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Worked example

Rafter connection to the purlin and the wall plate

ESSVE academy

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Disclaimer:
The following information is still under discussion and review and should not be used for design purposes.
The information may be incomplete and may contain errors.

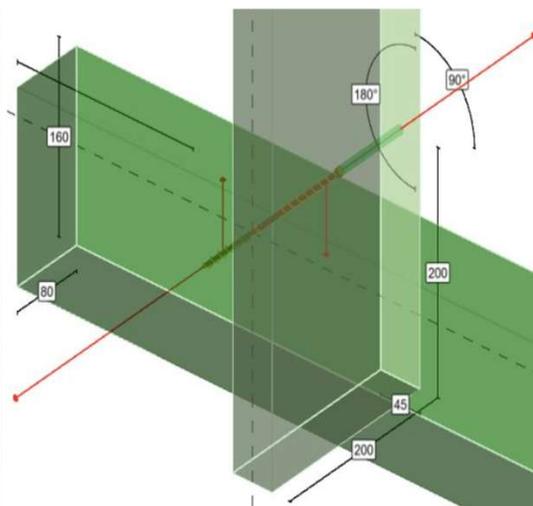
1

EUROCODE 5: CONNECTIONS

Challenges related to roof design



Image: Reet Sau



2

2

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EUROCODE 5: CONNECTIONS

Challenges related to roof design: loads

Wind zones of a duopitch roof

WIND ZONES: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z

LOADS: SNOW LOAD, WIND NEG. PRESSURE, WIND POS. PRESSURE, SELF-WEIGHT

TRIBUTARY AREA = RAFTER SPACING

WIND DIRECTION

VARIANT: WIND NEG. PRESSURE

VARIANT: WIND POS. PRESSURE

SELF-WEIGHT

WIND NEG. PRESSURE

WIND POS. PRESSURE

--- SIMPLIFICATION: WEIGHTED AVERAGE OR GREATER VALUE

3

3

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EUROCODE 5: CONNECTIONS

Challenges related to roof design: resistance of horizontal reactions

Gelenk

Massivdecke

b)

c)

Anker
Ø 25 mm

Deckenbewehrung

Rug & Mönck „Holzbau“

4

4

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Resisting horizontal reactions using steel shoes

VT.KATUSEPANEELIDE JOONIS

SOOJUSTAMINE PÄRAST PANEELIDE KINNITAMIST ANALOOGSELT PANEELIDE KIHITDELE

HARJAPLEKK

SOOJUSTAMINE PÄRAST PANEELIDE KINNITAMIST ANALOOGSELT PANEELIDE KIHITDELE

RISTKIHTPUIDUST KILP 50mm

RISTKIHTPUIDUST KILP 50mm

VL-1

+11.215

+10.470

+6.780

+6.570

+6.440

5

5

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Rafters supported by purlins

LÕIGE 1-1
M 1:50

HARJATUULUTUS

ÜLEMINE SARIKAS
50x150mm;s.600mm

IPF 200-S235

ALUMINE SARIKAS
50x200mm;s.600mm

DETAIL 1

DETAIL 2

+5.500

+5.350

+2.850

+2.600

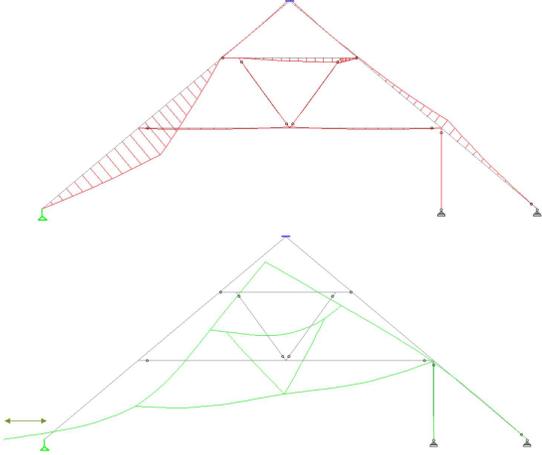
6

6

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Horizontal reactions resisted by the collar tie

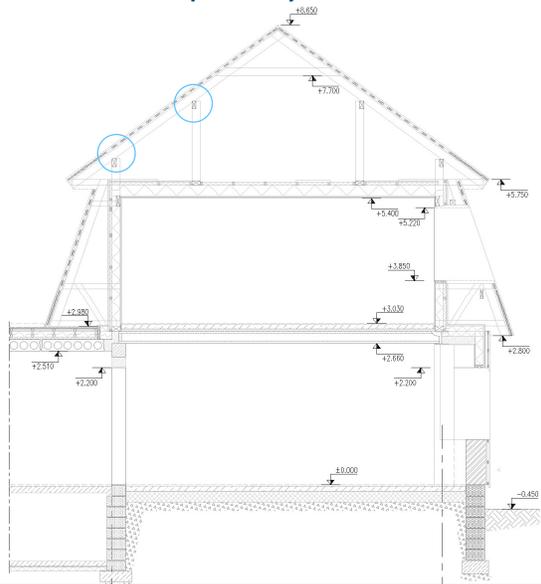
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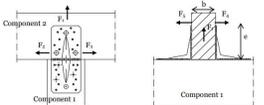
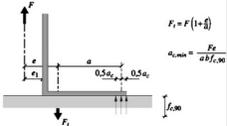
7

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Purlin-and-post systems



$$\left(\frac{F_{1,d}}{F_{Rd,1}}\right)^2 + \left(\frac{F_{2,d}}{F_{Rd,2}}\right)^2 + \left(\frac{F_{3,d}}{F_{Rd,3}}\right)^2 + \left(\frac{F_{4,d}}{F_{Rd,4}}\right)^2 + \left(\frac{F_{5,d}}{F_{Rd,5}}\right)^2 \leq 1$$

$$F_R = F \left(1 + \frac{a}{e_1}\right)$$

$$a_{min} = \frac{F_R}{0.5 \cdot f_{cp}}$$


<https://www.elmwoodfencing.co.uk>

8

8

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Rafter anchoring

9

9

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Principle of calculating the force acting on a screw

characteristic withdrawal resistance

$$F_{ax,t,d} = \min \begin{cases} \frac{k_{mod}}{\gamma_R} \max\{F_{pull,k}; F_{w,k}\} & \text{TIMBER} \\ \frac{F_{t,k}}{\gamma_{M2}} & \text{STEEL} \end{cases}$$

characteristic withdrawal strength

$$F_{w,k} = \pi \cdot d \cdot l_w \cdot f_{w,k}$$

$$f_{w,k} = k_{screw} \cdot k_w \cdot k_{mat} \cdot d^{-0,33} \cdot \left(\frac{\rho_k}{350}\right)^{k^p}$$

$$k_{screw} = k_{red} \cdot \frac{f_{ax,k}(\rho_{ref})}{\pi} \cdot \frac{l_d}{l_d - l_p} \cdot \frac{1}{k_w \cdot k_{mat} \cdot d^{-0,33}}$$

k_{screw} : default value = 8,2

$$\eta = \left(\frac{F_{ax,Ed}}{F_{ax,t,Rd}}\right)^2 + \left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2$$

10

10

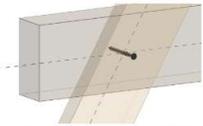
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TIP

LLC - Laterally loaded connection



Service class: 1

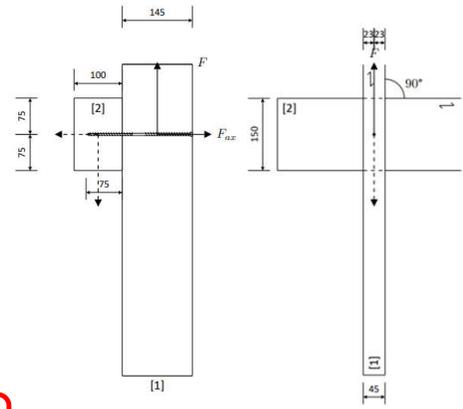
Angle of the shear load with member [1]: 0

Load input option: Design load, Permanent/Variable loads

Shear load: 2.5 [kN]

Axial load: 0 [kN]

Duration of load: Medium term



11

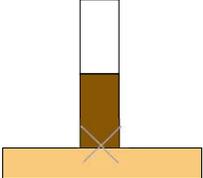
11

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Alternative

Source: <https://www.practicalarchitecture.com> | Image: Raise Architects

12

12



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13



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14