SLOVENSKI STANDARD
SIST EN 408:2010

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Nadomešča:
SIST EN 408:2004

Lesene konstrukcije - Konstrukcijski les in lepljeni lamelirani les - Ugotavljanje nekaterih fizikalnih in mehanskih lastnosti

Timber Structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties

Holzbauwerke - Bauholz für tragende Zwecke und Brettschichtholz - Bestimmung einiger physikalischer und mechanischer Eigenschaften

Structures en bois - Bois de structure et bois lamellé-collé - Détermination de certaines propriétés physiques et mécaniques

Ta slovenski standard je istoveten z: **EN 408:2010**

ICS:

79.040	Les, hlodovina in žagan les	Wood, sawlogs and sawn timber
91.080.20	Lesene konstrukcije	Timber structures

SIST EN 408:2010 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

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ICS 79.040; 79.060.99; 91.080.20

Supersedes EN 408:2003

English Version

Timber structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties

Structures en bois - Bois de structure et bois lamellé-collé - Détermination de certaines propriétés physiques et mécaniques

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 408:2010) has been prepared by Technical Committee CEN/TC 124 "Timber structures", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2011, and conflicting national standards shall be withdrawn at the latest by February 2011.

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

This document supersedes EN 408:2003.

In this revised standard a new test is added for the determination of the shear modulus.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This 2010 revision replaces the test for the determination of the shear strength parallel to grain.

The revised edition of 2003 added a global bending modulus of elasticity, whilst renaming the existing test as the local modulus of elasticity. It also includes the methods for determination of shear strength and mechanical properties perpendicular to the grain, previously given in EN 1193, which has now been withdrawn.

The values obtained in any determination of the properties of timber depend upon the test methods used. It is therefore desirable that these methods be standardized so that results from different test centres can be correlated. Moreover, with the adoption of limit state design and with the development of both visual and machine stress grading, attention will be increasingly centred on the determination and monitoring of the strength properties and variability of timber in structural sizes. Again, this can be more effectively undertaken if the basic data are defined and obtained under the same conditions.

This European Standard, which is based originally on ISO 8375, specifies laboratory methods for the determination of some physical and mechanical properties of timber in structural sizes. The methods are not intended for the grading of timber or for quality control.

For the determination of shear modulus, alternative methods have been specified. The choice of which to use will depend upon the objective of the investigation and, to some extent, on the equipment available. Following testing to this standard it is intended that the determination of characteristic values will normally be obtained according to procedures specified in other European Standards.

Attention is drawn to the advantages that may be gained, often with little extra effort, in extending the usefulness of test results by recording additional information on the growth characteristics of the pieces that are tested, particularly at the fracture sections. Generally, such additional information should include grade-determining features such as knots, slope of grain, rate of growth, wane, etc., on which visual grading rules are based, and strength indicating parameters such as localized modulus of elasticity, on which some machine stress grading is based.

1 Scope

This European Standard specifies test methods for determining the following properties of structural timber and 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 of test pieces are specified.

The methods apply to rectangular and circular shapes (of substantially constant cross section) of solid unjointed timber or finger-jointed timber and glued laminated timber unless stated otherwise.

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.

EN 13183-1, *Moisture content of a piece of sawn timber — Part 1: Determination by oven dry method*

3 Terms and definitions

Not applicable.

4 Symbols and abbreviations

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 newtons per square millimetre;
$E_{c,90}$	modulus of elasticity in compression perpendicular to the grain, in newtons per square millimetre;
$E_{m,g}$	global modulus of elasticity in bending, in newtons per square millimetre;
$E_{m,l}$	local modulus of elasticity in bending, in newtons per square millimetre;
$E_{t,0}$	modulus of elasticity in tension parallel to the grain, in newtons per square millimetre;
$E_{t,90}$	modulus of elasticity in tension perpendicular to the grain, in newtons per square millimetre;
F	load, in newtons;
$F_{c,90}$	compressive load perpendicular to the grain, 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;
$F_{t,90}$	tensile load perpendicular to the grain, in newtons;
$F_{t,90,max}$	maximum tensile load perpendicular to the grain, in newtons;
G	shear modulus, in newtons per square millimetre;
S	first moment of area, in millimetres to the third power;
$f_{c,0}$	compressive strength parallel to the grain, in newtons per square millimetre;
$f_{c,90}$	compressive strength perpendicular to the grain, in newtons per square millimetre;
f_m	bending strength, in newtons per square millimetre;
$f_{t,0}$	tensile strength parallel to the grain, in newtons per square millimetre;
$f_{t,90}$	tensile strength perpendicular to the grain, in newtons per square millimetre;
f_v	shear strength parallel to the grain, in newtons per square millimetre;
$f_{v,k}$	characteristic shear strength parallel to the grain, in newtons per square millimetre;
G	shear modulus, in newtons per square millimetre;
$G_{tor,t}$	shear modulus in torsion, in newtons per square millimetre;
$G_{tor,s}$	shear modulus in shear field, in newtons per square millimetre;
h	depth of cross section in a bending test, or the larger dimension of the cross section, or the test piece height in perpendicular to grain and shear 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;
k_{tor}	torque stiffness, in newton metres per radian;
k_s	shear stiffness;
ℓ	span in bending, or length of test piece between the testing machine grips in compression and tension, in millimetres;
ℓ_1	gauge length for the determination of modulus of elasticity or shear modulus, in millimetres;
ℓ_2	distance between the supports and gauge length in torsion, in millimetres;
t	plate thickness, in millimetres;
T_r	torque, in newton millimetres;
V_s	shear force, in newtons;

W section modulus, in millimetres to the third power;

w deformation or displacement, in millimetres;

φ rotation, in radians;

χ, η shape factors.

Suffixes

1, 2 refer to loads or deformations or pieces at particular points of a test and are referred to as necessary in the text.

5 Determination of dimensions of test pieces

The dimensions of the test piece shall be measured to an accuracy of 1 %. All measurements shall be made when the test pieces are conditioned as specified in Clause 8. If the width or thickness varies within a test piece, these dimensions should be recorded as the average of three separate measurements taken at different positions on the length of each piece.

The measurements shall not be taken closer than 150 mm to the ends.

Specimens for perpendicular to grain tests shall be planed.

6 Determination of moisture content of test pieces

The moisture content of the test piece shall be determined in accordance with EN 13183-1 on a section taken from the test piece. For structural timber the section shall be of full cross section, free from knots and resin pockets. For perpendicular to grain test specimens the moisture content shall be determined from the whole specimen.

In strength tests for bending and tension parallel to grain and compression parallel to grain, the section shall be cut as close as possible to the fracture.

7 Determination of density of test pieces

The density of the whole cross section of the test piece shall be determined on a section taken from the test piece. For structural timber the section shall be of full cross section, free from knots and resin pockets.

In strength tests, the section shall be cut as close as possible to the fracture.

For perpendicular to grain test specimens the density of the test pieces shall be determined prior to test after conditioning from the measurements of mass and volume of the whole test piece.

8 Conditioning of test pieces

All tests shall be carried out on pieces, which 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 piece.

Where the timber to be tested is not readily conditioned to the above standard environment (e.g. for hardwoods with high densities) that fact shall be reported.

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

Test pieces can be stored in the test area for up to 24 h provided they are close piled and wrapped in vapour tight sheeting.

9 Determination of local modulus of elasticity in bending

9.1 Test piece

The test piece shall have a minimum length of 19 times the depth of the section. Where this is not possible, the span of the beam shall be reported.

9.2 Procedure

The test piece shall be symmetrically loaded in bending at two points over a span of 18 times the depth as shown in Figure 1. If the test piece and equipment do not permit these conditions to be achieved exactly, the distance between the load points and the supports may be changed by an amount not greater than 1,5 times the piece depth, and the span and test piece length may be changed by an amount not greater than three times the piece depth, while maintaining the symmetry of the test.

The test piece shall be simply supported.

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

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

Load shall be applied at a constant rate. The rate of movement of the loading head shall be not greater than (0,003 h) mm/s (see Figure 1).

The maximum load applied shall not exceed 0,4 $F_{max,est}$.

The estimated maximum load, $F_{max,est}$ of the material under test shall be obtained either from tests on a least ten pieces of the appropriate species, size and grade or from appropriate existing test data.

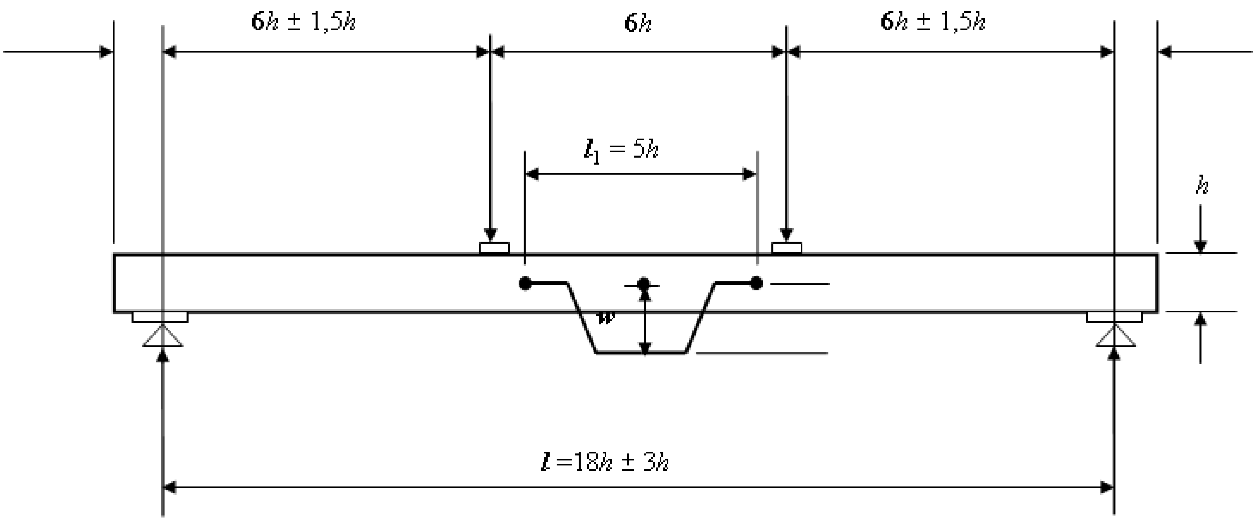

Figure 1 — Test arrangement for measuring local modulus of elasticity in bending

The loading equipment used shall be capable of measuring the load to an accuracy of 1 % of the load applied to the test piece 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 taken as the average of measurements on both side faces at the neutral axis, and shall be measured at the centre of a central gauge length of five times the depth of the section.

The measuring equipment used shall be capable of measuring deformation to an accuracy of 1 % or, for deformations less than 2 mm, with an accuracy of 0,02 mm.

9.3 Expression of results

Using data obtained from the local modulus of elasticity test, plot the load/deformation graph.

Use that section of the graph between 0,1 $F_{max,est}$ and 0,4 $F_{max,est}$ for a regression analysis.

Find the longest portion of this section that gives a correlation coefficient of 0,99 or better. Provided that this portion covers at least the range 0,2 $F_{max,est}$ to 0,3 $F_{max,est}$ calculate the local modulus of elasticity from the following expression:

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

where

$F_2 - F_1$ is an increment of load in newtons on the regression line with a correlation coefficient of 0,99 or better; and

$w_2 - w_1$ is the increment of deformation in millimetres corresponding to $F_2 - F_1$ (see Figure 2).

The local modulus of elasticity, $E_{m,l}$ shall be calculated to an accuracy of 1 %.

If a portion of the graph cannot be found with a correlation coefficient of 0,99 or better covering the range 0,2 $F_{max,est}$ to 0,3 $F_{max,est}$, check the test equipment and take measures to eradicate any errors caused by distorted specimens. If 0,99 is still not achieved, discard the specimen.

The modulus of elasticity shall be calculated to an accuracy of 1 %.