1. Input parameters

2. General statements

double shear plane connection, exact verification acc. to DIN EN 1995, 8.2.2
crossing angle δ = 180.0 °

3. materials

3.1. outer timber members

NKL 1, glue laminated timber EC GL24h, ρ_k = 385 kg/m³, t/b = 85.0/220.0 mm
angle between force and the grain direction α = 0.0 °
bar on one side right with overhang $ü_{left}$ = 210.0mm (measured from the node)

3.2. centre plate

steel plate S235 (St37), t = 10.0 mm, steel plate acc. to NA 8.2.5
bar on one side left with overhang $ü_{right}$ = 165.0mm (measured from the node)

4. fasteners

dowel 12 mm, S235 (1052)
coordinates of the fasteners (origin in the node, x to the right, y upwards)

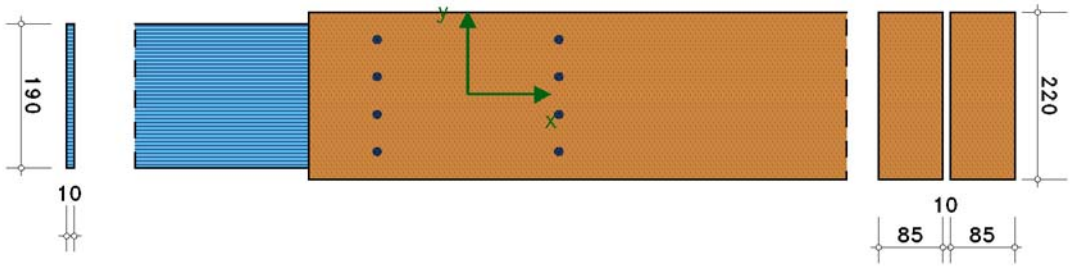
Nr	x_k mm	y_k mm	Nr	x_k mm	y_k mm
1	-120.0	73.5	5	120.0	73.5
2	-120.0	24.5	6	120.0	24.5
3	-120.0	-24.5	7	120.0	-24.5
4	-120.0	-73.5	8	120.0	-73.5

4.1. load combinations (design internal forces)

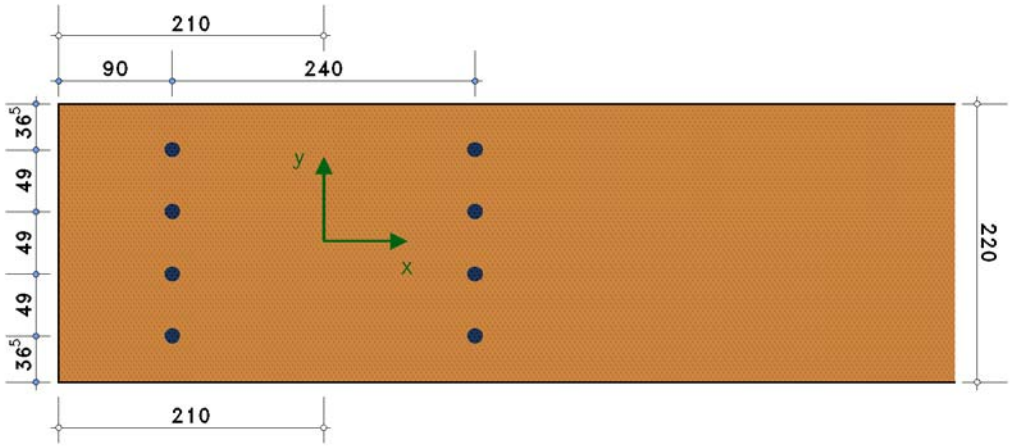
4.1.1. load, KLED: permanent

Nr	bar	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	out. t. memb. right	0.000	6.800	4.000	0.600	1.30
2	ctr. t.mem. left	0.000	-6.800	4.000	0.000	1.30
3	ΣH, ΣM, ΣV	-0.000	0.000	0.000	---	---

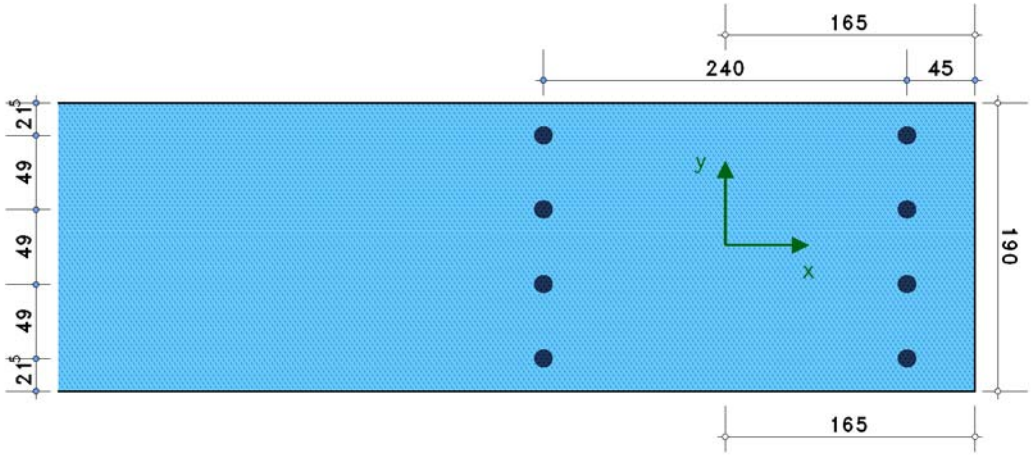
5. view



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 = -4.000 kN, $M_{v,d}$ = 6.800 KNm

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

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$f_{h,\alpha,k}$ N/mm²	case	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	6.874	3.590	-5.862	3.590	-6.362	7.305	-60.6	19.82	Gl.(h)	8.6042	0.42	0.85
2	5.983	1.197	-5.862	1.197	-6.362	6.473	-79.3	18.38	Gl.(g)	8.2051	0.15	0.79
3	5.983	-1.197	-5.862	-1.197	-6.362	6.473	-100.7	18.38	Gl.(g)	8.2051	0.15	0.79
4	6.874	-3.590	-5.862	-3.590	-6.362	7.305	-119.4	19.82	Gl.(h)	8.6042	0.42	0.85
5	6.874	3.590	5.862	3.590	5.362	6.453	56.2	20.34	Gl.(h)	8.7170	0.41	0.74
6	5.983	1.197	5.862	1.197	5.362	5.494	77.4	18.46	Gl.(g)	8.2387	0.15	0.67
7	5.983	-1.197	5.862	-1.197	5.362	5.494	102.6	18.46	Gl.(g)	8.2387	0.15	0.67
8	6.874	-3.590	5.862	-3.590	5.362	6.453	123.8	20.34	Gl.(h)	8.7170	0.41	0.74

maximum utilisation of the fasteners U_{max} = 0.85 ≤ 1 => **verification fulfilled**

8.3. results bars

8.3.1. outer timber member mit A_n = 29240 mm², W_n = 1147805 mm³, I_n = 126258547 mm⁴, k_h = 1.100

load	$f_{m,d}$ N/mm²	$f_{t,d}$ N/mm²	$f_{c,d}$ N/mm²	$f_{v,d}$ N/mm²	N_d kN	M_d kNm	$\sigma_{0,d}$ N/mm²	$\sigma_{mo,d}$ N/mm²	$\sigma_{mu,d}$ N/mm²	V_d kN	τ_d N/mm²	U_σ -	U_τ -
1	12.18	9.75	11.08	1.62	0.000	6.800	0.00	5.92	5.92	25.447	2.28	0.49	1.41

maximum utilisation of the bar U_{max} = 1.41 > 1 => **verification not fulfilled** !!

8.3.2. central timber member mit A_n = 1420 mm², W_n = 44942 mm³, I_n = 4269473 mm⁴, k_h = 0.000

load	$f_{y,d}$ N/mm²	$f_{v,d}$ N/mm²	N_d kN	M_d kNm	$\sigma_{y,d}$ N/mm²	V_d kN	$\tau_{v,d}$ N/mm²	$\sigma_{sv,d}$ N/mm²	$U_{\sigma sv}$ -	U_σ -	U_τ -
1	235.00	135.68	0.000	-6.800	-151.31	25.447	26.88	158.31	0.67	0.64	0.20

maximum utilisation of the bar U_{max} = 0.67 ≤ 1 => **verification fulfilled**

8.4. Punched hole forces

p_1 = 240 mm, e_1 = 22 mm, e_2 = 22 mm, p_2 = 49.00 mm, α_b = 1.00, k_1 = 2.50 => $F_{b,Rk}$ = 108.00 kN
e_1 = 22 mm, e_2 = 22 mm, p_2 = 49 mm, α_b = 0.60, k_1 = 2.50 => $F_{b,Rk,Rand}$ = 64.50 kN

8.4.1. load

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	7.30	51.60	0.14	5	6.45	51.60	0.13
2	6.47	51.60	0.13	6	5.49	86.40	0.06
3	6.47	51.60	0.13	7	5.49	86.40	0.06
4	7.30	51.60	0.14	8	6.45	51.60	0.13

maximum utilisation of the punched hole forces U_{max} = 0.14 ≤ 1 => **verification fulfilled**

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

$L_{net,t}$ = 147 mm, t_1 = 85 mm ⇒ $A_{net,t}$ = 12495 mm², $M_{y,k}$ = 69070.9 Nmm
$L_{net,v}$ = 660 mm, t_{ef} = 85 mm ⇒ $A_{net,v}$ = 56100 mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v}$ = 660 mm ⇒ $A_{net,v}$ = 56100 mm² ⇒ $F_{bs,Rk}$ = 395.84 kN

8.5.1. load

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	0.000	182.696	0.00

maximum utilisation block shear failure U_{max} = 0.00 ≤ 1 => **verification fulfilled**