Paving grids and Grass pavers with visual defects in the sample lot shall not be more than one.

10.3 If any test sample fails to comply with the requirements of either of the tests specified in 8.2 and 8.3, then one more set of test samples from the batch/lot comprising the same order shall be tested further.

10.4 If these further test samples comply with the requirements of the tests, the whole of the batch/lot represented by the samples shall be accepted, otherwise the whole batch/lot shall be rejected.

11 MANUFACTURER'S CERTIFICATE

The manufacturer shall supply test certificate/invoice with each batch mentioning the batch number and date of manufacture, to enable to trace back the same to factory records. Also, 0.5 percent of concrete paving flags from each batch shall be marked with batch number and date of manufacture.

12 MARKING

12.1 Concrete paving grids or grass pavers/package shall be marked with the following information suitably:

a) Name of the manufacturer or his trademark;

b) Brand name, if any; and

c) Identification in code or otherwise, to enable to trace back the date of manufacture, batch number to factory records (optional).

12.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product may be marked with the Standard Mark.

Table 2 Sampling Requirements

(*Clause* 9.6)

Sl No.	Property	Ref to Clause No.	No. of Paving Grids for Test
(1)	(2)	(3)	(4)
i)	Visual inspection	6	3
ii)	Dimensions	7	3
iii)	Compressive strength	8.2	3
iv)	Water absorption	8.3	3

ANNEX A

(*Clause 2*)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 44 : 1991	Iron oxide pigments for paints — Specification (*second revision*)
IS 54 : 1988	Specification for green oxide of chromium for paints (*second revision*)
IS 55 : 1970	Specification for ultramarine blue for paints (*first revision*)
IS 56 : 1993	Prussian blue (iron blue) for paints — Specification (*second revision*)
IS 269 : 2015	Ordinary Portland cement — Specification (*sixth revision*)
IS 383 : 2016	Coarse and fine aggregates for concrete — Specification (*third revision*)
IS 411 : 2020	Titanium dioxide, anatase, for paints — Specification (*fourth revision*)
IS 455 : 2015	Portland slag cement — Specification (*fifth revision*)
IS 456 : 2000	Plain and reinforced concrete — Code of practice (*fourth revision*)
IS 1489	Portland pozzolana cement — Specification:
(Part 1) : 2015	Fly ash based (*fourth revision*)
(Part 2) : 2015	Calcined clay based (*fourth revision*)
IS 2185 (Part 1) : 2005	Concrete masonry units — Specification: Part 1 Hollow and solid concrete blocks (*third revision*)
IS 3574 (Part 1) : 1965	Specification for organic pigments for paints: Part 1 Azo pigments (toluidine red, chlorinated p-nitroaniline red, arylamide yellow, and para red)
IS 3574 (Part 2) : 2000	Organic pigments for paints — Specification: Part 2 Phthalocyanines (*first revision*)
IS 3812	Pulverized fuel ash — Specification:
(Part 1) : 2013	For use as pozzolona in cement, cement mortar and concrete (*third revision*)
(Part 2) : 2013	For use as admixture in cement mortar and concrete
IS 4905 : 2015	Random sampling and randomization procedures (*first revision*)
IS 8041 : 1990	Rapid hardening Portland cement — Specification (*second revision*)
IS 9103 : 1999	Concrete admixtures — Specification (*first revision*)
IS 15388 : 2003	Silica fume — Specification
IS 15658 : 2021	Concrete paving blocks — Specification (*first revision*)
IS 16354 : 2015	Met kaolin for use in cement, cement mortar and concrete — Specification
IS 16415 : 2015	Composite cement — Specification
IS 16714 : 2018	Ground granulated blast furnace slag for use in cement, mortar and concrete — Specification

ANNEX B

(*Clause 7*)

METHOD FOR DETERMINATION OF VARIOUS DIMENSION REQUIREMENTS

B-1 MEASUREMENT OF LENGTH, WIDTH, THICKNESS AND ASPECT RATIO

B-1.1 Apparatus

The apparatus shall comprise the following:

a) Steel caliper; and

b) Steel rule capable of measuring up to 300 mm to an accuracy of 0.5 mm.

B-1.2 Procedure

B-1.2.1 *Length, Width and Thickness*

For each unit, measure and record the width (*W*) across the top and bottom bearing surfaces at the maximum width of the unit, thickness (*T*) at mid-length of each face, and length (*L*) at the maximum length of the unit across the top and bottom bearing surfaces to the nearest 1 mm. *See* Fig. 1.

B-2 MEASUREMENT OF THICKNESS OF WEARING LAYER

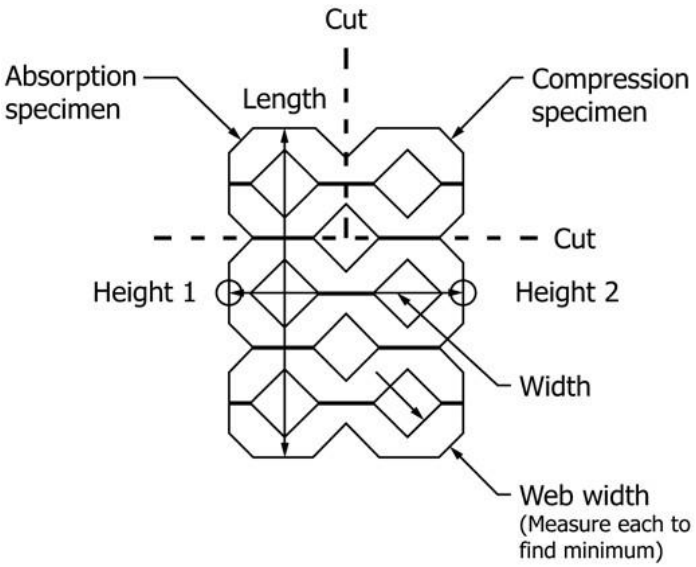
The thickness of the wearing layer for two-layer paving grids shall be measured at 4 points along the length of the grid. The thickness of the wearing layer shall not be measured on the chamfer. The mean of the two measurements which yielded the lowest value shall be the minimum thickness of the wearing layer.

B-3 MEASUREMENT OF WEB THICKNESS

For each grid, measure the width of each web at the thinnest point. Record the minimum value measured. For the web with the minimum thickness, measure and record two additional web readings. The two additional readings shall be at the maximum width of the web and at mid-height of the web. Measure and record all web width measurements to nearest 1 mm. Disregard grooves, scores, etc. in the measurements.

B-4 REPORT

Report individual and mean values of measured dimensions, thickness of wearing layer and web thickness.



NOTE — Fig. 1 shows a representative example of how to properly measure and obtain specimens from a common grid shape. There are many other shapes and sizes of grid paving units available which may require different procedures for measuring and obtaining specimens. Suppliers should be consulted for recommended specimen sampling procedures.

FIG. 1 TYPICAL GRID PAVER CONFIGURATION

ANNEX C

(*Clause* 8.2)

METHOD FOR DETERMINATION OF COMPRESSIVE STRENGTH

C-1 APPARATUS

C -1.1 Compression Testing Machine

The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable that the blocks have a minimum hardness of 60 HRC and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted. When the bearing area of the steel blocks is not sufficient to cover the bearing area of the paving grid or its saw-cut specimen as detailed in C-2, two steel bearing plates meeting the requirements of C-1.2 shall be placed between the steel bearing blocks fitted on the machine and the specimen.

C-1.2 Steel Bearing Blocks and Plates

The surfaces of the steel bearing blocks and plates shall not depart from the plane by more than 0.025 mm in any 15 mm dimension. The center of the sphere of the spherically seated upper bearing block shall coincide with the center of the bearing surface. If bearing plate is used, the center of the sphere of the upper bearing block shall be on a line passing vertically through the centroid of the specimen bearing face. The spherically seated block shall be held closely in its seat but shall be free to turn in any direction. The diameter of the face of the bearing blocks shall be at least 150 mm. When steel plates are employed between the steel bearing blocks and the specimen, the plates shall have a thickness equal to at least one-third the distance from the edge of the bearing block to the most distant corner of the specimen. In no case shall the plate thickness be less than 12 mm.

C-2 SPECIMENS

When compression testing full-sized units that are too large for the test machine's bearing block and platens or are beyond the load capacity of the test machine, saw-cut the units to properly size them to conform to the capabilities of the testing machine as shown in Fig. 1. The resulting specimen shall be symmetrical, have no projections or irregular features, and shall be a fully enclosed cell or cells. The compressive strength of the segment shall be considered to be the compressive strength of the whole unit.

C-3 CAPPING OF SPECIMENS

C-3.1 When specimen with surface projections or surface relief features has to be tested, its bearing surfaces shall be made plain by suitable capping, such as by using sulphur or gypsum, before testing as described in **C-3.1** and **C-3.2** of Annex D of IS 2185 (Part 1).

C-3.2 Alternatively, 3 mm thick plywood sheets of size larger than the specimens by a margin of at least 5 mm from all edges of the specimen shall be used for capping the specimens.

C-4 PROCEDURE

C-4.1 Position of Specimens

Test specimens with the centroid of their bearing surfaces aligned vertically with the center of thrust of the spherically seated steel bearing block of the testing machine. Prior to testing each unit, ensure that the upper platen moves freely within its spherical seat to attain uniform seating during testing.

C-4.2 Moisture Condition of Specimens

The blocks shall be stored for 24 h ± 4 h in water maintained at a temperature of 27 °C ± 2 °C. The bearing plates of the testing machine shall be wiped clean.

C-4.3 Speed of Testing

The load shall be applied without shock and increased continuously at a rate of 15 MPa/min ± 3 MPa/min until no greater load can be sustained by the specimen or delamination occurs.

C-4.4 Maximum Loads

Record the maximum compressive load in Newton as P_{max}.

C-5 CALCULATION

C-5.1 Average Net Area, A_n (Method 1)

This method will be used to calculate the Average Net Area when the cross-sectional area in every plane parallel to the bearing surface is the same throughout the thickness of the specimen. The

specimen shall be placed, wearing face facing up, on the cardboard and its perimeter and cavity outlines traced with the pencil. The shape and cavities shall be cut out accurately with the scissors/cutters and weighed to the nearest 0.000 1 N, and the result recorded as mass, m_{sp}. A rectangle measuring 200 mm × 100 mm, accurately cut out from the same cardboard, shall also be weighed to the nearest 0.000 1 N, and the result recorded as mass, m_{std}. The average net area for the block shall be calculated from the formula:

$$A_n = 20\,000 \times m_{sp}/m_{std} \text{ mm}^2$$

C-5.2 Average Net Area, A_n (Method 2)

This method will be used to calculate the average net area when the cross-sectional area in every plane parallel to the bearing surface is not the same throughout the thickness of the specimen. The test specimen shall then be weighed, while suspended by a metal wire, and completely submerged in water, and the weight shall be recorded in Nto the nearest 0.01 N, *Wa*. They shall be removed from the water and allowed to drain for 1 min by placing them on a 10 mm or coarser wire mesh. Visible water on the specimen shall be removed with a damp cloth. The specimen shall then be immediately weighed and the weight for each specimen noted in *N* to the nearest 0.01 N, W_w. The volume of the specimen shall be calculated as follows:

$$\text{Volume} = (W_w - W_a) \times 10^{-3} \text{ m}^3$$

The thickness of the specimen in mm shall be determined as per B-1.2. The volume shall be divided by thickness to obtain average net area A_n, in mm^2.

C-5.3 Compressive Strength

Calculate the compressive strength of the specimen as follows:

$$\text{Compressive strength, MPa} = P_{max}/A_n$$

where

P_{max} = maximum compressive load, N; and

A_n = average net area of specimen, mm^2.

C-6 REPORT

Report the individual and mean compressive strength of the specimens, correct to the nearest 0.1 MPa.

ANNEX D

(*Clause* 8.3)

METHOD FOR DETERMINATION OF WATER ABSORPTION

D-1 APPARATUS

The balance used shall be sensitive to within one percent of the mass of the smallest specimen tested.

D-2 PROCEDURE

D-2.1 Immerse the test specimens in water at a temperature of 27 °C ± 2 °C for 24 h to 28 h such that the top surfaces of the specimens are at least 150 mm below the surface of the water. Specimens shall be separated from each other and from the bottom of the immersion tank by at least 3 mm, using wire mesh, grating, or other spacers so that not more than 10 percent of the surface area of the specimen is in contact with the spacer.

D-2.2 Remove the specimens from water and allow to drain by placing them on a 10 mm or coarser wire mesh. While the specimen is draining and before weighing, remove visible surface water with a damp cloth. Weigh specimens 60 s ± 5 s following removal from water. Record as w_s (saturated weight).

D-2.3 After saturation, dry specimens in a ventilated oven at 105 °C ± 5 °C for not less than 24 h and until two successive weights at intervals of 2 h show an increment of loss not greater than 0.2 percent of the last previously determined weight of the specimen. Record weight of dried specimens as w_d (oven dry weight).

D-3 CALCULATION

The percent water absorption shall be calculated as follows:

$$W = [(w_s - w_d)/w_d] \times 100$$

where

w_s = saturated weight of specimen, kg; and

w_d = ovendry weight of specimen, kg.

D-4 REPORT

Report the individual and mean values of water absorption of specimens tested as per D-1 to D-3, correct to 0.1 percent.

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

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Member Secretary
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Working Group for New Indian Standard on Precast Concrete Paving Grids and Grass Pavers — Specification, CED 05/WG08

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Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: 5th Floor/MTNL CETTM Technology Street, Hiranandani Gardens, Powai, Mumbai - 400076	25700030 25702715

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