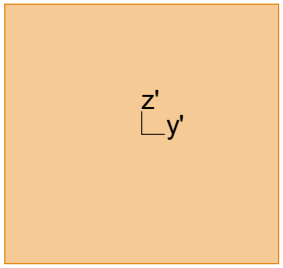
C.19.1
Maximum of load combinations

GL 32c
(Glued laminated), Service class 1

$E_{0,05}$	=	11200 N/mm²	$f_{t,90,k}$	=	0.50 N/mm²
$G_{0,05}$	=	540 N/mm²	$f_{c,0,k}$	=	24.50 N/mm²
γ_M	=	1.15	$f_{c,90,k}$	=	2.50 N/mm²
$\gamma_{M,acc./seis.}$	=	1.00	$f_{v,k}$	=	3.50 N/mm²
k_{sys}	=	1.00			

Glulam 190x180



A	=	34200 mm²	$f_{t,0,k}$	=	21.45 N/mm²
W_1	=	1.083e+06 mm³	$f_{m,1,k}$	=	35.20 N/mm²
W_2	=	1.026e+06 mm³	$f_{m,2,k}$	=	35.20 N/mm²
i_1	=	55 mm			
i_2	=	52 mm			
I_2	=	9.234e+07 mm⁴			
I_t	=	1.642e+08 mm⁴			

Combined bending and axial tension - 6.2.3
Not relevant

Combined bending and axial compression - 6.1.4, 6.2.4
LC: 'LC6ULS', k_{mod} = 0.90, x = 0.00 mm

$\sigma_{c,0,d} = 14.25\ N/mm^2 \le f_{c,0,d} = 19.17\ N/mm^2$ (6.2) - OK

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + \frac{\sigma_{m,1,d}}{f_{m,1,d}} + k_m \frac{\sigma_{m,2,d}}{f_{m,2,d}} = \left(\frac{14.25}{19.17}\right)^2 + \frac{0.16}{27.55} + 0.70\,\frac{0.46}{27.55} = 0.57 \le 1.00 \quad (6.19) - OK$$

$$\left(\frac{\sigma_{c,0,d}}{f_{c,0,d}}\right)^2 + k_m \frac{\sigma_{m,1,d}}{f_{m,1,d}} + \frac{\sigma_{m,2,d}}{f_{m,2,d}} = \left(\frac{14.25}{19.17}\right)^2 + 0.70\,\frac{0.16}{27.55} + \frac{0.46}{27.55} = 0.57 \le 1.00 \quad (6.20) - OK$$

Combined shear and torsion - 6.1.7, 6.1.8
LC: 'LC21ULS', k_{mod} = 0.90, x = 3000.00 mm

$\tau_d = 0.26\ N/mm^2 \le f_{v,d} = 2.74\ N/mm^2$ (6.13) - OK

Flexural buckling around axis 1 - 6.3.2

LC: 'LC6ULS', k_{mod} = 0.90, x = 0.00 mm

β_c = 0.1 (6.29)

$$\lambda_1 = \frac{l_0}{i_1} = \frac{3000}{55} = 54.70$$

$$\lambda_{rel,1} = \frac{\lambda_1}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{54.70}{\pi}\sqrt{\frac{24.50}{11200}} = 0.814 \quad (6.21)$$

$$k_1 = 0.5\left(1 + \beta_c\left(\lambda_{rel,1} - 0.3\right) + \lambda_{rel,1}^{\ 2}\right) =$$

$$= 0.5\left(1 + 0.1\left(0.814 - 0.3\right) + 0.814^2\right) = 0.857 \quad (6.27)$$

$$k_{c,1} = \frac{1}{k_1 + \sqrt{k_1^{\ 2} - \lambda_{rel,1}^{\ 2}}} = \frac{1}{0.857 + \sqrt{0.857^2 - 0.814^2}} = 0.889 \quad (6.25)$$

$$\frac{\sigma_{c,0,d}}{k_{c,1} \cdot f_{c,0,d}} + \frac{\sigma_{m,1,d}}{f_{m,1,d}} + k_m \cdot \frac{\sigma_{m,2,d}}{f_{m,2,d}} = \frac{14.25}{0.889 \cdot 19.17} + \frac{0.16}{27.55} + 0.70 \cdot \frac{0.46}{27.55} = 0.85 \le 1.00 \quad (6.23) \text{ - OK}$$

Flexural buckling around axis 2 - 6.3.2

LC: 'LC6ULS', k_{mod} = 0.90, x = 0.00 mm

β_c = 0.1 (6.29)

$$\lambda_2 = \frac{l_0}{i_2} = \frac{3000}{52} = 57.74$$

$$\lambda_{rel,2} = \frac{\lambda_2}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,05}}} = \frac{57.74}{\pi}\sqrt{\frac{24.50}{11200}} = 0.860 \quad (6.22)$$

$$k_2 = 0.5\left(1 + \beta_c\left(\lambda_{rel,2} - 0.3\right) + \lambda_{rel,2}^{\ 2}\right) =$$

$$= 0.5\left(1 + 0.1\left(0.860 - 0.3\right) + 0.860^2\right) = 0.897 \quad (6.28)$$

$$k_{c,2} = \frac{1}{k_2 + \sqrt{k_2^{\ 2} - \lambda_{rel,2}^{\ 2}}} = \frac{1}{0.897 + \sqrt{0.897^2 - 0.860^2}} = 0.866 \quad (6.26)$$

$$\frac{\sigma_{c,0,d}}{k_{c,2} \cdot f_{c,0,d}} + k_m \cdot \frac{\sigma_{m,1,d}}{f_{m,1,d}} + \frac{\sigma_{m,2,d}}{f_{m,2,d}} = \frac{14.25}{0.866 \cdot 19.17} + 0.70 \cdot \frac{0.16}{27.55} + \frac{0.46}{27.55} = 0.88 \le 1.00 \quad (6.24) \text{ - OK}$$

Lateral torsional buckling - 6.3.3

LC: 'LC6ULS', k_{mod} = 0.90, x = 0.00 mm

$$l_{ef} = l \,/\, \frac{12.5 \cdot M_{max}}{2.5 \cdot M_{max} + 3 \cdot M_2 + 4 \cdot M_3 + 3 \cdot M_4} + 2 \cdot h =$$

$$= 3000 \,/\, \frac{12.5 \cdot 0.24}{2.5 \cdot 0.24 + 3 \cdot 0.04 + 4 \cdot 0.04 + 3 \cdot 0.08} + 2 \cdot 190 = 1504 \text{ mm}$$

$$\sigma_{m,crit} = \frac{\pi\sqrt{E_{0,05} \cdot I_2 \cdot G_{0,05} \cdot I_t}}{l_{ef} \cdot W_1} = \frac{\pi\sqrt{11200 \cdot 9.234e{+}07 \cdot 540 \cdot 1.642e{+}08}}{1504 \cdot 1.083e{+}06} = 583.99 \text{ N/mm}^2 \quad (6.31)$$

$$\lambda_{rel,m} = \sqrt{\frac{f_{m,1,k}}{\sigma_{m,crit}}} = \sqrt{\frac{32.00}{583.99}} = 0.234 \quad (6.30)$$

$\lambda_{rel,m} = 0.234 \le 0.75 \rightarrow k_{crit} = 1.000$ (6.34)

$$\frac{\sigma_{m,1,d}}{k_{crit} \cdot f_{m,1,d}} = \frac{0.16}{1.000 \cdot 27.55} = 0.01 \le 1.00 \quad (6.33) \text{ - OK}$$

$$\left(\frac{\sigma_{m,1,d}}{k_{crit} \cdot f_{m,1,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,2} \cdot f_{c,0,d}} = \left(\frac{0.16}{1.000 \cdot 27.55}\right)^2 + \frac{14.25}{0.87 \cdot 19.17} = 0.86 \le 1.00 \quad (6.35) \text{ - OK}$$

Bending at apex - 6.4.3
Not relevant

Tension at apex - 6.4.3
Not relevant

Summary