

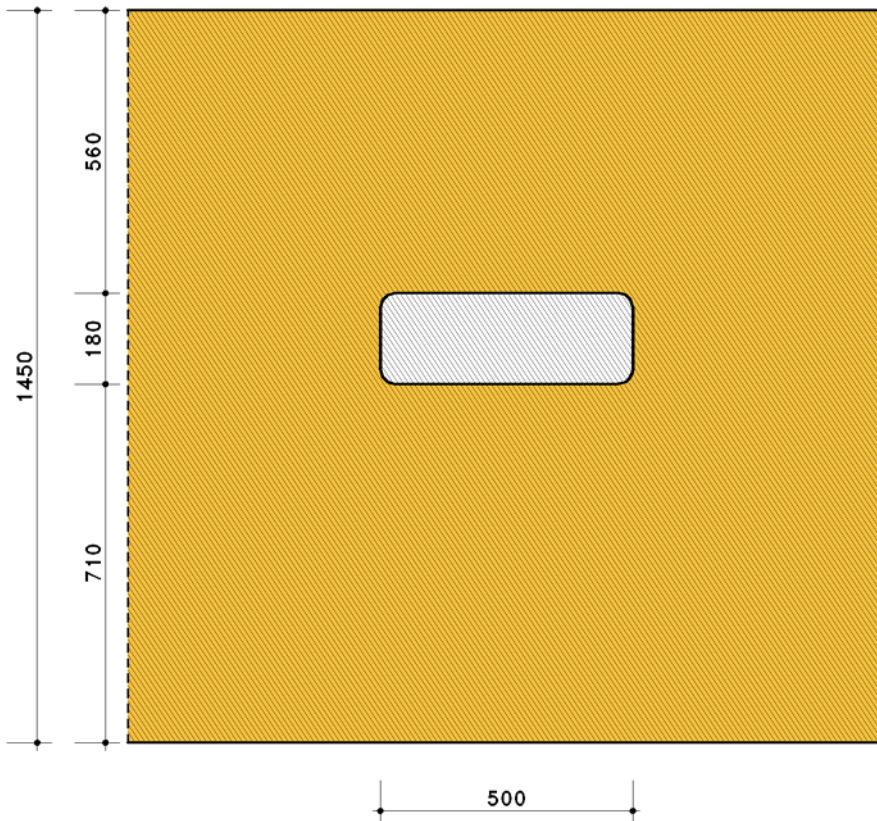
1. Input parameters

1.1. girder opening rectangular unreinforced acc. to DIN EN 1995-1-1/NA:2013-08, NCI NA.6.7

1.2. beam

beam of glue laminated timber EC, GL28h 200/1450 mm, $\rho_k = 425 \text{ kg/m}^3$, NKL 1
 $h_{ro} = 560 \text{ mm}$, $h_{ru} = 710 \text{ mm}$, $a = 500 \text{ mm}$ (expressions acc. to NA:2013-08, NCI NA.6.7 figure NA.7)
 $f_{m,k} = 28.00 \text{ N/mm}^2$, $f_{t,k} = 22.30 \text{ N/mm}^2$, $f_{c,k} = 28.00 \text{ N/mm}^2$, $f_{v,k} = 3.50 \text{ N/mm}^2$, $f_{t90,k} = 0.50 \text{ N/mm}^2$
 filleting of opening edges with $r \geq 15 \text{ mm}$ $r \geq \#\#\# \text{ mm}$
 $f_{m,k}$ increased with $k_h = 1.000$

elevation scale 1:150, unit of length [mm]



1.3. internal forces and moments

Nr.	name	left edge			right edge			KLED	k _{mod}	γ
		N _d kN	V _d kN	M _d kNm	N _d kN	V _d kN	M _d kNm			
1	g+t+s	0.00	100.00	-250.00	0.00	100.00	-200.00	sh.-term	0.900	1.30

2. results

2.1. tension stress perpendicular to grain in opening area

$h_r = 560 \text{ mm}$, $l_{t,90} = 815 \text{ mm}$, $f_{t,90k} = 0.500 \text{ N/mm}^2$

Nr	f _{t90,d} N/mm ²	zul	F _{t90,d} kN	left edge				right edge				u
				F _{tv,d} kN	F _{tM,d} kN	F _{t90,d} kN	u _l	F _{tv,d} kN	F _{tM,d} kN	F _{t90,d} kN	u _r	
1	0.346		15.716	9.26	3.57	12.83	0.817	9.26	2.86	12.12	0.771	0.817

$u_{max} = 0.817 \leq 1 \Rightarrow \text{ok.}$

2.2. bending at the opening area cross-section

$I_{nz} = 5048202 \text{ cm}^4$, $z_s = 736 \text{ mm}$, $W_{no} = 68624 \text{ cm}^3$, $W_{nu} = 70666 \text{ cm}^3$, $W_o = 10453 \text{ cm}^3$, $W_u = 16803 \text{ cm}^3$

Nr	$f_{m,d}$ N/mm ²	$f_{t,d}$ N/mm ²	$f_{c,d}$ N/mm ²	$\sigma_{N,d}$ N/mm ²	$\sigma_{M,o,d}$ N/mm ²	$\sigma_{M,u,d}$ N/mm ²	$\Delta\sigma_{M,o,d}$ N/mm ²	$\Delta\sigma_{M,u,d}$ N/mm ²	$\sigma_{u,d}$ N/mm ²	$\sigma_{o,d}$ N/mm ²	$u_{o,d}$ -	$u_{u,d}$ -	u -
1	19.38	15.44	19.38	0.000	3.279	-3.184	1.055	-0.832	4.333	-4.016	0.224	0.207	0.224

$u_{max} = 0.224 \leq 1 \Rightarrow \text{ok.}$

2.3. shear at the reduced cross section

beam width = 200 mm, beam height = 1270 mm, $k_{cr} = 0.714 \Rightarrow A_{ef} = 181429 \text{ mm}^2$, $\kappa_{max} = 1.630$

Nr	$f_{v,d}$ N/mm ²	left edge			right edge			u -
		V_d kN	$\tau_{m,d}$ N/mm ²	u -	V_d kN	$\tau_{m,d}$ N/mm ²	u -	
1	2.42	100.00	1.348	0.556	100.00	1.348	0.556	0.556

$u_{max} = 0.556 \leq 1 \Rightarrow \text{ok.}$

3. Summary

total utilization all verifications $u_{max,Ges} = 0.817 \leq 1 \Rightarrow \text{ok.}$