BRITISH STANDARD

BS EN 338:2003

Structural timber — Strength classes

The European Standard EN 338:2003 has the status of a British Standard

ICS 79.040

BSI British Standards

National foreword

This British Standard is the official English language version of EN 338:2003. It supersedes BS EN 338:1995 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/525, Building and civil engineering structures, to Subcommittee B/525/5, Structural use of timber, which has the responsibility to:

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English version

Structural timber - Strength classes

Bois de structure - Classes de résistance

Bauholz für tragende Zwecke - Festigkeitsklassen

This European Standard was approved by CEN on 14 February 2003.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 338:2003) has been prepared by Technical Committee CEN/TC 124 "Timber structures", the secretariat of which is held by DS.

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of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003*.*

This document supersedes EN 338:1995.

Annex A is informative.

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

Introduction

This revised edition has additional strength classes and lists the equations, formerly in EN 384, that form the relations between some of the characteristic values. Changes have also been made to some of the characteristic values and the requirements for assigning grades and species to strength classes.

Due to variations in the type and quality of timber available, the variety of end uses and the size of production output of the local timber industry, many different combinations of species and strength grade exist with different strength properties, which therefore complicate the design and specification of timber structures.

A strength class system groups together grades and species with similar strength properties thus making them interchangeable. This then permits an engineer to specify a chosen strength class and use the characteristic strength values of that class in design calculations.

Advantages of the strength class system are:

- Additional species/grades can be incorporated into the system at any time without affecting existing specifications for structural timber.

- At the time of carrying out design calculations, an engineer need not be aware of the costs and availability of alternative species and grades. He can simply design using the strength values of a particular class and then specify that class; he can then use the tenders to select the most suitable and economic species/grade on offer. Note that, where a particular species is not acceptable (e.g. for reasons of durability) for a project, the specification needs to make this clear.

- Suppliers can offer their material to meet more specifications than would be possible if species and grades were specified.

1 Scope

This standard establishes a system of strength classes for general use in structural codes.

It gives characteristic strength and stiffness properties and density values for each class and the rules for the allocation of timber populations (i.e. combinations of species, source and grade) to the classes.

This standard applies to all softwood and hardwood timber for structural use.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 384, *Structural timber – Determination of characteristic values of mechanical properties and density.*

prEN 14081-1, *Timber structures – Strength graded structural timber with rectangular cross-section – Part 1: General requirements*.

prEN 14081-2, *Timber structures – Strength graded structural timber with rectangular cross-section – Part 2: Machine Grading - Additional requirements for initial type testing*.

prEN 14081-3, *Timber structures – Strength graded structural timber with rectangular cross-section – Part 3: Machine Grading - Additional requirements for factory production control*.

3 Terms and definitions

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

3.1
population
material for which the characteristic values are relevant

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

4 Symbols and abbreviations

$E_{0,mean}$ mean characteristic value of modulus of elasticity parallel to grain (in N/mm^2)

$E_{0,05}$ 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)

$f_{c,0,k}$ characteristic value of compressive strength parallel to grain (in N/mm^2)

$f_{c,90,k}$ characteristic value of compressive strength perpendicular to grain (in N/mm^2)

$f_{m,k}$ characteristic value of bending strength (in N/mm^2)

$f_{t,0,k}$ characteristic value of tensile strength parallel to grain (in N/mm^2)

$f_{t,90,k}$ characteristic value of tensile strength perpendicular to grain (in N/mm^2)

$f_{v,k}$ characteristic value of shear strength (in N/mm^2)

G_{mean} mean characteristic value of shear modulus (in N/mm^2)

ρ_k characteristic value of density (in kg/m^3)

ρ_{mean} mean value of density (in kg/m^3)

5 Classification of structural timber

This standard provides for a number of strength classes, each designated by a number indicating the value of bending strength in newtons per square millimetre.

The characteristic values of strength, stiffness and density for the strength classes are given in Table 1.

Table 1 — Strength classes - Characteristic values

		Poplar and softwood species												Hardwood species					
		C14	C16	C18	C20	C22	C24	C27	C30	C35	C40	C45	C50	D30	D35	D40	D50	D60	D70
Strength properties (in N/mm^2)																			
Bending	$f_{m,k}$	14	16	18	20	22	24	27	30	35	40	45	50	30	35	40	50	60	70
Tension parallel	$f_{t,0,k}$	8	10	11	12	13	14	16	18	21	24	27	30	18	21	24	30	36	42
Tension perpendicular	$f_{t,90,k}$	0,4	0,5	0,5	0,5	0,5	0,5	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
Compression parallel	$f_{c,0,k}$	16	17	18	19	20	21	22	23	25	26	27	29	23	25	26	29	32	34
Compression perpendicular	$f_{c,90,k}$	2,0	2,2	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	3,1	3,2	8,0	8,4	8,8	9,7	10,5	13,5
Shear	$f_{v,k}$	1,7	1,8	2,0	2,2	2,4	2,5	2,8	3,0	3,4	3,8	3,8	3,8	3,0	3,4	3,8	4,6	5,3	6,0
Stiffness properties (in kN/mm^2)																			
Mean modulus of elasticity parallel	$E_{0,mean}$	7	8	9	9,5	10	11	11,5	12	13	14	15	16	10	10	11	14	17	20
5% modulus of elasticity parallel	$E_{0,05}$	4,7	5,4	6,0	6,4	6,7	7,4	7,7	8,0	8,7	9,4	10,0	10,7	8,0	8,7	9,4	11,8	14,3	16,8
Mean modulus of elasticity perpendicular	$E_{90,mean}$	0,23	0,27	0,30	0,32	0,33	0,37	0,38	0,40	0,43	0,47	0,50	0,53	0,64	0,69	0,75	0,93	1,13	1,33
Mean shear modulus	G_{mean}	0,44	0,5	0,56	0,59	0,63	0,69	0,72	0,75	0,81	0,88	0,94	1,00	0,60	0,65	0,70	0,88	1,06	1,25

Table 1 (*continued*)

Density (in kg/m^3)																			
Density	ρ_k	290	310	320	330	340	350	370	380	400	420	440	460	530	560	590	650	700	900
Mean density	ρ_{mean}	350	370	380	390	410	420	450	460	480	500	520	550	640	670	700	780	840	1080

NOTE a Values given above for tension strength, compression strength, shear strength, 5% modulus of elasticity, mean modulus of elasticity perpendicular to grain and mean shear modulus, have been calculated using the equations given in annex A

b The tabulated properties are compatible with timber at a moisture content consistent with a temperature of 20^{0}C and a relative humidity of 65%

c Timber conforming to classes C45 and C50 may not be readily available.

6 Allocation of a timber population to a strength class

6.1 Grading

6.1.1 Visually graded timber

Visually graded timber shall be to a grading standard that meets the requirements of prEN 14081-1.

NOTE EN 1912 lists a number of visual grades and species that are allocated to the strength classes of this standard.

6.1.2 Machine graded timber

Machine graded timber shall meet the requirements of prEN 14081-2 and prEN 14081-3.

6.2 Classification

6.2.1 Characteristic values

The characteristic values of bending strength, modulus of elasticity in bending (mean) and density for the timber population concerned shall be determined in accordance with EN 384 (see annex A).

6.2.2 Allocation to a strength class

A timber population may be assigned to a strength class if its characteristic values of bending strength and density equal or exceed the values for that strength class given in Table 1, and its characteristic mean modulus of elasticity in bending equals or exceeds 95% of the value for that strength class given in Table 1.

NOTE Provided information is available, a grading machine may be set to grade directly to the strength class strength and stiffness values. Timber graded in this way should be referred to by the strength class number and marked according to prEN 14081-1, prEN 14081-2 and prEN 14081-3.

Annex A
(informative)

Equations for characteristic values

The following equations were used to determine the characteristic values in Table 1 for properties other than bending strength, mean modulus of elasticity in bending and density.

Tensile strength parallel to grain $f_{t,0,k} = 0,6\, f_{m,k}$

Compression strength parallel to grain $f_{c,0,k} = 5\left(f_{m,k}\right)^{0,45}$

Shear strength $f_{v,k} = \min.\begin{cases} 3,8 \\ 0,2\left(f_{m,k}\right)^{0,8} \end{cases}$

Tensile strength perpendicular to grain $f_{t,90,k} = \min.\begin{cases} 0,6 \\ 0,0015\rho_k \end{cases}$

Compressive strength perpendicular to grain:

$f_{c,90,k} = 0,007\rho_k$ for softwoods

$f_{c,90,k} = 0,015\rho_k$ for hardwoods

Modulus of elasticity parallel to grain

$E_{0,05} = 0,67E_{0,mean}$ for softwoods

$E_{0,05} = 0,84E_{0,mean}$ for hardwoods

Mean modulus of elasticity perpendicular to grain

$E_{90,mean} = E_{0,mean} / 30$ for softwoods

$E_{90,mean} = E_{0,mean} / 15$ for hardwoods

Mean shear modulus $G_{mean} = E_{0,mean} / 16$

Bibliography

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

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