INTERNATIONAL STANDARD

ISO 8375

Third edition
2017-06

Timber structures — Glued laminated timber — Test methods for determination of physical and mechanical properties

Structures en bois — Bois lamellé-collé — Méthodes d'essai pour la détermination de certaines propriétés physiques et mécaniques

Reference number
ISO 8375:2017(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 165, *Timber structures*.

This third edition cancels and replaces the second edition (ISO 8375:2009), which has been technically revised.

Timber structures — Glued laminated timber — Test methods for determination of physical and mechanical properties

1 Scope

This document specifies test methods suitable for determining the following characteristic values of glued laminated timber: modulus of elasticity in bending; shear modulus; bending strength; modulus of elasticity in tension parallel to the grain; tension strength parallel to the grain; modulus of elasticity in compression parallel to the grain; compression strength parallel to the grain; modulus of elasticity in tension perpendicular to the grain; tension strength perpendicular to the grain; modulus of elasticity in compression perpendicular to the grain; compression strength perpendicular to the grain and shear strength.

In addition, the determination of dimensions, moisture content and density are specified.

This document is applicable to rectangular shapes of glued laminated timber.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
density
characteristic mean density obtained at a 75 % confidence limit with mass and volume corresponding to equilibrium moisture content at a temperature of 20 °C and a relative humidity of 65 %

Note 1 to entry: ISO 12122-1 and ISO 12122-3 provide guidelines for statistical processing of data to determine characteristic values such as density.

3.2
strength
characteristic lower 5-percentile value at a 75 % confidence limit obtained from the results of tests using test specimens at an equilibrium moisture content resulting from a temperature of 20 °C and a relative humidity of 65 % or the strength value at the observed moisture content when full size members are tested

Note 1 to entry: ISO 12122-1 and ISO 12122-3 provide guidelines for statistical processing of data to determine characteristic values such as strength.

3.3
elasticity
characteristic mean stiffness at a 75 % confidence limit obtained from the results of tests using test specimens at an equilibrium moisture content resulting from a temperature of 20 °C and a relative humidity of 65 %

Note 1 to entry: ISO 12122-1 and ISO 12122-3 provide guidelines for statistical processing of data to determine characteristic values such as elasticity.

3.4
specimen
item to be tested for the determination of all characteristic values

Note 1 to entry: The minimum number of test specimens required for the determination of all characteristic values is provided in ISO 12122-1 and ISO 12122-3, unless otherwise noted for the specific test involved.

3.5
population
specimens (3.4) used to determine characteristic values

Note 1 to entry: Specimens should be reflective of the population they are intended to represent.

4 Symbols and suffixes

4.1 Symbols

A	cross-sectional area, in square millimetres
a	distance between a loading position and the nearest support in a bending test, in millimetres
b	width of cross section in a bending test, or the smaller dimension of the cross section, in millimetres
$E_{c,0}$	modulus of elasticity in compression parallel to the grain, in megapascals
$E_{c,90}$	modulus of elasticity in compression perpendicular to the grain, in megapascals
$E_{m,g}$	global modulus of elasticity in bending, in megapascals
$E_{m,app}$	apparent modulus of elasticity in bending, in megapascals
$E_{t,0}$	modulus of elasticity in tension parallel to the grain, in megapascals
$E_{t,90}$	modulus of elasticity in tension perpendicular to the grain, in megapascals
F	load, in newtons
$F_{c,90,max}$	maximum compressive load perpendicular to the grain, in Newtons
$F_{c,90,max,est}$	estimated maximum compressive load perpendicular to the grain, in Newtons
F_{max}	maximum load, in Newtons
$F_{max,est}$	estimated maximum load, in Newtons
$F_{t,90,max}$	maximum tensile load perpendicular to the grain, in Newtons
$f_{c,0}$	compressive strength parallel to the grain, in megapascals

$f_{c,90}$	compressive strength perpendicular to the grain, in megapascals
f_m	bending strength, in megapascals
$f_{t,0}$	tensile strength parallel to the grain, in megapascals
$f_{t,90}$	tensile strength perpendicular to the grain, in megapascals
f_v	shear strength parallel to the grain, in megapascals
G	shear modulus, in megapascals
h	depth of cross section in a bending test, or the larger dimension of the cross section, or the test specimen height in perpendicular to grain tests, in millimetres
h_0	gauge length, in millimetres
I	second moment of area, in millimetres to the fourth power
K, k	coefficients
k_G	coefficient for shear modulus
l	span in bending, or length of test specimen between the testing machine grips in compression and tension, in millimetres
S	section modulus, in millimetres to the third power
w	deformation, in millimetres

4.2 Suffixes

1, 2 loads or deformations at particular points of a test, referred to as necessary in the text

5 Determination of dimensions of test specimens

The dimensions of the test specimen shall be measured to an accuracy of 1 %. The dimension measuring devices shall be such as to permit measuring dimensions in millimetres to three significant figures. All measurements shall be made when the test specimens are conditioned as specified in Clause 8. If the width or thickness varies within a test specimen, these dimensions should be recorded as the average of three separate measurements taken at different positions on the length of each specimen.

Where possible, the measurements should not be taken closer than 150 mm to the ends of the specimen.

6 Determination of moisture content of test specimens

The moisture content of the test specimen shall be determined on a section taken from the test specimen.

In strength tests for bending, shear, tension parallel and perpendicular to grain and compression parallel and perpendicular to grain, the moisture content of the test specimen shall be determined as soon as practical after testing or the specimen shall be sealed to prevent any further moisture change until testing can be initiated. The section shall be cut as close as possible to the fracture.

As an alternative, the provisions of ISO 3130 or ASTM D4442 may be used for determining moisture content.

7 Determination of density of test specimens

If a density value is needed, the density shall be determined on a portion of the cross section or the entire cross section taken from the test specimen near the fracture area.

In strength tests such as bending and parallel to grain, the density of the test specimen shall be determined after the testing and the section shall be cut as close as possible to the fracture.

For perpendicular to grain test specimens, the density of the test specimens shall be determined prior to test from the measurements of mass and volume of the whole test specimen.

As an alternative, the provisions of ISO 3131 or ASTM D2395 are acceptable for determining density.

8 Conditioning of test specimens

The tests shall be carried out on specimens that are conditioned at the standard environment of (20 ± 2) °C and (65 ± 5) % relative humidity. A test piece is conditioned when it attains constant mass. Constant mass is considered to be attained when the results of two successive weightings, carried out at an interval of 6 h, do not differ by more than 0,1 % of the mass of the test specimen.

The provisions of ASTM D4933 are also acceptable to establish moisture conditioning.

Where the timber to be tested cannot be readily conditioned to the above standard environment, that fact shall be reported and the moisture content of the test specimen shall be reported with the test results.

For small specimens, unless otherwise protected, test specimens shall not be removed from the conditioning environment more than 1 h before testing.

NOTE Test specimens can be stored in the test area for up to 24 h provided they are closely stacked and wrapped in vapour-tight wrapping.

9 Determination of local (shear-free) modulus of elasticity of the beam in bending

9.1 Test specimen

The test specimen shall have a minimum length to permit testing with a span of approximately 18 times the depth of the section. The test span shall be reported.

9.2 Procedure

The test specimen shall be symmetrically loaded in bending at two points over a span of 18 (± 3) times the depth as shown in Figure 1. The span between load heads shall be six times the specimen depth. All spans and distances shall be noted and measured to the nearest millimetre.

NOTE 1 The intent of this document is to test with a span equal to 18 times the depth. Tolerances are provided to enable testing of a broader range of specimens.

The test specimen shall be simply supported.

NOTE 2 Small steel plates of length not greater than one-half of the depth of the test specimen can be inserted between the specimen and the loading heads or supports to minimize local indentation.

Lateral restraint shall be provided as necessary to prevent buckling. This restraint shall permit the specimen to deflect without significant frictional resistance.

Load shall be applied at a constant rate and the test should be completed within approximately 300 s but not less than 180 s.

NOTE 3 Ideally, the load application rate is determined from the results of preliminary tests. The objective is that the average time to reach F_{max} is 300 s.

The maximum load applied shall not exceed the proportional limit load or cause damage to the piece.

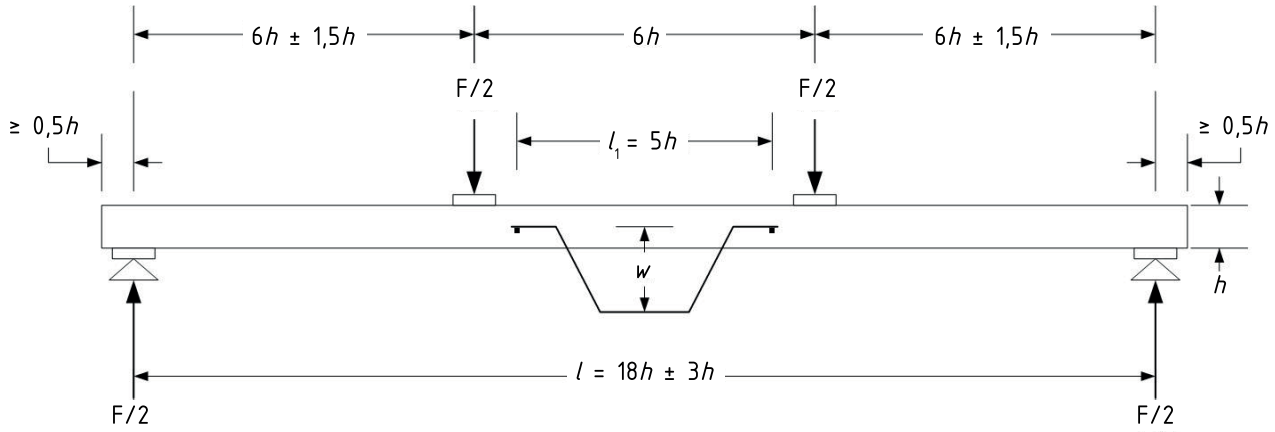


Figure 1 — Test arrangement for measuring local modulus of elasticity in bending

The loading equipment used shall be capable of measuring the load to an accuracy of 1 % of the load applied to the test specimen or, for loads less than 10 % of the applied maximum load, with an accuracy of 0,1 % of the maximum applied load.

The deformation, *w*, shall be measured at the neutral axis, at the centre of a central gauge length of five times the depth of the section as shown in Figure 1.

The deformation measuring devices and recording system shall be such as to permit measuring deflections to the nearest millimetre.

NOTE 4 ASTM D198 provides a description of an acceptable deflection measuring device and the yoke.

9.3 Expression of results

The local modulus of elasticity in bending is given by Formula (1):

$$E_{m,l} = \frac{a l_1^{\,2} (F_2 - F_1)}{16 I \, (w_2 - w_1)} \tag{1}$$

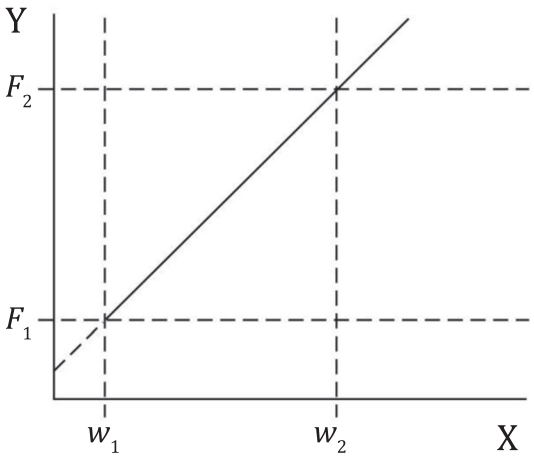
where

$F_2 - F_1$ is an increment of load on the straight-line portion of the load deformation curve, in Newtons;

$w_2 - w_1$ is the increment of deformation corresponding to $F_2 - F_1$, in millimetres.

See Figure 2 for $F_2 - F_1$ and $w_2 - w_1$ plot.

The local modulus of elasticity should be reported to no more than three significant figures.



Key

X deformation (mm)

Y load (N)

Figure 2 — Load-deformation graph within the range of elastic deformation

10 Determination of global modulus of elasticity of the beam in bending

10.1 Test specimen

The test specimen shall have a minimum length to permit testing with a span of approximately 18 times the depth of the section as shown in Figure 3. The test span shall be reported.

10.2 Procedure

The test specimen shall be symmetrically loaded in bending at two points over a span of 18 (± 3) times the depth. The span between the load heads shall be six times the specimen depth. All spans and distances shall be noted and measured to the nearest millimetre.

NOTE 1 The intent of this document is to test with a span equal to 18 times the depth. Tolerances are provided to enable testing of a broader range of specimens.

The test specimen shall be simply supported.

NOTE 2 Small steel plates of length not greater than one-half of the depth of the test specimen can be inserted between the specimen and the loading heads or supports to minimize local indentation.

Lateral restraint shall be provided as necessary to prevent buckling. This restraint shall permit the specimen to deflect without significant frictional resistance.

Load shall be applied at a constant rate and the test should be completed within approximately 300 s but not less than 180 s.

NOTE 3 Ideally, the load application rate is determined from the results of preliminary tests. The objective is that the average time to reach F_{max} is 300 s.

