

POSITION 3: ZGN./SCH-DBL.

1. Input parameters

1.1. Fasteners

shear plate connector C1 $d_c = 95$ mm, S235 (1052)

bolt M 24, S235 (1052) as fitted bolt

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

connection rafter/collar beam: 1 x shear plate connector C1

1.2. Internal forces combination collar beam

Nr	N _d kN	V _d kN	k _{mod} -	A
1	-33.30	-6.86	0.90	

* in column A in case of accidental combination

2. System visualisation

2.1. Static values and constructive boundary conditions

service class 2, connection angle $\alpha = 55.0^\circ$

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

pair of collar beams : $t = 6.0$ cm, $h = 24.0$ cm, $A_n = 122.30$ cm², $W_n = 562.40$ cm³, $I_n = 6748.80$ cm⁴

rafter: $t = 12.0$ cm, $h = 20.0$ cm, $A_n = 187.00$ cm², $W_n = 703.28$ cm³, $I_n = 6751.48$ cm⁴

connection collar beam/rafter

max $\alpha = 11.6^\circ \Rightarrow$ minimum spacings at collar beam

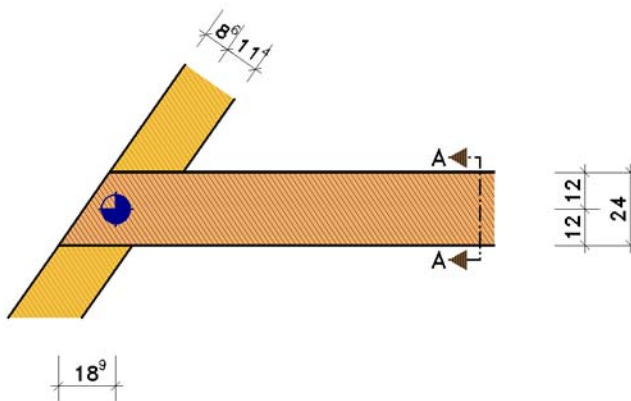
$a_1 = 14.2$ cm, $a_2 = 11.4$ cm, $a_{1,t} = 19.0$ cm, $a_{1,c} = 11.4$ cm, $a_{2,t} = 7.2$ cm, $a_{2,c} = 7.2$ cm

max $\alpha = 43.4^\circ \Rightarrow$ minimum spacings at rafter

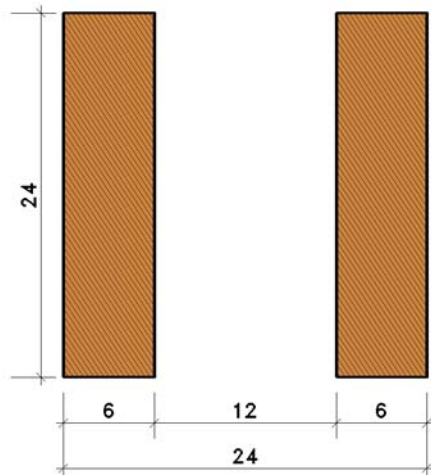
$a_1 = 13.5$ cm, $a_2 = 11.4$ cm, $a_{1,t} = 19.0$ cm, $a_{1,c} = 11.5$ cm, $a_{2,t} = 7.2$ cm, $a_{2,c} = 7.2$ cm

centroid of fasteners from hinge point S at $x_s = -1.68$ cm, $y_s = 0.00$ cm

elevation scale 1:25



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

$N_d = -33.30\text{ kN}$, $V_d = -6.86\text{ kN}$, $M_{v,d} = |-0.02 \times -6.86| = 0.12\text{ kNm}$, $k_{mod} = 0.90$

$F_{H1,d} = -33.30 / (2 \times 1) = -16.65\text{ kN}$

$F_{V1,d} = -6.86 / (2 \times 1) = -3.43\text{ kN}$

$\alpha_{min} = 43.36$, $n = 1 \Rightarrow n_{ef} = 1.00$

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

Nr	F_{M1} 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	-16.65	-3.43	17.00	11.64	43.36	16.34	0.548	27.2190	20.1722	0.84

maximum utilization of fasteners $U_{max} = 0.84 \leq 1 \Rightarrow$ **verification successful**

verification acc. to DIN 1052, 11.1.2 (3)

$A_{bol1} = 452.39\text{ mm}^2$, $\sigma_{R,d} = 330.58\text{ N/mm}^2$, $N_{R,d} = 149.55\text{ kN}$, $F_{t,d} = 8.76\text{ kN}$

$U_F = 0.06 \leq 1 \Rightarrow$ **verification successful**

4. Verification pair of collar beams

4.1. Decisive load combination collar beam

strengths and design resistances for $k_{mod} = 0.90$

$k_p = 1.00$, $k_t = 1.00 \Rightarrow R_{ks} = 16667.02\text{ N}$

$k_{90} = 2.77$, $f_{h,0,k} = 1.43\text{ N/mm}^2$

$f_{t,d} = 6.46\text{ N/mm}^2$, $f_{m,d} = 16.62\text{ N/mm}^2$, $f_{c,d} = 14.54\text{ N/mm}^2$, $f_{v,d} = 1.38\text{ N/mm}^2$

$\sigma_{c,d} = -1.36\text{ N/mm}^2$, $\tau_d = 0.84\text{ N/mm}^2 \Rightarrow U = 0.30$

maximum utilization of pair of collar beams $U_{max} = 0.30 \leq 1 \Rightarrow$ **verification successful**

5. Summary

maximum utilization of all verifications $U_{max} = 0.84 \leq 1 \Rightarrow$ **all verifications successful**