SRI LANKA STANDARD 863 : PART 2 : 1989
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CEMENT CONCRETE TILES
PART 2 : TEST METHODS

SRI LANKA STANDARDS INSTITUTION

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FOR CEMENT CONCRETE TILES
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SLS 863 : PART 2 : 1989

Gr. 8

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SRI LANKA STANDARD FOR CEMENT CONCRETE TILES PART 2 : TEST METHODS

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 1989-10-11 after the draft, finalized by the Drafting Committee on Cement concrete tiles, had been approved by the Civil Engineering Divisional Committee.

Cement concrete floor tiles and wall tiles are available with no pigments or with one or more pigments used on the wearing surface. The wearing surface can be plane or can have a pattern embossed on the surface.

For floorings, cement concrete tiles are popular due to moderate cost, free availability, pleasant appearance, ease with which intricate decorative or non-slip patterns can be incorporated, possibility of using colours, improved hardness compared to *in-situ* construction, facility for quick installation and easy replacement during repairs. Also it performs better in service as a cement concrete tiled floor adapts itself easily to slight settlement of the foundation and backfill or to drying shrinkage, and any cracks so developed will be imperceptibly localized at the joints. In addition, they have good strength, durability and resistance to wear. There is also a recent trend of using cement concrete tiles, particularly decorative patterned tiles, as a wall finish at moderate cost.

A Sri Lanka Standard on cement concrete tiles was considered useful to :

(a) encourage quality control by manufacturers:
(b) overcome the main shortcomings, such as liability to bloom or effloresce, non-durability of colour, crazing and poor strength, by specifying appropriate requirements ;
(c) provide as smooth transition to metric sizes ;
(d) specify suitable test procedures and a sampling method.
(e) encourage production of a variety of patterns and colours so as to provide a good selection to the user ;
(f) encourage manufacturers to innovate to reduce costs ; and
(g) stimulate healthy competition among large number of manufacturers scattered island wide, using semi-automatic and manual pressing machines.

This part of the standard deals with test methods, Part 1 of this standard covers the specification for manufacture and requirements for compliance of cement concrete floor or wall tiles.

Inclusion of a resistance to wear test was also considered. However, after careful deliberations and some preliminary tests, it was decided to exclude it as:

a) In this country resistance to wear is less critical that other modes of failure of tiled floor finishes ;
b) cement concrete tiles are superior to many other alternative floor finishes as regard wear
c) cost of such a test is high ; and
d) special equipment is required.

Test procedures reviewed were those in IS 1237 : 1979, ASTM C 944 – 80, ASTM C 418 – 81 and ASTMC 779 – 82 while the experimental work was based on IS 1237:1959.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed on calculated, expressing the result of a test or an analysis shall be rounded off in accordance with **CS 102**. The number of significant figures to be retained in the rounded off value shall be the same as that of the specified value in this standard.

In the preparation of this standard the assistance derived from the publications of the British Standards Institution, the Bureau of Indian Standards and the American Society of Testing and Materials is gratefully acknowledged.

1 SCOPE

This part of the standard specifies the tests to be conducted on cement concrete floor tiles and wall tiles.

2 REFERENCES

CS 102 Presentation of numerical values
SLS 863 Cement concrete tiles
Part 1 : Specification for manufacture

3. DEFINITIONS

For the purpose of this specification the following definitions shall apply:

3.1 **back** : The side opposite the face of a tile

3.2 **cement tile** : Tiles in the manufacture of which no pigments are used and having a plane wearing surface.

3.3 **chequered tile** : A patterned tile with the pattern made wholly of squares of side 25 mm to 50 mm measured from centre to centre of 'V' grooves and arranged parallel to the side of the tile.

3.4 **coloured cement tile** : Tile in the manufacture of which one or more pigments are used and having a plane wearing surface.

3.5 **face:** The wearing surface of a tile.

3.6 **patterned tile** : Tile having a pattern embossed on the wearing surface.

3.7 **plain tile** : Tile having a plain wearing surface.

4. DETERMINATION OF TILE DIMENSIONS

4.1 Determination of the length of a side of tiles

4.1.1 *Apparatus*

A steel rule, capable of being read to 0.5 mm.

4.1.2 *Number of tiles for testing*

The number of tiles to be used for testing shall be determined in accordance with 17 of **SLS 863: Part 1: 1989**. When testing for purposes other than for compliance with **SLS 863: Part 1: 1989**, number of tiles shall be suitably varied.

4.1.3 *Test procedure*

For each side of a tile, three measurements should be made to the nearest 0.5 mm, one near the middle of the tile and at regions approximately 50 mm from each end. Measurements shall be repeated on each of the four sides.

Each value shall correspond to the length of a side and respective tolerances specified in 8.1 of **SLS 863:Part 1: 1989.**

Note : Average value may be calculated for all the tiles tested to the nearest 0.5 mm.

4.2 Determination of the squareness of tiles

4.2.1 *Apparatus*

Metre rules, five in number, each of length one metre capabilities of being read to 0.5 mm.

4.2.2 *Number of tiles for testing*

The number of tiles to be used for testing shall be determined in accordance with 17 of **SLS 863:Part 1: 1989.**

4.2.3 *Test procedure*

Place four of the metre rules along the perimeter of a tile as shown in the Figure 1 on a flat surface. Denote points where sides, touching the tile, of adjacent rules meet as A, B, C and D. Measure the diagonals AC and BD with the remaining metre rule.

The difference in the two diagonal measurements shall comply with B.4 of **SLS 863: Part 1: 1989.**

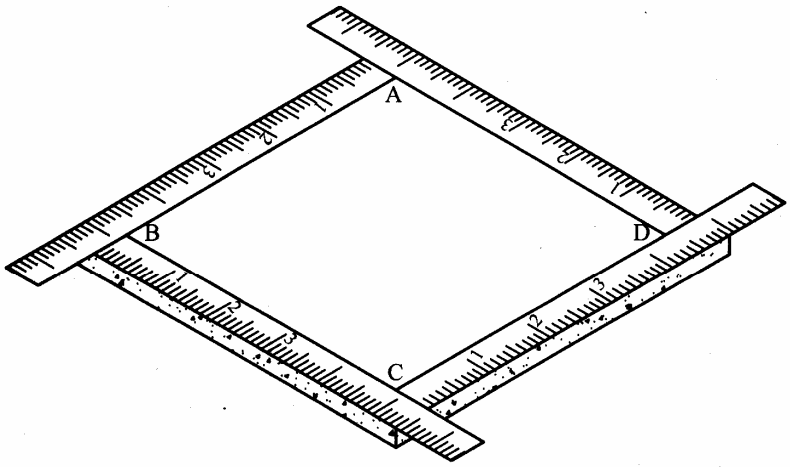

FIGURE 1 - Determination of squareness

4.3 Determination of the thickness of tiles

4.3.1 *Apparatus*

A micrometer, reading to at least 0.05 mm with flat measuring surfaces at least 10 mm in diameter.

4.3.2 *Number of tiles for testing*

The number of tiles to be used for testing shall be determined in accordance with 17 of **SLS 863: Part 1: 1989.** . When testing for purposes other than for compliance with **SLS 863: Part 1: 1989.** number of tiles shall be suitably varied.

4.3.3 *Test procedure*

Using the micrometer, measurements shall be taken at least at eight locations as indicated in Figure 2.

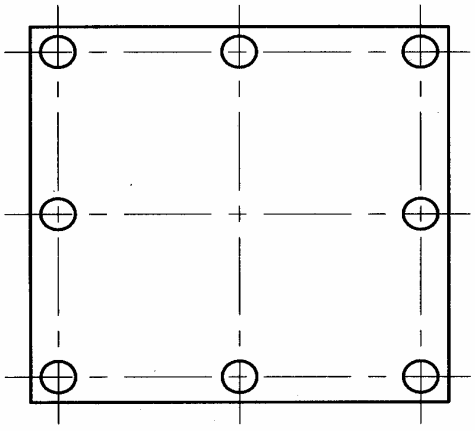

FIGURE 2 - Determination of thickness

Each value shall correspond to the thickness and the tolerance specified in 8.1 of **SLS 863: Part 1: 1989** for the basic size of the tile tested.

Note : Average value may be calculated for all the tiles tested to the nearest 0.05 mm.

4.4 Determination of the groove depth of patterned tiles and chequered tiles

4.4.1 *Apparatus*

A depth gauge, with a sharply pointed head and micrometer with an accuracy of 0.01 mm.

4.4.2 ***Number of tiles for testing***

The number of tiles to be used for testing shall be determined in accordance with 17 of **SLS 863: Part 1: 1989**

4.4.3 *Test procedure*

Using the depth gauge, measurements of maximum groove depth shall be take at least at eight locations, in the grooves, spaced evenly over the tiles.

The average value for each tile shall not exceed the maximum groove depth specified in **9.1** of **SLS 863: Part 1: 1989**

Note : Average value may be calculated for all the tiles tested to the nearest 0.1 mm.

4.5 Determination of the thickness of the wearing layer

4.5.1 ***Apparatus***

4.5.1.1 A vernier caliper; capable of being read to 0.05 mm.

4.5.1.2 A carborundum stone or a grinding wheel; capable of abrading the tile across its thickness

4.5.2 **Number of specimen tiles**

The number of tiles to be used as test specimens shall be the same as the number of tiles used for wet transverse strength test.

4.5.1 Test procedure

A piece of broken tile shall be taken form each transverse strength test (wet test) and, using a carborundum stone or a grinding wheel, the broken surface is made perpendicular to the face of the tile with the two surfaces meeting along a sharp edge.
Using the vernier caliper, thickness of the wearing layer shall be measured at least at ten locations spaced not less than 15 mm apart. Each value shall not be less than the minimum value specified in 9.1 of **SLS 863: Part 1: 1989.**

Note : Average value may be calculated for all the specimen tiles to the nearest 0.05 mm.

4. DETERMINATION OF TRANSVERSE STRENGTH

5.1 Apparatus

5.1.1 *Testing machine*

Testing apparatus for determination of transverse strength is shown are in Figure 3.

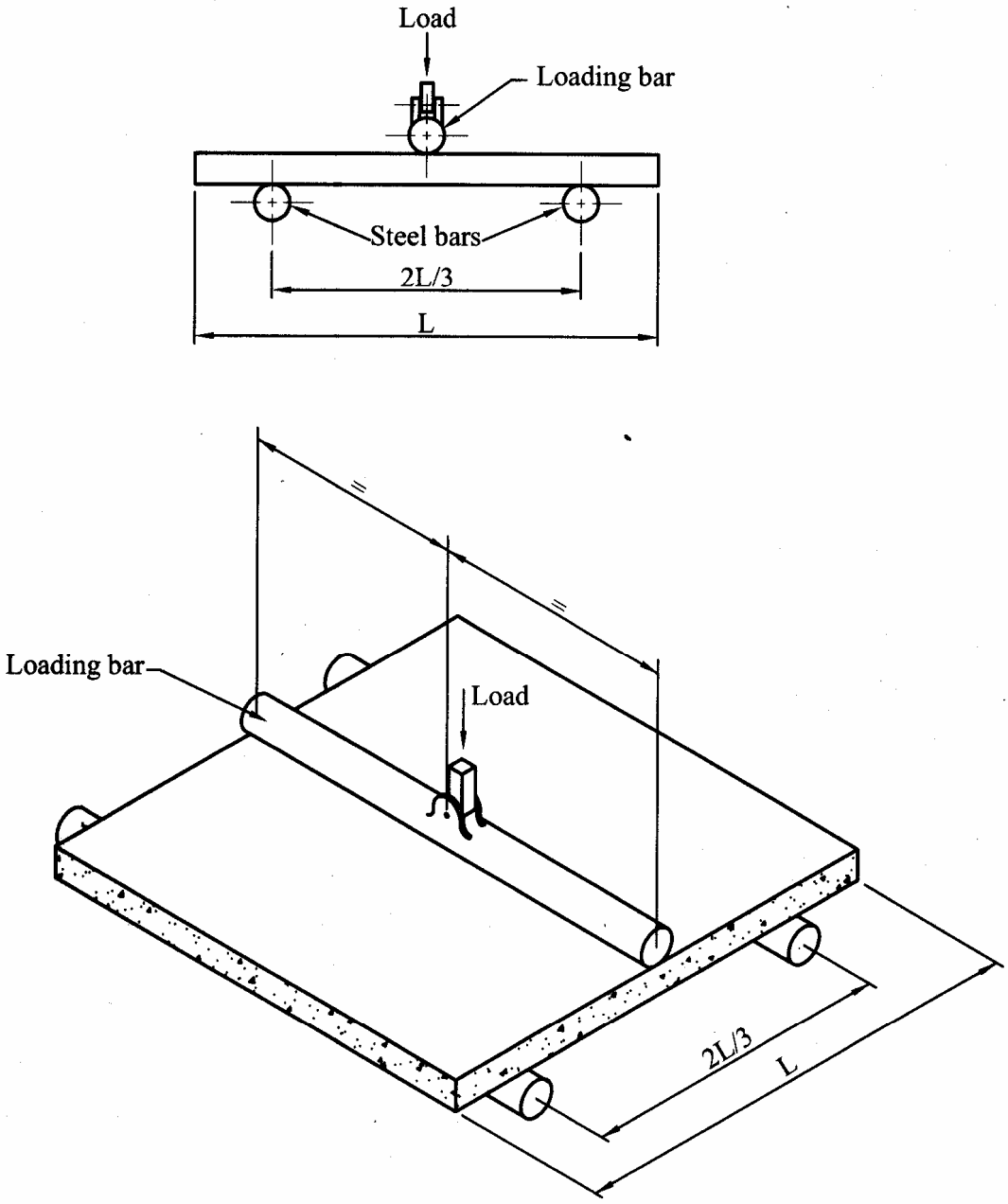

FIGURE 3 - Determination of transverse strength

5.4 Dry test for transverse strength

5.4.1 Test procedure

Test specimens which are full-size tiles should be stacked to provide free air circulation around the tiles for a sufficient time to reach the air-dry state. This state is considered to represent the condition of tiles in service at a dry location.

Each tiles shall be placed on the supports of the testing machine symmetrically with its wearing surface uppermost. The distance between the two supports shall be two-thirds of the length of the tile.

Starting from zero, the load at mid-span, shall be increased steadily and uniformly at a rate not exceeding 20 kN/m width of tile per minute until failure. The breaking load shall be recorded.

The test span and width of tile shall be measured with the steel rule, while thickness of the tile shall be measured with the micrometer.

5.4.2 Calculations

The dry transverse strength of each tile shall be calculated using the formula:

$$f_d = \frac{3\,PS}{2\,bt^2}$$

Where
P is the breaking load on tile, in newtons ;
S is the test span of tile, in mm ;
b is the width of tile, in mm, measured along the failure plane;
t is the thickness of tile, in mm ; and
f_d is the transverse strength of tile, in MPa.

Average value of dry transverse strength shall be calculated for all the tiles tested in the sample to the nearest 0.05 MPa.

5.5 Wet test for transverse strength

5.5.1 Test Procedure

The tile shall be immersed in water for 24 hours and then taken out and excess surface water wiped out with a-wet cloth.

Each tile shall be placed on the supports of the testing machine symmetrically with its wearing surface uppermost. The distance between the two supports shall be two-thirds of the length of the tile.

Starting from zero, the load at mid-span, shall be increased steadily and uniformly at a rate not exceeding 20 kN/m width of tile per minute until failure. The breaking load shall be recorded.

The test span and width of tile shall be measured with the steel rule, while thickness of the tile shall be measured with the micrometer.

5.5.2 Calculations

The wet transverse strength of each tile shall be calculated

$$f_w = \frac{3\,PS}{2\,bt^2}$$

Where
P is the breaking load on tile, in newtons ;
S is the test span of tile, in mm ;
b is the width of tile, in mm, measured along the failure plane;
t is the thickness of tile, in mm ; and
f_w is the transverse strength of tile, in MPa.

Average value of wet transverse strength shall be calculated for all the tiles tested in the sample to the nearest 0.05 MPa.

6 DETERMINATION OF WATER ABSORPTION

6.1 Apparatus

The following apparatus shall be provided ;

6.1.1 **Balance;** capable of weighing up to 10 kg to an accuracy of 5 g.

6.1.2 **Oven;** well ventilated, the temperature controllable between $100\ ^0$ C and $110\ ^0$ C

6.1.3 **Water tank;** at least 75 mm deep, in which the tiles may be immersed ; and

6.1.4 **One or more dishes;** in which tiles may be immersed face downwards with at least 99 per cent of each tile face exposed to water. For this purpose the inside surface of the base of each dish should be suitably ribbed. Alternatively, glass rods or beads on which specimens can be supported as above may be provided.

Number of tiles for testing

The number of tiles to be used for testing shall be determined in accordance with 17 of **SLS 863: Part 1: 1989**. When testing for purpose other than for compliance with **SLS 863: Part 1: 1989.** number of tiles shall be suitably varied.

6.2 Age of tile when tested

The test for water absorption shall be commenced between 28 days and 35 days after tiles have been pressed.

6.4 Test on water absorption by tile face

6.4.1 *Test procedure*

All test specimens shall be placed in the oven at the same time. They should be arranged so that they are separated from each other and from any heating surface by a distance of at least 25 mm. They shall be dried in the oven until they attain a constant mass. Constant mass shall be considered as having been reached when the variation in total mass of any three tiles does not exceed 2 g over a period of 8 hours.

The tiles after removal from the oven should preferably be cooled for 24 ± 1/2 h, exposed to the air of a room free from draughts and rapid temperature changes. Tiles shall then be weighed and the dry mass (M_1) of each shall be recorded.

Marks should be made, at the corners of each tile, at a level 5 mm below the tile face. Tiles shall be placed with the face downwards in the dishes (see 6.1.4). Water shall be poured carefully into each dish until the water level is within ± 2 mm of the marks of each tile. The water shall not surge more than 2 mm above these marks, nor shall wet the back of tiles. The specified level of the water shall be maintained for a period of 24 ± ½ h.

Thereafter each tile should be removed from water, care being taken to prevent the tile back becoming wet. Surface water should be removed from the wetted parts of the tile by dabbing them with a slightly dampened cloth. Each tile shall then be weighed in air and the mass (M_2) shall be recorded.

6.4.2 ***Calculations***

The water absorbed by the face of each tile shall be calculated using the formula:

$$m = \frac{M_2 - M_1}{A}$$

Where

A is the area of tile face, in square metres :

M_1 is the dry mass of tile, in kilograms :

M_2 is the mass of tile, after absorption of water by tile face (See 6.4.1), in kilograms ; and

m is the mass of water absorbed by tile face, in kg/m^2.

Average value of water absorption by tile face shall be calculated for al the tiles tested in the sample to the nearest. 0.1 kg/m^2.

6.3 Test on total absorption of water

6.5.1 *Test procedure*

Tiles, on completion of the previous test, shall again be dried and cooled as described in **6.4.1**. Immediately afterwards tiles shall be immersed once more in water. As far as possible, their faces should be parallel to the surface of the water. The depth of water over the top of each tile shall be between 25 mm and 50 mm. Tiles shall remain immersed under the above conditions for a period of 24 ± ½ h.

Thereafter each tile shall be removed from water. Burface water should be removed by dabbing the tiles with a slightly dampened cloth. Each tile shall then be weighed and its mass (M_2) shall be recorded.

6.5.2 Calculations

The total absorption of water by each tile shall be calculated using the formula :

$$T = \frac{M_3 - M_1}{M_1} \times 100$$

Where

M_1 is the dry mass of tile, in kilograms (see 6.4.1)'

M_3 is the mass of tile, after total absorption of water in kilograms ; and

T is the total absorption of water expressed as a percentage.

Average value of total absorption of water shall be calculated for all the tiles tested in the sample to the nearest 0.1 per cent.

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SRI LANKA STANDARDS INSTITUTION

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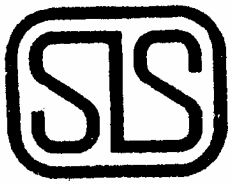

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