

POSITION 31: RAUTENSTRAUCH S. 316B

1. Input parameters

2. General statements

double shear plane connection, simplified verification acc. to NA.8.2.4
crossing angle $\delta = 180.0^\circ$

3. materials

3.1. outer timber members

NKL 1, solid coniferous timber C30, $\rho_k = 380 \text{ kg/m}^3$, $t/b = 60.0/160.0 \text{ mm}$
angle between force and the grain direction $\alpha = 0.0^\circ$
bar on one side left with overhang $\bar{u}_{\text{right}} = 190.0 \text{ mm}$ (measured from the node)

3.2. centre plate

steel plate S235 (St37), $t = 3.0 \text{ mm}$, steel plate acc. to NA 8.2.5
bar on one side right with overhang $\bar{u}_{\text{left}} = 120.0 \text{ mm}$ (measured from the node)

4. fasteners

dowel 6 mm, S235 (1052)

$F_{v,Rk}$ increased acc. to DIN EN 1995, 8.2.2(2)

R_k is increased acc. to DIN EN 1995, 9.2.4.2 (5)

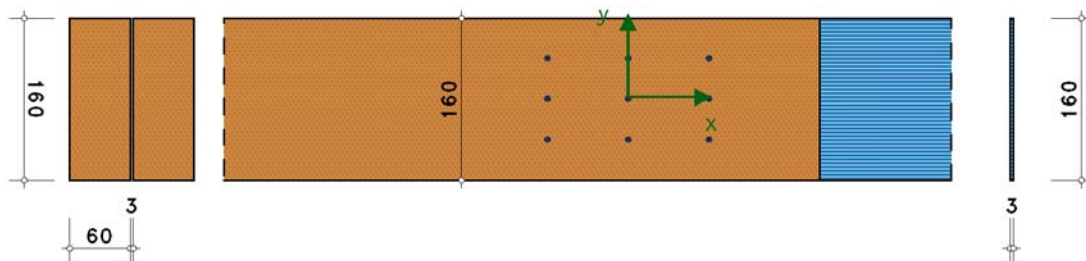
applies to panels with shear-resistant panel edges on all sides

4.1. load combinations (design internal forces)

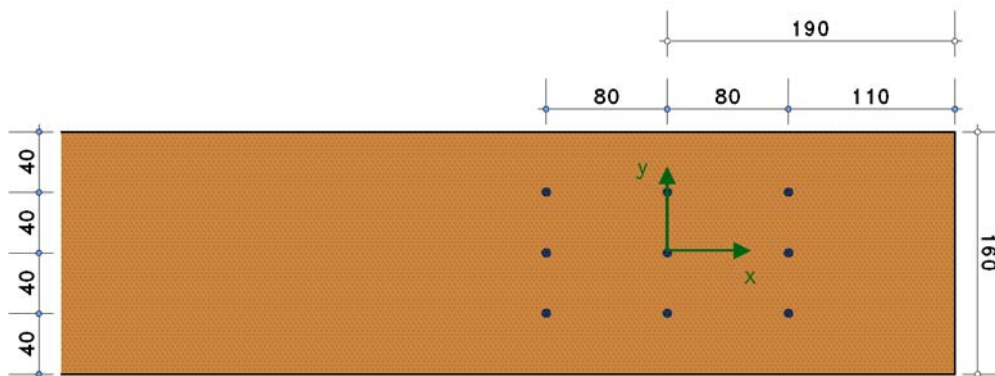
4.1.1. load, KLED: short-term

Nr	bar	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	outer t.memb. left	15.530	0.000	0.000	0.900	1.30
2	ctr. t.mem. right	15.530	0.000	0.000	0.900	1.30
3	$\Sigma H, \Sigma M, \Sigma V$	0.000	0.000	0.000	---	---

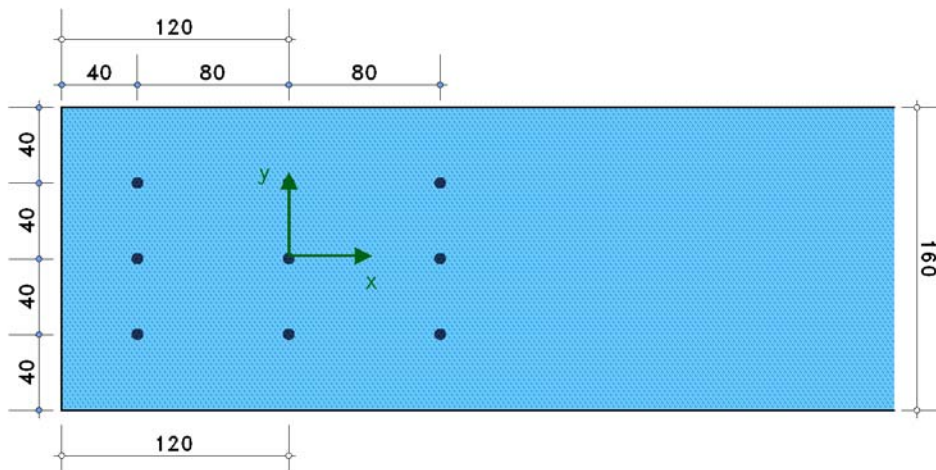
5. view



6. view outer timber members



7. view centre plate



8. Results only decisive load case combination

8.1. Results fasteners

8.2. fasteners

8.2.1. load

$N_d = 15.530 \text{ kN}$, $V_d = 0.000 \text{ kN}$, $M_{v,d} = 0.000 \text{ kNm}$

forces per connection centre point ($f_{red} = t_{vorh} / t_{req}$)

Nr	F_{M1} kN	F_{MH1} kN	F_{MV1} kN	F_{totH1} kN	F_{totV1} kN	F_{tot1} kN	α_{tot1} °	$f_{h,\alpha,k}$ N/mm ²	f_{red} -	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	0.000	0.000	-0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
2	0.000	0.000	-0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
3	0.000	-0.000	-0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
4	0.000	0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
5	0.000	0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
6	0.000	-0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
7	0.000	0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
8	0.000	0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37
9	0.000	-0.000	0.000	1.726	0.000	1.726	0.0	29.29	1.000	4.6308	0.41	0.37

maximum utilisation of the fasteners $U_{max} = 0.41 \leq 1 \Rightarrow$ **verification fulfilled**

8.3. results bars

8.3.1. outer timber member mit $A_n = 17040 \text{ mm}^2$, $W_n = 483119 \text{ mm}^3$, $I_n = 38649520 \text{ mm}^4$, $k_h = 1.000$

dimensioning as tension joint acc. to NCI NA.8.1.6 (NA.1) (red. of tensile load-bear. cap. by one third)

load	$f_{m,d}$ N/mm ²	$f_{t,d}$ N/mm ²	$f_{c,d}$ N/mm ²	$f_{v,d}$ N/mm ²	N_d kN	M_d kNm	$\sigma_{0,d}$ N/mm ²	$\sigma_{m0,d}$ N/mm ²	$\sigma_{m1,d}$ N/mm ²	V_d kN	τ_d N/mm ²	U_σ -	U_τ -
1	20.77	5.26	16.62	2.77	15.530	0.000	0.91	0.00	0.00	0.000	0.00	0.17	0.00

maximum utilisation of the bar $U_{max} = 0.17 \leq 1 \Rightarrow$ **verification fulfilled**

8.3.2. central timber member mit $A_n = 426 \text{ mm}^2$, $W_n = 12078 \text{ mm}^3$, $I_n = 966238 \text{ mm}^4$, $k_h = 0.000$

load	$f_{y,d}$ N/mm ²	$f_{v,d}$ N/mm ²	N_d kN	M_d kNm	$\sigma_{y,d}$ N/mm ²	V_d kN	$\tau_{v,d}$ N/mm ²	$\sigma_{sv,d}$ N/mm ²	$U_{\sigma sv}$ -	U_σ -	U_τ -
1	235.00	135.68	15.530	0.000	36.46	0.000	0.00	36.46	0.16	0.16	0.00

maximum utilisation of the bar $U_{max} = 0.16 \leq 1 \Rightarrow$ **verification fulfilled**

8.4. Punched hole forces

$p_1 = 80 \text{ mm}$, $e_1 = 40 \text{ mm}$, $e_2 = 40 \text{ mm}$, $p_2 = 40.00 \text{ mm}$, $\alpha_b = 1.00$, $k_1 = 2.50 \Rightarrow F_{b,Rk} = 16.20 \text{ kN}$

$e_1 = 40 \text{ mm}$, $e_2 = 40 \text{ mm}$, $p_2 = 40 \text{ mm}$, $\alpha_b = 1.00$, $k_1 = 2.50 \Rightarrow F_{b,Rk,Rand} = 16.20 \text{ kN}$

8.4.1. load

Nr	F_{tot1} kN	$F_{v,Rd}$ kN	U -	Nr	F_{tot1} kN	$F_{v,Rd}$ kN	U -	Nr	F_{tot1} kN	$F_{v,Rd}$ kN	U -
1	1.73	12.96	0.13	4	1.73	12.96	0.13	7	1.73	12.96	0.13
2	1.73	12.96	0.13	5	1.73	12.96	0.13	8	1.73	12.96	0.13
3	1.73	12.96	0.13	6	1.73	12.96	0.13	9	1.73	12.96	0.13

maximum utilisation of the punched hole forces $U_{max} = 0.13 \leq 1 \Rightarrow$ **verification fulfilled**

8.5. verification of block shear failure acc. to DIN EN 1995-1-1, annex A

$L_{net,t} = 80 \text{ mm}$, $t_1 = 60 \text{ mm} \Rightarrow A_{net,t} = 4800 \text{ mm}^2$, $M_{y,k} = 11392.4 \text{ Nmm}$

$L_{net,v} = 540 \text{ mm}$, $t_{ef} = 60 \text{ mm} \Rightarrow A_{net,v} = 32400 \text{ mm}^2$ (failure mechanism c,f,j/l,k,m)

$L_{net,v} = 540 \text{ mm} \Rightarrow A_{net,v} = 32400 \text{ mm}^2 \Rightarrow F_{bs,Rk} = 136.80 \text{ kN}$

8.5.1. load

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	15.530	94.708	0.16

maximum utilisation block shear failure $U_{max} = 0.16 \leq 1 \Rightarrow$ **verification fulfilled**