ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Internet
www.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

Member of EOTA

European Technical Assessment ETA-24/0816 of 2026/03/06

I General Part

Technical Assessment Body issuing the European Technical Assessment:
ETA-Danmark A/S

Trade name of the construction product:	T-FAST Plus self-tapping screws
Product family to which the above construction product belongs:	Screws and threaded rods for use in timber constructions
Manufacturer:	EJOT SE & Co. KG Market Unit Construction In der Stockwiese 35 57334 Bad Laasphe Internet: www.EJOT.com
Manufacturing plant:	EJOT Plant 13, EJOT Plant 21, EJOT Plant 29, EJOT Plant 50
This European Technical Assessment contains	39 pages including 6 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Article 95(4) of Regulation (EU) 2024/3110, on the basis of:	EAD 130118-01-0603: Screws and threaded rods for timber constructions
This version replaces:	The ETA with the same number issued on 2024-12-12

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of the product

EJOT T-FAST Plus screws are self-tapping screws to be used in timber structures. They shall be threaded over a part of the length or over the whole length. The screws shall be produced from carbon or stainless steel wire for nominal diameters of 3,0 mm to 8,0 mm. Where corrosion protection is required, the material or coating shall be declared in accordance with the relevant specification given in Annex A of EN 14592.

Geometry and Material
The nominal diameter (outer thread diameter), d, of EJOT screws shall not be less than 3,0 mm and shall not be greater than 8,0 mm. The overall length of the screws, ℓ, shall not be less than 30 mm and shall not be greater than 550 mm. Other dimensions are given in Annex A.

The ratio of inner thread diameter to outer thread diameter d_i/d is from 0,62 to 0,67.

The screws are threaded over a minimum length ℓ_g of $4{\cdot}d$ (i.e. $\ell_g \geq 4{\cdot}d$).

The lead p (distance between two adjacent thread flanks) ranges from $0{,}43{\cdot}d$ to $0{,}56{\cdot}d$.

No breaking of screws shall be observed at a bend angle, α, of less than $(45/d^{0,7} + 20)$ degrees.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

The screws are used for connections in load bearing timber structures between members of solid timber (softwood), glued laminated timber, cross-laminated timber, and laminated veneer lumber (softwood), similar glued members, wood-based panels or steel.

Steel plates and wood-based panels except solid wood panels, plywood, particleboard, OSB, laminated veneer lumber and cross laminated timber shall only be located on the side of the screw head. The following wood-based panels may be used:

- Plywood according to EN 636 or ETA
- Particleboard according to EN 312 or ETA
- Oriented Strand Board, Type OSB/3 and OSB/4 according to EN 300 or ETA
- Fibreboard according to EN 622-2 and 622-3 or ETA (minimum density 650 kg/m³) or national provisions that apply at the installation site
- Cement bonded particleboard according to EN 634 or ETA
- Solid wood panels according to EN 13353 and EN 13986 and cross laminated timber according to ETA
- Engineered wood products according to ETA, provided that the ETA for the product provides provisions for the use of self-tapping screws and these provisions are applied

The screws shall be driven into softwood without pre-drilling or after pre-drilling with a diameter not larger than the inner thread diameter for the length of the threaded part and with a maximum of the smooth shank diameter for the length of the smooth shank.

The screws are intended to be used in timber connections for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Regulation 305/2011 (EU) shall be fulfilled.

The design of the connections shall be based on the characteristic load-carrying capacities of the screws. The design capacities shall be derived from the characteristic capacities in accordance with Eurocode 5 or an appropriate national code.

The screws are intended for use for connections subject to static or quasi static loading.

The screws are for use in timber structures subject to the conditions defined by the service classes 1, 2 or 3 of EN 1995-1-1:2008 (Eurocode 5). In service class 1 and 2 the corrosion protection is given according to EN1995-1-1, or by equivalent measures. In service class 3 the corrosion protection is given according to EN1995-1-1 or by stainless steel.

The scope of the screws regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the screws of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic	
3.1 Mechanical resistance and stability*) (BWR1)		
Dimensions	See annex A	
Characteristic yield moment	See section 3.7	
Bending angle	See section 3.7	
Characteristic withdrawal parameter	See section 3.7	
Characteristic head pull-trough parameter of screws	See section 3.7	
Characteristic tensile strength	Characteristic value $f_{tens,k}$:	
Screws made from carbon steel	**d = 3,0 mm:**	**3,4 kN**
	d = 3,5 mm:	**4,1 kN**
	d = 4,0 mm:	**6,0 kN**
	d = 4,5 mm:	**7,4 kN**
	d = 5,0 mm:	**9,3 kN**
	d = 6,0 mm:	**13 kN**
	d = 8,0 mm:	**25 kN**
Screws made from stainless steel	**d = 3,0 mm:**	**2,3 kN**
	d = 3,5 mm:	**2,7 kN**
	d = 4,0 mm:	**3,7 kN**
	d = 4,5 mm:	**4,5 kN**
	d = 5,0 mm:	**7,0 kN**
	d = 6,0 mm:	**8,5 kN**
	d = 8,0 mm:	**12,5 kN**
Characteristic yield strength	See section 3.7	
Insertion moment	Ratio of the characteristic torsional strength to the mean insertion moment: $\mathbf{f_{tor,k} / R_{tor,mean} > 1,5}$	
Characteristic torsional strength	Characteristic value $f_{tor,k}$:	
Screws made from carbon steel	**d = 3,0 mm:**	**1,4 Nm**
	d = 3,5 mm:	**2,0 Nm**
	d = 4,0 mm:	**3,4 Nm**
	d = 4,5 mm:	**4,5 Nm**
	d = 5,0 mm:	**6,0 Nm**
	d = 6,0 mm:	**11 Nm**
	d = 8,0 mm:	**28 Nm**
Screws made from stainless steel	**d = 3,0 mm:**	**1,0 Nm**
	d = 3,5 mm:	**1,3 Nm**
	d = 4,0 mm:	**2,0 Nm**
	d = 4,5 mm:	**3,0 Nm**
	d = 5,0 mm:	**5,0 Nm**
	d = 6,0 mm:	**7,0 Nm**
	d = 8,0 mm:	**18 Nm**
Spacing, end and edge distances of the screws or threaded rods and minimum thickness of the timber material	See annex B	

Characteristic	Assessment of characteristic
Slip modulus for mainly axially loaded screws and threaded rods	See section 3.7
Durability against corrosion	See section 3.8
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The screws are made from steel classified as **class A1** in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364.

*) See additional information in section 3.3 – 3.5

3.3 Mechanical resistance and stability

The load-carrying capacities for EJOT screws are applicable to the wood-based materials mentioned in paragraph 1 even though the term timber has been used in the following.

The characteristic lateral load-carrying capacities and the characteristic axial withdrawal capacities of EJOT screws should be used for designs in accordance with Eurocode 5 or an appropriate national code.

Point side penetration length must be $\ell_{ef} \geq 4 \cdot d/\sin\varepsilon$, where d is the outer thread diameter of the screw and ε is the angle between screw axis and grain direction. For the fixing of rafters, point side penetration must be at least 40 mm, $\ell_{ef} \geq 40$ mm.

European Technical Assessments for structural members or wood-based panels must be considered where applicable.

Lateral load-carrying capacity

The characteristic lateral load-carrying capacity of EJOT screws shall be calculated according to EN 1995-1-1:2008 (Eurocode 5) using the outer thread diameter d as the nominal diameter of the screw. The contribution from the rope effect may be considered.

The characteristic yield moment shall be assumed as:

EJOT screws made from carbon steel:

d = 3,0 mm:	$M_{y,k}$ = 1,5 Nm
d = 3,5 mm:	$M_{y,k}$ = 2,0 Nm
d = 4,0 mm:	$M_{y,k}$ = 3,1 Nm
d = 4,5 mm:	$M_{y,k}$ = 3,9 Nm
d = 5,0 mm:	$M_{y,k}$ = 4,9 Nm
d = 6,0 mm:	$M_{y,k}$ = 9,5 Nm
d = 8,0 mm:	$M_{y,k}$ = 25 Nm

EJOT screws made from stainless steel:

d = 3,0 mm:	$M_{y,k}$ = 1,0 Nm
d = 3,5 mm:	$M_{y,k}$ = 1,3 Nm
d = 4,0 mm:	$M_{y,k}$ = 1,9 Nm
d = 4,5 mm:	$M_{y,k}$ = 2,6 Nm
d = 5,0 mm:	$M_{y,k}$ = 4,2 Nm
d = 6,0 mm:	$M_{y,k}$ = 6,3 Nm
d = 8,0 mm:	$M_{y,k}$ = 11 Nm

The embedding strength for screws in non-pre-drilled holes arranged at an angle between screw axis and grain direction, 0° ≤ ε ≤ 90° is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{2,5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon} \qquad \text{[N/mm²]}$$

And accordingly for screws in pre-drilled holes:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{2,5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon} \qquad \text{[N/mm²]}$$

Where

ρ_k characteristic timber density [kg/m³];
d outer thread diameter [mm];
ε angle between screw axis and grain direction;

The embedding strength for screws arranged parallel to the plane of cross laminated timber, independent of the angle between screw axis and grain direction, 0° ≤ ε ≤ 90°, shall be calculated from:

$$f_{h,k} = 20 \cdot d^{-0,5} \qquad \text{[N/mm²]}$$

unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber.

Where

d outer thread diameter [mm]

The embedding strength for screws in the wide face of cross laminated timber should be assumed as for solid timber based on the characteristic density of the outer layer. If relevant, the angle between force and grain direction of the outer layer should be taken into account.

The direction of the lateral force shall be perpendicular to the screw axis and parallel to the wide face of the cross laminated timber.

The embedding strength for screws in non-pre-drilled holes in softwood LVL arranged at an angle between screw axis and grain direction, 0° ≤ ε ≤ 90° is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{\left(2,5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon\right)\left(1,5 \cdot \cos^2 \beta + \sin^2 \beta\right)} \qquad \text{[N/mm²]}$$

and accordingly for screws in pre-drilled holes in softwood LVL:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{\left(2,5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon\right)\left(1,5 \cdot \cos^2 \beta + \sin^2 \beta\right)} \qquad \text{[N/mm²]}$$

Where:

ρ_k characteristic timber density [kg/m³]
d outer thread diameter [mm]
ε angle between screw axis and grain direction
β angle between screw axis and the LVL's wide face (0° ≤ β ≤ 90°).

For laterally loaded screws, the rules for multiple fastener connections in EN 1995-1-1, 8.3.1.1 (8) should be applied.

The lateral slip modulus K_{ser} for the serviceability limit state of screws in non-predrilled holes is given in EN 1995-1-1 (Eurocode 5) clause 7.1 and table 7.1 as for nails in non-predrilled holes.

The lateral slip modulus K_{ser} for the serviceability limit state of screws in predrilled holes is given in EN 1995-1-1 (Eurocode 5) clause 7.1 and table 7.1 as for nails in predrilled holes.

Axial withdrawal capacity
The characteristic axial withdrawal capacity of EJOT screws at an angle of 0° ≤ ε ≤ 90° to the grain in solid timber, glued laminated timber and cross-laminated timber members, and at an angle of 90° to the panel surface in plywood, OSB and particleboard shall be calculated from:

$$F_{ax,\varepsilon,Rk} = n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{\rho_a}\right)^{0,8} \quad [N]$$

Where:

$F_{ax,\varepsilon,Rk}$ characteristic withdrawal capacity of the screw at an angle α to the grain [N]

n_{ef} effective number of screws according to EN 1995-1-1

For inclined screws: $n_{ef} = \max\left\{n^{0,9}\,;0,9 \cdot n\right\}$

k_{ax} Factor, taking into account the angle α between screw axis and grain direction of timber members

k_{ax} = 1,0 for 45° ≤ ε < 90°

$k_{ax} = 0,3 + \frac{0,7 \cdot \alpha}{45}$ for 0° ≤ ε < 45°

$f_{ax,k}$ Characteristic withdrawal parameter for timber (ρ_a = 350 kg/m³):

d = 3 mm: $f_{ax,k} = 16,5 - 65/\ell_{ef}$ [N/mm²]
d = 3,5 mm: $f_{ax,k} = 16,5 - 65/\ell_{ef}$ [N/mm²]
d = 4 mm: $f_{ax,k} = 16,5 - 70/\ell_{ef}$ [N/mm²]
d = 4,5 mm: $f_{ax,k} = 13,5$ [N/mm²]
d = 5 mm: $f_{ax,k} = 16,0 - 80/\ell_{ef}$ [N/mm²]
d = 6 mm: $f_{ax,k} = 14,0 - 150/\ell_{ef}$ [N/mm²]
d = 8 mm: $f_{ax,k} = 13,0 - 190/\ell_{ef}$ [N/mm²]

$f_{ax,k}$ [N/mm²] for wood based panels with the tip outside the panel:

	PLY	PLY	OSB	PB
ρ_a [kg/m³]	400	600	550	600
d = 3 mm	19,0	45,0	12,5	22,0
d = 3,5 mm	17,0	45,0	12,5	18,0
d = 4 mm	17,0	45,0	12,5	18,0
d = 4,5 mm	17,0	40,0	12,5	18,0
d = 5 mm	17,0	40,0	16,0	18,0
d = 6 mm	14,5	40,0	10,5	16,0
d = 8 mm	14,0	35,0	10,5	13,0

PLY Plywood EN 636-1 S to EN 636-3 S
OSB OSB/3 to OSB/4 according to EN 300
PB Particleboard P4 to P7 according to EN 312
d outer thread diameter [mm]
ℓ_{ef} Penetration length of the threaded part including the tip according to EN 1995-1-1 [mm]
ε Angle between grain and screw axis (ε ≥ 15° for d = 3 mm, ε ≥ 0° for d > 3 mm)
ρ_k Characteristic density [kg/m³]

For screws arranged under an angle between screw axis and grain direction of less than 90°, the minimum threaded penetration length is:

$\ell_{ef} \geq 4 \cdot d/\sin\varepsilon$

For screws penetrating more than one layer of cross laminated timber, the different layers may be taken into account proportionally.

The axial withdrawal capacity is limited by the head pull-through capacity and the tensile capacity of the screw.

For axially loaded screws in tension, where the external force is parallel to the screw axes, the rules in EN 1995-1-1, 8.7.2 (8) should be applied.

For inclined screws in timber-to-timber or steel-to-timber shear connections, where the screws are arranged under an angle 30° ≤ α ≤ 60° between the shear plane and the screw axis, the effective number of screws n_{ef} should be determined as follows:

For one row of n screws parallel to the load, the load-carrying capacity should be calculated using the effective number of fasteners n_{ef}, where

$$n_{ef} = \max\left\{n^{0,9}\,;0,9 \cdot n\right\}$$

and n is the number of inclined screws in a row. If crossed pairs of screws are used in timber-to-timber connections, n is the number of crossed pairs of screws in a row.

Note: For screws for the fixing of thermal insulation material, n_{ef} = n.

The axial slip modulus K_{ser} of the threaded part of a screw for the serviceability limit state should be taken independent of angle α to the grain as:

$K_{ser} = 25 \cdot d \cdot \ell_{ef}$ [N/mm] for fasteners in softwood

Head pull-through capacity

The characteristic head pull-through capacity of EJOT screws shall be calculated according to EN 1995-1-1 from:

$$F_{ax,\varepsilon,Rk} = n_{ef} \cdot f_{head,k} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \quad [N]$$

where:

- $F_{ax,\varepsilon,RK}$ Characteristic head pull-through capacity of the connection at an angle $\varepsilon \geq 30°$ to the grain [N]
- n_{ef} Effective number of screws according to EN 1995-1-1:2008
  For inclined screws: $n_{ef} = \max\left\{n^{0,9}; 0,9 \cdot n\right\}$
  (see axial withdrawal capacity)
- $f_{head,k}$ Characteristic head pull-through parameter [N/mm²]
- d_h Diameter of the screw head or the washer [mm]. Outer diameter of heads or washers d_k > 35 mm shall not be considered.
- ρ_k Characteristic density [kg/m³], for wood-based panels ρ_k = 380 kg/m³

Characteristic head pull-through parameter for EJOT screws with washer head in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:

diameter $d_h \leq 15$ mm $f_{head,k}$ = 20 N/mm²
diameter 15 mm < $d_h \leq 21$ mm $f_{head,k}$ = 14 N/mm²

Characteristic head pull-through parameter for other EJOT screws with head diameter $d_h \leq 35$ mm in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:
$f_{head,k}$ = 10 N/mm²

Where
d_h head or washer diameter [mm]

Characteristic head pull-through parameter for screws in connections with wood-based panels with thicknesses between 12 mm and 20 mm:
$f_{head,k}$ = 8 N/mm²

Screws in connections with wood-based panels with a thickness below 12 mm (minimum thickness of the wood based panels of 1,2·d with d as outer thread diameter):
$f_{head,k}$ = 8 N/mm²
limited to $F_{ax,Rk}$ = 400 N

The head diameter d_h shall be greater than 1,8·d_s, where d_s is the smooth shank or the wire diameter. Otherwise, the characteristic head pull-through capacity $F_{ax,\alpha,Rk}$ = 0.

The minimum thickness of wood-based panels according to the clause 3.12 must be observed.

In steel-to-timber connections the head pull-through capacity is not governing.

Tensile capacity

The characteristic tensile strength $f_{tens,k}$ of EJOT screws is:

EJOT screws made from carbon steel:

d = 3,0 mm:	3,4 kN
d = 3,5 mm:	4,1 kN
d = 4,0 mm:	6,0 kN
d = 4,5 mm:	7,4 kN
d = 5,0 mm:	9,3 kN
d = 6,0 mm:	13 kN
d = 8,0 mm:	25 kN

EJOT screws made from stainless steel:

d = 3,0 mm:	2,3 kN
d = 3,5 mm:	2,7 kN
d = 4,0 mm:	3,7 kN
d = 4,5 mm:	4,5 kN
d = 5,0 mm:	7,0 kN
d = 6,0 mm:	8,5 kN
d = 8,0 mm:	12,5 kN

For screws used in combination with steel plates, the tear-off capacity of the screw head including a washer shall be greater than the tensile capacity of the screw.

Compressive capacity

The design compressive capacity $F_{c,90,Rd}$ of EJOT screws with full thread along the length embedded in timber with an angle between fastener axis and grain direction of 45° ≤ ε ≤ 90° is the minimum of the axial resistance against pushing-in and the buckling resistance:

$$F_{c,90,Rd} = \min\left\{F_{ax,Rd}; F_{ki,Rd}\right\}$$

$$F_{c,90,Rd} = \min\left\{f_{ax,d} \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{\rho_a}\right)^{0,8}; \frac{k_c \cdot N_{pl,k}}{\gamma_{M1}}\right\}$$

Where:

$$\kappa_c = \begin{cases} 1 & \text{for } \bar{\lambda}_k \leq 0,2 \\ \dfrac{1}{k + \sqrt{k^2 - \bar{\lambda}_k^2}} & \text{for } \bar{\lambda}_k > 0,2 \end{cases}$$

$$k = 0,5 \cdot \left[1 + 0,49 \cdot (\bar{\lambda}_k - 0,2) + \bar{\lambda}_k^2\right]$$

The relative slenderness ratio shall be calculated from:

$$\bar{\lambda}_k = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$$

where

$$N_{pl,k} = \pi \cdot \frac{d_1^2}{4} \cdot f_{y,k} \quad [N]$$

is the characteristic value for the axial capacity in case of plastic analysis referred to the inner thread cross-section.

Characteristic yield strength of screws from carbon steel:
$f_{y,k}$ = 1000 [N/mm²]

Characteristic yield strength of screws from stainless steel:
$f_{y,k} = 500$ [N/mm²]

Characteristic ideal elastic buckling load:
$$N_{ki,k} = \sqrt{c_h \cdot E_S \cdot I_S} \quad [N]$$

Elastic foundation of the screw:
$$c_h = (0{,}19 + 0{,}012 \cdot d) \cdot \rho_k \cdot \left(\frac{\varepsilon}{180°} + 0{,}5\right) \quad [N/mm^2]$$

Modulus of elasticity:
$E_s = 210000$ [N/mm²]

Second moment of area:
$$I_S = \frac{\pi}{64} \cdot d_1^4 \quad [mm^4]$$

$f_{ax,d}$ design value of the axial withdrawal parameter of the threaded part of the screw [N/mm²]

d_1 inner thread diameter [mm]

d outer thread diameter [mm]
ℓ_{ef} penetration length of the threaded part [mm]

ε angle between screw axis and grain direction
ρ_k characteristic density [kg/m³]
ρ_a associated density for $f_{ax,k}$ [kg/m³]
γ_{M1} partial factor according to EN 1993 or to the particular national annex

Combined laterally and axially loaded screws
For connections subjected to a combination of axial and lateral load, the following expression should be satisfied:

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^2 + \left(\frac{F_{la,Ed}}{F_{la,Rd}}\right)^2 \le 1$$

where
$F_{ax,Ed}$ axial design load of the screw
$F_{la,Ed}$ lateral design load of the screw
$F_{ax,Rd}$ design load-carrying capacity of an axially loaded screw
$F_{la,Rd}$ design load-carrying capacity of a laterally loaded screw

3.4 Aspects related to the performance of the product

3.4.1 Corrosion protection
The EJOT screws are produced from steel wire. Screws made from carbon steel are electrogalvanised. The thickness of the zinc coating is minimum 5 µm. Screws with diameter ≤ 6,0 mm may have a zinc flake coating or combination of electro galvanisation and zinc flake coating with thicknesses from 10 to 30 µm.

The screws are for use in timber structures subject to service classes 1, 2 and 3 of Eurocode 5. In service class 1 and 2 the corrosion protection is given according to EN1995-1-1, or by equivalent measures.

In service class 3 the corrosion protection is given by stainless steel no. 1.4301 1.4567, 1.4318, 1.4401, 1.4578, or 1.4539.

Contact corrosion shall be avoided.

3.5 General aspects related to the intended use of the product

The screws are manufactured in accordance with the provisions of the European Technical Assessment using the automated manufacturing process laid down in the technical documentation.

The installation shall be carried out in accordance with Eurocode 5 or an appropriate national code unless otherwise is defined in the following. Instructions from EJOT SE & Co. KG should be considered for installation.

The screws are used for connections in load bearing timber structures between members of solid timber (softwood), glued laminated timber, cross-laminated timber, and laminated veneer lumber, similar glued members, wood-based panels or steel members.

The screws may be used for connections in load bearing timber structures with structural members according to an associated European Technical Assessment, if according to the associated European Technical Assessment of the structural member a connection in load bearing timber structures with screws according to a European Technical Assessment is allowed.

A minimum of two screws should be used for connections in load bearing timber structures. This does not apply for the fixing of battens, rafters, purlins or similar on main beams or top plates, if the member is fixed with at least two screws in total.

The minimum penetration depth in structural members made of solid, glued or cross-laminated timber is $4 \cdot d / \sin\alpha$.

Wood-based panels and steel plates should only be arranged on the side of the screw head. The minimum thickness of wood-based panels should be $1{,}2 \cdot d$. Furthermore the minimum thickness for following wood-based panels should be:

- Plywood, Fibreboards: 6 mm
- Particleboards, OSB, Cement Particleboards: 8 mm
- Solid wood panels: 12 mm

For structural members according to European Technical Assessments the terms of the European Technical Assessments must be considered.

The minimum angle between the screw axis and the grain direction is $\alpha = 15°$.

The screws shall be driven into the wood with or without pre-drilling. The maximum pre-drilling diameter is 4 mm for the length of the threaded part and the smooth shank diameter for the depth of the smooth shank.

The hole diameter in steel members must be predrilled with a suitable diameter.

Only the equipment prescribed by EJOT SE & Co. KG shall be used for driving the screws.

In connections with screws with countersunk head according to Annex A the head must be flush with the surface of the connected structural member. A deeper countersink is not allowed.

Unless otherwise specified, minimum thickness for non-predrilled structural members is t = 24 mm for screws with outer thread diameter d = 6 mm.

For structural timber members, minimum spacing and distances for screws are given in EN 1995-1-1 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in predrilled or non-predrilled holes, respectively. Here, the outer thread diameter d must be considered.

For Douglas fir members minimum spacing and distances parallel to the grain shall be increased by 50%.

Minimum distances from the unloaded edge perpendicular to the grain may be reduced to 3·d, if the spacing parallel to the grain and the end distance is at least 25·d.

Minimum distances and spacing for screws in the plane surface of cross laminated timber members with a minimum thickness t = 10·d may be taken as (see Annex B):

Spacing a_1 parallel to the grain	$a_1 = 4 \cdot d$
Spacing a_2 perpendicular to the grain	$a_2 = 2{,}5 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded end grain	$a_{1,c,CG} = 6 \cdot d$
Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded end grain	$a_{1,t,CG} = 6 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge	$a_{2,c,CG} = 2{,}5 \cdot d$
Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge	$a_{2,t,CG} = 6 \cdot d$

Minimum distances and spacing for screws in the edge surface of cross laminated timber members with a minimum thickness t = 10·d and a minimum penetration depth perpendicular to the edge surface ℓ_{ef} = 10·d may be taken as (see Annex B):

Spacing a_1 parallel to the CLT plane	$a_1 = 10 \cdot d$
Spacing a_2 perpendicular to the CLT plane	$a_2 = 4 \cdot d$
Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded end	$a_{1,c,CG} = 7 \cdot d$
Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded end	$a_{1,t,CG} = 12 \cdot d$
Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge	$a_{2,c,CG} = 5 \cdot d$
Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge	$a_{2,t,CG} = 6 \cdot d$

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 AVCP system

According to the decision 1997/176/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is **3**.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

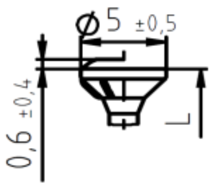
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2026-03-06 by

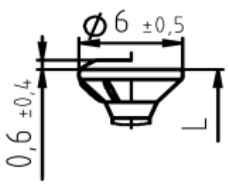
Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Drawing of EJOT screws

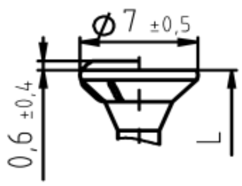
Head shapes for d = 3,0 mm



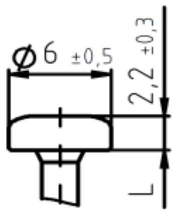
Countersunk-head
raised or flat
w. or w/o ribs



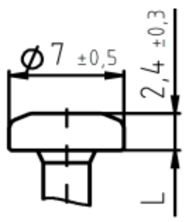
Countersunk-head
raised or flat
w. or w/o ribs



Countersunk-head
raised or flat
w. or w/o ribs



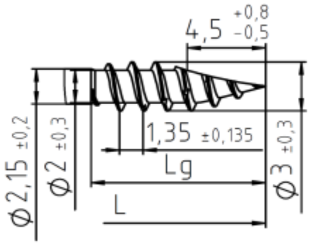
Raised-head



Raised-head

EJOT JW screw made of carbon steel or stainless steel	Annex A 1
T-FAST Plus - d = 3,0 mm	

Thread types for d = 3,0 mm



Single thread, Type S
Optional w. or w/o slot

Lengths for d = 3,0 mm

L	Lg	Material / surface	Thread type
14 ~ 30	12 ~ 25	Carbon steel / galvanik or organic	Type S
14 ~ 30	12 ~ 25	Stainless steel	Type S

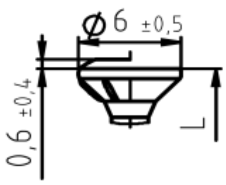
Tolerances according to EAD 130118-01-0603

Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

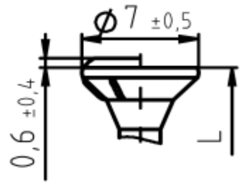
All dimensions in mm.

EJOT JW screw made of carbon steel or stainless steel	Annex A 2
T-FAST Plus - d = 3,0 mm	

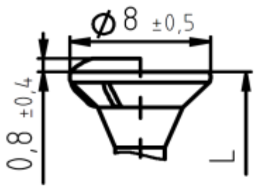
Head shapes for d = 3,5 mm



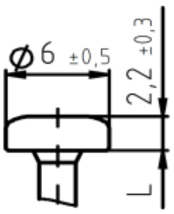
Countersunk-head
raised or flat
w. or w/o ribs



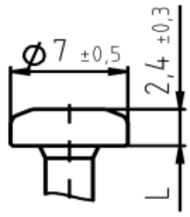
Countersunk-head
raised or flat
w. or w/o ribs



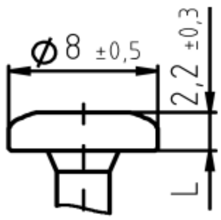
Countersunk-head
raised or flat
w. or w/o ribs



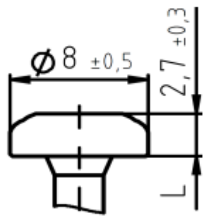
Raised-head



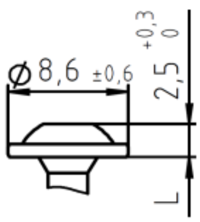
Raised-head



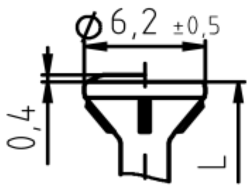
Raised-head



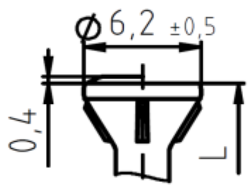
Raised-head



Washer-head



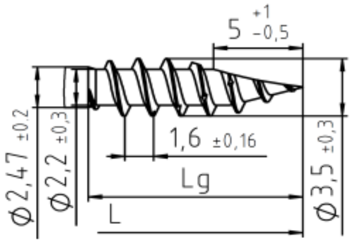
Countersunk-head 75°
raised or flat
w. or w/o ribs



Countersunk-head 60°
raised or flat
w. or w/o ribs

EJOT JW screw made of carbon steel or stainless steel	Annex A 3
T-FAST Plus - d = 3,5 mm	

Thread types for d = 3,5 mm



Single thread, Type S
Optional w. or w/o slot

Lengths for d = 3,5 mm

L	Lg	Material / surface	Thread type
16 ~ 70	14 ~ 40	Carbon steel / galvanik or organic	Type S
16 ~ 70	14 ~ 40	Stainless steel	Type S

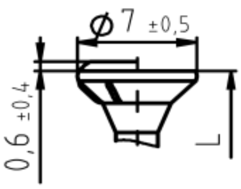
Tolerances according to EAD 130118-01-0603

Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

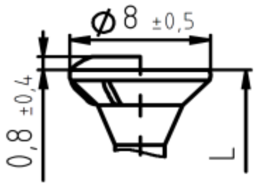
All dimensions in mm.

EJOT JW screw made of carbon steel or stainless steel	Annex A 4
T-FAST Plus - d = 3,5 mm	

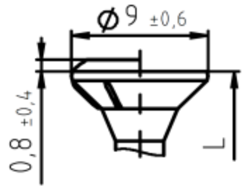
Head shapes for d = 4,0 mm



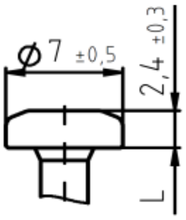
Countersunk-head
raised or flat
w. or w/o ribs



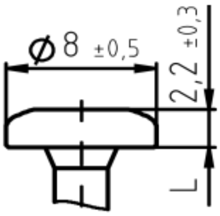
Countersunk-head
raised or flat
w. or w/o ribs



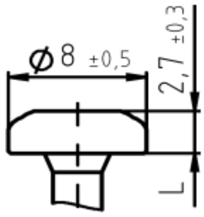
Countersunk-head
raised or flat
w. or w/o ribs



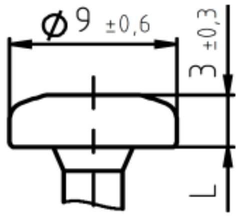
Raised-head



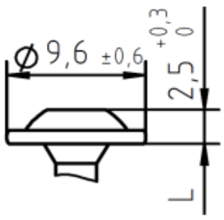
Raised-head



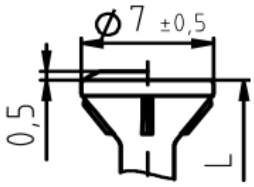
Raised-head



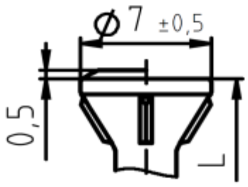
Raised-head



Washer-head



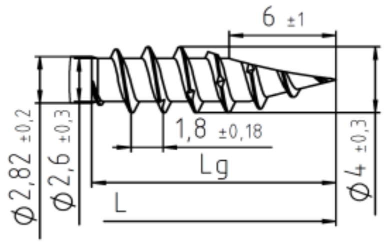
Countersunk-head 75°
raised or flat
w. or w/o ribs



Countersunk-head 60°
raised or flat
w. or w/o ribs

EJOT JW screw made of carbon steel or stainless steel	Annex A 5
T-FAST Plus - d = 4,0 mm	

Thread types for d = 4,0 mm



Single thread, Type S
Optional w. or w/o slot

Lengths for d = 4,0 mm

L	Lg	Material / surface	Thread type
18 ~ 70	16 ~ 64	Carbon steel / galvanik or organic	Type S
18 ~ 70	16 ~ 64	Stainless steel	Type S

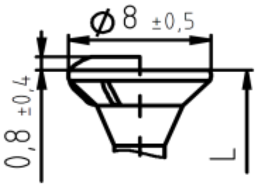
Tolerances according to EAD 130118-01-0603

Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

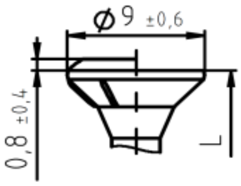
All dimensions in mm.

EJOT JW screw made of carbon steel or stainless steel	Annex A 6
T-FAST Plus - d = 4,0 mm	

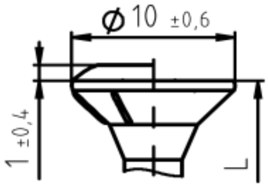
Head shapes for d = 4,5 mm



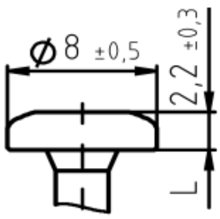
Countersunk-head
raised or flat
w. or w/o ribs



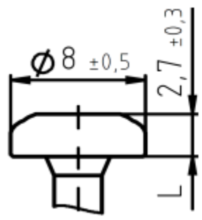
Countersunk-head
raised or flat
w. or w/o ribs



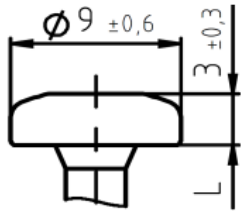
Countersunk-head
raised or flat
w. or w/o ribs



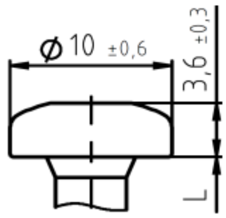
Raised-head



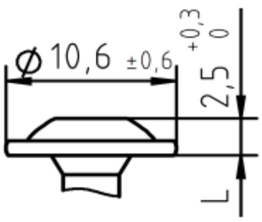
Raised-head



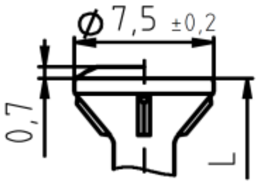
Raised-head



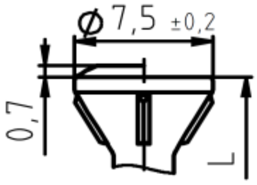
Raised-head



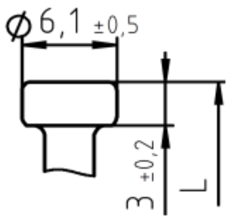
Washer-head



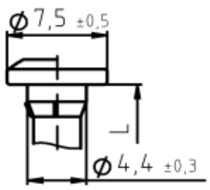
Countersunk-head 75°
raised or flat
w. or w/o ribs



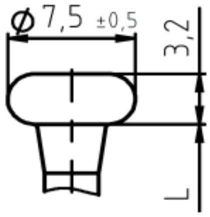
Countersunk-head 60°
raised or flat
w. or w/o ribs



Cylinder-head



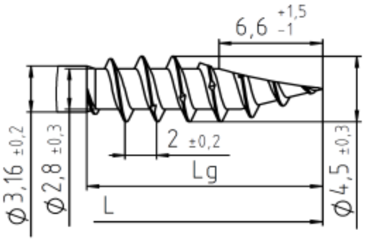
Connector-head
raised or flat
w. or w/o ribs



Connector-head

EJOT JW screw made of carbon steel or stainless steel	Annex A 7
T-FAST Plus - d = 4,5 mm	

Thread types for d = 4,5 mm



Single thread, Type S
Optional w. or w/o slot

Lengths for d = 4,5 mm

L	Lg	Material / surface	Thread type
20 ~ 80	18 ~ 74	Carbon steel / galvanik or organic	Type S
20 ~ 80	18 ~ 74	Stainless steel	Type S

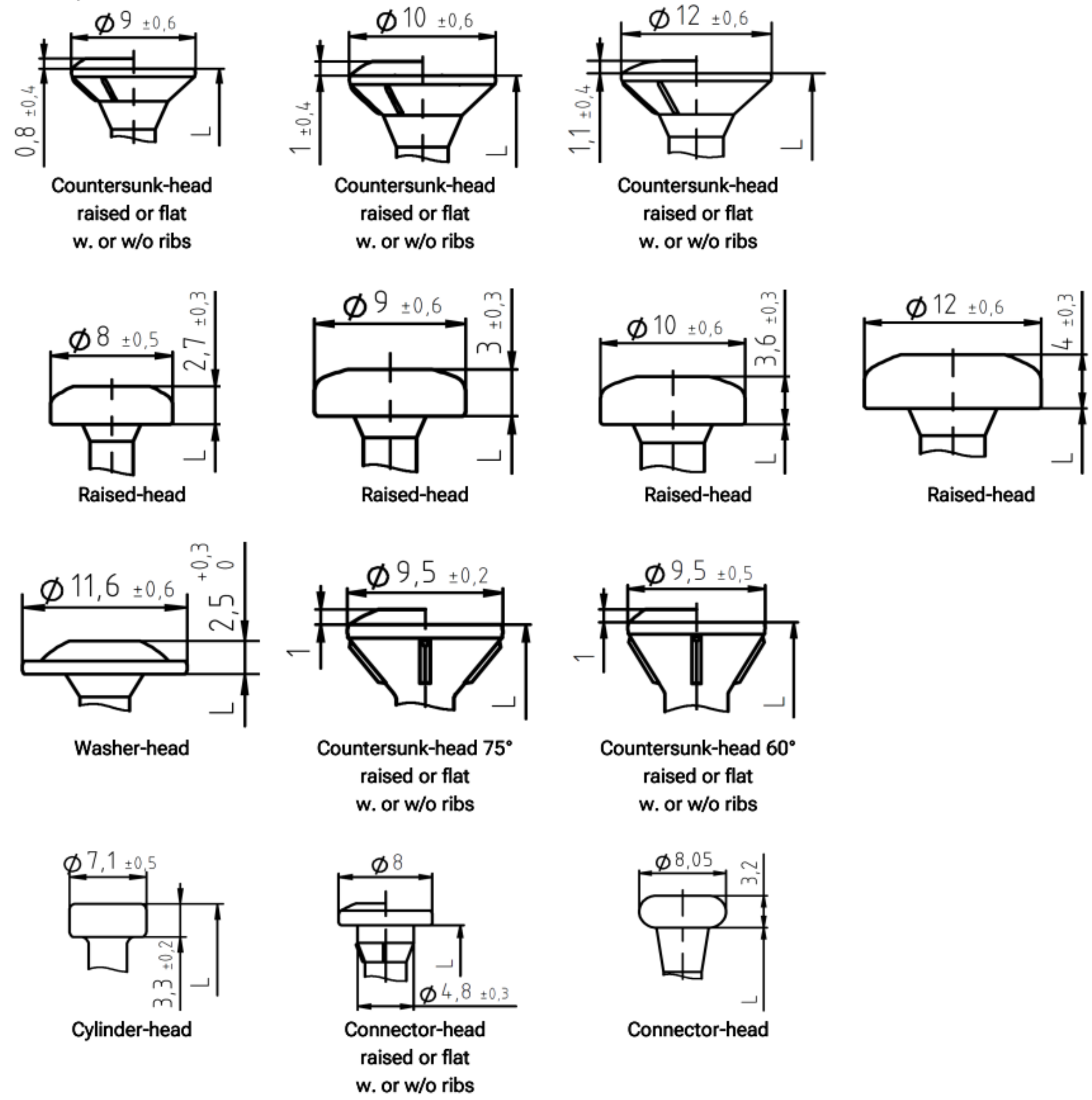
Tolerances according to EAD 130118-01-0603

Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

All dimensions in mm.

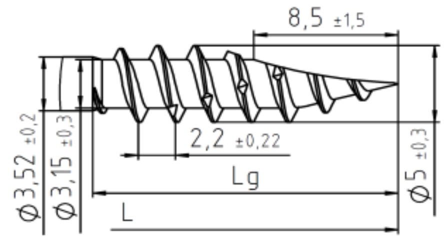
EJOT JW screw made of carbon steel or stainless steel	Annex A 8
T-FAST Plus - d = 4,5 mm	

Head shapes for d = 5,0 mm

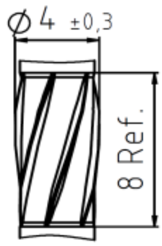


EJOT JW screw made of carbon steel or stainless steel	Annex A 9
T-FAST Plus - d = 5,0 mm	

Thread types for d = 5,0 mm



Single thread, Type S
Optional w. or w/o slot



Reamer

Lengths for d = 5,0 mm

L	Lg	Material / surface	Thread type
22 ~ 120	20 ~ 70	Carbon steel / galvanik or organic	Type S
22 ~ 120	20 ~ 70	Stainless steel	Type S

Tolerances according to EAD 130118-01-0603

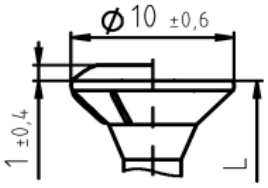
Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

Screws with partial thread and smooth shank length < 50 mm w/o reamer.
Screws with partial thread and smooth shank length ≥ 50 mm with reamer.

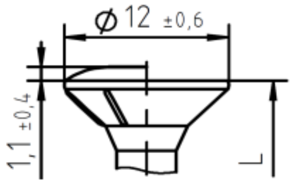
All dimensions in mm.

EJOT JW screw made of carbon steel or stainless steel	Annex A 10
T-FAST Plus - d = 5,0 mm	

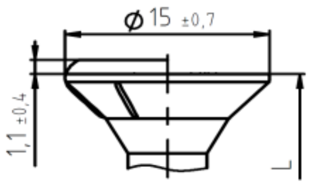
Head shapes for d = 6,0 mm



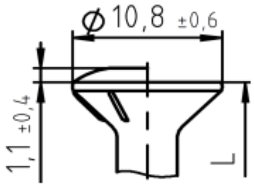
Countersunk-head raised or flat w. or w/o ribs



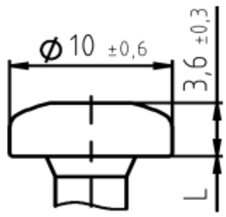
Countersunk-head raised or flat w. or w/o ribs



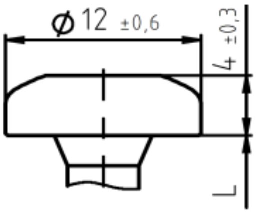
Countersunk-head raised or flat w. or w/o ribs



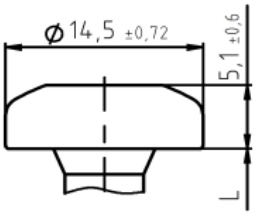
Countersunk-head raised or flat w. or w/o ribs



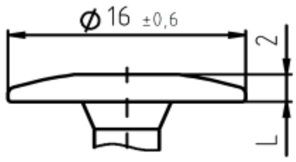
Raised-head



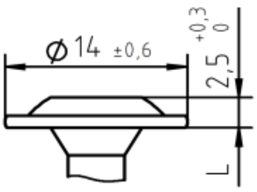
Raised-head



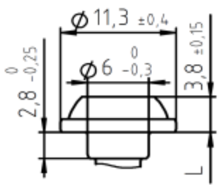
Raised-head



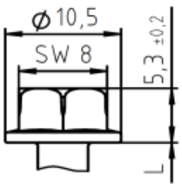
KD16-head



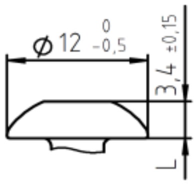
Washer-head



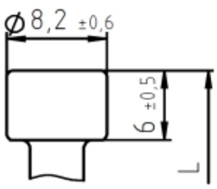
Washer-head w. cylinder



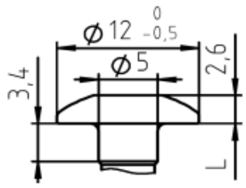
HEX-head



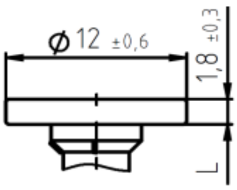
FR-head



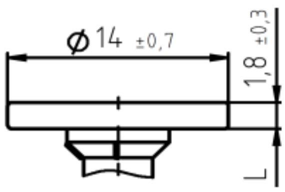
Cylinder-head



XT-head



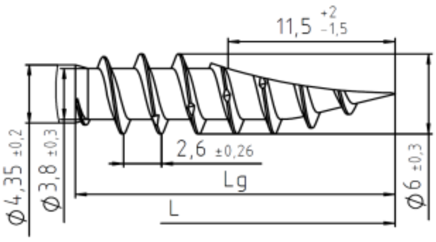
Flat washer-head w. or w/o ribs



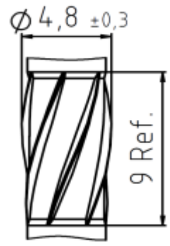
Flat washer-head w. or w/o ribs

EJOT JW screw made of carbon steel or stainless steel	Annex A 11
T-FAST Plus - d = 6,0 mm	

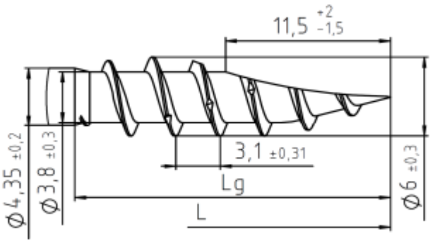
Thread types for d = 6,0 mm



Single thread, Type S
Optional w. or w/o slot



Reamer



Single thread, Type M
Optional w. or w/o slot

Lengths for d = 6,0 mm

L	Lg	Material / surface	Thread type
26 ~ 220	24 ~ 205	Carbon steel / galvanik or organic	Type S
26 ~ 300	24 ~ 90	Carbon steel / galvanik or organic	Type M
26 ~ 100	24 ~ 80	Stainless steel	Type S
26 ~ 300	24 ~ 80	Stainless steel	Type M

Tolerances according to EAD 130118-01-0603

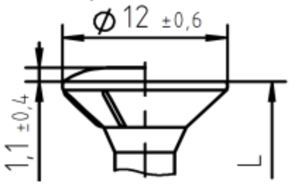
Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

Screws with partial thread and smooth shank length < 50 mm w/o reamer.
Screws with partial thread and smooth shank length ≥ 50 mm with reamer.

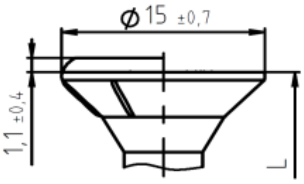
All dimensions in mm.

EJOT JW screw made of carbon steel or stainless steel	Annex A 12
T-FAST Plus - d = 6,0 mm	

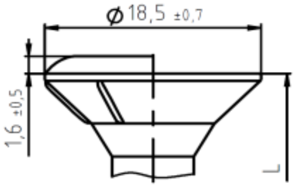
Head shapes for d = 8,0 mm



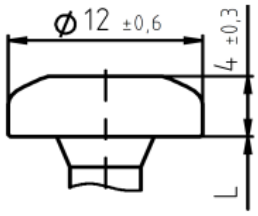
Countersunk-head
raised or flat
w. or w/o ribs



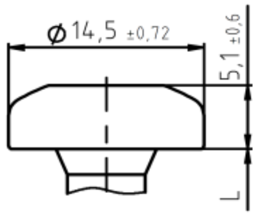
Countersunk-head
raised or flat
w. or w/o ribs



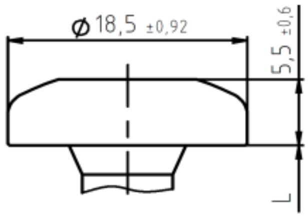
Countersunk-head
raised or flat
w. or w/o ribs



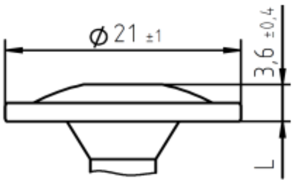
Raised-head



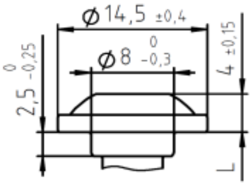
Raised-head



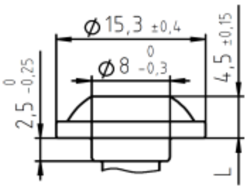
Raised-head



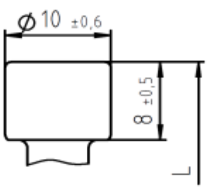
Washer-head



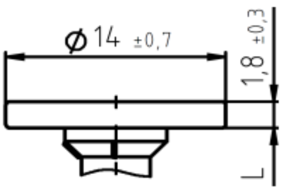
Washer-head w. cylinder



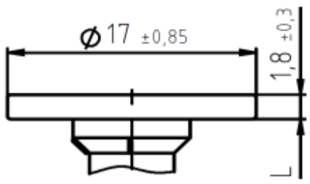
Washer-head w. cylinder



Cylinder-head



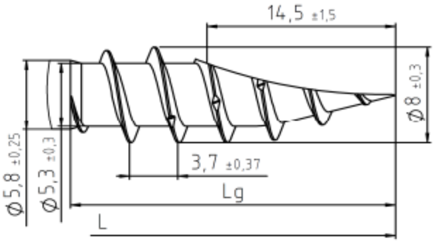
Flat washer-head
w. or w/o ribs



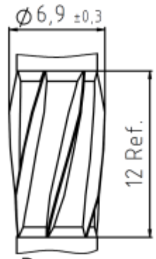
Flat washer-head
w. or w/o ribs

EJOT JW screw made of carbon steel or stainless steel	Annex A 13
T-FAST Plus - d = 8,0 mm	

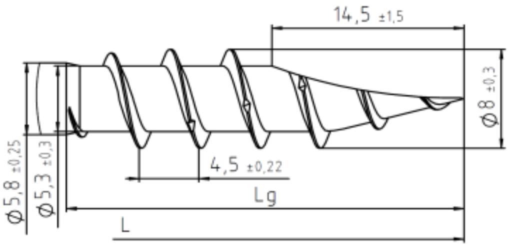
Thread types for d = 8,0 mm



Single thread, Type S
Optional w. or w/o slot



Reamer



Single thread, Type M
Optional w. or w/o slot

Lengths for d = 8,0 mm

L	Lg	Material / surface	Thread type
34 ~ 550	32 ~ 535	Carbon steel / galvanik	Type S
34 ~ 550	32 ~ 80	Carbon steel / galvanik	Type M
34 ~ 430	32 ~ 415	Stainless steel	Type S
34 ~ 400	32 ~ 80	Stainless steel	Type M

Tolerances according to EAD 130118-01-0603

Screws with full and partial threads are possible. The screw and thread lengths can be customised and manufactured within the specified ranges of L and Lg.

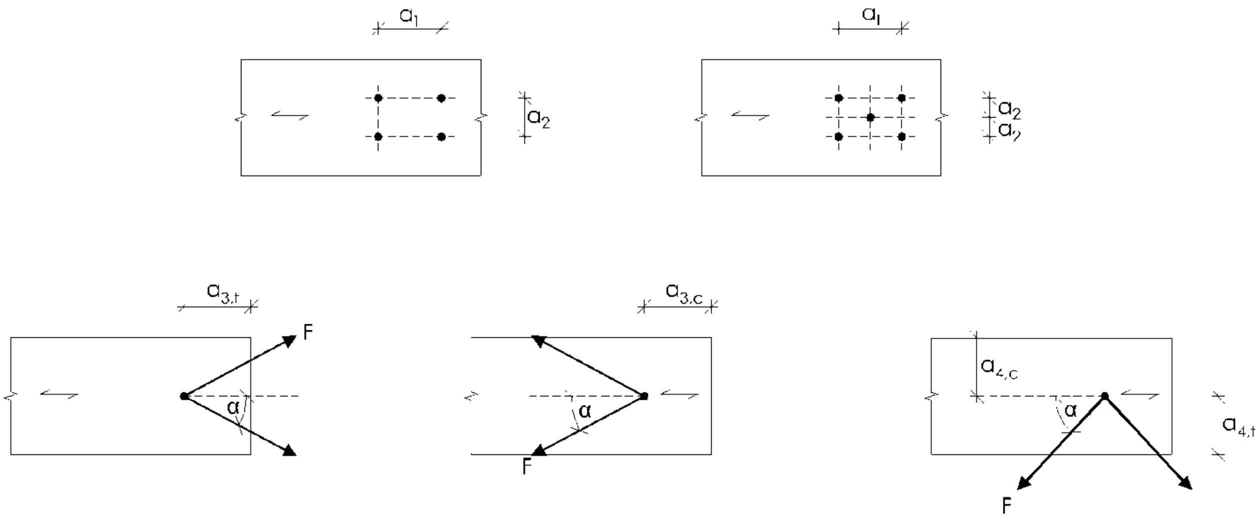
Screws with partial thread and smooth shank length < 50 mm w/o reamer.
Screws with partial thread and smooth shank length ≥ 50 mm with reamer.

All dimensions in mm.

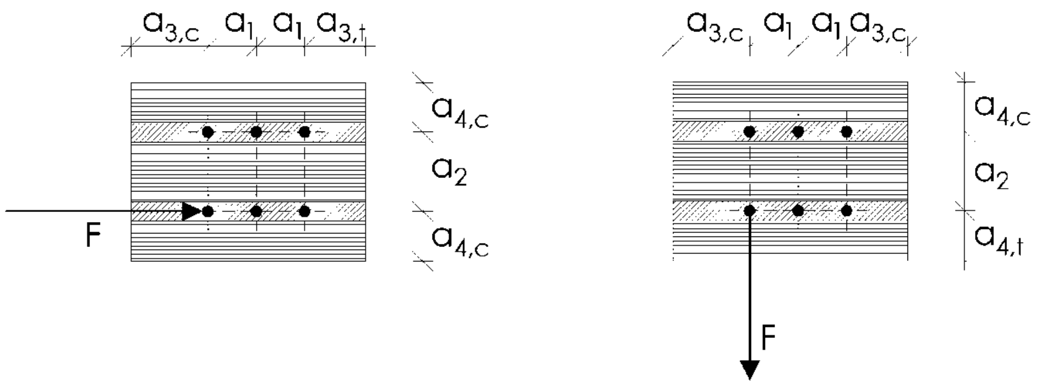
EJOT JW screw made of carbon steel or stainless steel	Annex A 14
T-FAST Plus - d = 8,0 mm	

Annex B
Axially or laterally loaded screws in the plane or edge surface of cross laminated timber

Definition of spacing, end and edge distances in the plane surface unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber:



Definition of spacing, end and edge distances in the edge surface unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber:



For screws in the edge surface, a_1 and a_3 are parallel to the CLT plane face, a_2 and a_4 perpendicular to CLT plane face.

Table B1: Minimum spacing, end and edge distances of screws in the plane or edge surfaces of cross laminated timber

	a_1	$a_{3,t}$	$a_{3,c}$	a_2	$a_{4,t}$	$a_{4,c}$
Plane surface (see Figure 1)	$4 \cdot d$	$6 \cdot d$	$6 \cdot d$	$2{,}5 \cdot d$	$6 \cdot d$	$2{,}5 \cdot d$
Edge surface (see Figure 2)	$10 \cdot d$	$12 \cdot d$	$7 \cdot d$	$4 \cdot d$	$6 \cdot d$	$3 \cdot d$

Annex C
Compression reinforcement

EJOT screws with a full thread may be used for reinforcement of timber members with compression stresses at an angle α to the grain of $45° \leq \varepsilon \leq 90°$. The compression force must be evenly distributed over all screws. The screw head must be flush with the surface of the timber member.

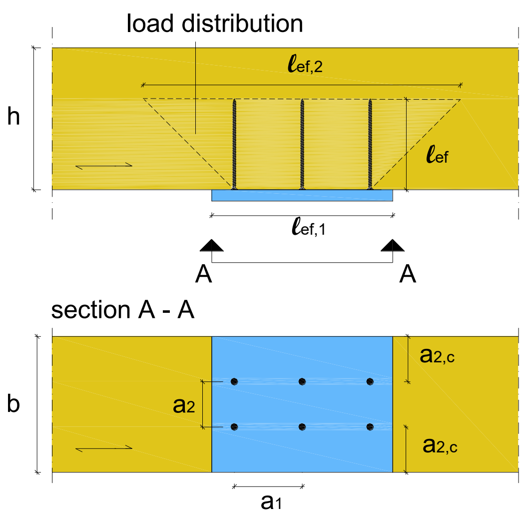
The characteristic load-carrying capacity for a contact area with screws with a full thread at an angle ε to the grain of $45° \leq \varepsilon \leq 90°$ shall be calculated from:

$$F_{90,Rk} = \min \begin{cases} k_{c,90} \cdot b \cdot \ell_{ef,1} \cdot f_{c,90,k} + n \cdot F_{ax,Rk} \\ b \cdot \ell_{ef,2} \cdot f_{c,90,k} \end{cases}$$

Where:

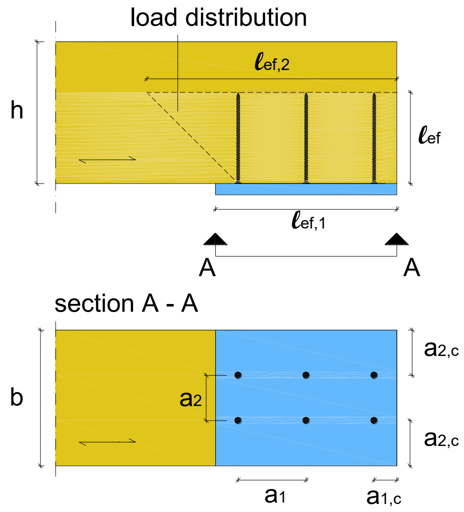
$F_{90,Rk}$ Load-carrying capacity of reinforced contact area [N]
$k_{c,90}$ factor for compression perpendicular to the grain according to EN 1995-1-1
b bearing width [mm]
$\ell_{ef,1}$ effective length of contact area according to EN 1995-1-1 [mm]
$f_{c,90,k}$ characteristic compressive strength perpendicular to the grain [N/mm²]
n number of reinforcement screws, $n = n_0 \cdot n_{90}$
n_0 number of reinforcement screws arranged in a row parallel to the grain
n_{90} number of reinforcement screws arranged in a row perpendicular to the grain
$F_{ax,Rk}$ characteristic compressive capacity [N]
$\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
$\ell_{ef,2}$ $= \ell_{ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{ef}; a_{1,c})$ for end-bearings [mm]
$\ell_{ef,2}$ $= 2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1$ for centre-bearings [mm]
ℓ_{ef} point side penetration length [mm]
a_1 spacing parallel to the grain [mm]
$a_{1,c}$ end distance [mm]

Reinforced centre-bearing



h component height [mm]
b bearing width [mm]
ℓ_{ef} point side penetration length [mm]
$\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
$= 2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1$ for centre-bearings

Reinforced end-bearing



h	component height [mm]
b	bearing width [mm]
ℓ_{ef}	point side penetration length [mm]
$\ell_{ef,2}$	effective distribution length in the plane of the screw tips [mm] $= \ell_{ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{ef}; a_{1,c})$ for end-bearings

Reinforcing screws for wood-based panels and hardwoods are not covered by this European Technical Assessment.

Annex D
Thermal insulation material on top of rafters

EJOT screws with an outer thread diameter 6 mm ≤ d ≤ 8 mm may be used for the fixing of thermal insulation material on top of rafters.

The thickness of the insulation shall not exceed 400 mm. The rafter insulation must be placed on top of solid timber or glued laminated timber rafters or cross-laminated timber members and be fixed by battens arranged parallel to the rafters or by wood-based panels on top of the insulation layer. The insulation of vertical facades is also covered by the rules given here.

Screws must be screwed in the rafter through the battens or panels and the insulation without pre-drilling in one sequence.

The angle ε between the screw axis and the grain direction of the rafter should be between 30° and 90°.

The rafter consists of solid timber (softwood) according to EN 338, glued laminated timber according to EN 14081, cross-laminated timber, or laminated veneer lumber according to EN 14374 or to ETA or similar glued members according to ETA.

The battens must be from solid timber (softwood) according to EN 338:2003-04. The minimum thickness t and the minimum width b of the battens is given as follows:

Screws d ≤ 8,0 mm: b_{min} = 50 mm t_{min} = 30 mm

The insulation must comply with an ETA.

Friction forces shall not be considered for the design of the characteristic axial capacity of the screws.

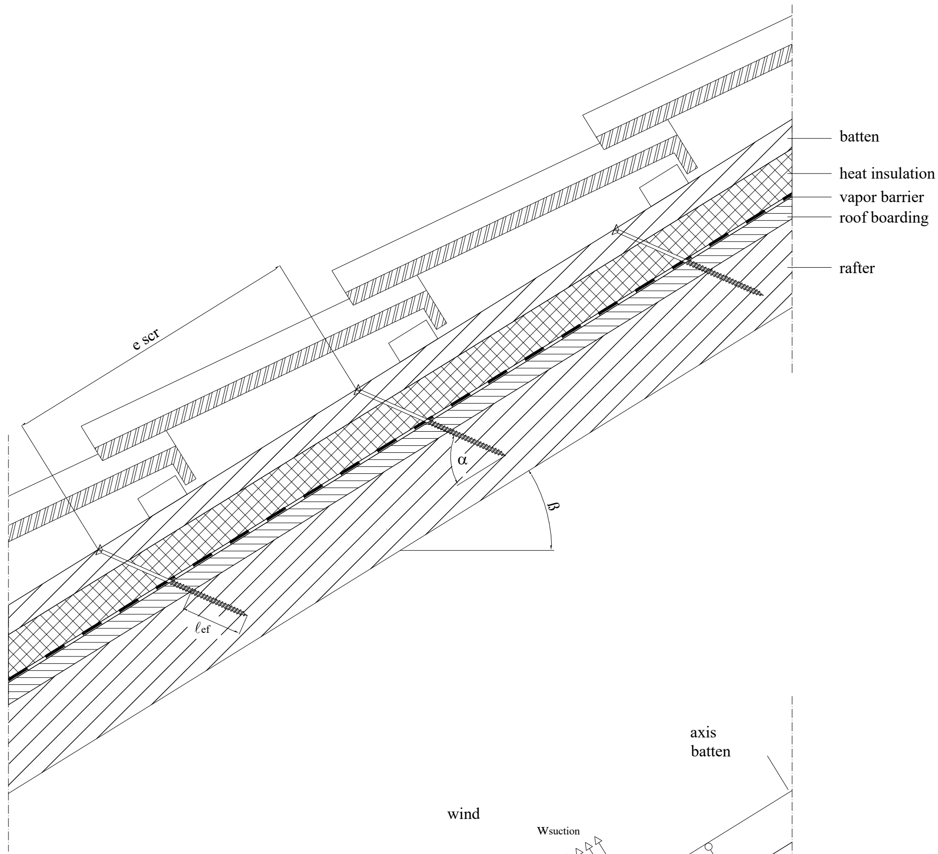
The anchorage of wind suction forces as well as the bending stresses of the battens or the boards, respectively, shall be considered in design. Additional screws perpendicular to the grain of the rafter (angle ε = 90°) may be arranged if necessary.

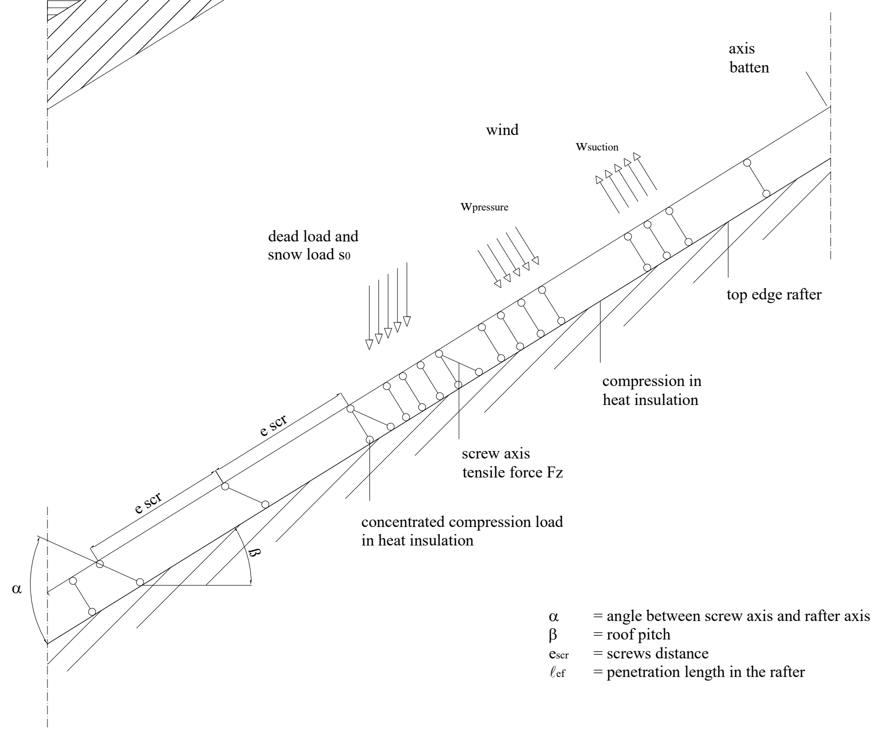
The maximum screw spacing is e_S = 1,75 m.

Thermal insulation material on rafters with parallel inclined screws

Mechanical model

The system of rafter, heat insulation on top of rafter and battens parallel to the rafter may be considered as a beam on elastic foundation. The batten represents the beam, and the heat insulation on top of the rafter the elastic foundation. The minimum compression stress of the heat insulation at 10 % deformation, measured according to EN 826[1], shall be $\sigma_{(10\,\%)}$ = 0,05 N/mm². The batten is loaded perpendicular to the axis by point loads F_b. Further point loads F_s are from the shear load of the roof due to dead and snow load, which are transferred from the screw heads into the battens.





1 EN 826:1996 Thermal insulating products for building applications - Determination of compression behaviour

Design of the battens

The bending stresses are calculated as:

$$M = \frac{(F_b + F_s) \cdot \ell_{char}}{4}$$

Where

ℓ_{char} = characteristic length $\ell_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}}$

EI = bending stiffness of the batten

K = coefficient of subgrade

w_{ef} = effective width of the heat insulation

F_b = Point loads perpendicular to the battens

F_s = Point loads perpendicular to the battens, load application in the area of the screw heads

The coefficient of subgrade K may be calculated from the modulus of elasticity E_{HI} and the thickness t_{HI} of the heat insulation if the effective width w_{ef} of the heat insulation under compression is known. Due to the load extension in the heat insulation the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the heat insulation may be determined according to:

$$w_{ef} = w + t_{HI} / 2$$

where

w = minimum width of the batten or rafter, respectively

t_{HI} = thickness of the heat insulation

$$K = \frac{E_{HI}}{t_{HI}}$$

The following condition shall be satisfied:

$$\frac{\sigma_{m,d}}{f_{m,d}} = \frac{M_d}{W \cdot f_{m,d}} \leq 1$$

For the calculation of the section modulus W the net cross section has to be considered.

The shear stresses shall be calculated according to:

$$V = \frac{(F_b + F_s)}{2}$$

The following condition shall be satisfied:

$$\frac{\tau_d}{f_{v,d}} = \frac{1,5 \cdot V_d}{A \cdot f_{v,d}} \leq 1$$

For the calculation of the cross section area the net cross section has to be considered.

Design of the heat insulation

The compressive stresses in the heat insulation shall be calculated according to:

$$\sigma = \frac{1,5 \cdot F_b + F_s}{2 \cdot \ell_{char} \cdot w}$$

The design value of the compressive stress shall not be greater than 110 % of the compressive stress at 10 % deformation calculated according to EN 826.

Design of the screws

The screws are loaded predominantly axially. The axial tension force in the screw may be calculated from the shear loads of the roof R_s:

$$T_S = \frac{R_S}{\cos\alpha}$$

The load-carrying capacity of axially loaded screws is the minimum design value of the axial withdrawal capacity of the threaded part of the screw, the head pull-through capacity of the screw and the tensile capacity of the screw.

In order to limit the deformation of the screw head for Thermal insulation material thicknesses over 200 mm or with compressive strength below 0,12 N/mm², respectively, the axial withdrawal capacity of the screws shall be reduced by the factors k_1 and k_2:

$$F_{ax,\varepsilon,Rd} = \min\left\{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2 \cdot \left(\frac{\rho_k}{350}\right)^{0.8}; f_{head,d} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0.8}; f_{tens,d}\right\} \quad \text{for screws with partial thread}$$

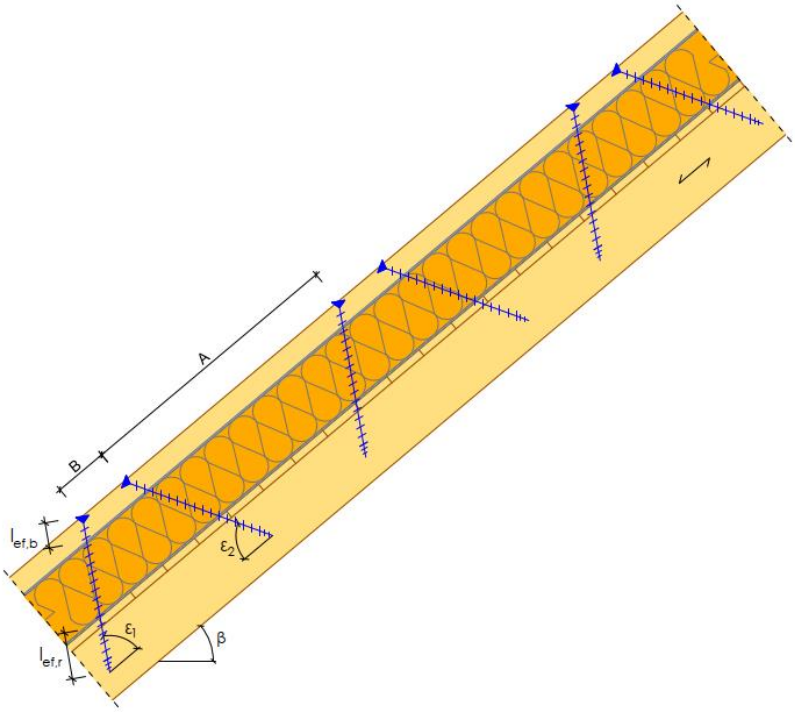
$$F_{ax,\varepsilon,Rd} = \min\left\{\begin{array}{l} k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2 \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \\ \max\left\{f_{head,d} \cdot d_h^2; k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,b} \cdot k_1 \cdot k_2\right\} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \\ f_{tens,d} \end{array}\right\} \quad \text{for screws with full thread}$$

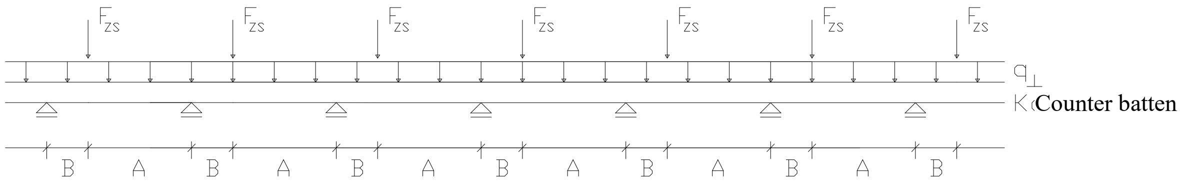
Where:

$f_{ax,d}$	design value of the axial withdrawal parameter of the threaded part of the screw
d	outer thread diameter of the screw
ℓ_{ef}	Point side penetration length of the threaded part of the screw in the batten, $l_{ef} \geq 40$ mm
ρ_k	characteristic density of the wood-based member [kg/m³]
$f_{head,d}$	design value of the head pull-through capacity of the screw
d_h	head diameter
$f_{tens,d}$	design value of the tensile capacity of the screw
k_1	min {1; 200/t_{HI}}
k_2	min {1; $\sigma_{10\%}$/0,12}
t_{HI}	thickness of the heat insulation [mm]
$\sigma_{10\%}$	compressive stress of the heat insulation under 10 % deformation [N/mm²]

If k_1 and k_2 are considered, the deflection of the battens does not need to be considered. Alternatively to the battens, panels with a minimum thickness of 22 mm from plywood according to EN 636, particle board according to EN 312, oriented strand board according to EN 300 or ETA and solid wood panels according to EN 13353 or cross laminated timber may be used.

Thermal insulation material on rafters with alternatively inclined screws





Mechanical model

Depending on the screw spacing and the arrangement of tensile and compressive screws with different inclinations the battens are loaded by significant bending moments. The bending moments are derived based on the following assumptions:

- The tensile and compressive loads in the screws are determined based on equilibrium conditions from the actions parallel and perpendicular to the roof plane.
  These actions are constant line loads $q_{\perp}$ and $q_{||}$.
- The screws act as hinged columns supported 10 mm within the batten or rafter, respectively. The effective column length consequently equals the length of the screw between batten and rafter plus 20 mm.
- The batten is considered as a continuous beam with a constant span $\ell = A + B$.
  The compressive screws constitute the supports of the continuous beam while the tensile screws transfer concentrated loads perpendicular to the batten axis.

The screws are predominantly loaded in withdrawal or compression, respectively. The screw's normal forces are determined based on the loads parallel and perpendicular to the roof plane:

Compressive screw: $$F_{c,Ed} = (A+B)\cdot\left(-\frac{q_{\parallel}\cdot\sin\varepsilon_2 + q_{\perp}\cdot\cos\varepsilon_2}{\sin(\varepsilon_1+\varepsilon_2)}\right)$$

Tensile screw: $$F_{t,Ed} = (A+B)\cdot\left(\frac{q_{\parallel}\cdot\sin\varepsilon_1 - q_{\perp}\cdot\cos\varepsilon_1}{\sin(\varepsilon_1+\varepsilon_2)}\right)$$

The bending moments in the batten follow from the constant line load $q_{\perp}$ and the load components perpendicular to the batten from the tensile screws. The span of the continuous beam is (A + B). The load component perpendicular to the batten from the tensile screw is:

$$F_{ZS,Ed} = (A+B) \cdot \left(\frac{q_{\parallel} \cdot \sin\varepsilon_1 \cdot \sin\varepsilon_2 - q_{\perp} \cdot \cos\varepsilon_1 \cdot \cos\varepsilon_2}{\sin(\varepsilon_1 + \varepsilon_2)} \right)$$

Where:

q_{II}	Constant line load parallel to batten
$q_{\perp}$	Constant line load perpendicular to batten
ε_1	Angle between compressive screw axis and grain direction
ε_2	Angle between tensile screw axis and grain direction

A positive value for F_{ZS} means a load towards the rafter, a negative value a load away from the rafter.

Design of the screws

The load-carrying capacity of the screws shall be calculated as follows:

Screws loaded in tension:

$$F_{ax,\varepsilon,Rd} = \min\left\{ \frac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,b}}{k_\beta} \cdot \left(\frac{\rho_{b,k}}{\rho_a} \right)^{0.8} ; \frac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,r}}{k_\beta} \cdot \left(\frac{\rho_{r,k}}{\rho_a} \right)^{0.8} ; f_{tens,d} \right\}$$

Screws loaded in compression:

$$F_{ax,\varepsilon,Rd} = \min\left\{ \frac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,b}}{k_\beta} \cdot \left(\frac{\rho_{b,k}}{\rho_a} \right)^{0.8} ; \frac{k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef,r}}{k_\beta} \cdot \left(\frac{\rho_{r,k}}{\rho_a} \right)^{0.8} ; \frac{\kappa_c \cdot N_{pl,k}}{\gamma_{M1}} \right\}$$

where:

$f_{ax,d}$	design value of the axial withdrawal capacity of the threaded part of the screw
d	outer thread diameter of the screw
$\ell_{ef,b}$	penetration length of the threaded part of the screw in the batten
$\ell_{ef,r}$	penetration length of the threaded part of the screw in the rafter, $l_{ef} \geq 40$ mm
$\rho_{b,k}$	characteristic density of the batten [kg/m³]
$\rho_{r,k}$	characteristic density of the rafter [kg/m³]
ε	angle ε_1 or ε_2 between screw axis and grain direction, $30° \leq \varepsilon_1 \leq 90°$, $30° \leq \varepsilon_2 \leq 90°$
$f_{tens,d}$	design value of the tensile capacity of the screw
γ_{M1}	partial factor according to EN 1993-1-1 or to the particular national annex
$\kappa_c \cdot N_{pl,k}$	Buckling capacity of the screw

Free screw length [mm]	$\kappa_c \cdot N_{pl,k}$ [kN]		
	6 mm carbon	8 mm carbon	8 mm stainless
≤ 100	0,91	4,07	3,58
120	0,68	3,11	2,81
140	0,53	2,44	2,25
160		1,98	1,84
180		1,62	1,53
200		1,36	1,29
220		1,15	1,10
240		0,99	0,95
260		0,86	0,83
280		0,75	0,73

Free screw length [mm]	$\kappa_c \cdot N_{pl,k}$ [kN]	
	8 mm carbon	8 mm stainless
300	0,67	0,64
320	0,59	0,57
340	0,53	0,52
360	0,48	
380	0,43	
400	0,39	
420	0,36	
440	0,33	
460	0,30	

Annex E
Tensile reinforcement perpendicular to grain

Connection forces at an angle to the grain

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a timber member loaded by a connection force perpendicular to the grain shall fulfil the following condition:

$$\frac{\left[1-3\cdot\alpha^2+2\cdot\alpha^3\right]\cdot F_{90,d}}{F_{ax,Rd}}\leq 1$$

Where:

$F_{90,d}$ Design value of the force component perpendicular to the grain in N,

α = a/H

H = member depth in mm

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack in N

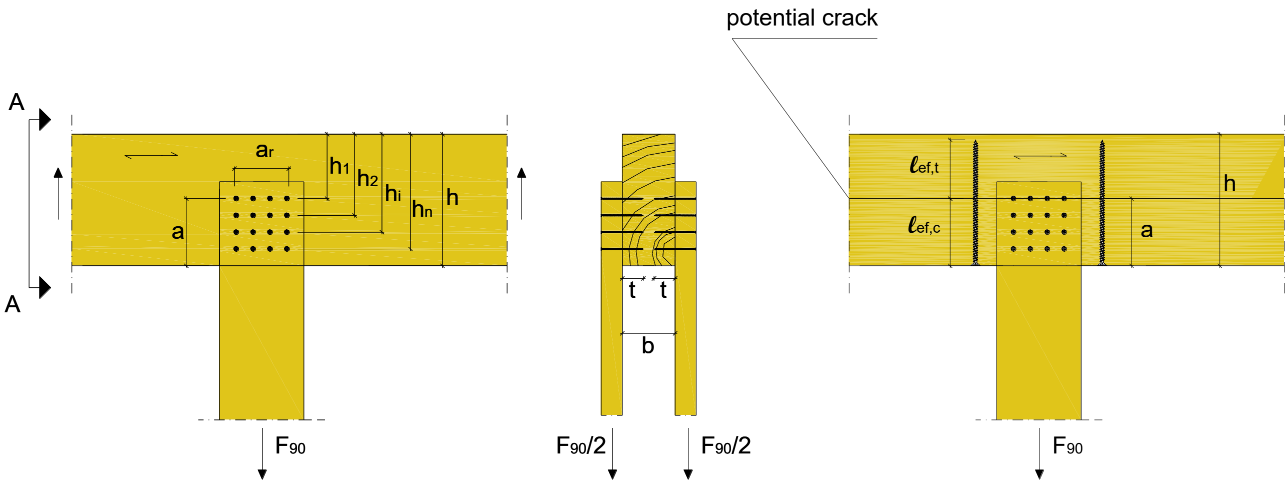


Figure E.1: Example for tensile reinforcement of a connection force perpendicular to the grain

Notched beam supports

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a notched beam support shall fulfil the following condition:

$$\frac{1{,}3 \cdot V_d \cdot \left[3 \cdot (1-\alpha)^2 - 2 \cdot (1-\alpha)^3\right]}{F_{ax,Rd}} \leq 1$$

Where

V_d Design value of the shear force in N,

α = h_e/H

H = member depth in mm

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack in N

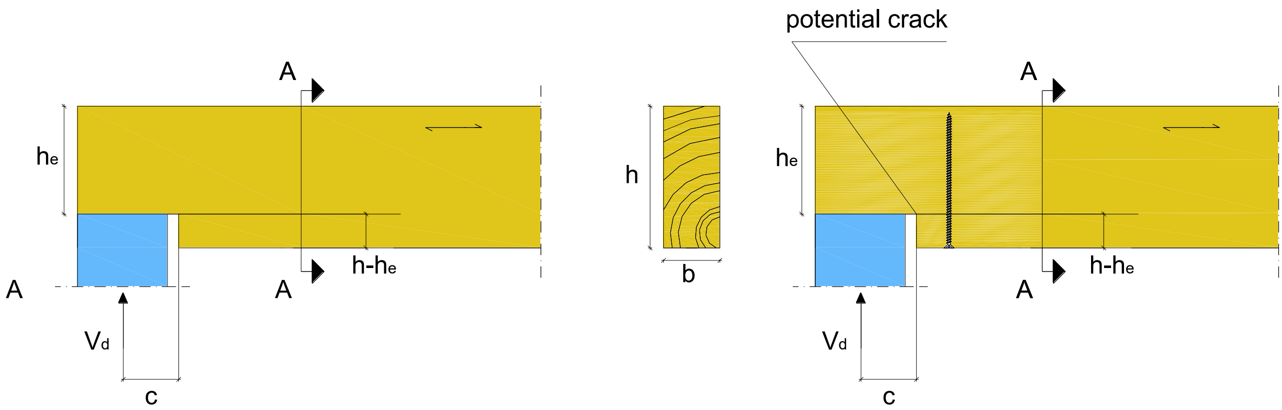


Figure E.2: Example for tensile reinforcement of a notched beam support

Beams with holes

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a hole in a beam shall fulfil the following condition:

$$\frac{F_{t,V,d} + F_{t,M,d}}{F_{ax,Rd}} \leq 1$$

Where

$F_{t,V,d}$ Design value of the force perpendicular to the grain due to shear force in N:

$$F_{t,V,d} = \frac{V_d \cdot h_d}{4 \cdot H} \cdot \left[3 - \frac{h_d^2}{H^2}\right]$$

V_d Design value of the member shear force at the hole end in N,

H = member depth in mm

h_d = hole depth for rectangular holes in mm

h_d = 70 % of hole diameter for circular holes in mm

$F_{t,M,d}$ Design value of the force perpendicular to the grain due to bending moment in N:

$$F_{t,M,d} = 0{,}008 \cdot \frac{M_d}{h_r}$$

M_d Design value of the member bending moment at the hole end in Nm,

h_r = min (h_{ro} ; h_{ru}) for rectangular holes in mm

h_r = min (h_{ro} ; h_{ru}) + 0,15·h_d for circular holes in mm

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack in N.

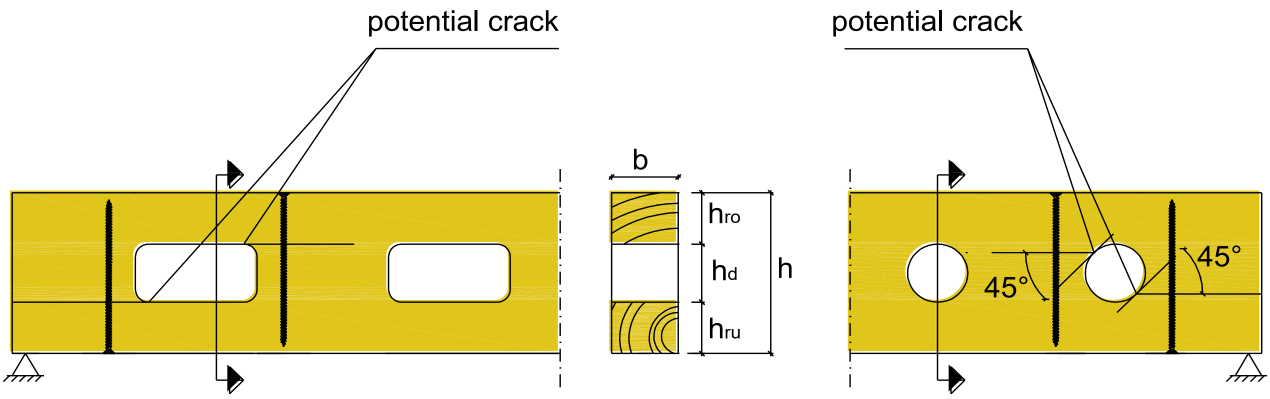


Figure E.3: Tensile reinforcement of a rectangular (left) and circular (right) hole

Connections with laterally loaded dowel-type fasteners

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a steel-to-timber or timber-to-timber connection with laterally loaded dowel-type fasteners loaded by a connection force parallel to the grain shall fulfil the following condition:

$$\frac{0.3 \cdot F_{v,0,Ed}}{F_{ax,Rd}} \leq 1$$

Where

$F_{v,0,Ed}$ Design value of the fastener force component parallel to the grain [N],
For outer timber members $F_{v,0,Ed}$ is the load per fastener per shear plane, for inner timber members $F_{v,0,Ed}$ is the accumulated load per fastener for the two shear planes

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing full thread screws where l_{ef} is the smaller value of the penetration depth at the screw tip or head (see Fig. E.4)

If the timber under each fastener in a connection is reinforced, the effective number n_{ef} according to EN 1995-1-1, equation (8.34) may be taken as $n_{ef} = n$.

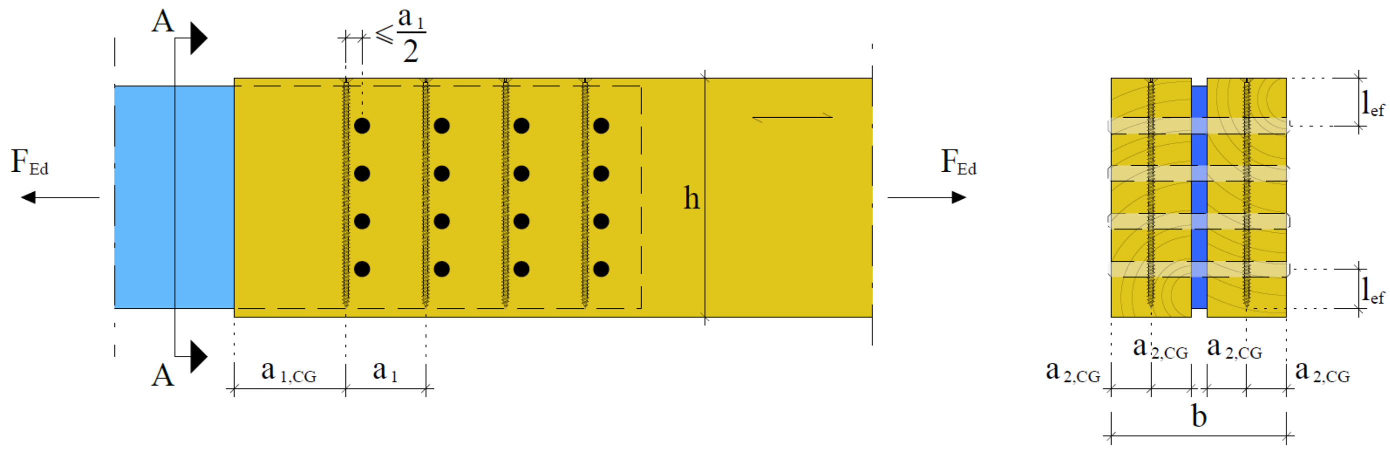


Figure E.4: Dowelled steel-to-timber connection with outer timber members and reinforcement;

Annex F
Shear reinforcement

Unless specified otherwise in national provisions that apply at the installation site, the shear stress in reinforced areas of timber members with a stress component parallel to the grain shall fulfil the following condition:

$$\tau_d \le f_{v,d} \cdot \min\left\{1{,}3; \frac{k_\tau}{\eta_H}\right\}$$

Where: τ_d is the design shear stress disregarding the reinforcement [N/mm²];

$f_{v,d}$ is the design shear strength [N/mm²];

$$k_\tau = 1 - 0{,}46 \cdot \sigma_{90,d} - 0{,}052 \cdot \sigma_{90,d}^2$$

$\sigma_{90,d}$ is the design stress perpendicular to the grain (negative value for compression) [N/mm²];

$$\sigma_{90,d} = \frac{n_{90} \cdot F_{ax,d}}{\sqrt{2} \cdot b \cdot a_1}$$

$$F_{ax,d} = \frac{\sqrt{2} \cdot (1 - \eta_H) \cdot V_d \cdot a_1}{n_{90} \cdot H}$$

$$\eta_H = \frac{G \cdot b}{G \cdot b + \dfrac{1}{\dfrac{2 \cdot \sqrt{2}}{n_{90}} \left(\dfrac{6 \cdot a_1}{\pi \cdot d \cdot H^2 \cdot k_{ax}} + \dfrac{a_1}{EA_S} \right)}}$$

V_d is the design shear force [N];

G is the shear modulus of the timber member, $G = 650$ N/mm²,

b is the width of the timber member in mm,

d is the outer thread diameter in mm,

H is the depth of the timber member in mm,

k_{ax} is the connection stiffness between screw and timber member in N/mm³,
$k_{ax} = 18{,}5$ N/mm³ for full thread screws $d = 8$ mm,

a_1 is the spacing parallel to the grain of the screws in mm,

n_{90} is the number of screw rows within the member width b. Multiple screw rows should be arranged evenly and symmetrically over the width of the timber.

EA_S is the axial stiffness of one screw [N],

$$EA_S = \frac{E \cdot \pi \cdot d_1^2}{4} = 165.000\, d_1^2$$

d_1 is the inner thread diameter of the screw in mm.

The axial capacity of a threaded screw shall fulfil the following condition:

$$\frac{F_{ax,Ed}}{F_{ax,Rd}} \le 1$$

Where:

$F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws [N]. The effective penetration length is 50 % of the threaded length.

A minimum of four screws are required in a row in each reinforced area. Outside reinforced areas (shaded area in Figure E.1) the shear design shall fulfil the conditions for unreinforced members.

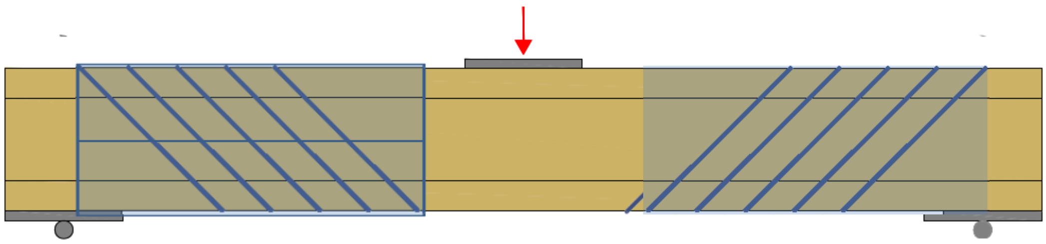


Figure F.1: Timber member with shear reinforcement; shaded areas: reinforced areas with screws arranged under 45°