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Timber structures — Strength graded timber — Test methods for structural properties

Structure en bois — Bois classé selon la résistance — Méthodes d'essai des propriétés structurelles

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Foreword

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The committee responsible for this document is ISO/TC 165 *Timber Structures*.

This second edition cancels and replaces the first edition (ISO 13910:2005), which has been technically revised.

Introduction

This International Standard provides requirements for testing of structural properties for a specific grade and size of sawn timber. In accordance with the requirements of performance-based International Standards, it is concerned with the measurement of properties similar to those that occur under service conditions and are intended for deriving engineering properties in structural design codes. Hence, terms such as “bending strength”, “shear strength”, “bearing strength”, etc. relate to the loading configuration used and to the targeted mode of failure.

It is not the intent to imply that every property of every grade and size of timber used in building construction needs to be assessed according to this International Standard. The requirements for any assessment typically are specified in building regulations, quality manuals or other material standards and specifications.

This document is an internationally-agreed reference standard for measurement of structural properties of strength-graded timber. Other standards related to the measurement of structural properties may be deemed to comply with this International Standard, provided that the adjustments necessary to establish equivalency between this and other standards are applied appropriately

Timber structures — Strength graded timber — Test methods for structural properties

1 Scope

This International Standard specifies test procedures for full-size sawn timber that has been strength-graded, for the derivation of design properties in codes dealing with structural engineering design. It is applicable to sawn timber of rectangular cross-section subjected to a short-duration load.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
grade
population of timber with defined design properties in a design standard

2.2
piece of timber
timber of rectangular cross-section manufactured for construction purposes of a specific grade

2.3
test specimen
length of timber, cut from a piece, for purposes of testing to evaluate a timber property

3 Symbols and abbreviated terms

3.1 General notation

a distance between a load point and nearest support in a bending test set-up, expressed in mm

b thickness (smaller dimension of a cross section) of a rectangular piece or specimen of timber, expressed in mm

E modulus of elasticity parallel to direction of grain, expressed in MPa

F applied load, expressed in N

f strength, expressed in MPa

G shear modulus of rigidity, expressed in MPa

h width (larger dimension of a cross section) of a rectangular piece or specimen of timber, expressed in mm

K stiffness, expressed in N per mm deformation

L length along a piece or specimen of timber, expressed in mm

L_T length of test specimen subjected to torsion forces, expressed in mm

l_h length cut from a specimen, expressed in mm

l_t lever arm of applied torsion load, expressed in mm

e displacement of beam, expressed in mm

m mass of specimen, expressed in kg

SH_v volumetric shrinkage of wood from green fibre saturation point (FSP) to oven-dry condition

w ratio of mass of water to mass of oven-dry wood, equivalent to moisture content

w_{FSP} moisture content at fibre saturation point

x_i data value

θ rotational deformation in a torsion test, in radians

ρ density, expressed in kg/m^3

ρ_{12} density, expressed in kg/m^3, at 12% moisture content

ρ_{test} density, expressed in kg/m^3, at time of test

3.2 Subscripts

0.1h value at deformation of 0.1h

0 property in a direction of 0° to the grain

90 property in a direction of 90° to the grain

c compression

m bending

t tension

ult value at failure

v shear

4 Test specimens

All test specimens are of full-size cross section. The length required for a test specimen shall be related to the specific test (see Clause 6).

Unless otherwise stated, test specimens shall be selected from random locations within a piece of timber. Specimens cut from pre-defined locations (centre of a piece of timber, a randomly selected end within a piece or clear sections, etc.) may be deemed to comply with this requirement provided this does not produce any bias in the measured properties.

Each test specimen for a given size, grade or property shall be cut from a different piece of timber and more than one type of test specimen may be cut from each piece.

5 Test conditions

Unless otherwise specified in the description of the reference population, the reference moisture content at the time of testing shall be consistent with conditioning at a temperature of 20°C (±2°C) and 65 % (±5 %) relative humidity. Other test procedures and conditioning criteria may be used provided they are more conservative; otherwise, an equivalency in performance for these alternative procedures and conditions shall be established. The rate of loading shall be selected that targets average time-to-failure in 1 min to 5 min.

NOTE The intent here is not to reject data for weak pieces that fail in a short time.

At the time of testing, the moisture content of the timber, the temperature of the timber, and the time to failure shall be recorded.

6 Test configurations

6.1 Density

The specimens for the measurement of density shall be free of knots and comprise the full cross-section of the piece of timber. The length of the test specimen shall be a minimum of 50 mm. The mass, m, and moisture content, w, are measured for each test specimen. The density at the time of test, ρ_{test}, shall be calculated from

$$\rho_{test} = \frac{m \times 10^9}{Lbh} \qquad (1)$$

The density at 12 % moisture content, ρ_{12}, shall be calculated from

$$\rho_{12} = \rho_{test}\,[1 - 0{,}5(w - 0{,}12)] \qquad (2)$$

where w is the moisture content at the time of test as determined by the oven-dry method.

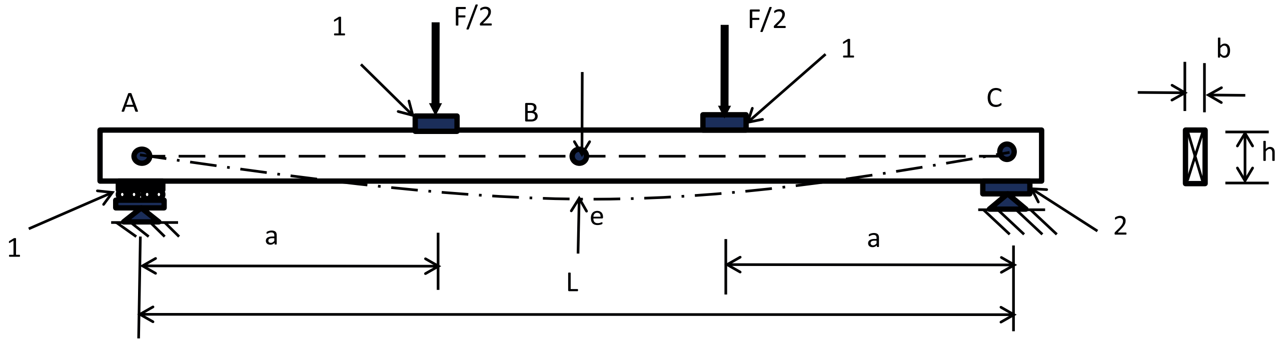
Alternatively, it may be sufficiently accurate to measure moisture content by means of a moisture meter, provided that the meter is calibrated against moisture content measurements determined by the oven dry method. Where such moisture meter measurements are made, they shall be made at several locations along each specimen.

NOTE If specific gravity (e.g. based on oven-dry mass and oven-dry volume, SG_{OD}) is desired, it can be estimated from wood density at test, ρ_{test}, moisture content, w, fibre saturation point, w_{FSP}, and wood volumetric shrinkage, SH_v, as follows:

$$SG_{OD} = \frac{(1 + wSH_v / w_{FSP})\rho_{test}}{1\,000(1 + w)}$$

6.2 Bending strength and stiffness

The bending strength and stiffness test configuration shall be as shown in Figure 1. The beam specimen shall be loaded at two points, equally spaced between the end supports, with each load equal to $F/2$. The distance between load points shall be 6 h and the distance between a load point and the nearest support, a, shall be 4,5 h to 7 h. The tension edge of the beam shall be chosen randomly. If the beam has a slenderness where there could be a tendency for the compression edge to buckle during loading, lateral restraints may be provided to the compression edge. Such restraints shall not resist any movement in the direction of the loading. Bearing blocks at loading and support points (see Figure 1), shall be of sufficient thickness and extend entirely across the beam thickness to eliminate high-stress concentrations at places of contact between beam and bearing blocks. Load shall be applied to the blocks in such a manner that the blocks may rotate about an axis perpendicular to the span. The slider bearing plate in Figure 1 shall allow rotation and horizontal movement whereas the bearing plate shall allow only rotation.



Key

1 slider bearing plate

2 bearing plate (rocker)

Figure 1 — Test set-up for measuring bending strength and stiffness

Modulus of elasticity, E, shall be calculated from measurement of e, the centre-point deflection of the centre-line of the beam relative to the position of the centre-line at the ends of the beam, i.e. the deflection of point B relative to points A and C as shown in Figure 1.

NOTE Centre-point deflection measured by referencing the displacement transducer against the top or bottom edge of the beam or by using loading head movement usually contains unintended displacement component due to the indentation of the wood material at the support and loading points, etc. Deflection measured by such methods can be used for calculation of E provided it can be shown that it leads to more conservative result.

The applied load, F, shall be increased until the maximum load is reached.

To evaluate the modulus of elasticity in bending, E_{m}, the incremental deflection Δe for an incremental load ΔF shall be selected from the linear elastic part of the load-deformation graph. E_{m} is calculated from:

$$E_{\mathrm{m}} = \frac{a}{4bh^3}\left(\frac{\Delta F}{\Delta e}\right)\left(3L^2 - 4a^2\right) \qquad (3)$$

The range of 10 % to 40 % of the maximum load shall be used to determine $\Delta F/\Delta e$. The deflection e may be evaluated by the measurement of the movement of points other than those described above, provided that an acceptable equivalency for these procedures is established, or it can be shown that the alternative procedures produce conservative results.

NOTE The test set-up will lead to the determination of apparent modulus of elasticity. Shear-corrected modulus of elasticity can be estimated by adjusting the measured deflection, Δs, using the following formula assuming shear modulus is known (For structural timber, G can be assumed to be $E/16$.), and substituting Δe into Formula (3):

$$\Delta e = \Delta s\left(1 - \frac{3\Delta Fa}{5bhG\Delta s}\right)$$

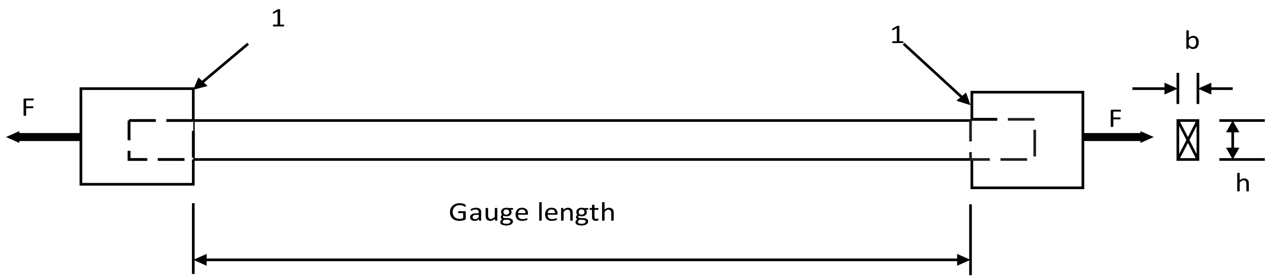
The bending strength, f_{m}, shall be calculated from

$$f_m = \frac{3F_{\mathrm{ult}}a}{bh^2} \qquad (4)$$

where F_{ult} is the value of the applied load at failure.

6.3 Tension strength parallel to the grain

NOTE The gauge length used is typically longer than the stated minimum to increase the likelihood that the critical strength-reducing defect is captured within the gauge length.



Key

1 grip

Figure 2 — Test setup for measuring tension strength parallel to the grain