# *Indian Standard* ( Reaffirmed 1998 )

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

## PART III TENSILE STRENGTH

## *( First Revision )*

---

Second Reprint JULY 1991

UDC 691.21:620.172



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

**Gr 2** *March* 1975

# *Indian Standard*

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

## PART III TENSILE STRENGTH

## *( First Revision )*

Stones Sectional Committee, BDC 6

| *Chairman* | *Representing* |
|---|---|
| SHRI C. B. L. MATHUR | Public Works Department, Government of Rajasthan, Jaipur |
| *Members* | |
| SHRI K. K. AGRAWALA<br>SHRI K. K. MADHOK (*Alternate*) | Builders' Association of India, Bombay |
| SHRI T. N. BHARGAVA | Ministry of Shipping & Transport (Roads Wing) |
| CHIEF ARCHITECT | Central Public Works Department, New Delhi |
| LALA G. C. DAS<br>SHRI P. R. DAS (*Alternate*) | National Test House, Calcutta |
| DEPUTY DIRECTOR (RESEARCH) | Public Works Department, Government of Uttar Pradesh, Lucknow |
| DEPUTY DIRECTOR (RESEARCH), CONTROL AND RESEARCH LABORATORY | Public Works Department, Government of Orissa, Bhubaneswar |
| DR M. P. DHIR | Central Road Research Institute (CSIR), New Delhi |
| SHRI R. L. NANDA (*Alternate*) | |
| DIRECTOR | Engineering Research Institute, Baroda |
| DIRECTOR (CSMRS) | Central Water & Power Commission, New Delhi |
| DEPUTY DIRECTOR (CSMRS) (*Alternate*) | |
| DIRECTOR, MERI | Building & Communication Department, Government of Maharashtra, Bombay |
| RESEARCH OFFICER, MERI (*Alternate*) | |
| SHRI M. K. GUPTA<br>SHRI S. D. PATHAK (*Alternate*) | Himalayan Tiles & Marble Pvt Ltd., Bombay |
| DR IQBAL ALI | Engineering Research Laboratory, Government of Andhra Pradesh, Hyderabad |
| SHRI A. B. LINGAM (*Alternate*) | |
| SHRI D. G. KADKADE<br>SHRI V. B. DESAI (*Alternate*) | Hindustan Construction Co Ltd, Bombay |

(*Continued on page* 2)

(*Continued from page* 1)

| *Members* | *Representing* |
|---|---|
| SHRI T. R. MEHANDRU | Institution of Engineers (India), Calcutta |
| SHRI PREM SWARUP | Department of Geology & Mining, Government of Uttar Pradesh, Lucknow |
| SHRI A. K. AGARWAL (*Alternate*) | |
| DR A. V. R. RAO | National Buildings Organisation, New Delhi |
| DEPUTY DIRECTOR (MATERIALS) (*Alternate*) | |
| SHRI M. L. SETHI | Department of Geology & Mining, Government of Rajasthan, Jaipur |
| SHRI Y. N. DAVE (*Alternate*) | |
| DR B. N. SINHA | Geological Survey of India, Calcutta |
| SUPERINTENDING ENGINEER (DESIGN) | Public Works Department, Government of Tamil Nadu, Madras |
| DEPUTY CHIEF ENGINEER (I & D) (*Alternate*) | |
| SUPERINTENDING ENGINEER (DESIGN AND PLANNING) | Public Works Department, Government of Andhra Pradesh, Hyderabad |
| SUPERINTENDING ENGINEER (DESIGNS) | Public Works Department, Government of Mysore, Bangalore |
| SUPERINTENDING ENGINEER (PLANNING CIRCLE) | Public Works Department, Government of West Bengal, Calcutta |
| SUPERINTENDING SURVEYOR OF WORKS | Public Works Department, Government of Himachal Pradesh, Simla |
| SHRI M. V. YOGI | Engineer-in-Chief's Branch (Ministry of Defence) |
| SHRI J. K. CHARAN (*Alternate*) | |
| SHRI D. AJITHA SIMHA, Director (Civ Engg) | Director General, ISI (*Ex-officio Member*) |

*Secretary*

SHRI K. M. MATHUR
Deputy Director (Civ Engg), ISI

# *Indian Standard*

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

## PART III TENSILE STRENGTH

## *( First Revision )*

## 0. FOREWORD

**0.1** This Indian Standard (Part III) (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 had, 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 of building stones 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 an important property for assessing the suitability of stone.

**0.2.1** This standard is now being issued in four parts, each part covering a specific property to facilitate the use of this standard. Part III covers the determination of tensile 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*.

## 1. SCOPE

**1.1** This standard (Part III) lays down the procedure for determination of split tensile 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 shall be made of the stone and boulders over the area 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** Test pieces shall be made from samples selected in accordance with **2** and shall be in the form of cylinders. They shall be drilled from the samples. The diameter of the test piece shall be not less than 50 mm and the ratio of diameter to height shall be 1 : 2.

**3.2** Three test pieces shall be used for conducting the test in each of the conditions mentioned in **3.2.1** and **3.2.2**.

**3.2.1** The test pieces shall be immersed in water maintained at 20 to 30°C for 72 h before testing and shall be tested in saturated condition.

**3.2.2** The test pieces shall also be tested in dry condition and shall be dried in an oven at 105 $\pm$ 5°C for 24 h and cooled in a desiccator to room temperature (20 to 30°C).

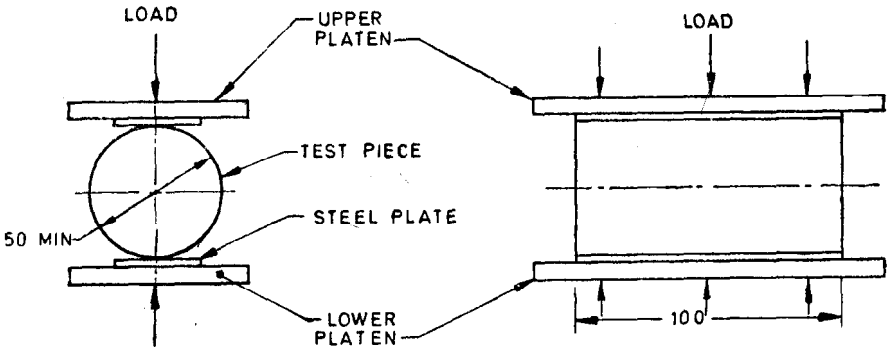
## 4. APPARATUS

**4.1** A testing machine of sufficient capacity for the tests and capable of applying load at the specified rate shall be used. The machine shall be equipped with two steel bearing plates not less than 10 mm thickness with hardened faces. One of the plates preferably the one that normally bears on the upper surface of the specimen shall be fitted with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central

point of the face of the plate. The other compression plate shall be a plain rigid bearing block. The bearing faces of both plates shall be a plain rigid bearing block. The bearing faces of both plates shall be of width greater than 25 mm and the length at least equal to the length of the test piece. The bearing surface of the plates when new, shall not depart from a plane by more than 0·012 5 mm at any point. The movable portion of spherically seated compression plate shall be held on the spherical seat, but the design shall be such that it is possible to rotate the bearing face freely and tilt it through small angles in any direction.

## 5. PROCEDURE

**5.1** Each test piece to be tested is sandwiched in between two steel plates of width 25 mm, thickness 10 mm and length equal to the length of test piece (*see* Fig. 1). The load shall be applied without shock and increased continuously at a uniform rate until the specimen splits and no greater load is sustained. The maximum load applied to the specimen shall be recorded.




All dimensions in millimetres.

FIG. 1 GENERAL ARRANGEMENT FOR TESTING TENSILE STRENGTH OF BUILDING STONE

## 6. EVALUATION AND REPORT OF TEST RESULTS

**6.1** The split tensile strength of the specimen shall be calculated as follows:

$$S = \frac{2\,W}{\pi\,dL}$$

where

$S$ = split tensile strength in kg/cm$^2$,
$W$ = applied load in kg at which specimen splits,
$d$ = diameter of specimen in cm, and
$L$ = length of specimen in cm.

**6.2** The average of all the three results separately for each condition shall be taken as the split tensile strength of the sample.

**6.3** In case any test piece gives a value of as much as 15 percent below the average, it may be examined for defects and if the low value appears to be due to a flaw or faulty test piece, a fresh test shall be made and the average of three tests taken.

**6.4** The split tensile strength of the sample shall be expressed in $kg/cm^2$.

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

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

**6.7** A description of the way in which the test pieces were prepared shall be included.

# BUREAU OF INDIAN STANDARDS

*Headquarters*:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 331 01 31, 331 13 75 Telegrams: Manaksanstha (Common to all Offices)

| *Regional Offices*: | *Telephone* |
|---|---|
| Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 | 331 01 31<br>331 13 75 |
| *Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054 | 36 24 99 |
| Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036 | 2 18 43<br>3 16 41 |
| Southern : C. I. T. Campus, MADRAS 600113 | 41 24 42<br>41 25 19<br>41 29 16 |
| †Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093 | 6 32 92 95 |

| *Branch Offices*: | |
|---|---|
| 'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001 | 2 63 48<br>2 63 49 |
| ‡Peenya Industrial Area 1st Stage, Bangalore Tumkur Road BANGALORE 560058 | 38 49 55<br>38 49 56 |
| Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003 | 6 67 16 |
| Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002 | 5 36 27 |
| 53/5, Ward No. 29, R.G. Barua Road, 5th Byelane, GUWAHATI 781003 | 3 31 77 |
| 5-8-56C L. N. Gupta Marg (Nampally Station Road), HYDERABAD 500001 | 23 10 83 |
| R14 Yudhister Marg, C Scheme, JAIPUR 302005 | 6 34 71<br>6 98 32 |
| 117/418 B Sarvodaya Nagar, KANPUR 208005 | 21 68 76<br>21 82 92 |
| Patliputra Industrial Estate, PATNA 800013 | 6 23 05 |
| T.C. No. 14/1421, University P.O., Palayam TRIVANDRUM 695035 | 6 21 04<br>6 21 17 |

*Inspection Offices* (With Sale Point):-

| | |
|---|---|
| Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010 | 2 51 71 |
| Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005 | 5 24 35 |

*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 — 27 68 00

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 — 89 65 28

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002 — 22 36 71

Reprography Unit, BIS, New Delhi, India