

related test method	EN 1363-1 and 1365-1
subject	Verification of wood studs in loadbearing samples
reference of original query	Helpdesk item 2014-04 EGOLF TC2 N720

Estimation of mechanical characteristics for timber to be used in fire resistance testing of load bearing elements

Timber is a natural material with a very wide scatter in the mechanical characteristics. The strength grading, and marking of the timber, is often made to suit the local market (you are not able to produce timber of a certain grade, it becomes what it is). Therefore timber may have mechanical properties that are much higher than what is declared. This can have a large impact on the results from fire resistance tests if the load bearing capacity of the tested element is much higher compared with the declared value from which the applied load has been established. Therefore it is important that the timber to be used in fire resistance tests of load bearing structures is graded in such way that its actual strength can be estimated. In the figure on next page the mechanical characteristics of timber in the different strength grades are presented.

One of the two methods presented below can be used for the grading, i.e. either selection through strength grading or selection through density measurement.

Selection through strength grading (visual or machine grading)

The timber must be graded in a two steps. In the first grading the timber is graded into the strength class that is used for calculating the load to be applied in the fire resistance test. The timber that falls into this class is then graded a second time, and in this grading to a strength class two steps above the first grading. For instance, if the test is to be carried out with timber of strength class C24, the first grading is done for C24. All timber that falls into the C24 grade is then graded for C30 (two steps above C24). The timber that is graded as C30 or higher is then removed, and the remaining timber will be of grade C24, but not higher than C30, and can thus be used in the fire resistance test.

Selection through density measurement

An alternative to strength grading is by measuring the density of the timber. The density is determined from the weight of the individual timber elements and their dimensions. The timber to be used in the fire shall have a density in the interval between the mean density of the grade below the one to be tested and the mean density of the grade one step above the one to be tested. For instance, if the grade to be used in the test is of grade C24, the density of each timber element in the test specimen shall be within $410 < \rho < 450 \text{ kg/m}^3$.

Table 1 — Strength classes - Characteristic values

	Softwood species										Hardwood species										
	C14	C16	C18	C20	C22	C24	C27	C30	C35	C40	C45	C50	D18	D24	D30	D35	D40	D50	D60	D70	
Strength properties (in N/mm²)																					
Bending	14	16	18	20	22	24	27	30	35	40	45	50	18	24	30	35	40	50	60	70	
Tension parallel	8	10	11	12	13	14	16	18	21	24	27	30	11	14	18	21	24	30	36	42	
Tension perpendicular	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	
Compression parallel	16	17	18	19	20	21	22	23	25	26	27	29	18	21	23	25	26	29	32	34	
Compression perpendicular	2,0	2,2	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	3,1	3,2	7,5	7,8	8,0	8,1	8,3	9,3	10,5	13,5	
Shear	3,0	3,2	3,4	3,6	3,8	4,0	4,0	4,0	4,0	4,0	4,0	4,0	3,4	4,0	4,0	4,0	4,0	4,0	4,5	5,0	
Stiffness properties (in kN/mm²)																					
Mean modulus of elasticity parallel	7	8	9	9,5	10	11	11,5	12	13	14	15	16	9,5	10	11	12	13	14	17	20	
5 % modulus of elasticity parallel	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	8,5	9,2	10,1	10,9	11,8	14,3	16,8	
Mean modulus of elasticity perpendicular	0,23	0,27	0,30	0,32	0,33	0,37	0,38	0,40	0,43	0,47	0,50	0,53	0,63	0,67	0,73	0,80	0,86	0,93	1,13	1,33	
Mean shear modulus	0,44	0,5	0,56	0,59	0,63	0,69	0,72	0,75	0,81	0,88	0,94	1,00	0,59	0,62	0,69	0,75	0,81	0,88	1,06	1,25	
Density (in kg/m³)																					
Density	290	310	320	330	340	350	370	380	400	420	440	460	475	485	530	540	550	620	700	900	
Mean density	350	370	380	390	410	420	450	460	480	500	520	550	570	580	640	650	660	750	840	1080	
NOTE 1 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.																					
NOTE 2 The tabulated properties are compatible with timber at a moisture content consistent with a temperature of 20 °C and a relative humidity of 65 %.																					
NOTE 3 Timber conforming to classes C45 and C50 may not be readily available.																					
NOTE 4 Characteristic values for shear strength are given for timber without fissures, according to EN 408. The effect of fissures should be covered in design codes.																					