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Indian Standard

METHOD OF TEST FOR SURFACE SOFTENING OF NATURAL BUILDING STONES BY EXPOSURE TO ACIDIC ATMOSPHERES

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 May 1967, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Several types of natural building stones show rapid deterioration when affected by atmospheric gases like carbon dioxide, sulphur dioxide and sulphur trioxide, which form sulphuric acid with the humid air that occurs in industrial centres and sea coasts. For the selection of the proper type of stone for use in such exposed areas, it is necessary to know the resistance of stone against surface softening by action of acids. This standard lays down the method of test for this purpose.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.4 This standard is one of a series of Indian Standards on method of test for natural building stones. Other standards published so far in the series

0.5 In reporting the results of a test or 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 IS : 2-1960*.

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1. SCOPE

1.1 This standard lays down the procedure for determining the extent of surface softening taking place in natural building stones when exposed to acidic atmospheres.

*Rules for rounding off numerical values (*revised*).

2. SAMPLING

2.1 The sample shall be selected to represent a true average of the type or grade of stone under consideration.

2.2 The sample shall be selected by the purchaser or his authorized representative from the quarried stone or taken from the natural rock, as described in **2.2.1** and **2.2.2** and shall be of adequate size to permit the preparation of the requisite number of test pieces.

2.2.1 In case of stone from ledges or quarries the ledge or quarry face of the stone shall be inspected to determine any variation in the different strata. Differences in colour, texture and structure shall be observed. Separate samples of stone weighing at least 25 kg each of unweathered specimen shall be obtained from all strata that appear to vary in colour, texture and structure. Pieces that have been damaged by blasting, driving wedges, heating, etc, shall not be included in the sample.

2.2.2 In case of field stone and boulder, a detailed inspection of the deposits of field stone and boulders over the area where the supply is to be obtained, shall be made. The different kinds of stone and their condition in the various deposits shall be recorded. Separate samples shall be selected for all classes of stone that would be considered for use in construction as indicated by visual inspection.

2.3 When perceptible variations occur in the quality of rock, the purchaser shall select as many samples as are necessary for determining the range in properties.

3. TEST SPECIMENS

3.1 Test pieces shall be either $10 \times 10 \times 20$ cm prisms or 10-cm cubes. The faces shall be ground smooth and finished with abrasive of IS Grit No. 80 (*see* IS : 715-1966*), and brushed free of all loose flakes.

4. HAND SCRAPING TOOL

4.1 The scraping tool shall be made by grinding down the blade of a putty knife to a length of 7·5 cm and width of 2 cm. The end of the blade shall be ground to a plane surface perpendicular to the length of the tool to form a sharp edge with either side of the blade. These sharp edges shall be referred to as cutting edges, and the scraping shall be done with these cutting edges.

NOTE — The type of steel shall be of T-90 V23 conforming to IS : 1570-1961†.

*Specification for coated abrasives, glue bond (*revised*).
†Schedules for wrought steels for general engineering purposes.

5. TEST PROCEDURE

5.1 Sample Preparation — The specimens tested shall not be less than 3 in number. One of the faces of each sample shall be scraped in the original condition at the centre. The scraping shall be done in the manner as explained in **5.1.1**. The centre of the face may be located by drawing the diagonals of the rectangle. The depth of scraping d_1 shall be found by making thickness measurements to the nearest 0·02 mm before and after scraping and computing their difference. The sample shall be scraped at room temperature (20° to 30°C).

5.1.1 *Procedure for Scraping* — Apply approximately 1·5 kg pressure (*see* Note below) on the cutting edge holding the blade on the surface of the specimen at an angle of 30°. Make each stroke by moving the cutting edge forward about 4 cm, and repeat the stroke with the same cutting edge 8 times, taking care that each stroke follows the same path. Make another 8 strokes with the other cutting edge in the same manner. Before each specimen is scraped, sharpen the cutting edge.

NOTE — The criteria for judging the pressure to be applied in the test, are the feel of pressure, and the amount of bending of the blade. By grasping the handle of the tool in the same way as in scraping the specimen and by pressing a cutting edge on the weighing table of a small platform scale having its weighing beam set for a load of 1·5 kg, the feel of pressure and the bending of blade could be ascertained.

5.2 After scraping the specimen as in **5.1**, put that in a glass vessel and completely cover with 1 percent (w/v) sulphuric acid solution (*see* Note below). Space the specimens in the container so that the acid has free access to the faces that are to be scraped subsequently as in **5.3**. Pour off the acid solution each day and replace with fresh solution. At the end of 7 days remove the specimens, wash thoroughly with water and dry in an oven for 24 hours at 105° ± 2°C.

NOTE — A convenient means of determining the amount of sulphuric acid required to make 1-percent solution is obtained from the following formula:

One percent (0·01 w/v) sulphuric acid solution = $\frac{0{\cdot}96\,x}{x + 10\,000}$

where

x = the weight of 96-percent sulphuric acid (sp gr 1·84) to be dissolved in 10 000 ml of water

Therefore, the value of x = 105·25 kg

The volume of 105·25 g of such sulphuric acid is $\frac{105{\cdot}25}{1{\cdot}84}$ = 57 ml.

The error due to assuming the density of water as 1 is not appreciable.

5.3 When the specimens have cooled to room temperature (20° to 30°C) after drying, scrape in each specimen the face opposite to the one scraped

previously as in **5.1**. The scraping shall be done in the same manner as explained in **5.1.1**. Find the depth of scraping (d_2) by measurement of thicknesses before and after scraping and computing the difference.

6. EVALUATION

6.1 The depth of softening shall be computed for each specimen as ($d_2 - d_1$) (*see* **5.1** and **5.3**). The average depth of softening for all the specimens tested shall be computed and reported. The result shall be expressed to nearest 0·02 mm.

6.2 The following additional information shall be reported:

a) Identification of the sample, including name and location of the quarry,

b) Name or position of the ledge,

c) Date when sample was taken,

d) Trade name or grade of stone,

e) Size and shape of the specimen used in the test, and

f) A description of the manner in which the specimens were prepared.

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