ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
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-18/1161 of 2019-02-01

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	EFG PowerCut, EFG PowerCut 2.0, EFG PowerBuild
Product family to which the above construction product belongs:	Screws for use in timber constructions
Manufacturer:	Heco Italia EFG s.r.l Via Sant' Agnese 20 IT-36061 Bassano del Grappa (VI) Tel. +39 0424 512111 Fax +39 0424 512115 Internet www.heco.it
Manufacturing plant:	Heco Italia EFG s.r.l Manufacturing plant 1
This European Technical Assessment contains:	20 pages including 1 annex which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	European Assessment document (EAD) no. EAD 130118-00-0603 "Screws for timber constructions"
This version replaces:	-

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
EFG PowerCut, EFG PowerCut 2.0 and EFG PowerBuild 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 steel wire for nominal diameters between 6,0 mm and 10,0 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 EFG PowerCut, EFG PowerCut 2.0 and EFG PowerBuild screws shall not be less than 6,0 mm and shall not be greater than 12,0 mm.

The overall length *L* of the screws, shall not be less than 50 mm and shall not be greater than 600 mm. Other dimensions are shown in Annex A.

The ratio of inner thread diameter to outer thread diameter d_i/d ranges from 0,60 to 0,75.

The screws are threaded over a minimum length L_t of 4·d (i.e. $L_t > 4 \cdot d$).

The thread pitch *p* (distance between two adjacent thread flanks) ranges from 0,50·d to 0,85·d.

No breaking shall be observed at a bend angle of
$\alpha \geq (45/d^{0,7} + 20)°$.

2 Specification of the intended use in accordance with the applicable EAD

The screws are used for connections in load bearing timber structures between members, softwood and hardwood of solid timber, glued laminated timber, cross-laminated timber and laminated veneer lumber, similar glued members, wood-based panels or steel. EFG screws with a thread over the full length are also used as tensile or compressive reinforcement perpendicular to the grain or as shear reinforcement in softwood members. Steel plates and wood-based panels except solid wood panels, laminated veneer lumber and cross laminated timber, shall only be fixed on the side of the screw head.
The following wood-based panels may be used:

- Plywood according to EN 636 or European Technical Assessment or national provisions that apply at the installation site
- Particleboard according to EN 312 or European Technical Assessment or national provisions that apply at the installation site
- Oriented Strand Board according to EN 300 or European Technical Assessment or national provisions that apply at the installation site
- Fibreboard according to EN 622-2 and 622-3 or European Technical Assessment (minimum density 650 kg/m³) or national provisions that apply at the installation site
- Cement bonded particleboard according to EN 634 or European Technical Assessment or national provisions that apply at the installation site
- Solid wood panels according to EN 13353 or European Technical Assessment or national provisions that apply at the installation site
- Cross laminated timber according to European Technical Assessment
- Laminated Veneer Lumber according to EN 14374 or European Technical Assessment
- Engineered wood products according to European Technical Assessment

The intended use of the screws is in timber connections for which all requirements of mechanical resistance, stability and safety in use in the sense of the Basic Works 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 zinc-coated screws are for use in timber structures subject to the moisture content, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1:2014.

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)	
Tensile strength of partial threaded screws	
EFG POWERCUT	Characteristic value $f_{tens,k}$:
	d=6 ,0 mm 13 kN
	d=8,0 mm 23 kN
	d=10,0 mm 33 kN
Tensile strength of fully threaded screws	
EFG POWERBUILD	Characteristic value $f_{tens,k}$:
	d=6 ,5 mm 22 kN
	d=8,0 mm 31 kN
	d=10,0 mm 46 kN
Insertion moment of partial threaded screws	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k}$ / $R_{tor,mean}$ > 1,5
EFG POWERCUT	Characteristic value $f_{tor,k}$:
	d=6 ,0 mm 8,6 Nm
	d=8,0 mm 17,9 Nm
	d=10,0 mm 43,7 Nm
Insertion moment of fully threaded screws	Characteristic value $f_{tor,k}$:
EFG POWERBUILD	d=6 ,5 mm, Tip 3 19,8 Nm
	d=8,0 mm, Tip 3 17,9 Nm
	d=10,0 mm, Tip 3 43,7 Nm
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The screws are made from steel classified as performance class A1 of the characteristic reaction to fire, in accordance with the provisions of Commission Delegated Regulation 2016/364 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC.
3.4 Safety in use (BWR4)	See aspects covered by BWR1
3.5 Sustainable use of natural resources (BWR7)	No Performance assessed
3.6 General aspects related to the performance of the product	The screws have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service classes 1, 2 and 3
Identification	See Annex A
Typical and special application area	See Annex B

*) See additional information in section 3.9 – 3.11.

3.9 Mechanical resistance and stability

The load-carrying capacities for EFG screws are applicable to the wood-based materials mentioned in paragraph 1 even though the term timber has been used in the following. European Technical Assessments for structural members or wood-based panels must be considered if applicable.

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

Reductions in the cross-sectional area caused by EFG screws shall be taken into account in accordance to the Eurocode 5.

3.9.1 Lateral load-carrying capacity

The characteristic lateral load-carrying capacity of EFG screws and self-drilling dowels shall be calculated according to EN 1995-1-1. The contribution of the rope effect may be considered. For the calculation of the load-carrying capacity, the following parameters should be taken into account.

Embedment strength $f_{h,k}$
Solid timber (EN 338 and EN 14080)

The embedding strength for EFG screws in non-pre-drilled holes arranged at an angle between screw axis and grain direction, 0° ≤ α ≤ 90° can be calculated with the help of equation (1).

$$f_{h,\alpha,k} = \frac{0,082 \cdot \rho_k \cdot d_1^{-0,3}}{k_{90} \cdot \cos\alpha^2 + \sin\alpha^2} \qquad (1)$$

The embedding strength for EFG screws in pre-drilled holes arranged at an angle between screw axis and grain direction, 0° ≤ α ≤ 90° can be calculated with the help of equation (2).

$$f_{h,\alpha,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d_1)}{k_{90} \cdot \cos\alpha^2 + \sin\alpha^2} \qquad (2)$$

With

$$k_{90} = \begin{cases} 1,35 + 0,015 \cdot d_1 & \text{for softwood} \\ 1,30 + 0,015 \cdot d_1 & \text{for LVL} \\ 0,90 + 0,015 \cdot d_1 & \text{for hardwood} \end{cases} \qquad (3)$$

Where

α Angle between load and the grain direction [°]
$f_{h,\alpha,k}$ Characteristic embedment strength [MPa]
ρ_k Characteristic timber gross density [kg/m³]
d_1 Inner diameter of the screw [mm];

Embedment strength $f_{h,k}$
Cross laminated timber (EN 16351)

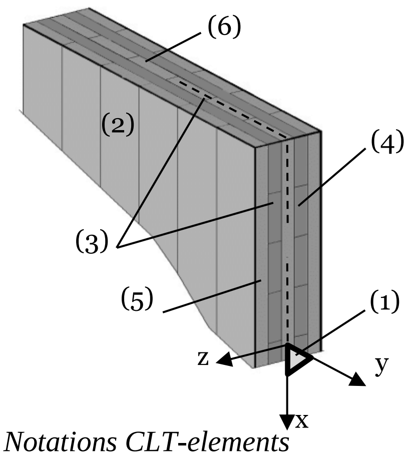


Figure 1: Notations CLT-elements

(1) Element plane
(2) Plane surface
(3) Edge surface (narrow side)
(4) Inner layer (lamellas)
(5) Outer layer (lamellas)
(6) Middle layer (lamella)

If there are no other technical specification (ETA or hEN) for cross laminated timber (CLT), the embedding strength for screws can be calculated as following.

Screws and self-drilling dowels in the plane surface:
The embedding strength for screws in the plane surface of CLT-elements should be assumed as for solid timber according to equation (1) or (2), based on the characteristic density of the outer layer. If relevant, the angle between force and grain direction of the outer layer has to be taken into account.

Screws in the narrow side:
The embedding strength for screws in the narrow side of CLT-elements should be assumed according to equation (4).

$$f_{h,k} = 20 \cdot d^{-0,5} \qquad (4)$$

Effective number of screws per row n_{ef}

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

Yield strength $f_{y,Rk}$

The characteristic yield strength for the EFG screws shall be taken into account with

$$f_{y,k} = 1000 \text{ MPa} \qquad (5)$$

Yield moment $M_{y,Rk}$

The characteristic yield moment shall be calculated with the help of equation (6).

$$M_{y,Rk} = 0,30 \cdot f_{y,k} \cdot d_1^{2,6} \qquad (6)$$

Where

$M_{y,Rk}$ Characteristic yield moment [Nmm]
d_1 Inner diameter of the screw [mm]
$f_{y,k}$ Characteristic yield tension strength [MPa]

3.9.2 Axial withdrawal capacity

The axial withdrawal capacity is limited by the head pull-through capacity and the tensile or compressive capacity of the screw.
For EFG screws, the withdrawal capacity of the thread in the member with the head may be taken into account instead of the head pull-through capacity.

Withdrawal capacity $F_{ax,Rk}$
Solid timber (EN 338 and EN 14080)

The characteristic axial withdrawal capacity of EFG screws with an angle of 0° ≤ α ≤ 90° shall be calculated according to equation (7). For screws with an outer diameter d ≤ 6,5 mm equation (7) is only valid for 15° ≤ α ≤ 90°.

$$F_{ax,\alpha,Rk} = k_{ax} \cdot f_{ax,90,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \qquad (7)$$

With

$$k_{ax} = \min \begin{cases} 0,3 + (0,7 \cdot \alpha) / 45° \\ 1,00 \end{cases} \qquad (8)$$

According to equation (9) the point side penetration length has to be considered between the following range

$$l_{ef} = \min \begin{cases} \dfrac{4 \cdot d}{\sin \alpha} \\ 20 \cdot d \end{cases} \qquad (9)$$

With

$F_{ax,\alpha,Rk}$ Characteristic withdrawal capacity of the screw with an angle α to the grain [N]

n_{ef} Effective number of screws according to EN 1995-1-1:2014

$f_{ax,90,k}$ Characteristic withdrawal parameter

EFG POWERCUT

d = 6,0 mm:	$f_{ax,90,k}$ = 12,0 MPa
d = 8,0 mm:	$f_{ax,90,k}$ = 11,5 MPa
d = 10,0 mm:	$f_{ax,90,k}$ = 11,0 MPa

EFG POWERBUILD

d = 6,5 mm:	$f_{ax,90,k}$ = 11,5 MPa
d = 8,0 mm:	$f_{ax,90,k}$ = 11,0 MPa
d = 10,0 mm:	$f_{ax,90,k}$ = 10,5 MPa

d Outer thread diameter [mm]

l_{ef} Penetration length of the threaded part acc. to EN 1995-1-1; For fully threaded screws the thread length including the head length [mm]

α Angle between grain and screw axis [°]

ρ_k Characteristic timber gross density [kg/m³]

Withdrawal capacity $F_{ax,Rk}$
Cross laminated timber (EN 16351)

If there are no other technical specification (ETA or hEN) for cross laminated timber (CLT), the withdrawal capacity for screws can be calculated as following.

Screws in the plane surface:
The withdrawal capacity for screws in the plane surface of CLT-elements should be assumed as for solid timber according to equation (7) based on a characteristic density of equation (11).

$$\rho_k = 1{,}1 \cdot \rho_{lay,k} \qquad (10)$$

With

$\rho_{lay,k}$ Lowest characteristic density of the lamella in the CLT-element [kg/m³]

Screws in the narrow side:
The withdrawal capacity for screws in the narrow side of CLT-elements should be assumed according to equation (12).

$$F_{ax,Rk} = 20 \cdot d^{0,8} \cdot l_{ef}^{\;0,9} \qquad (11)$$

Screws in the narrow side should be drilled perpendicular into the grain of the lamella. The penetration length has to be at least $3 \cdot d + l_{ef}$.
If it is guaranteed that the angle between the lamellas and the screw axis is 45° the characteristic withdrawal capacity from equation (11) can be increased of about 25%.

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

Effective number of screws n_{ef}

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.

$$n_{ef} = n^{0,9} \qquad (12)$$

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 with equation

$$n_{ef} = \max \begin{cases} n^{0,9} \\ 0,9 \cdot n \end{cases} \qquad (13)$$

With

n Number of (inclined/cross pairs) screws in a row

For screws as compression reinforcement or inclined screws as fasteners in mechanically jointed beams or columns $n_{ef} = n$.

Head pull-through capacity $f_{head,k}$
The characteristic head pull-through capacity of EFG screws calculate as following.

$$F_{ax,\alpha,Rk} = n_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \cdot \max\begin{cases} k_{ax} \cdot f_{ax,90,k} \cdot d \cdot l_{ef} \\ f_{head,k} \cdot d_h^{\ 2} \end{cases} \quad (14)$$

The characteristic value of the head pull-through parameter for a characteristic density of 380 kg/m³ of the timber and for the following wood based panels described in paragraph 1 with a thickness of more than 20 mm is

$$f_{head,k} = 10 \ \text{MPa} \quad (15)$$

For wood based panels with a thickness between 12 mm and 20 mm the characteristic value of the head pull-through parameter is

$$f_{head,k} = 8 \ \text{MPa} \quad (16)$$

For wood based panels with a thickness of less than 12 mm the characteristic head pull-through capacity shall be calculated with $f_{head,k}$=8 MPa with a limit of 400 N complying with a minimum thickness of the wood based panels of 1,2·d. In addition, the minimum thickness of *Table 1* apply.

Table 1: Minimum thickness of wood based panels

Wood based panel	Min. thickness [mm]
Plywood	6
Oriented Strand board OSB	8
Solid wood panels	12
Particleboards	8
Cement bonded particle boards	8
Fibreboards (hardboards and medium boards)	6

Tensile capacity $f_{tens,k}$
The characteristic tensile capacity $f_{tens,k}$ of EFG screws depending on the diameter is

EFG POWERCUT (partial threaded)
- d=6,0 mm: $f_{tens,k}$ =13 kN
- d=8,0 mm: $f_{tens,k}$ =23 kN
- d=10,0 mm : $f_{tens,k}$ =33 kN

EFG POWERBUILD (fully threaded)
- d=6,5 mm: $f_{tens,k}$ =22 kN
- d=8,0 mm: $f_{tens,k}$ =31 kN
- d=10,0 mm : $f_{tens,k}$ =46 kN

The tear-off capacity of the screw head is greater than the tensile capacity of the screw.

Compression capacity
The design compressive capacity $F_{ax,Rd}$ of EFG screws with full thread along the length embedded in timber shall be calculated as following.

$$F_{ax,Rd} = \min\begin{Bmatrix} F_{ax,Rd} \\ F_{crit,Rd} \end{Bmatrix} \quad (17)$$

Where
$F_{ax,Rd}$ According to equation (7)
$F_{crit,Rd}$ According to equation (19)

$$F_{crit,Rd} = \kappa_c \cdot N_{pl,d} \quad (18)$$

With

$$\kappa_c = 1 \qquad \text{for } \bar{\lambda}_k \le 0,2$$
$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \bar{\lambda}_k^{\ 2}}} \qquad \text{for } \bar{\lambda}_k > 0,2 \quad (19)$$

and

$$k = 0,5\left[1 + 0,49 \cdot (\bar{\lambda}_k - 0,2) + \bar{\lambda}_k^{\ 2}\right] \quad (20)$$

The relative slenderness ratio shall be calculated with

$$\bar{\lambda}_k = \sqrt{\frac{N_{pl,k}}{N_{ki,G,k}}} \quad (21)$$

With the characteristic value for the axial capacity in case of plastic analysis referred to the inner thread diameter

$$N_{pl,k} = \pi \cdot \frac{d_1^{\ 2}}{4} \cdot f_{y,k} \quad (22)$$

And the characteristic ideal elastic buckling load

$$N_{ki,G,k} = \sqrt{c_h \cdot E_s \cdot I_s} \quad (23)$$

With
Elastic foundation of the screw:

$$c_h = (0,19 + 0,012 \cdot d) \cdot \rho_k \cdot \left(\frac{\alpha}{180°} + 0,5\right) \quad (24)$$

Modulus of elasticity:

$$E_s = 210000 \ \text{MPa} \quad (25)$$

Second moment of area:

$$I_s = \frac{\pi \cdot d_1^{\,4}}{64} \qquad (26)$$

Note: When determining design values of the compressive capacity it should be considered that $f_{ax,d}$ is to be calculated using k_{mod} and γ_M for timber according to EN 1995 while $N_{pl,d}$ is calculated using $\gamma_{M,1}$ for steel buckling according to EN 1993.

3.9.3 Combined laterally and axially loaded screws and self-drilling dowels

For connections subjected to a combination of axial and lateral load, the following expression has to be considered according to equation

$$\left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 + \left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^2 \le 1 \qquad (27)$$

With

$F_{ax,Ed}$ Axial design load

$F_{v,Ed}$ Lateral design load

$F_{ax,Rd}$ Design load-carrying capacity of an axially loaded screw/dowel

$F_{v,Rd}$ Design load-carrying capacity of a laterally loaded screw/dowel

3.10 Slip modulus

Laterally loaded screws

For laterally loaded EFG screws the slip modulus for the serviceability limit state (SLS) could be calculated according to EN 1995-1-1 independent of the angle α to the grain:

$$K_{ser} = k_{sys} \cdot k_{sb} \cdot \frac{\rho_m^{\,1,5} \cdot d}{23} \qquad (28)$$

With

k_{sys} $k_{sys} = \begin{cases} 1 & \text{for timber-timber connections} \\ 2 & \text{for steel-timber connections} \end{cases}$

k_{sb} Number of shear bands

Where

K_{ser} Slip modulus in SLS [N/mm]

ρ_m Mean timber density [kg/m³]

Axially loaded screws

For axially loaded screws the slip modulus for the serviceability limit state (SLS) could be calculated independent of the angle α to the grain according to equation (30).

$$K_{ser} = 15 \cdot d \cdot l_{ef} \qquad (29)$$

To consider the slip modulus K_u in the ultimate limit state K_{ser} is to reduce for both direction (laterally and axially) according to EN 1995-1-1.

$$K_u = \tfrac{2}{3} \cdot K_{ser} \qquad (30)$$

3.11 Minimum timber cross section, end and edge distances

Solid timber

For structural timber members, minimum spacing and distances for screws in predrilled holes are given in EN 1995-1-1 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in predrilled holes.

For non-predrilled holes the following minimum spacings and distances are listed in Table 2

Table 2: Minimum spacings and distances

Parameter	Distances
a_1	8·d
a_2	4·d
$a_{3,t}$	15·d

The definition of the minimum thickness and cross sections of the timber elements are in Accordance to the EN 1995-1-1:2014.

3.12 Aspects related to the performance of the product

3.12.1 Corrosion protection in service class 1 and 2

The EFG screws are produced from carbon steel and stainless wire. They are zinc-plated, nickel-plated and bronze finished or electro-galvanized and e.g. yellow chromate or blue zinc with thicknesses of the zinc coating from 4 – 16 µm or have a zinc high corrosion coating with thicknesses from 10 – 30 µm

3.13 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 as identified during the inspection of the plant by the assessment body issuing the ETA and the notified body and 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.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/176/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 foreseen in the applicable EAD

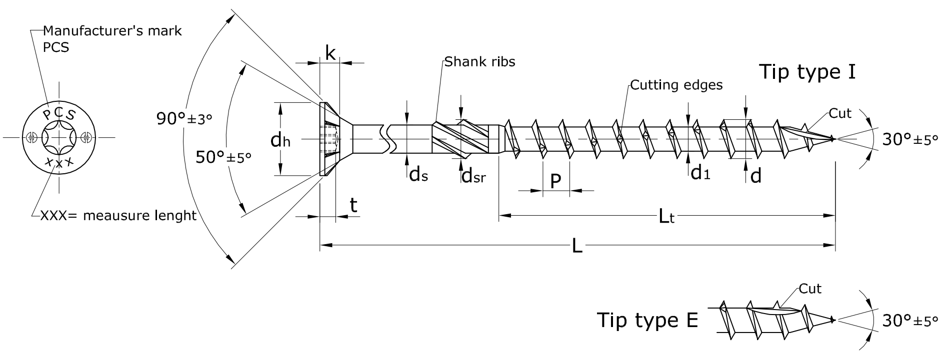
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking

Issued in Copenhagen on 2019-02-01 by

Thomas Bruun
Managing Director, ETA-Danmark

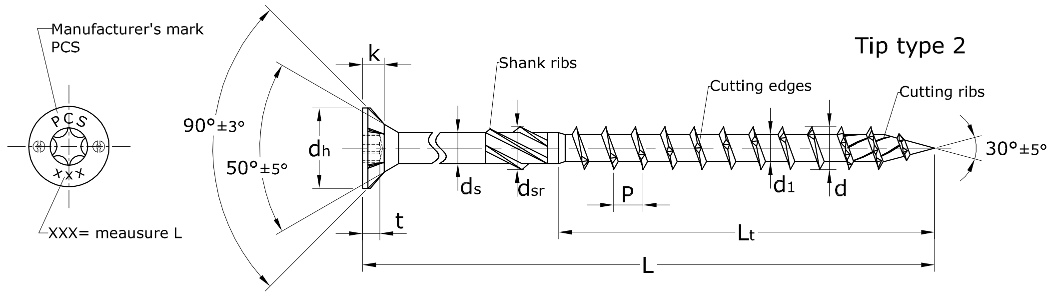
Annex A
Product details and definitions

Table A.1 Specifications of the SCREWS



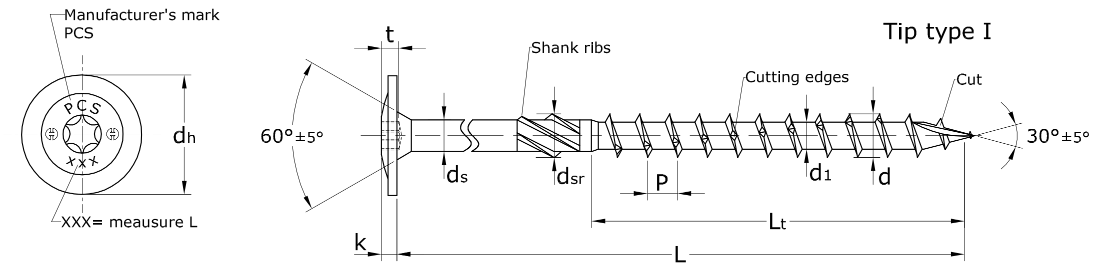
Nom. diameter	Ø 6,0		Ø 8,0		Ø 10,0	
d ±5%	6,00		8,00		10,00	
d_1 ±5%	4,00		5,35		6,50	
d_h ±5%	12,10		15,00		18,20	
d_s ±5%	4,30		5,78		7,00	
d_{sr} ref	4,75		6,35		7,75	
P ±10%	4,50		5,50		6,60	
K	3,10	+0,70 -0	4,80	+0 -0,80	5,80	+0 -0,80
Recess	T30		T40		T40	
t	2,85	+0 -0,40	3,45	+0 -0,45	3,85	+0 -0,45
L ±2,3	L_t ±2,0		L_t ±2,0		L_t ±2,0	
50	32					
60	32					
70	32					
80	50		50		50	
90	50		50		50	
100	50		50		50	
120	50		50		80	
140	70		80		80	
160	70		80		80	
180	70		80		80	
200	70		80		80	
220	70		80		80	
240	70		80		80	
260	70		80		80	
280	70		80		80	
300	70		80		80	
320			80		80	
340			80		80	
360			80		80	
380			80		80	
400			80		80	

EFG POWERCUT self-tapping screw EFG POWERCUT countersunk head screw, Torx-Drive	Annex 1.1



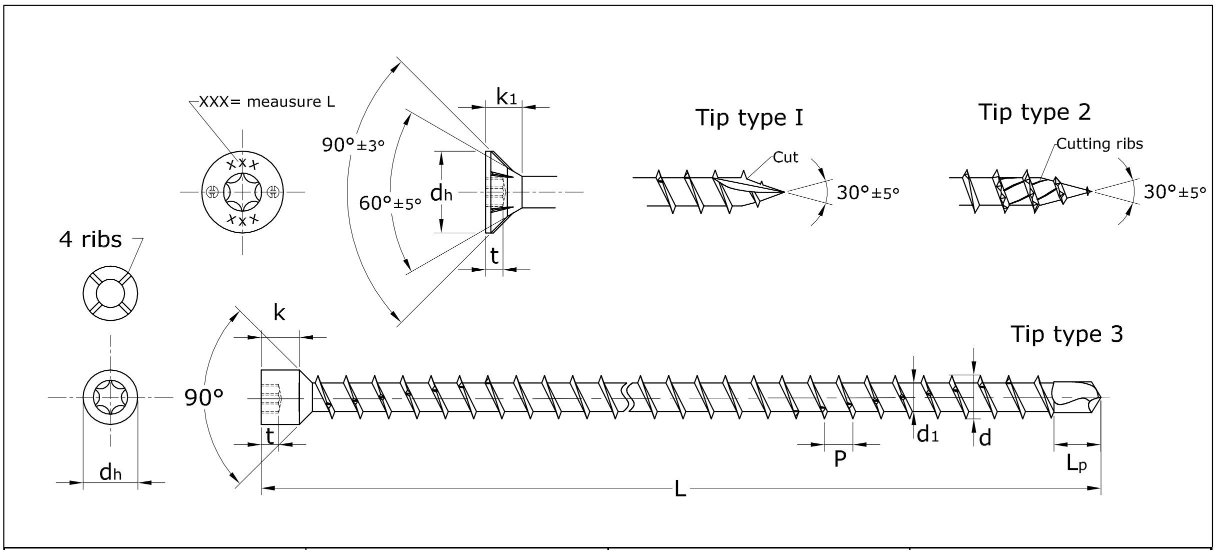
Nom. diameter	Ø 8,0	
d ±5%	8,00	
d1 ±5%	5,35	
dh ±5%	15,00	
ds ±5%	5,78	
dsr ref	6,35	
P ±10%	5,50	
K	4,80	+0 -0,80
Recess	T40	
t	3,45	+0 -0,45
L ±2,5	Lt ±2,0	
80	50	
90	50	
100	50	
120	50	
140	80	
160	80	
180	80	
200	80	
220	80	
240	80	
260	80	
280	80	
300	80	
320	80	
340	80	
360	80	
380	80	
400	80	

EFG POWERCUT self-tapping screw EFG POWERCUT countersunk head screw, Torx-Drive	Annex 1.2



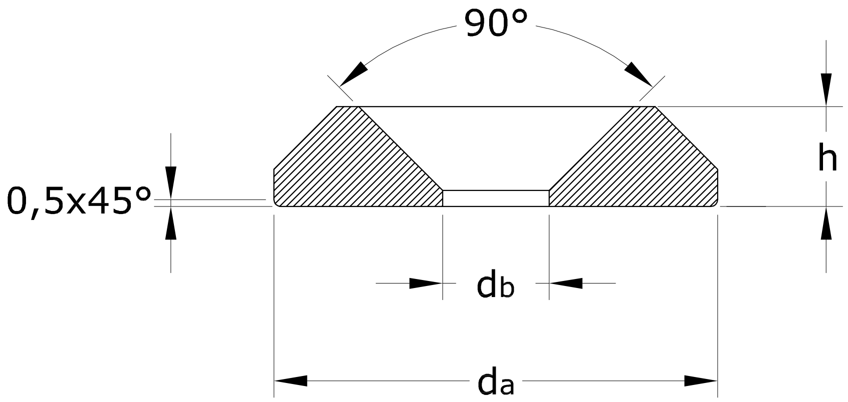
Nom. diameter	Ø 6,0	Ø 8,0	Ø 10,0
d ±5%	6,00	8,00	10,00
d_1 ±5%	4,00	5,35	6,50
d_h ±5%	14,00	22,00	25,00
d_s ±5%	4,30	5,78	7,00
d_{sr} ref	4,75	6,35	7,75
P ±10%	4,50	5,50	6,60
K	2,90	3,40	4,00
Recess	T30	T40	T40
t	2,85 (+0 / -0,40)	3,45 (+0 / -0,45)	3,85 (+0 / -0,45)
L ±2,3	L_t ±2,0	L_t ±2,0	L_t ±2,0
80	50	50	50
100	50	50	50
120	50	50	50
140	70	80	80
160	70	80	80
180	70	80	80
200	70	80	80
220	70	80	80
240	70	80	80
260	70	80	80
280	70	80	80
300	70	80	80
320		80	80
340		80	80
360		80	80
380		80	80
400		80	80

EFG POWERCUT self-tapping screw EFG POWERCUT washer head screw, Torx-Drive	Annex 1.3



Nom. diameter	Ø 6,5		Ø 8,0		Ø 10,0	
d ±5%	6,50		8,00		10,00	
d1 ±5%	4,50		5,35		6,50	
dh ±5%	8,00		10,00		13,00	
dh1 ±5%			14,50		17,80	
P ±10%	4,90		5,20		5,60	
K	5,45	+0,25 -0,25	7,00	+0,40 -0,40	6,50	+0,50 -0,50
K1	5,65	+0,25 -0,25	7,20	+0,20 -0,20	7,50	+0,20 -0,20
Recess	T30		T40		T50/T40*	
Lt	7	+1,00 -1,00	8	+1,00 -1,00	11,5	+0,50 -0,50
t	2,85	+0 -0,40	3,45	+0 -0,45	3,85	+0 -0,45
Toll.	L		L		L	
±2,0	120		95			
±2,0	140		125			
±2,0	160		155			
±2,0	195		180		125	
±2,0			195		155	
±2,0			200		195	
±3,0			220			
±3,0			240			
±3,0			245		220	
±3,0			260		245	
±3,0			280		270	
±3,0			295			
±4,0			300		300	
±4,0			330		330	
±4,0			350			
±4,0			375		360	
±4,0			400		400	
±5,0					450	
±5,0					500	
±5,0					550	
±5,0					600	

EFG POWERBUILD self-tapping screw EFG POWERBUILD reduced cylindric and countersunk head screw, Torx-Drive * T40 for countersunk head	Annex 1.4



Nom. diameter		Ø 6,0		Ø 8,0		Ø 10,0		Ø 12,0	
d_a	upper tol. Lower tol.	19,50	+0,40 -0,40	25,00	+0,40 -0,40	32,00	+0,40 -0,40	37,50	+0,40 -0,40
d_b	upper tol. Lower tol.	8,00	+0,40 -0,40	9,00	+0,40 -0,40	12,00	+0,40 -0,40	14,00	+0,40 -0,40
h	upper tol. Lower tol.	4,50	+0,30 -0,30	5,50	+0,30 -0,30	6,50	+0,30 -0,30	7,50	+0,30 -0,30

EFG self-tapping screw

EFG washer carbon steel for countersunk head 90°

Annex 1.6

Annex B
Examples of standard and special applications

Compression reinforcement

To reinforce the compression strength of timber elements EFG screws can be used as shown in Figure 2. It has to be considered that the axially forces are uniform distributed over all screws. Therefore, the screws have to be screwed-in into the timber member in such a way that the head of the screws flush with the timber surface to provide the hybrid functionality. To transfer the load between the loads an appropriate intermediate steel plate between timber member and the support is essential.

The design load-carrying capacity for a contact area with fully threaded screws with an angle between 45°≤ α≤ 90° to the grain can be calculated for section 1 and 2 with equation (32), cf. 3.9.2 - compression capacity of the screws.

$$F_{c,\alpha,Rd} = \min \begin{cases} b \cdot l_{ef,1} \cdot k_{c,\alpha} \cdot f_{c,\alpha,d} + n \cdot F_{ax,\alpha,Rd} \\ b \cdot l_{ef,2} \cdot f_{c,90,d} \end{cases} \tag{31}$$

Where

b	Width of the timber column/beam
$f_{c,\square,d}$	Design value of the compression strength depending on the load grain direction
$F_{c,\square,Rd}$	Design value of the compression force perpendicular to the grain
$F_{ax,\square,Rd}$	Design value of the withdrawal capacity of the screw
$k_{c,90}$	Factor to taking into account the load configuration, the possibility of splitting and the degree of compressive deformation acc. to EN 1995-1-1
$l_{ef,1}$	Effective supporting length
$l_{ef,2}$	Effective length at the section of the screw tips
n	Number of screws axially loaded

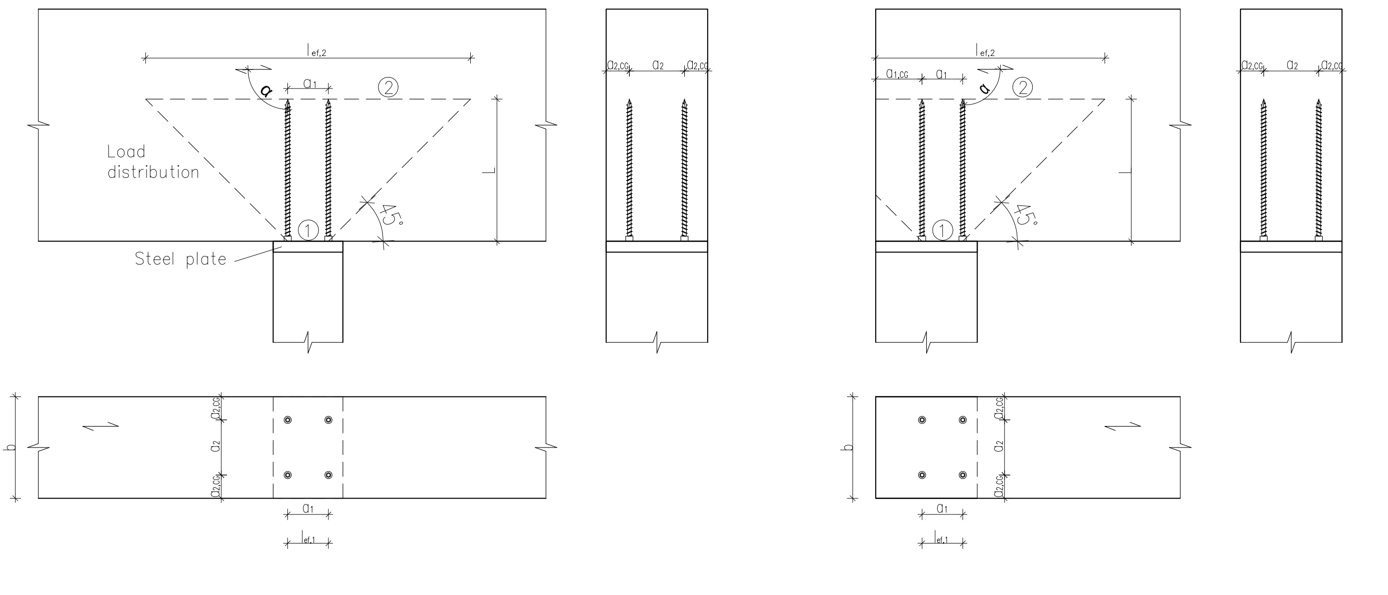


Figure 2: Compression reinforcement perpendicular to the grain with fully threaded screws

Table 3: Minimum spacing, end and edge distances for axially loaded screws acc. to EN 1995-1-1

Minimum screw spacing in plane parallel to the grain **a_1**	Minimum screw spacing perpendicular to a plane parallel to the grain **a_2**	Minimum end distance of the center of gravity of the threaded part of the screw member **$a_{1,CG}$**	Minimum edge distance of the center of gravity of the threaded part of the screw member **$a_{2,CG}$**	Minimum edge distance of the screw to the end grain in the case of reinforcement perp. to grain **$a_{3,CG}$**
7·d	5·d	10·d	4·d	4·d

Tension reinforcement perpendicular to the grain

Connection perpendicular to the grain

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a screw reinforcement of a timber beam loaded by a connection force perpendicular to the grain (Figure 3) shall fulfil equation (33).

$$\frac{\left(1-3\cdot\alpha^{2}+2\cdot\alpha^{3}\right)\cdot F_{90,Ed}}{F_{ax,Rd}}\leq 1 \qquad (32)$$

Where

$F_{90,Ed}$ Design value of the load perpendicular to the grain

$F_{ax,Rd}$ Minimum withdrawal and tensile capacity of the reinforcing screw depending on the effective length $l_{ad,c}$ or $l_{ad,t}$

and

$$\alpha=\frac{a}{h} \qquad (33)$$

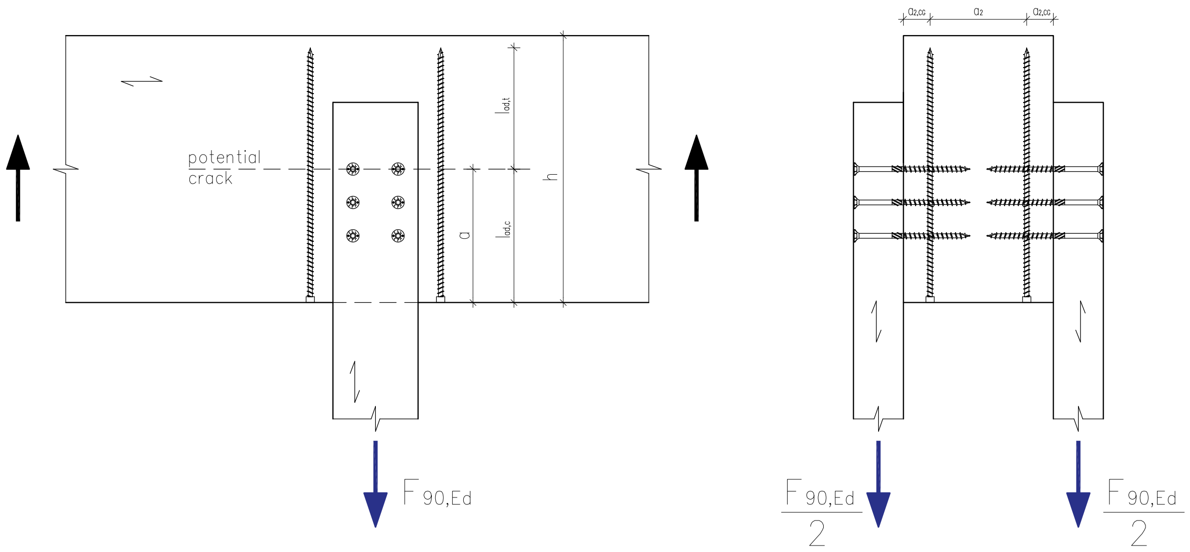


Figure 3: Reinforcement of connection perpendicular to the grain with fully threaded screws

Notched beam support

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a screw reinforcement of a notched timber beam support (Figure 4) shall fulfil equation (35) .

$$\frac{1{,}3 \cdot V_{Ed} \cdot \left[3 \cdot (1-\alpha)^2 - 2 \cdot (1-\alpha)^3\right]}{F_{ax,Rd}} \leq 1 \qquad (34)$$

Where

V_{Ed} Design value of the shear load at the edge of the notch

and

$$\alpha = \frac{h_{ef}}{h} \qquad (35)$$

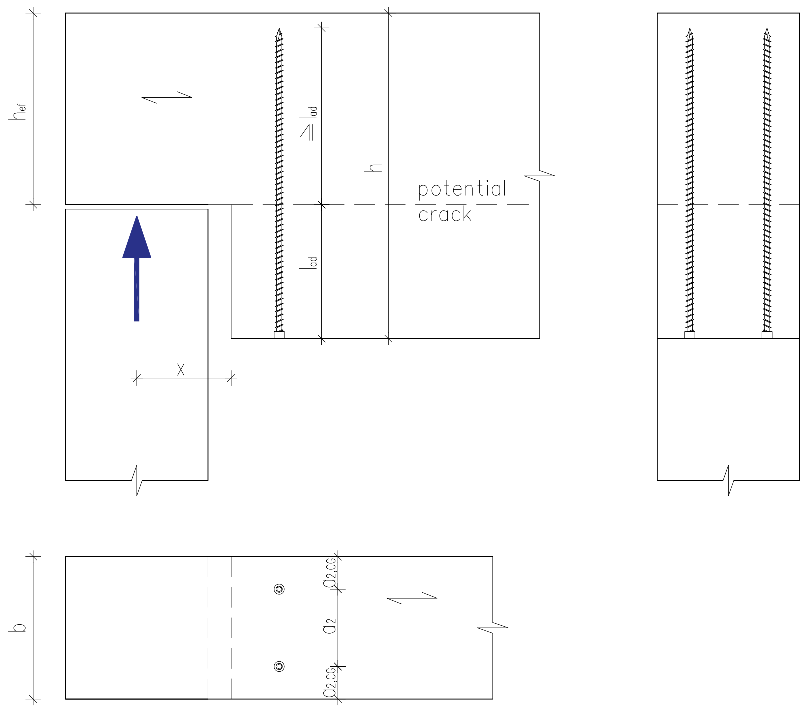


Figure 4: Reinforcement of notched beam support

Holes in beams

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a screw reinforcement of holes in timber beams () shall fulfil equation (37).

$$\frac{F_{t,V,Ed} + F_{t,M,Ed}}{F_{ax,Rd}} \leq 1 \qquad (36)$$

with

$$F_{t,V,Ed} = \frac{V_{Ed} \cdot h_d}{4 \cdot h} \cdot \left[3 - \left(\frac{h_d}{h} \right)^2 \right] \qquad (37)$$

$$F_{t,M,Ed} = 0,008 \cdot \frac{M_{Ed}}{h_r} \qquad (38)$$

and

$$h_r = \min \begin{cases} h_{ru} \\ h_{rl} \end{cases} \quad \text{for rectangular holes}$$

$$h_r = \min \begin{cases} h_{ru} + 0,15 \cdot h_d \\ h_{rl} + 0,15 \cdot h_d \end{cases} \quad \text{for circular holes} \qquad (39)$$

Where

$F_{t,V,Ed}$ Design value of the force perpendicular to the grain direction due to shear forces
$F_{t,M,Ed}$ Design value of the force perpendicular to the grain due to bending moment
$F_{ax,Rd}$ Minimum withdrawal and tensile capacity of the reinforcing screw depending on the effective length l_{ad}
d Height of the beam
h_d Height of the hole
h_r Calculated height for different shapes of holes

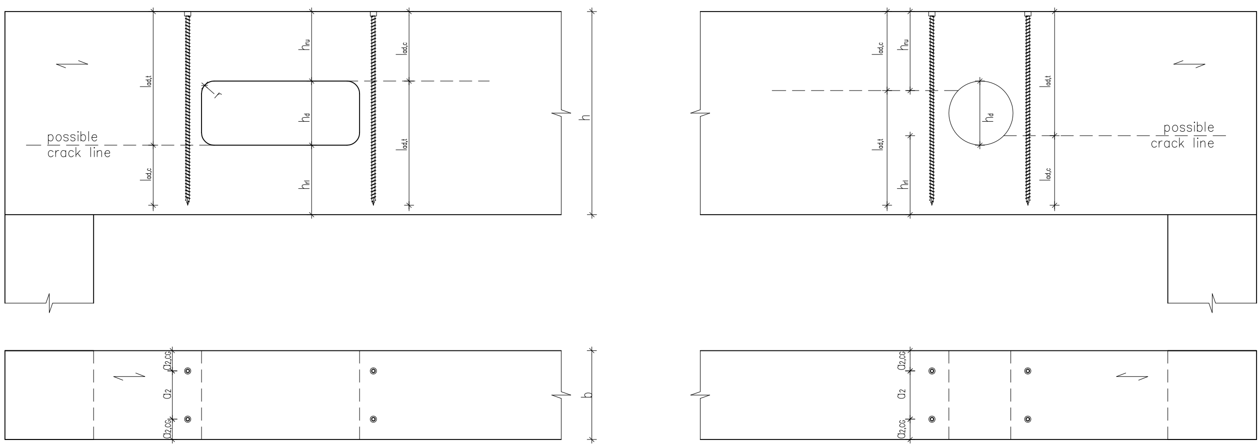


Figure 5: Reinforcement of holes in beams

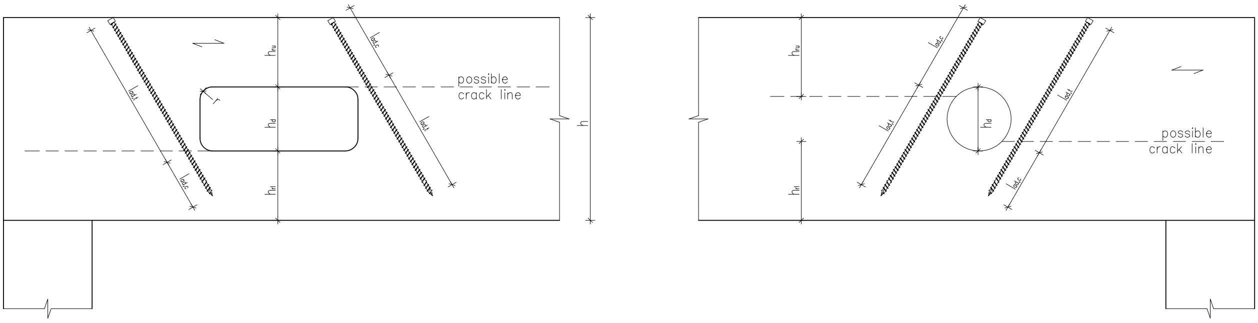


Figure 6: Reinforcement of holes in beams with inclined screws

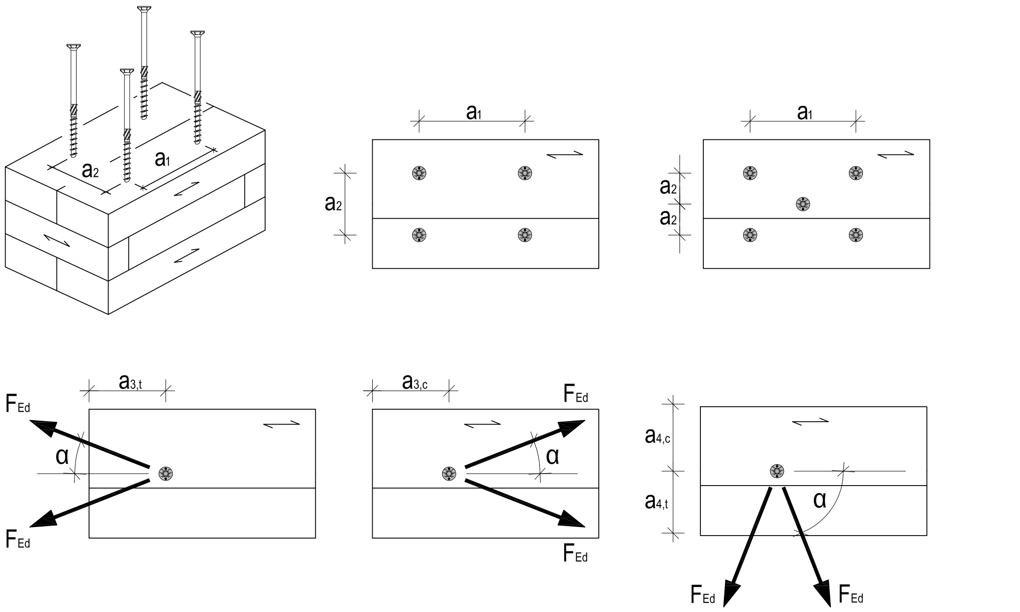


Figure 7: Recommended minimum spacing, end and edge distances for screws in the plane side of CLT elements

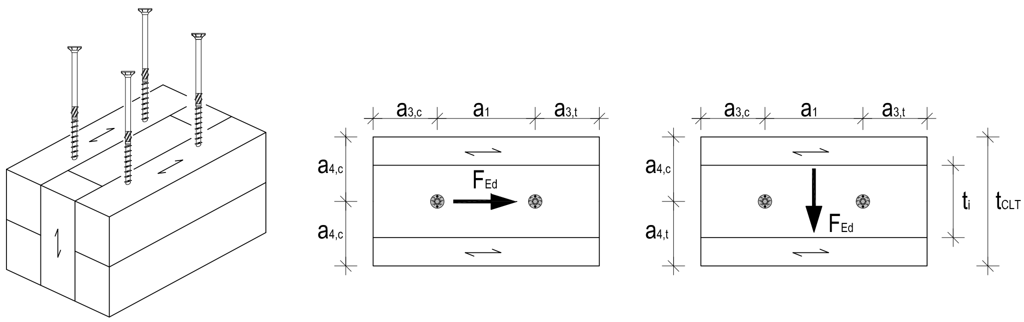


Figure 8: Recommended minimum spacing, end and edge distances for screws in the narrow side of CLT elements

Table 4: Recommended minimum spacing, end- and edge distances for screws in CLT-elements

Situation of the screw	$\mathbf{a_1}$	$\mathbf{a_2}$	$\mathbf{a_{3,t}}$	$\mathbf{a_{3,c}}$	$\mathbf{a_{4,t}}$	$\mathbf{a_{4,c}}$
Plane surface	4·d	2,5·d	6·d	6·d	6·d	2,5·d
Edge surface	10·d	3·d	12·d	7·d	5·d	5·d