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Indian Standard

(Reaffirmed 1998)

METHODS OF TEST FOR DETERMINATION OF STRENGTH PROPERTIES OF NATURAL BUILDING STONES

PART IV SHEAR STRENGTH

(First Revision)

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Indian Standard

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Indian Standard

METHODS OF TEST FOR DETERMINATION OF STRENGTH PROPERTIES OF NATURAL BUILDING STONES

PART IV SHEAR STRENGTH

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part IV) (First Revision) was adopted by the Indian Standards Institution on 1 October 1974, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Building stones are available in large quantity in various parts of the country and to choose and utilize them for their satisfactory performance it is necessary to know the various strength properties determined according to standard procedure. This standard has, therefore, been formulated to cover the standard method for determining the strength properties of various stones. This standard covering compressive, transverse and shear strength properties was published in 1957 and is being revised based on the actual use of it in the past 17 years and the experience gained in testing for these properties in the various research laboratories of this country. In this revision, property of tensile strength has also been added which is also important for assessing the suitability of stone.

0.2.1 This standard is now being issued in four parts, each part covering a specific property. Part IV covers the determination of shear strength of natural building stones.

0.3 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 (Part IV) lays down the procedure for determination of shear strength of natural building stones used for constructional purposes.

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

2. SELECTION OF SAMPLE

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 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 *Stones from Ledges or Quarries* — The ledge or quarry face of the stone shall be inspected to determine any variation in different strata. Differences in colour, texture and structure shall be observed. Separate samples of stone weighing at least 25 kg each of the unweathered specimens 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 *Field Stone and Boulders* — A detailed inspection of the stone and boulders over the area shall be made where the supply is to be obtained. The different kinds of stones and their conditions at various quarry sites shall be recorded. Separate samples for each class of stone that would be considered for use in construction as indicated by visual inspection shall be selected.

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

3. TEST PIECES AND CONDITIONING

3.1 Saws shall be used for making test pieces from samples selected in accordance with **2**. Use of hand tools, such as chisel for cutting shall not be permitted.

3.2 The load-bearing surfaces shall be finished to as nearly true and parallel planes as possible by using rock cutting saws, grinding, polishing wheels, abrasive powder. The test pieces shall be measured to the nearest 0·2 mm at the centre section.

3.3 The load-bearing surfaces and the direction of the rift shall be carefully marked on each test piece after finishing.

3.4 Test piece for use in the Johnson shear tool shall be bars 50×50 mm in section and not less than 180 mm in length.

3.5 Test piece for use with the Dutton punching shear device shall be slabs 30 mm in thickness, 100 mm in width and not less than 100 mm in length.

3.6 Three test pieces shall be used for conducting the test in each of the

conditions mentioned in **3.6.1** and **3.6.2**. In each of these conditions, separate tests shall be made for the specimen when load is parallel to the rift and perpendicular to the rift.

3.6.1 Test pieces to be tested in the dry condition shall be dried in an oven at 105±5°C for 24 h and cooled in desiccator to room temperature (20 to 30°C).

3.6.2 The test piece shall be immersed in water maintained at room temperature (20 to 30°C) for 72 h before testing and shall be tested in saturated condition.

4. APPARATUS

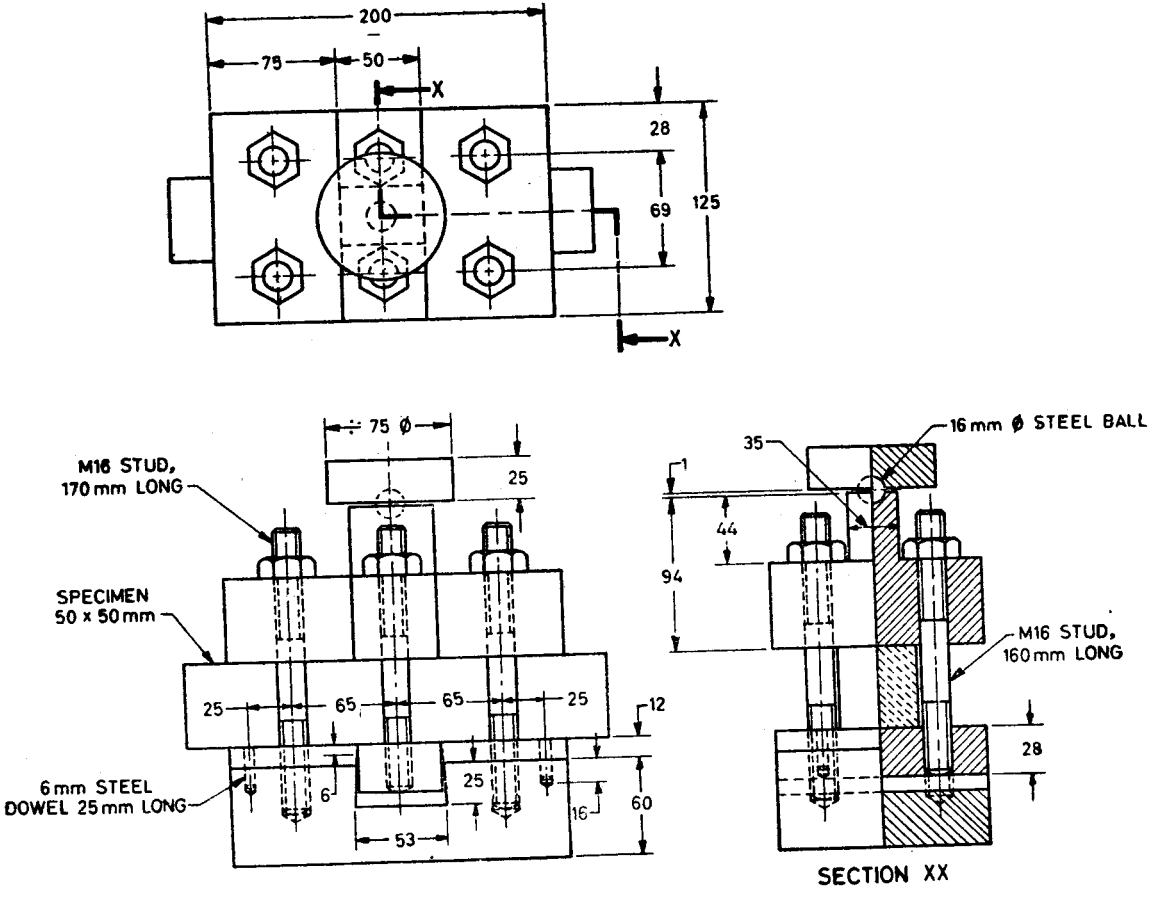
4.1 The apparatus shall be either the modified Johnson shear tool (*see* Fig. 1) or the Dutton punching shear device (*see* Fig. 2A and 2B) in conjunction with any standard testing machine of sufficient capacity.

4.2 When the Dutton punching shear device is used, a spherical bearing block of sufficient size to cover the upper end of the plunger of the punching shear device shall be used.

5. PROCEDURE

5.1 Using Johnson Shear Tool — The test piece shall be carefully centred in the shear tool as shown in Fig. 1 and the bolts drawn up tightly. The tool shall then be centred in the testing machine with the centre of the spherical block in contact with the centre of the top portion of the plunger of the shear tool. Accurate adjustments shall be made by hand under a small initial load. The speed of the moving head of the testing machine during the application of the load shall be not more than one millimetre per minute. During the test, the beam of the testing machine shall be kept constantly in a floating position.

5.2 Using Dutton Punching Shear Device — Centre lines shall be laid off on one surface of the slab and the thickness of the slab shall be measured to the nearest 0·2 mm at not less than three points approximately equidistant around the circumference of a 50 mm circle centred on the intersection of the two centre lines. The test piece shall be carefully centred between the upper and lower plates of the punching device so that the measured section of the test piece is under the plunger. The upper plate shall be carefully lowered to contact the test piece. The punching device shall then be centred in the testing machine with the centre of the spherical bearing block in contact with the centre of the top portion of the plunger of the shear device. Accurate adjustment shall be made by hand under a small initial load. The speed of the moving head of the testing machine during the application of the load shall be not more than 1 millimetre per minute. During the test, the beam of the testing machine shall be kept constantly in a floating position.



All dimensions in millimetres.

FIG. 1 DETAILS OF MODIFIED JOHNSON SHEAR TOOL

6. EVALUATION AND REPORT OF TEST RESULTS

6.1 Using Johnson Shear Tool — The shear strength of the test piece shall be calculated as follows:

$$S = \frac{W}{2A}$$

where

S = shear strength in kg/cm^2,

W = total maximum load in kg indicated by the testing machine, and

A = area in cm^2 of the centre cross-section of the test piece.

6.2 Using Dutton Punching Shear Device — The shear strength of the test piece tested shall be calculated as follows:

$$S = \frac{W_t - W_i}{\pi D T}$$

where

S = shear strength in kg/cm^2,

W_t = total maximum load in kg indicated by the testing machine,

W_i = initial load in kg required to bring the plunger in contact with the surface of the specimen,

D = diameter in cm of the plunger, and

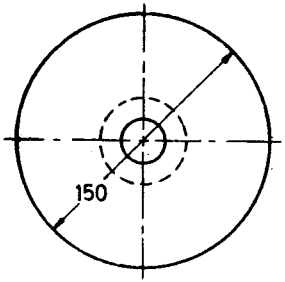
T = thickness in cm of the specimen.

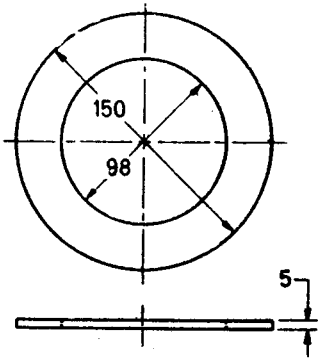
6.3 The average of all the three results separately for each condition (*see* **3.6**) shall be calculated and taken as the shear strength of the test piece and shall be expressed in kg/cm^2.

6.4 Identification of the sample, date when sample was taken and type of stone shall be reported.

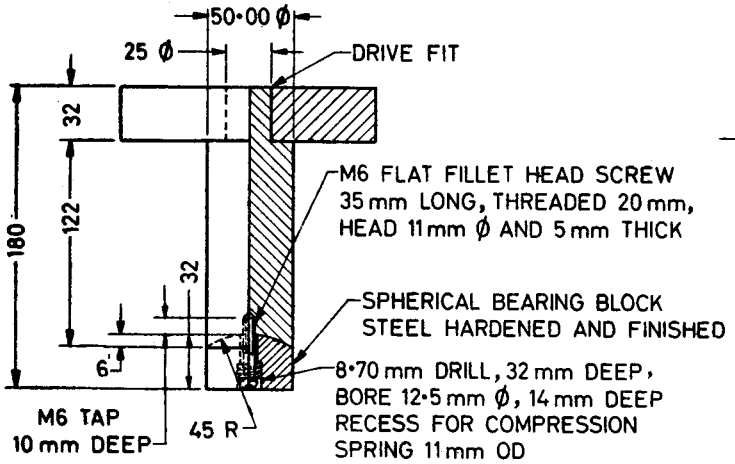
6.5 The size and shape of test piece used in the tests shall be indicated.

6.6 The type of shear appliance used shall also be indicated.

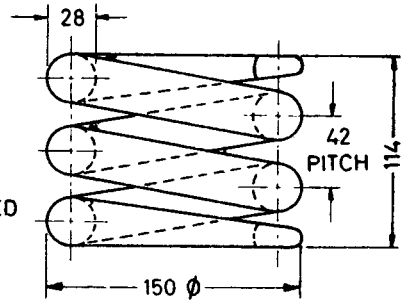




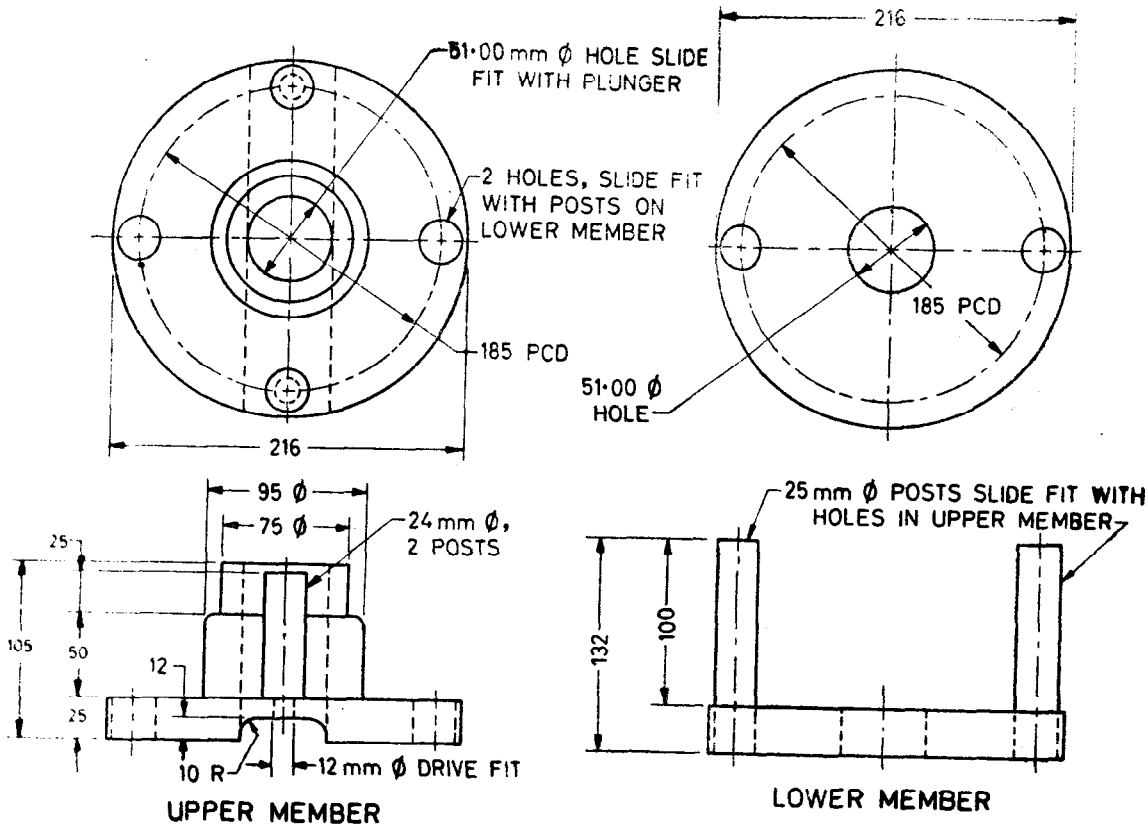
STEEL WASHER



STEEL PLUNGER



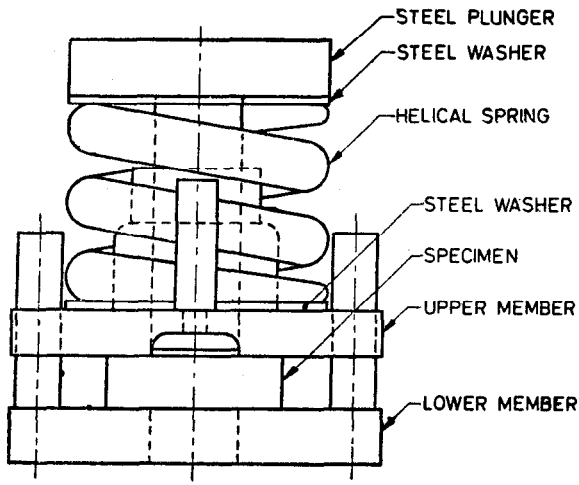
HELICAL SPRING OF SPRING STEEL, 2 FREE COILS



All dimensions in millimetres.

2A Details of Parts

FIG. 2 DETAILS OF DUTTON PUNCHING SHEAR DEVICE — *Contd*



2B Assembled View

FIG. 2 DETAILS OF DUTTON PUNCHING SHEAR DEVICE

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