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Structural timber — Characteristic values of strength-graded timber — Sampling, full-size testing and evaluation

Bois de structure — Valeurs caractéristiques du bois classé selon la résistance — Échantillonnage, essais en grandeur nature et évaluation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13910 was prepared by Technical Committee ISO/TC 165, *Timber structures*.

Introduction

This International Standard provides requirements for sampling, testing and assessing characteristic values of structural properties for a specific grade and size of sawn timber for use in a timber engineering design code. 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 the derived characteristic strength values are intended for use in structural design codes. For the characteristic strength values, the intent is to obtain a reliable load capacity. 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.

This first edition includes clauses dealing with sampling, testing and evaluation of the characteristic values of strength-graded timber. ISO/TC 165 plans to revise this International Standard once additional standards (dealing with the sampling, testing, and evaluation subjects separately) have been developed.

Structural timber — Characteristic values of strength-graded timber — Sampling, full-size testing and evaluation

1 Scope

This International Standard specifies sampling, full-size testing and evaluation procedures for the assessment of the characteristic values of the structural properties of sawn timber for use in codes dealing with structural engineering design. It provides methods for establishing equivalency with other standards for the testing and evaluation of characteristic properties of structural timber.

It is applicable to sawn timber of rectangular cross-section subjected to a short-duration (approx. 1 min) load. Its evaluation procedure is not intended to be used for quality-control purposes or for acceptance of parcels of timber.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM D198, *Standard test methods of static tests of lumber in structural sizes*

3 Terms and definitions

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

3.1
characteristic value
percentile of a statistical distribution estimated with a specified degree of accuracy

NOTE The characteristic values used are either the mean value of the sample or an estimate of the 5-percentile value.

3.2
grade
population of timber with defined characteristic values

3.3
***p*-percentile**
value for which the probability of getting lower values is p percent

3.4
piece of timber
timber of rectangular cross-section and length manufactured for construction purposes

3.5
population of strength-graded timber
all available pieces of structural timber that are covered by a defined set of parameters such as source, species, size and grade

3.6
reference population
population of strength-graded timber, for which the measured characteristic strength properties can be expected to remain constant

3.7
sample size
number of pieces or specimens selected from a specified population

3.8
test specimen
length of timber, cut from a piece, for purposes of testing to evaluate a timber property

3.9
thickness
d
lesser dimension, perpendicular to the longitudinal axis of a piece of timber

3.10
width
b
greater dimension, perpendicular to the longitudinal axis of a piece of timber

4 Symbols and abbreviated terms

4.1 General notation

b	width of a rectangular piece or specimen of timber, expressed in millimetres
b_c	width of a rectangular piece or specimen of timber under compression, expressed in millimetres
CV	coefficient of variation
d	thickness of a rectangular piece or specimens of timber, expressed in millimetres
E	modulus of elasticity parallel to direction of grain, expressed in newtons per square millimetre
F	applied load, expressed in newtons
f	strength, expressed in newtons per square millimetre
G	shear modulus of rigidity, expressed in newtons per square millimetre
K	grain stiffness
k_{imp}	importance factor
k_{samp}	sampling factor
k_{size}	size factor
L	length along a piece or specimen of timber, expressed in millimetres
L_T	length test specimen subjected to torsion forces, expressed in millimetres

l_h	length cut from a specimen, expressed in millimetres
l_t	lever arm of applied torsion load, expressed in millimetres
N	sample size
p	percentile
e	displacement of beam, expressed in millimetres
m	mass of specimen, expressed in kilograms
w	mass of water/mass of wood equivalent to moisture content
x_i	data value
θ	rotational deformation in a torsion test, in radians
ρ	density, expressed in kilograms per cubic metre,
ρ_{12}	density, expressed in kilograms per cubic metre, at 12% by mass moisture content
ρ_{test}	density, expressed in kilograms per cubic metre, at time of test

4.2 Subscripts

0,1b	value at deformation of 0,1b
0,05	5-percentile value
0	property in a direction 0° to the grain
90	property in a direction of 90° to the grain
c	compression
data	statistical property of the data
k	characteristic value
l	lower limit of a characteristic value
m	bending
mean	mean value
ref	value for a reference size
spec	value for a specific size
std	standard
t	tension
tail	property related to the tail of a statistical distribution
u	upper limit of a characteristic value
ult	value at failure
v	shear
y	value for specific value of y on graph

5 Sampling

The parameters defining the reference population shall be comprehensively defined in terms of species and other factors such as source, size, grade and method of grading.

All test specimens shall be cut from pieces that have been selected to be representative of a reference population. Representation of the reference population may be obtained by selecting pieces at random from the reference population. However, improved representation can be obtained if all population parameters, such as the proportion of pieces produced by each mill, are replicated in the sample selected for testing.

A minimum sample size of 40 shall be used for each grade or size or property to be evaluated. A sample size of greater than 40 is recommended so as to provide more reliable characteristic values for strength without having to introduce a penalty factor as related to sample size (see 9.2.1).

6 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 8).

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 or 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.

As specified in Clause 5, a minimum sample size of 40 shall be used for each grade/size/property.

7 Test conditions

Unless otherwise specified in this International Standard, test procedures shall be in accordance with ASTM D198. The reference moisture content at the time of testing should be consistent with conditioning at a temperature of 20 °C and 65 % 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.

For the reference conditioning temperature and humidity, the equilibrium moisture content for solid timber shall be approximately 12 %.

The reference temperature at the time of testing shall be 20 °C.

The rate of loading shall be one that leads to failure at about one minute.

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

8 Test configurations

8.1 Density

The specimens for the measurement of density shall comprise the full cross-section of the piece of timber. The length of the test specimen shall be not less than b. 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

$$\rho_{\text{test}} = \frac{m \times 10^9}{Ldb} \tag{1}$$

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

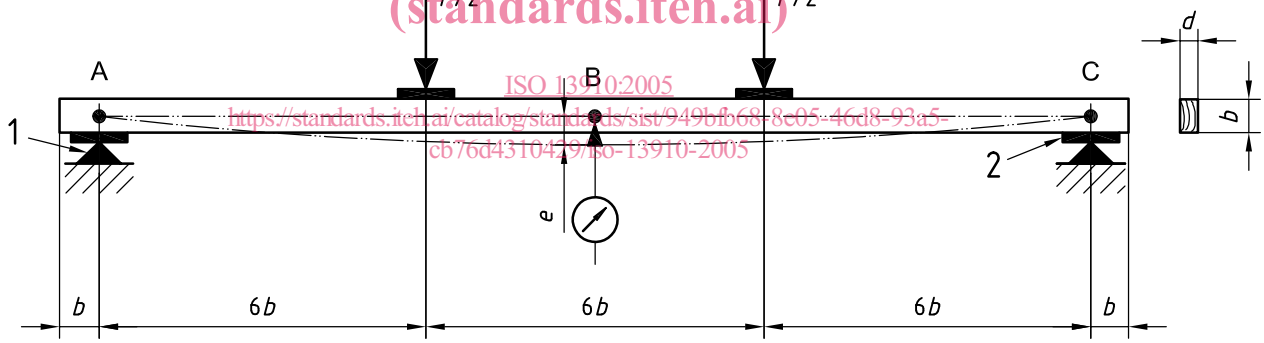
$$\rho_{12} = \rho_{\text{test}} \left(\frac{1{,}12}{1 + w} \right) \tag{2}$$

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 an electrical resistance meter, provided that the meter is calibrated against moisture content measurements determined by the oven dry method. Where such electrical moisture meter measurements are made, they should be made at two or three locations along each specimen.

8.2 Bending strength and stiffness

The bending strength and stiffness test configuration shall be as shown in Figure 1. A beam of span 18b shall be loaded at two points equally spaced between the end supports, with each load equal to F/2. A random edge of the beam shall be chosen to be the tension edge. If the beam has a slenderness where there could be a tendency to buckle during loading, then lateral restraints may be used to restrain the buckling. Such restraints shall not provide any resistance to movement in the direction of the loading.



Key

1 rocker slider

2 bearing plate

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

Measurement of the modulus of elasticity, E, shall be undertaken by measurement of e, the centrepoint deflection of the centreline of the beam relative to the position of the centreline at the ends of the beam, the deflection of point B relative to points A and C as shown in Figure 1. Where this is not possible, an acceptable conservative alternative is to measure the deflection of the centrepoint of the bottom surface of the beam relative to the end supports of the beam.

The applied load F shall be increased until the beam fails in bending or in a mode other than bending.

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 and calculated from

$$E_m = \frac{23}{108} \times \left(\frac{L}{b}\right)^3 \times \left(\frac{\Delta F}{\Delta e}\right) \times \frac{1}{d} \tag{3}$$

The range of 10 % to 40 % of the maximum load should be used to determine $\Delta F/\Delta e$.

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.

The bending strength f_m shall be calculated from

$$f_m = \frac{F_{ult} L}{d b^2} \tag{4}$$

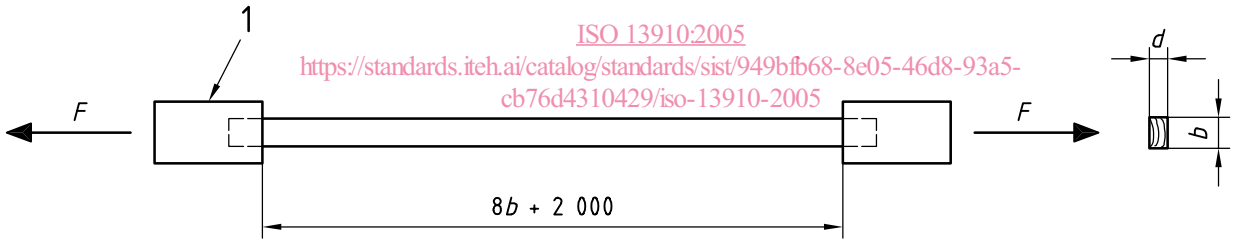
where

F_{ult} is the value of the applied load at failure (ultimate load).

8.3 Tension strength parallel to the grain

The tension strength parallel to the grain test configuration shall be as shown in Figure 2. The specimen length between grips shall be $8b + 2\,000$ mm. The specimen shall be loaded to failure.

Dimensions in millimetres



Key

1 tension grip

Figure 2 — Test set-up for measuring tension strength parallel to the grain

The tension strength $f_{t,0}$ shall be calculated from

$$f_{t,0} = \frac{F_{ult}}{db} \tag{5}$$

where

F_{ult} is the value of the applied load at failure (ultimate load).