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छत के लिए मिट्टी की टाइलें, मंगलौर  
प्रतिरूप — विशिष्टि

( चौथा पुनरीक्षण )

Clay Roofing Tiles, Mangalore  
Pattern — Specification

( Fourth Revision )

ICS 91.120.20

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## FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Clay and Stabilized Soil Products for Construction Sectional Committee had been approved by the Civil Engineering Division Council.

Clay roofing tiles of interlocking type, a particular pattern of which is known as Mangalore pattern in the trade, are being manufactured in large scale in southern part of this country. The provisions in regard to the minimum quality requirements of these tiles were provided in this standard which was first published in 1957 and revised in 1962, 1972 and in 1992. The second revision in 1972 contained provisions in regard to the uniformity in colour and also the actual sizes of tiles. In the third revision, an alternate method to determine breaking load of the tiles had been included.

The Committee responsible for the preparation of this standard has taken into consideration the views of producers, consumers and technologists has related the standard to the manufacturing and trade practices followed in the country in this field.

In this revision of the standard, the following changes have been incorporated:

- a) The provision to incorporate agro residues/industrial by-products in the raw material for tiles has been added;
- b) The classification of tiles has been modified to make it uniform across the standards;
- c) The figures have been modified for clarity;
- d) The sampling procedure has been modified;
- e) The criteria for attaining constant weight has been defined;
- f) The procedure for determining the tolerance in length/width has been clarified; and
- g) The tolerance criteria for length/width has also been modified.

This standard contributes to the following United Nations Sustainable Development Goals: Goal 11 'Sustainable Cities and Communities' towards strengthening the efforts to protect and safeguard the world's cultural and natural heritage and Goal 12 'Responsible consumption and production' towards substantially reducing waste generation through prevention, reduction, recycling and reuse.

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, 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***CLAY ROOFING TILES, MANGALORE PATTERN —  
SPECIFICATION***( Fourth Revision )***1 SCOPE**

This standard covers the specification of machine-pressed clay interlocking roofing tiles of the 'Mangalore pattern'.

**2 REFERENCES**

The standards given below 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 these standards:

<i>IS No.</i>	<i>Title</i>
IS 2248 :1992	Glossary of terms relating to clay products for buildings ( <i>second revision</i> )
IS 5454 : 1978	Methods for sampling of clay building bricks ( <i>first revision</i> )

**3 TERMINOLOGY**

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

**4 CLASSIFICATION**

Mangalore patterns roofing tiles shall be of two classes, namely class A and class B and shall be classified as per the characteristics as specified in Table 1.

**5 GENERAL QUALITY**

**5.1** The roofing tiles shall be made from suitable clay of even texture and shall be well burnt. They shall be free from irregularities, such as twists, bends, cracks, and laminations.

NOTE — The clay may be blended with industrial by-products and/or agro-residues while ensuring that the final product confirms to the requirements of this standard.

**5.2** The roofing tile shall be free from impurities like particles of stone, lime or other foreign materials visible to the naked eye either on the surface or on the fractured face of the tile obtained by breaking the tile. However, occasional particles up to 2 mm in size may be permissible. When struck, the tile shall give a characteristic ringing sound and when broken the fracture shall be clean and sharp at the edges. The class A tile shall be of uniform colour.

**5.3 Shape**

When the roofing tile is placed on either face, on a plane surface, the gap at the corners shall be not more than 6 mm.

**5.4 Lugs****5.4.1 Batten Lugs**

The tile shall have at least 2 batten lugs with base thickness (thickness at bottom) not less than 15 mm and thickness at top not less than 10 mm. The projection from surface of the tile shall be between 7 mm and 12 mm (*see Fig. 1*).

**5.4.2 Eave Lugs**

The tile shall be at least 2 eave lugs with base thickness not less than 15 mm and thickness at top not less than 10 mm. The projection from surface of lug shall be not less than 10 mm and shall be shaped to fit into the corrugations (*see Fig. 1*).

**5.5 Corrugations and Cross Ribs**

The cross-section of the roofing tile shall be such as to give the tile structural rigidity. This may be achieved by providing longitudinal corrugations with intermediate cross ribs or stiffeners (*see Fig. 1*).

**5.6 Tie Down Hole**

At least one hole shall be provided in one of the cross ribs near the eave end of the tile for securing the tile to the reeper or batten with wire. The hole shall be clear and true and shall be not more than 2 mm in diameter, but shall be large enough to pass a 1.6 mm wire easily (*see Fig. 1*).

**Table 1 Classification of Roofing Tiles**

(Clauses 4, 7.1, 7.3, 10.5.3 and 10.5.4)

Sl No.	Characteristic	Requirement	
		Class A	Class B
(1)	(2)	(3)	(4)
i)	Water absorption percent, <i>Max</i>	18	20
ii)	Breaking load, kN, <i>Min</i> :		
	a) Average	1.10 (for 410 × 235 mm) 1.0 (for 420 × 250 mm and 425 mm × 260 mm)	0.90 (for 410 mm × 235 mm) 0.80 (for 420 mm × 250 mm and 425 mm × 260 mm)
	b) Individual	1.00 (for 410 mm × 235 mm) 0.90 (for 420 mm × 250 mm and 425 mm × 260 mm)	0.78 (for 410 mm × 235 mm) 0.68 (for 420 mm × 250 mm and 425 mm × 260 mm)

## 6 DIMENSIONS AND TOLERANCES

### 6.1 Dimensions

There shall be three sizes of tiles, with principal dimensions as given in Table 2. The tolerances in length and width are given in 6.2.

The minimum overlap while laying (*see* Fig. 1) shall be 60 mm lengthwise and 25 mm width wise for each type of tile.

### 6.2 Tolerances

**6.2.1** For measurement of variations in length of tiles, arrange 2 tiles lengthwise, as per 6.1.1 and measure their length as per 6.2.3. Similarly measure the length of an individual tile and calculate the difference in these measurements and this value shall be within the limits mentioned below.

**6.2.2** For measurement of variations in width of tiles, arrange 2 tiles width-wise, as per 6.1.1 and measure their width as per 6.2.3. Similarly measure the width of an individual tile and calculate the difference in these measurements and this value shall be within

the limits mentioned below:

Sl No.	For tiles Sizes mm	Value for Length mm	Value for Width mm
(1)	(2)	(3)	(4)
i)	410 × 235	690 to 710	410 to 430
ii)	420 × 250	710 to 730	440 to 460
iii)	425 × 260	720 to 740	460 to 480

**6.2.3** Two tiles shall be selected at random from the sample selected under 7.3. All blisters, loose particles of clay and small projections shall be removed. These shall be arranged upon a level surface interlocked along length/width wise on straight line in tight position, and overall dimensions are measured (*see* Fig. 2).

### 6.3 Weight

The average mass of the six tiles, when dried at 105 °C ± 5 °C to constant mass; such that 2 consecutive masses taken 2 h apart shall not be vary by more than 0.05 percent; and weighed, shall be not less than 2 kg and not more than 3 kg.

**Table 2 Dimensions of Tiles**

(Clause 6.1)

Sl No.	Overall Length	Overall Width
(1)	(2)	(3)
i)	410	235
ii)	420	250
iii)	425	260

NOTE — If the maximum overlaps are kept, the tile at Sl No. (i) is used for batten spacing up to 320 mm. Sl No. (ii) up to 350 mm and Sl No. (iii) up to 360 mm. However by reducing suitably overlaps in the tiles at Sl No. (i) and (ii) these can also be used for batten spacing up to 350 mm and 360 mm.

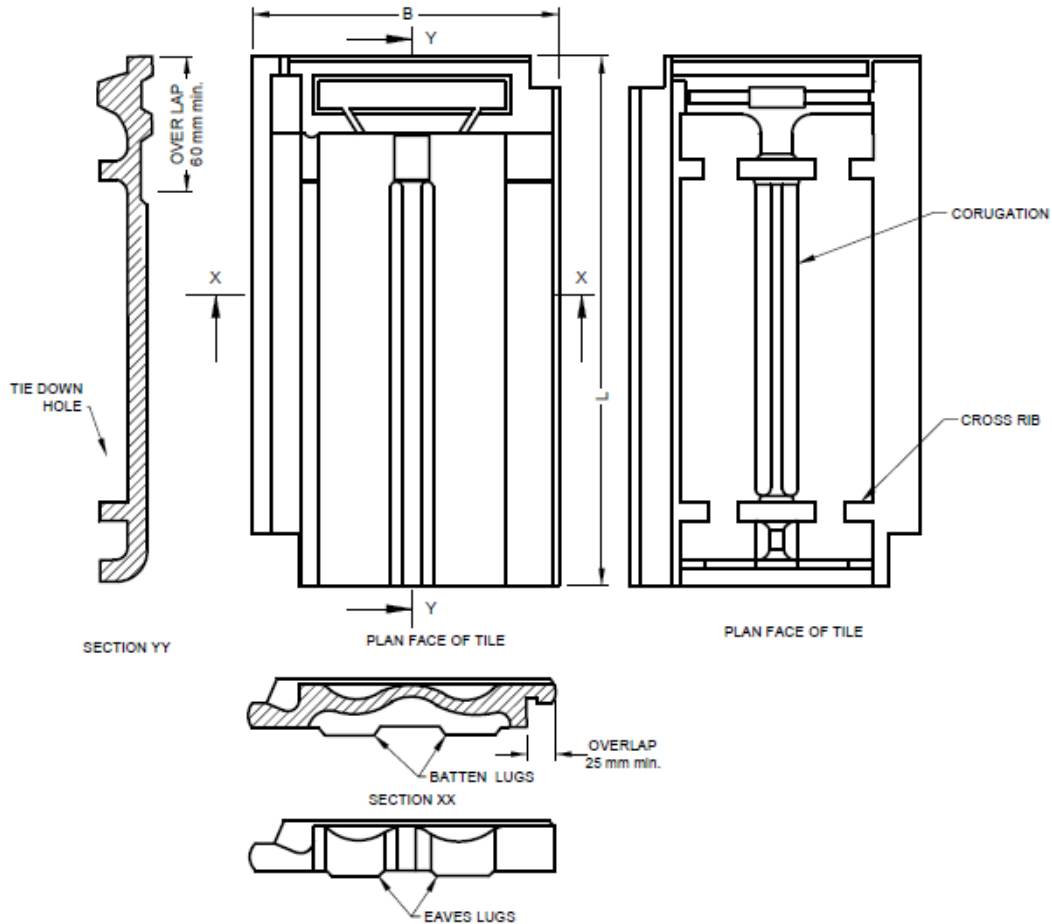


FIG. 1 TYPICAL DETAILS OF MANGALORE TILE

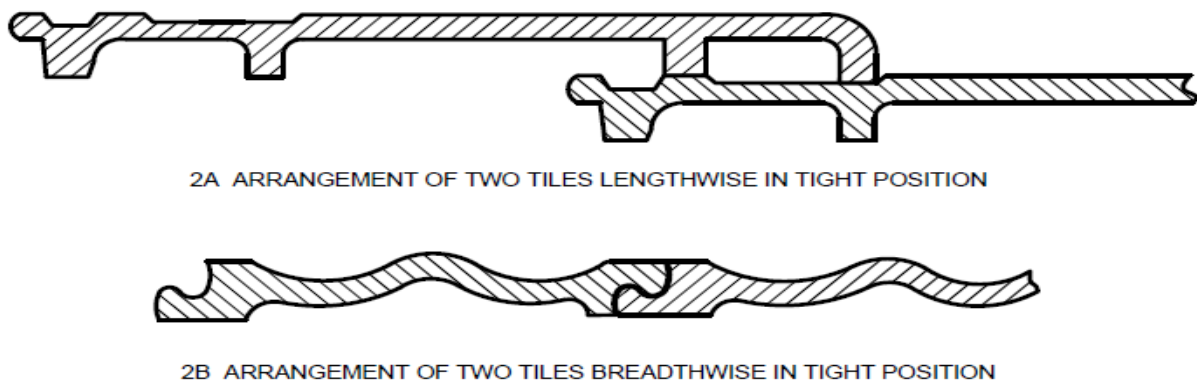


FIG. 2 MEASUREMENT OF TOLERANCES

6.3.1 The weight of tile shall be noted correct to the nearest 0.01 kg.

**7 REQUIREMENTS**

**7.1 Water Absorption Test**

The water absorption of tiles shall conform to the requirements laid down in Table 1, when determined in accordance with the procedure laid down in

Annex A. The maximum individual percentage water absorption shall not exceed the average water absorption by more than 15 percent.

**7.2 Permeability Test**

The tiles shall also be tested for permeability, if so specified by the purchaser, in accordance with the procedure laid down in Annex B.

The tiles shall be considered as satisfying the test, if no water dripping is found at the bottom of the tile after the test.

### 7.3 Breaking Load Test

The breaking load of tiles shall conform to the requirements laid down in Table 1, when determined in accordance with the procedure laid down in Annex C.

## 8 NON-COMPLIANCE WITH TESTS

If any of the roofing tiles in the sample fails to comply with the requirements of any of the tests specified in 7 another sample shall be similarly drawn and tested. If any of the tiles in the second sample also fails to comply with the requirements of tests specified in 7 then the whole lot from which the samples were taken be rejected as not complying with this standard.

## 9 MARKING

**9.1** Each roofing tile shall be legibly and indelibly marked with the name of the manufacturer or his trade-mark, if any; the marking shall not cover more than five percent of the area of the specimen.

**9.2** The clay roofing tiles conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

## 10 SAMPLING

**10.1** The sampling shall be as per IS 5454. The sample for testing shall be taken by the purchaser or his representative or by any person appointed to superintend the works for the purpose of which the tiles are required or by the latter's representative.

## 10.2 Lot

In any consignment all the tiles of the same class and size and from the same batch of manufacture shall be grouped into a minimum number of lots of 10 000 tiles or part thereof.

**10.3** The number of tiles to be selected at random from the lot shall depend upon its size and shall be in accordance with IS 5454.

## 10.4 Number of Tests

**10.4.1** All the tiles selected as in **10.3** shall be examined for shape (*see 5.3*), dimensions (*see 6.1 and 6.2*) and weight (*see 6.3*).

**10.4.2** Out of those tiles examined in **10.4.1**, the samples for water absorption, breaking load test and permeability test, shall be chosen as per IS 5454.

## 10.5 Criteria for Conformity

**10.5.1** The lot shall be considered as conforming to the requirements of the specification if the conditions mentioned under **10.5.2** to **10.5.5** are all satisfied.

**10.5.2** The number of tiles failing to satisfy the requirements of any of the characteristics mentioned in **10.4.1** shall not exceed the corresponding number given in IS 5454.

**10.5.3** From the test results for water absorption, the average ( $\bar{X}$ ) and range ( $R$ ) shall be calculated. The value of  $(\bar{X} + 0.5R)$  shall be less than or equal to the corresponding limit given in Table 1.

**10.5.4** All the individual values of breaking load shall be above the corresponding minimum value specified for individual in Table 1. The average of the test results shall be above the corresponding minimum limit specified for the average in Table 1.

**10.5.5** In the case of permeability test all the tiles tested for permeability shall satisfy the requirements of the test.

## ANNEX A

(Clause 7.1)

## WATER ABSORPTION TEST

## A-1 TEST SPECIMEN

Six tiles shall be used for this test from the sample selected in the manner given under 10.

## A-2 PROCEDURE

Dry the six tiles selected in an oven at a temperature of 105 °C to 110 °C till they attain constant mass such that two consecutive mass taken 2 h apart shall not vary by more than 0.05 percent; and then cool and weigh. After cooling, soak the dry specimens completely in clean water 24 °C to 30 °C for 24 h. Remove each specimen, wipe off the surface water carefully with a damp cloth and weigh the specimen. Weigh the specimen nearest to a gram within three minutes after removing the specimen from the tank.

## A-3 EVALUATION AND REPORT OF TEST RESULTS

A-3.1 The percentage water absorption shall be calculated using the following formula:

$$\text{Percentage absorption} = \frac{B - A}{A} \times 100$$

where

$B$  = mass of the specimen after 24 h immersion in water; and

$A$  = mass of the dry specimen.

A-3.2 The individual and average percentage water absorption of the six tiles shall be calculated and reported to the nearest 1 digit.

## ANNEX B

(Clause 7.2)

## PERMEABILITY TEST

## B-1 TEST SPECIMEN

Six tiles shall be used for this test from the sample selected in the manner given under 10.

## B-2 APPARATUS

The test shall be conducted in a rectangular trough (see Fig. 3) which is open at bottom, the dimensions at the bottom being equal to the size of the Mangalore Pattern tile. When the tile is kept against its bottom, it shall be held in position and the fitment shall facilitate easy plugging of the space between the edges of the tiles against leakage of water.

## B-3 TEST PROCEDURE

B-3.1 The test shall be conducted at temperature of

27 °C ± 2 °C.

B-3.2 The tile shall be fitted at the bottom of the trough and the space between the tile and the sides of the trough plugged water-tight with a suitable material like wax, bitumen, etc.

Water shall be poured into the mould so that it stands over the lowest tile surface to a height of 50 mm.

B-3.3 The water in the trough shall be allowed to stand for a period of 6 h. The bottom of the tile shall then be carefully examined to see whether the water droplets are visible underneath the tile.

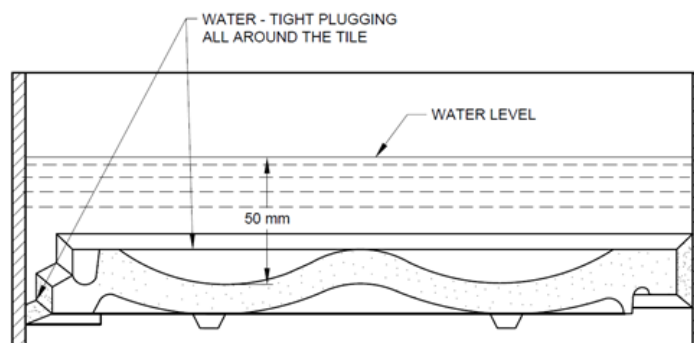


FIG. 3 ARRANGEMENTS FOR PERMEABILITY TEST

## ANNEX C

(Clause 7.3)

### DETERMINATION OF BREAKING LOAD

#### C-1 TEST SPECIMEN

Six tiles shall be used for this test from the sample selected in the manner as given under **10**.

#### C-2 APPARATUS

**C-2.1** The apparatus (*see* Fig. 4) shall consist of two parallel self-aligning cylindrical steel rods (bearers), with the bearing surface rounded to 40 mm diameter, so placed that the distance between the centres could be altered. The load is applied through a third steel bearer of similar shape placed midway between and parallel to the supports. The length of all the bearers shall exceed the maximum width of the tile under test.

The loading device may consist of a container such as a bucket connected either directly or through levers to the loading arms. The loading shall be at a uniform rate of 450 N/min to 540 N/min by allowing lead shots to flow into the container. Provision shall be made to arrest the flow of lead shots immediately the tile breaks.

**C-2.2** Alternatively, a suitably modified hand operated compression testing machine with a minimum load frame capacity of 100 kN may be used (*see* Fig. 5). In this system the bearer assembly is mounted on a rigid mild steel plate and the third central loading bearing is fixed through a suitable

dial micrometer (least count 0.25 mm) or an equally sensitive device to bear on the loading member or on the specimen at mid span. The specimen is supported on the bottom parallel bearers separated by a distance of minimum three-fourths (3/4) of the length of the tile.

The error in the load reading shall not exceed 2.2 N for loads up to 220 N and for greater load, the error shall not exceed 1 percent of the maximum load. The rate of loading should be uniform and vary in the range of 450 N/min to 540 N/min (45 kg/min to 54 kg/min).

#### C-3 PROCEDURE

Test six tiles after soaking them in water at  $27\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  for 24 h, in the wet condition. Support the tile evenly flatwise on the bearers set with a span of 250 mm and resting on the bottom surface. Apply the load with the direction of the load perpendicular to the span, at a uniform rate of 450 N/min to 540 N/min.

#### C-4 EVALUATION AND REPORT OF TEST RESULTS

The individual breaking load of each of the six tiles separately in wet condition shall be recorded and the average calculated.



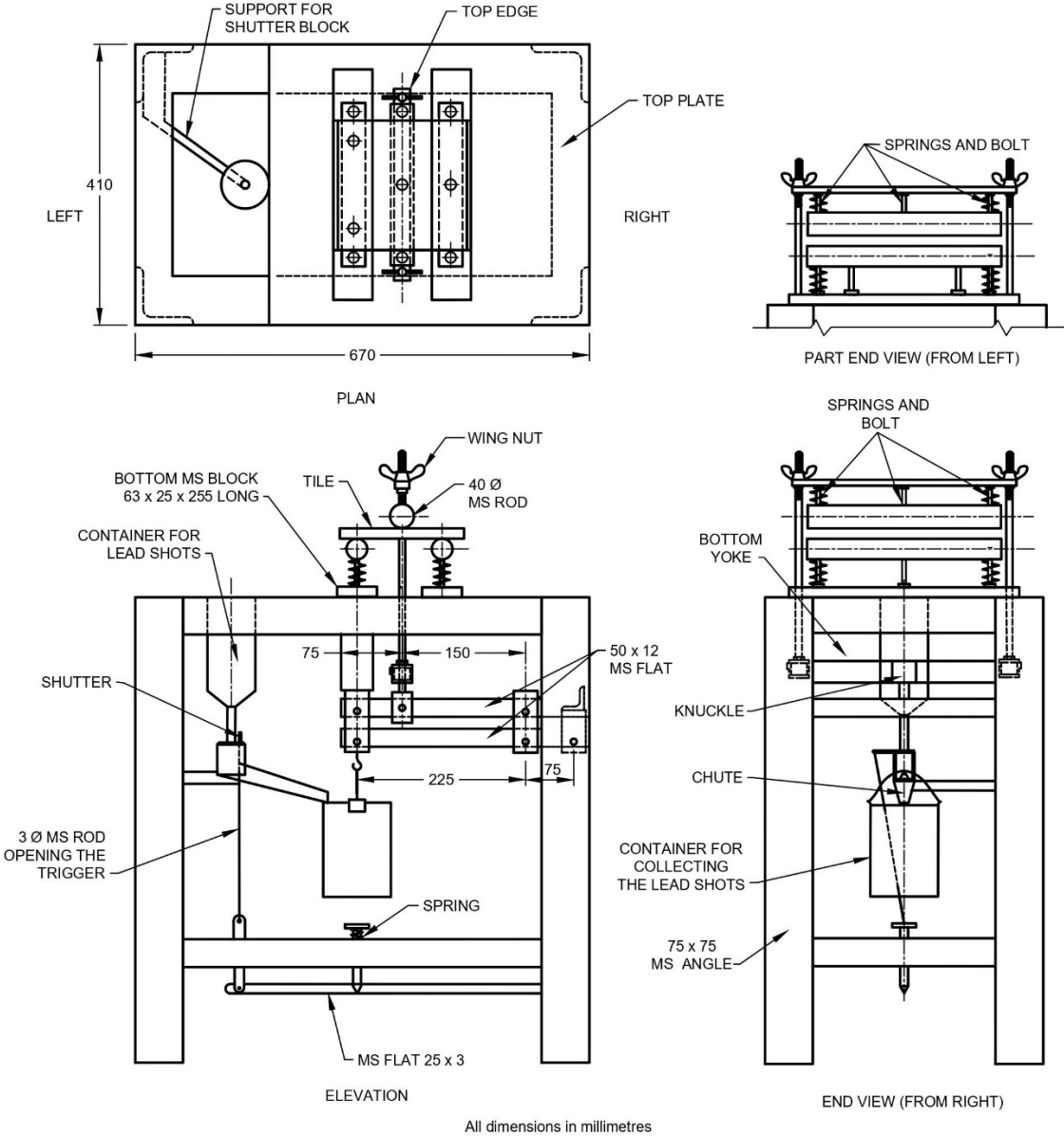
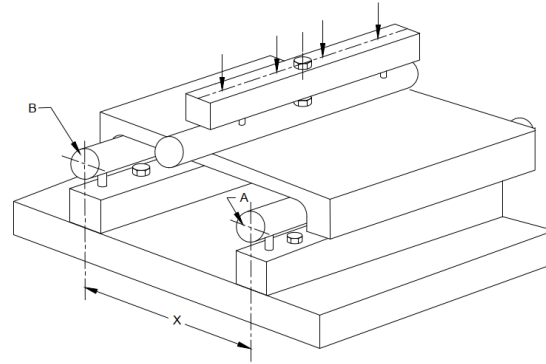
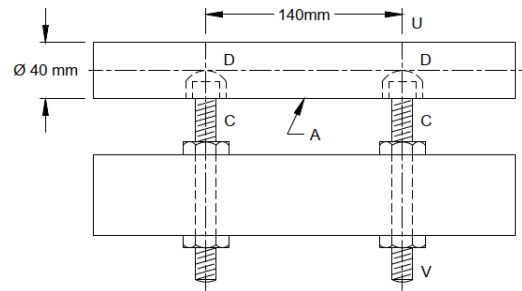


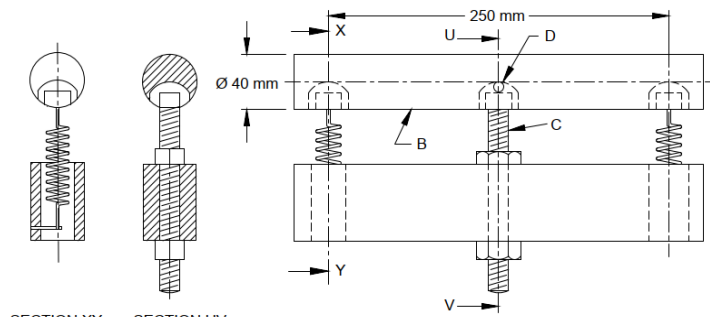
FIG. 4 TILE TESTING MACHINE



X = SPAN AS PER TILE SIZE



DETAIL OF BEARER A



DETAIL OF BEARER B  
DETAIL OF BEARER B AND LOADING SUPPORT C

FIG. 5 ESSENTIALS OF APPARATUS FOR TRANSVERSE TEST

**ANNEX D***(Foreword)***COMMITTEE COMPOSITION**

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### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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