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IS 3951-2 (2009): Hollow clay tiles for floors and roofs,
Part 2: Structural type [CED 30: Clay and Stabilized Soil
Products for Construction]



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विशिष्टि

भाग 2 संरचना प्रकार
(दूसरा पुनरीक्षण)

Indian Standard

HOLLOW CLAY TILES FOR FLOORS AND ROOFS —
SPECIFICATION

PART 2 STRUCTURAL TYPE

(*Second Revision*)

ICS 91.060.30; 91.100.25

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Part 2) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Clay Products for Buildings Sectional Committee had been approved by the Civil Engineering Division Council.

Burnt clay floor/roofing tiles have been used both as filler material, and structural units. Investigations carried in recent years have established that a large variety of clays occurring in the country can be successfully utilized in the manufacture of such tiles. These tiles act as light weight material for floor and roof construction because of their hollowness and impart sound and thermal insulation to the building. Adequate caution may be observed as the porous nature of the ceramic body may induce corrosion process, if steel is not adequately protected by dense concrete or cement mortar. The grooves wherein the steel is required to be laid should be sufficiently big to ensure desired protection to the steel when the grooves are filled with concrete or mortar.

This standard covering the essential requirements of such hollow clay tiles for floors and roofs was first published in 1967 which covered a few types of filler tiles. The standard was subsequently revised in 1975 in two parts, Part 1 dealing with filler type of tiles, and Part 2 dealing with structural type of tiles. This part covers structural type of tiles. This revision of the standard has been formulated to take its provision up-to-date.

In the formulation of this standard due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. The modifications in this revision are in respect of general requirements, dimensions and tolerances, sampling procedure and in the procedure to determine water absorption of tiles. The minimum value of compressive strength has been increased from 150 kg/cm² to 180 kg/cm². The limit of water absorption has been revised from its earlier requirement of 20 percent.

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

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 rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HOLLOW CLAY TILES FOR FLOORS AND ROOFS — SPECIFICATION

PART 2 STRUCTURAL TYPE

(Second Revision)

1 SCOPE

This standard (Part 2) covers the quality, dimensions, bulk density, water absorption and strength requirements of structural hollow clay tiles suitable for use in floor/roof.

2 REFERENCE

The following standard contains provision which, through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was 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 the standard indicated below:

IS No.	Title
2248 : 1992	Glossary of terms relating to clay products for buildings (<i>second revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2248 shall apply.

4 GENERAL REQUIREMENTS

4.1 The tiles shall be made from suitable clay. Pulverized coal ash (fly ash, pond ash, mound ash,

bottom ash), crushed stone sand dust, etc., in suitable proportions may be added to clay such that the requirements prescribed in this standard are complied with. The tiles shall be of fairly uniform colour and shall be well burnt. The tiles shall be free from cracks, flaws or inclusions of any deleterious materials like lime nodules, soluble salts, etc.

4.2 The tiles shall have at least one plane of symmetry in cross-section. When broken, the fractured face shall show a fine, compact and uniform texture.

4.2.1 The tiles shall have serrations on all faces designed to be concreted, mortared or plastered. The serrations shall not be deeper than 3 mm and wider than 5 mm.

4.3 The tiles shall be free from extensive winding or bowing and external angles shall be right angles. The tiles shall be tested for trueness of shape as specified in 4.3.1 to 4.3.3.

4.3.1 *Winding or Bowing in the Longitudinal and Transverse Directions*

The tile shall be placed between two parallel straight-edges running along the direction of length or width and the distance between either straight-edge and the adjacent face of the tile at any point shall not be more than 3 mm/300 mm length or width (see Fig. 1).

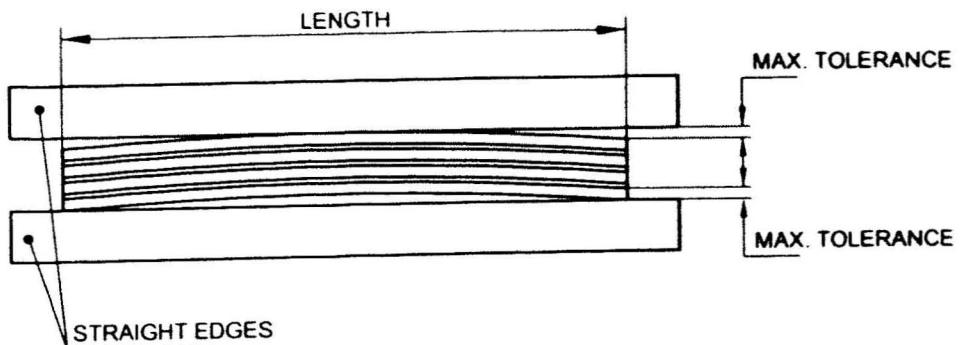


FIG. 1 TEST FOR WINDING OR BOWING

4.3.2 Concavity or Convexity in the External Faces of the Tiles

The tile shall be placed between two parallel straight-edges running diagonally across the face of the tile and the distance between either straight-edge and the adjacent face of the tile at any point shall not be more than 3 mm/300 mm run at any point on either diagonal (see Fig. 2).

4.3.3 Angles Between Sides and Joining Edges

In case of right angled sides and edges, any variation from the right angle in the angle contained by any side and a joining edge shall be measured by placing a builder's square against the side and the maximum distance between the inner edge of the square and the side shall be not more than 3 mm/300 mm run (see Fig. 3).

5 DIMENSIONS AND TOLERANCES

5.1 The hollow tiles may be either with small perforations or large holes or a combination of the two.

5.1.1 The thickness of any shell shall be not less than 10 mm and that of the web not less than 7 mm.

5.1.2 Either or both the vertical faces may be recessed or chamfered for receiving mortar and two sides of the tile have flanges, on either side set at angle ranging from 70° to 110° to the vertical side, if required.

5.1.3 The standard dimensions of the tiles shall be as follows:

Length : 290 mm and 390 mm

Width : 90 mm to 190 mm in the stages of 50 mm

Height : 125 mm to 200 mm in the stages of 25 mm

Typical shapes are given in Fig. 4.

5.1.4 Tolerances

The length and widths can deviate from the specified values up to ± 5 percent; while the height can deviate from the specified value by ± 3 percent.

6 BULK DENSITY

6.1 The mean bulk densities of the tiles when tested as per method given in 6.1.1 shall not exceed 1 200 kg/m³ and shall be not below 900 kg/m³.

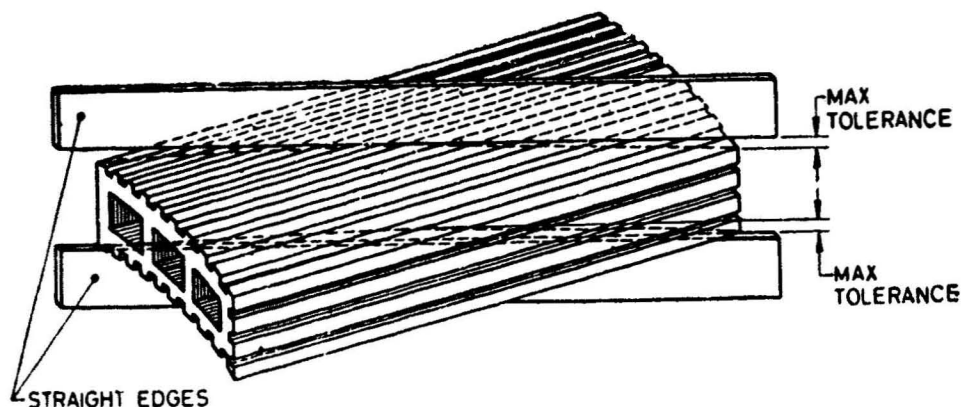


FIG. 2 TEST FOR CONCAVITY OR CONVEXITY

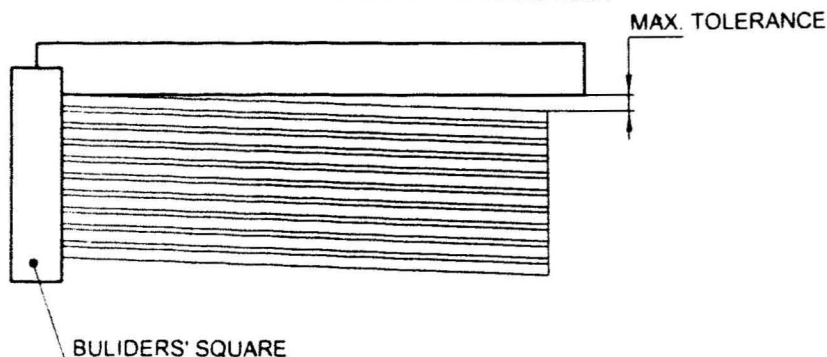


FIG. 3 TEST FOR CORRECTNESS OF EDGES

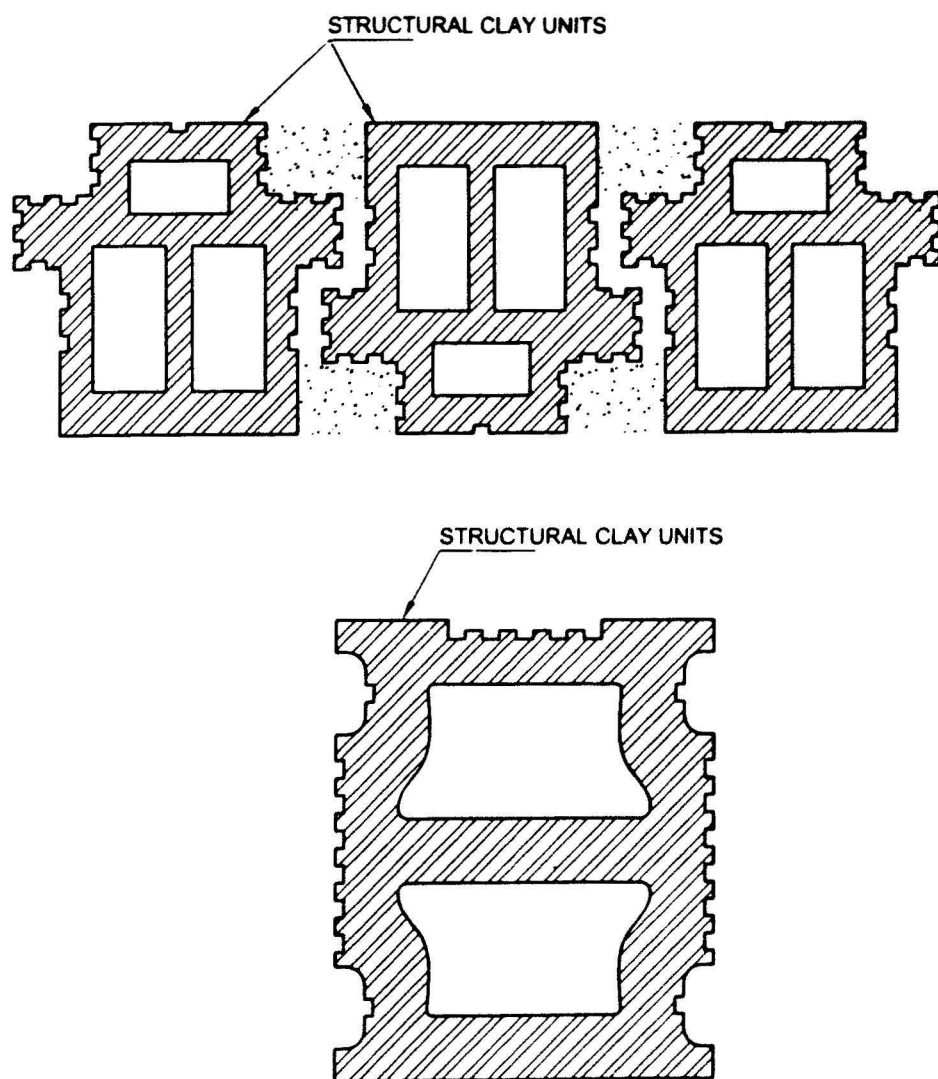


FIG. 4 TYPICAL SHAPES OF STRUCTURAL CLAY UNITS FOR FLOORING AND ROOFING

6.1.1 The test specimen shall be dried at 110°C to constant weight, cooled and weighed. The bulk volume of the tile is determined by measuring the external dimensions without counting the grooves. Bulk density (D) shall be calculated by the formula, $D = w/v$, where w is the weight of the dry sample and v is the bulk volume. The result shall be expressed in kg/m^3 to an accuracy of 0.1 units.

7 COMPRESSIVE STRENGTH

The average compressive strength of the tiles shall be not less than 200 kg/cm^2 on the net area with individual minimum value of 180 kg/cm^2 when tested in accordance with the procedure laid down in Annex A.

8 WATER ABSORPTION

The water absorption of the tiles by weight, when tested in accordance with the procedure laid down in Annex B shall not exceed 15 percent.

NOTE — An alternate value of 10 percent, maximum water content may also be agreed upon, if specified by the purchaser.

9 SAMPLING

9.1 Procedure for Sampling

For checking the requirements specified in 4 to 7, 25 tiles shall be selected at random for every 2 500 tiles or fraction thereof in a lot, by the purchaser (or his representative). The number of tiles taken for tests shall be not less than 25 in any one lot.

10 MARKING

10.1 Each tile shall be clearly and indelibly marked with the following:

- a) Identification of the source of manufacture,
- b) A mark 'Structural' or 'S' to indicate filler tile, and
- c) Batch/Control unit number.

10.2 BIS Certification Marking

Each tile may also be marked with the Standard Mark.

10.2.1 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 the 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 7)

DETERMINATION OF COMPRESSIVE STRENGTH

A-1 PREPARATION OF SPECIMEN

A-1.1 At least six tiles shall be selected at random for this test from the sample selected in the manner described in 9. Each tile shall be immersed in water maintained between 20°C and 25°C for 24 h and then bedded with cement-sand mortar as follows.

A-1.1.1 A steel plate not less than 10 mm thick machined on one face to give a smooth plane surface, shall be firmly supported with the machined surface up and levelled in two directions at right angles by means of a spirit-level. The machined face shall be coated with a film of mould oil to prevent mortar from adhering. A layer of cement-sand mortar, composed of one part cement to one part of clean sand (grade 2.36 mm and less) shall then be placed on the plate and one bed face of the tile pressed firmly into the layer to form a bed as uniform as possible in thickness. The mortar over each large cavity shall be cut out when the mortar is still green. Smaller cavities shall be pierced by a small hole to allow removal of water from the cavities before testing.

A-1.1.2 The surplus mortar shall be trimmed off flush with the sides of the tile. The tiles and mortar shall then be covered with a damp cloth and shall remain undisturbed for a minimum period of 24 h after which the bedded tile shall be carefully removed from the steel plate without damaging the mortar and inverted. The second bed face shall be bedded in the same manner as the first, using the same cement-sand mix and water-cement ratio as before. The two mortar faces shall be made parallel

to each other by levelling the specimen in two directions at right angles on the second mortar layer by means of a spirit-level. After bedding, the tile shall again be covered with a damp cloth for another 24 h and then immersed in water until tested. The period of immersion shall be such that 7.05 cm mortar cubes cast from the same batch used for bedding the second bed face and stored under identical conditions shall have a crushing strengths of not less than 280 kg/cm² and not more than 420 kg/cm².

A-2 PROCEDURE

When the mortar strength has attained the required value the specimen shall be crushed between two 3-ply plywood sheets approximately 3 mm thick. The load shall be applied axially at a rate of 150 kg/cm² of base area per minute till complete failure.

A-3 CALCULATION OF RESULTS

The maximum load, in kg, supported by the specimen before failure occurs divided by the area of the specimen excluding cavities (net area), in cm², shall be taken as the crushing strength of the specimen. The arithmetic mean of the crushing strengths of six tiles shall be taken as the crushing strength of the batch under test.

A-4 RETEST

If the mean strength so obtained is less than the specified in 7 further sample of ten tiles shall be taken and tested.

ANNEX B

(Clause 8)

DETERMINATION OF WATER ABSORPTION TEST**B-1 TEST SPECIMEN**

At least six tiles shall be selected at random for this test from the sample selected in the manner described in 9.

B-2 APPARATUS

The apparatus shall consist of a balance sensitive to within ± 0.1 percent of the mass of the specimen.

B-3 PROCEDURE

The test specimen shall be dried to constant mass in a ventilated oven at 110° to 115°C . If the specimen is known to be relatively dry this may be accomplished within 24 h; if wet, drying may be prolonged till constant mass is attained. The specimen shall then be cooled approximately to room temperature and weighed (W_1). The cool specimen shall be completely immersed in clean water at $27 \pm 2^\circ\text{C}$ for 24 h. Each specimen shall be

removed/draind; the surface water wiped off with a damp cloth and weighed (W_2). Weighing of each specimen shall be completed within three minutes after removal from water.

B-4 CALCULATION

The percentage of water absorption by mass shall be calculated as given below:

Water absorption,

$$\text{percent by mass} = \frac{W_2 - W_1}{W_1} \times 100$$

where

W_2 = mass after soaking in water, and

W_1 = mass of the dry specimen.

B-5 RESULT

The average value of the specimens shall be taken as the water absorption of the lot.

ANNEX C

(Foreword)

COMMITTEE COMPOSITION

Clay Products for Buildings Sectional Committee, CED 30

<i>Organization</i>	<i>Representative(s)</i>
In personal capacity (651/37, Ganga Enclave Sainik Colony, Roorkee 247667)	DR J. M. BHATNAGAR (<i>Chairman</i>)
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All India Brick & Tile Manufacturers Federation, New Delhi	SHRI R. P. S. CHANDEL SHRI R. K. VERMA (<i>Alternate</i>)
A.P. Engineering Research Laboratory, Hyderabad	SHRI P. JOHN VICTOR SHRI R. VISWANADHAM (<i>Alternate</i>)
Building Materials & Technology Promotion Council, New Delhi	SHRI J. K. PRASAD SHRI C. N. JHA (<i>Alternate</i>)
Central Building Research Institute, Roorkee	SHRI R. K. GOEL
Central Public Works Department, New Delhi	SE (P&A) NDZ III EE (P) (NDZ) III (<i>Alternate</i>)
Central Soil and Materials Research Station, New Delhi	SHRI N. CHANDRASEKHARAN SHRI P. K. JHA (<i>Alternate</i>)
Delhi Development Authority, New Delhi	CHIEF ENGINEER (DESIGN) SUPERINTENDING ENGINEER (DESIGN) (<i>Alternate</i>)
Department of Atomic Energy, Mumbai	SHRI D. R. BATLIWALA SHRI M. G. WACH (<i>Alternate</i>)
Engineer-in-Chief's Branch (Army Headquarters), New Delhi	SMT DEEPANJALI DUTTA SHRI R. N. ENDLEY (<i>Alternate</i>)
Fly Ash Utilization Programme (TIFAC), New Delhi	DR VIMAL KUMAR SHRI MUKESH MATHUR (<i>Alternate</i>)

IS 3951 (Part 2) : 2009

<i>Organization</i>	<i>Representative(s)</i>
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Housing and Urban Development Corporation Limited, New Delhi	SHRI SURENDER GERA SHRI JITENDRA SINGH (<i>Alternate</i>)
National Building Construction Corporation, New Delhi	SHRI S. K. SHARMA
National Test House, Kolkata	SHRI D. V. S. PRASAD SHRI NARESH GUPTA (<i>Alternate</i>)
Prabhakar Tile Works, Kundapura Taluk	SHRI PRASHAN THOLAR
Public Works Department, Chennai	SUPERINTENDING ENGINEER (PLG & DESIGN) EXECUTIVE ENGINEER (PLG) (<i>Alternate</i>)
Ram Brick Field, Roorkee	SHRI RAJ KUMAR PANDHI
Regional Research Laboratory (CSIR), Jorhat	SHRI PINAKI SEN GUPTA SHRI AMITAVA BISWAS (<i>Alternate</i>)
Research, Designs and Standards Organization, Lucknow	SHRI PRABHAT KUMAR
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The Commonwealth Trust (India), Calicut	SHRI M. G. GOPINATH SHRI N. PRAMOD (<i>Alternate</i>)
U.P. Brick Kiln Association (Regd), Lucknow	REPRESENTATIVE
BIS Directorate General	SHRI A. K. SAINI, Scientist 'F' & Head (Civ Engg) [Representing Director General (<i>Ex-officio</i>)]
<i>Member Secretary</i> SHRI S. ARUN KUMAR Scientist 'B' (Civ Engg), BIS	

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Amend No.	Date of Issue	Text Affected

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