

POSITION 8: BODDENBERG II, ÜBUNG 2.2 TRÄGER

1. Input parameters

2. General statements

double shear plane connection, exact verification acc. to DIN EN 1995, 8.2.2
crossing angle $\delta = 180.0^\circ$

3. materials

3.1. outer timber members

NKL 1, glue laminated timber EC GL24h, $\rho_k = 385 \text{ kg/m}^3$, $t/b = 80.0/380.0 \text{ mm}$
angle between force and the grain direction $\alpha = 0.0^\circ$
bar on one side left with overhang $\bar{u}_{\text{right}} = 170.0 \text{ mm}$ (measured from the node)

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 right with overhang $\bar{u}_{\text{left}} = 285.0 \text{ mm}$ (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)

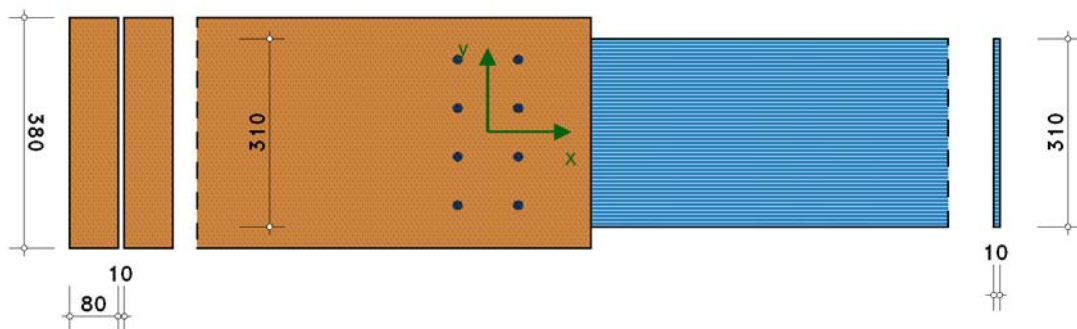
Nr	x _k mm	y _k mm	Nr	x _k mm	y _k mm
1	-50.0	120.0	5	50.0	120.0
2	-50.0	40.0	6	50.0	40.0
3	-50.0	-40.0	7	50.0	-40.0
4	-50.0	-120.0	8	50.0	-120.0

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.mem. left	0.000	-6.500	26.000	0.800	1.30
2	ctr. t.mem. right	0.000	6.500	26.000	0.000	1.30
3	$\Sigma H, \Sigma M, \Sigma V$	-0.000	0.000	0.000	---	---

5. view



6. Results only decisive load case combination

6.1. Results fasteners

6.2. fasteners

6.2.1. load

$N_d = -0.000 \text{ kN}$, $V_d = 26.000 \text{ kN}$, $M_{v,d} = -6.500 \text{ kNm}$

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,α,k} N/mm ²	case	F _{v,Rd} kN	U _{n,ef} -	U _{F,v} -
1	-10.060	-9.286	3.869	-9.286	7.119	11.701	142.5	21.77	G1.(g)	17.2800	0.62	0.68
2	-4.955	-3.095	3.869	-3.095	7.119	7.763	113.5	17.72	G1.(g)	14.6224	0.22	0.53
3	-4.955	3.095	3.869	3.095	7.119	7.763	66.5	17.72	G1.(g)	14.6224	0.22	0.53
4	-10.060	9.286	3.869	9.286	7.119	11.701	37.5	21.77	G1.(g)	17.2800	0.62	0.68

Nr	F _{Mi} kN	F _{MHi} kN	F _{MVi} kN	F _{totHi} kN	F _{totVi} kN	F _{toti} kN	α _{toti} °	f _{h,α,k} N/mm ²	case	F _{v,Rd} kN	U _{n,ef} -	U _{F,v} -
5	-10.060	-9.286	-3.869	-9.286	-0.619	9.306	-176.2	26.45	G1.(g)	20.3534	0.58	0.46
6	-4.955	-3.095	-3.869	-3.095	-0.619	3.157	-168.7	25.93	G1.(g)	20.0130	0.19	0.16
7	-4.955	3.095	-3.869	3.095	-0.619	3.157	-11.3	25.93	G1.(g)	20.0130	0.19	0.16
8	-10.060	9.286	-3.869	9.286	-0.619	9.306	-3.8	26.45	G1.(g)	20.3534	0.58	0.46

maximum utilisation of the fasteners $U_{\max} = 0.68 \leq 1 \Rightarrow$ **verification fulfilled**

6.3. results bars

6.3.1. outer timber member mit $A_n = 50560 \text{ mm}^2$, $W_n = 3418359 \text{ mm}^3$, $I_n = 649488213 \text{ mm}^4$, $k_h = 1.047$

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	σ _{0,d} N/mm ²	σ _{mo,d} N/mm ²	σ _{mu,d} N/mm ²	V _d kN	τ _d N/mm ²	U _σ -	U _τ -
1	15.46	12.37	14.77	2.15	0.000	-6.500	0.00	-1.90	-1.90	28.476	1.48	0.12	0.69

maximum utilisation of the bar $U_{\max} = 0.69 \leq 1 \Rightarrow$ **verification fulfilled**

6.3.2. 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	σ _{y,d} N/mm ²	V _d kN	τ _{v,d} N/mm ²	σ _{sv,d} N/mm ²	U _{σsv} -	U _σ -	U _τ -
1	235.00	135.68	0.000	6.500	51.16	28.476	17.36	59.35	0.25	0.22	0.13

maximum utilisation of the bar $U_{\max} = 0.25 \leq 1 \Rightarrow$ **verification fulfilled**

6.4. Punched hole forces

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

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

6.4.1. load

Nr	F _{toti} kN	F _{v,Rd} kN	U	Nr	F _{toti} kN	F _{v,Rd} kN	U
1	11.70	84.00	0.14	5	9.31	84.00	0.11
2	7.76	84.00	0.09	6	3.16	115.20	0.03
3	7.76	84.00	0.09	7	3.16	115.20	0.03
4	11.70	84.00	0.14	8	9.31	84.00	0.11

maximum utilisation of the punched hole forces $U_{\max} = 0.14 \leq 1 \Rightarrow$ **verification fulfilled**

6.5. Nachweis block shearversagen acc. to DIN EN 1995-1-1, annex A

$L_{net,t} = 240 \text{ mm}$, $t_1 = 80 \text{ mm} \Rightarrow A_{net,t} = 19200 \text{ mm}^2$, $M_{y,k} = 145927.0 \text{ Nmm}$

$L_{net,v} = 440 \text{ mm}$, $t_{ef} = 80 \text{ mm} \Rightarrow A_{net,v} = 35200 \text{ mm}^2$ (Versagensmechanismus c,f,j/l,k,m)

$L_{net,v} = 440 \text{ mm} \Rightarrow A_{net,v} = 35200 \text{ mm}^2 \Rightarrow F_{bs,Rk} = 578.80 \text{ kN}$

6.5.1. load

load	N _d kN	F _{bs,Rd} kN	U _{bs} -
1	0.000	356.186	0.00

Maximale Ausnutzung block shearversagen $U_{\max} = 0.00 \leq 1 \Rightarrow$ **verification fulfilled**