POSITION 5: STIEL/Z/STB-DBL.

1. Input parameters

1.1. Fasteners

dowel 16 mm, S235 (1052)
$F_{v,Rd}$ calculated with the simplified verification acc. to NA.8.2.4
connection rafter/collar beam: 4 x dowel

1.2. Internal forces combination collar beam

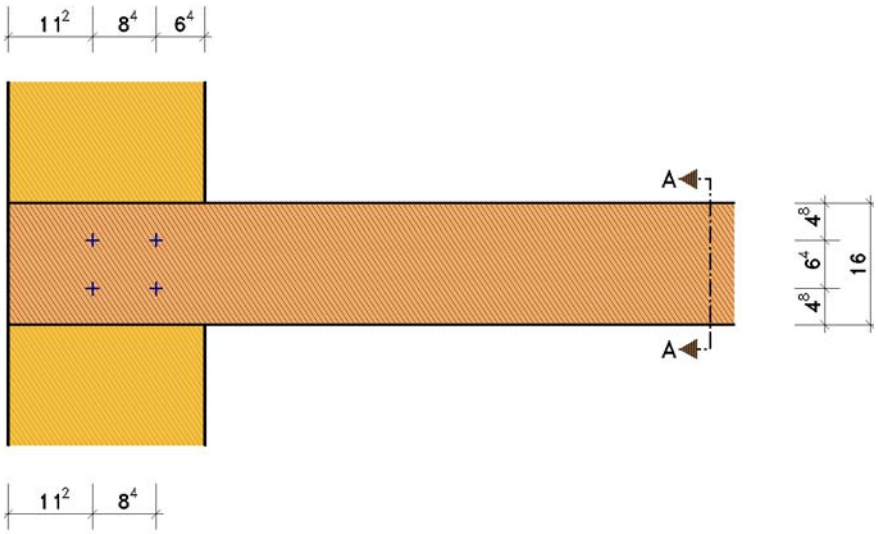
Nr	N_d kN	V_d kN	k_{mod} -	A
1	50.00	0.00	0.80	

* in column A in case of accidental combination

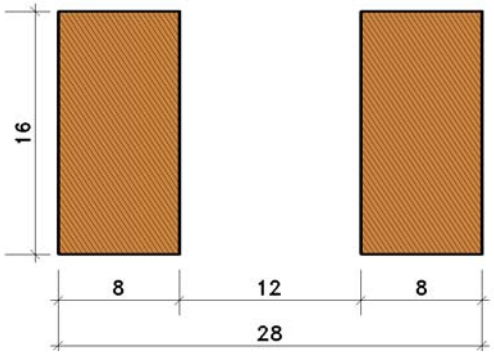
2. System visualisation

2.1. Static values and constructive boundary conditions

service class 2, connection angle α = 90.0°
rafter of solid coniferous timber, C30 (S13) with ρ_k = 380 kg/m³
pair of collar beams of solid coniferous timber, C24 (S10) with ρ_k = 350 kg/m³
pair of collar beams : t = 8.0 cm, h = 16.0 cm, A_n = 102.40 cm², W_n = 340.65 cm³, I_n = 2725.21 cm⁴
rafter: t = 12.0 cm, h = 26.0 cm, A_n = 264.00 cm², W_n = 1215.67 cm³, I_n = 15317.44 cm⁴
connection collar beam/rafter
max α = 0.0 ° => minimum spacings at collar beam
a_1 = 8.0 cm, a_2 = 4.8 cm, $a_{1,t}$ = 11.2 cm, $a_{1,c}$ = 0.0 cm, $a_{2,t}$ = 4.8 cm, $a_{2,c}$ = 4.8 cm
max α = 90.0 ° => minimum spacings at rafter
a_1 = 4.8 cm, a_2 = 4.8 cm, $a_{1,t}$ = 11.2 cm, $a_{1,c}$ = 11.2 cm, $a_{2,t}$ = 6.4 cm, $a_{2,c}$ = 4.8 cm
$a_{1,exist}$ = 8.40 cm, $a_{2,exist}$ = 6.40 cm
centroid of fasteners from hinge point S at x_s = 2.40 cm, y_s = 0.00 cm
polar moment of inertia I_{pl} = 111.52 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, γ_{steel} = 1.10, $\gamma_{accidental}$ = 1.00

3.1. Decisive load combination collar beam

3.1.1. Fasteners rafter/collar beam

N_d = 50.00 kN, V_d = 0.00 kN, $M_{v,d}$ = |0.02 x 0.00| = 0.00 kNm, k_{mod} = 0.80
$F_{Hi,d}$ = 50.00 / (2 x 4) = 6.25 kN
α_{min} = 90.00, a_1 = 84 mm, n = 2 => n_{ef} = 1.49
forces per shear plane (f_{red} = t_{exist} / t_{req})

Nr	F_{Mi} kN	F_{MHi} kN	F_{MVi} kN	F_{totHi} kN	F_{totVi} kN	F_{toti} kN	$\alpha_{toti,k}$ °	$\alpha_{toti,s}$ °	$f_{h,\alpha,k}$ N/mm²	f_{red} -	$F_{v,Rk}$ kN	$F_{v,Rd}$ kN	U -
1	0.00	0.00	0.00	6.25	0.00	6.25	0.00	90.00	16.46	1.000	9.5582	5.1704	1.21

maximum utilization of fasteners U_{max} = 1.21 > 1 => **verification not successful** !!

4. Verification pair of collar beams

4.1. Decisive load combination collar beam

strengths and design resistances for k_{mod} = 0.80
pair of collar beams: $f_{t,d}$ = 5.74 N/mm², $f_{m,d}$ = 14.77 N/mm², $f_{c,d}$ = 12.92 N/mm², $f_{v,d}$ = 1.23 N/mm²
rafter: $f_{t,d}$ = 11.08 N/mm², $f_{m,d}$ = 18.46 N/mm², $f_{c,d}$ = 14.15 N/mm², $f_{v,d}$ = 1.23 N/mm²
$\sigma_{t,d}$ = 2.44 N/mm², τ_d = 0.00 N/mm² => U = 0.43
maximum utilization of pair of collar beams U_{max} = 0.43 ≤ 1 => **verification successful**

5. Summary

maximum utilization of all verifications U_{max} = 1.21 > 1 => **verification not successful** !!