POSITION 65: BLOCK SHEAR 1

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. steel plate

steel plate S235 (St37), t = 5.0 mm, b = 140 mm, thick plate
bar on one side right with overhang $ü_{left}$ = 110.0mm (measured from the node)

3.2. central timber member

NKL 1, solid coniferous timber C16, ρ_k = 310 kg/m³, t/b = 200.0/200.0 mm
bar on one side left with overhang $ü_{right}$ = 100.0mm (measured from the node)

4. fasteners

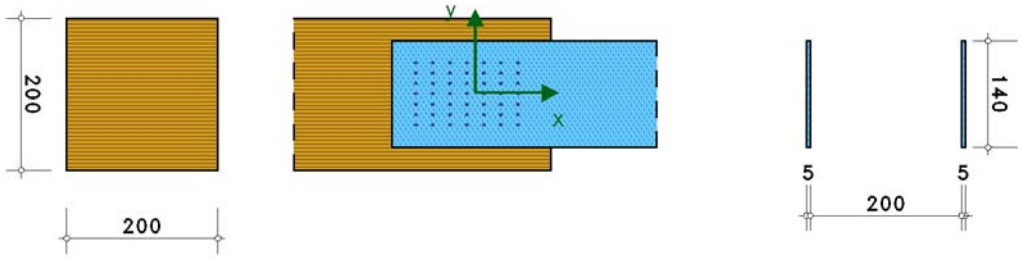
HECO Topix plus Senkkopf Fräst. Teilgewinde, 4.5 x 30.0 mm, d_k = 8.9 mm, l_{ef} = 18.0 mm
screwing angle β = 90.0 °
made of carbon steel, predrilled
double-sided arrangement
$F_{v,Rk}$ increased acc. to DIN EN 1995, 8.2.3(4)

4.1. load combinations (design internal forces)

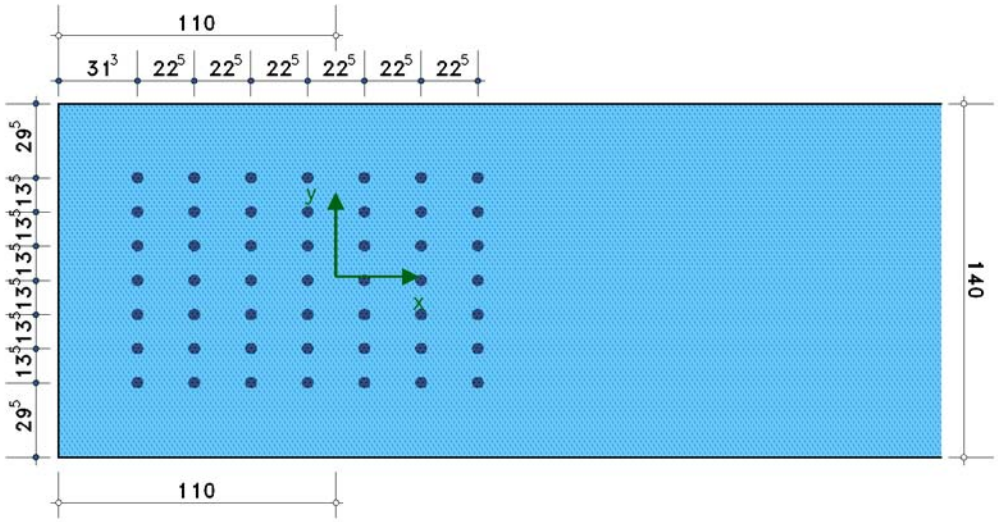
4.1.1. load, KLED: medium-term

Nr	bar	N_d kN	M_d kNm	V_d kN	k_{mod} -	γ -
1	out. t. memb. right	30.000	0.000	0.000	0.000	1.30
2	ctr. t.mem. left	30.000	0.000	-0.000	0.800	1.30
3	ΣH, ΣM, ΣV	0.000	0.000	0.000	---	---

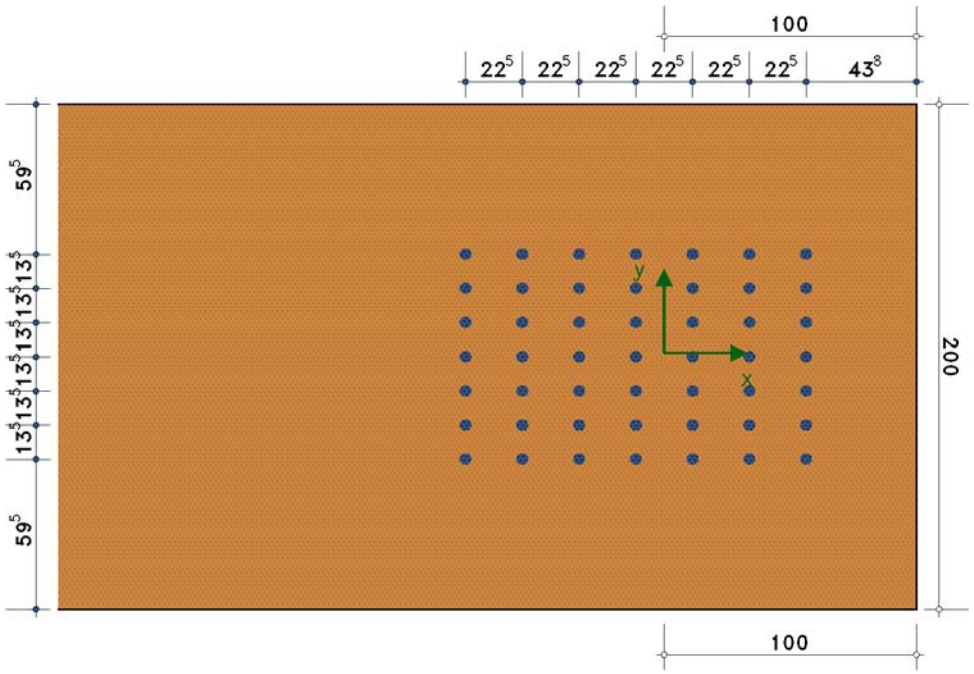
5. view



6. view side plates



7. view central timber member



8. Results only decisive load case combination

8.1. Results fasteners

8.2. fasteners

8.2.1. load

N_d = -30.000 kN, V_d = 0.000 kN, $M_{v,d}$ = 0.000 KNm

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
1	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
2	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
3	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
4	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
5	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
6	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
7	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
8	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
9	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
10	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
11	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
12	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
13	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
14	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
15	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
16	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
17	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
18	0.000	0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
19	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
20	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
21	0.000	-0.000	-0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
22	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
23	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
24	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
25	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
26	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
27	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
28	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
29	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
30	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
31	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
32	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
33	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
34	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
35	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rd}$ kN	$U_{n,ef}$ -	$U_{F,v}$ -
36	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
37	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
38	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
39	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
40	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
41	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
42	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
43	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
44	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
45	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
46	0.000	0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
47	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
48	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36
49	0.000	-0.000	0.000	-0.612	0.000	0.612	180.0	1.6895	0.84	0.36

maximum utilisation of the fasteners $U_{max} = 0.84 \leq 1$ => **verification fulfilled**

8.3. results bars

8.3.1. outer timber member mit $A_n = 1400$ mm², $W_n = 32667$ mm³, $I_n = 2286667$ 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	30.000	0.000	21.43	0.000	0.00	21.43	0.09	0.09	0.00

maximum utilisation of the bar $U_{max} = 0.09 \leq 1$ => **verification fulfilled**

8.3.2. central timber member mit $A_n = 36850$ mm², $W_n = 1310317$ mm³, $I_n = 131031668$ mm⁴, $k_h = 1.000$

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	9.85	5.23	10.46	1.97	30.000	0.000	0.81	0.00	0.00	0.000	0.00	0.16	0.00

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

8.4. Punched hole forces

$p_1 = 23$ mm, $e_1 = 30$ mm, $e_2 = 30$ mm, $p_2 = 13.50$ mm, $\alpha_b = 1.00$, $k_1 = 1.74$ => $F_{b,Rk} = 14.06$ kN
$e_1 = 30$ mm, $e_2 = 30$ mm, $p_2 = 14$ mm, $\alpha_b = 1.00$, $k_1 = 1.74$ => $F_{b,Rk,Rand} = 14.06$ kN

8.4.1. load

Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -	Nr	F_{toti} kN	$F_{v,Rd}$ kN	U -
1	0.31	11.25	0.03	18	0.31	11.25	0.03	35	0.31	11.25	0.03
2	0.31	11.25	0.03	19	0.31	11.25	0.03	36	0.31	11.25	0.03
3	0.31	11.25	0.03	20	0.31	11.25	0.03	37	0.31	11.25	0.03
4	0.31	11.25	0.03	21	0.31	11.25	0.03	38	0.31	11.25	0.03
5	0.31	11.25	0.03	22	0.31	11.25	0.03	39	0.31	11.25	0.03
6	0.31	11.25	0.03	23	0.31	11.25	0.03	40	0.31	11.25	0.03
7	0.31	11.25	0.03	24	0.31	11.25	0.03	41	0.31	11.25	0.03
8	0.31	11.25	0.03	25	0.31	11.25	0.03	42	0.31	11.25	0.03
9	0.31	11.25	0.03	26	0.31	11.25	0.03	43	0.31	11.25	0.03
10	0.31	11.25	0.03	27	0.31	11.25	0.03	44	0.31	11.25	0.03
11	0.31	11.25	0.03	28	0.31	11.25	0.03	45	0.31	11.25	0.03
12	0.31	11.25	0.03	29	0.31	11.25	0.03	46	0.31	11.25	0.03
13	0.31	11.25	0.03	30	0.31	11.25	0.03	47	0.31	11.25	0.03
14	0.31	11.25	0.03	31	0.31	11.25	0.03	48	0.31	11.25	0.03
15	0.31	11.25	0.03	32	0.31	11.25	0.03	49	0.31	11.25	0.03
16	0.31	11.25	0.03	33	0.31	11.25	0.03				
17	0.31	11.25	0.03	34	0.31	11.25	0.03				

maximum utilisation of the punched hole forces $U_{max} = 0.03 \leq 1$ => **verification fulfilled**

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

$L_{net,t} = 81$ mm, $t_1 = 25$ mm $\Rightarrow A_{net,t} = 2025$ mm², $M_{y,k} = 4500.0$ Nmm
$L_{net,v} = 358$ mm, $t_{ef} = 25$ mm $\Rightarrow A_{net,v} = 8938$ mm² (failure mechanism c,f,j/l,k,m)
$L_{net,v} = 358$ mm $\Rightarrow A_{net,v} = 8938$ mm² $\Rightarrow F_{bs,Rk} = 25.82$ kN

8.5.1. load

load	N_d kN	$F_{bs,Rd}$ kN	U_{bs} -
1	15.000	15.888	0.94

maximum utilisation block shear failure $U_{max} = 0.94 \leq 1$ => **verification fulfilled**