

SRI LANKA STANDARD 1189 : PART 2 :1999
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SPECIFICATION FOR
CONCRETE ROOFING SEMI-SHEETS, TILES
AND FITTINGS
PART 2 - TEST METHODS

SRI LANKA STANDARDS INSTITUTION

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TILES AND FITTINGS
PART 2 - TEST METHODS**

SLS 1189 PART 2 : 1999

Gr. 8

**SRI LANKA STANDARDS INSTITUTION
No. 17, Victoria Place,
Elvitigala Mawatha,
Colombo 08
SRI LANKA**

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CONTENT

CLAUSE		PAGE
0	Foreword	3
1	Scope	4
2	References	4
3	Definitions	4
4	Test Methods	4
4.1	General	4
4.2	Determination of Hanging Length and Squareness	5
4.3	Determination of Covered Width	6
4.4	Determination of Fatness	7
4.5	Determination of Mass	7
4.6	Determination of Transverse Strength	8
4.7	Assessment of Impermeability	10
4.8	Assessment of Nib Support	11
4.9	Assessment of Shape of Overlapping Ends	12
4.10	Pore and Crack Test	14
4.11	Ring Test	14
4.12	Water Absorption	15
4.13	Determination of Thickness	15

FIGURES

CLAUSE	PAGE
Figure 1 Determination of hanging length and squareness	5
Figure 2 Determination of covered width	6
Figure 3 Determination of flatness	7
Figure 4 Determination of transverse strength	8
Figure 5 Assessment of impermeability	11
Figure 6 Assessment of nib support	12
Figure 7 Assessment of shape of overlapping ends	13
Figure 8 Ring test	14

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FOREWORD

This standard was approved by the sectoral committee on Building and Construction Materials, and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 1999-02-11.

Micro-concrete roofing, a newly introduced roofing material in Sri Lanka, is prepared using concrete with small size aggregates but without reinforcements. This can be made as a semi-sheet or a tile, but the semi-sheet is more popular.

Micro-concrete semi-sheets and roofing tiles, developed using economic, simple and labour intensive technology as an alternative to asbestos roofing sheets, gained popularity in Sri Lanka rapidly, and is now used in housing as well as institutional buildings. Their advantages are : asbestos free and, hence, more environmentally friendly; labour intensive production process with even unskilled workers; economical compared to asbestos or burnt clay roofing; capital investment required is small; avoids use of scarce materials like clay and firewood; lighter than burnt clay tiles and hence a lighter roof structure is required; good fire resistance; uses more local materials easy to obtain; provides good thermal control inside the building; production can be set up in a location with meagre infrastructure facilities; can be coloured; good roof drainage and, hence, roof slope can be 20 degrees and above; can be cut to shape with a hack-saw or pincers; and a unit can be removed and replaced from inside the roof. Their disadvantages are: machine and moulds are imported still; greater care is needed during transport to minimise breakages; although skills needed are easily learned, greater supervisory effort is needed at all stages of production and delivery; at ridges, more effort and materials are required to close openings; not intended to be walked on without a crawling board or roof ladder; and more prone to breakage by impact. Emergence of new manufacturers and new users emphasise that advantages seem to outweigh the disadvantages of these roofing units.

Sri Lanka Standard on these roofing units was considered opportune to ensure good quality control, build up manufacturer and user confidence, introduce technological changes more suited to local conditions, and to stimulate this industry to grow rapidly.

This part of the standard specifies the test methods, while Part 1 of this standard specifies the requirements.

In reporting the results of a test or an analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with **CS 102**.

The Sri Lanka Standards Institution gratefully acknowledges the use of the following standards and publications as guidance documents in the preparation of this standard:

AS 4046 . 1 : 1992	Methods of testing roof tiles.
BS 473, 550 : Part 2 : 1971	Concrete roofing tiles and fittings
BS EN 490 : 1994	Concrete roofing tiles and fittings - Product specifications
BS EN 491 : 1994	Concrete roofing tiles and fittings - Test methods
SABS 542 : 1990	Concrete roofing tiles
SS 310 : 1996	Concrete interlocking roofing tiles
ICTAD/GEN/MCR/01	Micro-concrete roofing tiles

1. SCOPE

This part of the standard specifies test methods for concrete roofing semi-sheets, tiles and fittings, for assembly into pitched roof coverings.

2. REFERENCES

SLS 1189 : Concrete roofing semi-sheets, tiles and fittings
Part 1 - Requirements.

3. DEFINITIONS

For the purpose of this part of the standard, definitions given in **SLS 1189 : Part 1** shall apply.

4. TEST METHODS

4.1 General

All the tests listed in succeeding Clauses **4.2** to **4.13** can be done on a semi-sheet. A tile can be tested similarly except the test on flatness (see clause **4.4**).

A valley tile may be subjected to tests **4.5, 4.7, 4.10, 4.11, 4.12** and **4.13** only.

A ridge tile may be subjected to tests **4.5, 4.10, 4.11, 4.12** and **4.13** only.

4.2 Determination of Hanging Length and Squareness

Hang the semi-sheet or tile at an angle of 20 degrees to 70 degrees on a straight timber batten (see Figure 1 a) which does not deviate by more than 1 mm in any 1 m length. After having removed any burrs and/or other irregularities, measure from the top face of the batten to the lower front edge of the tile at the sides (see Figure 1 b).

Record the values (see Figure 1 b) l_2 and l_3 to the nearest millimetre. Calculate the average per semi-sheet or tile, l_1 , to the nearest millimetre using;

$$l_1 = \frac{l_2 + l_3}{2}$$

Calculate the squareness of the semi-sheet or tile, s , to the nearest millimetre using ;

$$s = l_2 - l_3 \text{ or } l_3 - l_2$$

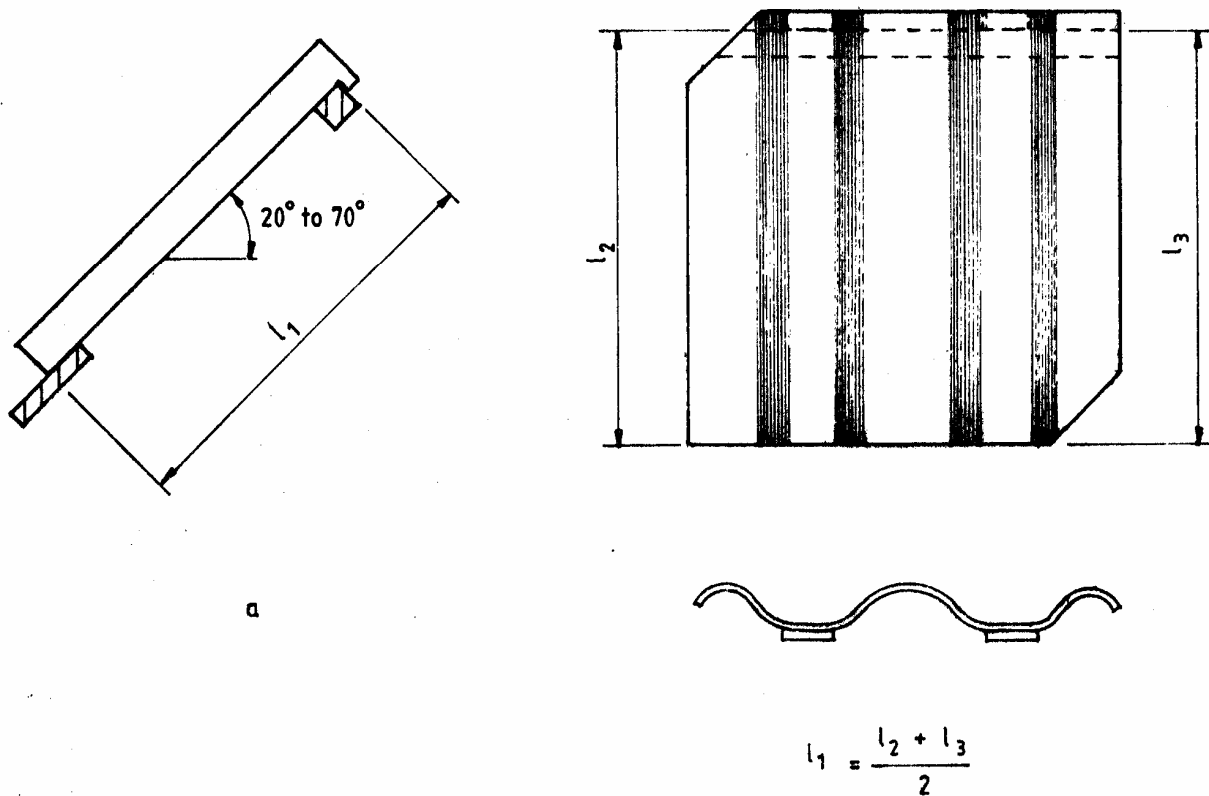


FIGURE 1 - Determination of hanging length and squareness

4.3 Determination of Covered Width

Hang 10 semi-sheets or tiles on two timber battens placed at a roof slope not less than 20 degrees and no more than 70 degrees. Top timber batten shall be straight and shall not deviate by more than 1 mm in any 1 m length.

Push the semi-sheets or tiles together or to and fro for the semi-sheets or tiles to overlap properly (see Figure 2).

Measure to the nearest millimetre and record the width of the 10 semi-sheets or tiles. Calculate to 0.1 mm the average covered width.

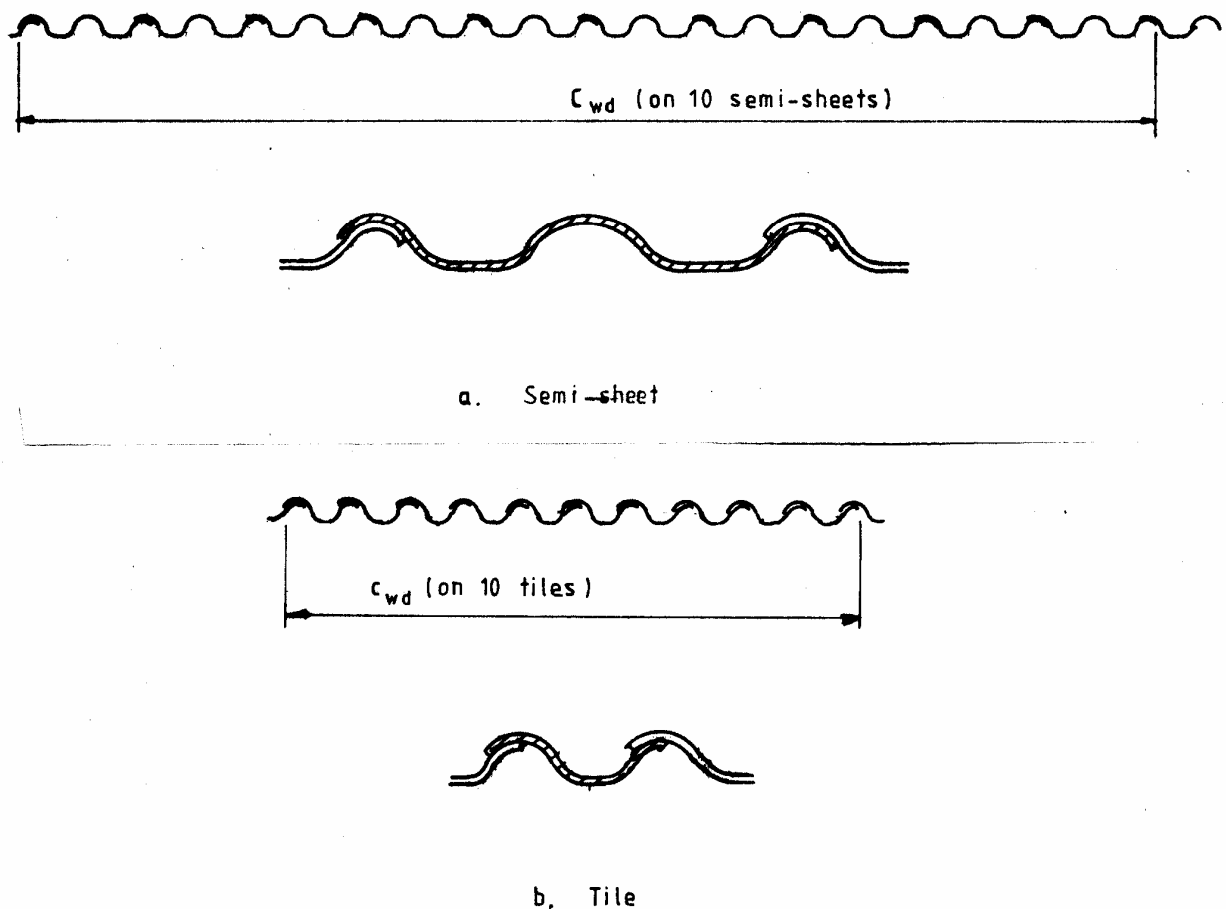


FIGURE 2 - Determination of covered width

4.4 Determination of Flatness

Place the semi-sheet or tile on a flat level surface or two co-planar flat metal bars with the nibs projecting, as shown in Figure 3. Hold the semi-sheet or tile to ensure that the head of the semi-sheet or tile is in contact with the surface.

Using a steel bar of diameter 3 mm, check without lifting the semi-sheet or tile, whether any gap between the lower front edge of the semi-sheet or tile and the measuring surface at any nominal contact point, is greater than 3 mm.

Record the results for each semi-sheet or tile tested.

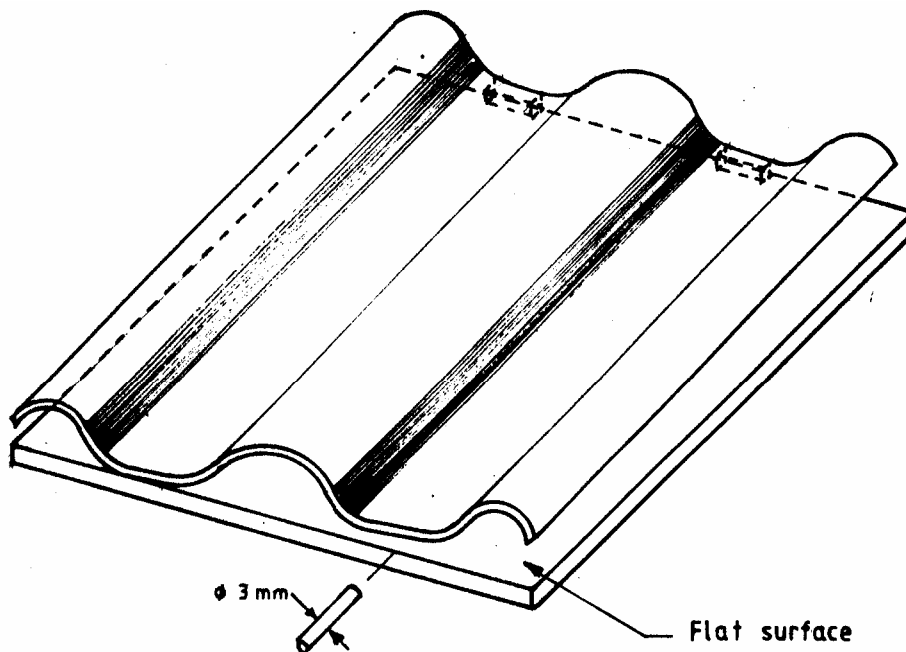


FIGURE 3 - Determination of flatness

FIGURE 3 - Determination of flatness

4.5 Determination of Mass

Condition the semi-sheets or tiles to be tested at 25°C to 30°C and at a minimum of 40 per cent relative humidity for at least 24 h in such a manner that air is free to circulate to all sides of each semi-sheet or tile.

Weigh each semi-sheet or tile to at least the nearest 100 g. Record the values measured and calculate the average mass of semi-sheets or the tiles in the sample to the nearest 50 g.

4.6 Determination of Transverse Strength

4.6.1 Conditioning of semi-sheets or tiles

Store the semi-sheets or tiles to be tested at 25°C to 30°C , at a minimum of 40 per cent relative humidity for at least 24 h, in such a manner that air is free to circulate to all sides of each semi-sheet or tile.

4.6.2 Test machine details

The test machine shall have two lower rounded metal bearers in a horizontal plane whose centres are spaced at $2/3$ of the hanging length of semi-sheet or tile to be tested, and a single rounded metal upper bearer, fixed with a contoured packing block, positioned centrally between the two lower bearers (see Figure 4). The rounded part of the lower bearers shall have a radius of 10 mm to 20 mm. The bearers shall have a minimum width of 20 mm. The upper bearer and the bearer nearest the tail of the semi-sheet or tile shall be free to pivot perpendicularly to their long axis. The length of the bearers shall be not less than the width of the semi-sheet or tile to be tested.

The test machine shall be calibrated such that the indicated value shall be within ± 3 per cent of true value.

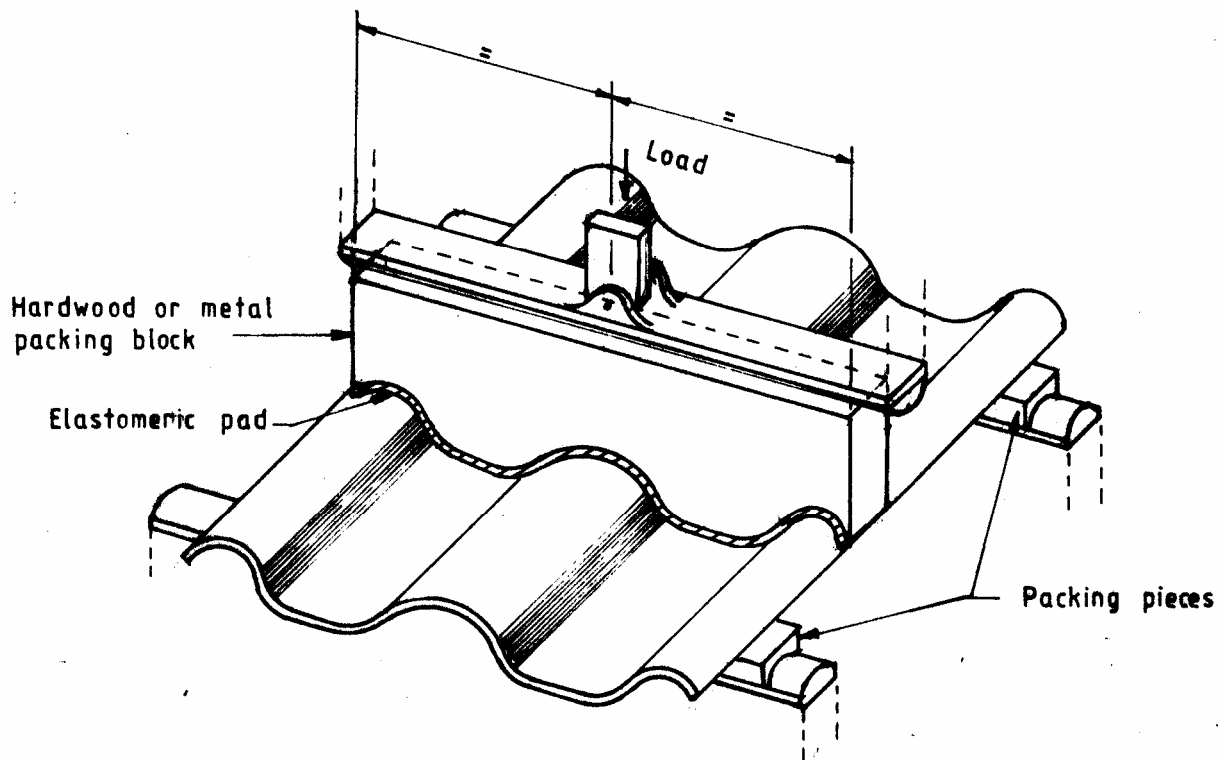


FIGURE 4 - Determination of transverse strength

4.6.3 Procedure

4.6.3.1 Positioning of the semi-sheet or tile in the machine

Place the semi-sheet or tile to be tested with the top surface uppermost on the lower bearers of the test machine so that the centre line of the hanging length is midway between the lower bearers (see Figure 4.) Move the semi-sheet or tile so that semi-sheet or tile is stable over the two lower bearers.

When compared to the fixed lower bearers, the angle of the upper bearer shall be not greater than 10 degrees. Packing pieces with a flat top, shall be used as necessary to achieve this (see Figure 4). The packing pieces shall be no wider than the diameter of the rounded part of the lower bearers.

Arrange a contoured packing block between the upper bearer and the semi-sheet or tile (see Figure 4). The contoured packing block shall be made of hardwood or metal or moulded with plaster. The contoured packing block shall be 20 ± 1 mm wide. Where the contoured packing block is made of hardwood or metal, place an elastomeric pad between the contoured packing piece and the semi-sheet or tile.

The elastomeric pad shall be in length at least the width of the semi-sheet or tile, not less than 20 mm wide, and 10 ± 5 mm thick with a hardness of (50 ± 10) Shore A.

The tile shall be placed in such a way that the load can be applied centrally on the covered width (see Figure 4).

NOTE

For quality control purposes the test may be carried out without the use of the elastomeric pad and contoured packing block.

4.6.3.2 Load application

Apply the load through the upper bearer at a rate not exceeding 6500 N/min until failure occurs.

4.6.4 Recording of test results

Record the maximum load of each semi-sheet or tile to the nearest 10 N. When calculating the total load, include the weight of the packing pieces used on the top surface if they exceed 5 N.

4.6.5 Characteristic transverse strength

Calculate to the nearest 10 N, the characteristic transverse strength :

$$F_c = F - 1.64 S_d$$

where

$$S_d = \sqrt{\frac{\sum (F_i - F)^2}{n - 1}}$$

n is the number of semi-sheets or tiles tested;
 F_i is the maximum load of a semi-sheet or tile; and
 F is the arithmetic mean of F_i values of the sample.

Alternatively, compare the value F_i of each semi-sheet or tile to the appropriate characteristic transverse strength requirement in 6.1.5 and 6.2.5 of SLS 1189 : Part 1 : 1999 and record the number of semi-sheets or tiles with values less than the required value.

4.7 Assessment of Impermeability

4.7.1 Conditioning

Store the semi-sheet, tile or valley tile to be tested at 25 °C to 30 °C, at a minimum of 40 per cent relative humidity for at least 20 h, in such a manner that air is free to circulate to all sides of each semi-sheet, tile or valley tile.

4.7.2 Procedure

In each waterway of the semi-sheet, tile or valley tile, form two small weirs to allow water to stand in a pool with a maximum depth of 10 mm to 15 mm. Make weirs using wet mortar or clay. Put the semi-sheet, tile or valley tile on supports away from the weirs (see Figure 5). Carefully fill the pools with water and store at 25 °C to 30 °C and at least 40 per cent relative humidity for 20 h ± 5 min.

Record whether or not drops of water have fallen from the underside of the semi-sheet, tile or valley tile during the period of 20 h ± 5 min.

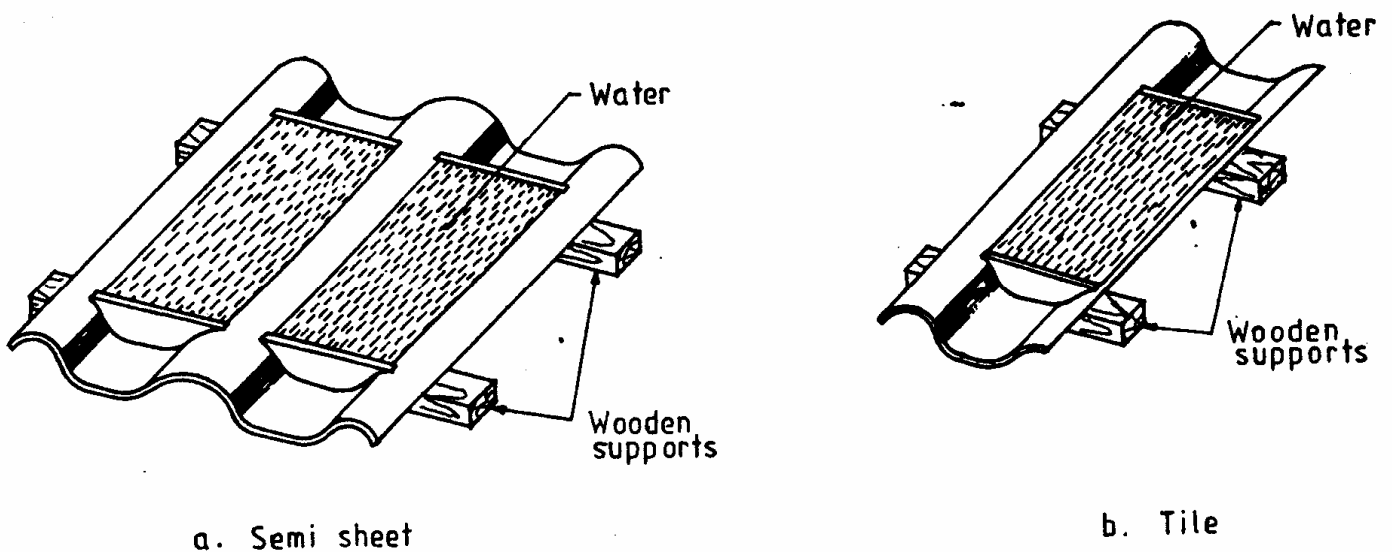


FIGURE 5 - Assessment of Impermeability

4.8 Assessment of Nib support

Prepare a vertical surface by fixing wooden battens at the appropriate distance for the semi-sheets or tiles to be tested. The size of the battens to be used shall be as specified in Appendix C of **SLS 1189: Part 1 : 1999**.

Hang the semi-sheets or tiles on the battens as shown in Figure 6.

Secure the lower semi-sheet or tile where necessary, with nails, screws or clips. Place the test tile in its position without fixings.

Record, whether or not, the semi-sheet or tile remains in the test position without falling for at least 1 min.

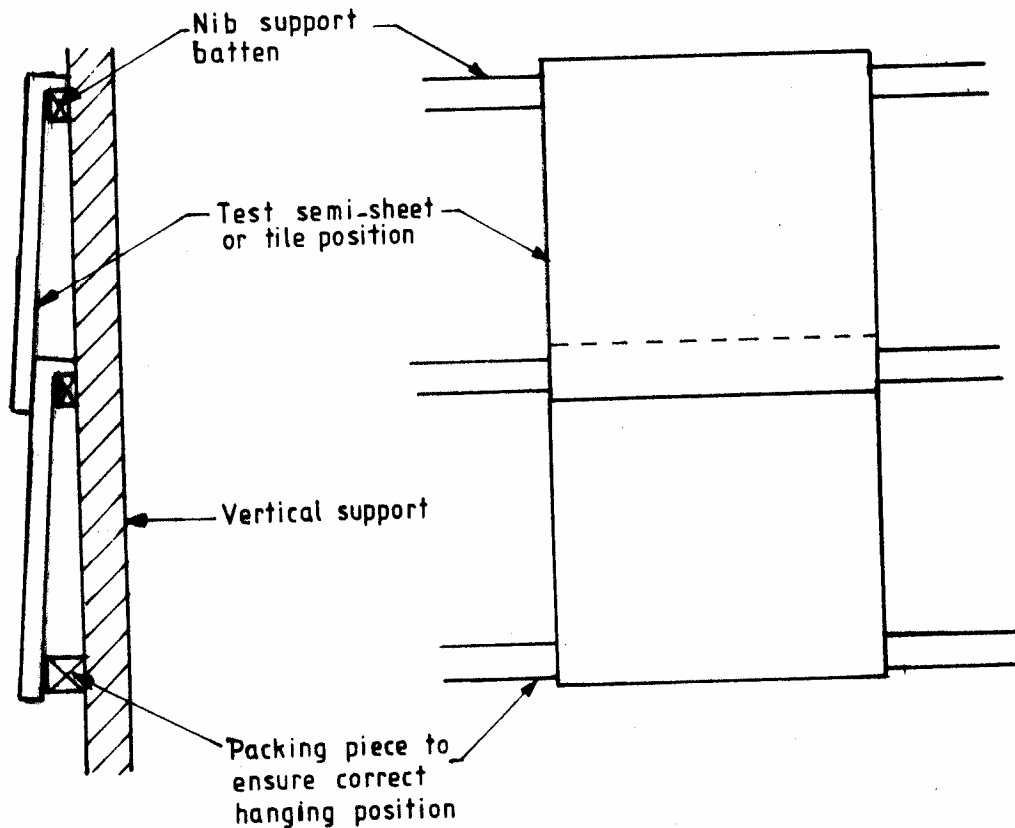


FIGURE 6 - Assessment of nib support

4.9 Assessment of shape of overlapping ends

4.9.1 Apparatus :

Make an array of four battens and rafters to give a roof slope of 20 degrees to 70 degrees to the horizontal. Size and spacings of battens and rafters shall comply with Appendix C of **SLS 1189 : Part 1 : 1999** (see Figure 7).

Select a set of 8 semi-sheets or tiles of the same type as the test specimen, but free of any distortion.

NOTE

These 8 master semi-sheets or tiles may be made from some other more durable material.

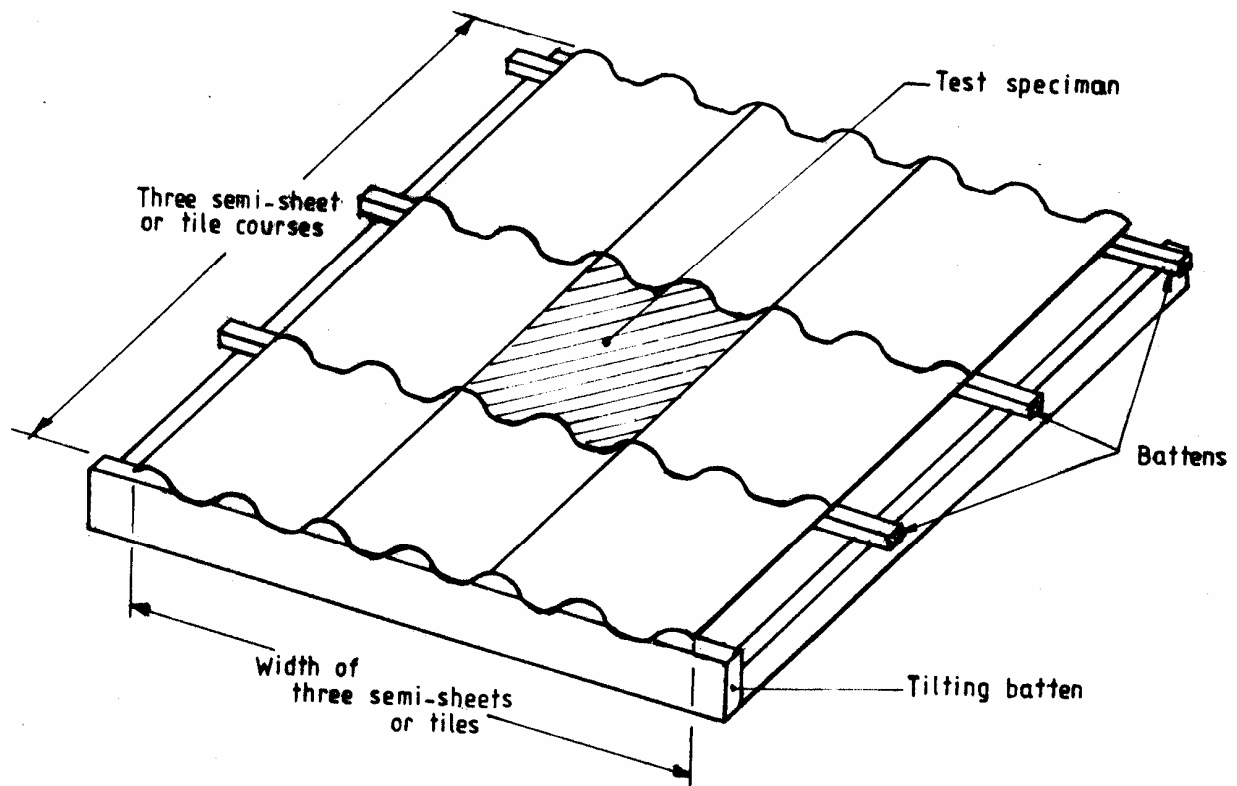


FIGURE 7 - Assessment of shape of overlapping ends

4.9.2 Procedure

The following procedure shall be repeated for each semi-sheet or tile to be tested :

- (a) Position the test stand to permit easy fixing and measurement of the semi- sheets or tiles;
- (b) Fix the first course using three reference semi-sheets or tiles;
- (c) Fix the second course using three semi-sheets or tiles with the test specimen in the centre and a reference semi-sheet or tile on either side;
- (d) Fix the third course using three reference semi-sheets or tiles;
- (e) Hold a string line from top semi-sheet or tile to bottom semi-sheet or tile along the left hand edge of the tested tile. Measure maximum deviation of the left hand edge of the tested tile form this string line;

(f) Hold a string line from top semi-sheet or tile to bottom semi-sheet or tile along the right hand edge of the tested tile. Measure the maximum deviation of the right hand edge of the tested tile from this string line; and

(g) Hold a string line along the bottom edge of the middle row of tiles. Measure the maximum deviation of the bottom edge of the tested tile from this string line.

4.9.3 Report

For each test specimen report the maximum deviation of the left hand edge, right hand edge and the bottom edge in millimetres.

4.10 Pore and crack test

Check the semi-sheet or tile visually for pores and cracks on either side. Measure depth of pores by a wire probe and a scale graduated in millimetres. Measure diameter of pores by a scale graduated in millimetres.

Record the presence or absence of the following :

- (a) Surface pores deeper than 2 mm;
- (b) Surface pores with a diameter greater than 5 mm;
- (c) More than 6 surface pores whose diameters are each greater than 2 mm and less than or equal to 5 mm; and
- (d) Visible cracks longer than 5 mm.

4.11 Ring Test

Select a semi-sheet or a tile which is dry.

Hold the semi-sheet or tile with one hand clear of any other support and tap the semi-sheet or tile with a coin of at least 25 mm diameter. Record whether a clear ring sound or a dull sound is heard. (see Figure 8)

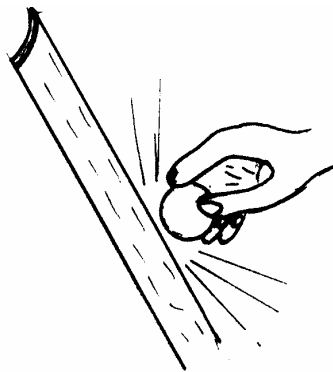


FIGURE 8 - Ring test

4.12 Water Absorption

Prepare a test piece from a semi-sheet or a tile fractured during the transverse strength test. In the case of a ridge or valley tile, a piece should be broken from it.

Immerse the test piece in water. Record the mass of the saturated test piece (M_1). Oven-dry the test piece at a temperature of 100°C - 110°C in a well ventilated oven for a period of 24 hours. Cool to room temperature, reweigh and record the dry mass of the test piece (M_2).

Calculate the percentage of water absorption to the nearest 0.1 per cent, using the formula:

$$\text{Percentage of water absorption} = \frac{M_1 - M_2}{M_2} \times 100$$

M_2

4.13 Determination of thickness

Measure the thickness at 12 places well spaced along the perimeter of the semi-sheet or tile inclusive of four corners, using a vernier caliper or a micrometer screw gauge which can read to an accuracy of 0.1 mm.

Break or cut the semi-sheet or tile at the middle parallel to top or bottom edge, and measure thickness at 4 places each along the two fractured edges, in a similar manner.

Record the average thickness to the nearest 0.1 mm.

NOTE

A semi-sheet or tile to be used for the transverse strength test can be used for this test.

SRI LANKA STANDARDS INSTITUTION

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