Nailing plates and nailing plate strips - design of the load-carrying capacity of a joint

Nailing plates and nailing plate strips are provided to transfer tensile forces in joints.
A joint should always consist of two nailing plates positioned opposite each other. The width of the joined timber elements must be the same.
Threaded (connector) nails ∅ 4 mm and GH screws ∅ 5 mm can be used as fasteners.
The minimum timber thickness as well as the minimum spacings for the fasteners to EN 1995-1-1 must be satisfied.
The nailing pattern must be such that its centre of gravity lies on the line of action of the force. Only holes whose centre of gravity is at least 6 mm from the edge of the nailing plate may be used.

The following verifications must be provided for the design of the joint:

Fastener resistance $R_d = n_{ef} \cdot k_{mod} / 1.3 \cdot R_{v,k}$

Nailing plate resistance in the net cross-section $R_d = 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2}$ where $A_{net} = 0.75 \cdot b \cdot t$, $\gamma_{M2} = 1.25$ to EN 1993-1-1 6.2.3

Tension verification in the flange to EN 1995-1-1 8.1.4 $R_{90,d} = 14 \cdot b \sqrt{\frac{h_e}{1-h_e/h} \cdot \frac{k_{mod}}{1,3}}$

Design example:

Flange Softwood C24 100 mm x 160 mm
Tension member Softwood C24 100 mm x 160 mm
Nailing plates 2 x 80x240x1.5 Sheet steel S 250 with tensile strength $f_u = 330$ N/mm²
Connector nails (threaded nails) 4x50 to ETA-13/0523 - 2 x 5 Connector nails in the flange and 2 x 6 connector nails in the tension member
Service class 2, short load duration class → $k_{mod} = 0.9$

Resistance of nails in the flange

Shear resistance of a connector nail 4x50 to ETA-13/0523: $R_{v,k} = 2.21$ kN
4.0 x 2 5 0.9 / 1.3 2.21 / 100 mm

Nail resistance in tension member

Determination of n_{ef} to EN 1995-1-1 8.3.1.1 (8): $n_{ef} = n^{0,85} = 2 \cdot 3 \cdot 2^{0,85} = 10.8$
$R_d = 10.8 \cdot 0.9 / 1.3 \cdot 2.21 =$ **16.5 kN**

Nailing plate resistance

Net cross-sectional area: $A_{net} = 0.75 \cdot b \cdot t = 0.75 \cdot 80 \cdot 1.5 = 90$ mm²
$R_d = 0.9 \cdot 2 \cdot 90 \cdot 330 / 1.25 =$ **42.8 kN**
The eccentric loading of the nailing plates is ignored.

Transverse joint resistance

Distance of the outer row of fasteners to the loaded edge: $h_e = 120$ mm

$$R_{90,d} = 14 \cdot 100 \cdot \sqrt{\frac{120}{1 - 120/160} \cdot \frac{0,9}{1,3}} = \mathbf{21,2\ kN}$$

Resistance of the connection: R_d **= min (15.3; 16.5; 42.8; 21.2) =** **15.3 kN**

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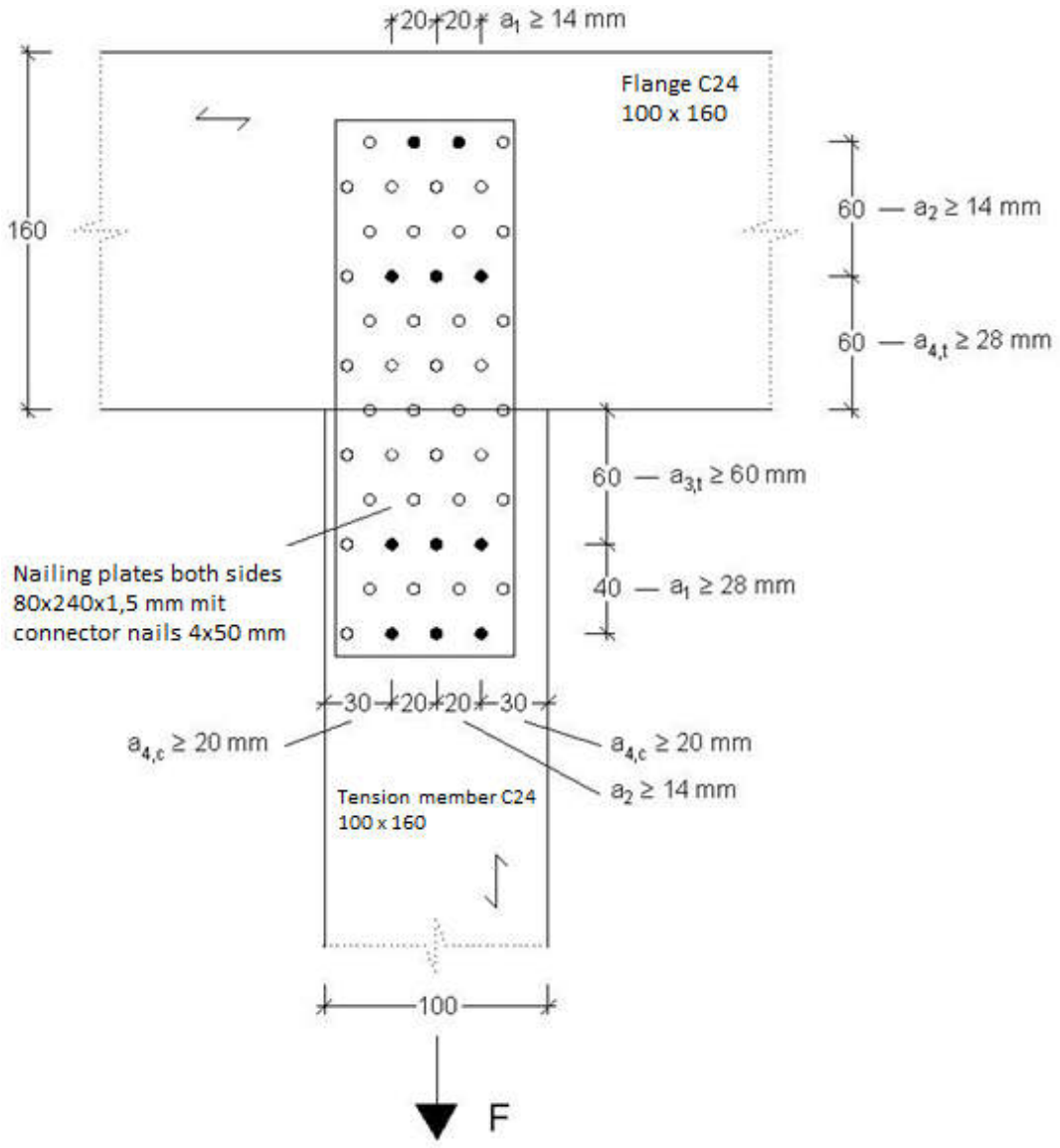

Minimum spacings to EN 1995-1-1 for threaded nails ∅ 4 mm in nailing plates, $\rho_k \leq 420$ kg/m³

		Force parallel to the grain	Force perpendicular to the grain
a_1	in grain direction	28 mm	14 mm
a_2	perpendicular to the grain direction	14 mm	14 mm
$a_{3,t}$	loaded end	60 mm	40 mm
$a_{3,c}$	unloaded end	40 mm	40 mm
$a_{4,t}$	loaded edge	20 mm	28 mm
$a_{4,c}$	unloaded edge	20 mm	20 mm