POSITION 8: EINSCHNITTIGES HALF LAP

1. Input parameters

1.1. Fasteners

HECO Topix plus Senkkopf Fräst. Teilgewinde, 6.0 x 150.0 mm, alternating, d_k = 11.7 mm, l_{ef} = 72.0 mm
made of carbon steel, predrilled
application of timber species: spruce, fir or pine
design resistance reduced acc. to DIN EN 1995-1-1, 8.3.1.1(8)
$F_{v,Rk}$ increased acc. to DIN EN 1995-1-1, 8.2.2(2)
$F_{v,Rd}$ calculated with the exact verification acc. to DIN EN 1995-1-1, 8.2.2
18 x Senkkopf Fräst. Teilgewinde

1.2. characteristic internal forces and moments

LF	type	M_k	N_k	V_k	remark
-		kN	kN	kN	
2	permanent loads	0.500	0.000	0.000	
3	live loads	1.100	12.000	0.000	

LF 3, live loads duration of load medium-term

1.3. design loads (splice in bending)

service class 2

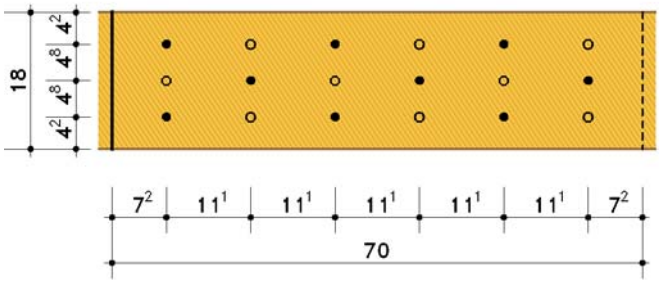
Nr	M_d	N_d	V_d	k_{mod}	A	comment
	kNm	kN	kN	-		
1	0.68	0.00	0.00	0.60		1.35*LF2 / permanent
2	0.50	0.00	0.00	0.60		1.00*LF2 / permanent
3	2.33	18.00	0.00	0.80		1.35*LF2 + 1.00*1.50*LF3 / medium-term
4	2.15	18.00	0.00	0.80		1.00*LF2 + 1.00*1.50*LF3 / medium-term

2. System visualisation

2.1. Static values and constructive boundary conditions

half lap splice
Important! secondary moments from splice asymmetry are not considered!
timber members from solid coniferous timber C24 with ρ_k = 350 kg/m³
timber: 16.0/18.0 cm, A_n = 129.60 cm², W_n = 407.36 cm³, I_n = 3666.23 cm⁴
min α = 8.7 ° => minimum spacings
a_1 = 3.0 cm, a_2 = 1.9 cm, $a_{3,t}$ = 7.2 cm, $a_{3,c}$ = 4.2 cm, $a_{4,t}$ = 2.2 cm, $a_{4,c}$ = 1.8 cm
$a_{1,exist}$ = 11.13 cm, $a_{2,exist}$ = 4.80 cm
polar moment of inertia I_p = 6784.51 cm²
centroid of fasteners S at x_s = 0.00 cm, y_s = 0.00 cm

elevation scale 1:10, unit of length [cm]



3. verifications acc. to DIN EN 1995, Germany

γ_M = 1.30, γ_s = 1.00

3.1. Load combination 1

3.1.1. Strengths and design resistances

$f_{t,d}$ = 6.69 N/mm², $f_{m,d}$ = 11.08 N/mm², $f_{c,d}$ = 9.69 N/mm², $f_{v,d}$ = 1.85 N/mm²

3.1.2. Fasteners

N_d = 0.00 kN, V_d = 0.00 kN, $M_{v,d}$ = |0.68| + |0.00 x 0.00| = 0.68 KNm, k_{mod} = 0.60
α_{min} = 49.23, a_1 = 111 mm, n = 6 => n_{ef} = 6.00
1-shear connection, fastener alternating, penetration depth t = 110 mm

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	u -
1	0.28	-0.05	-0.28	-0.05	-0.28	0.28	80.22	2.4959	1.1519	0.24
2	0.28	0.00	-0.28	0.00	-0.28	0.28	90.00	2.4959	1.1519	0.24
3	0.28	0.05	-0.28	0.05	-0.28	0.28	80.22	2.4959	1.1519	0.24
4	0.17	-0.05	-0.17	-0.05	-0.17	0.17	73.96	2.4959	1.1519	0.15
5	0.17	0.00	-0.17	0.00	-0.17	0.17	90.00	2.4959	1.1519	0.14
6	0.17	0.05	-0.17	0.05	-0.17	0.17	73.96	2.4959	1.1519	0.15
7	0.07	-0.05	-0.06	-0.05	-0.06	0.07	49.23	2.4959	1.1519	0.06
8	0.06	0.00	-0.06	0.00	-0.06	0.06	90.00	2.4959	1.1519	0.05
9	0.07	0.05	-0.06	0.05	-0.06	0.07	49.23	2.4959	1.1519	0.06
10	0.07	-0.05	0.06	-0.05	0.06	0.07	49.23	2.4959	1.1519	0.06
11	0.06	0.00	0.06	0.00	0.06	0.06	90.00	2.4959	1.1519	0.05
12	0.07	0.05	0.06	0.05	0.06	0.07	49.23	2.4959	1.1519	0.06
13	0.17	-0.05	0.17	-0.05	0.17	0.17	73.96	2.4959	1.1519	0.15
14	0.17	0.00	0.17	0.00	0.17	0.17	90.00	2.4959	1.1519	0.14
15	0.17	0.05	0.17	0.05	0.17	0.17	73.96	2.4959	1.1519	0.15
16	0.28	-0.05	0.28	-0.05	0.28	0.28	80.22	2.4959	1.1519	0.24
17	0.28	0.00	0.28	0.00	0.28	0.28	90.00	2.4959	1.1519	0.24
18	0.28	0.05	0.28	0.05	0.28	0.28	80.22	2.4959	1.1519	0.24

maximum utilization of fasteners u_{max} = 0.24 ≤ 1 => **verification successful**

3.1.3. timber members

inner timber member : max $V_{90,d}$ = 0.83 N, $\sigma_{90,d}$ = 0.03 N/mm², $f_{t90,d}$ = 1.15 N/mm² ⇒ u = 0.03
timber lamellas : $\sigma_{t,d}$ = 0.00 N/mm², $\sigma_{m,d}$ = 1.66 N/mm², τ_d = 0.35 N/mm² (mit V_d = 1.50 kN) ⇒ u = 0.19
maximum utilization of timber lamellas u_{max} = 0.19 ≤ 1 ⇒ **verification successful**

3.2. Load combination 2

3.2.1. Fasteners

N_d = 0.00 kN, V_d = 0.00 kN, $M_{v,d}$ = |0.50| + |0.00 x 0.00| = 0.50 KNm, k_{mod} = 0.60
α_{min} = 49.23, a_1 = 111 mm, n = 6 => n_{ef} = 6.00
1-shear connection, fastener alternating, penetration depth t = 110 mm

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	u -
1	0.21	-0.04	-0.21	-0.04	-0.21	0.21	80.22	2.4959	1.1519	0.18
2	0.21	0.00	-0.21	0.00	-0.21	0.21	90.00	2.4959	1.1519	0.18
3	0.21	0.04	-0.21	0.04	-0.21	0.21	80.22	2.4959	1.1519	0.18
4	0.13	-0.04	-0.12	-0.04	-0.12	0.13	73.96	2.4959	1.1519	0.11
5	0.12	0.00	-0.12	0.00	-0.12	0.12	90.00	2.4959	1.1519	0.11
6	0.13	0.04	-0.12	0.04	-0.12	0.13	73.96	2.4959	1.1519	0.11
7	0.05	-0.04	-0.04	-0.04	-0.04	0.05	49.23	2.4959	1.1519	0.05
8	0.04	0.00	-0.04	0.00	-0.04	0.04	90.00	2.4959	1.1519	0.04
9	0.05	0.04	-0.04	0.04	-0.04	0.05	49.23	2.4959	1.1519	0.05
10	0.05	-0.04	0.04	-0.04	0.04	0.05	49.23	2.4959	1.1519	0.05
11	0.04	0.00	0.04	0.00	0.04	0.04	90.00	2.4959	1.1519	0.04
12	0.05	0.04	0.04	0.04	0.04	0.05	49.23	2.4959	1.1519	0.05
13	0.13	-0.04	0.12	-0.04	0.12	0.13	73.96	2.4959	1.1519	0.11
14	0.12	0.00	0.12	0.00	0.12	0.12	90.00	2.4959	1.1519	0.11
15	0.13	0.04	0.12	0.04	0.12	0.13	73.96	2.4959	1.1519	0.11
16	0.21	-0.04	0.21	-0.04	0.21	0.21	80.22	2.4959	1.1519	0.18
17	0.21	0.00	0.21	0.00	0.21	0.21	90.00	2.4959	1.1519	0.18
18	0.21	0.04	0.21	0.04	0.21	0.21	80.22	2.4959	1.1519	0.18

maximum utilization of fasteners u_{max} = 0.18 ≤ 1 => **verification successful**

3.2.2. timber members

inner timber member : max $V_{90,d}$ = 0.62 N, $\sigma_{90,d}$ = 0.02 N/mm², $f_{t90,d}$ = 1.15 N/mm² ⇒ u = 0.02
timber lamellas : $\sigma_{t,d}$ = 0.00 N/mm², $\sigma_{m,d}$ = 1.23 N/mm², τ_d = 0.26 N/mm² (mit V_d = 1.11 kN) ⇒ u = 0.14
maximum utilization of timber lamellas u_{max} = 0.14 ≤ 1 ⇒ **verification successful**

3.3. Load combination 3

3.3.1. Strengths and design resistances

$f_{t,d}$ = 8.92 N/mm², $f_{m,d}$ = 14.77 N/mm², $f_{c,d}$ = 12.92 N/mm², $f_{v,d}$ = 2.46 N/mm²

3.3.2. Fasteners

N_d = 18.00 kN, V_d = 0.00 kN, $M_{v,d}$ = |2.33| + |0.00 x 0.00| = 2.33 KNm, k_{mod} = 0.80
$F_{Hi,d}$ = 18.00 / (1 x 18) = 1.00 kN
α_{min} = 9.30, a_1 = 111 mm, n = 6 => n_{ef} = 6.00
1-shear connection, fastener alternating, penetration depth t = 110 mm

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	u -
1	0.97	-0.16	-0.95	0.84	-0.95	1.27	48.78	2.4959	1.5359	0.83
2	0.95	0.00	-0.95	1.00	-0.95	1.38	43.65	2.4959	1.5359	0.90
3	0.97	0.16	-0.95	1.16	-0.95	1.51	39.32	2.4959	1.5359	0.98
4	0.60	-0.16	-0.57	0.84	-0.57	1.01	34.41	2.4959	1.5359	0.66
5	0.57	0.00	-0.57	1.00	-0.57	1.15	29.78	2.4959	1.5359	0.75
6	0.60	0.16	-0.57	1.16	-0.57	1.30	26.17	2.4959	1.5359	0.84
7	0.25	-0.16	-0.19	0.84	-0.19	0.86	12.86	2.4959	1.5359	0.56
8	0.19	0.00	-0.19	1.00	-0.19	1.02	10.80	2.4959	1.5359	0.66
9	0.25	0.16	-0.19	1.16	-0.19	1.18	9.30	2.4959	1.5359	0.77
10	0.25	-0.16	0.19	0.84	0.19	0.86	12.86	2.4959	1.5359	0.56
11	0.19	0.00	0.19	1.00	0.19	1.02	10.80	2.4959	1.5359	0.66
12	0.25	0.16	0.19	1.16	0.19	1.18	9.30	2.4959	1.5359	0.77
13	0.60	-0.16	0.57	0.84	0.57	1.01	34.41	2.4959	1.5359	0.66
14	0.57	0.00	0.57	1.00	0.57	1.15	29.78	2.4959	1.5359	0.75
15	0.60	0.16	0.57	1.16	0.57	1.30	26.17	2.4959	1.5359	0.84
16	0.97	-0.16	0.95	0.84	0.95	1.27	48.78	2.4959	1.5359	0.83
17	0.95	0.00	0.95	1.00	0.95	1.38	43.65	2.4959	1.5359	0.90
18	0.97	0.16	0.95	1.16	0.95	1.51	39.32	2.4959	1.5359	0.98

maximum utilization of fasteners u_{max} = 0.98 ≤ 1 => **verification successful**

3.3.3. timber members

inner timber member : max $V_{90,d}$ = 2.86 N, $\sigma_{90,d}$ = 0.11 N/mm², $f_{t90,d}$ = 1.54 N/mm² ⇒ u = 0.07
timber lamellas : $\sigma_{t,d}$ = 1.39 N/mm², $\sigma_{m,d}$ = 5.71 N/mm², τ_d = 1.19 N/mm² (mit V_d = 5.15 kN) ⇒ u = 0.54
maximum utilization of timber lamellas u_{max} = 0.54 ≤ 1 ⇒ **verification successful**

3.4. Load combination 4

3.4.1. Fasteners

N_d = 18.00 kN, V_d = 0.00 kN, $M_{v,d}$ = |2.15| + |0.00 x 0.00| = 2.15 KNm, k_{mod} = 0.80
$F_{Hi,d}$ = 18.00 / (1 x 18) = 1.00 kN
α_{min} = 8.71, a_1 = 111 mm, n = 6 => n_{ef} = 6.00
1-shear connection, fastener alternating, penetration depth t = 110 mm

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	α_{toti} °	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	u -
1	0.90	-0.15	-0.88	0.85	-0.88	1.22	46.13	2.4959	1.5359	0.80
2	0.88	0.00	-0.88	1.00	-0.88	1.33	41.41	2.4959	1.5359	0.87
3	0.90	0.15	-0.88	1.15	-0.88	1.45	37.44	2.4959	1.5359	0.94
4	0.55	-0.15	-0.53	0.85	-0.53	1.00	31.97	2.4959	1.5359	0.65
5	0.53	0.00	-0.53	1.00	-0.53	1.13	27.89	2.4959	1.5359	0.74
6	0.55	0.15	-0.53	1.15	-0.53	1.27	24.67	2.4959	1.5359	0.83
7	0.23	-0.15	-0.18	0.85	-0.18	0.87	11.75	2.4959	1.5359	0.56
8	0.18	0.00	-0.18	1.00	-0.18	1.02	10.00	2.4959	1.5359	0.66
9	0.23	0.15	-0.18	1.15	-0.18	1.17	8.71	2.4959	1.5359	0.76
10	0.23	-0.15	0.18	0.85	0.18	0.87	11.75	2.4959	1.5359	0.56
11	0.18	0.00	0.18	1.00	0.18	1.02	10.00	2.4959	1.5359	0.66
12	0.23	0.15	0.18	1.15	0.18	1.17	8.71	2.4959	1.5359	0.76
13	0.55	-0.15	0.53	0.85	0.53	1.00	31.97	2.4959	1.5359	0.65
14	0.53	0.00	0.53	1.00	0.53	1.13	27.89	2.4959	1.5359	0.74
15	0.55	0.15	0.53	1.15	0.53	1.27	24.67	2.4959	1.5359	0.83
16	0.90	-0.15	0.88	0.85	0.88	1.22	46.13	2.4959	1.5359	0.80
17	0.88	0.00	0.88	1.00	0.88	1.33	41.41	2.4959	1.5359	0.87
18	0.90	0.15	0.88	1.15	0.88	1.45	37.44	2.4959	1.5359	0.94

maximum utilization of fasteners u_{max} = 0.94 ≤ 1 => **verification successful**

3.4.2. timber members

inner timber member : max $V_{90,d}$ = 2.65 N, $\sigma_{90,d}$ = 0.10 N/mm², $f_{t90,d}$ = 1.54 N/mm² ⇒ u = 0.06
timber lamellas : $\sigma_{t,d}$ = 1.39 N/mm², $\sigma_{m,d}$ = 5.28 N/mm², τ_d = 1.10 N/mm² (mit V_d = 4.76 kN) ⇒ u = 0.51
maximum utilization of timber lamellas u_{max} = 0.51 ≤ 1 ⇒ **verification successful**

4. Summary

maximum utilization of all verifications $u_{max} = 0.98 \leq 1$ => **all verifications successful**