

POSITION 7: PAIR OF COLLAR BEAMS/RINGDBL.

1. Input parameters

1.1. Fasteners

ring connector type A1 dc 126

bolt M 12, S235 (1052) as fitted bolt

connection rafter/collar beam: 1 x ring connector A1

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 $\rho_k = 350 \text{ kg/m}^3$

pair of collar beams : $t = 6.0 \text{ cm}$, $h = 20.0 \text{ cm}$, $A_n = 95.25 \text{ cm}^2$, $W_n = 367.26 \text{ cm}^3$, $I_n = 3672.56 \text{ cm}^4$

rafter: $t = 12.0 \text{ cm}$, $h = 20.0 \text{ cm}$, $A_n = 180.90 \text{ cm}^2$, $W_n = 669.06 \text{ cm}^3$, $I_n = 6423.00 \text{ cm}^4$

connection collar beam/rafter

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

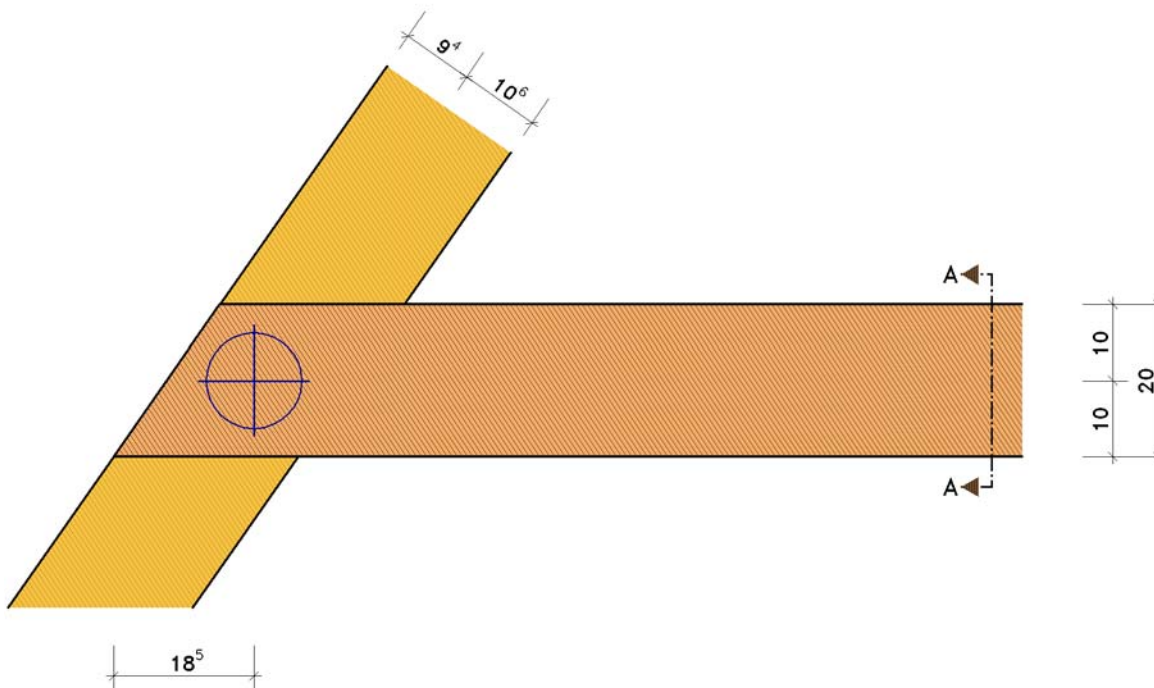
$a_1 = 25.0 \text{ cm}$, $a_2 = 15.1 \text{ cm}$, $a_{1,t} = 18.9 \text{ cm}$, $a_{1,c} = 15.1 \text{ cm}$, $a_{2,t} = 8.1 \text{ cm}$, $a_{2,c} = 7.6 \text{ cm}$

max $\alpha = 66.6^\circ \Rightarrow$ minimum spacings at rafter

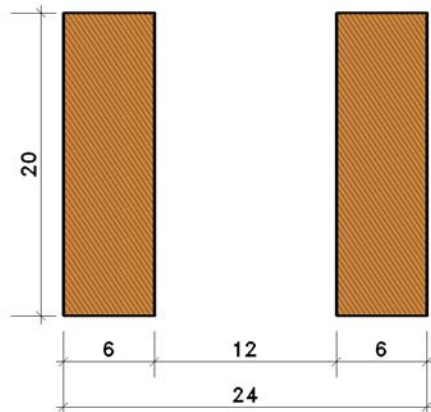
$a_1 = 19.1 \text{ cm}$, $a_2 = 15.1 \text{ cm}$, $a_{1,t} = 18.9 \text{ cm}$, $a_{1,c} = 15.1 \text{ cm}$, $a_{2,t} = 9.9 \text{ cm}$, $a_{2,c} = 7.6 \text{ cm}$

centroid of fasteners from hinge point S at $x_s = -0.68 \text{ cm}$, $y_s = 0.00 \text{ cm}$

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

$N_d = 33.30\text{ kN}$, $V_d = -6.86\text{ kN}$, $M_{v,d} = |-0.01 \times -6.86| = 0.05\text{ kNm}$, $k_{mod} = 0.90$

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

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

$\alpha_{min} = 66.64$, $n = 1 \Rightarrow n_{ef} = 1.00$

Nr	F_{M1} kN	F_{MH1} kN	F_{MV1} kN	F_{totH1} kN	F_{totV1} kN	F_{tot1} kN	$\alpha_{tot1,k}$ °	$\alpha_{tot1,s}$ °	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	U -
1	0.00	0.00	0.00	16.65	-3.43	17.00	11.64	66.64	36.4247	25.2171	0.67

maximum utilization of fasteners $U_{max} = 0.67 \leq 1 \Rightarrow$ **verification successful**

4. Verification pair of collar beams

4.1. Decisive load combination collar beam

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

$k_{\alpha} = 0.74$, $k_p = 1.00$, $k_t = 1.00$

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

$\sigma_{t,d} = 1.75\text{ N/mm}^2$, $\tau_d = 1.08\text{ N/mm}^2 \Rightarrow U = 0.39$

maximum utilization of pair of collar beams $U_{max} = 0.39 \leq 1 \Rightarrow$ **verification successful**

5. Summary

maximum utilization of all verifications $U_{max} = 0.67 \leq 1 \Rightarrow$ **all verifications successful**