SIST

SLOVENSKI STANDARD
SIST EN 384:2016

01-november-2016

Nadomešča:
SIST EN 384:2010

Konstrukcijski les - Ugotavljanje karakterističnih vrednosti mehanskih lastnosti in gostote

Structural timber - Determination of characteristic values of mechanical properties and density

Bauholz für tragende Zwecke - Bestimmung charakteristischer Werte für mechanische Eigenschaften und Rohdichte

Bois de structure - Détermination des valeurs caractéristiques des propriétés mécaniques et de la masse volumique

Ta slovenski standard je istoveten z: **EN 384:2016**

ICS:

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

SIST EN 384:2016 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 384

August 2016

ICS 79.040

Supersedes EN 384:2010

English Version

Structural timber - Determination of characteristic values of mechanical properties and density

Bois de structure - Détermination des valeurs caractéristiques des propriétés mécaniques et de la masse volumique

Bauholz für tragende Zwecke - Bestimmung charakteristischer Werte für mechanische Eigenschaften und Rohdichte

This European Standard was approved by CEN on 30 January 2016.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 384:2016 E

Contents

Page

European foreword

This document (EN 384:2016) 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 2017, and conflicting national standards shall be withdrawn at the latest by February 2017.

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 384:2010.

Compared to EN 384:2010, the following modifications have been made:

— the definitions have been revised;

— the adjustments of test results to the reference moisture content are presented as equations;

— the equations for determining other properties from properties derived by testing have been changed;

— regarding the determination of 5 %-percentiles the standard has been adopted to the revised EN 14358;

— the procedure for verification of a lot has been transferred to EN 14358.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Structural design codes can only function effectively if standard methods of determining the mechanical and physical properties exist. The aim of the procedures given in this standard is to derive characteristic values that are comparable in terms of the populations they represent. The standard permits the use of as much existing test data as possible from various sampling and testing techniques.

Where methods are given to permit characteristic values to be determined from a less than ideal amount of structural size test data, reduction factors to reflect a lower degree of confidence are employed.

1 Scope

This European Standard gives a method for determining characteristic values of mechanical properties and density, for defined populations of visual grades and/or strength classes of machine graded structural timber. Additionally it covers the stages of sampling, testing, analysis and presentation of the data.

The standard provides methods to derive strength, stiffness and density properties for structural timber from tests with defect-free specimen.

The values determined in accordance with this standard for mechanical properties and density are suitable for assigning grades and species to the strength classes of EN 338.

NOTE 1 For assigning grades and species to the strength classes in EN 338 only three properties, i.e. bending or tension strength, modulus of elasticity parallel to grain in bending or tension and density need to be determined from test data, other properties can be calculated according to Table 2.

NOTE 2 EN 1912 gives examples of established visual grades assigned to strength classes.

2 Normative references

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

EN 338, *Structural timber — Strength classes*

EN 408, *Timber structures — Structural timber and glued laminated timber — Determination of some physical and mechanical properties*

EN 13183-2, *Moisture content of a piece of sawn timber — Part 2: Estimation by electrical resistance method*

EN 13183-3, *Moisture content of a piece of sawn timber — Part 3: Estimation by capacitance method*

EN 14081-1:2016, *Timber structures — Strength graded structural timber with rectangular cross section — Part 1: General requirements*

EN 14081-2, *Timber structures — Strength graded structural timber with rectangular cross section — Part 2: Machine grading; additional requirements for initial type testing*

EN 14081-3, *Timber structures — Strength graded structural timber with rectangular cross section — Part 3: Machine grading; additional requirements for factory production control*

EN 14358:2016, *Timber structures — Calculation and verification of characteristic values*

3 Terms and definitions

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

3.1
characteristic value
representative value of a material property used for design, which is based either on 5-percentile values (e.g. strength properties and density) or mean values (e.g. modulus of elasticity)

3.2
***p*-percentile**
value for which the probability of getting lower values is *p* %

3.3
population
timber for which the characteristic values are relevant

3.4
timber source
identifiable geographical origin of a species or species combination from which timber is, or is intended to be, strength graded

3.5
sample
a number of ungraded specimens of one timber species or species combination, one source, with sizes and quality representative of the timber population (see 5.1)

3.6
sub-sample
part of one or more samples consisting of specimens of one grade

3.7
small clear test
test to determine mechanical properties of small defect-free specimens

3.8
specimen
piece of timber from which the test piece is taken

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

3.10
width
larger dimension perpendicular to the longitudinal axis of a piece of timber

3.11
depth
in the case of bending, cross-sectional dimension parallel to the direction of loading; in the case of tension, the width

4 Symbols and abbreviations

a_f	distance between the inner load points of the bending test (in mm)
E_0	modulus of elasticity parallel to grain (in N/mm^2)
$E_{0,mean}$	mean characteristic value of modulus of elasticity parallel to grain (in N/mm^2)
$E_{0,k}$	5-percentile characteristic value of modulus of elasticity parallel to grain (in N/mm^2)
$E_{90,mean}$	mean characteristic value of modulus of elasticity perpendicular to grain (in N/mm^2)
$\overline{E}_i$	mean modulus of elasticity for one sub-sample (in N/mm^2)

$\overline{E}_{i,min}$	lowest mean modulus of elasticity of all sub-samples (in N/mm²)
$E_{m,global}$	global modulus of elasticity in bending (in N/mm²)
$E_{m,local}$	local modulus of elasticity in bending (in N/mm²)
f	strength property
$f_{c,0,k}$	5- percentile characteristic value of compression strength parallel to grain (in N/mm²)
$f_{c,90,k}$	5- percentile characteristic value of compression strength perpendicular to grain (in N/mm²)
f_k	5- percentile characteristic value of strength (in N/mm²)
$f_{m,k}$	5- percentile characteristic value of bending strength (in N/mm²)
$f_{t,0,k}$	5- percentile characteristic value of tension strength parallel to grain (in N/mm²)
$f_{t,90,k}$	5- percentile characteristic value of tension strength perpendicular to grain (in N/mm²)
$f_{05,i}$	5-percentile value for each sub-sample (in N/mm²)
$f_{05,i,min}$	lowest 5-percentile value of all sub-samples (in N/mm²)
$f_{v,k}$	5- percentile characteristic value of shear strength (in N/mm²)
G_{mean}	mean characteristic value of shear modulus (in N/mm²)
h	depth (in mm)
k_h	factor for adjusting f when h is not 150 mm
k_l	factor for adjusting f when test span is not 18 h
k_n	factor to adjust for the number of sub-samples
k_v	factor to allow for the lower variability of f_{05} values between sub-samples for machine grades in comparison with visual grades
ℓ	span (in mm)
ℓ_{et}	effective length for the test (in mm)
n	total number of specimens
n_i	number of specimens in a sub-sample
n_s	number of sub-samples
u	moisture content (in %)
u_{ref}	reference moisture content, normally at 12 %
ρ	density (in kg/m³)
ρ_{mean}	mean density (in kg/m³)
ρ_k	characteristic density (5-percentile) (in kg/m³)
$\rho_{05,i}$	5-percentile density for a sub-sample (in kg/m³)
$\rho_{05,i,min}$	lowest 5-percentile density of all sub-samples (in kg/m³)

5 Mechanical properties determined from full-size specimens

5.1 Sampling

The sampling shall be representative of the population.

Any known or suspected difference in the mechanical properties of the population due to e.g. sawmills, tree size, countries or silviculture shall be represented within the sampling by a similar proportion to their frequency in the population. This shall be the major influence in determining the number and size of samples.

Samples shall be selected from one source of timber and shall be graded visually or by machine to sub-samples according to the requirements given in EN 14081-1.

For visual grading, each sub-sample shall consist of at least 40 specimens and be of one source.

For bending and tension parallel to grain tests, specimens shall have a sufficient length so that critical defects can be located in the critical test zone (see 5.2). A length of at least 30 times the depth or 3.6 m whichever is the lesser meets this requirement.

For the determination of strengths perpendicular to the grain and shear strength clear specimens shall be sampled.

5.2 Testing

Testing shall be carried out in accordance with EN 408 for strength, modulus of elasticity, density and moisture content. For bending parallel to grain, tension parallel to grain or modulus of elasticity, a critical section shall be selected in each piece of timber. This section is the position at which failure is expected to occur and therefore determines the grade for that piece. For bending the tension edge shall be selected at random. Whenever possible the critical section shall be placed inside the inner load points in a bending test or between the jaws in a tension test (centrally if possible). If this is not possible, the second most critical section shall be tested and determines the grade for that piece.

Existing historical data (before 1995) from different test methods or moisture conditions are acceptable provided sufficient information exists to adjust the results to the reference conditions given in 5.3.

5.3 Reference conditions

5.3.1 Moisture content

The reference moisture content shall be consistent with a temperature of 20 °C and 65 % relative humidity.

NOTE For most timber species this corresponds to a moisture content of about 12 %.

For specimens not tested to failure, the moisture content of each specimen is permitted to be determined from EN 13183-2 or EN 13183-3.

5.3.2 Bending strength

The reference condition corresponds to bending to a depth of 150 mm and to the standard test set-up proportions of third point loading with an overall span of 18 times the specimen depth.

5.3.3 Tension strength

The reference condition corresponds to a depth of 150 mm.

5.3.4 Density

Density is determined on small defect-free prisms according EN 408.

For specimens not tested to failure, the density of each specimen is permitted to be determined from the mass and volume of the test piece and adjusted to the density of the small defect-free prisms, by dividing by 1,05 in case of softwood. For hardwood no adjustment is necessary.

Adjustment for moisture content may also be necessary.

5.4 Adjustment factors

5.4.1 General

Test results shall be adjusted, piece by piece, to the standard reference conditions as given in 5.3.

If historical data (before 1995) is being used and records for individual specimen are incomplete, sub-sample 5-percentile or mean value shall be adjusted.

5.4.2 Moisture content

Test values for compression parallel to the grain, modulus of elasticity parallel to the grain and density of specimens not tested at the reference moisture content shall be adjusted either:

— by adjustment factors derived from tests;

— or by Formulae (1), (2) or (3).

$$f_{c,0}=f_{c,0}\ (u)(1+0{,}03(u-u_{ref})) \quad (1)$$

$$E_0 = E_0(u)\ (1+0{,}01\ (u-u_{ref})) \quad (2)$$

$$\rho = \rho\ (u)(1-0{,}005(u-u_{ref})) \quad (3)$$

where

$f_{c,0}$ is the compression strength parallel to the grain;

E_0 is the modulus of elasticity parallel to the grain;

ρ is the density;

u is the moisture content at testing ($8\ \% \leq u \leq 18\ \%$)

u_{ref} is the reference moisture content, normally $u_{ref} = 12\ \%$ (see 5.3.1).

For the adjustment of compression strength parallel to the grain and the modulus of elasticity u shall be taken as 18 % for moisture contents higher than 18 %.

If the moisture content u is lower than 8 %, special consideration is required for the adjustment of strength properties, modulus of elasticity and density.

For the adjustment of density special consideration is required for moisture contents above fibre saturation.

If other more relevant factors are available from test data, then they shall be used instead.

5.4.3 Timber size and test length

For depth less than 150 mm, and characteristic density less than or equal to 700 kg/m³, bending and tension strength shall be adjusted to 150 mm depth by dividing by the factor k_h from Formula (4):

$$k_h = Min \begin{cases} \left(\dfrac{150}{h}\right)^{0,2} \\ 1{,}3 \end{cases} \quad (4)$$