POSITION 80: BODDENBERG III, T1, S.26 RECTANGLE BRACKET

4H-HLZ79 Version: 2/2017-1d

1. Input parameters

1.1. girder opening rectangular with glued on reinforcements acc. to DIN EN 1995-1-1/NA:2013-08, NCI NA.6.8.4

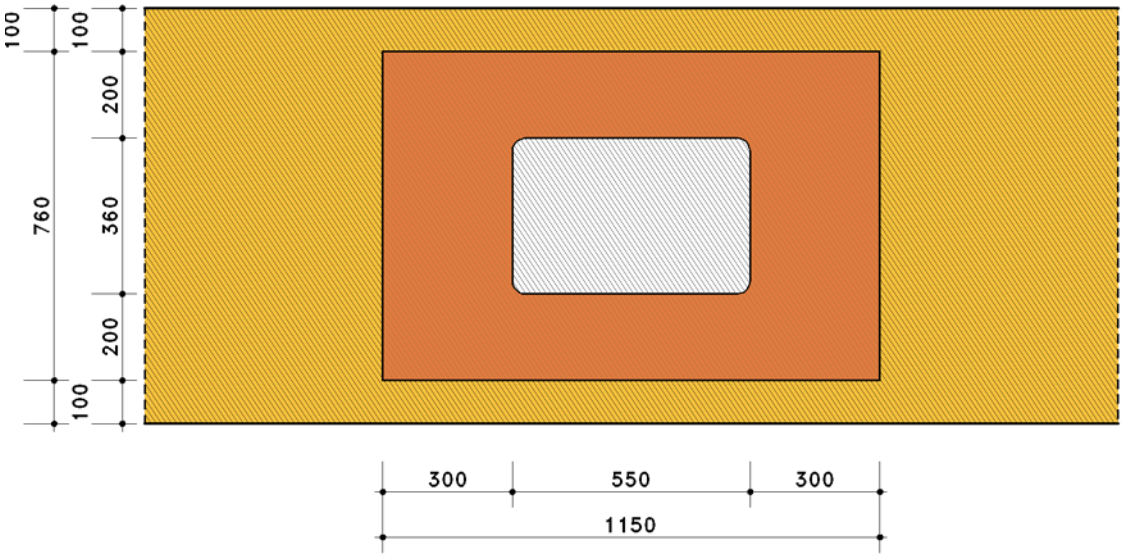
1.2. beam

beam of glue laminated timber EC, GL24h **200/960 mm**, ρ_k = 385 kg/m³, NKL 1
h_{ro} = 300 mm, h_{ru} = 300 mm, a = 550 mm (expressions acc. to NA:2013-08, NCI NA.6.7 figure NA.7)
$f_{m,k}$ = 24.00 N/mm², $f_{t,k}$ = 19.20 N/mm², $f_{c,k}$ = 24.00 N/mm², $f_{v,k}$ = 3.50 N/mm², $f_{t90,k}$ = 0.50 N/mm²
filleting of opening edeges with r ≥ 15 mm r ≥ ### mm
$f_{m,k}$ increased with k_h = 1.000

1.3. reinforcement by glued lugs

plywood F40/30 a_r = 300 mm, h_l = 200 mm, t_r = 12 mm, $f_{t,k}$ = 29.00 N/mm² parallel to the grain direction of the fac

elevation scale 1:175, unit of length [mm]



1.4. internal forces and moments

Nr.	name	left edge N_d kN	left edge V_d kN	left edge M_d kNm	right edge N_d kN	right edge V_d kN	right edge M_d kNm	KLED	k_{mod} -	γ -
1	g+w+s	0.00	0.00	924.80	0.00	88.00	900.60	med.-term	0.800	1.30

2. results

2.1. tension stress perpendicular to grain in opening area

$f_{k2,k}$ = 0.75 N/mm² (table NA.12)

left edge

Nr	$f_{t90,d}$ N/mm²	$f_{k2,d}$ N/mm²	$f_{t,d}$ N/mm²	$F_{tV,d}$ kN	$F_{tM,d}$ kN	$F_{t90,d}$ kN	$\tau_{ef,d}$ N/mm²	$\sigma_{t,d}$ N/mm²	$u_{\tau ef,d}$ -	$u_{\sigma,d}$ -	u_l -
1	0.308	0.462	17.85	0.00	24.66	24.66	0.206	3.43	0.445	0.384	0.445

right edge

Nr	$f_{t90,d}$ N/mm²	$f_{k2,d}$ N/mm²	$f_{t,d}$ N/mm²	$F_{tV,d}$ kN	$F_{tM,d}$ kN	$F_{t90,d}$ kN	$\tau_{ef,d}$ N/mm²	$\sigma_{t,d}$ N/mm²	$u_{\tau ef,d}$ -	$u_{\sigma,d}$ -	u_r kN	u -
1	0.308	0.462	17.85	23.59	24.02	47.61	0.397	6.61	0.860	0.741	0.860	0.860

u_{max} = 0.860 ≤ 1 ⇒ ok.

2.2. bending at the opening area cross-section

I_{nz} = 1396800 cm⁴, z_s = 480 mm, W_{no} = 29100 cm³, W_{nu} = 29100 cm³, W_o = 3000 cm³, W_u = 3000 cm³

Nr	$f_{m,d}$ N/mm²	$f_{t,d}$ N/mm²	$f_{c,d}$ N/mm²	$\sigma_{N,d}$ N/mm²	$\sigma_{M,o,d}$ N/mm²	$\sigma_{M,u,d}$ N/mm²	$\Delta\sigma_{M,o,d}$ N/mm²	$\Delta\sigma_{M,u,d}$ N/mm²	$\sigma_{u,d}$ N/mm²	$\sigma_{o,d}$ N/mm²	$u_{o,d}$ -	$u_{u,d}$ -	u -
1	14.77	11.82	14.77	0.000	-31.364	31.364	-2.017	2.017	-33.38	33.381	2.260	2.260	2.260

u_{max} = 2.260 > 1 ⇒ not ok. !!

2.3. shear at the reduced cross section

beam width = 200 mm, beam height = 600 mm, k_{cr} = 0.714 ⇒ A_{ef} = 85714 mm², κ_{max} = 2.379

Nr	$f_{v,d}$	left edge			right edge			
		V_d	$\tau_{m,d}$	u	V_d	$\tau_{m,d}$	u	u
	N/mm²	kN	N/mm²	-	kN	N/mm²	-	-
1	2.15	0.00	0.000	0.000	88.00	3.663	1.701	1.701

u_{max} = 1.701 > 1 ⇒ not ok. !!

3. Summary

total utilization all verifications $u_{max,Ges}$ = 2.260 > 1 ⇒ not ok. !!