

POSITION 6: ZANG./SCHEIB.-DBL.

1. Input parameters

1.1. Fasteners

shear plate connector C10 $d_c = 80$ mm, S235 (1052)

bolt M 12, S235 (1052) as fitted bolt

$F_{V,Rd}$ calculated with the simplified verification acc. to NA.8.2.4

connection rafter/collar beam: 2 x shear plate connector C10

1.2. Internal forces combination collar beam

Nr	N _d kN	V _d kN	k _{mod} -	A
1	60.00	0.00	0.80	

* in column A in case of accidental combination

2. System visualisation

2.1. Static values and constructive boundary conditions

service class 1, connection angle $\alpha = 35.0^\circ$

rafter of solid coniferous timber, C30 (S13) with $\rho_k = 380$ kg/m³

pair of collar beams of solid coniferous timber, C24 (S10) with $\rho_k = 350$ kg/m³

pair of collar beams : $t = 9.0$ cm, $h = 16.0$ cm, $A_n = 124.80$ cm², $W_n = 371.20$ cm³, $I_n = 2969.60$ cm⁴

rafter: $t = 14.0$ cm, $h = 26.0$ cm, $A_n = 286.40$ cm², $W_n = 1291.18$ cm³, $I_n = 16268.89$ cm⁴

connection collar beam/rafter

max $\alpha = 0.0^\circ \Rightarrow$ minimum spacings at collar beam

$a_1 = 16.0$ cm, $a_2 = 9.6$ cm, $a_{1,t} = 16.0$ cm, $a_{1,c} = 9.6$ cm, $a_{2,t} = 4.8$ cm, $a_{2,c} = 4.8$ cm

max $\alpha = 35.0^\circ \Rightarrow$ minimum spacings at rafter

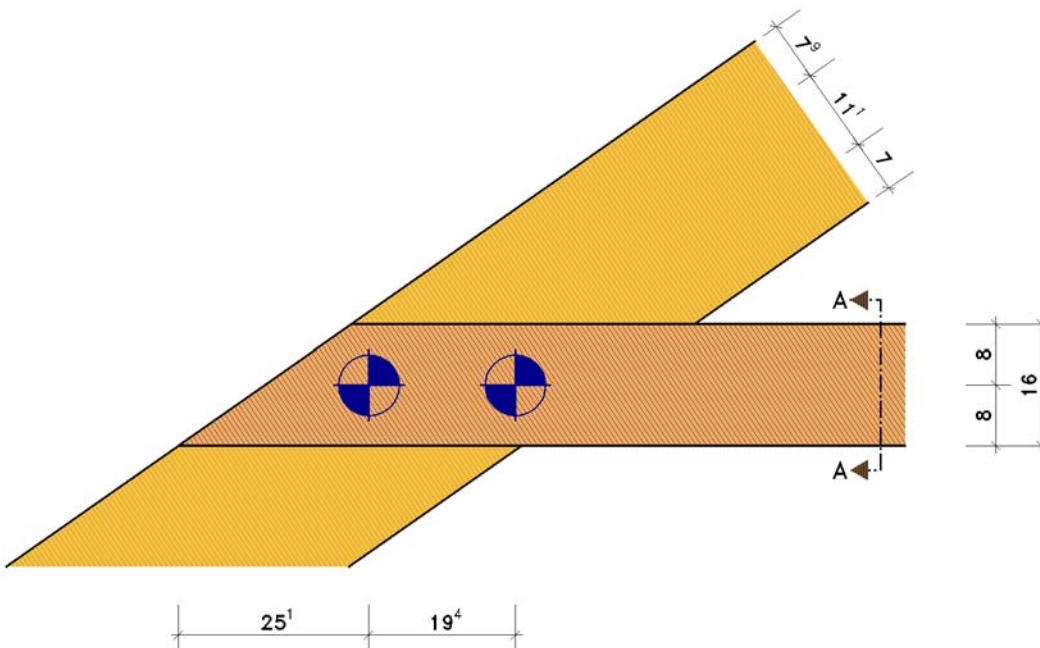
$a_1 = 14.8$ cm, $a_2 = 9.6$ cm, $a_{1,t} = 16.0$ cm, $a_{1,c} = 9.6$ cm, $a_{2,t} = 5.7$ cm, $a_{2,c} = 4.8$ cm

$a_{1,exist} = 19.36$ cm

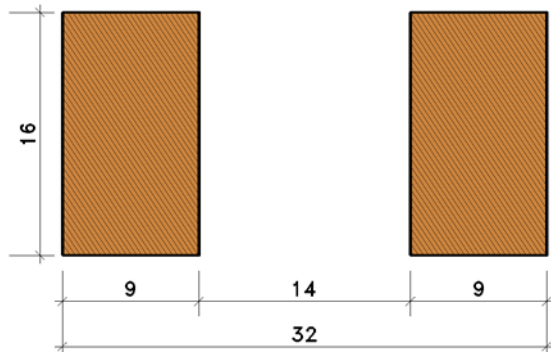
centroid of fasteners from hinge point S at $x_s = 0.73$ cm, $y_s = 0.00$ cm

polar moment of inertia $I_{p1} = 187.43$ cm⁴

elevation scale 1:10



section A-A collar beam scale 1: 5



3. Verification of fasteners acc. to DIN EN 1995, NA Germany

$\gamma_{M,outer\ timber\ member} = 1.30$, $\gamma_{M,central\ timber\ member} = 1.30$, $\gamma_{steel} = 1.10$, $\gamma_{accidental} = 1.00$

3.1. Decisive load combination collar beam

3.1.1. Fasteners rafter/collar beam

$N_d = 60.00\text{ kN}$, $V_d = 0.00\text{ kN}$, $M_{v,d} = |0.01 \times 0.00| = 0.00\text{ kNm}$, $k_{mod} = 0.80$

$F_{H1,d} = 60.00 / (2 \times 2) = 15.00\text{ kN}$

$\alpha_{min} = 35.00$, $n = 2 \Rightarrow n_{ef} = 2.00$

forces per shear plane ($f_{red} = t_{exist} / t_{req}$)

Nr	F _{H1} kN	F _{MH1} kN	F _{MV1} kN	F _{totH1} kN	F _{totV1} kN	F _{tot1} kN	$\alpha_{tot1,k}$ °	$\alpha_{tot1,s}$ °	$f_{h,\alpha,k}$ N/mm ²	f_{red} -	F _{v,Rk} kN	F _{v,Rd} kN	U -
1	0.00	0.00	0.00	15.00	0.00	15.00	0.00	35.00	23.35	1.000	19.7587	12.8688	1.17

maximum utilization of fasteners $U_{max} = 1.17 > 1 \Rightarrow$ **verification not successful**

verification acc. to DIN 1052, 11.1.2 (3)

$A_{bolt} = 113.10\text{ mm}^2$, $\sigma_{R,d} = 330.58\text{ N/mm}^2$, $N_{R,d} = 37.39\text{ kN}$, $F_{t,d} = 14.06\text{ kN}$

$U_F = 0.38 \leq 1 \Rightarrow$ **verification successful**

4. Verification pair of collar beams

4.1. Decisive load combination collar beam

strengths and design resistances for $k_{mod} = 0.80$

$k_p = 1.00$, $k_t = 1.00 \Rightarrow R_{ks} = 13416.41\text{ N}$

$k_{90} = 2.55$, $f_{h,0,k} = 5.74\text{ N/mm}^2$

pair of collar beams: $f_{t,d} = 5.74\text{ N/mm}^2$, $f_{m,d} = 14.77\text{ N/mm}^2$, $f_{c,d} = 12.92\text{ N/mm}^2$, $f_{v,d} = 1.23\text{ N/mm}^2$

rafter: $f_{t,d} = 11.08\text{ N/mm}^2$, $f_{m,d} = 18.46\text{ N/mm}^2$, $f_{c,d} = 14.15\text{ N/mm}^2$, $f_{v,d} = 1.23\text{ N/mm}^2$

$\sigma_{t,d} = 2.40\text{ N/mm}^2$, $\tau_d = 0.00\text{ N/mm}^2 \Rightarrow U = 0.42$

maximum utilization of pair of collar beams $U_{max} = 0.42 \leq 1 \Rightarrow$ **verification successful**

5. Summary

maximum utilization of all verifications $U_{max} = 1.17 > 1 \Rightarrow$ **verification not successful**