



MECHANICAL PROPERTIES OF THE GFP CROSS LAMINATED TIMBER ELEMENTS

According to Annex 2 of the ETA-19/0675, issued on 2020-03-31

Mechanical actions perpendicular to the solid wood slab

The following values for mechanical properties shall be used, when design calculations are made according to the principles given in Annex 3.

Property	Value in N/mm ²
Bending strength $f_{m,k}$	24
Compression strength $f_{c,90,k}$	2,5
Tension strength $f_{t,90,k}$	0,4
Shear strength perpendicular to the grain of the boards $f_{R,v,k}$	1,2
Shear strength parallel to the grain of the boards $f_{v,k}$	4,0
Modulus of elasticity parallel to the grain of the boards $E_{0,mean}$	12000
Modulus of elasticity perpendicular to the grain of the boards $E_{90,mean}$	390
Shear modulus parallel to the grain of the boards G_{mean}	650
Shear modulus perpendicular to the grain of the boards $G_{R,mean}$	50

Mechanical actions in plane of the solid wood slab

The following values for mechanical properties shall be used, when design calculations are made according to the principles given in Annex 3.

Property	Value in N/mm ²
Bending strength $f_{m,k}$	24
Compression strength $f_{c,0,k}$	24
Tension strength $f_{t,0,k}$	16,5
Shear strength parallel to the grain of the boards $f_{v,k}$	3,2
Modulus of elasticity parallel to the grain of the boards $E_{0,mean}$	12000
Shear modulus parallel to the grain of the boards G_{mean}	650



Creep and duration of load

The following modification factors, k_{mod} and k_{def} as defined in Eurocode 5, shall be used.

Duration of load	Actions perpendicular and in plane to the slab	
	k_{mod}	
	Service class 1	Service class 2
Permanent	0,60	0,60
Long term	0,70	0,70
Medium term	0,80	0,80
Short term	0,90	0,90
Instantaneous	1,10	1,10

Actions perpendicular to the slab		Actions in plane of the slab	
k_{def}		k_{def}	
Service class 1	Service class 2	Service class 1	Service class 2
0,80	1,00	0,60	0,80



DESIGN PRINCIPLES OF THE GFP CROSS LAMINATED TIMBER ELEMENTS

According to Annex 3 of the ETA-19/0675, issued on 2020-03-31

Mechanical actions perpendicular to the solid wood slab

Stress distribution within the solid wood slab shall be calculated taking into account the rolling shear deformation of the cross layers. For simply supported solid wood slabs with up to 5 layers the stress distribution may be calculated applying EN 1995-1-1 Annex B. Mechanically jointed beams, where the deformation between the parts due to yield of the fasteners is replaced by the shear deformation of the cross layers. Characteristic strength and stiffness values to be used are given in Annex 2. Thus, with the symbols as defined in Figure 3-1, the following equations apply:

$$I_{ef} = I_1 + I_2 + I_3 + \gamma_1 a_1^2 A_1 + \gamma_2 a_2^2 A_2 + \gamma_3 a_3^2 A_3$$

$$\gamma_1 = \left(1 + \frac{\pi^2 E A_1 \cdot d_{12}}{\ell^2 G \cdot b} \right)^{-1} \quad \gamma_2 = 1 \quad \gamma_3 = \left(1 + \frac{\pi^2 E A_3 \cdot d_{23}}{\ell^2 G \cdot b} \right)^{-1}$$

$$a_1 = \left(\frac{d_1}{2} + d_{12} + \frac{d_2}{2} \right) - a_2 \quad a_3 = \left(\frac{d_1}{2} + d_{23} + \frac{d_3}{2} \right) + a_2$$

$$a_2 = \frac{\gamma_1 A_1 \cdot \left(\frac{d_1}{2} + d_{12} + \frac{d_2}{2} \right) - \gamma_3 A_3 \cdot \left(\frac{d_2}{2} + d_{23} + \frac{d_3}{2} \right)}{\gamma_1 A_1 + \gamma_2 A_2 + \gamma_3 A_3}$$

$$\sigma_{r,i} = \pm \frac{M}{I_{ef}} \cdot \left(\gamma_i a_i + \frac{d_i}{2} \right) \quad \tau_{max} = \frac{V \gamma_i S_i}{I_{ef} \cdot b}$$

For symmetrical layouts, $a_2 = 0$ and $\gamma_1 = \gamma_3$. For 3 layers, $d_2 = 0$, $d_{12} = d_{23} = d/2$ (half the thickness of the cross layer in the middle of the slab). For solid wood slabs with more than 5 layers, computer programs based on the same principles shall be used.

For the bending design only the stresses at the edges of the boards are decisive, axial stresses in the center of the boards need not to be considered in the design. The characteristic bending strength properties may be multiplied by a system strength factor.

$$k_r = \min \begin{cases} 1 + 0,025 \cdot n \\ 1,2 \end{cases}$$

n = number of adjoined boards along the width of the element.

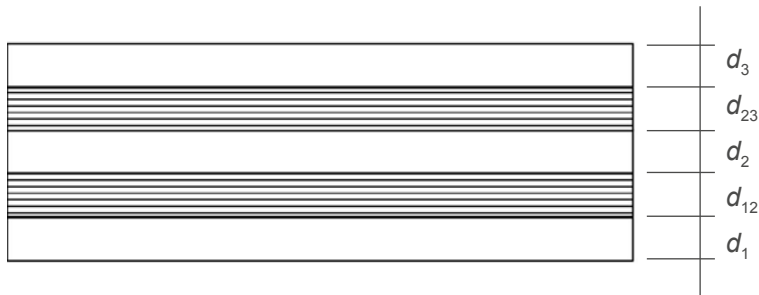


Figure 3-1. Symbols used in the calculations. Layers effective in bending are d_1 , d_2 and d_3 . Rolling shear layers are d_{12} and d_{23} .

Mechanical actions in plane of the solid wood slab

Stress distribution within the solid wood slab has to be calculated by taking into account only the boards which are oriented in the direction of the actions.

For the design of solid wood slabs the characteristic strength and stiffness values according to Annex 2 shall be used.

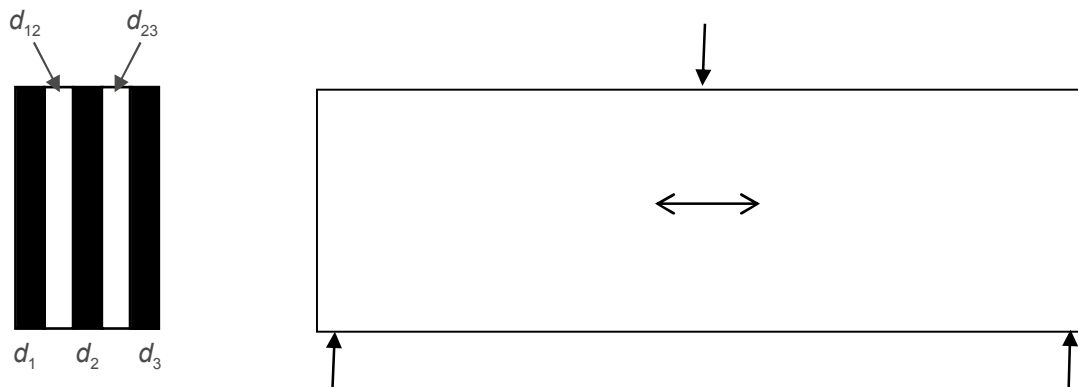


Figure 3-2. Symbols used in the calculations. Effective layers are either d_1 , d_2 and d_3 or d_{12} and d_{23} . This depends on the grain direction of the layers. In the case shown layers d_1 , d_2 and d_3 are effective and their grain direction is shown by an arrow.