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Indian Standard
SPECIFICATION FOR
ROOFING SLATE TILES
(*First Revision*)

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Indian Standard

SPECIFICATION FOR ROOFING SLATE TILES

(*First Revision*)

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Indian Standard

SPECIFICATION FOR ROOFING SLATE TILES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 January 1981, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Slates are low-grade regionally metamorphosed argillaceous rocks which have developed a well-marked cleavage but have suffered little recrystallization, so that the rock are still very finegrained. Where slates are subjected to thermal metamorphism they may develop spots or clots of incipient new minerals (spotted or knotted slates), or recognizable crystals of new minerals such as pyrite or the chistolite variety of andalusite. The term slate appears therefore as part of the name of certain thermally metamorphosed rocks because of their cleavage. Thermal metamorphism does not produce slaty cleavage, in fact it tends to destroy it, with the production of hornfelds.

0.3 Slates are important roofing material. Rectangular tiles made out of slate are used for the covering of sloped roof as single slating or double slating. Slates are available in Kumaon, Garhwal, Mandi, Kangra and Chamba hills of outer Himalayas; Naga hills of Assam; Kurnool, Nellore, Guntur and Prakasan districts of Andhra Pradesh; in Alwar district of Rajasthan; in Rewari, Gurgaon and Kund of Mohindergarh districts of Haryana; and in Monghyr and Singhbhum district of Bihar. The physical properties of slates vary considerably from place to place. Even in the same place there is large variation of the properties. But the slates fulfilling certain minimum requirements are only suitable for roofing purpose and, therefore, a careful selection in their procurement is necessary before use. This standard was first published in 1971 and has therefore been formulated to provide guidance for the selection of such natural stone for using them as roofing material. In this revision a technical definition of the slates alongwith their precise location in the country have been included in order to differentiate them from other natural building stones. Two additional tests along with their requirements which are considered to be critical in examining the slates under atmospheric pollution have been added. Only SI Units have been specified in this revision.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified values in this standard.

1. SCOPE

1.1 This standard lays down the requirements of dimensions, physical properties and workmanship of slate tiles used for sloped roof covering.

NOTE — The requirements in regard to the method of laying and fixing of slate tiles for roofing have been covered separately in IS : 5119 (Part I)-1968†.

2. GENERAL REQUIREMENTS

2.1 The slate for roofing shall be free from veins, cracks, or other similar source of weakness. They shall be of uniform colour and texture and shall not contain white patches and deleterious minerals. The slate shall be of reasonably straight cleavage and the grains shall be longitudinal.

NOTE — The presence of deleterious minerals could be ascertained with the help of petrographic examination.

3. DIMENSIONS AND TOLERANCES

3.1 The standard size of slate tiles shall be as follows:

<i>Length</i>	<i>Breadth</i>	<i>Thickness</i>
mm	mm	mm
600	300	15 Min
500	250	15 Min

3.1.1 Sizes other than those mentioned in 3.1, may be supplied as agreed to between the supplier and the purchaser.

3.2 A tolerance of ± 5 mm shall be allowed on length and breadth.

4. PHYSICAL PROPERTIES

4.1 The physical properties of slate tiles shall conform to the requirements given in col 3 of Table 1, when tested in accordance with the method mentioned in col 4.

*Rules for rounding off numerical values (revised),

†Code of practice for laying and fixing of sloped roof covering: Part I Slating.

TABLE 1 PHYSICAL PROPERTIES OF SLATE TILES

(Clause 4.1)

Sl No.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST
(1)	(2)	(3)	(4)
i)	Water absorption	a) Maximum average: 2 percent by mass b) Variation should not exceed 20 percent between individual sample	Appendix A
ii)	Modulus of rupture	60 N/mm ² (dry), <i>Min</i> 40 N/mm ² (wet), <i>Min</i>	Appendix B
iii)	Depth of softening	0.05 mm, <i>Max</i>	IS : 4122-1967*
iv)	Permeability	No water shall ooze from the bottom	Appendix C
v)	Sulphuric acid immersion (see Note)	Shall show no sign of de- lamination along the edge or swelling, softening, flaking of the surface and shall not exhibit gaseous evolution during immersion	Appendix D
vi)	Wetting and drying	Shall show no sign of de- lamination or splitting along the edge nor flak- ing of the surface	Appendix E

NOTE — This requirement is related to the conditions of atmospheric pollution and the slate tiles shall be subjected to this requirement only if required by the purchaser.

*Method of test for surface softening of natural building stones.

5. WORKMANSHIP

5.1 Unless otherwise specified the slates shall be of uniform thickness and rectangular shape with reasonably full corners and the edges shall be true. The surface of the slate shall be such as to permit proper laying. The exposed surfaces shall be finished as specified and in accordance with an approved sample.

6. MARKING

6.1 Each slate tile shall be marked in a suitable manner with the manufacturers' identification mark or initial.

6.1.1 Each tile may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. PACKING

7.1 The tiles shall be placed side by side along the cleavage planes and different rows in the packing boxes should be closely spaced.

8. SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Lot — In any consignment all the roofing tiles of the same type, dimensions and from the same batch of manufacture shall be grouped together to constitute a lot.

8.2 The number of tiles to be selected at random from the lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 2.

TABLE 2 SAMPLE SIZE AND CRITERION FOR CONFORMITY

LOT SIZE	SAMPLE SIZE	PERMISSIBLE NO. OF DEFECTIVE TILES	NO. OF TESTS FOR EACH PHYSICAL CHARACTERISTIC
(1)	(2)	(3)	(4)
Up to 10 000	30	3	1
10 001 ,, 20 000	60	5	2
20 001 ,, 30 000	90	7	3
30 001 ,, 40 000	120	8	4
40 001 ,, 50 000	150	10	5

8.2.1 If the tiles are stacked in any orderly manner, the samples may be drawn equally from as many stacks as possible. Randomness within a stack can be ensured by using a random number table and following the procedure prescribed in IS : 4905-1968*.

*Methods for random sampling.

8.3 All the tiles selected under col 2 of Table 2 shall be examined for general requirements (*see 2*) dimensions and tolerances (*see 3*) and workmanship (*see 5*). Any tile failing in any one or more of the above requirements shall be considered as defective. A lot shall be conforming to these requirements if the number of defective tiles is not more than the permissible number of defectives given in col 3 of Table 2.

8.4 The lot having been found satisfactory with respect to general requirements, dimensions and tolerances and workmanship shall be divided into as many groups as the number of tests prescribed in col 4 of Table 2. Each of the groups shall contain not less than 25 tiles. Each group shall be subjected to physical tests enumerated in Table 1. A lot shall be considered to have satisfied the requirements of the physical properties if none of the tiles tested for these requirements fail in any of these tests.

APPENDIX A

[Table 1, Sl No. (i)]

WATER ABSORPTION TEST

A-1. TEST SPECIMEN

A-1.1 Six tiles shall be used from the sample selected in the manner given under 8.

A-2. PROCEDURE

A-2.1 Dry the tiles in an oven at a temperature of 105 to 110°C till they attain constant mass and then cool and weigh. When cool, immerse the dry specimens completely in clean water at $27 \pm 2^\circ\text{C}$ for 24 hours. Remove each specimen, wipe off the surface water carefully, with a damp cloth and weigh the specimen. Complete weighing within three minutes after removing the specimen from the tank.

A-3. CALCULATION

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 hours immersion in clean water, and

A = mass of the dry specimen.

A-4. REPORT

A-4.1 The average percentage water absorption of the six tiles shall be calculated and reported as the percentage water absorption.

APPENDIX B

[Table 1, Sl No. (ii)]

DETERMINATION OF THE MODULUS OF RUPTURE

B-1. TEST SPECIMEN

B-1.1 Six tiles (three wet and three dry) shall be used for this test from the sample selected in the manner as given under 8. The specimens 100 mm wide and 150 mm long with the grain running lengthwise shall be cut from the tiles.

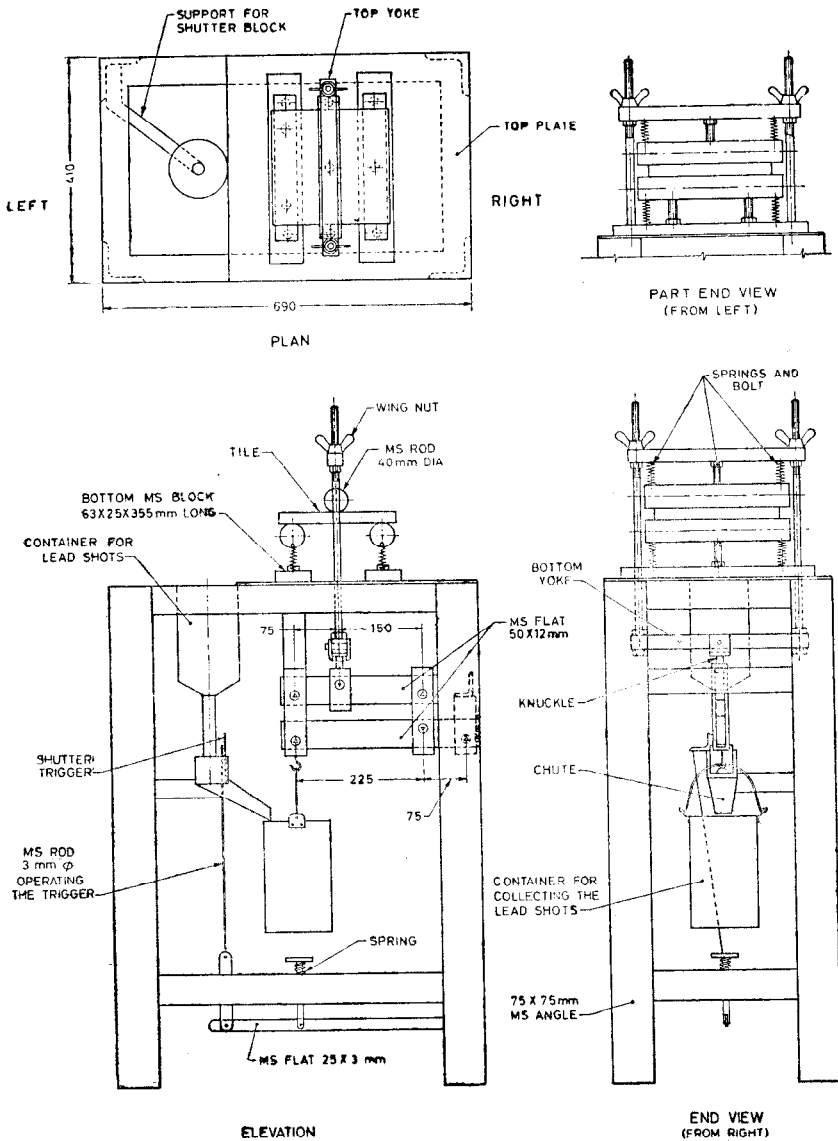
B-2. APPARATUS

B-2.1 The apparatus (see Fig. 1) shall consist of two parallel self-aligning cylindrical steel bearers, with the bearing surface rounded to 40 mm diameter, placed in such a way that the distance between the centres is 100 mm. 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 be more than 100 mm.

B-2.2 The loading device may consist of a bucket connected either directly or through levers to the loading arms. The loading shall be at a uniform rate of 5 ± 0.5 N/min by allowing lead shot to flow into the bucket. Provisions shall be made to arrest the flow of lead shots immediately the tile breaks.

B-3. PROCEDURE

B-3.1 Test three tiles, soaking them in water at $27 \pm 2^\circ\text{C}$ for 72 hours in the wet condition and three tiles in the dry condition. Support the tile evenly flatwise on the bearers and resting on the natural bottom surface. Apply the load with the direction of the load perpendicular to the span.



All dimensions in millimetres.

FIG. 1 TILE TESTING MACHINE
(For the Determination of Flexural Strength)

B-4. CALCULATION

B-4.1 The individual breaking load of the tiles shall be calculated as under:

$$R = 1.5 \frac{WL}{bd^2}$$

where

R = modulus of rupture in N/mm^2 ,

W = breaking load in N ,

L = length of span between supporting steel bearings in mm ,

b = width of specimen in mm , and

d = thickness of specimen in mm .

B-5. REPORT

B-5.1 The average breaking load of wet and dry tiles individually shall be reported.

A P P E N D I X C

[Table 1, Sl No. (iv)]

PERMEABILITY TEST

C-1. TEST SPECIMEN

C-1.1 Six tiles shall be used from the sample selected in the manner given under 8.

C-2. APPARATUS

C-2.1 The test shall be conducted in a rectangular trough (see Fig. 2) which is open at bottom. The dimensions at bottom shall be sufficient to accommodate the tile specimens. 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 the water.

C-3. TEST PROCEDURE

C-3.1 The tile shall be fitted at the bottom of the trough and the space between the tile and the sides of the trough shall be plugged water-tight with either wax or bitumen.

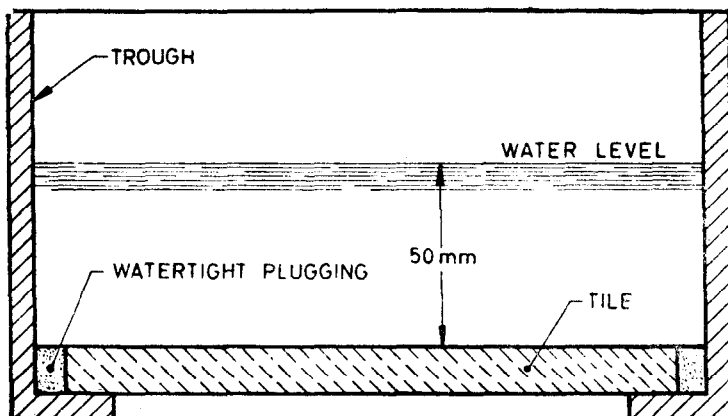


FIG. 2 ARRANGEMENT FOR PERMEABILITY TEST

C-3.1.1 Water shall be poured into the trough so that it stands over the tile surface to a height of 50 mm. The water in the trough shall be allowed to stand for a period of 48 hours.

C-4. REPORT

C-4.1 Any seepage or oozing of water through the bottom of the tile shall be reported.

A P P E N D I X D

[Table 1, Sl No. (v)]

SULPHURIC ACID IMMERSION TEST

D-1. TEST SPECIMEN

D-1.1 Three test specimens measuring 50 × 50 mm shall be cut from the samples selected as given under 8, with a suitable tool. Care shall be taken to avoid cracking or splintering of the slate. All the edges shall be ground with water to give a smooth finish.

NOTE — Use of specimens having cracks or other defects shall be avoided.

D-2. CHEMICALS

D-2.1 Solution of Sulphuric Acid (Specific Gravity 1.145) — It shall be prepared by adding 1 volume of concentrated sulphuric acid (sp gr 1.84) to 7 volumes of distilled water.

D-3. PROCEDURE

D-3.1 The test specimens shall be immersed in the solution of sulphuric acid at $27 \pm 2^{\circ}\text{C}$ for 10 days and then examined.

D-4. REPORT

D-4.1 Any sign of delamination along the edges, swelling, softening or flaking of the surface, or evolution of gas during immersion shall be reported.

A P P E N D I X E

[*Table 1, Sl No. (vi)*]

WETTING AND DRYING TEST

E-1. TEST SPECIMENS

E-1.1 Three test specimens measuring 50×50 mm shall be cut from the samples selected as given under **8**, with a suitable tool. Care shall be taken to avoid cracking and splintering of the samples. All the edges shall be ground with water to give a smooth finish.

E-2. APPARATUS

E-2.1 A circulating air oven of adequate capacity and having thermostatic control that will maintain a temperature of $110 \pm 2^{\circ}\text{C}$.

E-3. PROCEDURE

E-3.1 The test specimens shall be subjected to 16 cycles of alternate immersion in distilled water for 6 hours at $27 \pm 2^{\circ}\text{C}$ and heating in the air oven at $110 \pm 2^{\circ}\text{C}$ for 17 hours and cooling to a temperature of $27 \pm 2^{\circ}\text{C}$. The specimens shall then be examined.

E-4. REPORT

E-4.1 Any splitting, flaking, delamination or any other sign of failure shall be reported.