IS 8242 (1976): Methods of tests for split bamboos [CED 9: Timber and Timber Stores]

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IS : 8242 - 1976
(Reaffirmed 2004)

Indian Standard

METHODS OF TESTS FOR SPLIT BAMBOOS

UDC 691'12 : 620'17

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

Price Rs 5·00 Gr 2

January 1977

Indian Standard

METHODS OF TESTS FOR SPLIT BAMBOOS

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(*Continued on page* 2)

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(*Continued on page* 8)

Indian Standard

METHODS OF TESTS FOR SPLIT BAMBOOS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 September 1976, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Owing to the extensive use of split bamboo as reinforcement in different types of constructions, a need has arisen to lay down methods of tests to evaluate its physical and mechanical properties. This standard has, therefore, been prepared to meet such needs. The methods of tests for solid bamboos for structural purposes are covered in IS : 6874-1973*.

0.3 In the formulation of this standard, due weightage has been given to the need for 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 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 prescribes the methods of tests for split bamboos for evaluating the following physical and mechanical properties:

a) *Physical Properties*
   1) Moisture content
   2) Specific gravity

b) *Mechanical Properties*
   1) Static bending
   2) Compression parallel to grain

*Methods of tests for round bamboos.
†Rules for rounding off numerical values (*revised*).

3) Shear parallel to grain (where the specimens of required size are available)

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 707-1976* and IS : 6874-1973† shall apply.

3. SELECTION OF MATERIAL

3.1 The specimens for tests shall be taken from different representative culms in a locality in such a way as to cover whole portion of the culm, that is, bottom, middle and top together. If the samples of split bamboos from a depot are to be tested, the number of test specimens shall be such as to represent the whole lot.

3.2 The tests shall be carried out in green condition, that is, above 25 percent moisture content, or kiln dry condition at 12 percent moisture content or both, or according to the agreement.

4. TESTS

4.1 Moisture Content

4.1.1 *General* — Moisture content of each specimen tested for mechanical tests shall be determined.

4.1.2 *Procedure* — Immediately after each mechanical test, a small piece of about 2·5 cm length shall be taken from the splint preferably near the place of failure. The sample shall be weighed correct to 0·01 g and then dried in an oven at a temperature of $103 \pm 2°C$. The mass shall be recorded at regular intervals till the two consecutive weighings may not vary by more than 0·002 g. The final mass shall be taken as oven-dry mass. The loss in mass expressed as a percentage of oven dry mass shall be taken as the moisture content of the test specimen. This shall be calculated correct to one place of decimal, by formula given below:

$$M = \frac{W' - W}{W} \times 100$$

where

M = moisture content, percent;

W' = mass of sample at test in g; and

W = oven dry mass of the same in g.

*Glossary of terms applicable to timber technology and utilization (*second revision*).
†Methods of tests for round bamboos.

4.2 Specific Gravity

4.2.1 *General* — Specific gravity shall be generally determined from a sample taken from static bending test specimen.

4.2.2 *Procedure* — After carrying out static bending test (**4.3**) a sample approximately 2·0 × 2·0 cm in size shall be cut from the sound portion of tested specimen. The sample shall be weighed correct to 0·01 g and its volume shall be measured with the help of mercury volume-meter correct to 0·01 cm^3. Care shall be taken that no air bubble may remain stuck with the specimen, while noting the final reading. The specific gravity shall be calculated correct to 3 places of decimal by the formula given below:

a) Specific gravity at test $= \frac{W}{V}$

b) Adjusted specific gravity $= \frac{W}{V} \times \frac{100}{100 + M}$

where

W = mass of sample in g;

V = volume of the sample in cm^3; and

M = moisture content, percent.

NOTE — If the specimen is 'green', the adjusted specific gravity is known as 'standard specific gravity'.

4.3 Static Bending Test

4.3.1 *Test Specimen* — The width of test specimen shall be at least equal to twice the thickness. The depth of the specimen shall be equal to thickness of the splint. The length of the specimen shall be 14 times the depth plus 5 cm. For small variation in thickness of specimens in a consignment the span may be taken as constant. The specimen shall be free from any defect like crack, crookedness, etc. The specimen shall be tested with 'centre-internode' only, and shall be practically treated as rectangular in cross section. The dimensions shall be measured correct to 0·01 cm and mass of the specimen shall be determined correct to 0·01 g.

4.3.2 *Procedure* — The test shall be conducted on suitable testing machine. The test specimen shall be placed horizontally on two parallel rollers of about 2 cm diameter spaced at a distance centre to centre of 14 times the depth of the specimen. The skin surface shall be the bottom surface of the specimen. The load shall be applied through another roller of 2 cm diameter at the centre on a line parallel to the end rollers. The load shall be applied continuously throughout the test such that the movable head of the testing machine moves, at a uniform rate of $0{\cdot}000\,25\ l^2/h$ cm per minute,

where l is the span and h is the depth of the specimen. The test shall be continued till a failure is indicated. Deflections shall be measured at the centre of the specimen by means of a dial gauge or telescope and scale correct to 0·2 mm. The deflection shall be noted at suitable load intervals such that 10 to 15 readings may be recorded before proportional limit. The deflection shall also be noted at first failure and at the point of sudden change in deflection or load. A record of nature of failure shall also be kept.

4.3.3 *Calculation* — From the above readings a load deflection curve shall be drawn. Load at proportional limit, maximum load and deflection at proportional limit shall be determined from the load deflection curve. The following characteristics shall be calculated by the formula given against each:

a) Fibre stress at proportional limit (kgf/cm^2) $= \frac{3\,Pl}{2\,bh^2}$

b) Modulus of rupture (kgf/cm^2) $= \frac{3\,P'l}{2\,bh^2}$

c) Modulus of elasticity (kgf/cm^2) $= \frac{Pl^3}{4\,bh^3d}$

where

P = load at proportional limit in kg,
b = width of specimen in cm,
h = depth of specimen in cm,
l = span in cm,
P' = maximum load in kgf, and
d = deflection at proportional limit in cm.

4.4 Compression Parallel to Grain Test

4.4.1 *Test Specimen* — The width of test specimen shall be equal to twice the thickness. The length shall be 4 times the thickness subject to the minimum of 8 cm. The thickness of the specimen shall be the thickness of the splint. The dimensions shall be measured correct to 0·01 cm. The specimen shall be practically rectangular in cross section. The specimen shall be free from any defect like split, crack, crookedness, node, etc.

4.4.2 *Procedure* — The specimen shall be compressed vertically along the grain through a self-adjusting hemispherical loading block. Lateral supports shall be provided to the specimen when needed. The load shall be applied in a uniform rate of motion of moving head equal to 0·6 mm per minute till maximum load is reached and a failure is indicated. Maximum load and the nature of failure shall be recorded.

4.4.3 *Calculation* — Maximum compressive strength shall be calculated by the formula given below:

$$\text{Maximum compressive stress } (\text{kgf/cm}^2) = \frac{P}{bh}$$

where

P = maximum crushing load in kg,

b = width of the specimen in cm, and

h = thickness of the specimen in cm.

4.5 Shear Parallel to Grain Test

4.5.1 *Test Specimen* — The test specimen shall be 6 cm in length and 3·5 cm in width and shall have full thickness. It shall be free from all defects like crack. A step notch of 1 × 1 cm shall be made at one of the corners of the specimen for seating the shearing tool. The actual shearing area, that is, length of shearing face and thickness of the specimen shall be measured correct to 0·01 cm.

4.5.2 *Procedure* — The specimen shall be supported in a vertical plane in a cage placed at the platform of the testing machine such that the shearing portion may remain outside the cage. The shearing tool fixed on the moving head shall be set at the notch. The load shall be applied at a uniform rate of moving head equal to 0·4 mm per minute through the shearing tool in such a manner that the direction of shearing may be parallel to the longitudinal direction of the grain. Maximum shearing load shall be noted. A record of the nature of failure shall also be kept.

4.5.3 *Calculation* — Maximum shearing stress parallel to grain shall be calculated by the formula given below:

$$S = \frac{P}{lh}$$

where

S = maximum shearing stress in kgf/cm²,

P = maximum shearing load in kg,

l = length of shearing surface in cm, and

h = thickness of specimen in cm.

(*Continued from page* 2)

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Printed at New India Printing Press, Khurja, India