SLOVENSKI STANDARD
SIST EN 384:2010

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Nadomešča:
SIST EN 384:2004

Konstrukcijski les - Ugotavljanje značilnih vrednosti mehanskih lastnosti in gostote

Timber structures - Determination of characteristic values of mechanical properties and density

Bauholz für tragende Zwecke - Bestimmung charakteristischen festigkeits-, Steifigkeits- und Rohdichtewerte

Structures en bois - Détermination des valeurs caractéristiques des propriétés mécaniques et de la masse volumique

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91.080.20	Lesene konstrukcije	Timber structures

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

Structures en bois - Détermination des valeurs caractéristiques des propriétés mécaniques et de la masse volumique

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

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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 384:2010) has been prepared by Technical Committee CEN/TC 124 “Timber structures”, the secretariat of which is held by SFS.

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of an identical text or by endorsement, at the latest by October 2010, and conflicting national standards shall be withdrawn at the latest by October 2010.

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Introduction

In this revised edition, changes have been made to the equations giving the relativities between properties in 6.2.1, and the method of calculating the 5-percentile density. Also, the verification requirements in Clause 9 have been rewritten.

Structural codes can only function effectively if standard methods of determining the mechanical and physical properties exist.

Whilst total accuracy of characteristic values for any defined population is an aim, it is recognized that this is not achievable. A major aim of the procedures given in this standard is to produce characteristic values that are comparable in terms of the populations they represent. It is also important that 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 or from small, clear, defect-free specimen test data, reduction factors to reflect a lower degree of confidence are employed.

This standard covers the stages of population definition, sampling, testing and analysis and presentation of data in the determination of characteristic values.

1 Scope

This European Standard gives a method for determining characteristic values of mechanical properties and density, for defined populations of visual and/or mechanical strength grades of sawn timber.

A method is also given for checking the strength of a timber sample against its designated value.

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 characteristic values, i.e. bending strength, mean modulus of elasticity parallel to grain and density, need to be determined, other properties may be taken from the table in EN 338.

NOTE 2 EN 1912 gives examples of assignment to strength classes of established national or regional visual grades.

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 338, *Structural timber — Strength classes*

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

EN 1912, *Structural timber — Strength classes — Assignment of visual grades and species*

EN 14081-1, *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*

ISO 3131:1975, *Wood — Determination of density for physical and mechanical tests*

3 Terms and definitions

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

3.1
characteristic value
generally, value that corresponds to a fractile of the statistical distribution of a timber property

NOTE For strength properties, modulus of elasticity and density the fractile is the 5-percentile. For modulus of elasticity, the mean value is also a characteristic value.

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

3.3
population
material for which the associated characteristic values are relevant

NOTE The population is defined by parameters such as species or species combination, source and strength grade.

3.4
sample
number of specimens of one cross section size and from one population

NOTE See 5.1.

3.5
small clear test
test to determine mechanical properties of small defect-free specimens

3.6
specimen
piece of timber for testing

3.7
thickness
lesser dimension perpendicular to the longitudinal axis of a piece of timber

3.8
width
greater dimension perpendicular to the longitudinal axis of a piece of timber

3.9
depth
dimension perpendicular to the longitudinal axis of a timber beam, in the plane of the bending forces

4 Symbols and abbreviations

a_f distance between the inner load points of the bending test (in millimetres)

COV coefficient of variation

$\overline{E}$ mean modulus of elasticity for one sample (in newtons per square millimetre)

$E_{0,mean}$ mean characteristic value of modulus of elasticity parallel to grain (in newtons per square millimetre)

$E_{0,05}$ 5-percentile characteristic value of modulus of elasticity parallel to grain (in newtons per square millimetre)

$E_{90,mean}$ mean characteristic value of modulus of elasticity perpendicular to grain (in newtons per square millimetre)

$E_{mean,acc}$ mean modulus of elasticity for an acceptable quality lot (in newtons per square millimetre)

$E_{mean,unacc}$ mean modulus of elasticity for an unacceptable quality lot (in newtons per square millimetre)

f strength property

$f_{c,0,k}$ characteristic value of compression strength parallel to grain (in newtons per square millimetre)

$f_{c,90,k}$ characteristic value of compression strength perpendicular to grain (in newtons per square millimetre)

f_k characteristic value of strength (in newtons per square millimetre)

$f_{m,k}$	characteristic value of bending strength (in newtons per square millimetre)
$f_{t,0,k}$	characteristic value of tensile strength parallel to grain (in newtons per square millimetre)
$f_{t,90,k}$	characteristic value of tensile strength perpendicular to grain (in newtons per square millimetre)
f_{05}	5-percentile value for each sample (in newtons per square millimetre)
$f_{05,acc}$	5-percentile value for an acceptable quality lot (in newtons per square millimetre)
$f_{05,unacc}$	5-percentile value for an unacceptable quality lot (in newtons per square millimetre)
$\overline{f}_{05}$	the mean value of f_{05} for several samples (in newtons per square millimetre)
$f_{v,k}$	characteristic value of shear strength (in newtons per square millimetre)
G_{mean}	mean characteristic value of shear modulus (in newtons per square millimetre)
h	depth of a bending specimen or width of a tension specimen (in millimetres)
k_h	factor for adjusting f_k when h is different from 150 mm
k_l	factor for adjusting length;
k_q	factor for use when checking the quality of a graded sample
k_s	factor for adjusting for the number and size of samples
k_v	factor for adjusting for machine grading
ℓ	span (in millimetres)
ℓ_{et}	effective length for the test (in millimetres)
n	number of specimens in a sample
p_{lim}	acceptable probability limit for strength
α	producers risk
β	consumers risk
ρ	density (in kilograms per cubic metre)
ρ_k	characteristic density (5-percentile) (in kilograms per cubic metre)
ρ_{05}	5-percentile density for a sample (in kilograms per cubic metre)

5 Mechanical properties determined from full-size specimens

5.1 Sampling

Samples shall be selected from the population of timber graded visually or by machine to the requirements given in EN 14081-1.

The test material shall be representative of the population. It shall represent the timber source, sizes, and quality that will be graded in production. Each sample shall be from one source.

NOTE 1 For the derivation of settings for grading machines additional sampling requirements are given in EN 14081-2.

Any known or suspected difference in the mechanical properties of the population distribution due to growth regions, sawmills, tree size or method of conversion shall be represented within the number of samples selected, by a similar proportion to their frequency in the population.

NOTE 2 The above should be the major influence in determining the number and size of samples.

The number of specimens in each sample shall be not less than 40.

NOTE 3 Where samples are small and/or few in number the characteristic values will be penalized, see 5.4.

The cross section size of specimens shall be the same within a sample, but different for other samples, except where the test data are to be used to determine settings for a grading machine that measures size as part of its operation (see EN 14081-2). The number of sizes shall reflect the range of sizes to which the grading rules are applicable.

Test specimens for shear, tension perpendicular to grain and compression perpendicular to grain strengths are comparatively small and therefore shall be free of strength reducing characteristics, but shall represent the full range of growth areas, density and rates of growth.

5.2 Testing

Testing shall be carried out in accordance with EN 408. Except for the strength properties of shear, tension perpendicular to grain and compression perpendicular to grain, a critical section shall be selected in each piece of timber. This section is the position at which failure is expected to occur, based on a visual examination and any other information such as measurements from a strength grading machine. The critical section shall be in a position that can be tested, e.g. not outside the inner load points in a bending test or in close proximity to the jaws in a tension test. For tests to determine global modulus of elasticity, the procedure shall be as given in EN 408 and the critical section shall be positioned between the loading heads. The grade of the piece of timber shall be deemed to be the grade of the critical section.

NOTE 1 Because the method used for determining the 5-percentile values of the strength properties is non-parametric (see 5.3.1), not all specimens in the test samples need to be tested to failure.

For a bending test for strength or modulus of elasticity the load shall be applied on the edge of the test specimen and the tension edge shall be selected at random after the critical section has been chosen.

For a tension test for strength or modulus of elasticity, the timber test length clear of the machine grips shall be nine times the width of the piece.

NOTE 2 Existing data from different test methods or moisture conditions are acceptable provided sufficient information exists to adjust the results to the reference conditions given in 5.3.3. These differences might be in moisture content, test spans or orientation of test specimens. If these data are not available, recommendations for some of these adjustments are given in 5.3.4.

5.3 Analysis of data

5.3.1 Determination of sample 5-percentile for strength

For each sample, a 5-percentile value f_{05} shall be determined by ranking all the test values for a sample in ascending order. The 5-percentile value is the test value for which 5 % of the values are lower or equal. If this is not an actual test value (i.e. the number of test values is not divisible by 20) then linear interpolation between the two adjacent values is required.

5.3.2 Determination of the sample mean of modulus of elasticity

The sample mean value of modulus of elasticity $\overline{E}$ shall be calculated from the following equation, which includes an adjustment to a pure bending modulus of elasticity:

$$\overline{E} = [\sum E_i / n] \, 1{,}3 - 2\,690$$

where

E_i is the ith value of modulus of elasticity (see 5.2) in the range 1 to n (in newtons per square millimetre).

5.3.3 Reference conditions

5.3.3.1 Moisture content

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

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

5.3.3.2 Bending strength

The reference condition corresponds 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.

5.3.3.3 Tension strength

The reference condition corresponds to a width of 150 mm. All other requirements are implicit in 5.2.

5.3.4 Adjustment factors

5.3.4.1 General

Each specimen or sample 5-percentile or mean value shall be adjusted to the standard reference conditions as below.

5.3.4.2 Moisture content of the samples

Test values of specimens not tested at the reference conditions but having a moisture content in the range 8 % to 18 %, shall be adjusted to 12 % moisture content (or a value shown by test to be more appropriate to the reference conditions for that species), as follows. If other more relevant factors are available from test data, then they shall be used instead. When making this adjustment, test values of specimens with a moisture content above 18 % shall be adjusted from 18 % and not from their actual moisture content.

a) For bending and tension strength: no adjustment.

b) For compression parallel to grain strength: 3 % change for every percentage point difference in moisture content.

c) For modulus of elasticity: 1 % change for every percentage point difference in moisture content.

d) For compression parallel to grain strength and modulus of elasticity: the adjustments are carried out so that the properties increase if the data are adjusted from higher moisture content, and vice versa.