

POSITION 10: BODDENBERG II, ÜBUNG 2.2 STÜTZE

1. Input parameters

2. General statements

double shear plane connection, exact verification acc. to DIN EN 1995, 8.2.2
crossing angle $\delta = 90.0^\circ$

3. materials

3.1. outer timber members

NKL 1, glue laminated timber EC GL24h, $\rho_k = 385 \text{ kg/m}^3$, $t/b = 80.0/160.0 \text{ mm}$
angle between force and the grain direction $\alpha = 0.0^\circ$
bar continuous to the left and right

3.2. centre plate

steel plate S235 (St37), $t = 10.0 \text{ mm}$, steel plate acc. to NA 8.2.5
bar on one side left with overhang $\bar{u}_{\text{right}} = 120.0 \text{ mm}$ (measured from the node)

4. fasteners

dowel 16 mm, S235 (1052)

coordinates of the fasteners (origin in the node, x to the right, y upwards)

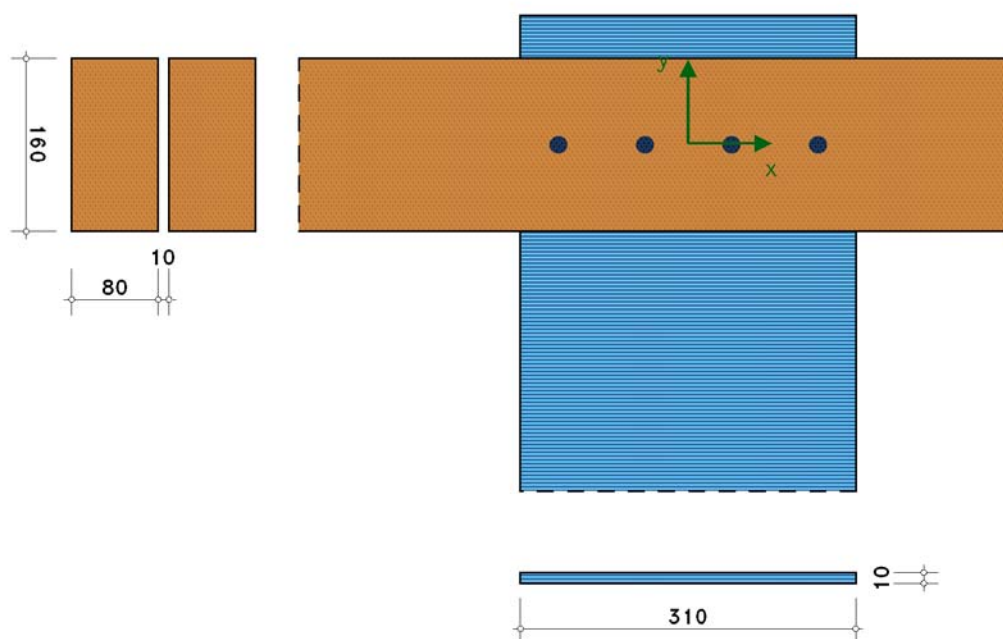
Nr	x_k mm	y_k mm
1	-120.0	0.0
2	-40.0	0.0
3	40.0	0.0
4	120.0	0.0

4.1. load combinations (design internal forces)

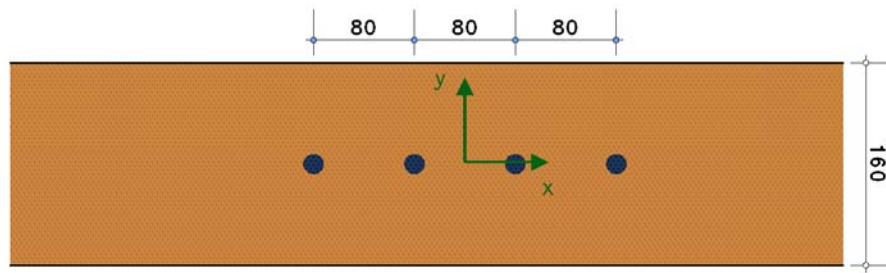
4.1.1. load, KLED: medium-term

Nr	bar	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	outer t.memb. left	-26.000	0.000	0.000	0.800	1.30
2	out. t. memb. right	0.000	0.000	0.000	0.800	1.30
3	ctr. t.mem. left	0.000	0.000	26.000	0.800	1.30
4	$\Sigma H, \Sigma M, \Sigma V$	-0.000	0.000	0.000	---	---

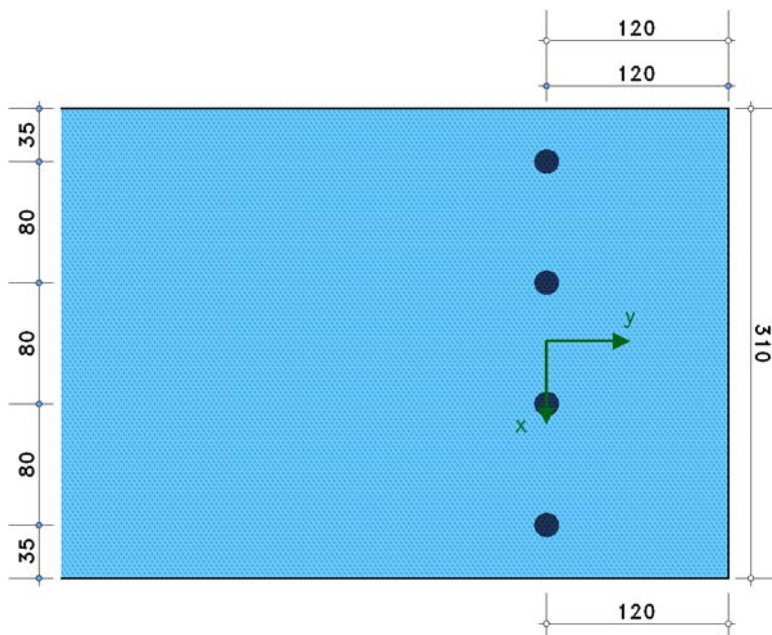
5. view



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

$N_d = -0.000$ kN, $V_d = -26.000$ kN, $M_{v,d} = 0.000$ KNm

forces per connection centre point, case = decisive failure case acc. to DIN EN 1995-1-1, 8.2.2

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	case	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	0.000	0.000	-0.000	-0.000	-6.500	6.500	-90.0	26.52	G1.(g)	20.3987	0.46	0.32
2	0.000	0.000	-0.000	-0.000	-6.500	6.500	-90.0	26.52	G1.(g)	20.3987	0.46	0.32
3	0.000	0.000	0.000	-0.000	-6.500	6.500	-90.0	26.52	G1.(g)	20.3987	0.46	0.32
4	0.000	0.000	0.000	-0.000	-6.500	6.500	-90.0	26.52	G1.(g)	20.3987	0.46	0.32

maximum utilisation of the fasteners $U_{max} = 0.46 \leq 1 \Rightarrow$ verification fulfilled

8.3. results bars

8.3.1. outer timber member mit $A_n = 23040$ mm², $W_n = 681984$ mm³, $I_n = 54558720$ mm⁴, $k_n = 1.100$

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	$\sigma_{mu,d}$ N/mm ²	V_d kN	τ_d N/mm ²	U_σ -	U_τ -
1	16.25	13.00	14.77	2.15	-26.000	0.000	-1.13	0.00	0.00	0.000	0.00	0.01	0.00

maximum utilisation of the bar $U_{max} = 0.01 \leq 1 \Rightarrow$ verification fulfilled

8.3.2. outer timber member mit $A_n = 23040 \text{ mm}^2$, $W_n = 681984 \text{ mm}^3$, $I_n = 54558720 \text{ mm}^4$, $k_h = 1.100$

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	$\sigma_{mu,d}$ N/mm ²	V_d kN	τ_d N/mm ²	U_σ -	U_τ -
1	16.25	13.00	14.77	2.15	0.000	0.000	0.00	0.00	0.00	0.000	0.00	0.00	0.00

maximum utilisation of the bar $U_{\max} = 0.00 \leq 1 \Rightarrow$ **verification fulfilled**

8.3.3. central timber member mit $A_n = 2460 \text{ mm}^2$, $W_n = 127046 \text{ mm}^3$, $I_n = 19692180 \text{ mm}^4$, $k_h = 0.000$

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	0.000	0.000	0.00	26.000	15.85	27.46	0.12	0.00	0.12

maximum utilisation of the bar $U_{\max} = 0.12 \leq 1 \Rightarrow$ **verification fulfilled**

8.4. Punched hole forces

$p_1 = 100 \text{ mm}$, $e_1 = 35 \text{ mm}$, $e_2 = 35 \text{ mm}$, $p_2 = 80.00 \text{ mm}$, $\alpha_b = 1.00$, $k_1 = 2.50 \Rightarrow F_{b,Rk} = 144.00 \text{ kN}$

$e_1 = 35 \text{ mm}$, $e_2 = 35 \text{ mm}$, $p_2 = 80 \text{ mm}$, $\alpha_b = 0.73$, $k_1 = 2.50 \Rightarrow F_{b,Rk,Rand} = 105.00 \text{ kN}$

8.4.1. load

Nr	F_{tot1} kN	$F_{v,Rd}$ kN	U -
1	6.50	84.00	0.08
2	6.50	84.00	0.08
3	6.50	84.00	0.08
4	6.50	84.00	0.08

maximum utilisation of the punched hole forces $U_{\max} = 0.08 \leq 1 \Rightarrow$ **verification fulfilled**