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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-07/0245 of 15/08/2018

### 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:**

SIMPSON STRONG-TIE® Joist End connector  
SIMPSON STRONG-TIE® concealed beam hangers

**Product family to which the above construction product belongs:**

Three-dimensional nailing plate (connector for wood to wood connections and wood to concrete or steel connections)

**Manufacturing plant:**

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SIMPSON STRONG-TIE Manufacturing facilities

**This European Technical Assessment contains:**

123 pages including 4 annexes 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:**

Guideline for European Technical Approval (ETAG) No. 015 Three Dimensional Nailing Plates, April 2013, used as European Assessment Document (EAD).

**This version replaces:**

The ETA with the same number and issued on 2016-08-10

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## **II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT**

### **1 Technical description of product and intended use**

#### **Technical description of the product**

The SIMSPON Strong-Tie Concealed Beam Hangers are three dimensional nailing plates made of pre-galvanized steel Grade S 250 GD + (min. Z 275) according to EN 10346 or stainless steel 1.4401 and 1.4404 according to EN 10088 or a stainless steel with a minimum characteristic yield stress of 235 N/mm<sup>2</sup> or a minimum ultimate tensile strength of 330 N/mm<sup>2</sup>, or aluminium AlMgSi 0,7 according to DIN 1749-1. The range addressed by this approval consists of various hangers which have in common the necessity to practice a notch and holes in the joist for the dowels path : TU, TUB, TUS, TUBS, ETNM, BTN, BT4, BT, BTC, BTALU, CBH, Janebo-family. They are intended for wood-wood connections and wood-concrete connections with angles varying from 30° to 90°. The geometry and standard dimensions are given in Annexes D.

ETB and ETS connectors are two-piece non-welded, face-fixed connectors to be used in timber to timber connections.

ICS and ICST are two-piece non-welded element-connectors to be used in timber to timber connections.

EL connectors are one-piece non-welded, face-fixed connectors to be used in timber to timber connections as well as connections between a timber joist and a concrete structure or a steel member.

ELS connectors are one-piece non-welded, face-fixed connectors to be used in timber to timber connections.

The connectors are made from aluminium grade EN AW-6082 T6 according to EN 755-2 with minimum yield strength of 250 MPa, a minimum tensile strength of 295 MPa and a minimum ultimate strain of 8%. Dimensions, hole positions and aluminium type are shown in Annex D6 to D8. Typical installations are shown in Annex C.

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

The intended use of the SIMPSON Strong-Tie Concealed Beam Hangers is to establish connections of joists with rectangular cross sections to their support, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

The joist may be either of solid sawn or Engineering Wood Product listed in Annex C1.

The support may also be either a solid sawn element, an Engineering Wood Product listed in Annex C1, or concrete. With regard to moisture behaviour of the support and/or joist, the use is possible in service classes 1 and 2 as defined in EN 1995-1-1:2004 for the Concealed Beam Hangers made out of galvanised steel. The use is possible in service class 1, 2 and 3 defined in EN 1995-1-1:2004 for Concealed Beam Hangers made out of stainless steel 1.4401 and 1.4404 according to EN 10088, or another stainless steel as described before in structures subject to internal or external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used). A concealed joist hanger produced from steel, which is resistant for these atmospheres, may be used in these areas.

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

They are not intended to be used in areas where they might support seismic actions. They are supposed to be used with specified fasteners mentioned in Annex C3 and according to fastening combinations and nail patterns given in Annexes B.

The ETB, ETS, EL and EL-S connectors are intended for use in making end-grain to side-grain connections in load bearing timber structures, as a connection between a timber joist and a solid timber or wood based header, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled. The EL connectors are also intended for use in making an end-grain connection between a timber joist and a concrete structure or a steel member.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the connectors 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
<b>3.1 Mechanical resistance and stability*) (BWR1)</b>	
Characteristic load-carrying capacity	See Annex D
Stiffness	No performance assessed
Ductility in cyclic testing	No performance assessed
<b>3.2 Safety in case of fire (BWR2)</b>	
Reaction to fire	SIMPSON Strong-Tie Concealed Beam Hangers and Joist End connectors are classified as Euro class A1 in accordance with EN 13501-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
<b>3.3 Hygiene, health and the environment (BWR3)</b>	
Influence on air quality	The product does not contain/release dangerous substances specified in TR 034, dated March 2012**)
<b>3.7 Sustainable use of natural resources (BWR7)</b>	
	No Performance Determined
<b>3.8 General aspects related to the performance of the product</b>	
	The SIMPSON Strong-Tie Concealed Beam Hangers and Joist End connectors 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 class 1, 2 and 3
Identification	See Annex A

\*) See additional information in section 3.9 – 3.12.

\*\*) In addition to the specific clauses relating to dangerous substances contained in this European technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

### 3.9 Mechanical resistance and stability

See annex D for characteristic load-carrying capacities of the SIMPSON Strong-Tie Concealed Beam Hangers and SIMPSON Strong-Tie Joist End connectors.

The mechanical capacities of the concealed beam hangers and Joist End connectors are determined by calculation assisted by testing as described in the EOTA Guideline 015 clause 5.1.2. They should be used for designs in accordance with EN-1995-1-1 (Eurocode 5) or a similar national timber code.

The load-bearing capacities given in Annexes D of the concealed beam hangers and Joist End connectors have been determined based on the use of connector nails or 4.0 x 60 in accordance to ETA-04/0013 and screws are described in Annex C3. It is allowed to use connector screws or connector nails 4.0 x 50 or 4.2 x 50 or 4.2 x 60 in accordance to ETA-04/0013. Case by case calculations have to be carried out to determine the load-bearing capacity of the connection.

The design also allows the use of threaded nails in accordance to EN 14592 with a diameter in the range 4.0-4.2 mm and a minimum length of 35 mm, assuming a thick steel plate when calculating the lateral nail load-bearing capacity. If no calculations are made a reduction factor equal to the ratio between the characteristic withdrawal capacity of the actual used threaded nail and the characteristic withdrawal capacity of the corresponding connector nail according to table B1 in ETA-04/0013 is applicable for all load-bearing capacities of the connection.

No performance has been determined in relation to ductility of a joint under cyclic testing.

The contribution to the performance of structures in seismic zones, therefore, has not been assessed

### 3.10 Aspects related to the performance of the product

#### 3.10.1 Corrosion protection in service class 1, 2 and 3.

The thickness of galvanisation (Z275 according to EN 10143) or the aluminium AlMgSi 0,7 is such that a reasonable durability may be expected in service classes 1 and 2 according to EN 1995-1-1:2004, in the conditions stated in 1.1 above. ZM310 can be used as corrosion protection in service class 3 (applicable for all steel thicknesses).

The use of stainless steel 1.4401 and 1.4404 according to EN 10088 extends the scope to service class 3 according to EN 1995-1-1:2004 in the conditions stated in 1.1 above.

The ETB, ETS, EL and EL-S connectors 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 class 1 and 2

The ATFN connectors 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 class 1

Serviceability of the Concealed Beam Hangers is understood as their ability to resist loads without unacceptable deformations.

### 3.11 General aspects related to the fitness for use of the product

Concealed Beam Hangers and Joist End connectors are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

SIMPSON Strong-Tie Concealed Beam Hangers and Joist End connectors shall be installed on the basis of a specific structural design for each installation, using the load-bearing capacities given in Annexes D and applying the appropriate  $k_{mod}$  factor depending on the relevant service class / load duration and the appropriate National partial safety factor for materials.

The fixing of the Concealed Beam Hangers and Joist End connectors to the support shall use the appropriate nails or screws in case of solid wood or wood-based support, appropriate CE marked metal anchors for use in concrete in case of concrete support. The load bearing capacities indicated in the Annexes are given provided that the fixing device has been appropriately designed and installed.

The Concealed Beam Hangers shall be installed by appropriately qualified personnel, following an installation plan and relevant construction details worked out for each individual building project. The installation plan shall be based on the manufacturers general guide and provisions for installing SIMPSON Strong-Tie connections

#### **4 Attestation and verification of constancy of performance (AVCP)**

##### **4.1 AVCP system**

According to the decision 97/638/EC of the European Commission<sup>1</sup>, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

#### **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 2018-08-15 by



Thomas Bruun  
Managing Director, ETA-Danmark

## Annex A Revision History

Revision History	
Issue	update
3	<p>TU for force direction axial and lateral</p> <p>Update BTN, BT4, BTALU up to size 240</p> <p>BT280 up to BT600</p> <p>BTC120 up to BTC600</p> <p>Merged with the ETA 07/0245 Joist End connectors ET, ETB, ELS Added the possibility for a slope <math>&lt; 0^\circ</math></p>
4	Add ETS
5	BT - Update of the tables 13 to 20 in annex D1
6	<p>New definition of force directions</p> <p>BTN, BT4, BTALU, BT - several revisions</p> <p>BTALU – Download with dowels <math>\varnothing 7</math>, <math>\varnothing 8</math>, <math>\varnothing 10</math> and <math>\varnothing 12</math></p> <p>BTx for Racking</p> <p>BTC - all types added in the tables</p> <p>Fire resistant for concealed beam hangers/hidden connectors - principle</p> <p>TU, TUB, TUS, TUBS - several revisions</p> <p>Addition of new product range Janebo: JHHU, JHDU, JHGU, JHH, JHD</p> <p>Addition of new product: ICST</p> <p>Some more correction / clarifications, update of standards reference</p>
7	<p>ATF - renamed to ATFN</p> <p>modified depth of holes from 2,8 to 3,1, and d=12 to d=10</p> <p>Change the corrosion protection to Chrome VI free</p> <p>Add the fire rules to get F30 with timber protection</p> <hr/> <p>BTN/BT4/BTALU/BT</p> <p>Update tables for BT acc to modifications made next to mistake identified</p> <p>Table 9 to 12: values corrected</p> <p>Table 33 and 34 values for BTN corrected</p> <p>Table 34 the number of SD's and nails are corrected</p> <hr/> <p>BTC</p> <p>Table D4-3, additional option for timber size b=60mm.</p> <p>added the option for slope connections</p> <hr/> <p>CBH</p> <p>added the types of fastener to header for CBH, table D9-3</p> <p>to added the size CBH105</p> <p>CBH - thickness changed from 3,0 to 2,5mm</p>



Janebo

correct a typing error in the formula (the index 2 in the box shall be 4)

added the product names/sizes for types without uplift hook

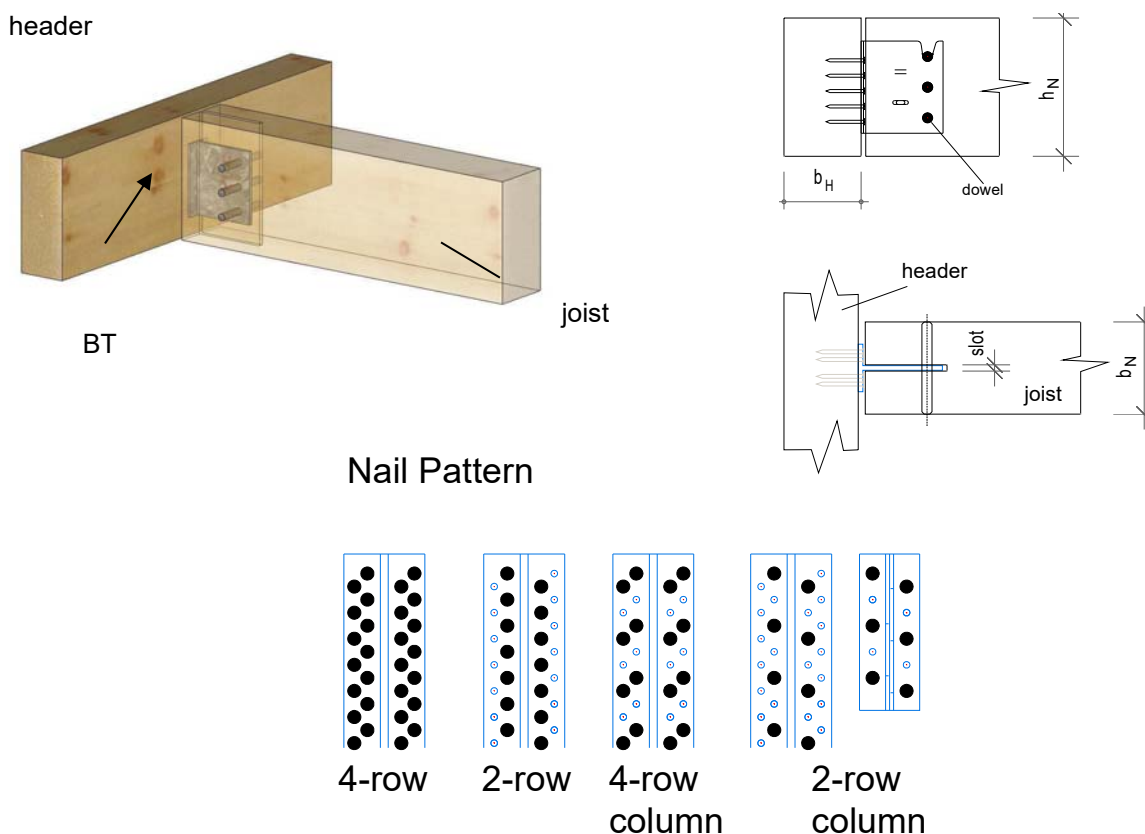
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Correction of some typing errors.

to add additional coatings: Z800 and ZM310

## Annex B Typical Installation

### B.1 Concealed joist hangers typical installation



Other nail pattern is described in annex D.

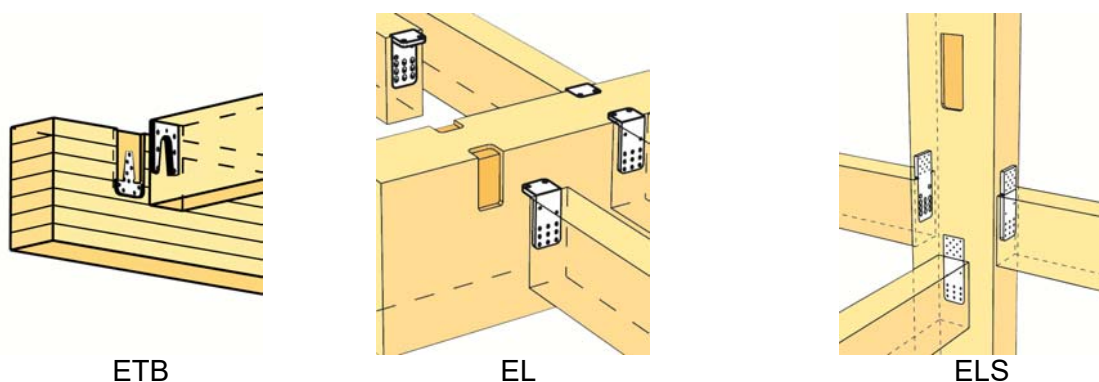
Concealed joist hangers (“BT” in the following text)

A BT connection is deemed fit for its intended use under following conditions:

1. BT can be fastened to wood-based members by nails or screws.
2. There shall be nails or screws in all holes or a partial nailing pattern as shown in Annex A and prescribed in Annex B can be used.
3. The characteristic capacity of the BT connection is calculated according to the manufacturer’s technical documentation.
4. The concealed Joist Hangers connection is designed in accordance with Eurocode 5 or an appropriate National Code.
5. The thickness of the beam shall be at least  $l$ , where  $l$  is the length of the fasteners in the beam. This is in accordance with Eurocode 5.
6. The depth of the Joist shall be so large that the steel dowel has at least a distance of  $3d$  to the edge, where  $d$  = the diameter of the steel dowel.
7. The depth of the beam shall be so large that the fasteners have at least a distance according EN 1995-1-1, in relation to the force direction.

8. The slot for the BT in the joist may be  $t +1/ +2$  mm , where  $t$  = the thickness of the bar of the BT, for the type TU12, TUS12, TUB12 and TUBS12 the slot may be 6 mm, for the other size of type TU, TUS, TUB and TUBS the slot may be 9-10mm
9. For connection to concrete the anchor bolts shall be mounted according to the approval of the used anchor bolt
10. For connection to steel the bolts shall be mounted according the relevant standard
11. The backside of the BT shall have contact along the full height of the connector.
12. BT made from stainless steel shall only be fastened with fasteners made from suitable stainless steel. Zinc-coated concealed joist hangers shall not be fastened with fasteners of stainless steel.
13. Nails or screws to be used shall have a diameter, which fits to the holes of the BTs. They shall have a diameter which is not smaller than the diameter of the hole minus 1 mm.
14. The execution of the connection shall be in accordance with the approval holder's technical literature.

## B.2 Typical Installation for ETB, EL, ELS



The connection to the header or the column for the ETB and ELS can be made with Nails or CSA screws and screws only for Type EL.

The connection to the end grain of the joist is made with screws  $\text{\O}5$  mm according to the corresponding Annex. The angle between the Joist End connector and the screws is  $45^\circ$ . A slope and a skew is possible in these product ranges.

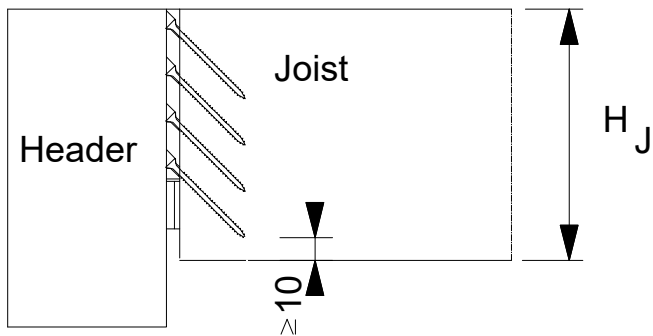
An ETB, EL and EL-S connection is deemed fit for its intended use provided:

1. The header shall be restrained against rotation.
2. If the connection only has a connector on one side of the header, the eccentricity moment from the joists shall be considered when verifying the strength of the header.
3. For a header with joists from both sides but with different reaction forces a similar consideration applies.
4. There shall be nails or screws in all holes or a partial nailing pattern as prescribed in Annex D.
5. For EL connectors fastened to timber frame members as shown in arrangement 1 (see following), only the thread length in the timber member may be taken into account.
6. For EL connectors fastened to timber frame members as shown in arrangement 2 (see following), the sheathing (e.g. OSB) must be flush with the header surface.
7. The gap between the side grain of the header and the vertical flap of the hanger shall be limited. The gap between the side grain of the header and the vertical flap of the connector shall be maximum 3 mm for connections made with the EL connector. For connections made with the ETB and ELS connectors the gap between the member surface and the connector shall be maximum 1 mm.
8. The EL connector shall be in close contact with the concrete or steel over the horizontal flap.
9. For ETB and EL-S connectors the width of the header shall be at least  $l+4d$ , where  $l$  is the length and  $d$  is the diameter of the nails or screws in the header.

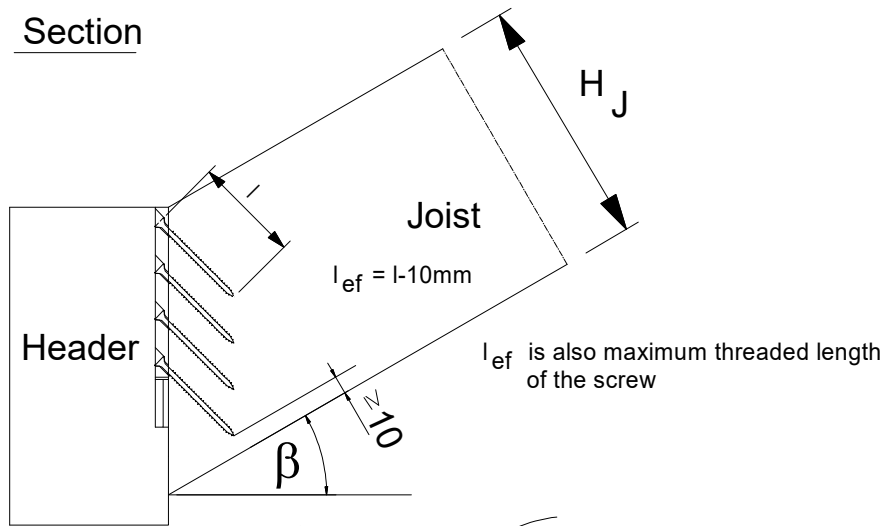
10. For ETB, EL and EL-S connectors the depth of the joist shall allow an edge distance of at least 10 mm between the screw tip and the adjacent joist surface.
11. The header shall have a plane surface against the whole ETB, EL or EL-S connector.
12. Nails or screws to be used shall have a diameter, which fits the holes of the ETB, EL and EL-S connectors.
13. Minimum end and edge distance for the nails/screws have to be observed according to the standard or, if applicable, according to the relevant assessment of the fastener.

ETB

Section



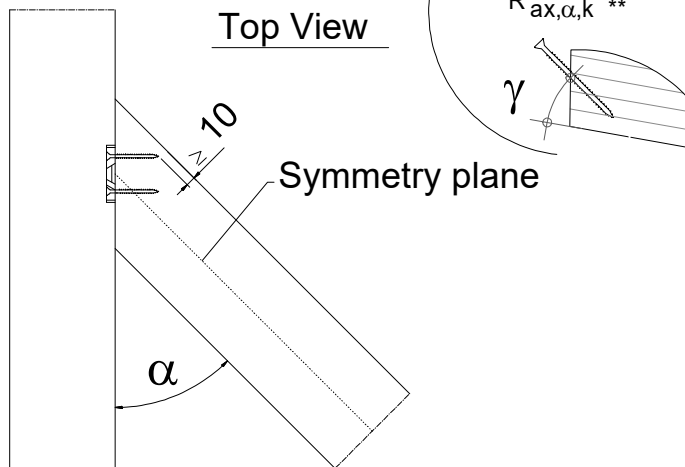
Section



$-15^\circ \leq \beta \leq 90^\circ$  \*\*

For a slope  $\beta < 0^\circ$  the angle  $\gamma \geq 30^\circ$ , in accordance with the approval of the screws, which is used to determine  $R_{ax,\alpha,k}$  \*\*

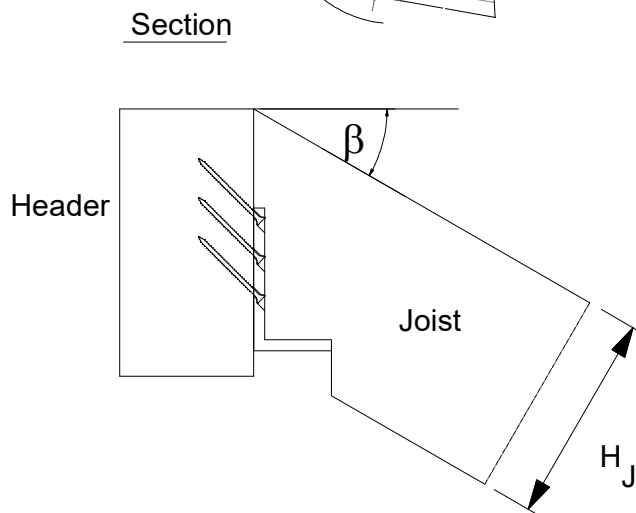
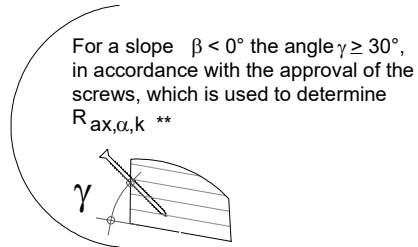
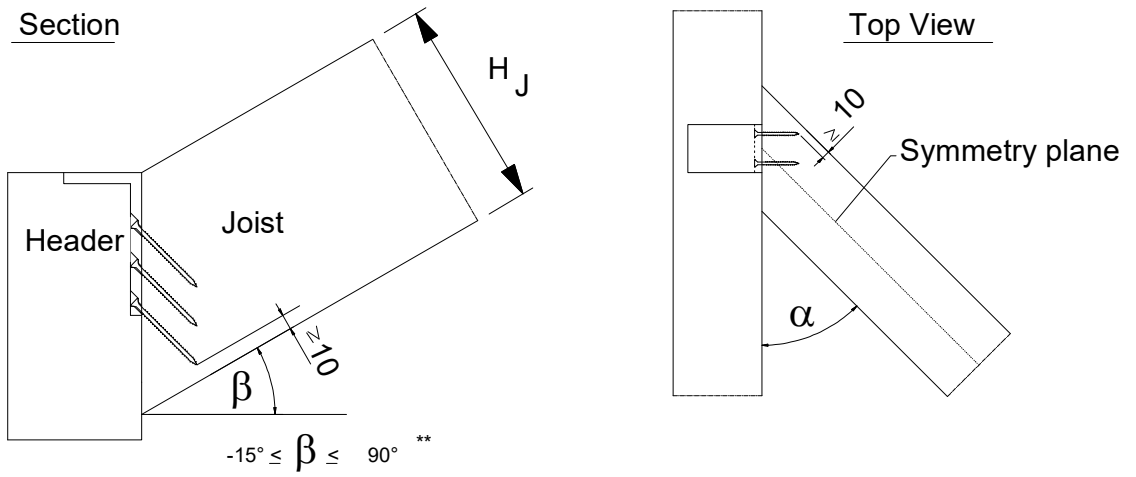
Top View



$15^\circ \leq \alpha \leq 165^\circ$

\*\* if  $\gamma < 30^\circ$  and the screws are covered by approval for this application, the values for the connector may be evaluated accordingly.

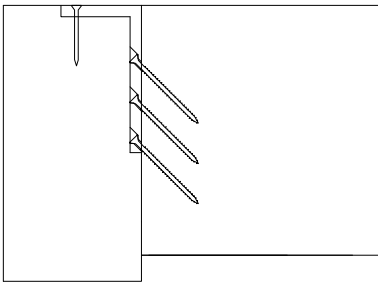
EL



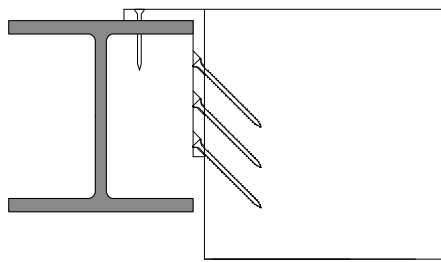
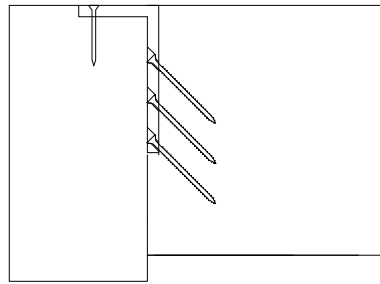
\*\* if  $\gamma < 30^\circ$  and the screws are covered by approval for this application, the values for the connector may be evaluated accordingly.

### Installations

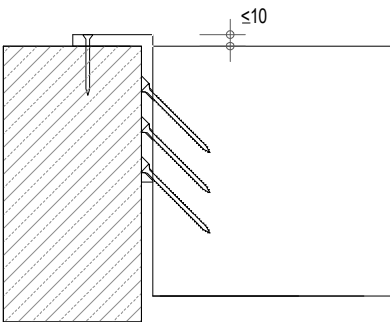
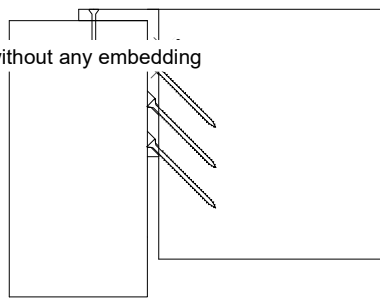
embed in the header



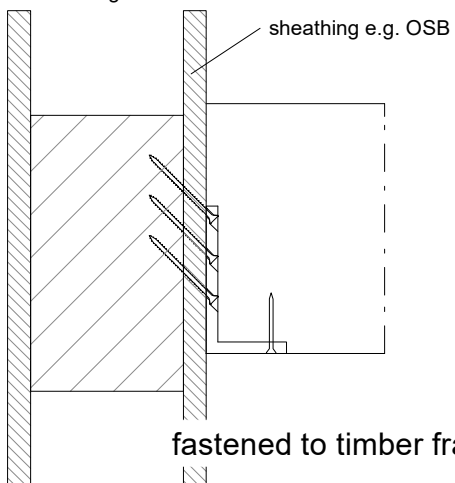
embed in the header and the front of joist



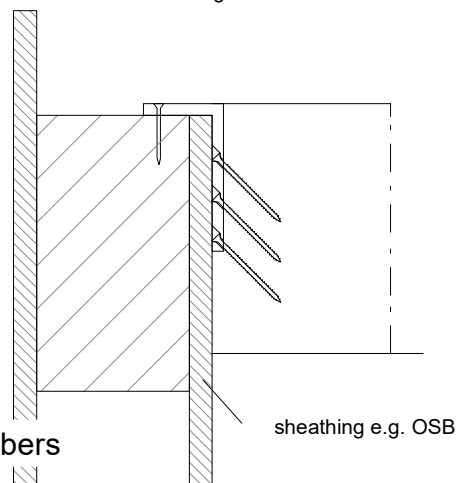
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Arrangement 1

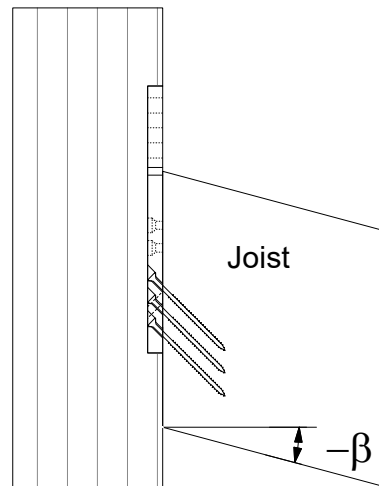
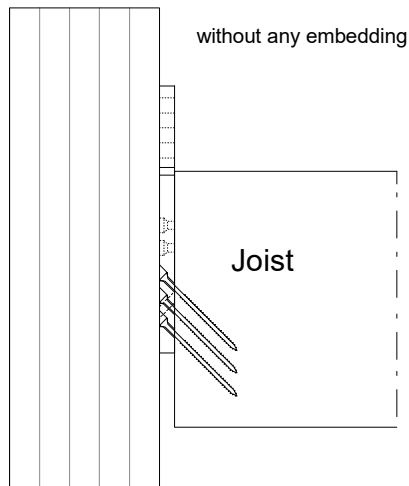
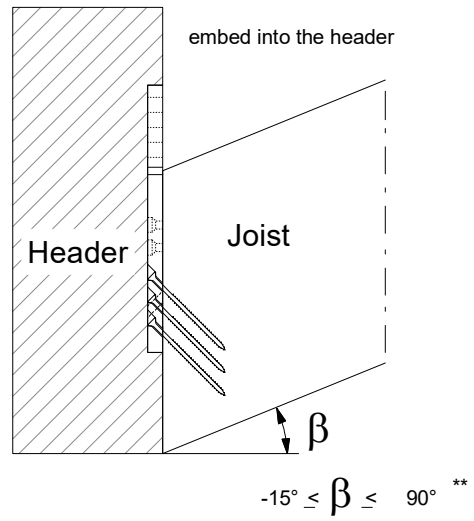
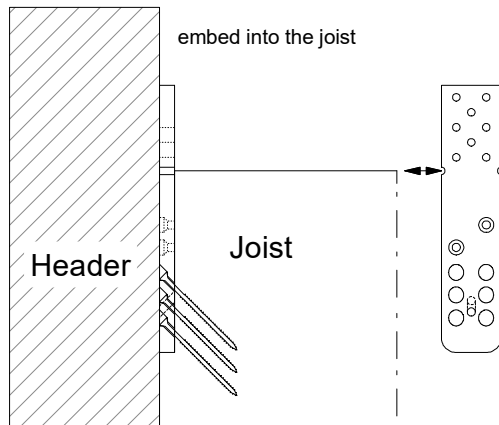


Arrangement 2

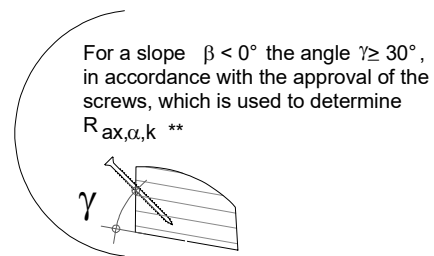
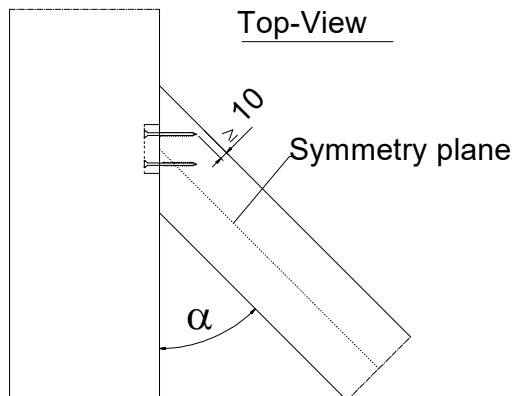


ELS

Section



Top-View



\* if  $\gamma < 30^\circ$  and the screws are covered by approval for this application, the values for the connector may be evaluated accordingly.



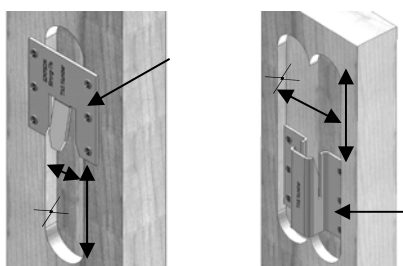
### B.3 Typical Installation of ICS and ICST:

#### ICS

A 12 mm deep pocket is necessary in each timber element before installing the ICS male and female part. The characteristic capacities given below are only available when the ICS are installed in these pockets.

The ICS male part needs to be fixed on the face of the timber element, on top of the 12 mm deep and 40 mm wide pocket as shown below. The pocket must continue at least 80 mm below the male part in order to connect the 2 parts

The ICS female part needs to be fixed in the back of the 12 mm deep and 80 mm wide pocket as shown below. The pocket must continue at least 80 mm above the female part in order to connect the 2 parts.



#### ICST

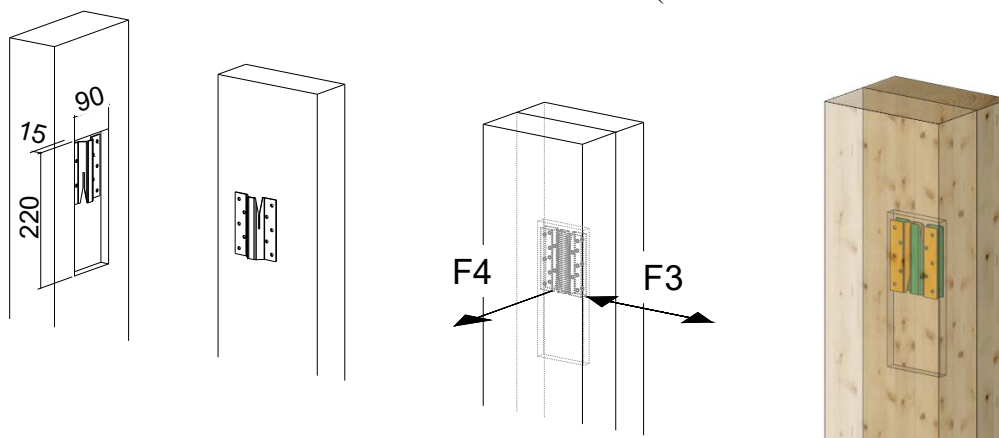
Routing is necessary on 1 side only. This routing should be 15 mm deep, 90 mm wide and 220 mm long as a minimum.

The distance between the ICST and the end of the timber elements should be 100 mm as a minimum.

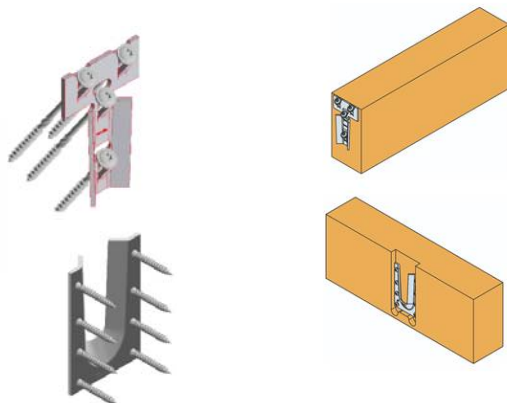
ICST is composed of two parts, which will be face to face in final position.

The guiding central part of the connector facilitates the timber assembly.

The ICST connector is intended in the case of “closed” walls (installation of exterior and interior wall coverings).



### B.4 Typical installation of ETS/ETSN



The connection to the header for the ETS can be only made with CSA screws.

For ETS: The connection to the end grain of the joist is made with screws  $\text{\O}5$  mm according to the corresponding Annex. The angle between the Joist End connector and the screws is  $45^\circ$ .

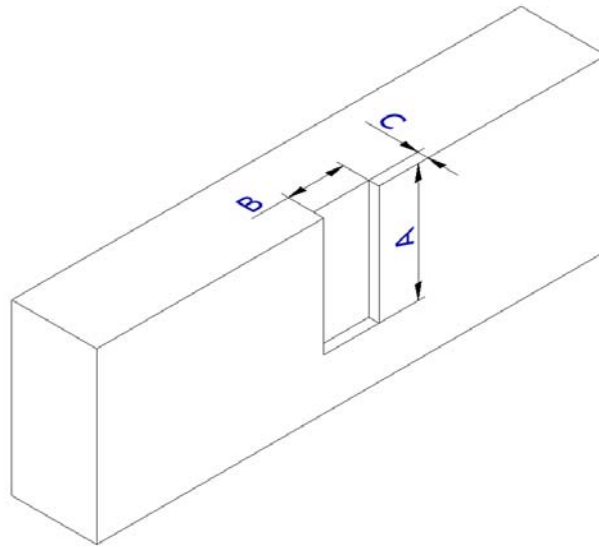
For ETSN: The connection to the end grain of the joist is made with washer head screws  $\text{\O}6$  mm according to the corresponding Annex. A slope and a skew is possible in these product ranges.

An ETS/ETSN connection is deemed fit for its intended use provided:

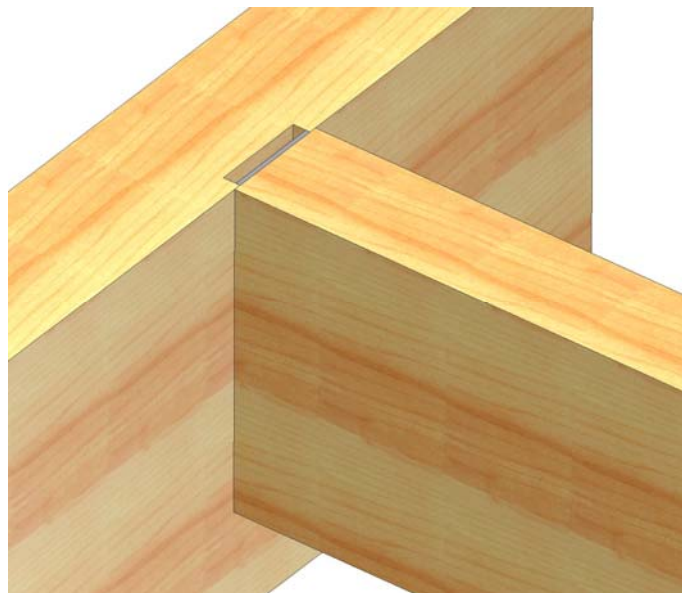
1. The header shall be restrained against rotation.
2. If the connection only has a connector on one side of the header, the eccentricity moment from the joists shall be considered when verifying the strength of the header.
3. For a header with joists from both sides but with different reaction forces a similar consideration applies.
4. For ETS, there shall be screws in all tab-aperture, filling the additional  $\text{\O}5$  mm hole is optional. For ETSN, there shall be one screw for each fastener alignment guide composed of a tab-aperture and an oblong hole.
5. For connections made with the ETS/ETSN connectors the gap between the member surface and the connector shall be maximum 1 mm.
6. For ETS connectors the width of the header shall be at least  $l+4d$ , where  $l$  is the length and  $d$  is the diameter of the nails or screws in the header.
7. For ETS connectors the depth of the joist shall allow an edge distance of at least 10 mm between the screw tip and the adjacent joist surface.
8. For ETSN connectors the depth of the joist shall allow an edge distance of at least 8 mm (for ETSN100) & 10 mm (for ETSN130 & ETSN180) between the screw tip and the adjacent joist surface.
9. The header shall have a plane surface against the whole ETS / ETSN connector.
10. Screws to be used shall have a diameter, which fits the holes of the ETS connectors.

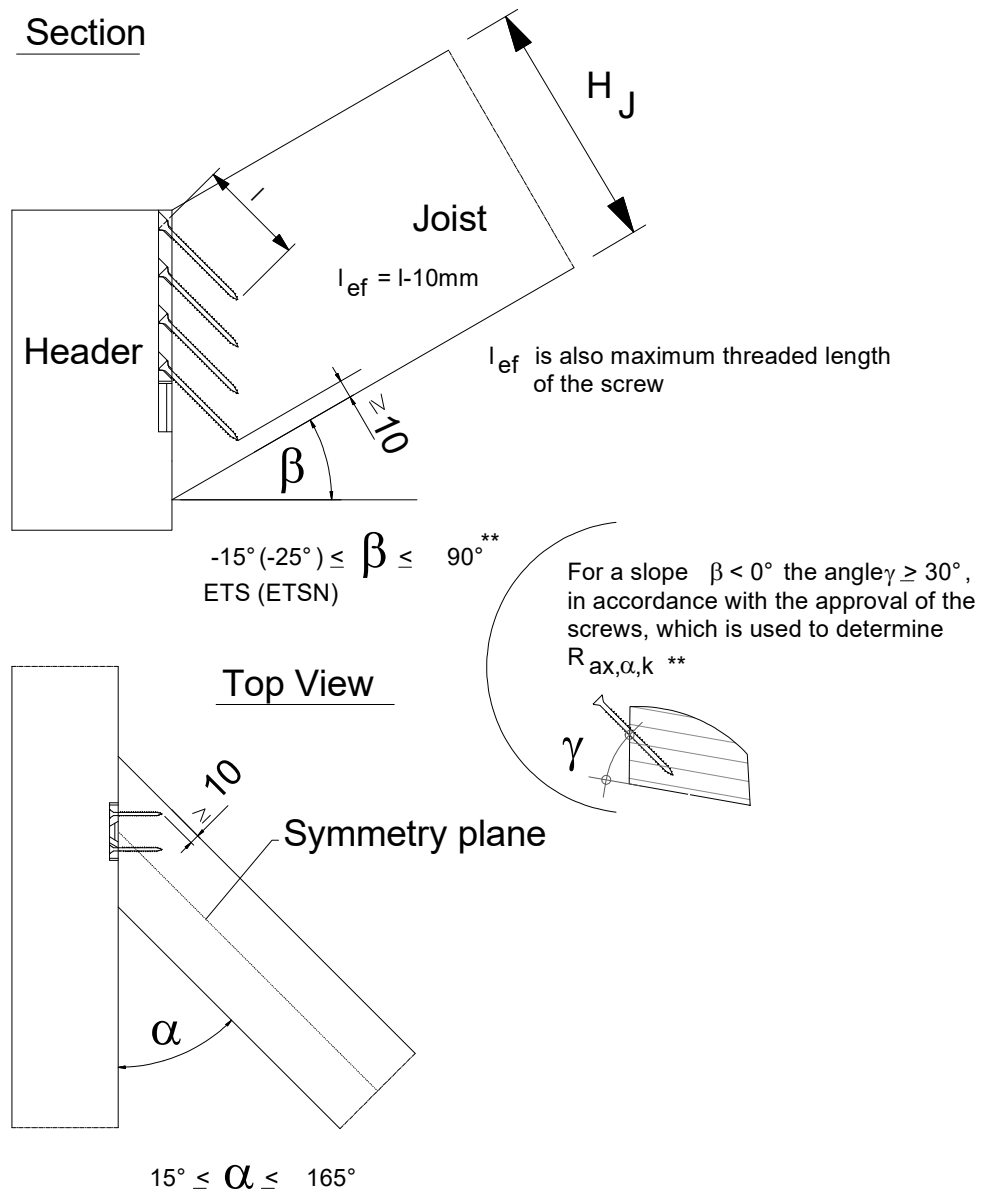
**ETS / ETSN**

The header must be routed as described below.



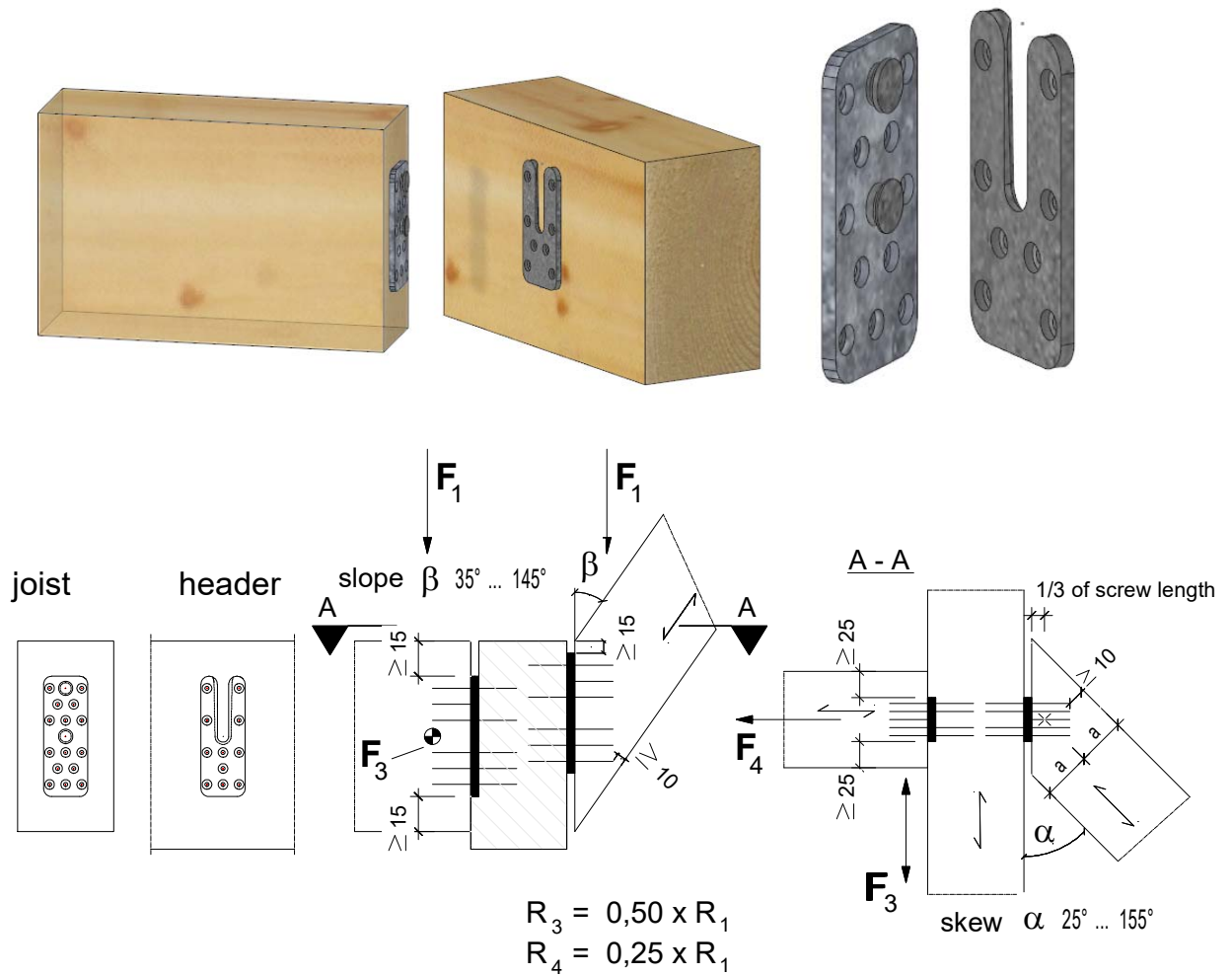
Model	Dimensions of the routing		
	A (mm)	B (mm)	C (mm)
ETS100	100	65	12
ETS140	140	65	12
ETS180	180	75	12
ETSN100	100	60	12
ETSN130	130	65	12
ETSN180	180	75	12





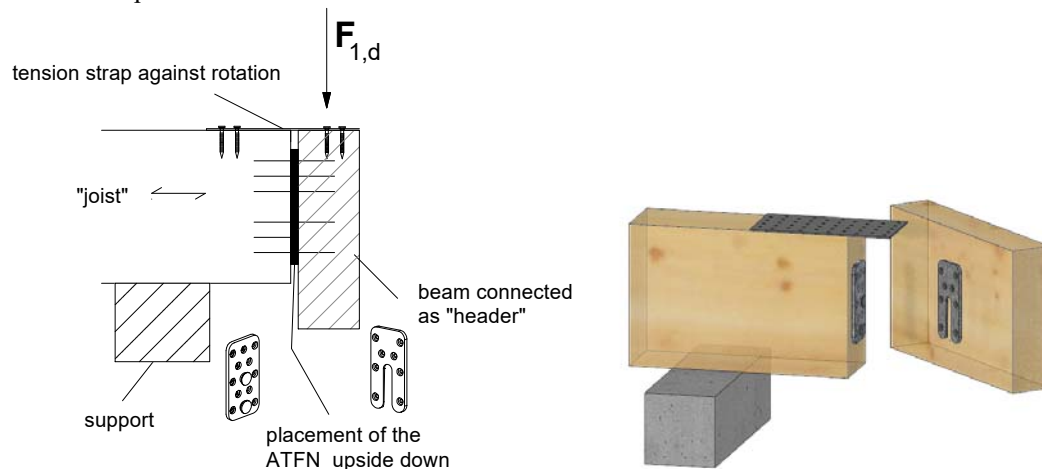
\*\* if  $\gamma < 30^\circ$  and the screws are covered by approval for this application, the values for the connector may be evaluated accordingly.

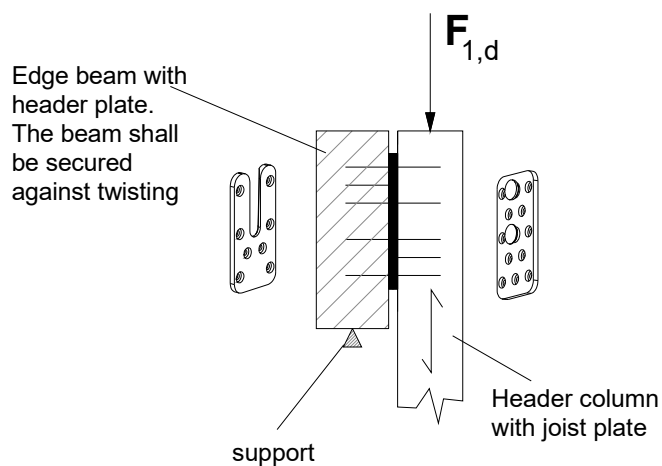
### B.5 Typical Installation of ATFN



The distances to the border according to the picture above have to be considered.

Additional option for installation:

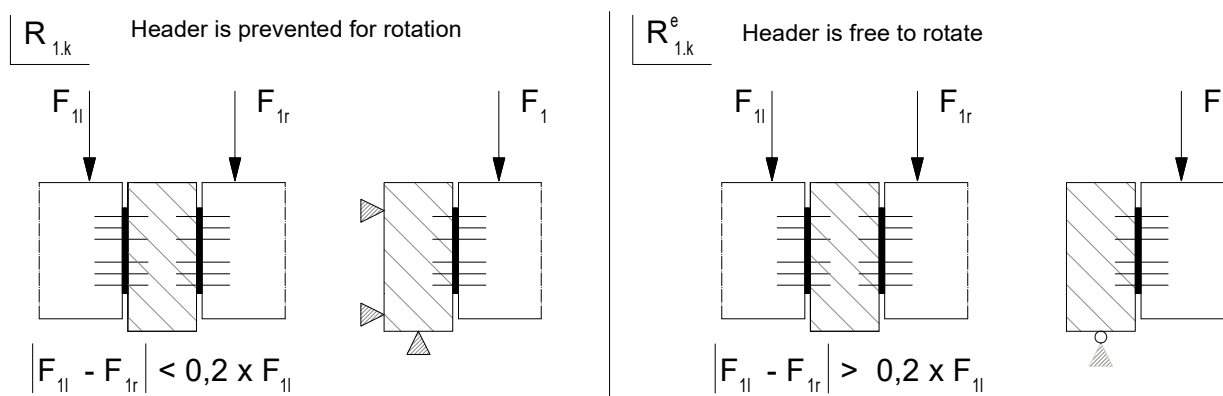




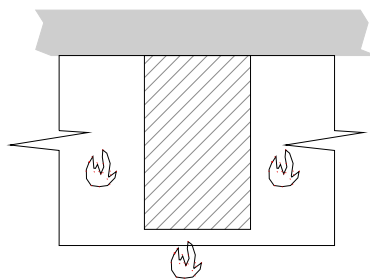
The routing can be made a) in the joist with 10mm, b) in the header with 10mm, or c) in both parts with together  $\leq 10\text{mm}$ .



The connection to the header can be made with nails in the case where the header is prevented from rotation. In other cases, the CSA screws have to be installed.



## B.6 Installation for fire justification



Fire from max 3 sides.

- **Concealed beam Hangers:** (TU, CBH, BT, BT4, BTN, BTALU, BTC, Janebo)
- Below are the parameters for the concealed beam hangers for a 30min and a 60min fire resistance.

**Routing is compulsory**

	Fire resistance period – timber C24	
	30min	60min
$t_1$ (mm)	50	50
$a_{fi}$ (mm)	10	30*
$d_{g1}$ (mm)	10 [30]	30 [Not Applicable]
$d_{g2}$ (mm)	20[30]	60[Not Applicable]

\*must be plugs

For BTALU connector use values between [ ]

For connection with a gap of  $\leq 1$ mm  $d_{g2}$  can be decreased to  $d_{g1}$ , this does not apply for the BTALU.

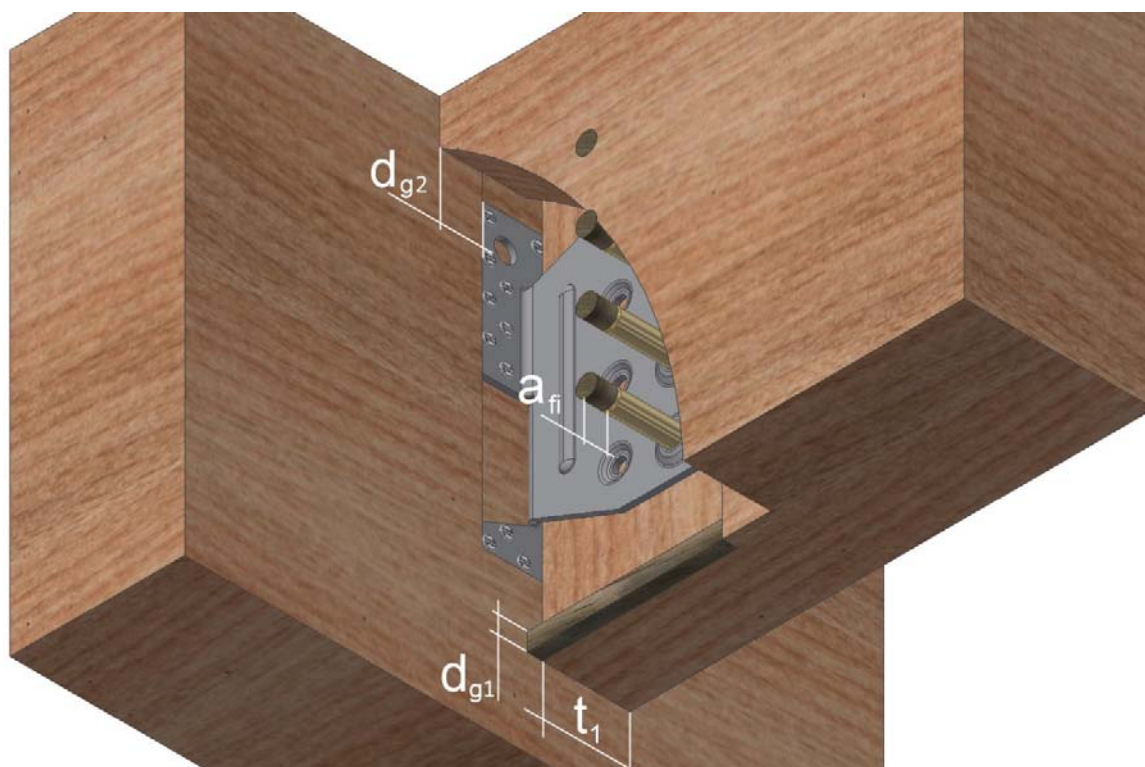
$t_1$ : thickness of the timber member on each side of the connector

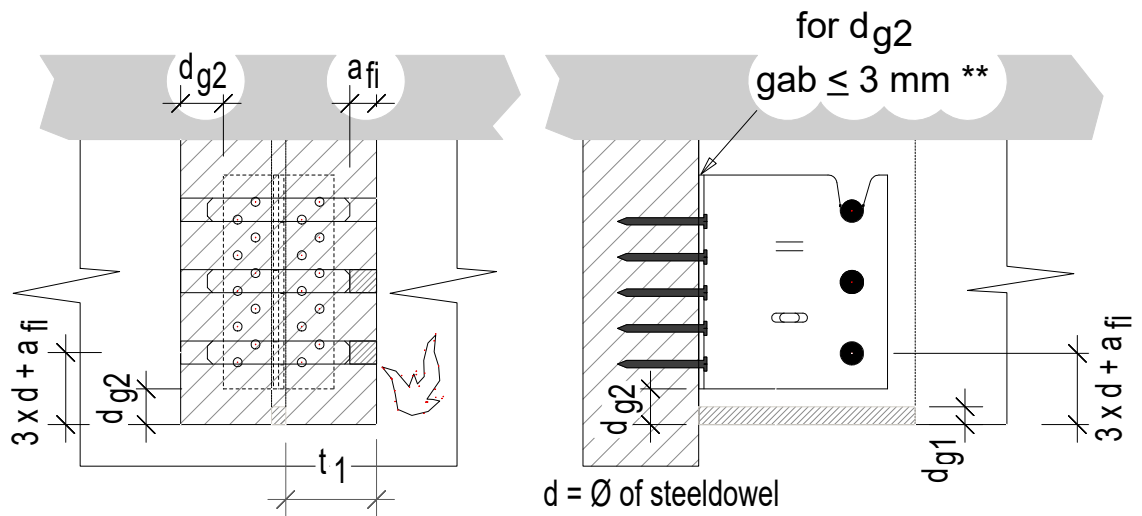
$a_{fi}$ : the end and edge distance to dowels (can be plugs)

$d_{g1}$ : thickness of the glued-in strips

$d_{g2}$ : thickness of timber for overlapping for the back plate with a gap  $\leq 3$  mm,

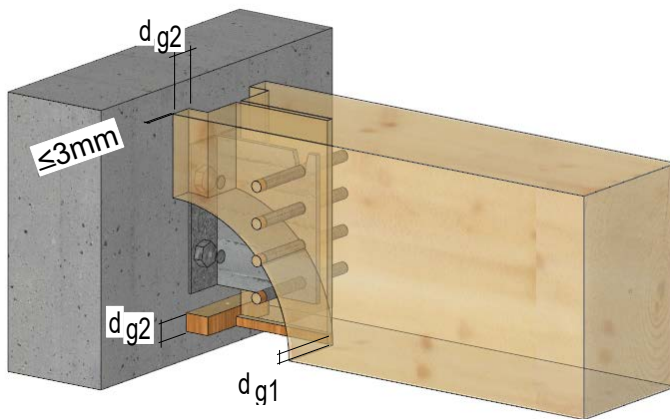
gap = the distance between the end of the joist and the surface of the header





\*\* For connector type BTALU: the gap is limited by  $\leq 1\text{mm}$ .

- **BTC ; CBH bolted**



The gap is limited by  $\leq 3\text{mm}$



- **Hidden connector :** (ATFN, ETB, ETS, EL/ELS, ICS, ICST)

Hidden connectors such as ATFN, ETB, ETS, and EL/ELS, ICS, ICST can also be justified by using this solution. In this case, a routing is compulsory. A thickness of timber  $d_g$  on each side of the connector must be respected.

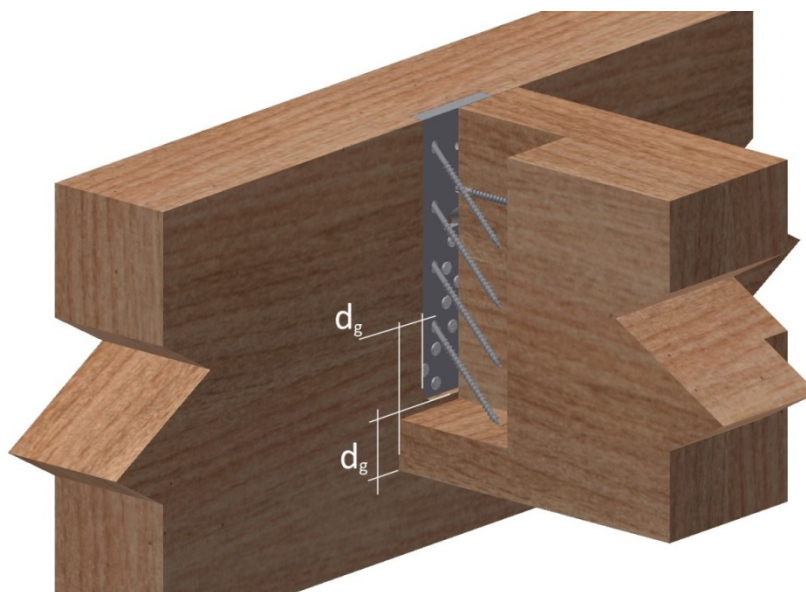
		Fire resistance period – timber C24	
		30min	60min
$d_g$ (mm)	ETS/ETSN ICS, ICST	10	30
	ATFN, ETB, EL/ELS	30	-
	ICS, ICST	10	30
$a_1$ (mm)	ETS, ETSN, ICS, ICST	40	55
	ATFN, EL/ELS, ETB	40	-
	ETS, ETSN, ATFN, EL/ELS, ETB	28	58
$a_3$ (mm)	ETS, ETSN, ATFN, EL/ELS, ETB	28	-

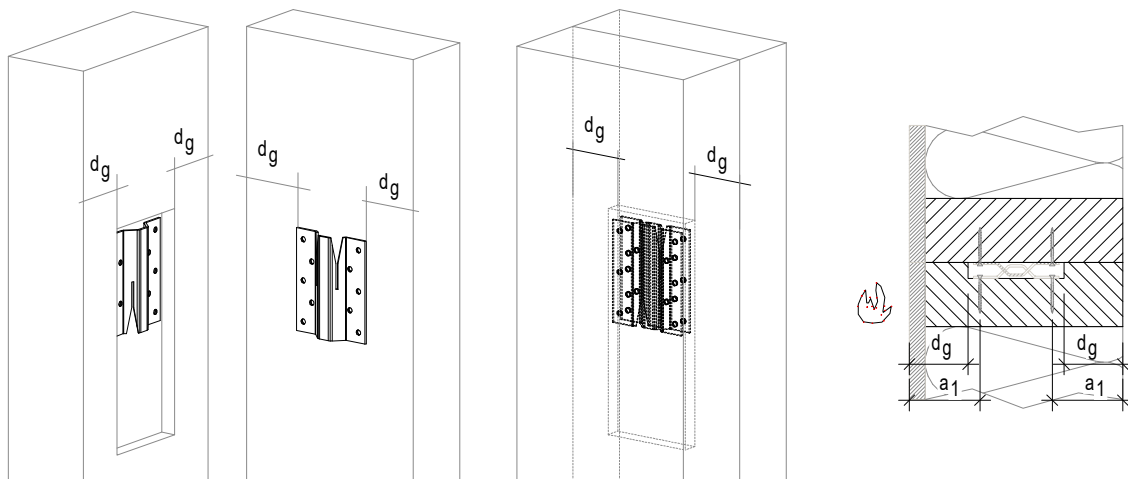
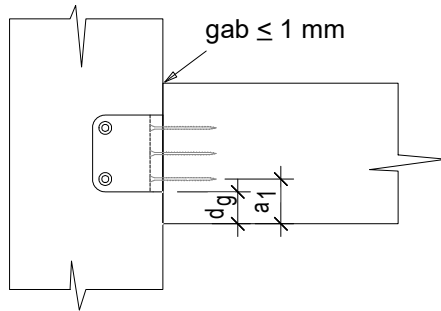
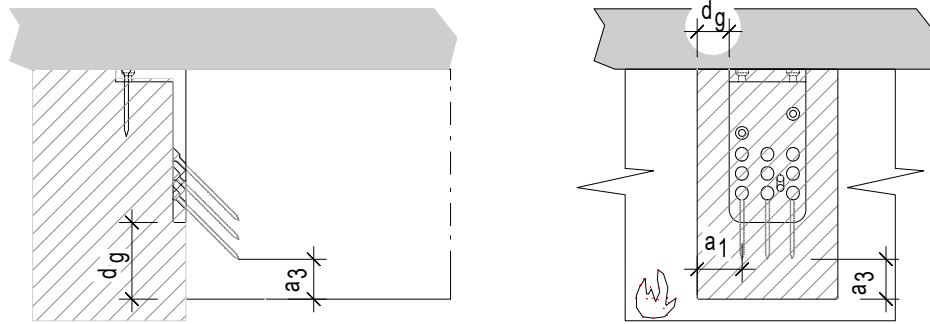
$d_g$ : thickness of the timber protection

$a_1$ : edge distance of the axis of the fastener

$a_3$ : edge distance of the point of the fastener

The protection of the top of the connector is made with the deck, a timber element, or other protective materials.





For ICS and ICST; fire from max 2 sides

## Annex C Design

### C.1 Basis of Design

Characteristic capacities of the concealed joist hangers with nails or screws.

The formulas are applicable for connectors made from stainless steel with a characteristic yield stress of at least 235 Mpa or a characteristic ultimate tensile strength of at least 330 Mpa and for ordinary steel of the quality S250GD + Z275 according to EN 10346 or S235JR according to EN10025, or aluminium AlMgSi 0,7 to DIN 1749-1.

The Joist End connectors are made from aluminium grade EN AW-6082 T6 according to EN 755-2 with minimum yield strength of 250 MPa, a minimum tensile strength of 295 MPa and a minimum ultimate strain of 8 %.

The ATFN connector is made from:

Plates; S355MC according to EN10149

Pins: steel with a minimum yield strength of 580N/mm<sup>2</sup> a minimum tensile strength of 610 N/mm<sup>2</sup> and a minimum ultimate strain of 16%. The pins are connected with the plates by compression strain

Requirements for the header or the joist for the concealed beam hangers:

- The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members.
- The requirements of the wood members can be fulfilled by using the following materials:
- Solid timber classified to C24 or better according to EN 338
- Glued members of timber classified to C24 or better according to EN 338 when structural adhesives are used.
- Glued laminated timber classified to GL24c or better according to EN 1194.
- Solid Wood Panels, SWP according to EN 13353.
- Laminated Veneer Lumber LVL according to EN 14374
- Plywood according to EN 636
- Other Engineering Wood products classified for their resistance and with certified mechanical performances for fasteners

The characteristic density of the wood members shall be at least 350 kg/m<sup>3</sup>. Lower densities are applicable but the load bearing capacities shall be reduced by the  $k_{dens}$  factor, given by

$$k_{dens} = \left( \frac{\rho_k}{350} \right)^2$$

Where  $\rho_k$  is the characteristic density of the timber in kg/m<sup>3</sup>.

In case of concrete support, concrete shall be specified according to EN 206-1 with a resistance class within the following range : C20/25 to C50/60.

The wood members shall have a thickness which is larger than the penetration depth of the fasteners into the members

Requirements for the header or the joist for the Joist End connectors:

For screws or nails in the end grain of the wood (joist) the requirement to the material of the wood members can be fulfilled by using the following materials:

- Solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glued members of timber classified to GL24c or better according to EN 1194 / EN 14080,
- Solid Wood Panels, SWP according to EN 13353,

For nailing in the side of the wood members (header) the requirement to the wood members can be fulfilled by using the following materials:

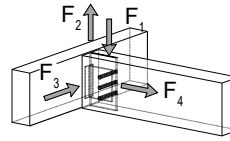
- Solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glued members of timber classified C14-C40 according to EN 338 / EN 14081 when structural adhesives are used.
- Glued members of timber classified to GL24c or better according to EN 1194 / EN 14080,
- Solid Wood Panels, SWP according to EN 13353,
- Laminated Veneer Lumber LVL according to EN 14374,
- Parallam PSL,
- Laminated Strand Lumber LSL e.g. Parallam PSL and Timber Strand,
- Oriented Strand Board OSB according to EN 300
- Duo- and Triobalken,
- Layered wood plates,
- Plywood according to EN 636
- For EWP (Engineered Wood Products), please refer to the manufacturer's specifications.

The load-carrying formulas stated in Annex B are applicable for a wood density from 290 kg/m<sup>3</sup> to 460 kg/m<sup>3</sup>. It is allowed to use wood with a density up to 500 kg/m<sup>3</sup>. However, increased load-carrying capacity than that for a density of 460 kg/m<sup>3</sup> should not be employed. For density between 420 and 500 kg/m<sup>3</sup> pre-drilling of nail and screw holes are necessary.

## C.2 Definition of force directions

The characteristic load-carrying capacities are for the following force directions:

- $F_1$  Downward
- $F_2$  Uplift
- $F_3$  Lateral – horizontal
- $F_4$  Axial in the middle of the beam



Concealed joist hangers type BTN, BT4, BTALU, BTx, BTCx

Force direction  $F_1$  :

These are given in different tables for each connection.

“Table for connection with header free from rotation”. Here it is assumed, that the connection has a BT both sides of the header and the difference between the active forces is no more than 20%, or the header is clamped. In this case the calculation for the header may be made separately.

“Table for connection with header free to rotate”. Here the eccentricity of the BT is used so the moment is absorbed in the BT – connection.

For the capacity for the header with  $b = 240$  mm it is to multiply the values for  $b_{HT} = 180$ mm with the factor 0,77.

For an uplift force, the upper dowel in the cut-out hole may not be used for the calculation.

Force direction  $F_2$  :

The values for  $F_1$  can be used where the number of steel dowel has to reduce by the upper one in the “cut-out” hole.

How to use the tables:

Force direction	the used fastener and size		nail pattern	
$R_{1,k}$	CNA 4,0x50	4-row	length of steeldowel	
Length SD [mm]	80	100		
number of SD	$n_N$	[kN]	$n_N$	[kN]
3	20	18,2	20	19,4
	44	32,2	44	34,5
4	28	29,5	28	31,2
	48	43,0	52	46,1
5	36	41,9	36	44,3
	56	53,9	60	57,6

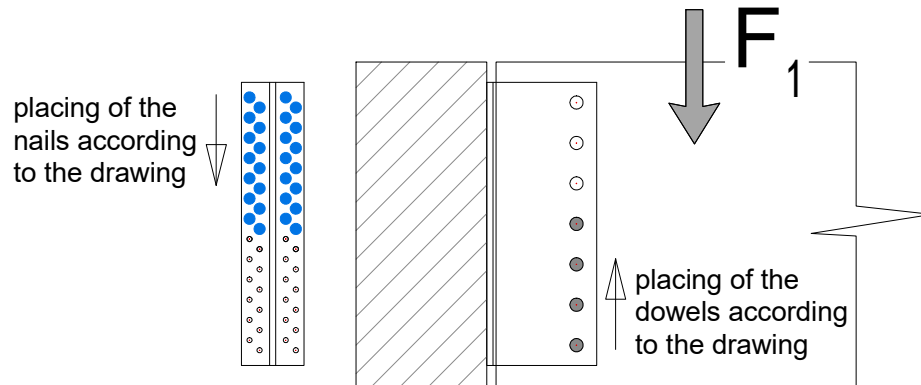
number of steel dowel

number of nails

capacity for the nails/steel dowel

Sample: a connection with a BT with 4 Steel dowel with a length of 100mm, the width of joist is min. 100mm, nail pattern = 4-row, and 28 nails 4,0x50 is  $R_{1,k} = 31,2$  kN.  
for the same connection with 52 nails  $R_{1,k} = 46,1$  kN.

For using another number of nails, it must be between the number of fasteners listed in the table, the capacity may be determined by linear interpolation based on the number of nails. In the sample before the number of nails may be between 28 and 52.



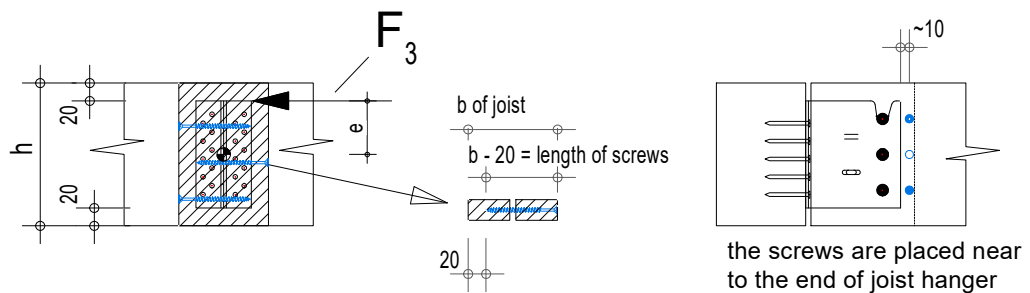
Force direction  $F_3$  :

These are given in the table, with and without screws. For connections with screws, the screws are inserted perpendicular next to the BT, see following picture.

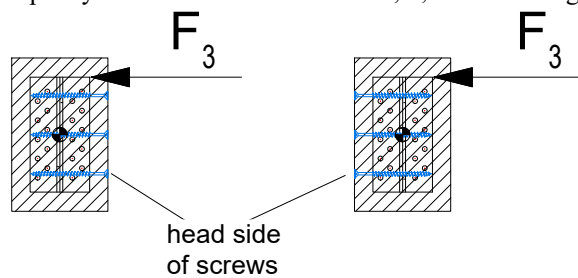
The screws for reinforcement of the joist shall have a length  $<$  the width of the joist. The assumed length for the tables in Annex B is width of the joist  $-20$ mm. The screws are inserted from both sides. The screws shall be fully threaded.

$b$  des Nebenträgers

$b - 20 = \text{Länge der Schraube}$



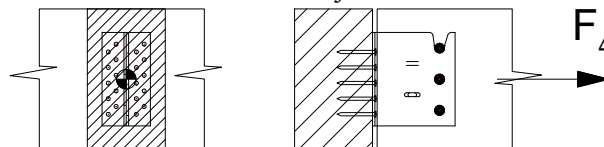
Where screws are inserted from one side, it shall be the side of the applied force. Otherwise the capacity is reduced with the factor 0,8 ; see following picture



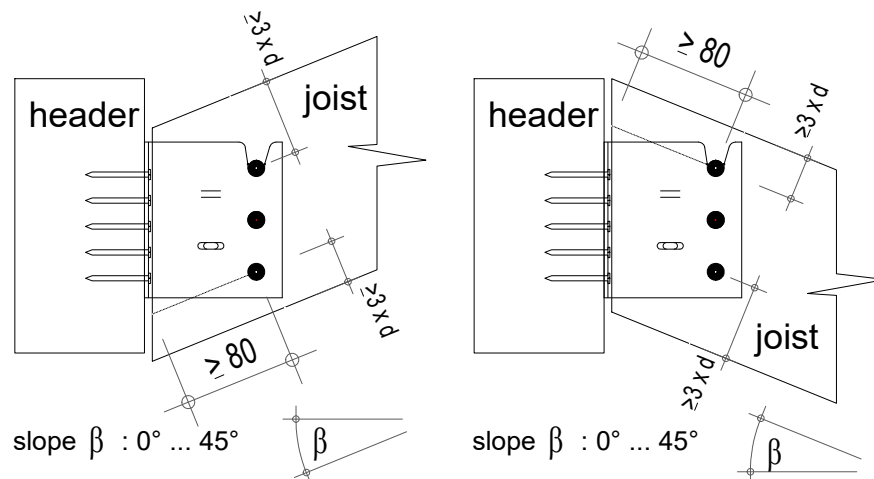
Use the table values use the table values  $\times 0,8$

Force direction  $F_4$

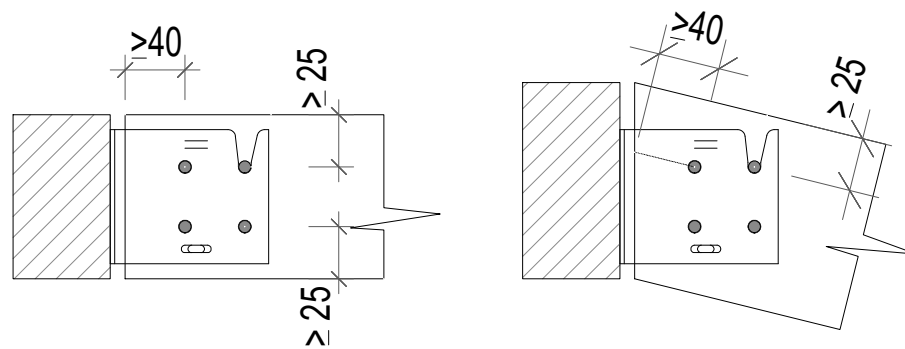
The force is in the direction of joist and in the middle of the joist.



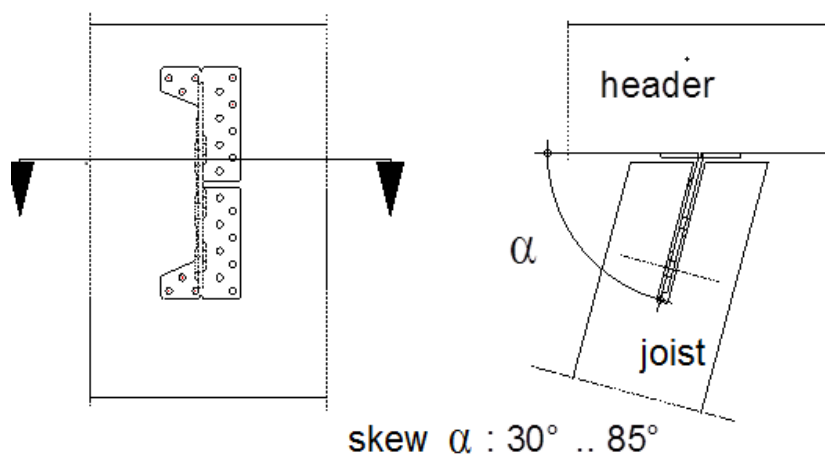
General



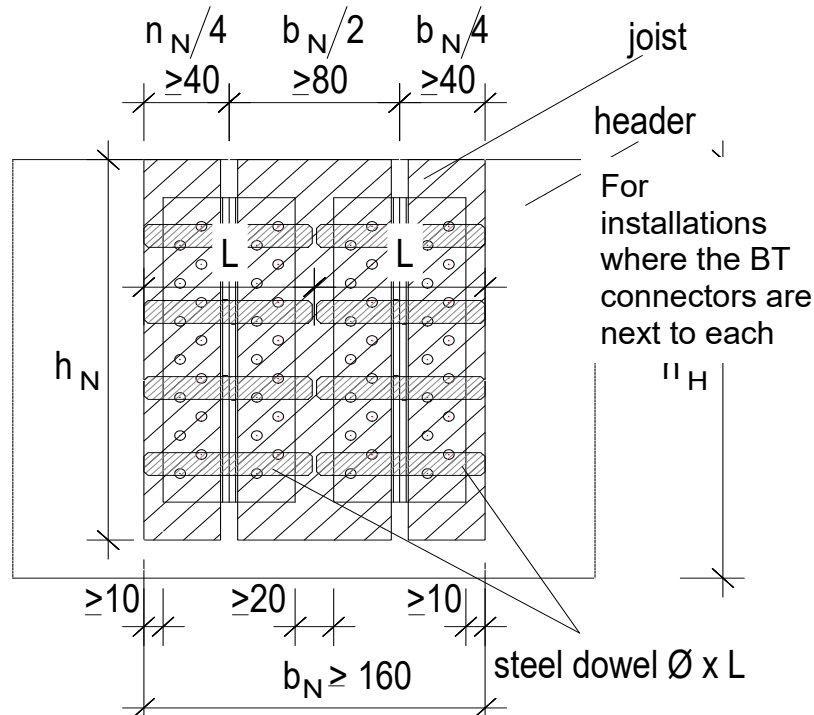
Type BTN-90 and BT4-90.



For the types TUS and TUBS; additional skews are possible:

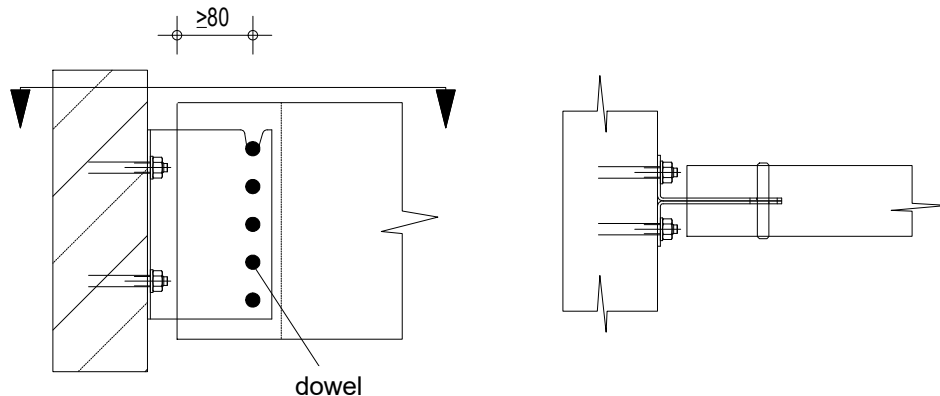


The above picture shows a skew to the left side. The design for right is the same.



The dowels should be inserted from both sides meeting in the middle of the joist.

Connection to concrete / steel



The connection for force direction  $F_1$  is with min. 2 anchor bolts, used in the upper holes.

For an uplift force,  $F_2$  and  $F_3$  a minimum of 4 anchor bolts, must be used in the upper and lower holes.

### Racking check

Due to the high rigidity of CLT wall, the racking load can be transferred to the BTALU at the bottom and decomposed as an axial load and a lateral load.

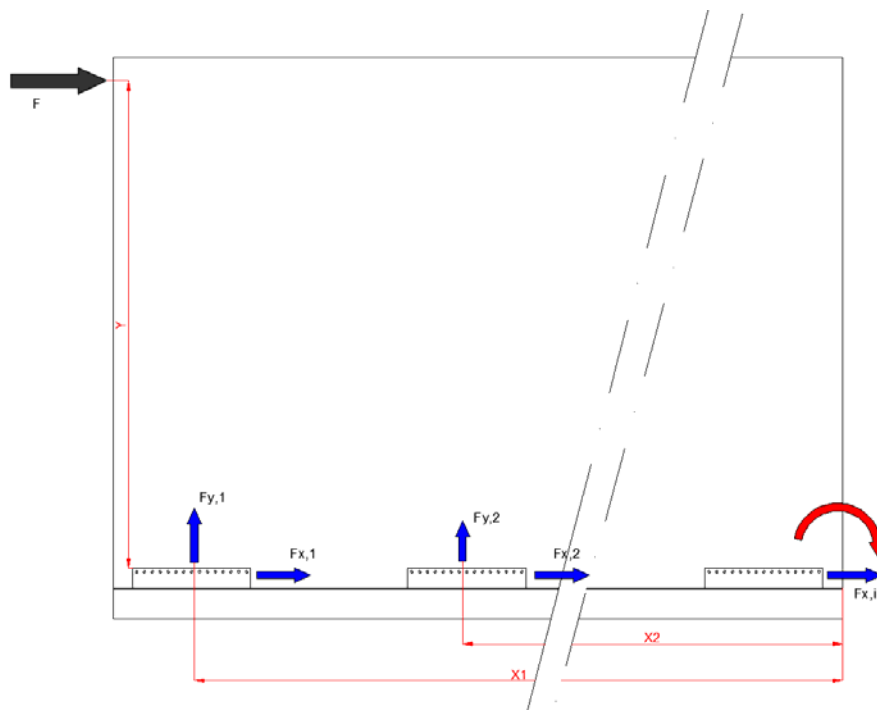
$$F = F_{x,1} + F_{x,2} + \dots + F_{x,i} \text{ and } F_{x,1} = F_{x,2} = \dots = F_{x,i}$$

$$F_{y,1} = F \times x_1 \times y / (\sum x_i^2)$$

$$\text{Optional : For the other BTALU : } F_{y,i} = x_i / x_1 \times F_{y,1}$$

The use of formulas provides no gap between wall and floor members. With  $F$  the racking load,  $Y$  the height of the wall and  $X_i$  the distance between the BTALU and the rotation point. It is assumed, that the "pressure" area is close to the end of the CLT wall, and the last Connector (it's the right one in the picture below) doesn't absorb any axial load.





Then interaction formula must be used on the first BTALU:

$$\left(\frac{F_{y,1}}{R_{y,1}}\right)^2 + \left(\frac{F_{x,1}}{R_{x,1}}\right)^2 \leq 1$$

With

$R_{y,1}$  the resistance of the first BTALU to tension loads

$R_{x,1}$  the resistance of the first BTALU to downloads

### Characteristic capacities $R_{4,k}$ for BTALU with steel dowel Ø7, 8 and 10mm

Table 35

Tension resistance of BTALU is calculated using the following equation:

$$R_{4,k} = \min(n_d \times F_{lat,SD,Rk}; n_N \times F_{ax,Rk})$$

$n_d$  is the number of dowels

$n_N$  is the number of nails/screws

$F_{lat,SD,Rk}$  is the characteristic load-carrying capacity per dowel in the timber for both shear planes (acc.to EN1995-1-1 §8.6).

$F_{ax,Rk}$  is the axial capacity of the fastener in the header

The slot to be used with the BTALU is 7 to 8 mm thick.

See the additional information below table 34 for placing the nails/ steel dowel, respectively the number for using in the calculation.

### Steel dowels

The steel dowels must be mechanically equivalent or greater than S235JR ( $f_{y,k,min} = 235$  N/mm).

The standard spacing between dowels is 40mm. If the spacing increases and the number of dowels remain the same, the capacity with standard spacing can be used as normally it increases the values.

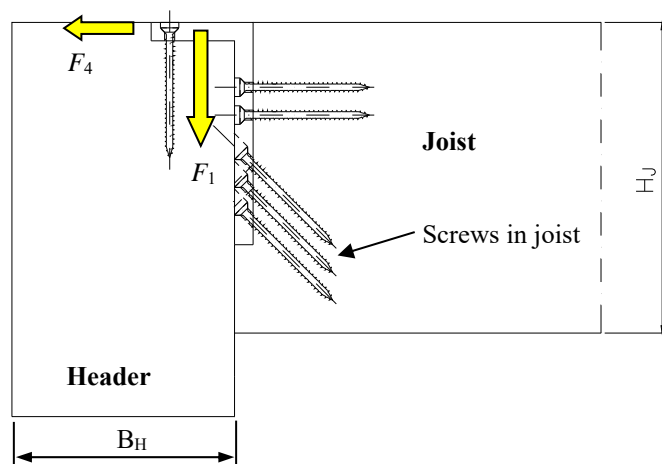
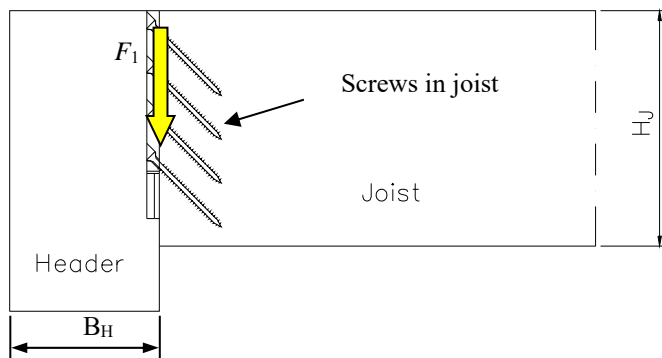
For dowels Ø8 the values can be used with a distance between the header and the dowels of 89mm to 93mm

### ETB, EL, ELS, ETS, ETSN

The part in the header has to be fixed with nails or CSA screws or only with CSA screws for ETS connectors. The part in the joist has to be fixed with screws with an angle of 45° to the connector. For ETSN, the part in the joist has

to be fixed with screws with an angle of 35° to the connector. The screws have to have a angle between grain of timber and the screw according the approval of the screws. For the ETB, ETS & ETSN both parts of the connector are to be fixed separately on the header and the joist before assembly of the connection

For the types EL and EL-S the connector has to be fixed to the joist and then connected to the header or the column.



### C.3 Fastener specification and capacities

Nail and screw type	Nail and screw size (mm)		Finish
	Diameter	Length	
According to ETA 04/0013 Annex A drawing 1 and 2			Electroplated zinc
Connector nail	4	35, 40, 50, 60, 75, 100	
Connector screw	5	35, 40, 50	
Connector nail	4,2	35, 50, 60	stainless steel as described
Connector nail	4	35, 40, 50, 60, 75, 100	
Connector screw	5	35, 40, 50	

other fastener	size [mm]		Finish
	Diameter	Length	
Screws according to EN 14592 or according to an ETA	5	60-120	Electroplated zinc
Washer head screws according to EN14592 or according to an ETA	6	80-160	Electroplated zinc
Screws according to EN 14592 or according to an ETA	8	Up to 300	Electroplated zinc
dowel according to EN 14529	8	-	Electroplated zinc hot dip galvanised stainless steel
	12	-	
Bolt M10	10	-	For relevant concealed joist hangers see the assumed characteristic capacities of the bolt connection and compare with the specification of the manufacturer
Bolt M12	12	-	

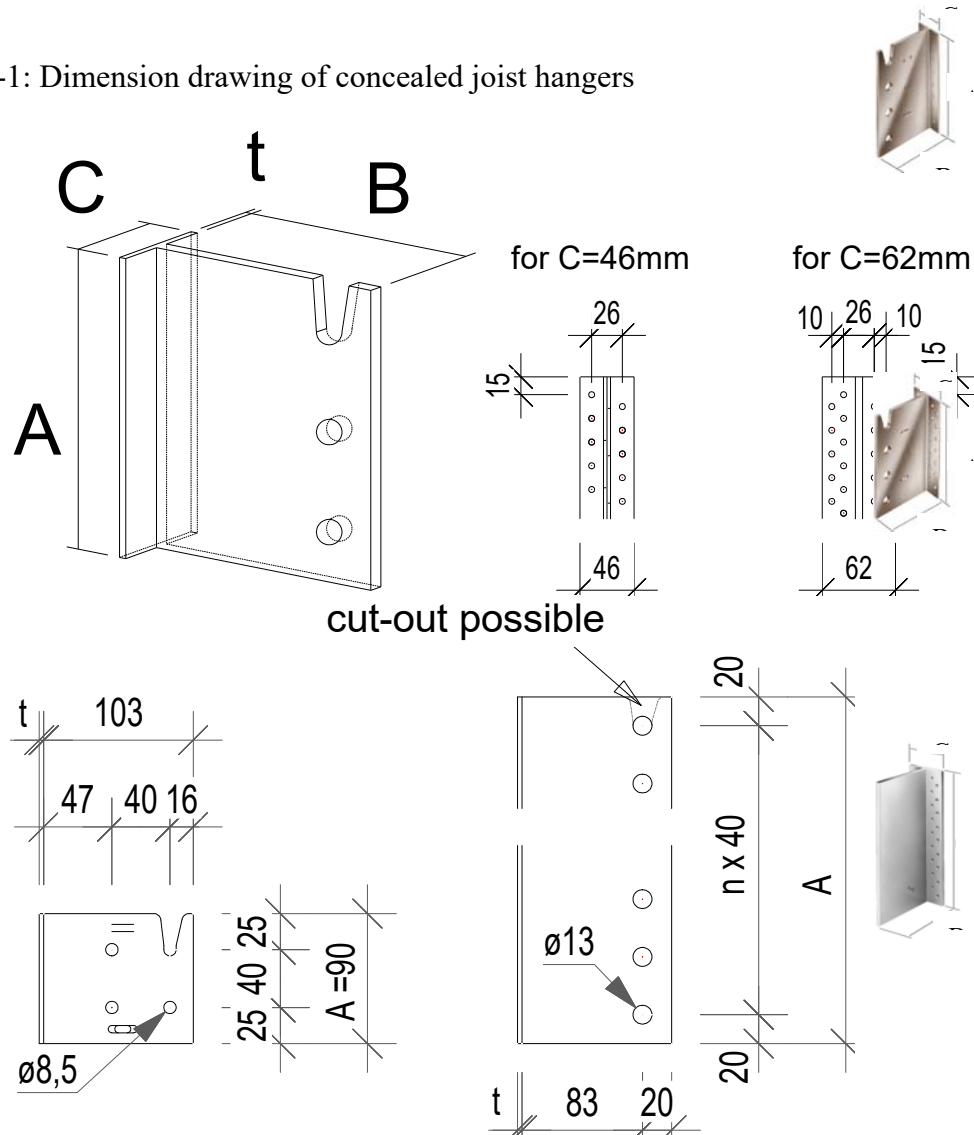
The capacities are given in the named standards or relevant approvals.

## Annex D- Product definition and capacities

### D1 Concealed joist hanger BTN, BT4, BTALU, BTx

Product Name	alternative names				old name
	Branch 36	Branch 40	Branch 46	Branch 47	
BTN					2 rows
BT4					4 rows
BTALU					ALU
BT					-

Figure D1-1: Dimension drawing of concealed joist hangers



Type BTALU connectors are produced without holes for the dowels, these holes should be made before or during installation by the user, the hole pattern is shown above., the holes can be made also with other diameters ( $\varnothing$  of steel dowel :7, 8 and 10 mm)  
 The concealed joist hanger BTN and BT4 up to size 240 are supplied with the cut-out for the upper dowel and it's an option for the other sizes.

### Additional Option for outside using

For the types BTALU, up to size 240, and the BT made from stainless steel also up to size 240, it's allowed to reduce the distance of the steel dowel to the end grain of the joist like the following. In this case, full threaded screws have to be placed as given in the picture. An approval/assessment for the screw and the given distances is necessary.

The minimum edge and end distances for the full threaded screws have to be observe according to the approval/ assessment of the used screws.

For a construction in this way the load directions F1, F2 and F4 are possible.

This application is an option for service class 3, e.g. balcony, where a distance is meaningful for a good aeration.

A professional construction for a wood preservation is required.

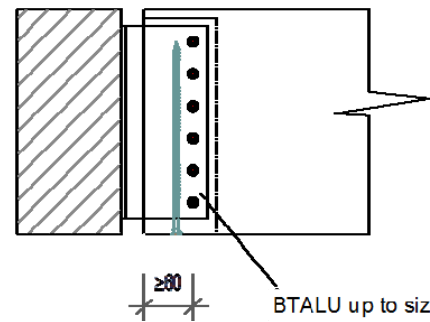
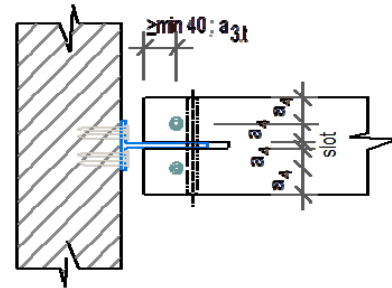


Table D1-1: Size specification

Type	A [mm]	B [mm]	C [mm]	t [mm]	no of holes	
					Ø 5mm	Ø13mm dowel
BTN90	90	103	46	3	8	4*
BTN120	120	103	46	3	10	3
BTN160	160	103	46	3	14	4
BTN200	200	103	46	3	18	5
BTN240	240	103	46	3	22	6
BT4-90	90	103	62	3	16	4*
BT4-120	120	103	62	3	20	3
BT4-160	160	103	62	3	28	4
BT4-200	200	103	62	3	36	5
BT4-240	240	103	62	3	44	6
BTALU90	90	103	62	6	16	4 <sup>*,**</sup>
BTALU120	120	103	62	6	20	3 <sup>**</sup>
BTALU160	160	103	62	6	28	4 <sup>**</sup>
BTALU200	200	103	62	6	36	5 <sup>**</sup>
BTALU240	240	103	62	6	44	6 <sup>**</sup>
BTALUx <sup>***</sup>	up to 600	103	62	6	up to 112	up to 12 x Ø13 <sup>**</sup>
BTx <sup>***</sup>	up to 600	103	62	3	up to 112	up to 15x Ø13

\* Ø8,5mm

\*\* hole pattern according the types BT4, to drill additional

\*\*\* here is given the high in mm, same as the size "A" in the table.

Table D1-2: Material specification

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
6	Aluminium AW-6005A according to EN755- 2:2008	
3	stainless steel as described	

For installation for fire justification, see clause B6

**Characteristic capacities**

The tables are based on a timber having a density of 350 kg/m<sup>3</sup> and a slope of 0°

For other configurations the following modification are necessary:

for different density the values shall be multiplied by:

$\rho_k =$	380	410	430,0
factor	1,05	1,10	1,13

for different slope  $\beta$

$\beta$	0°	15°	30°	45°
factor	1	0,95	0,9	0,85

only for less as 7 SD, for 7 or more SD no reducing is necessary

SD = Steel dowel

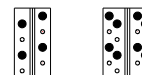
For using steel dowels with a length of 60mm the values for steel dowel with 80mm may be multiplied by 0,95; only for the types BTN90 and BT4-90 the values for a dowel with l=60mm are given directly.

Characteristic capacity  $R_{1,k}$  [kN] for BTN90/ BT4-90 and steel dowel Ø8mm

BTN90 / BT4-90		$R_{1,k}$ [kN]		to beam	
CNA 4,0x50		kg/m <sup>3</sup>			
$n_N$	Timber width = length of steel dowel [mm]				
	60	80	100	≥ 120	
8	8,3	9,2	10,3	11,02	
16	10,8	11,8	12,9	13,72	

BTN90 / BT4-90		$R_{1,k}$ [kN]		to column	
CNA 4,0x50		kg/m <sup>3</sup>			
$n_N$	Timber width = length of steel dowel [mm]				
	60	80	100	≥ 120	
4	7,1	7,9	8,6	8,9	
8	9,0	9,9	10,9	11,6	

BTN90 / BT4-90  
column nailing



	BTN90 / BT4-90		$R_{3,k}$ [kN]		to column	
	CNA 4,0x50		kg/m <sup>3</sup>			
	$n_N$	Timber width = length of steel dowel [mm]				
60		80	100	≥ 120		
without screws	4	1,2	1,6	2,0	2,4	
	8	1,5	1,9	2,3	2,7	
with screws	4	1,7	3,4	4,7	5,0	
	8	1,9	3,7	4,7	5,8	

The characteristic capacities for the different load directions  $F_1$ ,  $F_2$ ,  $F_3$  for the other dimensions of BTs, please refer to table 1 to 35 on the following pages. The connections are with steel dowel  $\varnothing 12\text{mm}$ , except for BT90 with  $\varnothing 8\text{mm}$ . The values in the tables 1 to 34 are also for the concealed joist hangers BTALU with  $\varnothing 12\text{mm}$  steel dowel.

Tables for BTN, BT4, BT, BTALU

No of table	force direction	nail /screw	nail pattern	supporting member as a	supported member	$b_H$ [mm]	No of table	force direction	nail /screw	reinforcement: with/without screws	supporting member as a	
1	$F_1$	CNA4,0x50	4-row	Header	C24		21	$F_3$	CNA 4,0x50	with screws	Header	
2		CNA 4,0x60					without screws					
3		CSA 5,0x50					with screws					
4		CNA4,0x50								without screws		
5		CNA 4,0x60	with screws									
6		CSA 5,0x50					without screws					
7		CNA4,0x50	4-row	Column			27		CNA 4,0x50	with screws	Column	
8		CNA 4,0x60					without screws					
9		CSA 5,0x50					with screws					
10		CNA4,0x50							without screws			
11		CNA 4,0x60	with screws									
12		CSA 5,0x50					without screws					
13	$F_1$ f. H.	CNA 4,0x60	4-row	Header	120	33	all	Header				
14					CSA 5,0x50	2-row	180	34	all	Column		
15							CNA 4,0x60	with screws	120	35	all	Header/Column
16									CSA 5,0x50			
17		CNA 4,0x60	with screws				120					
18					CSA 5,0x50	without screws	180					
19		CNA 4,0x60	with screws				120					
20					CSA 5,0x50	without screws	180					

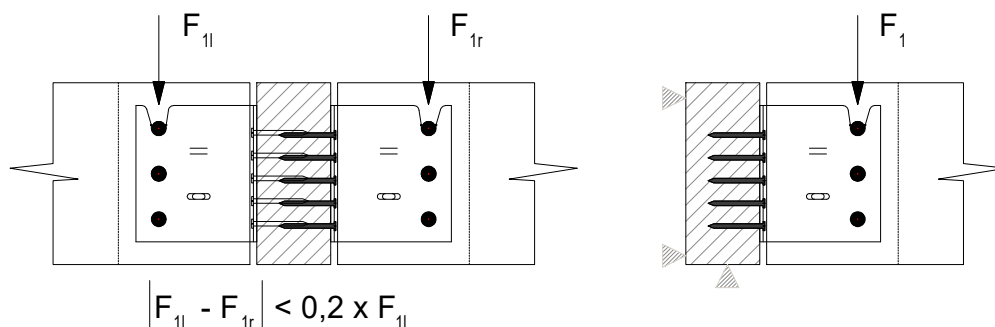
$F_1$  f.H. : the header is free for rotation

Tables for force direction  $F_1$  for BTALU only

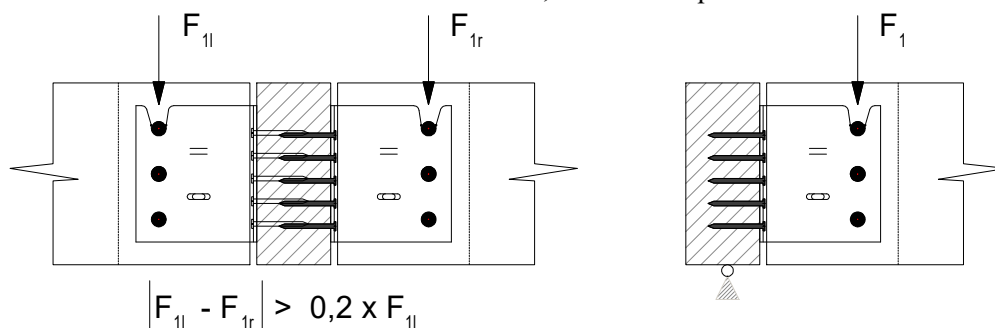
No of table	force direction	nail /screw	nail pattern	supporting member as a	supported member	Steel dowel $\varnothing$	No of table	force direction	nail /screw	nail pattern	supporting member as a	supported member	Steel dowel $\varnothing$		
40	$F_1$	CNA4.0x50	4-row	Header	C24	SD $\varnothing 7$	70	$F_1$	CNA4.0x50	4-row	Header	C24	SD $\varnothing 10$		
41		CNA4.0x60					with screws								
42		CSA5.0x50												without screws	
43		CNA4.0x50					2-row								Column
44		CNA4.0x60	without screws												
45		CSA5.0x50							with screws						
46		CNA4.0x50	4-row							Column				72	
47		CNA4.0x60					with screws								
48		CSA5.0x50		without screws											
49		CNA4.0x50					2-row		Column		73			CNA4.0x50	
50		CNA4.0x60	without screws												
51		CSA5.0x50		with screws											
52		CNA4.0x50	4-row								Column			74	CNA4.0x60
53		CNA4.0x60		with screws											
54		CSA5.0x50					without screws								
55		CNA4.0x50		2-row						Header				75	CSA5.0x50
56		CNA4.0x60	without screws												
57		CSA5.0x50			with screws										
58		CNA4.0x50	4-row			Header	76		CNA4.0x50			without screws			
59		CNA4.0x60		with screws											
60		CSA5.0x50			without screws										
61		CNA4.0x50		2-row			Column		77		CNA4.0x60	with screws			
62		CNA4.0x60	without screws												
63		CSA5.0x50			with screws										
64		CNA4.0x50	4-row						Column	78	CSA5.0x50	without screws			
65		CNA4.0x60		with screws											
66		CSA5.0x50			without screws										
67		CNA4.0x50		2-row		Column				79	CNA4.0x50	with screws			
68		CNA4.0x60	without screws												
69		CSA5.0x50			with screws										
70		CNA4.0x50	4-row				Column			80	CNA4.0x60	without screws			
71		CNA4.0x60		with screws											
72	CSA5.0x50	without screws													
73	CNA4.0x50			2-row	Column			81	CNA4.0x50	with screws					
74	CNA4.0x60	without screws													
75	CSA5.0x50		with screws												
76	CNA4.0x50	4-row				Column		82	CNA4.0x60	without screws					
77	CNA4.0x60		with screws												
78	CSA5.0x50			without screws											
79	CNA4.0x50		2-row				Column	83	CNA4.0x50	with screws					
80	CNA4.0x60	without screws													
81	CSA5.0x50			with screws											
82	CNA4.0x50	4-row			Column			84	CNA4.0x60	without screws					
83	CNA4.0x60		with screws												
84	CSA5.0x50			without screws											
85	CNA4.0x50		2-row			Column		85	CNA4.0x50	with screws					
86	CNA4.0x60	without screws													
87	CSA5.0x50			with screws											



Refer to Tables 1 to 12: for header with clamped or lateral hold, or nearly same load each side (free from rotation)



Refer to Tables 13 to 20: header free to rotate, and/or unequal load on both side



For tables 21 to 32: The note *with screws* or *without screws* means extra screws for an reinforcement of the timber perpendicular to the fibre.

### Load direction $F_2$ (uplift)

The topmost steel dowel in the cut out hole shall not be considered.

The capacities for  $R_{2,k}$  shall be modified in relation to one steel dowel less, e.g. for a BTN120/ BT120 with 3 steel dowels, the uplift capacity shall be reduced to:  $(3-1) / 3 = 0,67$

For the BTN90/ BT4-90 it shall be  $(4-1) / 4 = 0,75$

For the types 160 and up: the values have to be increased for the effective number of steel dowel, or simplified using the method as described before.

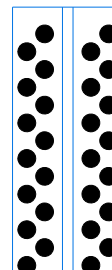
**For combination of load direction the following equation should be used:**

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

$F_1$  and  $F_2$  have to be considered independently

R <sub>1,k</sub>		CNA 4,0x50				4-row header				SD: Ø 12mm		C24		table 1										
no of SD	width of timber = length of the dowels [mm]																							
	80		100		120		140		160		180													
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]												
3	20	18,2	20	19,4	20	20,7	20	22,3	20	23,9	20	23,9	44	32,2	44	34,5	48	37,6	48	41,2	52	45,0	52	49,1
	28	29,5	28	31,2	28	33,3	28	35,7	28	38,2	28	38,5	48	43,0	52	46,1	56	50,1	56	55,0	60	60,1	64	65,5
4	36	41,9	36	44,3	36	47,2	36	50,4	36	53,9	36	54,9	56	53,9	60	57,6	60	62,7	64	68,7	68	75,1	72	81,9
	44	54,9	44	57,9	44	61,7	44	65,9	44	70,3	44	72,3	64	64,6	64	69,2	68	75,3	72	82,4	76	90,1	80	98,3
5	52	68,0	56	74,4	60	82,0	64	90,3	68	99,1	72	108,3	68	75,4	72	80,7	76	87,8	80	96,1	84	105,2	88	114,7
	60	85,5	60	85,5	64	93,8	68	103,0	72	112,8	80	125,7	72	86,2	76	92,3	80	100,5	84	109,9	88	120,2	96	131,2
6	64	91,6	68	99,0	72	108,2	76	118,4	80	129,3	88	143,0	80	97,0	84	103,8	88	113,0	92	123,6	96	135,3	104	147,6
	72	112,9	76	121,5	80	132,3	88	146,6	92	159,6	100	175,4	84	107,8	88	115,4	92	125,6	96	137,4	104	150,3	108	164,0
7	80	123,6	80	132,9	88	146,5	92	159,7	100	175,8	100	188,1	88	118,6	92	126,9	96	138,1	104	151,2	108	165,3	116	180,4
	88	129,3	96	138,4	104	150,7	108	164,9	116	180,4	116	195,8	92	102,2	72	110,3	76	120,2	80	131,4	88	145,5	92	158,0

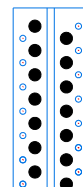
R <sub>1,k</sub>		CNA 4,0x60				4-row header				SD: Ø 12mm		C24		table 2										
no of SD	width of timber = length of the dowels [mm]																							
	80		100		120		140		160		180													
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]												
3	20	19,7	20	20,8	20	22,2	20	23,7	20	25,3	20	25,4	40	32,2	40	34,5	40	37,6	44	41,1	48	45,0	48	49,1
	28	31,8	28	33,5	28	35,6	28	37,9	28	40,4	28	40,9	44	43,1	48	46,1	48	50,2	52	54,9	52	60,0	56	65,6
4	36	44,9	36	47,2	36	50,2	36	53,4	36	56,8	36	58,1	52	53,8	52	57,7	56	62,7	60	68,6	60	75,1	64	82,0
	44	58,4	44	61,4	44	65,2	44	69,5	44	73,9	44	76,3	56	64,6	60	69,2	60	75,3	64	82,5	68	90,2	72	98,4
5	52	65,8	48	72,5	52	80,3	56	88,9	60	97,9	64	107,3	60	75,4	64	80,7	68	87,8	72	96,1	76	105,2	80	114,7
	60	83,8	52	83,8	56	92,4	60	101,8	64	111,8	72	125,2	68	86,2	68	92,3	72	100,5	76	109,9	80	120,3	88	131,2
6	68	90,3	60	98,0	64	107,4	68	117,7	72	128,7	76	140,2	72	97,0	76	103,8	80	113,0	84	123,6	88	135,3	92	147,6
	76	101,1	64	109,4	68	119,6	72	130,8	76	142,8	84	158,0	80	107,8	80	115,3	84	125,5	88	137,4	92	150,3	100	164,0
7	84	112,0	68	120,9	72	131,8	76	144,0	84	159,6	88	173,1	84	112,0	84	126,9	88	138,1	92	151,1	100	165,4	104	180,4
	80	118,6	84	126,9	88	138,1	92	151,1	100	165,4	104	180,4	88	122,9	72	132,4	80	146,4	84	159,6	88	173,7	96	190,9
8	88	122,9	72	132,4	80	146,4	84	159,6	88	173,7	96	190,9	84	129,4	88	138,5	96	150,7	100	164,9	104	180,4	112	196,8



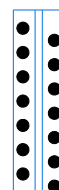
R <sub>1,k</sub>		CSA 5,0x50				4-row header				SD: Ø 12mm		C24		table 3										
no of SD	width of timber = length of the dowels [mm]																							
	80		100		120		140		160		180													
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]												
3	20	28,2	20	29,2	20	30,5	20	31,9	20	33,3	20	33,8	24	32,3	28	34,5	28	37,6	28	41,2	32	45,0	32	49,1
	28	42,7	28	44,6	28	46,9	28	49,2	28	51,5	28	52,8	32	43,0	32	46,1	32	50,2	36	54,9	36	60,1	40	65,5
4	36	53,8	36	57,6	36	62,5	36	66,4	36	69,9	36	72,6	36	53,8	36	57,6	40	62,7	40	68,6	44	75,1	44	81,9
	44	64,6	44	69,2	44	75,3	44	82,3	44	87,9	44	92,4	44	64,6	40	69,2	44	75,3	48	82,4	48	90,1	52	98,3
5	52	80,6	28	63,2	32	71,9	36	81,1	40	90,6	40	92,8	44	75,4	44	80,8	48	87,8	52	96,1	56	105,2	56	114,7
	60	93,6	32	74,5	36	83,7	40	93,4	44	103,5	48	112,8	48	86,2	48	92,3	52	100,4	56	109,9	60	120,2	64	131,2
6	68	104,5	36	85,7	40	95,4	44	105,6	48	116,0	56	132,8	52	97,0	52	103,8	56	113,0	60	123,7	64	135,3	72	147,6
	76	115,3	44	102,8	44	106,9	52	123,9	56	135,0	60	145,5	40	93,6	44	102,8	44	106,9	52	123,9	56	135,0	60	145,5
7	84	124,5	48	114,0	52	124,7	56	135,9	60	147,3	68	165,4	56	107,8	60	115,3	60	125,5	68	137,4	72	150,3	76	164,0
	88	118,5	64	126,9	68	138,1	72	151,1	76	165,3	84	180,4	44	104,5	48	114,0	52	124,7	56	135,9	60	147,3	68	165,4
8	96	129,3	52	125,2	56	136,3	60	147,7	68	166,2	72	177,7	48	115,3	52	125,2	56	136,3	60	147,7	68	166,2	72	177,7
	104	129,3	68	138,4	72	150,7	76	164,9	84	180,4	88	196,8	64	129,3	68	138,4	72	150,7	76	164,9	84	180,4	88	196,8

R <sub>1,k</sub>		CNA 4,0x50				2-row header				SD: Ø 12mm				C24		table 4	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	10	14,5	10	15,6	10	16,9	10	18,3	10	19,5	10	19,5					
	32	32,2	32	34,6	34	37,6	36	41,1	38	45,0	40	49,1					
4	14	23,2	14	24,7	14	26,6	14	28,5	14	30,1	14	30,1					
	36	43,0	38	46,2	40	50,2	42	55,0	44	60,0	48	65,5					
5	18	32,7	18	34,7	18	37,0	18	39,1	18	39,9	18	39,9					
	42	53,9	44	57,6	46	62,8	48	68,6	52	75,1	54	82,0					
6	22	42,6	22	45,0	22	47,5	22	48,8	22	48,8	22	48,8					
	46	64,6	50	69,2	52	75,3	54	82,4	58	90,2	58	97,0					
7	44	70,9	46	76,0	48	82,2	50	88,9	50	93,7	50	97,0					
	52	75,4	54	80,8	56	87,8	58	95,5	58	101,8	58	107,4					
8	48	81,4	50	87,0	50	91,9	50	97,0	50	101,9	50	104,4					
	56	86,2	58	92,2	58	98,8	58	105,1	58	111,1	58	115,5					
9	50	90,1	50	94,3	50	99,4	50	104,4	50	108,6	50	110,0					
	58	96,2	58	101,3	58	107,4	58	113,6	58	119,3	58	122,7					
10	50	96,9	50	101,2	50	106,1	50	110,0	50	110,8	50	110,8					
	58	104,2	58	109,2	58	115,2	58	121,1	58	126,0	58	127,8					
11	50	103,2	50	107,3	50	110,6	50	110,8	50	110,8	50	110,8					
	58	111,3	58	116,4	58	122,2	58	127,1	58	128,5	58	128,5					
12	50	108,6	50	110,8	50	110,8	50	110,8	50	110,8	50	110,8					
	58	118,0	58	122,8	58	127,5	58	128,5	58	128,5	58	128,5					

R <sub>1,k</sub>		CNA 4,0x60				2-row header				SD: Ø 12mm				C24		table 5	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	10	15,2	10	16,3	10	17,6	10	18,9	10	20,1	10	20,1					
	28	32,3	30	34,5	30	37,6	32	41,2	34	45,1	36	49,1					
4	14	24,3	14	25,8	14	27,6	14	29,5	14	31,3	14	31,3					
	34	43,0	34	46,1	36	50,2	38	55,0	40	60,1	42	65,5					
5	18	34,2	18	36,1	18	38,4	18	40,6	18	42,3	18	42,4					
	38	53,9	40	57,6	42	62,7	44	68,7	46	75,1	50	81,9					
6	22	44,5	22	46,8	22	49,4	22	51,6	22	52,0	22	52,0					
	42	64,7	44	69,2	46	75,3	50	82,4	52	90,1	56	98,4					
7	38	68,7	42	76,1	44	82,4	48	91,4	50	98,6	50	102,8					
	46	75,4	50	80,7	52	87,9	56	96,1	58	105,2	58	112,4					
8	44	81,6	46	87,4	48	94,3	50	101,7	50	106,8	50	110,0					
	52	86,2	54	92,3	56	100,4	58	109,1	58	116,2	58	122,1					
9	48	92,4	50	98,6	50	103,9	50	109,2	50	113,8	50	115,9					
	56	97,0	58	103,8	58	111,6	58	118,6	58	124,8	58	129,2					
10	50	101,2	50	105,6	50	110,8	50	115,4	50	118,1	50	118,2					
	58	107,5	58	113,4	58	120,1	58	126,5	58	132,0	58	134,8					
11	50	107,6	50	111,9	50	116,3	50	118,2	50	118,2	50	118,2					
	58	115,7	58	121,1	58	127,4	58	133,0	58	136,7	58	137,1					
12	50	113,3	50	116,8	50	118,2	50	118,2	50	118,2	50	118,2					
	58	122,7	58	127,9	58	133,5	58	137,0	58	137,1	58	137,1					



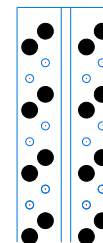
2-row



R <sub>1,k</sub>		CSA 5,0x50				2-row header				SD: Ø 12mm				C24		table 6	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	10	19,0	10	19,8	10	20,7	10	21,7	10	22,7	10	22,7					
	20	32,2	20	34,5	22	37,6	22	41,1	24	45,0	26	49,1					
4	14	29,3	14	30,4	14	31,6	14	32,8	14	33,9	14	33,9					
	24	43,0	24	46,1	26	50,1	28	54,9	30	60,0	32	65,5					
5	18	40,0	18	41,2	18	42,6	18	43,9	18	44,8	18	44,9					
	28	53,8	30	57,6	30	62,7	34	68,6	36	75,1	38	81,9					
6	22	50,8	22	52,2	22	53,6	22	54,7	22	55,2	22	55,2					
	32	64,6	34	69,2	36	75,3	38	82,4	42	90,1	44	98,3					
7	28	65,2	30	70,5	32	76,2	36	85,9	38	91,9	42	101,6					
	36	75,4	38	80,7	40	87,8	44	96,1	46	105,2	50	114,7					
8	32	76,0	34	81,5	36	87,4	40	97,3	44	107,5	48	117,5					
	40	86,2	42	92,2	44	100,4	48	109,9	52	120,2	56	131,2					
9	36	86,7	38	92,3	42	102,3	46	112,6	50	123,0	50	124,3					
	44	97,0	46	103,8	50	113,0	54	123,6	58	135,3	58	141,5					
10	40	97,3	42	103,0	46	113,2	50	123,6	50	125,1	50	125,5					
	48	107,8	50	115,4	54	125,5	58	137,3	58	142,4	58	144,3					
11	44	107,8	48	117,6	50	124,0	50	125,4	50	125,5	50	125,5					
	52	118,5	56	126,9	58	137,9	58	142,8	58	144,9	58	145,5					
12	48	118,3	50	124,2	50	125,4	50	125,5	50	125,5	50	125,5					
	56	129,3	58	138,1	58	142,9	58	145,1	58	145,6	58	145,6					

R <sub>1,k</sub>		CNA 4,0x50				4-row column				SD: Ø 12mm				C24		table 7	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	12	15,5	12	16,6	12	17,9	12	19,4	12	20,7	12	20,7					
	32	32,2	32	34,5	36	37,6	36	41,2	40	45,0	40	49,2					
4	16	24,4	16	26,0	16	27,9	16	30,0	16	32,0	16	32,0					
	40	43,0	40	46,1	40	50,2	44	54,9	48	60,0	48	65,5					
5	20	34,1	20	36,2	20	38,7	20	41,2	20	43,4	20	43,5					
	44	53,8	44	57,7	48	62,7	52	68,6	52	75,2	56	81,9					
6	24	44,3	24	46,8	24	49,7	24	52,3	24	53,2	24	53,2					
	48	64,6	52	69,2	52	75,4	56	82,4	60	90,1	60	98,0					
7	36	62,7	40	69,9	44	77,9	44	82,3	44	86,6	44	88,7					
	52	75,5	56	80,7	60	87,8	60	96,1	60	103,2	60	109,2					
8	40	73,4	44	81,0	44	85,4	44	90,0	44	94,1	44	95,5					
	56	86,2	60	92,2	60	99,7	60	106,6	60	112,9	60	118,0					
9	44	84,0	44	87,9	44	92,4	44	96,3	44	97,5	44	97,5					
	60	96,9	60	102,4	60	108,9	60	115,4	60	121,5	60	125,5					
10	44	90,4	44	94,1	44	97,3	44	97,5	44	97,5	44	97,5					
	60	105,4	60	110,7	60	117,0	60	123,4	60	128,8	60	131,3					
11	44	95,8	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5					
	60	112,9	60	118,2	60	124,4	60	130,0	60	133,0	60	133,0					
12	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5					
	60	119,8	60	125,0	60	130,5	60	133,0	60	133,0	60	133,0					

R <sub>1,k</sub>		CNA 4,0x60				4-row column				SD: Ø 12mm				C24		table 8	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	12	16,5	12	17,5	12	18,8	12	20,2	12	21,6	12	21,6					
	28	32,3	32	34,5	32	37,6	32	41,1	36	45,0	36	49,2					
4	16	25,8	16	27,3	16	29,2	16	31,2	16	33,2	16	33,2					
	36	43,0	36	46,1	36	50,2	40	54,9	40	60,0	44	65,5					
5	20	35,9	20	37,9	20	40,3	20	42,8	20	45,1	20	45,3					
	40	53,8	40	57,7	44	62,7	44	68,7	48	75,1	52	81,9					
6	24	46,4	24	48,8	24	51,7	24	54,5	24	56,5	24	56,6					
	44	64,6	44	69,2	48	75,3	52	82,4	56	90,1	56	98,4					
7	32	61,7	36	69,2	36	72,9	40	81,8	44	91,0	44	93,6					
	48	75,4	52	80,7	52	87,9	56	96,1	60	105,2	60	113,8					
8	36	72,6	40	80,6	44	89,5	44	94,2	44	98,4	44	100,3					
	52	86,2	56	92,2	60	100,4	60	109,8	60	117,8	60	124,3					
9	40	83,4	44	91,9	44	96,4	44	100,7	44	103,7	44	104,0					
	56	97,0	60	103,8	60	112,5	60	120,3	60	127,0	60	132,1					
10	44	94,3	44	98,2	44	102,2	44	104,0	44	104,0	44	104,0					
	60	107,8	60	114,5	60	121,8	60	128,7	60	134,8	60	138,2					
11	44	99,9	44	103,1	44	104,0	44	104,0	44	104,0	44	104,0					
	60	117,0	60	122,8	60	129,5	60	135,8	60	140,5	60	141,7					
12	44	103,8	44	104,0	44	104,0	44	104,0	44	104,0	44	104,0					
	60	124,5	60	130,0	60	136,2	60	140,9	60	141,8	60	141,8					



4-row column

R <sub>1,k</sub>		CSA 5,0x50				4-row column				SD: Ø 12mm				C24		table 9	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]					
3	12	21,4	12	22,3	12	23,3	12	24,4	12	25,4	12	25,5					
	20	32,2	20	34,6	24	37,6	24	41,1	24	45,1	28	49,1					
4	16	32,1	16	33,3	16	34,6	16	35,9	16	37,2	16	37,4					
	24	43,0	28	46,1	28	50,1	28	54,9	32	60,0	32	65,5					
5	20	43,1	20	44,4	20	46,0	20	47,5	20	48,8	20	49,0					
	28	53,8	32	57,6	32	62,7	36	68,6	36	75,1	40	81,9					
6	24	54,1	24	55,6	24	57,3	24	58,8	24	59,8	24	60,0					
	32	64,6	36	69,2	36	75,3	40	82,4	44	90,1	44	98,3					
7	20	49,9	24	59,0	24	60,0	28	69,7	32	79,4	36	88,6					
	36	75,4	40	80,7	40	87,9	44	96,1	48	105,2	52	114,7					
8	24	60,0	28	69,5	32	79,2	32	80,2	36	90,1	40	99,7					
	40	86,2	44	92,2	48	100,4	48	109,9	52	120,3	56	131,2					
9	28	70,2	32	79,9	36	89,8	40	99,8	44	109,9	44	110,3					
	44	97,0	48	103,8	52	113,0	56	123,6	60	135,3	60	145,0					
10	32	80,3	36	90,2	40	100,2	44	110,3	44	110,4	44	110,4					
	48	107,8	52	115,3	56	125,5	60	137,4	60	146,1	60	148,8					
11	36	90,4	40	100,4	44	110,4	44	110,4	44	110,4	44	110,4					
	52	118,5	56	126,9	60	138,1	60	146,5	60	149,4	60	150,3					
12	40	100,4	44	110,4	44	110,4	44	110,4	44	110,4	44	110,4					
	56	129,3	60	138,4	60	146,5	60	149,5	60	150,6	60	150,6					

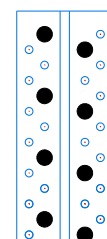
R <sub>1,k</sub>		CNA 4,0x50				2-row column				SD: Ø 12mm				C24		table 10	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]			
3	6	13,0	6	13,3	6	13,3	6	13,3	6	13,3	6	13,3	6	13,3			
	24	32,2	26	34,5	26	37,7	28	41,1	30	45,0	30	48,7	30	48,7			
4	8	17,7	8	17,7	8	17,7	8	17,7	8	17,7	8	17,7	8	17,7			
	28	43,0	30	46,1	30	49,4	30	51,8	30	53,9	30	55,3	30	55,3			
5	10	22,2	10	22,2	10	22,2	10	22,2	10	22,2	10	22,2	10	22,2			
	30	51,5	30	53,3	30	55,5	30	57,7	30	59,7	30	60,6	30	60,6			
6	12	26,6	12	26,6	12	26,6	12	26,6	12	26,6	12	26,6	12	26,6			
	30	56,6	30	58,4	30	60,6	30	62,8	30	64,6	30	65,0	30	65,0			
7	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	61,1	30	62,9	30	64,9	30	66,2	30	66,5	30	66,5	30	66,5			
8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	64,9	30	66,1	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5			
9	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5			
10	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5			
11	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5			
12	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8			
	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5			

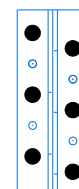
R <sub>1,k</sub>		CNA 4,0x60				2-row column				SD: Ø 12mm				C24		table 11	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]			
3	6	13,0	6	13,8	6	14,2	6	14,2	6	14,2	6	14,2	6	14,2			
	22	32,2	22	34,5	24	37,6	26	41,1	28	45,0	28	49,2	28	49,2			
4	8	18,9	8	18,9	8	18,9	8	18,9	8	18,9	8	18,9	8	18,9			
	26	43,0	28	46,1	30	50,1	30	54,8	30	57,8	30	59,8	30	59,8			
5	10	23,6	10	23,6	10	23,6	10	23,6	10	23,6	10	23,6	10	23,6			
	30	53,9	30	56,7	30	59,2	30	61,5	30	63,6	30	64,7	30	64,7			
6	12	28,4	12	28,4	12	28,4	12	28,4	12	28,4	12	28,4	12	28,4			
	30	60,2	30	62,1	30	64,3	30	66,4	30	68,3	30	68,8	30	68,8			
7	22	51,2	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	64,7	30	66,5	30	68,5	30	70,1	30	70,9	30	70,9	30	70,9			
8	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	68,4	30	69,9	30	70,8	30	70,9	30	70,9	30	70,9	30	70,9			
9	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	70,7	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9			
10	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9			
11	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9			
12	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0			
	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9	30	70,9			

R <sub>1,k</sub>		CSA 5,0x50				2-row column				SD: Ø 12mm				C24		table 12	
no of SD	width of timber = length of the dowels [mm]																
	80		100		120		140		160		180						
	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]	n <sub>N</sub>	[kN]			
3	6	14,2	6	14,7	6	15,0	6	15,1	6	15,1	6	15,1	6	15,1			
	16	32,2	18	34,5	18	37,6	20	41,1	22	45,0	22	49,1	22	49,1			
4	8	20,0	8	20,1	8	20,1	8	20,1	8	20,1	8	20,1	8	20,1			
	20	43,0	22	46,1	24	50,1	24	55,0	26	60,1	28	65,6	28	65,6			
5	10	25,1	10	25,1	10	25,1	10	25,1	10	25,1	10	25,1	10	25,1			
	24	53,8	26	57,6	28	62,7	30	68,6	30	72,3	30	73,2	30	73,2			
6	12	30,1	12	30,1	12	30,1	12	30,1	12	30,1	12	30,1	12	30,1			
	28	64,6	30	69,2	30	72,4	30	73,5	30	74,3	30	74,5	30	74,5			
7	22	54,8	22	55,1	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	72,5	30	73,5	30	74,3	30	74,9	30	75,2	30	75,3	30	75,3			
8	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	74,2	30	74,8	30	75,2	30	75,3	30	75,3	30	75,3	30	75,3			
9	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	75,1	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3			
10	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3			
11	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3			
12	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2			
	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3	30	75,3			

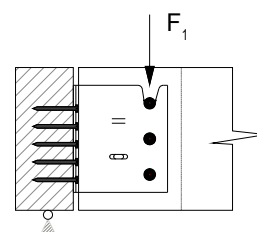
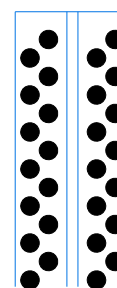


2-row column



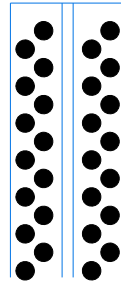
R <sub>1,k</sub>		CNA 4,0x60		4-row		The header is free to rotate, b <sub>HT</sub> = 120mm		table		13		
Length SD [mm]	CNA 4,0x60											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	20	7,4	20	8,2	20	9,1	20	10,2	20	11,0	20	11,0
4	20	12,1	20	13,4	24	15,0	24	16,7	24	18,2	24	18,2
5	24	17,9	24	19,8	28	22,1	28	24,6	28	26,8	28	26,8
6	28	24,6	32	27,1	32	30,3	32	33,7	36	36,9	36	36,9
7	32	32,0	36	35,4	36	39,4	40	43,9	40	48,2	40	48,2
8	20	14,9	24	20,6	24	20,6	28	27,0	32	34,1	32	34,1
	36	40,2	40	44,4	40	49,4	44	55,0	48	60,7	48	60,7
9	24	20,6	28	27,0	32	34,1	32	34,1	36	41,7	36	41,7
	40	49,1	44	54,1	48	60,2	48	66,9	52	74,1	52	74,2
10	32	34,1	32	34,1	36	41,7	40	49,8	44	58,3	44	58,3
	48	58,4	48	64,3	52	71,5	56	79,4	60	87,9	60	88,5
11	36	41,7	36	41,7	40	49,8	44	58,3	48	67,2	48	67,2
	52	68,2	52	75,0	56	83,3	60	92,5	64	102,4	64	103,5
12	40	49,8	44	58,3	48	67,2	52	76,3	56	85,7	56	85,7
	56	78,4	60	86,1	64	95,6	68	106,1	72	117,3	72	119,2

R <sub>1,k</sub>		CNA 4,0x60		4-row		The header is free to rotate, b <sub>HT</sub> = 180mm		table		14		
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	20	6,2	20	6,9	20	7,7	20	8,6	20	9,3	20	9,3
4	20	10,2	24	11,3	24	12,7	24	14,1	28	15,3	28	15,3
5	28	15,1	28	16,8	28	18,7	32	20,9	32	22,7	32	22,7
6	32	20,9	32	23,1	36	25,8	36	28,8	40	31,3	40	31,3
7	20	10,2	24	14,3	24	14,3	28	18,9	28	18,9	28	18,9
	36	27,4	40	30,4	40	33,9	44	37,7	44	41,2	44	41,2
8	24	14,3	28	18,9	28	18,9	32	24,1	36	29,9	36	29,9
	40	34,7	44	38,3	44	42,7	48	47,6	52	52,1	52	52,1
9	28	18,9	32	24,1	36	29,9	40	36,1	40	36,1	40	36,1
	44	42,6	48	47,0	52	52,3	56	58,3	56	64,1	56	64,1
10	36	29,9	36	29,9	40	36,1	44	42,8	48	49,9	48	49,9
	52	51,0	52	56,2	56	62,6	60	69,7	64	76,9	64	76,9
11	40	36,1	44	42,8	48	49,9	48	49,9	52	57,4	56	65,2
	56	59,9	60	66,0	64	73,5	64	81,7	68	90,4	72	90,6
12	44	42,8	48	49,9	52	57,4	56	65,2	60	73,4	60	73,4
	60	69,3	64	76,3	68	84,8	72	94,3	76	104,3	76	104,9

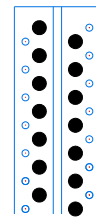


R <sub>1,k</sub>		CSA 5,0x50		4-row		The header is free to rotate, b <sub>HT</sub> = 120mm		table		15		
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	20	7,4	20	8,2	20	9,1	20	10,2	20	11,0	20	11,0
4	20	12,1	20	13,4	20	15,0	20	16,7	20	18,2	20	18,2
5	20	17,9	20	19,8	20	22,1	20	24,6	20	26,8	20	26,8
6	20	24,6	20	27,1	20	30,3	24	33,7	24	36,9	24	36,9
7	24	32,0	24	35,4	24	39,4	28	43,9	28	48,2	28	48,2
8	24	40,2	28	44,4	28	49,4	32	55,0	32	60,7	32	60,7
9	28	49,1	32	54,1	32	60,2	36	66,9	40	74,1	40	74,2
10	32	58,4	36	64,3	36	71,5	40	79,4	44	87,9	44	88,5
11	20	30,9	24	40,7	28	50,9	28	50,9	32	61,4	32	61,4
	36	68,2	40	75,0	44	83,3	44	92,5	48	102,4	48	103,5
12	24	40,7	28	50,9	32	61,4	36	72,1	40	82,8	40	82,8
	40	78,4	44	86,1	48	95,6	52	106,1	56	117,3	56	119,2

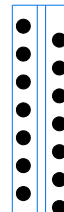
R <sub>1,k</sub>		CSA 5,0x50		4-row		The header is free to rotate, b <sub>HT</sub> = 180mm		table		16		
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	20	6,2	20	6,9	20	7,7	20	8,6	20	9,3	20	9,3
4	20	10,2	20	11,3	20	12,7	20	14,1	20	15,3	20	15,3
5	20	15,1	20	16,8	20	18,7	20	20,9	20	22,7	20	22,7
6	20	20,9	20	23,1	24	25,8	24	28,8	24	31,3	24	31,3
7	24	27,4	24	30,4	28	33,9	28	37,7	32	41,2	32	41,2
8	28	34,7	28	38,3	32	42,7	32	47,6	36	52,1	36	52,1
9	32	42,6	32	47,0	36	52,3	36	58,3	40	64,1	40	64,1
10	20	23,2	20	23,2	24	31,4	24	31,4	28	40,4	28	40,4
	36	51,0	36	56,2	40	62,6	40	69,7	44	76,9	44	76,9
11	24	31,4	24	31,4	28	40,4	32	49,9	32	49,9	32	49,9
	40	59,9	40	66,0	44	73,5	48	81,7	48	90,4	48	90,6
12	24	31,4	28	40,4	32	49,9	36	59,8	40	70,0	40	70,0
	40	69,3	44	76,3	48	84,8	52	94,3	56	104,3	56	104,9



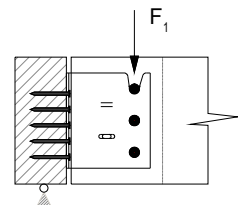
R <sub>1,k</sub>		CNA 4,0x60		2-row		The header is free to rotate, b <sub>HT</sub> = 120mm		table		17		
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	10	7,4	12	8,2	12	9,1	12	10,2	14	11,0	14	11,0
4	14	12,1	14	13,4	16	15,0	16	16,7	18	18,2	18	18,2
5	18	17,9	18	19,8	20	22,1	20	24,6	22	26,8	22	26,8
6	20	24,6	22	27,1	24	30,3	26	33,7	26	36,9	26	36,9
7	16	17,0	18	20,9	20	24,9	22	29,2	24	33,6	24	33,6
	24	32,0	26	35,4	28	39,4	30	43,9	32	48,2	32	48,2
8	20	24,9	22	29,2	24	33,6	26	38,2	28	42,9	28	42,9
	28	40,2	30	44,4	32	49,4	34	55,0	36	60,7	36	60,7
9	24	33,6	26	38,2	28	42,9	30	47,6	34	57,4	34	57,4
	32	49,1	34	54,1	36	60,2	38	66,9	42	74,1	42	74,2
10	28	42,9	30	47,6	32	52,5	36	62,4	40	72,5	40	72,5
	36	58,4	38	64,3	40	71,5	44	79,4	48	87,9	48	88,5
11	32	52,5	34	57,4	38	67,5	40	72,5	44	82,7	46	87,8
	40	68,2	42	75,0	46	83,3	48	92,5	52	102,4	54	103,5
12	36	62,4	38	67,5	42	77,6	46	87,8	50	98,0	50	98,0
	44	78,4	46	86,1	50	95,6	54	106,1	58	117,3	58	118,4



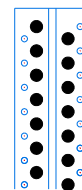
2-row



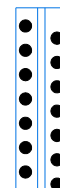
R <sub>1,k</sub>		CNA 4,0x60		2-row		The header is free to rotate, b <sub>HT</sub> = 180mm		table		18		
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	10	5,1	10	5,1	10	5,1	10	5,1	10	5,1	10	5,1
	12	6,2	12	6,9	14	7,7	14	8,6	14	9,3	14	9,3
4	14	9,5	14	9,5	14	9,5	14	9,5	14	9,5	14	9,5
	16	10,2	16	11,3	18	12,7	18	14,1	20	15,3	20	15,3
5	18	14,9	18	14,9	18	14,9	18	14,9	18	14,9	18	14,9
	20	15,1	20	16,8	22	18,7	22	20,9	24	22,7	24	22,7
6	22	20,9	24	23,1	26	25,8	28	28,8	28	31,3	28	31,3
7	18	14,9	20	18,1	22	21,4	24	25,0	26	28,7	26	28,7
	26	27,4	28	30,4	30	33,9	32	37,7	34	41,2	34	41,2
8	22	21,4	24	25,0	26	28,7	28	32,6	30	36,7	30	36,7
	30	34,7	32	38,3	34	42,7	36	47,6	38	52,1	38	52,1
9	26	28,7	28	32,6	30	36,7	32	40,9	36	49,7	36	49,7
	34	42,6	36	47,0	38	52,3	40	58,3	44	64,1	44	64,1
10	30	36,7	32	40,9	34	45,3	38	54,3	40	58,9	40	58,9
	38	51,0	40	56,2	42	62,6	46	69,7	48	76,9	48	76,9
11	34	45,3	36	49,7	40	58,9	42	63,6	46	73,3	46	73,3
	42	59,9	44	66,0	48	73,5	50	81,7	54	90,4	54	90,6
12	38	54,3	40	58,9	44	68,4	48	78,1	50	83,1	50	83,1
	46	69,3	48	76,3	52	84,8	56	94,3	58	103,1	58	103,1



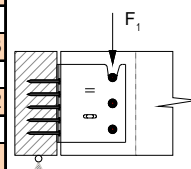
R <sub>1,k</sub>		CSA 5,0x50		2-row		The header is free to rotate, b <sub>HT</sub> = 120mm						table 19
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	10	7,4	10	8,2	10	9,1	10	10,2	10	11,0	10	11,0
	10	12,1	10	13,4	10	15,0	12	16,7	12	18,2	12	18,2
4	12	17,9	12	19,8	14	22,1	14	24,6	16	26,8	16	26,8
	14	24,6	16	27,1	16	30,3	18	33,7	20	36,9	20	36,9
7	10	15,5	10	15,5	12	20,4	14	25,5	16	30,7	16	30,7
	18	32,0	18	35,4	20	39,4	22	43,9	24	48,2	24	48,2
8	12	20,4	14	25,5	16	30,7	18	36,0	20	41,4	20	41,4
	20	40,2	22	44,4	24	49,4	26	55,0	28	60,7	28	60,7
9	16	30,7	18	36,0	20	41,4	22	46,8	26	57,5	26	57,5
	24	49,1	26	54,1	28	60,2	30	66,9	34	74,1	34	74,2
10	20	41,4	22	46,8	24	52,1	28	62,9	30	68,2	30	68,2
	28	58,4	30	64,3	32	71,5	36	79,4	38	87,9	38	88,5
11	22	46,8	26	57,5	28	62,9	32	73,5	36	84,1	36	84,1
	30	68,2	34	75,0	36	83,3	40	92,5	44	102,4	44	103,5
12	26	57,5	30	68,2	34	78,8	38	89,3	42	99,8	42	99,8
	34	78,4	38	86,1	42	95,6	46	106,1	50	117,3	50	119,2



2-row



R <sub>1,k</sub>		CSA 5,0x50		2-row		The header is free to rotate, b <sub>HT</sub> = 180mm						table 20
Length SD [mm]	width of timber = length of the dowels [mm]											
	80		100		120		140		160		180	
Anzahl SD	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]	n	[kN]
3	10	6,2	10	6,9	10	7,7	10	8,6	10	9,3	10	9,3
	10	10,2	10	11,3	12	12,7	12	14,1	12	15,3	12	15,3
4	12	15,1	14	16,8	14	18,7	16	20,9	16	22,7	16	22,7
	16	20,9	16	23,1	18	25,8	18	28,8	20	31,3	20	31,3
7	10	11,6	12	15,7	12	15,7	14	20,2	16	24,9	16	24,9
	18	27,4	20	30,4	20	33,9	22	37,7	24	41,2	24	41,2
8	12	15,7	14	20,2	16	24,9	18	29,9	20	35,0	20	35,0
	20	34,7	22	38,3	24	42,7	26	47,6	28	52,1	28	52,1
9	16	24,9	18	29,9	20	35,0	22	40,2	24	45,5	24	45,5
	24	42,6	26	47,0	28	52,3	30	58,3	32	64,1	32	64,1
10	20	35,0	20	35,0	24	45,5	26	50,8	28	56,2	28	56,2
	28	51,0	28	56,2	32	62,6	34	69,7	36	76,9	36	76,9
11	22	40,2	24	45,5	28	56,2	30	61,6	34	72,4	34	72,4
	30	59,9	32	66,0	36	73,5	38	81,7	42	90,4	42	90,6
12	26	50,8	28	56,2	32	67,0	36	77,8	38	83,2	40	88,6
	34	69,3	36	76,3	40	84,8	44	94,3	46	104,3	48	104,9





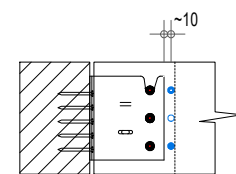
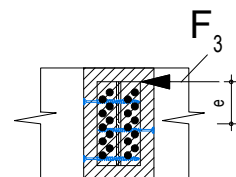
**R<sub>3,k</sub> beam to beam**

R <sub>3,k</sub>	CNA 4,0x50			with screws *							table	21
	number of	joist min.	width of timber [mm]									
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180		
90-2	4	8	... / 100	1,9	3,7	4,7	5,7	5,7	5,7	5,7		
120-2	3	10	... / 160	2,0	3,1	4,8	4,8	4,8	4,8	4,8		
160-2	4	14	... / 200	2,7	4,2	6,5	6,5	6,5	6,5	6,5		
200-2	5	18	... / 240	3,3	4,7	7,3	8,3	8,3	8,3	8,3		
240-2	6	22	... / 280	4,0	5,0	7,7	10,0	10,0	10,0	10,0		
280-2	7	26	... / 320	4,6	5,8	8,1	11,7	11,8	11,8	11,8		
320-2	8	30	... / 360	5,2	6,5	8,6	12,4	13,6	13,6	13,6		
360-2	9	34	... / 400	5,8	7,2	9,1	13,0	15,4	15,4	15,4		
400-2	10	38	... / 440	6,5	7,9	9,7	13,7	17,2	17,2	17,2		
440-2	11	42	... / 480	7,2	8,7	10,6	14,4	18,8	19,1	19,1		
480-2	12	46	... / 520	7,8	9,6	11,4	14,4	19,7	20,9	20,9		
520-2	12	50	... / 560	8,5	10,4	12,3	15,2	20,2	22,7	22,7		
560-2	12	54	... / 600	9,2	11,3	13,2	15,4	21,1	24,5	24,5		
600-2	12	58	... / 640	9,8	12,1	14,1	16,6	21,5	26,4	26,4		
90-4	4	16	... / 100	1,9	3,7	4,7	5,8	6,8	7,8	8,9		
120-4	3	20	... / 160	2,2	3,1	4,8	6,6	8,3	10,1	10,5		
160-4	4	28	... / 200	2,9	4,7	7,3	9,9	12,5	13,7	13,7		
200-4	5	36	... / 240	3,5	5,0	8,1	13,0	16,7	17,1	17,1		
240-4	6	44	... / 280	4,2	5,4	8,6	13,7	19,7	20,5	20,5		
280-4	7	52	... / 320	4,8	6,1	9,1	13,7	21,1	24,0	24,0		
320-4	8	60	... / 360	5,5	6,8	9,6	14,4	21,1	27,6	27,6		
360-4	9	68	... / 400	6,1	7,6	9,7	14,5	21,8	30,0	31,2		
400-4	10	76	... / 440	6,7	8,3	10,3	15,2	22,2	32,0	34,8		
440-4	11	84	... / 480	7,3	9,1	11,0	15,2	22,2	32,0	38,4		
480-4	12	92	... / 520	7,9	9,8	11,9	16,1	23,2	32,0	41,6		
520-4	12	100	... / 560	8,6	10,6	12,8	16,1	23,4	32,0	44,0		
560-4	12	108	... / 600	9,2	11,3	13,8	16,9	23,4	33,6	45,1		
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	24,2	33,6	46,1		

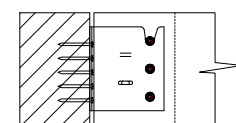
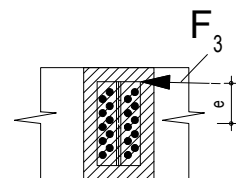
screw 6,0x L  
with L = b-20mm

(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel



R <sub>3,k</sub>	CNA 4,0x50			without screws *							table	22
	number of	joist	width of timber [mm]									
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180		
90-2	4	8	... / 100	1,4	1,8	2,2	2,6	3,0	3,4	3,8		
120-2	3	10	... / 160	2,0	2,6	3,2	3,8	4,4	4,9	4,8		
160-2	4	14	... / 200	2,7	3,4	4,1	4,8	5,6	6,2	6,5		
200-2	5	18	... / 240	3,3	4,1	5,1	5,9	6,7	7,7	8,3		
240-2	6	22	... / 280	4,0	4,9	5,9	6,9	8,1	8,9	9,9		
280-2	7	26	... / 320	4,6	5,8	6,8	8,2	9,2	10,5	11,4		
320-2	8	30	... / 360	5,2	6,5	7,9	9,2	10,4	11,8	12,9		
360-2	9	34	... / 400	5,8	7,2	8,8	10,2	11,6	13,1	14,6		
400-2	10	38	... / 440	6,5	7,9	9,7	11,3	12,9	14,5	16,1		
440-2	11	42	... / 480	7,2	8,7	10,6	12,3	14,3	15,8	17,6		
480-2	12	46	... / 520	7,8	9,6	11,4	13,3	15,5	17,1	19,0		
520-2	12	50	... / 560	8,5	10,4	12,3	14,3	16,7	18,6	20,5		
560-2	12	54	... / 600	9,2	11,3	13,2	15,4	17,9	20,0	22,0		
600-2	12	58	... / 640	9,8	12,1	14,1	16,6	19,1	21,6	23,4		
90-4	4	16	... / 100	1,5	1,9	2,3	2,7	3,1	3,6	4,0		
120-4	3	20	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2		
160-4	4	28	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7		
200-4	5	36	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5		
240-4	6	44	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1		
280-4	7	52	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7		
320-4	8	60	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3		
360-4	9	68	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9		
400-4	10	76	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5		
440-4	11	84	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1		
480-4	12	92	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7		
520-4	12	100	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2		
560-4	12	108	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8		
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4		



Type: the first number gives the size of the concealed joist hangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2

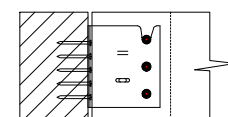
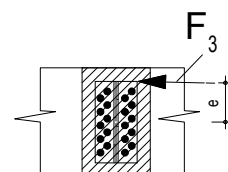
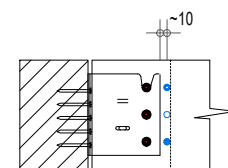
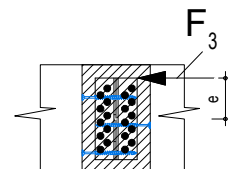
**R<sub>3,k</sub> beam to beam**

R <sub>3,k</sub>	CNA 4,0x60		joist min. b / h [mm]	with screws *						table 23
	number of			width of timber [mm]						
Type	SD	nails		60	80	100	120	140	160	180
90-2	4	8	... / 100	1,9	3,7	4,7	5,8	6,8	6,9	6,9
120-2	3	10	... / 160	2,2	3,1	4,8	5,8	5,8	5,8	5,8
160-2	4	14	... / 200	2,9	4,7	7,1	7,9	7,9	7,9	7,9
200-2	5	18	... / 240	3,5	5,0	7,8	10,0	10,0	10,0	10,0
240-2	6	22	... / 280	4,2	5,4	8,6	11,9	12,1	12,1	12,1
280-2	7	26	... / 320	4,8	6,1	9,1	12,9	14,3	14,3	14,3
320-2	8	30	... / 360	5,5	6,8	9,6	13,7	16,5	16,5	16,5
360-2	9	34	... / 400	6,1	7,6	9,7	14,4	18,6	18,6	18,6
400-2	10	38	... / 440	6,7	8,3	10,3	15,0	19,9	20,8	20,8
440-2	11	42	... / 480	7,3	9,1	11,0	15,2	20,8	23,0	23,0
480-2	12	46	... / 520	7,9	9,8	11,9	16,1	21,3	25,2	25,2
520-2	12	50	... / 560	8,6	10,6	12,8	16,1	22,2	27,4	27,4
560-2	12	54	... / 600	9,2	11,3	13,8	16,9	23,4	29,2	29,6
600-2	12	58	... / 640	9,8	12,1	14,7	17,6	23,4	30,6	31,8
90-4	4	16	... / 100	1,9	3,7	4,7	5,8	6,8	7,8	8,9
120-4	3	20	... / 160	2,2	3,1	4,8	6,6	8,3	10,1	11,9
160-4	4	28	... / 200	2,9	4,7	7,3	9,9	12,5	15,1	16,5
200-4	5	36	... / 240	3,5	5,0	8,1	13,0	16,7	20,2	20,6
240-4	6	44	... / 280	4,2	5,4	8,6	13,7	20,2	23,5	24,8
280-4	7	52	... / 320	4,8	6,1	9,1	13,7	21,1	26,7	29,0
320-4	8	60	... / 360	5,5	6,8	9,6	14,4	21,1	29,9	33,3
360-4	9	68	... / 400	6,1	7,6	9,7	14,5	21,8	30,6	37,5
400-4	10	76	... / 440	6,7	8,3	10,3	15,2	22,2	32,0	41,2
440-4	11	84	... / 480	7,3	9,1	11,0	15,2	22,2	32,0	44,0
480-4	12	92	... / 520	7,9	9,8	11,9	16,1	23,2	32,0	44,0
520-4	12	100	... / 560	8,6	10,6	12,8	16,1	23,4	32,0	44,0
560-4	12	108	... / 600	9,2	11,3	13,8	16,9	23,4	33,6	45,1
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	24,2	33,6	46,1

screw 6,0x L  
with L = b-20mm

(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel



R <sub>3,k</sub>	CNA 4,0x60		joist min. b / h [mm]	without screws *						table 24
	number of			width of timber [mm]						
Type	SD	nails		60	80	100	120	140	160	180
90-2	4	8	... / 100	1,5	1,9	2,3	2,7	3,1	3,6	4,0
120-2	3	10	... / 160	2,2	2,9	3,5	4,1	4,6	5,2	5,7
160-2	4	14	... / 200	2,9	3,6	4,4	5,2	6,0	6,6	7,3
200-2	5	18	... / 240	3,5	4,4	5,4	6,4	7,2	8,1	9,0
240-2	6	22	... / 280	4,2	5,3	6,4	7,4	8,6	9,5	10,5
280-2	7	26	... / 320	4,8	6,1	7,3	8,5	9,9	11,1	12,0
320-2	8	30	... / 360	5,5	6,8	8,3	9,7	11,1	12,5	13,9
360-2	9	34	... / 400	6,1	7,6	9,2	10,9	12,4	13,9	15,4
400-2	10	38	... / 440	6,7	8,3	10,1	12,1	13,8	15,3	17,0
440-2	11	42	... / 480	7,3	9,1	11,0	13,2	15,2	16,7	18,5
480-2	12	46	... / 520	7,9	9,8	11,9	14,3	16,5	18,2	20,1
520-2	12	50	... / 560	8,6	10,6	12,8	15,4	17,8	19,8	21,6
560-2	12	54	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,2
600-2	12	58	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	24,9
90-4	4	16	... / 100	1,5	1,9	2,3	2,7	3,1	3,6	4,0
120-4	3	20	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2
160-4	4	28	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7
200-4	5	36	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5
240-4	6	44	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1
280-4	7	52	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7
320-4	8	60	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3
360-4	9	68	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9
400-4	10	76	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5
440-4	11	84	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1
480-4	12	92	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7
520-4	12	100	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2
560-4	12	108	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4

Type: the first number gives the size of the concealed joisthangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2

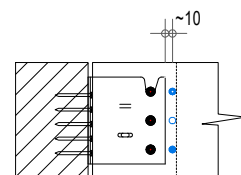
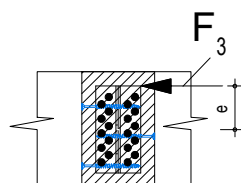
**R<sub>3,k</sub> beam to beam**

R <sub>3,k</sub>	CSA 5,0x50			with screws *							table 25
	number of		joist min.	width of timber [mm]							
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180	
90-2	4	8	... / 100	1,9	3,7	4,7	5,8	6,8	7,3	7,3	
120-2	3	10	... / 160	2,2	3,1	4,8	6,2	6,2	6,2	6,2	
160-2	4	14	... / 200	2,9	4,7	7,3	8,4	8,4	8,4	8,4	
200-2	5	18	... / 240	3,5	5,0	8,1	10,6	10,6	10,6	10,6	
240-2	6	22	... / 280	4,2	5,4	8,6	12,4	12,9	12,9	12,9	
280-2	7	26	... / 320	4,8	6,1	9,1	13,4	15,2	15,2	15,2	
320-2	8	30	... / 360	5,5	6,8	9,6	14,4	17,6	17,6	17,6	
360-2	9	34	... / 400	6,1	7,6	9,7	14,5	19,3	19,9	19,9	
400-2	10	38	... / 440	6,7	8,3	10,3	15,2	20,6	22,2	22,2	
440-2	11	42	... / 480	7,3	9,1	11,0	15,2	21,6	24,6	24,6	
480-2	12	46	... / 520	7,9	9,8	11,9	16,1	22,2	26,9	26,9	
520-2	12	50	... / 560	8,6	10,6	12,8	16,1	23,4	29,2	29,3	
560-2	12	54	... / 600	9,2	11,3	13,8	16,9	23,4	30,6	31,6	
600-2	12	58	... / 640	9,8	12,1	14,7	17,6	24,2	31,4	34,0	
90-4	4	16	... / 100	1,9	3,7	4,7	5,8	6,8	7,8	8,9	
120-4	3	20	... / 160	2,2	3,1	4,8	6,6	8,3	10,1	11,9	
160-4	4	28	... / 200	2,9	4,7	7,3	9,9	12,5	15,1	17,6	
200-4	5	36	... / 240	3,5	5,0	8,1	13,0	16,7	20,2	22,0	
240-4	6	44	... / 280	4,2	5,4	8,6	13,7	20,2	23,5	26,4	
280-4	7	52	... / 320	4,8	6,1	9,1	13,7	21,1	26,7	30,2	
320-4	8	60	... / 360	5,5	6,8	9,6	14,4	21,1	29,9	33,9	
360-4	9	68	... / 400	6,1	7,6	9,7	14,5	21,8	30,6	37,5	
400-4	10	76	... / 440	6,7	8,3	10,3	15,2	22,2	32,0	41,2	
440-4	11	84	... / 480	7,3	9,1	11,0	15,2	22,2	32,0	44,0	
480-4	12	92	... / 520	7,9	9,8	11,9	16,1	23,2	32,0	44,0	
520-4	12	100	... / 560	8,6	10,6	12,8	16,1	23,4	32,0	44,0	
560-4	12	108	... / 600	9,2	11,3	13,8	16,9	23,4	33,6	45,1	
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	24,2	33,6	46,1	

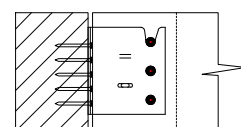
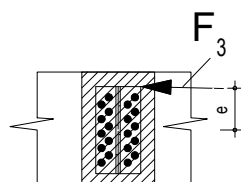
screw 6,0x L  
with L = b-20mm

(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel



R <sub>3,k</sub>	CSA 5,0x50			without screws *							table 26
	number of		joist min.	width of timber [mm]							
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180	
90-2	4	8	... / 100	1,5	1,9	2,3	2,7	3,1	3,6	4,0	
120-2	3	10	... / 160	2,2	2,9	3,5	4,2	4,8	5,4	5,9	
160-2	4	14	... / 200	2,9	3,6	4,4	5,3	6,2	6,9	7,5	
200-2	5	18	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,3	
240-2	6	22	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	10,8	
280-2	7	26	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,6	
320-2	8	30	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3	
360-2	9	34	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9	
400-2	10	38	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5	
440-2	11	42	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1	
480-2	12	46	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7	
520-2	12	50	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2	
560-2	12	54	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8	
600-2	12	58	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4	
90-4	4	16	... / 100	1,5	1,9	2,3	2,7	3,1	3,6	4,0	
120-4	3	20	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2	
160-4	4	28	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7	
200-4	5	36	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5	
240-4	6	44	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1	
280-4	7	52	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7	
320-4	8	60	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3	
360-4	9	68	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9	
400-4	10	76	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5	
440-4	11	84	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1	
480-4	12	92	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7	
520-4	12	100	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2	
560-4	12	108	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8	
600-4	12	116	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4	



Type: the first number gives the size of the concealed joisthangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2

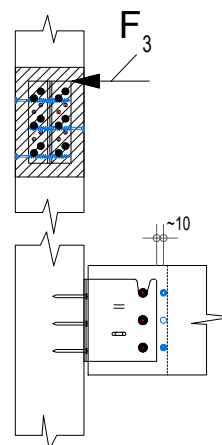
**R<sub>3,k</sub> beam to column**

R <sub>3,k</sub>	CNA 4,0x50		joist min. b / h [mm]	with screws *						table 27
	number of			width of timber [mm]						
Type	SD	nails		60	80	100	120	140	160	180
120-2	3	6	... / 160	1,8	3,1	4,1	4,1	4,1	4,1	4,1
160-2	4	8	... / 200	2,4	3,8	5,3	5,3	5,3	5,3	5,3
200-2	5	10	... / 240	2,9	4,2	6,3	6,3	6,3	6,3	6,3
240-2	6	12	... / 280	3,4	4,4	7,0	7,4	7,4	7,4	7,4
280-2	7	14	... / 320	3,9	5,0	7,3	8,5	8,5	8,5	8,5
320-2	8	16	... / 360	4,4	5,7	7,7	9,6	9,6	9,6	9,6
360-2	9	18	... / 400	5,0	6,3	8,1	10,7	10,7	10,7	10,7
400-2	10	20	... / 440	5,5	6,9	8,6	11,6	11,8	11,8	11,8
440-2	11	22	... / 480	6,1	7,6	9,4	12,2	12,9	12,9	12,9
480-2	12	24	... / 520	6,6	8,3	10,2	12,5	14,0	14,0	14,0
520-2	12	26	... / 560	7,1	9,0	11,0	13,0	15,1	15,1	15,1
560-2	12	28	... / 600	7,6	9,6	11,8	13,9	16,2	16,2	16,2
600-2	12	30	... / 640	8,1	10,3	12,6	14,8	17,3	17,3	17,3
120-4	3	12	... / 160	2,2	3,1	4,8	6,6	8,3	8,8	8,8
160-4	4	16	... / 200	2,9	4,4	7,3	9,9	11,1	11,1	11,1
200-4	5	20	... / 240	3,5	4,4	8,1	12,4	12,9	12,9	12,9
240-4	6	24	... / 280	4,2	5,3	8,6	13,1	15,1	15,1	15,1
280-4	7	28	... / 320	4,8	6,1	9,1	13,7	17,2	17,2	17,2
320-4	8	32	... / 360	5,5	6,8	9,1	14,4	19,3	19,4	19,4
360-4	9	36	... / 400	6,1	7,6	9,2	14,5	20,2	21,5	21,5
400-4	10	40	... / 440	6,7	8,3	10,1	15,2	21,1	23,7	23,7
440-4	11	44	... / 480	7,3	9,1	11,0	15,2	22,2	25,9	25,9
480-4	12	48	... / 520	7,9	9,8	11,9	16,1	23,2	28,1	28,1
520-4	12	52	... / 560	8,6	10,6	12,8	16,1	23,4	29,2	30,3
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	23,4	30,6	32,5
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	24,2	32,0	34,7

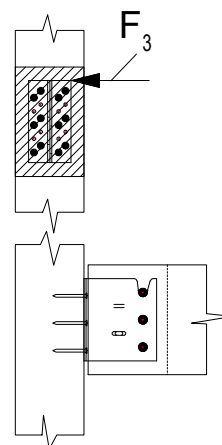
screw 6,0x L  
with L = b-20mm

(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel



R <sub>3,k</sub>	CNA 4,0x50		joist min. b / h [mm]	without screws *						table 28
	number of			width of timber [mm]						
Type	SD	nails		60	80	100	120	140	160	180
120-2	3	6	... / 160	1,8	2,4	3,0	3,6	4,1	4,1	4,1
160-2	4	8	... / 200	2,4	3,1	3,8	4,6	5,2	5,3	5,3
200-2	5	10	... / 240	2,9	3,8	4,6	5,5	6,2	6,3	6,3
240-2	6	12	... / 280	3,4	4,4	5,5	6,5	7,3	7,4	7,4
280-2	7	14	... / 320	3,9	5,0	6,3	7,4	8,3	8,5	8,5
320-2	8	16	... / 360	4,4	5,7	7,1	8,3	9,5	9,6	9,6
360-2	9	18	... / 400	5,0	6,3	7,8	9,3	10,6	10,7	10,7
400-2	10	20	... / 440	5,5	6,9	8,6	10,2	11,6	11,8	11,8
440-2	11	22	... / 480	6,1	7,6	9,4	11,1	12,7	12,9	12,9
480-2	12	24	... / 520	6,6	8,3	10,2	12,1	13,8	14,0	14,0
520-2	12	26	... / 560	7,1	9,0	11,0	13,0	14,8	15,1	15,1
560-2	12	28	... / 600	7,6	9,6	11,8	13,9	15,9	16,2	16,2
600-2	12	30	... / 640	8,1	10,3	12,6	14,8	16,9	17,3	17,3
120-4	3	12	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2
160-4	4	16	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7
200-4	5	20	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5
240-4	6	24	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1
280-4	7	28	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7
320-4	8	32	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3
360-4	9	36	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9
400-4	10	40	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5
440-4	11	44	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1
480-4	12	48	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7
520-4	12	52	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4



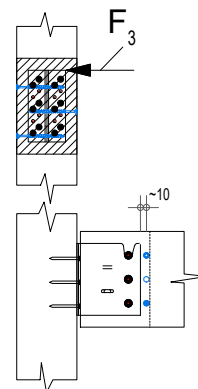
Type: the first number gives the size of the concealed joisthangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2

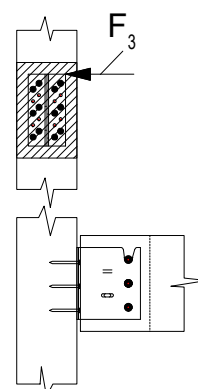
**R<sub>3,k</sub> beam to column**

R <sub>3,k</sub>	CNA 4,0x60			with screws *							table 29
	number of		joist min. b / h [mm]	width of timber [mm]							
Type	SD	nails			60	80	100	120	140	160	180
120-2	3	6	... / 160	2,0	3,1	4,4	4,4	4,4	4,4	4,4	
160-2	4	8	... / 200	2,5	4,0	5,6	5,6	5,6	5,6	5,6	
200-2	5	10	... / 240	3,2	4,4	6,6	6,7	6,7	6,7	6,7	
240-2	6	12	... / 280	3,8	4,6	7,2	7,9	7,9	7,9	7,9	
280-2	7	14	... / 320	4,3	5,4	7,7	9,0	9,0	9,0	9,0	
320-2	8	16	... / 360	4,9	6,1	8,1	10,2	10,2	10,2	10,2	
360-2	9	18	... / 400	5,4	6,9	8,6	11,4	11,4	11,4	11,4	
400-2	10	20	... / 440	5,9	7,6	9,0	12,1	12,6	12,6	12,6	
440-2	11	22	... / 480	6,5	8,2	9,8	12,6	13,7	13,7	13,7	
480-2	12	24	... / 520	7,0	8,9	10,6	13,0	14,9	14,9	14,9	
520-2	12	26	... / 560	7,6	9,6	11,4	13,7	16,1	16,1	16,1	
560-2	12	28	... / 600	8,1	10,3	12,2	14,4	17,3	17,3	17,3	
600-2	12	30	... / 640	8,7	11,0	13,0	15,3	18,4	18,4	18,4	
120-4	3	12	... / 160	2,2	3,1	4,8	6,6	8,3	9,4	9,4	
160-4	4	16	... / 200	2,9	4,4	7,3	9,9	11,8	11,8	11,8	
200-4	5	20	... / 240	3,5	4,4	8,1	12,8	13,7	13,7	13,7	
240-4	6	24	... / 280	4,2	5,3	8,6	13,7	16,1	16,1	16,1	
280-4	7	28	... / 320	4,8	6,1	9,1	13,7	18,3	18,3	18,3	
320-4	8	32	... / 360	5,5	6,8	9,1	14,4	20,2	20,7	20,7	
360-4	9	36	... / 400	6,1	7,6	9,2	14,5	21,1	22,9	22,9	
400-4	10	40	... / 440	6,7	8,3	10,1	15,2	22,2	25,3	25,3	
440-4	11	44	... / 480	7,3	9,1	11,0	15,2	22,2	27,6	27,6	
480-4	12	48	... / 520	7,9	9,8	11,9	16,1	23,2	29,2	30,0	
520-4	12	52	... / 560	8,6	10,6	12,8	16,1	23,4	30,6	32,3	
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	23,4	32,0	34,6	
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	24,2	33,6	37,0	

screw 6,0x L  
with L = b-20mm  
  
(for timber with b=60mm  
use screws 5,0x50)  
  
number of screws =  
number of steel dowel



R <sub>3,k</sub>	CNA 4,0x60			without screws *							table 30
	number of		joist min. b / h [mm]	width of timber [mm]							
Type	SD	nails			60	80	100	120	140	160	180
120-2	3	6	... / 160	2,0	2,6	3,1	3,7	4,2	4,4	4,4	
160-2	4	8	... / 200	2,5	3,3	4,0	4,7	5,3	5,6	5,6	
200-2	5	10	... / 240	3,2	3,9	4,9	5,7	6,4	6,7	6,7	
240-2	6	12	... / 280	3,8	4,6	5,7	6,7	7,5	7,9	7,9	
280-2	7	14	... / 320	4,3	5,4	6,5	7,7	8,7	9,0	9,0	
320-2	8	16	... / 360	4,9	6,1	7,3	8,6	9,8	10,2	10,2	
360-2	9	18	... / 400	5,4	6,9	8,1	9,6	10,9	11,4	11,4	
400-2	10	20	... / 440	5,9	7,6	9,0	10,5	12,0	12,6	12,6	
440-2	11	22	... / 480	6,5	8,2	9,8	11,5	13,1	13,7	13,7	
480-2	12	24	... / 520	7,0	8,9	10,6	12,4	14,2	14,9	14,9	
520-2	12	26	... / 560	7,6	9,6	11,4	13,4	15,3	16,1	16,1	
560-2	12	28	... / 600	8,1	10,3	12,2	14,4	16,3	17,3	17,3	
600-2	12	30	... / 640	8,7	11,0	13,0	15,3	17,4	18,4	18,4	
120-4	3	12	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2	
160-4	4	16	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7	
200-4	5	20	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5	
240-4	6	24	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1	
280-4	7	28	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7	
320-4	8	32	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3	
360-4	9	36	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9	
400-4	10	40	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5	
440-4	11	44	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1	
480-4	12	48	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7	
520-4	12	52	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2	
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8	
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4	



Type: the first number gives the size of the concealed joisthangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2

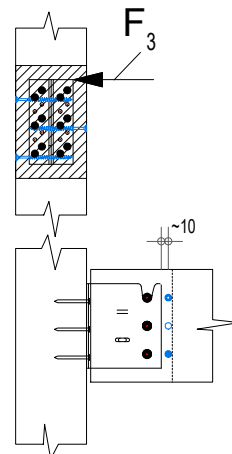
**R<sub>3,k</sub> beam to column**

R <sub>3,k</sub>	CSA 5,0x50		joist min.	with screws *							table 31
	number of			R <sub>2</sub> , k [kN] bei b =							
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180	
120-2	3	6	... / 160	2,2	3,1	4,7	4,7	4,7	4,7	4,7	
160-2	4	8	... / 200	2,9	4,4	6,0	6,0	6,0	6,0	6,0	
200-2	5	10	... / 240	3,5	4,4	7,0	7,1	7,1	7,1	7,1	
240-2	6	12	... / 280	4,2	5,3	8,0	8,4	8,4	8,4	8,4	
280-2	7	14	... / 320	4,8	6,1	8,8	9,6	9,6	9,6	9,6	
320-2	8	16	... / 360	5,5	6,8	9,1	10,9	10,9	10,9	10,9	
360-2	9	18	... / 400	6,1	7,6	9,2	12,0	12,1	12,1	12,1	
400-2	10	20	... / 440	6,7	8,3	10,1	13,0	13,3	13,3	13,3	
440-2	11	22	... / 480	7,3	9,1	11,0	13,9	14,6	14,6	14,6	
480-2	12	24	... / 520	7,9	9,8	11,9	14,9	15,8	15,8	15,8	
520-2	12	26	... / 560	8,6	10,6	12,8	15,7	17,1	17,1	17,1	
560-2	12	28	... / 600	9,2	11,3	13,8	16,5	18,3	18,3	18,3	
600-2	12	30	... / 640	9,8	12,1	14,7	17,6	19,4	19,6	19,6	
120-4	3	12	... / 160	2,2	3,1	4,8	6,6	8,3	9,9	9,9	
160-4	4	16	... / 200	2,9	4,4	7,3	9,9	12,5	12,5	12,5	
200-4	5	20	... / 240	3,5	4,4	8,1	13,0	14,6	14,6	14,6	
240-4	6	24	... / 280	4,2	5,3	8,6	13,7	17,1	17,1	17,1	
280-4	7	28	... / 320	4,8	6,1	9,1	13,7	19,3	19,4	19,4	
320-4	8	32	... / 360	5,5	6,8	9,1	14,4	21,1	22,0	22,0	
360-4	9	36	... / 400	6,1	7,6	9,2	14,5	21,8	24,4	24,4	
400-4	10	40	... / 440	6,7	8,3	10,1	15,2	22,2	26,9	26,9	
440-4	11	44	... / 480	7,3	9,1	11,0	15,2	22,2	29,2	29,3	
480-4	12	48	... / 520	7,9	9,8	11,9	16,1	23,2	31,5	31,8	
520-4	12	52	... / 560	8,6	10,6	12,8	16,1	23,4	32,0	34,3	
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	23,4	33,6	36,8	
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	24,2	33,6	39,3	

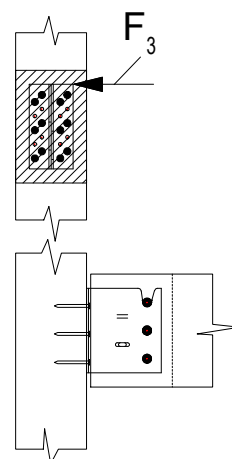
screw 6,0x L  
with L = b-20mm

(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel



R <sub>3,k</sub>	CSA 5,0x50		joist min.	without screws *							table 32
	number of			width of timber [mm]							
Type	SD	nails	b / h [mm]	60	80	100	120	140	160	180	
120-2	3	6	... / 160	2,2	2,9	3,5	4,2	4,5	4,7	4,7	
160-2	4	8	... / 200	2,9	3,6	4,4	5,3	5,8	6,0	6,0	
200-2	5	10	... / 240	3,5	4,4	5,4	6,4	6,9	7,1	7,1	
240-2	6	12	... / 280	4,2	5,3	6,4	7,4	8,1	8,4	8,4	
280-2	7	14	... / 320	4,8	6,1	7,3	8,5	9,2	9,6	9,6	
320-2	8	16	... / 360	5,5	6,8	8,3	9,7	10,4	10,9	10,9	
360-2	9	18	... / 400	6,1	7,6	9,2	10,8	11,6	12,2	12,1	
400-2	10	20	... / 440	6,7	8,3	10,1	11,9	12,7	13,4	13,3	
440-2	11	22	... / 480	7,3	9,1	11,0	13,1	13,9	14,6	14,6	
480-2	12	24	... / 520	7,9	9,8	11,9	14,3	15,1	15,8	15,8	
520-2	12	26	... / 560	8,6	10,6	12,8	15,4	16,3	17,1	17,1	
560-2	12	28	... / 600	9,2	11,3	13,8	16,5	17,5	18,3	18,3	
600-2	12	30	... / 640	9,8	12,1	14,7	17,6	18,7	19,5	19,6	
120-4	3	12	... / 160	2,2	2,9	3,5	4,2	4,8	5,6	6,2	
160-4	4	16	... / 200	2,9	3,6	4,4	5,3	6,2	7,0	7,7	
200-4	5	20	... / 240	3,5	4,4	5,4	6,4	7,4	8,4	9,5	
240-4	6	24	... / 280	4,2	5,3	6,4	7,4	8,6	9,8	11,1	
280-4	7	28	... / 320	4,8	6,1	7,3	8,5	9,9	11,3	12,7	
320-4	8	32	... / 360	5,5	6,8	8,3	9,7	11,1	12,9	14,3	
360-4	9	36	... / 400	6,1	7,6	9,2	10,9	12,4	14,4	15,9	
400-4	10	40	... / 440	6,7	8,3	10,1	12,1	13,8	15,8	17,5	
440-4	11	44	... / 480	7,3	9,1	11,0	13,2	15,2	17,2	19,1	
480-4	12	48	... / 520	7,9	9,8	11,9	14,3	16,6	18,7	20,7	
520-4	12	52	... / 560	8,6	10,6	12,8	15,4	17,8	20,1	22,2	
560-4	12	56	... / 600	9,2	11,3	13,8	16,5	19,1	21,5	23,8	
600-4	12	60	... / 640	9,8	12,1	14,7	17,6	20,4	23,0	25,4	



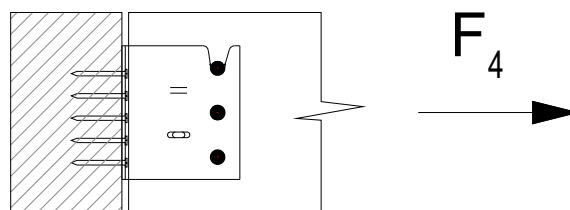
Type: the first number gives the size of the concealed joisthangers, the second number is given for the nailing - means 2-row or 4-row

\* - with / without screws: for reinforcement of the joist, see Annex C2



**R<sub>4</sub> beam to beam**

R <sub>4,k</sub>	number of		joist min.	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5,0x40	CSA5,0x50
Type	SD	nails	b / h [mm]					
BTN90-c	4	8	.../100	5,9	7,8	9,8	14,3	14,3
BTN120-c	3	10	.../160	7,4	9,8	12,2	17,6	19,1
BTN160-c	4	14	.../200	10,3	13,7	16,7	24,4	25,2
BTN200-c	5	18	.../240	13,2	17,6	21,2	31,1	31,2
BTN240-c	6	22	.../280	16,2	21,6	25,8	37,3	37,3
BT4-90	4	16	.../100	5,9	7,8	9,8	14,3	14,3
BT4-120	3	20	.../160	7,4	9,8	12,2	17,6	19,1
BT4-160	4	28	.../200	10,3	13,7	16,7	24,4	25,2
BT4-200	5	36	.../240	13,2	17,6	21,2	31,1	31,2
BT4-240	6	44	.../280	16,2	21,6	25,8	37,3	37,3
BT4-280	7	52	.../320	19,1	25,5	30,3	44,5	44,5
BT4-320	8	60	.../360	22,0	29,4	34,8	51,2	56,9
BT4-360	9	68	.../400	25,0	33,3	39,3	57,9	64,0
BT4-400	10	76	.../440	27,9	37,2	43,9	64,6	71,0
BT4-440	11	84	.../480	30,9	41,2	48,4	71,3	78,1
BT4-480	12	92	.../520	33,8	45,1	52,9	78,0	85,1
BT4-520	12	100	.../560	36,8	49,0	57,4	84,7	92,2
BT4-560	12	108	.../600	39,7	52,9	62,0	91,4	99,2
BT4-600	12	116	.../640	42,6	56,8	66,5	98,2	106,3
BTALU120	3	20	.../160	7,4	9,8	12,2	21,8	30,6
BTALU160	4	28	.../200	10,3	13,7	17,2	30,5	42,8
BTALU200	5	36	.../240	13,2	17,6	22,0	39,2	55,1
BTALU240	6	44	.../280	16,2	21,6	27,0	48,0	67,3
BTALU280	7	52	.../320	19,1	25,5	31,8	56,7	79,6
BTALU320	8	60	.../360	22,0	29,4	36,8	65,4	91,8
BTALU360	9	68	.../400	25,0	33,3	41,6	74,1	104,0
BTALU400	10	76	.../440	27,9	37,2	46,6	82,8	116,3
BTALU440	11	84	.../480	30,9	41,2	51,4	91,6	128,5
BTALU480	12	92	.../520	33,8	45,1	56,4	100,3	140,8
BTALU520	12	100	.../560	36,8	49,0	61,2	109,0	153,0
BTALU560	12	108	.../600	39,7	52,9	66,2	117,7	165,2
BTALU600	12	116	.../640	42,6	56,8	71,0	126,4	177,5



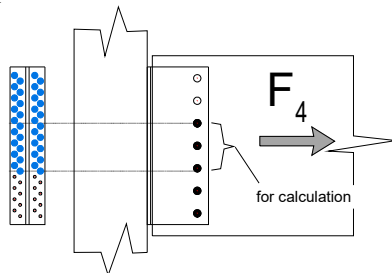
See also the comment below table 34

**R<sub>4</sub> beam to column**

R <sub>4,k</sub>							table	34
Type	number of		joist min.	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5,0x40	CSA5,0x50
	SD	nails	b / h [mm]					
BTN90-c	4	4	.../100	2,9	3,9	4,9	8,7	8,7
BTN120-c	3	6	.../160	4,4	5,9	7,4	12,7	15,7
BTN160-c	4	8	.../200	5,9	7,8	9,8	16,9	20,9
BTN200-c	5	10	.../240	7,4	9,8	12,3	21,1	26,1
BTN240-c	6	12	.../280	8,8	11,8	14,7	25,3	31,3
BT4-90-c	4	8	.../100	2,9	3,9	4,9	8,7	8,7
BT4-120-c	3	12	.../160	4,4	5,9	7,4	12,7	15,7
BT4-160-c	4	16	.../200	5,9	7,8	9,8	16,9	20,9
BT4-200-c	5	20	.../240	7,4	9,8	12,3	21,1	26,1
BT4-240-c	6	24	.../280	8,8	11,8	14,7	25,3	31,3
BT4-280-c	7	28	.../320	10,3	13,7	17,2	29,5	29,5
BT4-320-c	8	32	.../360	11,8	15,7	19,6	33,7	41,8
BT4-360-c	9	36	.../400	13,2	17,6	22,1	38,0	47,0
BT4-400-c	10	40	.../440	14,7	19,6	24,5	42,2	52,2
BT4-440-c	11	44	.../480	16,2	21,6	27,0	46,4	57,5
BT4-480-c	12	48	.../520	17,6	23,5	29,4	50,6	62,7
BT4-520-c	12	52	.../560	19,1	25,5	31,9	54,8	67,9
BT4-560-c	12	56	.../600	20,6	27,4	34,3	59,1	73,1
BT4-600-c	12	60	.../640	22,1	29,4	36,8	63,3	78,4
BTALU120-c	3	12	.../160	4,4	5,9	7,4	13,1	18,4
BTALU160-c	4	16	.../200	5,9	7,8	9,8	17,4	24,5
BTALU200-c	5	20	.../240	7,4	9,8	12,3	21,8	30,6
BTALU240-c	6	24	.../280	8,8	11,8	14,7	26,2	36,7
BTALU280-c	7	28	.../320	10,3	13,7	17,2	30,5	42,8
BTALU320-c	8	32	.../360	11,8	15,7	19,6	34,9	49,0
BTALU360-c	9	36	.../400	13,2	17,6	22,1	39,2	55,1
BTALU400-c	10	40	.../440	14,7	19,6	24,5	43,6	61,2
BTALU440-c	11	44	.../480	16,2	21,6	27,0	48,0	67,3
BTALU480-c	12	48	.../520	17,6	23,5	29,4	52,3	73,4
BTALU520-c	12	52	.../560	19,1	25,5	31,9	56,7	79,6
BTALU560-c	12	56	.../600	20,6	27,4	34,3	61,0	85,7
BTALU600-c	12	60	.../640	22,1	29,4	36,8	65,4	91,8

C= index for column nailing

Basis of the values for force direction  $F_4$  is, that the force is acting in the middle of the steel dowel and in the middle of the nail group. In case of a asymmetric placing of steel dowel and nails, calculate with the number of fasteners in the overlapping area – see picture below

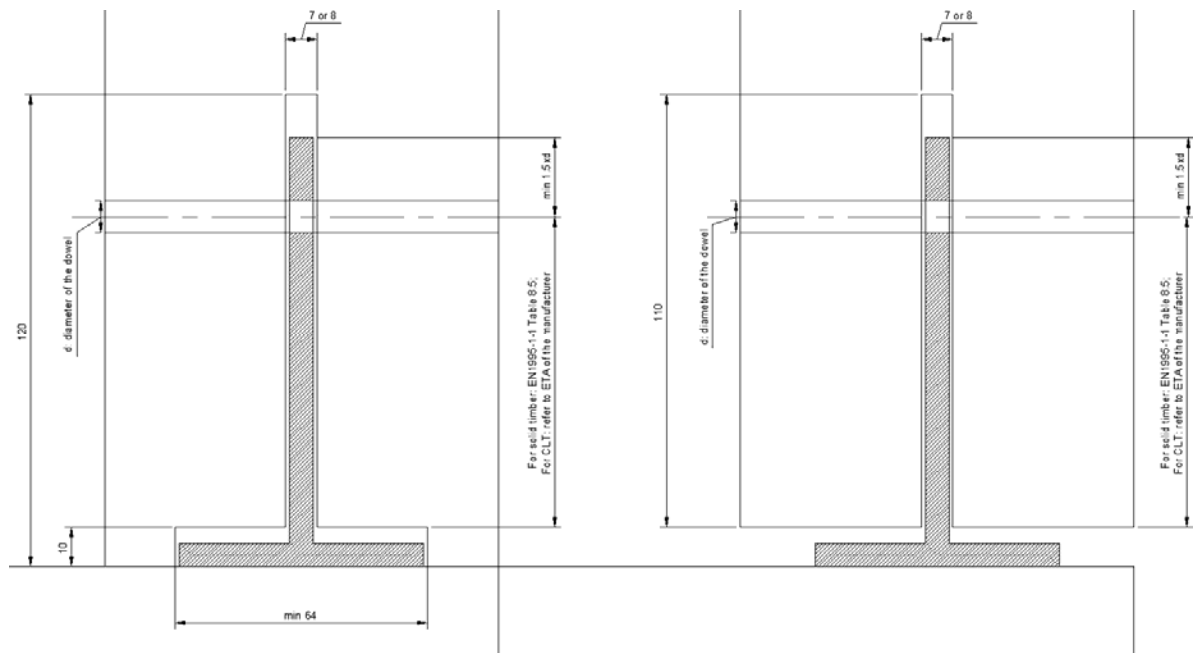




## Force direction F4

### Additional information:

- The BTALU can be used with CNA nails of a diameter of  $\varnothing 4$  mm with a length from 35 to 100mm and CSA screws of a diameter of  $\varnothing 5$  mm and a length from 35 to 50mm. Capacity of these fasteners can be found in ETA-04/0013.
- The load is located on the centre of gravity of the dowels
- The dowels must be distributed equally across the whole height of the hanger.
- The nails must be distributed equally across all around the dowels
- For solid timber: The spacing and edge distance to the timber must respect rules given by EUROCODE 5 (EN1995-1-1 §8.6 Table 8.5)
- For CLT: the spacing and edge distance to the timber must respect rules from ETA of the CLT manufacturer.
- The minimum distance between the edge of the hangers and the dowels is equal to  $1,5 \times d$  (d is the diameter of the dowels)
- All dowels must have the same diameter, length and yield capacity.







R1,k	CNA4.0x50		4-Row		SD: Ø7		C24		Column		Table 46		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	8,3	8	9,4	12	12,4	12	12,4	12	12,4	12	12,4	
	24	18,0	24	20,5	28	23,3	28	25,7	28	25,7	28	25,7	
4 SD	12	14,1	16	18,3	16	19,8	16	19,8	16	19,8	16	19,8	
	28	24,2	32	27,5	32	31,5	32	33,9	32	33,9	32	33,9	
5 SD	16	20,6	16	22,8	20	28,0	20	28,0	20	28,0	20	28,0	
	32	30,3	32	34,5	36	39,5	36	42,3	36	42,3	36	42,3	
6 SD	20	27,6	20	30,4	24	36,6	28	40,4	28	40,4	28	40,4	
	36	36,4	36	41,6	40	47,4	44	50,9	44	50,9	44	50,9	
7 SD	20	32,0	24	38,4	28	45,3	28	45,8	28	45,8	28	45,8	
	36	42,5	40	48,6	44	55,3	44	59,5	44	59,5	44	59,5	
8 SD	24	39,3	28	46,4	32	54,1	32	55,0	32	55,0	32	55,0	
	40	48,8	44	55,6	48	63,1	48	68,1	48	68,1	48	68,1	
9 SD	28	46,7	32	54,5	36	62,9	36	64,2	36	64,2	36	64,2	
	44	54,9	48	62,4	52	71,0	52	76,8	52	76,8	52	76,8	
10 SD	32	54,0	36	62,5	40	71,7	40	73,5	40	73,5	40	73,5	
	48	60,9	52	69,3	56	78,8	56	85,4	56	85,4	56	85,4	
11 SD	32	58,7	36	67,7	44	80,4	44	82,8	44	82,8	44	82,8	
	48	67,1	52	76,3	60	86,8	60	94,0	60	94,0	60	94,0	
12 SD	36	66,0	40	75,7	44	86,1	44	88,3	44	88,3	44	88,3	
	52	73,3	56	83,4	60	94,7	60	101,3	60	101,3	60	101,3	
R1,k	CNA4.0x60		4-Row		SD: Ø7		C24		Column		Table 47		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	8,8	8	9,8	8	10,5	12	13,4	12	13,4	12	13,4	
	20	18,0	24	20,5	24	23,7	28	25,1	28	25,1	28	25,1	
4 SD	8	12,3	12	16,5	12	17,8	16	21,2	16	21,2	16	21,2	
	24	24,3	28	27,5	28	31,6	32	33,7	32	33,7	32	33,7	
5 SD	12	18,8	16	24,0	16	26,0	20	29,9	20	29,9	20	29,9	
	28	30,5	32	34,5	32	39,5	36	42,3	36	42,3	36	42,3	
6 SD	16	25,9	20	32,0	20	34,9	24	39,0	24	39,0	24	39,0	
	32	36,4	36	41,5	36	47,4	40	50,9	40	50,9	40	50,9	
7 SD	20	33,4	20	36,8	24	44,0	24	44,2	24	44,2	24	44,2	
	36	42,5	36	48,6	40	55,2	40	59,6	40	59,6	40	59,6	
8 SD	20	37,8	24	45,1	28	53,0	28	53,7	28	53,7	28	53,7	
	36	48,8	40	55,5	44	63,0	44	68,3	44	68,3	44	68,3	
9 SD	24	45,4	28	53,4	32	62,1	32	63,2	32	63,2	32	63,2	
	40	54,9	44	62,4	48	70,9	48	77,0	48	77,0	48	77,0	
10 SD	28	53,1	28	58,4	32	67,5	36	72,8	36	72,8	36	72,8	
	44	60,9	44	69,3	48	78,9	52	85,5	52	85,5	52	85,5	
11 SD	28	57,6	32	66,7	36	76,6	40	82,4	40	82,4	40	82,4	
	44	67,1	48	76,4	52	86,9	56	94,0	56	94,0	56	94,0	
12 SD	32	65,3	36	75,1	40	85,6	44	91,9	44	91,9	44	91,9	
	48	73,2	52	83,3	56	94,8	60	102,4	60	102,4	60	102,4	
R1,k	CSA5.0x50		4-Row		SD: Ø7		C24		Column		Table 48		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	11,5	8	12,4	8	13,1	8	13,1	8	13,1	8	13,1	
	16	18,0	16	20,5	16	23,7	20	25,1	20	25,1	20	25,1	
4 SD	8	14,5	8	15,8	8	16,9	8	16,9	8	16,9	8	16,9	
	16	24,3	20	27,5	20	31,3	20	34,1	20	34,1	20	34,1	
5 SD	8	17,8	8	19,3	8	20,1	8	20,1	8	20,1	8	20,1	
	20	30,3	20	34,6	24	39,2	24	42,3	24	42,3	24	42,3	
6 SD	8	20,1	8	20,1	12	29,3	12	29,3	12	29,3	12	29,3	
	24	36,4	24	41,5	28	47,2	28	50,9	28	50,9	28	50,9	
7 SD	8	20,1	12	30,1	12	30,1	16	38,9	16	38,9	16	38,9	
	24	42,6	28	48,4	28	55,3	32	59,5	32	59,5	32	59,5	
8 SD	12	30,1	12	30,1	16	40,2	20	48,7	20	48,7	20	48,7	
	28	48,7	28	55,5	32	63,0	36	68,1	36	68,1	36	68,1	
9 SD	12	30,1	16	40,2	20	50,2	20	50,2	20	50,2	20	50,2	
	28	54,9	32	62,4	36	70,9	36	77,0	36	77,0	36	77,0	
10 SD	16	40,2	20	50,2	24	60,2	24	60,2	24	60,2	24	60,2	
	32	60,9	36	69,3	40	78,8	40	85,3	40	85,3	40	85,3	
11 SD	16	40,2	20	50,2	24	60,2	28	70,2	28	70,2	28	70,2	
	32	67,1	36	76,4	40	86,9	44	93,9	44	93,9	44	93,9	
12 SD	20	50,2	24	60,2	28	70,3	32	80,1	32	80,1	32	80,1	
	36	73,1	40	83,2	44	94,7	48	102,4	48	102,4	48	102,4	

R1,k	CNA4.0x50		2-Row		SD: Ø7		C24		Column		Table 49	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	10	11,6	10	12,5	12	15,5	12	15,5	12	15,5	12	15,5
	18	18,0	18	20,7	20	23,7	20	25,2	20	25,2	20	25,2
4 SD	12	16,7	14	20,2	16	24,0	16	24,0	16	24,0	16	24,0
	20	24,4	22	27,8	24	31,5	24	33,8	24	33,8	24	33,8
5 SD	16	24,2	18	28,4	20	32,8	20	33,1	20	33,1	20	33,1
	24	30,3	26	34,5	28	39,2	28	42,6	28	42,6	28	42,6
6 SD	18	29,8	20	34,5	22	39,4	22	39,7	22	39,7	22	39,7
	26	36,6	28	41,7	30	47,3	30	49,8	30	49,8	30	49,8
7 SD	20	35,5	22	40,6	22	43,6	22	43,7	22	43,7	22	43,7
	28	42,6	30	48,3	30	52,8	30	54,3	30	54,3	30	54,3
8 SD	22	41,2	22	44,4	22	47,2	22	47,2	22	47,2	22	47,2
	30	48,5	30	53,2	30	57,3	30	58,4	30	58,4	30	58,4
9 SD	22	44,7	22	47,7	22	48,8	22	48,8	22	48,8	22	48,8
	30	52,9	30	57,4	30	61,5	30	62,1	30	62,1	30	62,1
10 SD	22	47,7	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8
	30	56,9	30	61,3	30	64,9	30	65,2	30	65,2	30	65,2
11 SD	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8
	30	60,5	30	64,6	30	66,5	30	66,5	30	66,5	30	66,5
12 SD	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8
	30	63,8	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5
R1,k	CNA4.0x60		2-Row		SD: Ø7		C24		Column		Table 50	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	10,6	8	11,5	10	14,5	10	14,5	10	14,5	10	14,5
	16	18,0	16	20,6	18	23,7	18	25,1	18	25,1	18	25,1
4 SD	10	15,7	12	19,4	14	23,3	14	23,3	14	23,3	14	23,3
	18	24,4	20	27,7	22	31,3	22	34,0	22	34,0	22	34,0
5 SD	14	23,6	14	25,4	16	29,9	18	32,7	18	32,7	18	32,7
	22	30,3	22	34,5	24	39,3	26	42,8	26	42,8	26	42,8
6 SD	16	29,3	18	34,1	20	39,2	22	42,4	22	42,4	22	42,4
	24	36,4	26	41,5	28	47,4	30	50,9	30	50,9	30	50,9
7 SD	18	35,1	20	40,4	22	45,9	22	46,2	22	46,2	22	46,2
	26	42,7	28	48,6	30	55,0	30	57,6	30	57,6	30	57,6
8 SD	20	41,0	22	46,6	22	49,5	22	49,6	22	49,6	22	49,6
	28	48,8	30	55,3	30	60,2	30	61,8	30	61,8	30	61,8
9 SD	22	46,8	22	49,9	22	51,9	22	51,9	22	51,9	22	51,9
	30	54,8	30	60,1	30	64,5	30	65,5	30	65,5	30	65,5
10 SD	22	49,9	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0
	30	59,3	30	64,1	30	68,1	30	68,7	30	68,7	30	68,7
11 SD	22	51,9	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0
	30	63,1	30	67,6	30	70,6	30	70,7	30	70,7	30	70,7
12 SD	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0
	30	66,5	30	70,2	30	70,9	30	70,9	30	70,9	30	70,9
R1,k	CSA5.0x50		2-Row		SD: Ø7		C24		Column		Table 51	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	4	8,3	4	9,0	6	12,4	6	12,4	6	12,4	6	12,4
	12	18,0	12	20,5	14	23,3	14	25,1	14	25,1	14	25,1
4 SD	6	13,5	6	14,3	8	18,4	8	18,4	8	18,4	8	18,4
	14	24,1	14	27,7	16	31,3	16	33,7	16	33,7	16	33,7
5 SD	8	18,9	10	23,4	10	24,2	12	28,2	12	28,2	12	28,2
	16	30,3	18	34,5	18	39,2	20	42,3	20	42,3	20	42,3
6 SD	10	24,3	12	29,1	14	34,1	16	38,2	16	38,2	16	38,2
	18	36,4	20	41,5	22	47,2	24	50,9	24	50,9	24	50,9
7 SD	12	29,6	14	34,6	16	39,7	18	44,1	18	44,1	18	44,1
	20	42,5	22	48,5	24	55,1	26	59,9	26	59,9	26	59,9
8 SD	14	34,9	18	44,3	20	49,6	22	54,1	22	54,1	22	54,1
	22	48,8	26	55,4	28	63,0	30	68,1	30	68,1	30	68,1
9 SD	16	40,1	20	49,8	22	55,0	22	55,1	22	55,1	22	55,1
	24	54,9	28	62,4	30	71,0	30	72,8	30	72,8	30	72,8
10 SD	20	49,7	22	55,1	22	55,2	22	55,2	22	55,2	22	55,2
	28	60,9	30	69,3	30	73,7	30	74,2	30	74,2	30	74,2
11 SD	22	55,0	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2
	30	67,0	30	73,2	30	74,9	30	75,1	30	75,1	30	75,1
12 SD	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2
	30	72,2	30	74,7	30	75,3	30	75,3	30	75,3	30	75,3

R1,k	CNA4.0x50		4-Row		SD: Ø7		CLT		Column		Table 52		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	7,0	8	7,7	12	10,8	12	11,3	12	11,3	12	11,3	
	24	18,0	24	20,5	28	23,3	28	25,7	28	25,7	28	25,7	
4 SD	12	12,2	16	16,3	16	17,5	16	18,3	16	18,3	16	18,3	
	28	24,1	32	27,5	32	31,4	32	33,8	32	33,8	32	33,8	
5 SD	16	18,4	16	19,9	20	25,0	20	26,1	20	26,1	20	26,1	
	32	30,3	32	34,5	36	39,5	36	42,3	36	42,3	36	42,3	
6 SD	20	25,2	20	27,2	24	33,1	28	38,7	28	38,7	28	38,7	
	36	36,4	36	41,5	40	47,4	44	50,9	44	50,9	44	50,9	
7 SD	24	32,4	24	34,9	28	41,6	32	47,7	32	47,7	32	47,7	
	40	42,5	40	48,6	44	55,3	48	59,5	48	59,5	48	59,5	
8 SD	24	36,2	28	42,9	32	50,3	36	56,9	36	56,9	36	56,9	
	40	48,8	44	55,6	48	63,1	52	68,1	52	68,1	52	68,1	
9 SD	28	43,7	32	51,1	36	59,2	36	61,9	36	61,9	36	61,9	
	44	54,9	48	62,4	52	70,9	52	76,7	52	76,7	52	76,7	
10 SD	32	51,3	36	59,3	40	68,1	40	71,2	40	71,2	40	71,2	
	48	60,9	52	69,3	56	78,8	56	85,3	56	85,3	56	85,3	
11 SD	32	55,4	36	63,8	44	77,0	44	80,6	44	80,6	44	80,6	
	48	67,0	52	76,3	60	86,8	60	94,0	60	94,0	60	94,0	
12 SD	36	63,0	40	72,1	44	81,9	44	85,6	44	85,6	44	85,6	
	52	73,3	56	83,4	60	94,7	60	100,9	60	100,9	60	100,9	
R1,k	CNA4.0x60		4-Row		SD: Ø7		CLT		Column		Table 53		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	7,5	8	8,1	8	8,9	12	12,3	12	12,3	12	12,3	
	24	18,0	24	20,5	24	23,7	28	25,1	28	25,1	28	25,1	
4 SD	8	10,6	12	14,2	12	15,4	16	19,8	16	19,8	16	19,8	
	24	24,3	28	27,5	28	31,5	32	33,7	32	33,7	32	33,7	
5 SD	12	16,4	16	21,3	16	23,0	20	28,2	20	28,2	20	28,2	
	28	30,5	32	34,5	32	39,5	36	42,3	36	42,3	36	42,3	
6 SD	16	23,3	20	29,1	20	31,3	24	37,2	24	37,2	24	37,2	
	32	36,4	36	41,5	36	47,4	40	50,9	40	50,9	40	50,9	
7 SD	20	30,7	20	33,2	24	40,1	24	41,9	24	41,9	24	41,9	
	36	42,5	36	48,6	40	55,1	40	59,5	40	59,5	40	59,5	
8 SD	20	34,5	24	41,5	28	49,1	28	51,3	28	51,3	28	51,3	
	36	48,8	40	55,5	44	63,0	44	68,2	44	68,2	44	68,2	
9 SD	24	42,3	28	49,9	32	58,3	32	60,9	32	60,9	32	60,9	
	40	54,8	44	62,4	48	70,9	48	76,9	48	76,9	48	76,9	
10 SD	28	50,2	28	54,2	32	62,9	36	70,5	36	70,5	36	70,5	
	44	60,9	44	69,3	48	78,8	52	85,5	52	85,5	52	85,5	
11 SD	28	54,2	32	62,8	36	72,2	40	80,1	40	80,1	40	80,1	
	44	67,1	48	76,4	52	86,9	56	94,0	56	94,0	56	94,0	
12 SD	32	62,1	36	71,4	40	81,4	44	89,8	44	89,8	44	89,8	
	48	73,1	52	83,2	56	94,8	60	102,4	60	102,4	60	102,4	
R1,k	CSA5.0x50		4-Row		SD: Ø7		CLT		Column		Table 54		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	10,5	8	11,1	8	11,8	8	12,2	8	12,2	8	12,2	
	16	18,0	16	20,5	16	23,7	20	25,1	20	25,1	20	25,1	
4 SD	8	13,0	8	13,9	8	14,9	8	15,5	8	15,5	8	15,5	
	16	24,2	20	27,5	20	31,3	20	34,1	20	34,1	20	34,1	
5 SD	8	15,7	8	17,8	8	19,8	8	19,8	8	19,8	8	19,8	
	20	30,3	20	34,5	24	39,2	24	42,3	24	42,3	24	42,3	
6 SD	8	20,1	8	20,1	12	26,9	12	27,8	12	27,8	12	27,8	
	24	36,4	24	41,5	28	47,2	28	50,9	28	50,9	28	50,9	
7 SD	8	20,1	12	30,1	12	30,1	16	37,4	16	37,4	16	37,4	
	24	42,5	28	48,4	28	55,3	32	59,5	32	59,5	32	59,5	
8 SD	12	30,1	12	30,1	16	40,2	20	47,2	20	47,2	20	47,2	
	28	48,7	28	55,5	32	63,0	36	68,1	36	68,1	36	68,1	
9 SD	12	30,1	16	40,2	20	50,2	20	50,2	20	50,2	20	50,2	
	28	54,9	32	62,4	36	70,9	36	77,0	36	77,0	36	77,0	
10 SD	16	40,2	20	50,2	24	59,1	24	59,4	24	59,4	24	59,4	
	32	60,9	36	69,3	40	78,8	40	85,3	40	85,3	40	85,3	
11 SD	16	40,2	20	50,2	24	60,2	28	69,3	28	69,3	28	69,3	
	32	67,0	36	76,4	40	86,9	44	93,9	44	93,9	44	93,9	
12 SD	20	50,2	24	60,2	28	70,3	32	79,3	32	79,3	32	79,3	
	36	73,1	40	83,2	44	94,7	48	102,4	48	102,4	48	102,4	

R1,k	CNA4.0x50		4-Row		SD: Ø8		C24		Header		Table 55		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	20	12,3	20	13,4	20	14,4	24	16,8	24	16,8	24	16,8	
	32	18,3	36	20,5	36	23,5	40	25,1	40	25,1	40	25,1	
4 SD	20	15,9	24	19,6	28	23,8	28	23,8	28	23,8	28	23,8	
	36	24,1	40	27,8	44	31,5	44	34,1	44	34,1	44	34,1	
5 SD	28	24,1	28	26,5	32	31,4	36	34,4	36	34,4	36	34,4	
	44	30,3	44	34,6	48	39,5	52	42,5	52	42,5	52	42,5	
6 SD	32	30,5	36	35,9	36	39,4	40	42,6	40	42,6	40	42,6	
	48	36,5	52	41,5	52	47,2	56	51,3	56	51,3	56	51,3	
7 SD	36	37,2	40	43,2	44	49,9	44	51,2	44	51,2	44	51,2	
	52	42,6	56	48,5	60	55,2	60	59,8	60	59,8	60	59,8	
8 SD	40	43,9	44	50,7	48	58,1	48	59,9	48	59,9	48	59,9	
	56	48,7	60	55,5	64	63,2	64	68,2	64	68,2	64	68,2	
9 SD	40	48,8	48	58,1	52	66,4	56	71,3	56	71,3	56	71,3	
	56	54,8	64	62,4	68	71,1	72	76,9	72	76,9	72	76,9	
10 SD	44	55,6	52	65,6	56	74,7	60	80,1	60	80,1	60	80,1	
	60	61,0	68	69,4	72	79,0	76	85,5	76	85,5	76	85,5	
11 SD	48	62,4	52	71,4	60	83,0	64	88,9	64	88,9	64	88,9	
	64	67,1	68	76,3	76	86,9	80	94,1	80	94,1	80	94,1	
12 SD	52	69,2	56	78,9	64	91,3	68	97,8	68	97,8	68	97,8	
	68	73,3	72	83,3	80	94,8	84	102,6	84	102,6	84	102,6	
R1,k	CNA4.0x60		4-Row		SD: Ø8		C24		Header		Table 56		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	20	13,6	20	14,7	20	15,7	20	15,7	20	15,7	20	15,7	
	28	18,1	32	20,5	32	23,5	36	25,1	36	25,1	36	25,1	
4 SD	20	17,1	20	18,7	24	23,0	24	23,0	24	23,0	24	23,0	
	32	24,1	36	27,8	40	31,3	40	34,2	40	34,2	40	34,2	
5 SD	24	23,4	24	25,8	28	30,9	28	31,1	28	31,1	28	31,1	
	40	30,3	40	34,7	44	39,5	44	42,4	44	42,4	44	42,4	
6 SD	24	27,7	28	33,2	32	39,2	36	42,7	36	42,7	36	42,7	
	40	36,4	44	41,6	48	47,4	52	50,9	52	50,9	52	50,9	
7 SD	28	34,6	32	40,8	36	47,6	40	51,5	40	51,5	40	51,5	
	44	42,6	48	48,6	52	55,3	56	59,8	56	59,8	56	59,8	
8 SD	32	41,7	36	48,6	40	56,2	44	60,5	44	60,5	44	60,5	
	48	48,8	52	55,5	56	63,2	60	68,4	60	68,4	60	68,4	
9 SD	36	48,7	40	56,4	44	64,8	48	69,5	48	69,5	48	69,5	
	52	54,9	56	62,5	60	71,1	64	77,0	64	77,0	64	77,0	
10 SD	40	55,8	44	64,1	48	73,3	52	78,7	52	78,7	52	78,7	
	56	61,0	60	69,5	64	79,0	68	85,5	68	85,5	68	85,5	
11 SD	44	62,7	48	71,8	52	81,9	56	87,8	56	87,8	56	87,8	
	60	67,1	64	76,4	68	86,9	72	94,1	72	94,1	72	94,1	
12 SD	44	67,9	52	79,5	56	90,4	60	96,9	60	96,9	60	96,9	
	60	73,2	68	83,3	72	94,8	76	102,6	76	102,6	76	102,6	
R1,k	CSA5.0x50		4-Row		SD: Ø8		C24		Header		Table 57		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	20	18,0	20	20,8	20	23,0	20	23,7	20	23,7	20	23,7	
	20	18,0	20	20,8	24	23,3	24	25,1	24	25,1	24	25,1	
4 SD	20	23,5	20	25,5	20	27,4	20	27,8	20	27,8	20	27,8	
	24	24,1	24	27,6	28	31,3	28	33,7	28	33,7	28	33,7	
5 SD	20	27,3	20	29,6	20	32,1	20	32,3	20	32,3	20	32,3	
	24	30,4	28	34,5	28	39,3	32	42,3	32	42,3	32	42,3	
6 SD	20	31,2	20	34,0	20	37,0	20	37,1	20	37,1	20	37,1	
	28	36,6	32	41,5	32	47,4	36	50,9	36	50,9	36	50,9	
7 SD	20	35,2	20	38,6	20	42,1	20	42,1	20	42,1	20	42,1	
	32	42,5	32	48,5	36	55,2	36	59,5	36	59,5	36	59,5	
8 SD	20	39,4	20	43,3	24	51,4	24	51,8	24	51,8	24	51,8	
	32	48,7	36	55,5	40	63,0	40	68,4	40	68,4	40	68,4	
9 SD	20	43,7	24	51,9	28	60,8	28	61,6	28	61,6	28	61,6	
	36	54,9	40	62,4	44	70,9	44	77,0	44	77,0	44	77,0	
10 SD	24	51,7	24	56,4	28	65,7	32	71,4	32	71,4	32	71,4	
	40	60,9	40	69,4	44	79,0	48	85,3	48	85,3	48	85,3	
11 SD	24	55,9	28	65,2	32	75,1	36	81,3	36	81,3	36	81,3	
	40	67,2	44	76,4	48	86,9	52	93,9	52	93,9	52	93,9	
12 SD	28	63,9	32	73,8	36	84,4	36	86,0	36	86,0	36	86,0	
	44	73,1	48	83,2	52	94,7	52	102,4	52	102,4	52	102,4	

R1,k	CNA4.0x50		2-Row		SD: Ø8		C24		Header		Table 58		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	16	13,4	16	14,5	18	17,2	20	19,0	20	19,0	20	19,0	
	24	18,0	24	20,5	26	23,5	28	25,7	28	25,7	28	25,7	
4 SD	20	19,8	22	23,1	24	26,7	24	27,0	24	27,0	24	27,0	
	28	24,2	30	27,6	32	31,5	32	33,9	32	33,9	32	33,9	
5 SD	22	25,1	26	30,6	28	34,8	30	37,4	30	37,4	30	37,4	
	30	30,4	34	34,6	36	39,5	38	42,7	38	42,7	38	42,7	
6 SD	26	32,1	28	36,7	32	43,2	34	46,2	34	46,2	34	46,2	
	34	36,6	36	41,6	40	47,4	42	51,3	42	51,3	42	51,3	
7 SD	30	39,2	32	44,5	36	51,7	38	55,1	38	55,1	38	55,1	
	38	42,7	40	48,6	44	55,3	46	59,9	46	59,9	46	59,9	
8 SD	32	45,0	36	52,3	38	58,8	42	64,1	42	64,1	42	64,1	
	40	48,8	44	55,6	46	63,1	50	68,4	50	68,4	50	68,4	
9 SD	36	52,1	38	58,7	42	67,3	46	73,2	46	73,2	46	73,2	
	44	54,9	46	62,4	50	71,1	54	77,0	54	77,0	54	77,0	
10 SD	38	58,0	42	66,5	46	75,9	50	82,2	50	82,2	50	82,2	
	46	61,1	50	69,5	54	79,0	58	85,5	58	85,5	58	85,5	
11 SD	40	63,9	46	74,2	50	84,3	50	88,1	50	88,1	50	88,1	
	48	67,1	54	76,4	58	86,9	58	93,4	58	93,4	58	93,4	
12 SD	44	70,9	48	80,8	50	90,4	50	93,9	50	93,9	50	93,9	
	52	73,3	56	83,4	58	94,3	58	100,2	58	100,2	58	100,2	
R1,k	CNA4.0x60		2-Row		SD: Ø8		C24		Header		Table 59		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	12	11,5	14	14,2	16	17,0	16	17,0	16	17,0	16	17,0	
	20	18,0	22	20,7	24	23,7	24	25,1	24	25,1	24	25,1	
4 SD	16	18,1	18	21,5	20	25,1	22	27,4	22	27,4	22	27,4	
	24	24,3	26	27,7	28	31,6	30	34,1	30	34,1	30	34,1	
5 SD	20	25,2	22	29,3	24	33,7	26	36,3	26	36,3	26	36,3	
	28	30,5	30	34,7	32	39,5	34	42,7	34	42,7	34	42,7	
6 SD	22	30,9	26	37,3	28	42,4	30	45,4	30	45,4	30	45,4	
	30	36,5	34	41,5	36	47,4	38	51,3	38	51,3	38	51,3	
7 SD	26	38,3	28	43,7	32	51,2	34	54,7	34	54,7	34	54,7	
	34	42,7	36	48,6	40	55,2	42	59,7	42	59,7	42	59,7	
8 SD	28	44,2	32	51,8	34	58,3	36	62,1	36	62,1	36	62,1	
	36	48,8	40	55,5	42	63,1	44	68,3	44	68,3	44	68,3	
9 SD	32	51,7	34	58,3	38	67,2	40	71,5	40	71,5	40	71,5	
	40	54,9	42	62,5	46	71,1	48	77,0	48	77,0	48	77,0	
10 SD	34	57,6	38	66,4	40	74,4	44	80,8	44	80,8	44	80,8	
	42	61,1	46	69,4	48	78,9	52	85,5	52	85,5	52	85,5	
11 SD	36	63,6	40	73,0	44	83,2	48	90,2	48	90,2	48	90,2	
	44	67,1	48	76,4	52	86,9	56	94,0	56	94,0	56	94,0	
12 SD	38	69,6	42	79,6	48	91,9	50	97,7	50	97,7	50	97,7	
	46	73,2	50	83,3	56	94,8	58	102,6	58	102,6	58	102,6	
R1,k	CSA5.0x50		2-Row		SD: Ø8		C24		Header		Table 60		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	10	14,1	10	15,0	10	15,9	10	15,9	10	15,9	10	15,9	
	14	18,2	16	20,5	16	23,7	18	25,1	18	25,1	18	25,1	
4 SD	10	17,0	10	18,3	12	22,3	12	22,3	12	22,3	12	22,3	
	16	24,3	18	27,7	20	31,3	20	34,1	20	34,1	20	34,1	
5 SD	12	22,7	12	24,4	14	29,0	16	32,1	16	32,1	16	32,1	
	20	30,3	20	34,6	22	39,4	24	42,3	24	42,3	24	42,3	
6 SD	14	28,6	16	33,5	18	38,7	18	38,9	18	38,9	18	38,9	
	22	36,4	24	41,5	26	47,2	26	51,0	26	51,0	26	51,0	
7 SD	16	34,5	18	39,8	20	45,4	22	49,0	22	49,0	22	49,0	
	24	42,6	26	48,6	28	55,3	30	59,9	30	59,9	30	59,9	
8 SD	18	40,4	20	46,1	24	55,1	26	59,1	26	59,1	26	59,1	
	26	48,8	28	55,5	32	63,0	34	68,1	34	68,1	34	68,1	
9 SD	20	46,3	24	55,3	26	61,6	28	65,7	28	65,7	28	65,7	
	28	54,9	32	62,4	34	71,1	36	77,0	36	77,0	36	77,0	
10 SD	22	52,1	26	61,5	30	71,3	32	75,8	32	75,8	32	75,8	
	30	61,0	34	69,3	38	78,8	40	85,3	40	85,3	40	85,3	
11 SD	24	57,8	28	67,6	32	77,7	34	82,2	34	82,2	34	82,2	
	32	67,1	36	76,4	40	86,9	42	94,0	42	94,0	42	94,0	
12 SD	26	63,5	30	73,5	36	87,3	38	92,2	38	92,2	38	92,2	
	34	73,1	38	83,3	44	94,7	46	102,6	46	102,6	46	102,6	



R1,k	CNA4.0x50		4-Row		SD: Ø8		C24		Column		Table 61		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	8,3	8	9,4	12	12,4	12	12,4	12	12,4	12	12,4	
	24	18,0	24	20,5	28	23,3	28	25,7	28	25,7	28	25,7	
4 SD	12	14,1	16	18,3	16	19,8	16	19,8	16	19,8	16	19,8	
	28	24,2	32	27,5	32	31,5	32	33,9	32	33,9	32	33,9	
5 SD	16	20,6	16	22,8	20	28,0	20	28,0	20	28,0	20	28,0	
	32	30,3	32	34,5	36	39,5	36	42,3	36	42,3	36	42,3	
6 SD	20	27,6	20	30,4	24	36,6	28	40,4	28	40,4	28	40,4	
	36	36,4	36	41,6	40	47,4	44	50,9	44	50,9	44	50,9	
7 SD	20	32,0	24	38,4	28	45,3	28	45,8	28	45,8	28	45,8	
	36	42,5	40	48,6	44	55,3	44	59,5	44	59,5	44	59,5	
8 SD	24	39,3	28	46,4	32	54,1	32	55,0	32	55,0	32	55,0	
	40	48,8	44	55,6	48	63,1	48	68,1	48	68,1	48	68,1	
9 SD	28	46,7	32	54,5	36	62,9	36	64,2	36	64,2	36	64,2	
	44	54,9	48	62,4	52	71,0	52	76,8	52	76,8	52	76,8	
10 SD	32	54,0	36	62,5	40	71,7	40	73,5	40	73,5	40	73,5	
	48	60,9	52	69,3	56	78,8	56	85,4	56	85,4	56	85,4	
11 SD	32	58,7	36	67,7	44	80,4	44	82,8	44	82,8	44	82,8	
	48	67,1	52	76,3	60	86,8	60	94,0	60	94,0	60	94,0	
12 SD	36	66,0	40	75,7	44	86,1	44	88,3	44	88,3	44	88,3	
	52	73,3	56	83,4	60	94,7	60	101,3	60	101,3	60	101,3	
R1,k	CNA4.0x60		4-Row		SD: Ø8		C24		Column		Table 62		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	8,8	8	9,8	12	10,5	12	13,4	12	13,4	12	13,4	
	20	18,0	24	20,5	24	23,7	28	25,1	28	25,1	28	25,1	
4 SD	8	12,3	12	16,5	12	17,8	16	21,2	16	21,2	16	21,2	
	24	24,3	28	27,5	28	31,6	32	33,7	32	33,7	32	33,7	
5 SD	12	18,8	16	24,0	16	26,0	20	29,9	20	29,9	20	29,9	
	28	30,5	32	34,5	32	39,5	36	42,3	36	42,3	36	42,3	
6 SD	16	25,9	20	32,0	20	34,9	24	39,0	24	39,0	24	39,0	
	32	36,4	36	41,5	36	47,4	40	50,9	40	50,9	40	50,9	
7 SD	20	33,4	20	36,8	24	44,0	24	44,2	24	44,2	24	44,2	
	36	42,5	36	48,6	40	55,2	40	59,6	40	59,6	40	59,6	
8 SD	20	37,8	24	45,1	28	53,0	28	53,7	28	53,7	28	53,7	
	36	48,8	40	55,5	44	63,0	44	68,3	44	68,3	44	68,3	
9 SD	24	45,4	28	53,4	32	62,1	32	63,2	32	63,2	32	63,2	
	40	54,9	44	62,4	48	70,9	48	77,0	48	77,0	48	77,0	
10 SD	28	53,1	28	58,4	32	67,5	36	72,8	36	72,8	36	72,8	
	44	60,9	44	69,3	48	78,9	52	85,5	52	85,5	52	85,5	
11 SD	28	57,6	32	66,7	36	76,6	40	82,4	40	82,4	40	82,4	
	44	67,1	48	76,4	52	86,9	56	94,0	56	94,0	56	94,0	
12 SD	32	65,3	36	75,1	40	85,6	44	91,9	44	91,9	44	91,9	
	48	73,2	52	83,3	56	94,8	60	102,4	60	102,4	60	102,4	
R1,k	CSA5.0x50		4-Row		SD: Ø8		C24		Column		Table 63		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	11,5	8	12,4	8	13,1	8	13,1	8	13,1	8	13,1	
	16	18,0	16	20,5	16	23,7	20	25,1	20	25,1	20	25,1	
4 SD	8	14,5	8	15,8	8	16,9	8	16,9	8	16,9	8	16,9	
	16	24,3	20	27,5	20	31,3	20	34,1	20	34,1	20	34,1	
5 SD	8	17,8	8	19,3	8	20,1	8	20,1	8	20,1	8	20,1	
	20	30,3	20	34,6	24	39,2	24	42,3	24	42,3	24	42,3	
6 SD	8	20,1	8	20,1	12	29,3	12	29,3	12	29,3	12	29,3	
	24	36,4	24	41,5	28	47,2	28	50,9	28	50,9	28	50,9	
7 SD	8	20,1	12	30,1	12	30,1	16	38,9	16	38,9	16	38,9	
	24	42,6	28	48,4	28	55,3	32	59,5	32	59,5	32	59,5	
8 SD	12	30,1	12	30,1	16	40,2	20	48,7	20	48,7	20	48,7	
	28	48,7	28	55,5	32	63,0	36	68,1	36	68,1	36	68,1	
9 SD	12	30,1	16	40,2	20	50,2	20	50,2	20	50,2	20	50,2	
	28	54,9	32	62,4	36	70,9	36	77,0	36	77,0	36	77,0	
10 SD	16	40,2	20	50,2	24	60,2	24	60,2	24	60,2	24	60,2	
	32	60,9	36	69,3	40	78,8	40	85,3	40	85,3	40	85,3	
11 SD	16	40,2	20	50,2	24	60,2	28	70,2	28	70,2	28	70,2	
	32	67,1	36	76,4	40	86,9	44	93,9	44	93,9	44	93,9	
12 SD	20	50,2	24	60,2	28	70,3	32	80,1	32	80,1	32	80,1	
	36	73,1	40	83,2	44	94,7	48	102,4	48	102,4	48	102,4	

R1,k	CNA4.0x50		2-Row		SD: Ø8		C24		Column		Table 64		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	10	11,6	10	12,5	12	15,5	12	15,5	12	15,5	12	15,5	
	18	18,0	18	20,7	20	23,7	20	25,2	20	25,2	20	25,2	
4 SD	12	16,7	14	20,2	16	24,0	16	24,0	16	24,0	16	24,0	
	20	24,4	22	27,8	24	31,5	24	33,8	24	33,8	24	33,8	
5 SD	16	24,2	18	28,4	20	32,8	20	33,1	20	33,1	20	33,1	
	24	30,3	26	34,5	28	39,2	28	42,6	28	42,6	28	42,6	
6 SD	18	29,8	20	34,5	22	39,4	22	39,7	22	39,7	22	39,7	
	26	36,6	28	41,7	30	47,3	30	49,8	30	49,8	30	49,8	
7 SD	20	35,5	22	40,6	22	43,6	22	43,7	22	43,7	22	43,7	
	28	42,6	30	48,3	30	52,8	30	54,3	30	54,3	30	54,3	
8 SD	22	41,2	22	44,4	22	47,2	22	47,2	22	47,2	22	47,2	
	30	48,5	30	53,2	30	57,3	30	58,4	30	58,4	30	58,4	
9 SD	22	44,7	22	47,7	22	48,8	22	48,8	22	48,8	22	48,8	
	30	52,9	30	57,4	30	61,5	30	62,1	30	62,1	30	62,1	
10 SD	22	47,7	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	
	30	56,9	30	61,3	30	64,9	30	65,2	30	65,2	30	65,2	
11 SD	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	
	30	60,5	30	64,6	30	66,5	30	66,5	30	66,5	30	66,5	
12 SD	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	22	48,8	
	30	63,8	30	66,5	30	66,5	30	66,5	30	66,5	30	66,5	
R1,k	CNA4.0x60		2-Row		SD: Ø8		C24		Column		Table 65		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	10,6	8	11,5	10	14,5	10	14,5	10	14,5	10	14,5	
	16	18,0	16	20,6	18	23,7	18	25,1	18	25,1	18	25,1	
4 SD	10	15,7	12	19,4	14	23,3	14	23,3	14	23,3	14	23,3	
	18	24,4	20	27,7	22	31,3	22	34,0	22	34,0	22	34,0	
5 SD	14	23,6	14	25,4	16	29,9	18	32,7	18	32,7	18	32,7	
	22	30,3	22	34,5	24	39,3	26	42,8	26	42,8	26	42,8	
6 SD	16	29,3	18	34,1	20	39,2	22	42,4	22	42,4	22	42,4	
	24	36,4	26	41,5	28	47,4	30	50,9	30	50,9	30	50,9	
7 SD	18	35,1	20	40,4	22	45,9	22	46,2	22	46,2	22	46,2	
	26	42,7	28	48,6	30	55,0	30	57,6	30	57,6	30	57,6	
8 SD	20	41,0	22	46,6	22	49,5	22	49,6	22	49,6	22	49,6	
	28	48,8	30	55,3	30	60,2	30	61,8	30	61,8	30	61,8	
9 SD	22	46,8	22	49,9	22	51,9	22	51,9	22	51,9	22	51,9	
	30	54,8	30	60,1	30	64,5	30	65,5	30	65,5	30	65,5	
10 SD	22	49,9	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	
	30	59,3	30	64,1	30	68,1	30	68,7	30	68,7	30	68,7	
11 SD	22	51,9	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	
	30	63,1	30	67,6	30	70,6	30	70,7	30	70,7	30	70,7	
12 SD	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	22	52,0	
	30	66,5	30	70,2	30	70,9	30	70,9	30	70,9	30	70,9	
R1,k	CSA5.0x50		2-Row		SD: Ø8		C24		Column		Table 66		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	4	8,3	4	9,0	6	12,4	6	12,4	6	12,4	6	12,4	
	12	18,0	12	20,5	14	23,3	14	25,1	14	25,1	14	25,1	
4 SD	6	13,5	6	14,3	8	18,4	8	18,4	8	18,4	8	18,4	
	14	24,1	14	27,7	16	31,3	16	33,7	16	33,7	16	33,7	
5 SD	8	18,9	10	23,4	10	24,2	12	28,2	12	28,2	12	28,2	
	16	30,3	18	34,5	18	39,2	20	42,3	20	42,3	20	42,3	
6 SD	10	24,3	12	29,1	14	34,1	16	38,2	16	38,2	16	38,2	
	18	36,4	20	41,5	22	47,2	24	50,9	24	50,9	24	50,9	
7 SD	12	29,6	14	34,6	16	39,7	18	44,1	18	44,1	18	44,1	
	20	42,5	22	48,5	24	55,1	26	59,9	26	59,9	26	59,9	
8 SD	14	34,9	18	44,3	20	49,6	22	54,1	22	54,1	22	54,1	
	22	48,8	26	55,4	28	63,0	30	68,1	30	68,1	30	68,1	
9 SD	16	40,1	20	49,8	22	55,0	22	55,1	22	55,1	22	55,1	
	24	54,9	28	62,4	30	71,0	30	72,8	30	72,8	30	72,8	
10 SD	20	49,7	22	55,1	22	55,2	22	55,2	22	55,2	22	55,2	
	28	60,9	30	69,3	30	73,7	30	74,2	30	74,2	30	74,2	
11 SD	22	55,0	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	
	30	67,0	30	73,2	30	74,9	30	75,1	30	75,1	30	75,1	
12 SD	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	22	55,2	
	30	72,2	30	74,7	30	75,3	30	75,3	30	75,3	30	75,3	

R1,k	CNA4.0x50		4-Row		SD: Ø8		CLT		Column		Table 67	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	7,0	8	7,7	12	10,8	12	11,3	12	11,3	12	11,3
	24	18,0	24	20,5	28	23,3	28	25,7	28	25,7	28	25,7
4 SD	12	12,2	16	16,3	16	17,5	16	18,3	16	18,3	16	18,3
	28	24,1	32	27,5	32	31,4	32	33,8	32	33,8	32	33,8
5 SD	16	18,4	16	19,9	20	25,0	20	26,1	20	26,1	20	26,1
	32	30,3	32	34,5	36	39,5	36	42,3	36	42,3	36	42,3
6 SD	20	25,2	20	27,2	24	33,1	28	38,7	28	38,7	28	38,7
	36	36,4	36	41,5	40	47,4	44	50,9	44	50,9	44	50,9
7 SD	24	32,4	24	34,9	28	41,6	32	47,7	32	47,7	32	47,7
	40	42,5	40	48,6	44	55,3	48	59,5	48	59,5	48	59,5
8 SD	24	36,2	28	42,9	32	50,3	36	56,9	36	56,9	36	56,9
	40	48,8	44	55,6	48	63,1	52	68,1	52	68,1	52	68,1
9 SD	28	43,7	32	51,1	36	59,2	36	61,9	36	61,9	36	61,9
	44	54,9	48	62,4	52	70,9	52	76,7	52	76,7	52	76,7
10 SD	32	51,3	36	59,3	40	68,1	40	71,2	40	71,2	40	71,2
	48	60,9	52	69,3	56	78,8	56	85,3	56	85,3	56	85,3
11 SD	32	55,4	36	63,8	44	77,0	44	80,6	44	80,6	44	80,6
	48	67,0	52	76,3	60	86,8	60	94,0	60	94,0	60	94,0
12 SD	36	63,0	40	72,1	44	81,9	44	85,6	44	85,6	44	85,6
	52	73,3	56	83,4	60	94,7	60	100,9	60	100,9	60	100,9
R1,k	CNA4.0x60		4-Row		SD: Ø8		CLT		Column		Table 68	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	7,5	8	8,1	8	8,9	12	12,3	12	12,3	12	12,3
	24	18,0	24	20,5	24	23,7	28	25,1	28	25,1	28	25,1
4 SD	8	10,6	12	14,2	12	15,4	16	19,8	16	19,8	16	19,8
	24	24,3	28	27,5	28	31,5	32	33,7	32	33,7	32	33,7
5 SD	12	16,4	16	21,3	16	23,0	20	28,2	20	28,2	20	28,2
	28	30,5	32	34,5	32	39,5	36	42,3	36	42,3	36	42,3
6 SD	16	23,3	20	29,1	20	31,3	24	37,2	24	37,2	24	37,2
	32	36,4	36	41,5	36	47,4	40	50,9	40	50,9	40	50,9
7 SD	20	30,7	20	33,2	24	40,1	24	41,9	24	41,9	24	41,9
	36	42,5	36	48,6	40	55,1	40	59,5	40	59,5	40	59,5
8 SD	20	34,5	24	41,5	28	49,1	28	51,3	28	51,3	28	51,3
	36	48,8	40	55,5	44	63,0	44	68,2	44	68,2	44	68,2
9 SD	24	42,3	28	49,9	32	58,3	32	60,9	32	60,9	32	60,9
	40	54,8	44	62,4	48	70,9	48	76,9	48	76,9	48	76,9
10 SD	28	50,2	28	54,2	32	62,9	36	70,5	36	70,5	36	70,5
	44	60,9	44	69,3	48	78,8	52	85,5	52	85,5	52	85,5
11 SD	28	54,2	32	62,8	36	72,2	40	80,1	40	80,1	40	80,1
	44	67,1	48	76,4	52	86,9	56	94,0	56	94,0	56	94,0
12 SD	32	62,1	36	71,4	40	81,4	44	89,8	44	89,8	44	89,8
	48	73,1	52	83,2	56	94,8	60	102,4	60	102,4	60	102,4
R1,k	CSA5.0x50		4-Row		SD: Ø8		CLT		Column		Table 69	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	10,5	8	11,1	8	11,8	8	12,2	8	12,2	8	12,2
	16	18,0	16	20,5	16	23,7	20	25,1	20	25,1	20	25,1
4 SD	8	13,0	8	13,9	8	14,9	8	15,5	8	15,5	8	15,5
	16	24,2	20	27,5	20	31,3	20	34,1	20	34,1	20	34,1
5 SD	8	15,7	8	17,8	8	19,8	8	19,8	8	19,8	8	19,8
	20	30,3	20	34,5	24	39,2	24	42,3	24	42,3	24	42,3
6 SD	8	20,1	8	20,1	12	26,9	12	27,8	12	27,8	12	27,8
	24	36,4	24	41,5	28	47,2	28	50,9	28	50,9	28	50,9
7 SD	8	20,1	12	30,1	12	30,1	16	37,4	16	37,4	16	37,4
	24	42,5	28	48,4	28	55,3	32	59,5	32	59,5	32	59,5
8 SD	12	30,1	12	30,1	16	40,2	20	47,2	20	47,2	20	47,2
	28	48,7	28	55,5	32	63,0	36	68,1	36	68,1	36	68,1
9 SD	12	30,1	16	40,2	20	50,2	20	50,2	20	50,2	20	50,2
	28	54,9	32	62,4	36	70,9	36	77,0	36	77,0	36	77,0
10 SD	16	40,2	20	50,2	24	59,1	24	59,4	24	59,4	24	59,4
	32	60,9	36	69,3	40	78,8	40	85,3	40	85,3	40	85,3
11 SD	16	40,2	20	50,2	24	60,2	28	69,3	28	69,3	28	69,3
	32	67,0	36	76,4	40	86,9	44	93,9	44	93,9	44	93,9
12 SD	20	50,2	24	60,2	28	70,3	32	79,3	32	79,3	32	79,3
	36	73,1	40	83,2	44	94,7	48	102,4	48	102,4	48	102,4

R1,k	CNA4.0x50		4-Row		SD: Ø10		C24		Header		Table 70	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	24	17,4	24	18,6	28	22,6	28	24,1	32	27,3	32	27,3
	40	24,7	40	27,3	44	30,3	44	33,8	48	37,3	48	37,4
4 SD	28	24,7	32	29,1	32	31,2	36	36,4	40	40,4	40	40,4
	44	33,0	48	36,4	48	40,5	52	45,0	56	49,8	56	49,9
5 SD	32	32,5	36	37,6	40	43,3	44	49,4	48	54,3	48	54,3
	48	41,3	52	45,5	56	50,6	60	56,3	64	62,3	64	62,5
6 SD	40	43,3	40	46,6	44	53,0	48	59,9	52	65,4	52	65,4
	56	49,6	56	54,6	60	60,8	64	67,6	68	74,8	68	75,1
7 SD	44	51,7	48	58,1	52	65,4	56	73,3	60	80,0	60	80,0
	60	57,9	64	63,7	68	70,9	72	78,8	76	87,2	76	87,5
8 SD	48	60,2	52	67,3	56	75,5	60	84,2	64	91,6	64	91,6
	64	66,2	68	72,9	72	81,0	76	90,1	80	99,8	80	100,1
9 SD	52	68,9	56	76,7	60	85,6	68	97,4	72	106,3	72	106,3
	68	74,5	72	82,0	76	91,2	84	101,4	88	112,2	88	112,6
10 SD	56	77,5	60	86,0	64	95,8	72	108,5	76	118,2	76	118,2
	72	82,7	76	91,1	80	101,3	88	112,6	92	124,7	92	125,2
11 SD	60	86,2	64	95,4	68	106,1	76	119,6	80	130,2	84	132,6
	76	91,0	80	100,2	84	111,4	92	123,9	96	137,1	100	137,6
12 SD	64	94,9	68	104,8	76	118,1	80	130,7	88	144,6	88	144,6
	80	99,3	84	109,3	92	121,6	96	135,2	104	149,6	104	150,2
R1,k	CNA4.0x60		4-Row		SD: Ø10		C24		Header		Table 71	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	20	16,4	20	17,6	24	21,8	24	23,2	28	26,7	28	26,7
	36	24,7	36	27,3	40	30,3	40	33,7	44	37,3	44	37,4
4 SD	24	23,9	28	28,6	28	30,7	32	36,1	32	36,8	32	36,8
	40	33,0	44	36,4	44	40,5	48	45,0	48	49,8	48	50,0
5 SD	28	32,0	32	37,4	32	40,3	36	46,5	40	51,3	40	51,3
	44	41,4	48	45,5	48	50,6	52	56,3	56	62,3	56	62,5
6 SD	32	40,5	36	46,5	40	53,3	44	60,5	48	66,4	48	66,4
	48	49,6	52	54,6	56	60,7	60	67,5	64	74,8	64	75,0
7 SD	36	49,2	40	55,9	44	63,5	48	71,5	52	78,0	52	78,0
	52	57,9	56	63,8	60	70,9	64	78,8	68	87,2	68	87,5
8 SD	40	58,1	44	65,5	48	73,8	52	82,7	56	90,0	56	90,0
	56	66,1	60	72,9	64	81,1	68	90,1	72	99,7	72	100,1
9 SD	44	67,0	48	75,1	52	84,2	60	96,5	64	105,3	64	105,3
	60	74,4	64	82,0	68	91,2	76	101,4	80	112,2	80	112,6
10 SD	48	76,0	52	84,7	56	94,6	64	107,7	68	117,4	68	117,4
	64	82,7	68	91,1	72	101,3	80	112,6	84	124,7	84	125,2
11 SD	52	84,9	56	94,3	60	105,1	68	119,0	72	129,5	72	129,5
	68	91,0	72	100,2	76	111,4	84	123,9	88	137,2	88	137,7
12 SD	56	93,8	60	103,9	68	117,6	72	130,3	76	141,7	80	144,5
	72	99,3	76	109,3	84	121,6	88	135,2	92	149,6	96	150,1
R1,k	CSA5.0x50		4-Row		SD: Ø10		C24		Header		Table 72	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	20	23,9	20	25,2	20	26,7	20	28,2	20	28,7	20	28,7
	24	24,7	24	27,3	24	30,4	28	33,7	28	37,3	28	37,4
4 SD	20	28,4	20	30,0	20	31,9	20	33,9	20	34,3	20	34,3
	28	33,0	28	36,4	32	40,5	32	45,0	36	49,8	36	49,9
5 SD	20	33,0	20	35,2	20	37,7	20	40,2	24	45,8	24	45,8
	32	41,3	32	45,5	36	50,6	36	56,3	40	62,3	40	62,5
6 SD	20	38,0	20	40,7	24	48,3	24	51,4	28	57,6	28	57,6
	32	49,6	36	54,6	40	60,7	40	67,6	44	74,8	44	75,0
7 SD	20	43,1	24	50,7	28	59,1	28	62,8	32	69,5	32	69,5
	36	57,9	40	63,7	44	70,9	44	78,9	48	87,2	48	87,5
8 SD	24	52,7	28	60,9	28	64,9	32	74,1	36	81,4	36	81,4
	40	66,1	44	72,9	44	81,0	48	90,1	52	99,7	52	100,1
9 SD	28	62,3	32	71,0	32	75,5	36	85,4	40	93,2	40	93,2
	44	74,4	48	82,0	48	91,2	52	101,4	56	112,2	56	112,6
10 SD	32	71,9	32	76,2	36	86,2	40	96,5	48	111,0	48	111,0
	48	82,7	48	91,1	52	101,3	56	112,6	64	124,7	64	125,1
11 SD	32	76,7	36	86,3	40	96,8	44	107,5	52	122,7	52	122,7
	48	91,0	52	100,2	56	111,5	60	123,9	68	137,1	68	137,6
12 SD	36	86,3	40	96,4	44	107,3	52	124,4	56	134,3	56	134,3
	52	99,3	56	109,3	60	121,6	68	135,2	72	149,6	72	150,1

R1,k	CNA4.0x50		2-Row		SD: Ø10		C24		Header		Table 73	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	20	19,6	22	22,5	22	23,9	24	27,3	26	29,9	26	29,9
	28	24,7	30	27,3	30	30,4	32	33,8	34	37,4	34	37,5
4 SD	24	27,6	26	31,1	28	35,1	30	39,3	32	42,6	32	42,6
	32	33,1	34	36,4	36	40,5	38	45,1	40	49,9	40	50,0
5 SD	28	36,0	30	40,2	32	44,9	36	51,7	38	55,8	38	55,8
	36	41,4	38	45,6	40	50,6	44	56,3	46	62,4	46	62,6
6 SD	32	44,7	34	49,5	38	56,6	40	62,4	44	69,3	44	69,3
	40	49,6	42	54,6	46	60,7	48	67,6	52	74,8	52	75,1
7 SD	36	53,5	38	58,9	42	66,7	46	75,0	48	80,7	50	82,8
	44	57,9	46	63,7	50	70,9	54	78,8	56	87,2	58	87,5
8 SD	40	62,3	44	69,9	46	76,9	50	85,9	50	90,1	50	90,1
	48	66,2	52	72,9	54	81,1	58	90,1	58	97,9	58	97,9
9 SD	44	71,1	46	77,8	50	87,0	50	93,5	50	97,1	50	97,1
	52	74,4	54	82,0	58	91,2	58	99,7	58	105,9	58	105,9
10 SD	48	79,9	50	87,3	50	94,1	50	100,6	50	103,6	50	103,6
	56	82,7	58	91,1	58	99,8	58	107,9	58	113,1	58	113,1
11 SD	50	87,4	50	93,8	50	100,7	50	107,0	50	109,0	50	109,0
	58	91,0	58	99,0	58	107,4	58	115,4	58	119,8	58	119,8
12 SD	50	93,4	50	100,0	50	106,7	50	110,8	50	110,8	50	110,8
	58	98,3	58	106,1	58	114,5	58	122,2	58	125,5	58	125,5
R1,k	CNA4.0x60		2-Row		SD: Ø10		C24		Header		Table 74	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	16	17,7	18	20,7	20	24,1	22	27,7	22	28,2	24	30,7
	24	24,8	26	27,3	28	30,3	30	33,7	30	37,3	32	37,4
4 SD	20	26,0	22	29,7	24	33,8	26	38,1	28	41,4	28	41,4
	28	33,0	30	36,4	32	40,5	34	45,1	36	49,9	36	50,0
5 SD	24	34,8	26	39,1	28	43,9	32	51,1	34	55,3	34	55,3
	32	41,3	34	45,5	36	50,6	40	56,3	42	62,3	42	62,6
6 SD	28	43,8	30	48,7	34	56,2	36	62,1	40	69,2	40	69,2
	36	49,6	38	54,6	42	60,7	44	67,6	48	74,8	48	75,0
7 SD	32	52,9	34	58,4	38	66,5	40	73,2	44	81,0	44	81,0
	40	57,9	42	63,8	46	70,9	48	78,8	52	87,3	52	87,6
8 SD	36	62,0	38	68,1	42	76,9	46	86,2	48	92,7	48	92,7
	44	66,1	46	72,9	50	81,0	54	90,1	56	99,7	56	100,0
9 SD	38	69,4	42	77,9	46	87,3	50	97,4	50	102,1	50	102,1
	46	74,4	50	82,0	54	91,2	58	101,4	58	110,7	58	110,7
10 SD	42	78,6	46	87,5	50	97,7	50	104,7	50	108,6	50	108,6
	50	82,7	54	91,1	58	101,3	58	111,4	58	118,6	58	118,6
11 SD	46	87,6	48	95,6	50	104,5	50	111,3	50	114,2	50	114,2
	54	91,0	56	100,2	58	110,6	58	119,6	58	125,4	58	125,4
12 SD	48	95,1	50	103,6	50	110,8	50	116,6	50	117,9	50	117,9
	56	99,3	58	108,9	58	118,3	58	126,9	58	131,3	58	131,3
R1,k	CSA5.0x50		2-Row		SD: Ø10		C24		Header		Table 75	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	10	16,5	10	17,4	12	21,4	12	22,4	14	25,8	14	25,8
	16	24,7	18	27,3	20	30,3	20	33,7	22	37,3	22	37,4
4 SD	12	23,0	14	27,3	16	31,9	16	33,4	18	37,1	18	37,1
	20	33,0	22	36,4	24	40,5	24	45,1	26	49,9	26	50,0
5 SD	16	32,7	16	34,3	18	39,3	20	44,5	24	52,3	24	52,3
	24	41,3	24	45,5	26	50,7	28	56,3	32	62,3	32	62,5
6 SD	18	39,5	20	44,6	22	50,0	24	55,6	28	63,8	28	63,8
	26	49,6	28	54,6	30	60,8	32	67,5	36	74,8	36	75,0
7 SD	22	49,4	24	54,9	26	60,7	30	70,1	32	75,1	32	75,1
	30	57,9	32	63,7	34	70,9	38	78,8	40	87,2	40	87,5
8 SD	24	56,1	28	65,1	30	71,3	34	81,1	36	86,3	36	86,3
	32	66,2	36	72,9	38	81,0	42	90,1	44	99,7	44	100,0
9 SD	28	66,0	30	72,0	34	81,8	38	92,0	42	101,4	42	101,4
	36	74,4	38	82,0	42	91,2	46	101,4	50	112,2	50	112,6
10 SD	30	72,4	34	82,1	38	92,3	42	102,7	46	112,3	46	112,3
	38	82,7	42	91,1	46	101,3	50	112,6	54	124,7	54	125,1
11 SD	34	82,3	38	92,2	42	102,7	46	113,4	50	123,2	50	123,2
	42	91,0	46	100,2	50	111,4	54	123,9	58	137,1	58	137,4
12 SD	36	88,5	40	98,7	46	113,1	50	123,9	50	125,0	50	125,0
	44	99,3	48	109,3	54	121,6	58	135,2	58	142,1	58	142,1

R1,k	CNA4.0x50		4-Row		SD: Ø10		C24		Column		Table 76		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	12	13,1	16	17,2	16	18,5	16	19,7	20	23,5	20	23,5	
	28	24,7	32	27,3	32	30,3	32	33,8	36	37,3	36	37,4	
4 SD	16	20,7	20	25,6	20	27,6	24	33,3	24	33,7	24	33,7	
	32	33,1	36	36,4	36	40,5	40	45,0	40	49,9	40	50,0	
5 SD	20	29,0	24	34,7	24	37,3	28	43,9	32	49,0	32	49,0	
	36	41,4	40	45,5	40	50,6	44	56,3	48	62,3	48	62,5	
6 SD	24	37,7	28	44,1	32	51,2	32	54,7	36	60,3	36	60,3	
	40	49,6	44	54,6	48	60,7	48	67,6	52	74,8	52	75,1	
7 SD	28	46,6	32	53,7	36	61,4	40	69,6	40	71,8	44	76,3	
	44	57,9	48	63,7	52	70,9	56	78,8	56	87,2	60	87,5	
8 SD	32	55,7	36	63,3	40	71,7	44	80,6	44	83,3	44	83,3	
	48	66,2	52	72,9	56	81,0	60	90,1	60	99,2	60	99,3	
9 SD	36	64,8	40	72,9	44	82,0	44	87,7	44	89,9	44	89,9	
	52	74,4	56	82,0	60	91,2	60	100,7	60	107,8	60	107,8	
10 SD	40	73,8	44	82,6	44	88,6	44	94,1	44	95,6	44	95,6	
	56	82,7	60	91,1	60	100,7	60	109,4	60	115,3	60	115,3	
11 SD	44	82,9	44	88,6	44	94,4	44	97,5	44	97,5	44	97,5	
	60	91,0	60	99,8	60	108,8	60	117,2	60	122,2	60	122,2	
12 SD	44	88,5	44	94,1	44	97,5	44	97,5	44	97,5	44	97,5	
	60	99,0	60	107,3	60	116,1	60	124,3	60	128,3	60	128,3	
R1,k	CNA4.0x60		4-Row		SD: Ø10		C24		Column		Table 77		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	11,2	12	15,1	12	16,4	16	21,3	16	21,3	16	21,3	
	24	24,8	28	27,3	28	30,3	32	33,7	32	37,3	32	37,4	
4 SD	12	18,7	16	23,7	16	25,6	20	31,5	20	31,7	20	31,7	
	28	33,0	32	36,4	32	40,5	36	45,0	36	49,8	36	50,0	
5 SD	16	27,1	20	33,0	20	35,5	24	42,3	28	47,7	28	47,7	
	32	41,3	36	45,5	36	50,6	40	56,3	44	62,3	44	62,5	
6 SD	20	36,0	24	42,6	28	50,0	28	53,4	32	59,2	32	59,2	
	36	49,6	40	54,6	44	60,7	44	67,6	48	74,8	48	75,0	
7 SD	24	45,2	28	52,5	32	60,5	32	64,6	36	70,9	36	70,9	
	40	57,9	44	63,7	48	70,9	48	78,8	52	87,3	52	87,6	
8 SD	28	54,5	32	62,4	36	71,1	40	80,2	40	82,7	40	82,7	
	44	66,1	48	72,9	52	81,0	56	90,1	56	99,7	56	100,0	
9 SD	32	63,8	36	72,3	40	81,6	44	91,4	44	94,3	44	94,3	
	48	74,4	52	82,0	56	91,2	60	101,4	60	111,9	60	112,1	
10 SD	36	73,2	40	82,1	44	92,1	44	97,9	44	100,1	44	100,1	
	52	82,7	56	91,1	60	101,3	60	112,3	60	120,7	60	120,7	
11 SD	40	82,5	40	87,9	44	98,2	44	103,0	44	103,9	44	103,9	
	56	91,0	56	100,2	60	111,3	60	121,2	60	127,9	60	127,9	
12 SD	40	87,8	44	97,7	44	103,0	44	104,0	44	104,0	44	104,0	
	56	99,3	60	109,3	60	119,7	60	128,9	60	134,2	60	134,2	
R1,k	CSA5.0x50		4-Row		SD: Ø10		C24		Column		Table 78		
Width of the timber = length of the dowels (mm)													
		80		100		120		140		160		180	
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	
3 SD	8	13,7	8	14,7	8	15,7	8	16,6	8	16,6	8	16,6	
	16	24,7	20	27,3	20	30,3	20	33,7	24	37,3	24	37,4	
4 SD	8	17,6	8	18,8	8	19,8	8	20,1	12	26,9	12	26,9	
	20	33,0	24	36,4	24	40,5	24	45,1	28	49,8	28	49,9	
5 SD	8	20,1	8	20,1	12	29,5	12	30,1	16	37,7	16	37,7	
	24	41,3	24	45,5	28	50,6	28	56,3	32	62,3	32	62,5	
6 SD	12	29,9	12	30,1	16	39,6	16	40,2	20	48,6	20	48,6	
	28	49,6	28	54,6	32	60,7	32	67,5	36	74,8	36	75,0	
7 SD	16	39,4	16	40,2	20	49,7	24	59,0	24	59,3	24	59,3	
	32	57,9	32	63,7	36	70,9	40	78,8	40	87,2	40	87,5	
8 SD	16	40,2	20	50,2	24	59,9	28	69,6	28	69,8	28	69,8	
	32	66,2	36	72,9	40	81,0	44	90,1	44	99,7	44	100,0	
9 SD	20	50,2	24	60,2	28	70,0	32	79,9	36	89,0	36	89,0	
	36	74,4	40	82,0	44	91,2	48	101,4	52	112,2	52	112,6	
10 SD	24	60,2	28	70,2	32	80,2	36	90,2	40	99,6	40	99,6	
	40	82,7	44	91,1	48	101,3	52	112,6	56	124,7	56	125,1	
11 SD	28	70,3	32	80,2	36	90,3	40	100,4	44	110,0	44	110,0	
	44	91,0	48	100,2	52	111,4	56	123,9	60	137,1	60	137,6	
12 SD	28	70,3	32	80,3	40	100,4	44	110,4	44	110,4	44	110,4	
	44	99,3	48	109,3	56	121,6	60	135,2	60	145,9	60	145,9	



R1,k	CNA4.0x50		4-Row		SD: Ø10		CLT		Column		Table 82	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	12	11,5	16	15,4	16	16,3	16	17,2	20	22,1	20	22,1
	28	24,7	32	27,3	32	30,3	32	33,8	36	37,3	36	37,4
4 SD	16	18,5	20	23,3	20	24,6	24	30,2	24	31,7	24	31,8
	32	33,0	36	36,4	36	40,5	40	45,0	40	49,8	40	50,0
5 SD	20	26,4	24	31,9	28	38,1	28	40,1	32	47,0	32	47,1
	36	41,4	40	45,5	44	50,6	44	56,3	48	62,3	48	62,5
6 SD	24	34,8	28	41,0	32	47,8	32	50,4	36	57,9	36	58,0
	40	49,6	44	54,6	48	60,7	48	67,5	52	74,8	52	75,1
7 SD	28	43,6	32	50,3	36	57,8	40	65,8	44	74,2	44	74,3
	44	57,9	48	63,7	52	70,9	56	78,8	60	87,2	60	87,5
8 SD	32	52,6	36	59,9	40	68,0	44	76,6	44	80,4	44	80,6
	48	66,2	52	72,9	56	81,0	60	90,1	60	98,7	60	99,0
9 SD	36	61,7	40	69,5	44	78,2	44	82,5	44	86,6	44	86,7
	52	74,4	56	82,0	60	91,2	60	100,1	60	106,4	60	106,7
10 SD	40	70,9	44	79,2	44	83,8	44	88,2	44	92,3	44	92,4
	56	82,7	60	91,1	60	100,2	60	107,2	60	113,1	60	113,4
11 SD	44	80,0	44	84,4	44	89,2	44	97,5	44	97,5	44	97,5
	60	91,0	60	99,5	60	107,0	60	113,6	60	119,4	60	119,6
12 SD	44	85,0	44	89,5	44	97,5	44	97,5	44	97,5	44	97,5
	60	98,8	60	106,1	60	113,2	60	119,6	60	125,1	60	125,3
R1,k	CNA4.0x60		4-Row		SD: Ø10		CLT		Column		Table 83	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	9,5	12	13,2	12	14,0	16	18,8	16	19,8	16	19,8
	24	24,8	28	27,3	28	30,3	32	33,7	32	37,3	32	37,4
4 SD	16	20,1	16	21,1	16	22,4	20	28,2	20	29,6	20	29,7
	32	33,0	32	36,4	32	40,5	36	45,0	36	49,8	36	50,0
5 SD	16	24,3	20	29,9	24	36,4	24	38,4	28	45,6	28	45,7
	32	41,3	36	45,5	40	50,6	40	56,3	44	62,3	44	62,5
6 SD	20	32,9	24	39,3	28	46,5	28	49,0	32	56,9	32	57,0
	36	49,6	40	54,6	44	60,7	44	67,6	48	74,8	48	75,0
7 SD	24	42,0	28	49,0	32	56,8	32	59,9	36	68,4	36	68,5
	40	57,9	44	63,7	48	70,9	48	78,8	52	87,3	52	87,6
8 SD	28	51,3	32	58,9	36	67,3	40	76,3	44	85,6	44	85,7
	44	66,1	48	72,9	52	81,0	56	90,1	60	99,7	60	100,0
9 SD	32	60,7	36	68,8	40	77,8	44	87,3	44	91,4	44	91,6
	48	74,4	52	82,0	56	91,2	60	101,4	60	111,6	60	111,9
10 SD	36	70,2	40	78,8	44	88,3	44	92,9	44	97,0	44	97,1
	52	82,7	56	91,1	60	101,3	60	112,0	60	119,4	60	119,6
11 SD	40	79,6	44	88,7	44	93,6	44	98,7	44	101,9	44	101,9
	56	91,0	60	100,2	60	111,1	60	119,4	60	125,8	60	126,0
12 SD	40	84,4	44	93,7	44	98,9	44	104,0	44	104,0	44	104,0
	56	99,3	60	109,3	60	118,4	60	125,7	60	131,5	60	131,7
R1,k	CSA5.0x50		4-Row		SD: Ø10		CLT		Column		Table 84	
Width of the timber = length of the dowels (mm)												
80		100		120		140		160		180		
Dowels	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	12,4	8	13,0	8	13,7	8	14,4	8	15,2	8	15,2
	20	24,7	20	27,3	20	30,3	20	33,7	24	37,3	24	37,4
4 SD	8	15,7	8	16,7	8	18,9	8	20,1	12	25,3	12	25,3
	20	33,0	24	36,4	24	40,5	24	45,1	28	49,8	28	49,9
5 SD	8	20,1	8	20,1	12	27,2	12	30,1	16	36,1	16	36,1
	24	41,3	24	45,5	28	50,6	28	56,3	32	62,3	32	62,5
6 SD	12	28,4	12	30,1	16	37,0	20	45,6	20	47,0	20	47,0
	28	49,6	28	54,6	32	60,7	36	67,5	36	74,8	36	75,0
7 SD	16	37,4	16	40,2	20	47,3	24	56,5	24	57,9	24	57,9
	32	57,9	32	63,7	36	70,9	40	78,8	40	87,2	40	87,5
8 SD	16	40,2	20	49,7	24	57,7	28	67,2	28	68,6	32	77,0
	32	66,2	36	72,9	40	81,0	44	90,1	44	99,7	48	100,0
9 SD	20	50,2	24	59,0	28	68,1	32	77,9	36	87,8	36	87,9
	36	74,4	40	82,0	44	91,2	48	101,4	52	112,2	52	112,6
10 SD	24	60,2	28	68,7	32	78,4	36	88,4	40	98,5	40	98,6
	40	82,7	44	91,1	48	101,3	52	112,6	56	124,7	56	125,1
11 SD	28	69,8	32	78,8	36	88,8	40	98,9	44	109,1	44	109,2
	44	91,0	48	100,2	52	111,4	56	123,9	60	137,1	60	137,6
12 SD	28	70,3	32	80,3	40	99,0	44	110,4	44	110,4	44	110,4
	44	99,3	48	109,3	56	121,6	60	135,2	60	145,2	60	145,4



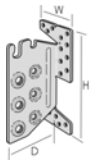
R1,k	CNA4.0x50		4-Row		SD: Ø10		CLT		Column		Table 85	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	16	16,8	16	17,4	20	22,1	20	23,0	24	28,6	24	29,6
	32	32,2	32	34,5	36	37,6	36	41,2	40	45,0	40	49,2
4 SD	24	29,6	24	30,6	24	31,8	28	38,0	32	44,7	32	46,3
	40	43,0	40	46,1	40	50,1	44	54,9	48	60,0	48	65,5
5 SD	28	39,2	28	40,6	32	47,1	36	54,3	36	56,4	40	64,1
	44	53,8	44	57,7	48	62,7	52	68,6	52	75,2	56	81,9
6 SD	32	49,3	36	55,8	36	58,1	40	65,8	44	73,9	44	76,7
	48	64,6	52	69,2	52	75,3	56	82,4	60	90,1	60	97,5
7 SD	36	59,7	40	66,6	44	74,4	44	77,6	44	80,7	44	83,8
	52	75,5	56	80,7	60	87,8	60	96,0	60	101,8	60	106,2
8 SD	40	70,1	44	77,5	44	80,7	44	84,1	44	87,4	44	90,6
	56	86,2	60	92,2	60	99,2	60	104,7	60	109,4	60	113,6
9 SD	44	80,7	44	83,4	44	86,8	44	91,1	44	97,5	44	97,5
	60	96,8	60	101,7	60	106,9	60	111,8	60	116,3	60	120,4
10 SD	44	86,4	44	89,2	44	95,4	44	97,5	44	97,5	44	97,5
	60	104,4	60	108,7	60	113,5	60	118,3	60	122,7	60	126,6
11 SD	44	91,8	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5
	60	111,0	60	115,0	60	119,8	60	124,4	60	132,5	60	133,0
12 SD	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5	44	97,5
	60	117,0	60	121,0	60	125,4	60	133,0	60	133,0	60	133,0
R1,k	CNA4.0x60		4-Row		SD: Ø10		CLT		Column		Table 86	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	12	14,5	16	19,1	16	19,8	16	20,7	20	26,5	20	27,5
	28	32,3	32	34,5	32	37,6	32	41,1	36	45,0	36	49,2
4 SD	20	27,6	20	28,5	20	29,7	24	36,2	28	43,3	28	44,8
	36	43,0	36	46,1	36	50,1	40	54,9	44	60,0	44	65,5
5 SD	24	37,5	24	38,8	28	45,7	28	47,6	32	55,3	36	63,5
	40	53,8	40	57,6	44	62,7	44	68,7	48	75,1	52	81,9
6 SD	28	47,9	28	49,6	32	57,1	36	65,2	40	73,7	40	76,3
	44	64,6	44	69,2	48	75,3	52	82,4	56	90,1	56	98,4
7 SD	32	58,6	36	66,0	36	68,6	40	77,2	44	86,3	44	89,3
	48	75,4	52	80,7	52	87,9	56	96,1	60	105,2	60	113,0
8 SD	36	69,4	40	77,1	44	85,8	44	89,3	44	92,6	44	95,7
	52	86,2	56	92,2	60	100,4	60	109,8	60	116,2	60	121,0
9 SD	40	80,2	44	88,3	44	91,7	44	95,2	44	100,5	44	104,0
	56	97,0	60	103,8	60	112,2	60	118,4	60	123,4	60	127,7
10 SD	44	91,0	44	93,9	44	97,2	44	104,0	44	104,0	44	104,0
	60	107,8	60	114,0	60	119,9	60	125,1	60	129,7	60	133,7
11 SD	44	96,2	44	99,0	44	104,0	44	104,0	44	104,0	44	104,0
	60	116,3	60	121,0	60	126,2	60	131,1	60	135,3	60	139,2
12 SD	44	101,8	44	104,0	44	104,0	44	104,0	44	104,0	44	104,0
	60	122,8	60	127,1	60	131,9	60	136,3	60	141,8	60	141,8
R1,k	CSA5.0x50		4-Row		SD: Ø10		CLT		Column		Table 87	
Width of the timber = length of the dowels (mm)												
Dowels	80		100		120		140		160		180	
	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk	nails	Fk
3 SD	8	14,1	8	14,6	8	15,2	8	16,2	8	17,7	12	23,5
	20	32,2	20	34,6	24	37,6	24	41,1	24	45,1	28	49,1
4 SD	8	19,0	12	24,5	12	25,4	12	26,3	16	34,2	16	35,2
	24	43,0	28	46,1	28	50,1	28	54,9	32	60,0	32	65,5
5 SD	12	27,6	16	35,1	16	36,2	20	44,7	20	45,8	24	54,9
	28	53,8	32	57,6	32	62,7	36	68,6	36	75,1	40	81,9
6 SD	16	37,8	20	46,0	20	47,1	24	56,1	28	65,5	28	66,7
	32	64,6	36	69,2	36	75,3	40	82,4	44	90,1	44	98,3
7 SD	20	48,1	24	56,8	24	58,0	28	67,3	32	77,0	36	86,8
	36	75,4	40	80,7	40	87,9	44	96,1	48	105,2	52	114,7
8 SD	24	58,5	28	67,6	32	77,1	32	78,3	36	88,2	40	98,1
	40	86,2	44	92,2	48	100,4	48	109,9	52	120,3	56	131,2
9 SD	28	68,9	32	78,2	36	87,9	40	97,9	44	108,0	44	109,1
	44	97,0	48	103,8	52	113,0	56	123,6	60	135,3	60	144,2
10 SD	32	79,3	36	88,8	40	98,6	44	108,7	44	110,4	44	110,4
	48	107,8	52	115,3	56	125,5	60	137,4	60	145,0	60	147,2
11 SD	36	90,4	40	99,2	44	109,2	44	110,4	44	110,4	44	110,4
	52	118,5	56	126,9	60	138,1	60	145,4	60	147,7	60	149,1
12 SD	40	100,4	44	110,4	44	110,4	44	110,4	44	110,4	44	110,4
	56	129,3	60	138,4	60	145,5	60	148,0	60	149,5	60	150,6

**D2 Concealed joist hanger TU, TUB, TUS, TUBS**

Product Name	Alternative names				Previous name
	France	UK	Denmark	Germany	
TU		TU			JANE TU
TUB					
TUS					JANE TUS
TUBS					

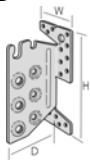
Figure D2-1: drawings ; Table D2-1: size specification

TU



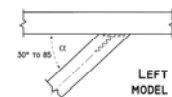
Model N°	Width W	Height H	Depth	Skew Angle	
	(mm)			degree	Direction
TU12	40	96	101	90°	~
TU16	60	134	108	90°	~
TU20	60	174	108	90°	~
TU24	60	214	108	90°	~
TU28	60	254	108	90°	~

TUB

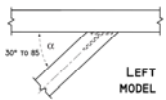


Model N°	Width W	Height H	Depth	Skew Angle	
	(mm)			degree	Direction
TUB16	60	134	108	90°	~
TUB20	60	174	108	90°	~
TUB24	60	214	108	90°	~
TUB28	60	254	108	90°	~

TUS



Model N°	Width W	Height H	Depth	Angle	
	(mm)			degree	Direction
TU/SL12	40	96	101	30 to 85°	Left
TU/SL16	60	134	108	30 to 85°	Left
TU/SL20	60	174	108	30 to 85°	Left
TU/SL24	60	214	108	30 to 85°	Left
TU/SL28	60	254	108	30 to 85°	Left
TU/SR12	40	96	101	30 to 85°	Right
TU/SR16	60	134	108	30 to 85°	Right
TU/SR20	60	174	108	30 to 85°	Right
TU/SR24	60	214	108	30 to 85°	Right
TU/SR28	60	254	108	30 to 85°	Right

**TUBS**

Model N°	Width W	Height H	Depth	Angle	
				degree	Direction
TUBSL16	60	134	108	30 to 85°	Left
TUBSL20	60	174	108	30 to 85°	Left
TUBSL24	60	214	108	30 to 85°	Left
TUBSL28	60	254	108	30 to 85°	Left
TUBSR16	60	134	108	30 to 85°	Right
TUBSR20	60	174	108	30 to 85°	Right
TUBSR24	60	214	108	30 to 85°	Right
TUBSR28	60	254	108	30 to 85°	Right

Hanger Type	Header Fasteners		Joist Fasteners	
	Ø4.0 Connector nails	Bolt M12 Concrete screw	Dowels Ø8	Dowels Ø12
TU12	6	~	4	~
TU16	18	~	~	3
TU20	22	~	~	4
TU24	26	~	~	5
TU28	30	~	~	6
TUB16	16	2	~	3
TUB20	20	2	~	4
TUB24	24	2	~	5
TUB28	28	2	~	6
TUS 12	6	~	4	~
TUS 16	18	~	~	3
TUS 20	22	~	~	4
TUS 24	26	~	~	5
TUS 28	30	~	~	6
TUBS16	16	2	~	3
TUBS20	20	2	~	4
TUBS24	24	2	~	5
TUBS28	28	2	~	6

Table D2-2: Material specification

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
3	stainless steel as described	

For installation for fire justification, see clause B6.

Table D2-3: Characteristic capacities  $R_{1,k}$  [kN] TU and TUS full nailing

		Characteristic capacity $R_{1,k}$ [kN] with CNA 4,0x50 full nailing, connection beam to beam											
skew $\alpha$		Width of joist = length of dowel [mm]											
		60	80	120	160	60	80	120	160	60	80	120	160
90°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TU12</b>		8,1	9,0	10,7	10,7	8,1	9,0	10,7	10,7	8,1	9,0	10,7	10,7
<b>TU16</b>		17,5	18,1	20,5	23,5	16,6	17,0	18,8	21,2	15,9	16,4	17,9	20,0
<b>TU20</b>		26,7	27,6	31,1	35,6	25,3	25,8	28,5	32,2	24,4	25,1	27,4	30,5
<b>TU24</b>		36,6	37,7	42,5	48,3	34,8	35,5	39,1	43,9	33,6	34,7	37,8	42,0
<b>TU28</b>		46,9	48,3	54,1	61,1	44,5	45,6	50,0	55,9	43,4	44,9	48,7	53,9
45°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUS12</b>		7,4	8,2	9,5	9,5	6,9	7,6	9,1	9,1	6,6	7,1	8,5	8,7
<b>TUS16</b>		16,3	16,9	18,9	21,4	15,6	15,9	17,4	19,5	15,0	15,4	16,6	18,4
<b>TUS20</b>		24,9	25,6	28,7	32,3	23,7	24,1	26,5	29,5	22,9	23,5	25,4	28,0
<b>TUS24</b>		34,2	35,2	39,2	44,1	32,6	33,2	36,3	40,4	31,5	32,5	35,0	38,6
<b>TUS28</b>		44,0	45,2	50,3	56,1	42,0	42,8	46,7	51,7	40,8	42,0	45,3	49,7
85°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUS12</b>		7,6	8,4	9,7	9,7	7,1	7,7	9,3	9,3	6,7	7,3	8,7	8,9
<b>TUS16</b>		16,7	17,3	19,5	22,1	15,9	16,2	17,9	20,1	15,3	15,7	17,1	18,9
<b>TUS20</b>		25,6	26,4	29,6	33,4	24,3	24,8	27,2	30,5	23,4	24,1	26,1	28,9
<b>TUS24</b>		35,1	36,2	40,4	45,3	33,5	34,1	37,3	41,6	32,3	33,3	36,1	39,8
<b>TUS28</b>		45,2	46,5	51,6	57,0	43,0	43,9	48,0	53,1	41,8	43,2	46,6	51,2

Intermediary values can be determined by interpolation.

For a skew between 30° and 45° the values for 45° shall be used.

The capacities for  $R_{2,k}$  shall be modified in relation to one steel dowel less, mean e.g. for a TU20 with 4 steel dowel, the uplift capacity shall be reduced to:  $(4-1)/4 = 0,75$ .

The topmost steel dowel in the cut out hole shall not be considered.

Table D2-4: Characteristic capacities  $R_{1,k}$  [kN] TUB and TUBS full nailing

		Characteristic capacity $R_{1,k}$ [kN] with CNA 4,0x50 full nailing, connection beam to beam											
skew $\alpha$		Width of joist = length of dowel [mm]											
		60	80	120	160	60	80	120	160	60	80	120	160
90°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUB16</b>		16,7	17,3	19,7	22,6	15,7	16,1	17,9	20,4	15,1	15,1	17,0	19,1
<b>TUB20</b>		25,6	26,5	30,0	34,4	24,2	24,7	27,4	31,0	23,3	23,3	26,2	29,3
<b>TUB24</b>		35,3	36,5	41,1	46,8	33,5	34,2	37,7	42,5	32,3	32,3	36,4	40,5
<b>TUB28</b>		45,5	46,9	52,6	59,1	43,1	44,1	48,5	54,3	41,9	41,9	47,1	52,2
45°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUBS16</b>		15,4	15,9	17,9	20,3	14,6	14,9	16,5	18,5	14,1	14,4	15,6	17,4
<b>TUBS20</b>		23,6	24,4	27,3	30,9	22,4	22,9	25,2	28,2	21,6	22,2	24,1	26,7
<b>TUBS24</b>		32,7	33,7	37,6	42,3	31,1	31,7	34,7	38,7	30,0	30,9	33,4	36,9
<b>TUBS28</b>		42,3	43,5	48,4	53,8	40,4	41,1	44,9	49,8	39,0	40,2	43,4	47,7
85°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUBS16</b>		15,8	16,4	18,5	21,0	15,0	15,3	17,0	19,1	14,4	14,8	16,1	18,0
<b>TUBS20</b>		24,4	25,2	28,3	31,8	23,1	23,6	26,0	29,1	22,2	22,9	24,9	27,6
<b>TUBS24</b>		33,7	34,8	38,8	43,1	32,1	32,7	35,9	39,9	30,9	31,9	34,6	38,1
<b>TUBS28</b>		43,6	44,8	49,7	53,8	41,5	42,3	46,3	51,0	40,2	41,5	44,9	49,2

Intermediary values can be determined by interpolation.

For a skew between 30° and 45° the values for 45° shall be used.

The capacities for  $R_{2,k}$  shall be modified as described below the table D2-3

Table D2-5: Characteristic capacities  $R_{1,k}$  [kN] TU and TUS

with nail pattern as given below

		Characteristic capacity $R_{1,k}$ [kN] with CNA 4,0x50 partial nailing, connection beam to post											
skew $\alpha$		Width of joist = length of dowel [mm]											
		60	80	120	160	60	80	120	160	60	80	120	160
90°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TU12</b>	8,1	9,0	10,7	10,7	8,1	9,0	10,7	10,7	8,1	9,0	10,7	10,7	
<b>TU16</b>	16,1	16,7	19,0	21,9	15,2	15,5	17,3	19,7	14,5	14,9	16,4	18,4	
<b>TU20</b>	22,9	23,7	26,8	30,1	21,6	22,1	24,6	27,7	20,7	21,3	23,4	26,1	
<b>TU24</b>	31,9	33,0	36,9	39,9	30,2	30,9	34,1	37,9	29,0	30,0	32,7	36,2	
<b>TU28</b>	38,0	38,9	39,9	39,9	36,3	36,9	39,6	39,9	35,0	36,0	38,6	39,9	
45°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUS12</b>	7,4	8,2	9,5	9,5	6,9	7,6	9,1	9,1	6,6	7,1	8,5	8,7	
<b>TUS16</b>	15,0	15,5	17,4	19,7	14,2	14,5	16,0	18,0	13,7	14,0	15,2	16,9	
<b>TUS20</b>	21,3	22,0	24,5	26,1	20,2	20,7	22,7	25,2	19,5	20,0	21,7	23,9	
<b>TUS24</b>	29,5	30,4	33,7	34,4	28,1	28,7	31,4	34,4	27,1	27,8	30,1	33,0	
<b>TUS28</b>	35,3	36,1	36,1	36,1	33,9	34,4	36,1	36,1	32,8	33,5	35,8	36,1	
85°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUS12</b>	7,6	8,4	9,7	9,7	7,1	7,7	9,3	9,3	6,7	7,3	8,7	8,9	
<b>TUS16</b>	15,3	15,9	17,9	20,3	14,5	14,8	16,4	18,5	13,9	14,3	15,6	17,4	
<b>TUS20</b>	21,8	22,5	25,0	26,1	20,6	21,1	23,2	25,6	19,8	20,4	22,2	24,4	
<b>TUS24</b>	30,3	31,2	34,1	34,4	28,8	29,4	32,1	34,4	27,7	28,5	30,9	33,6	
<b>TUS28</b>	35,7	36,1	36,1	36,1	34,5	35,0	36,1	36,1	33,4	34,2	36,0	36,1	

Intermediary values shall be determined by interpolation.

For a skew between 30° and 45° the values for 45° shall be used.

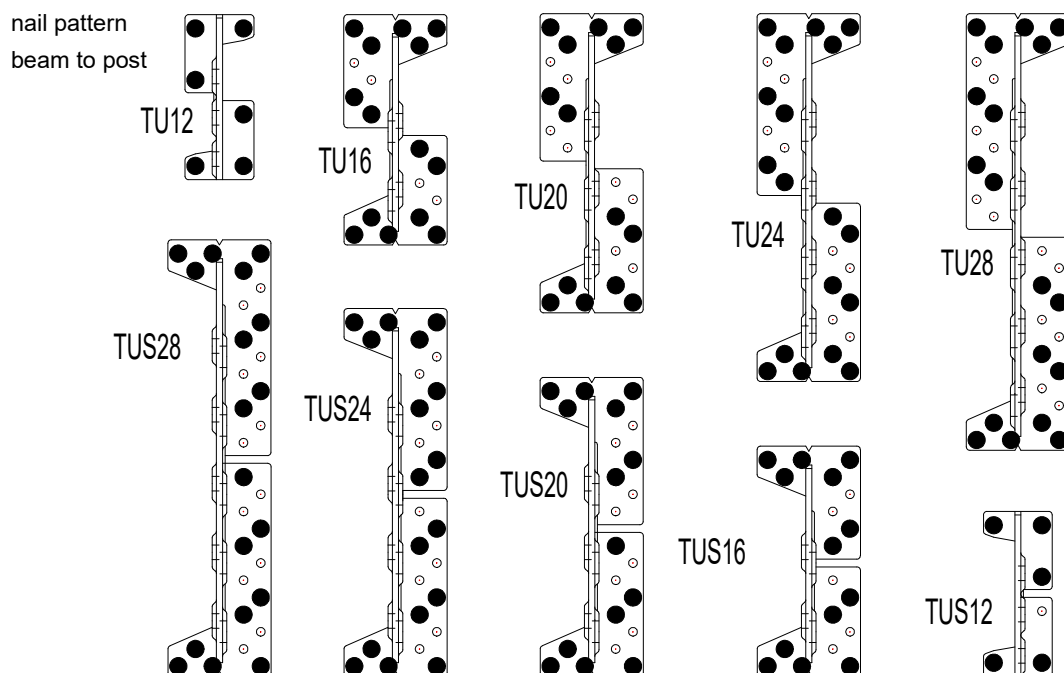
The capacities for  $R_{2,k}$  shall be modified as described below the table D2-3

Table D2-6: Characteristic capacities  $R_{1,k}$  [kN] TUB and TUBS

with nail pattern as given below

		Characteristic capacity $R_{1,k}$ [kN] with CNA 4,0x50 partial nailing, connection beam to post											
skew $\alpha$		Width of joist = length of dowel [mm]											
		60	80	120	160	60	80	120	160	60	80	120	160
90°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUB16</b>		15,2	15,8	18,1	20,8	14,3	14,7	16,4	18,8	13,7	13,7	15,5	17,5
<b>TUB20</b>		21,5	22,3	25,1	26,6	20,3	20,8	23,2	25,8	19,5	19,5	22,0	24,5
<b>TUB24</b>		30,4	31,4	34,8	35,5	28,7	29,4	32,4	35,4	27,5	27,5	31,0	34,1
<b>TUB28</b>		35,3	35,5	35,5	35,5	34,1	34,6	35,5	35,5	33,0	33,0	35,4	35,5
45°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUBS16</b>		13,9	14,4	16,3	18,5	13,2	13,5	15,0	16,9	12,7	13,0	14,2	15,8
<b>TUBS20</b>		19,8	20,4	22,3	22,3	18,8	19,2	21,1	22,3	18,1	18,5	20,1	22,1
<b>TUBS24</b>		27,7	28,6	30,3	30,3	26,4	26,9	29,5	30,3	25,4	26,1	28,2	30,3
<b>TUBS28</b>		31,9	31,9	31,9	31,9	31,5	31,9	31,9	31,9	30,6	31,2	31,9	31,9
85°		$\beta = 0^\circ$				$\beta = 25^\circ$				$\beta = 45^\circ$			
<b>TUBS16</b>		14,3	14,9	16,8	18,9	13,6	13,9	15,5	17,4	13,0	13,3	14,6	16,3
<b>TUBS20</b>		20,2	20,9	22,3	22,3	19,2	19,7	21,5	22,3	18,5	18,9	20,6	22,2
<b>TUBS24</b>		28,4	29,2	30,3	30,3	27,1	27,7	29,9	30,3	26,1	26,8	28,9	30,3
<b>TUBS28</b>		31,9	31,9	31,9	31,9	31,8	31,9	31,9	31,9	31,1	31,6	31,9	31,9

Intermediary values can be determined by interpolation.

For a skew between 30° and 45° the values for 45° shall be used.

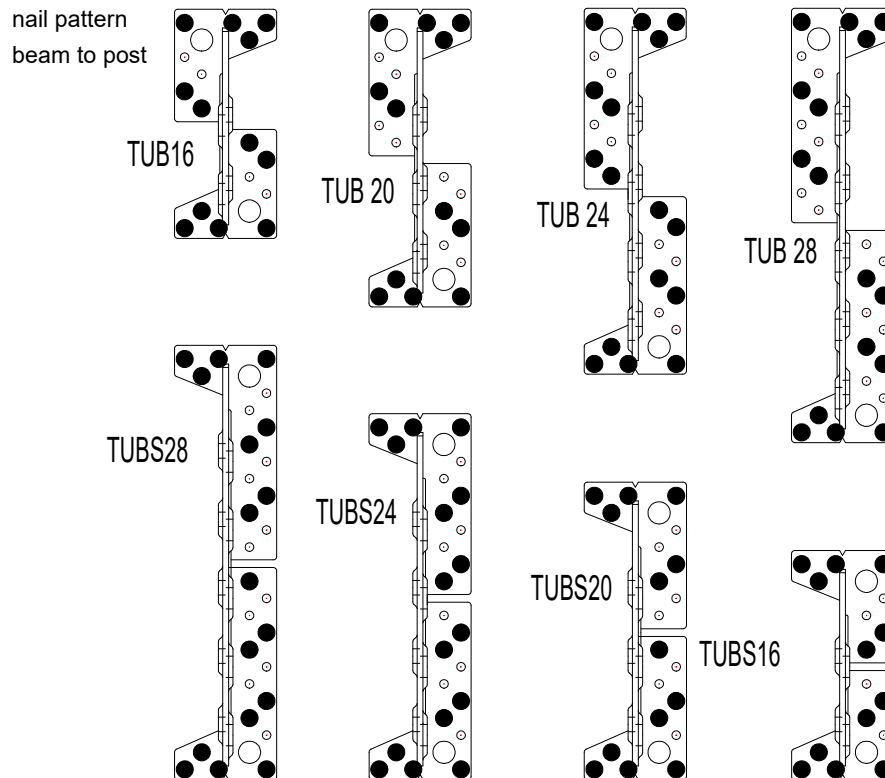
The capacities for  $R_{2,k}$  shall be modified as described below the table D2-3





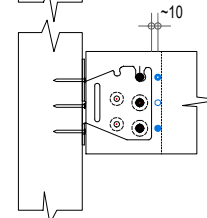
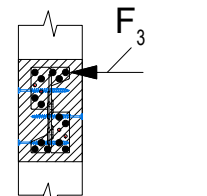
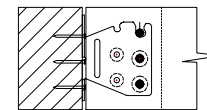
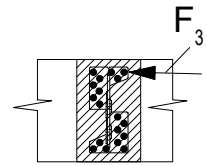
Table D2-8: Characteristic capacities  $R_{3,k}$  [kN] TU

				CSA 5,0x40							with screws	
Typ	number of		joist b / h [mm]	$R_{3,k}$ [kN] for b =								
	SD	nails		60	80	100	120	140	160	180		
TU12	4	6	... / 120	1,6	3,4	5,6	5,6	5,6	5,6	5,6	5,6	
TU16	3	18	... / 160	1,6	3,1	4,8	6,6	8,3	10,1	11,9	11,9	
TU20	4	22	... / 200	2,2	3,8	7,0	9,9	12,5	15,1	17,8	17,8	
TU24	5	26	... / 240	2,7	4,0	7,3	12,0	16,7	20,2	21,1	21,1	
TU28	6	30	... / 280	3,2	4,4	7,7	12,4	19,3	23,4	23,4	23,4	
TU12c	4	6	... / 120	1,6	3,4	5,6	5,6	5,6	5,6	5,6	5,6	
TU16c	3	14	... / 160	1,6	3,1	4,8	6,6	8,3	10,1	11,9	11,9	
TU20c	4	14	... / 200	2,2	3,8	7,0	9,9	12,5	13,7	13,7	13,7	
TU24c	5	18	... / 240	2,7	4,0	7,3	12,0	15,8	15,8	15,8	15,8	
TU28c	6	18	... / 280	3,2	4,4	7,7	12,4	16,3	16,3	16,3	16,3	
											without screws	
TU12	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16	3	18	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20	4	22	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24	5	26	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28	6	30	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	
TU12c	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16c	3	14	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20c	4	14	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24c	5	18	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28c	6	18	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	
											without screws	
TU12	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16	3	18	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20	4	22	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24	5	26	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28	6	30	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	
TU12c	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16c	3	14	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20c	4	14	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24c	5	18	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28c	6	18	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	

				CSA 5,0x50							with screws	
Typ	number of		joist b / h [mm]	$R_{3,k}$ [kN] for b =								
	SD	nails		60	80	100	120	140	160	180		
TU12	4	6	... / 120	1,6	3,4	5,9	6,1	6,1	6,1	6,1	6,1	
TU16	3	18	... / 160	1,6	3,1	4,8	6,6	8,3	10,1	11,9	11,9	
TU20	4	22	... / 200	2,2	3,8	7,0	9,9	12,5	15,1	17,8	17,8	
TU24	5	26	... / 240	2,7	4,0	7,3	12,0	16,7	20,2	22,9	22,9	
TU28	6	30	... / 280	3,2	4,4	7,7	12,4	19,3	23,5	25,5	25,5	
TU12c	4	6	... / 120	1,6	3,4	5,9	6,1	6,1	6,1	6,1	6,1	
TU16c	3	14	... / 160	1,6	3,1	4,8	6,6	8,3	10,1	11,9	11,9	
TU20c	4	14	... / 200	2,2	3,8	7,0	9,9	12,5	14,9	14,9	14,9	
TU24c	5	18	... / 240	2,7	4,0	7,3	12,0	16,7	17,2	17,2	17,2	
TU28c	6	18	... / 280	3,2	4,4	7,7	12,4	17,7	17,7	17,7	17,7	
											without screws	
TU12	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16	3	18	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20	4	22	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24	5	26	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28	6	30	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	
TU12c	4	6	... / 120	1,2	1,7	2,2	2,8	3,3	3,8	4,3	4,3	
TU16c	3	14	... / 160	1,6	2,2	2,9	3,6	4,4	5,1	5,7	5,7	
TU20c	4	14	... / 200	2,2	2,9	3,8	4,6	5,6	6,4	7,3	7,3	
TU24c	5	18	... / 240	2,7	3,6	4,7	5,8	6,7	7,9	8,8	8,8	
TU28c	6	18	... / 280	3,2	4,4	5,5	6,7	7,9	9,2	10,3	10,3	

c = index for column nailing



screw 6,0x L  
with L = b-20mm

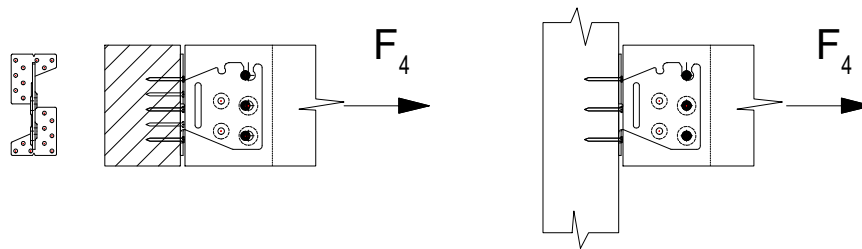
(for timber with b=60mm  
use screws 5,0x50)

number of screws =  
number of steel dowel

Table D2-9: Characteristic capacities  $R_{4k}$  [kN] TU

$R_{4,k}$ [kN] to beam / to column								
Typ	number of		min. size of joist b / h [mm]	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5,0x40	CSA5,0x50
	SD	nails						
TU12	4	6	.../120	4,1	4,9	5,7	8,4	8,4
TU16	3	18	.../160	6,1	7,5	8,9	11,4	11,4
TU20	4	22	.../200	8,2	9,8	11,5	16,2	16,2
TU24	5	26	.../240	10,2	12,1	14,1	21,0	21,0
TU28	6	30	.../280	11,8	14,4	16,7	25,4	25,8
TU12c	4	6	.../120	4,1	4,9	5,7	8,4	8,4
TU16c	3	14	.../160	5,3	6,4	7,5	11,4	11,4
TU20c	4	14	.../200	5,9	7,6	8,7	13,1	16,2
TU24c	5	18	.../240	7,4	9,8	11,3	16,8	21,0
TU28c	6	18	.../280	7,4	9,8	12,3	17,9	23,0

c = index for column nailing



### D3 Concealed joist hanger ETNM

Product Name	alternative names			
	France	UK	Danmark	Germany
ETNM		ETNM		

Figure D3-1: drawings

ETNM

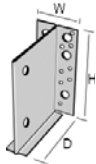


Table D3-1: size specification

Model N°	Width W	Height H	Depth	Angle	
	(mm)			degree	Direction
ETNM135/130/2	70	135	130	90°	~
ETNM155/130/2	70	155	130	90°	~
ETNM185/130/2	70	185	130	90°	~
ETNM230/130/2	80	230	130	90°	~

Table D3-2 number of fastener

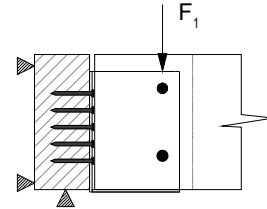
Hanger Type	Header Fasteners		Joist Fasteners	
	Ø4.0 connector nails	Bolt M12 Concrete screw	Dowels Ø8	Dowels Ø12
ETNM135/130/2	14	5	~	2
ETNM155/130/2	15	6	~	2
ETNM185/130/2	18	6	~	2
ETNM230/130/2	22	6	~	3

Table D3-3: Material specification

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
3	stainless steel as described	

**Table D3-4: Characteristic capacities ETNM  $R_{1,k}$   
Beam to beam**

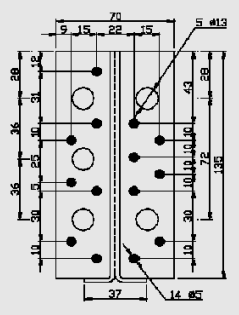
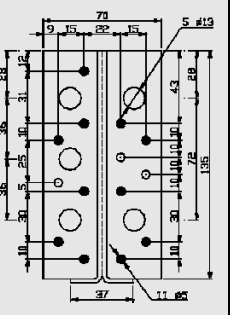
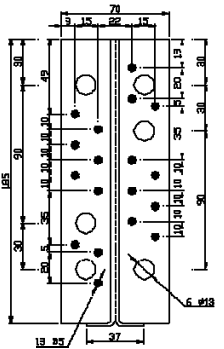
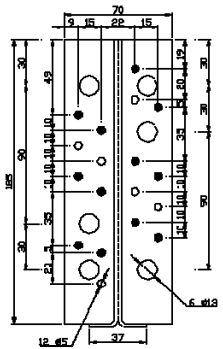
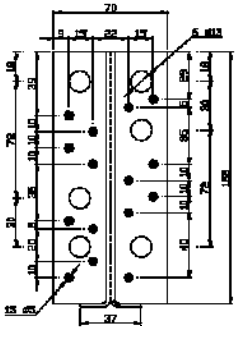
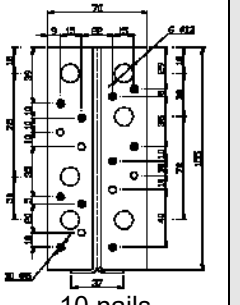
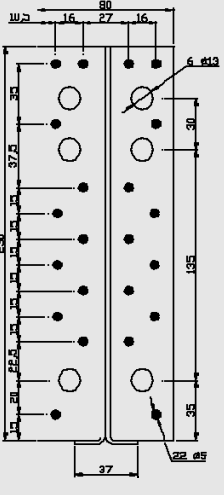
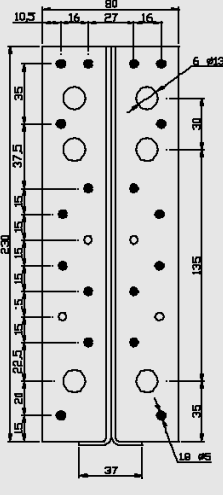
Joist width [mm]	Characteristic capacity $R_{1,k}$ [kN] with CNA4,0x50 connection beam to beam			
	ETNM135	ETNM155	ETNM185	ETNM230
60	11,7	14,4	17,1	26,2
80	12,2	15,0	17,8	27,0
100	13,1	16,0	18,9	28,6
120	14,2	17,2	20,4	30,6
140	15,4	18,6	22,0	32,8
160	16,6	20,0	23,8	35,1



**Table D3-5: Characteristic capacities ETNM  $R_{1,k}$   
Beam to post**

Joist width [mm]	Characteristic capacity $R_{1,k}$ [kN] with CNA4,0x50 connection beam to post			
	ETNM135	ETNM155	ETNM185	ETNM230
60	11,0	13,1	15,5	25,1
80	11,6	13,7	16,2	25,9
100	12,5	14,7	17,3	27,4
120	13,6	15,8	18,7	29,3
140	14,7	17,1	20,3	31,3
160	15,9	18,4	21,9	33,4

Figure D3-2: Nail pattern ETNM

TYPE	BEAM to BEAM	BEAM to POST	TYPE	BEAM to BEAM	BEAM to POST
135			185		
	14 nails 2 dowels Ø12	11 nails 2 dowels Ø12		18 nails 5 dowels Ø2	12 nails 5 dowels Ø12
155			230		
	15 nails 2 dowels Ø12	10 nails 2 dowels Ø12		22 nails 3 dowels Ø12	18 nails 3 dowels Ø12

### D4 Concealed joist hanger BTCx

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
BTCx				BTCx

Figure D4-1: Dimension drawing of concealed joist hangers

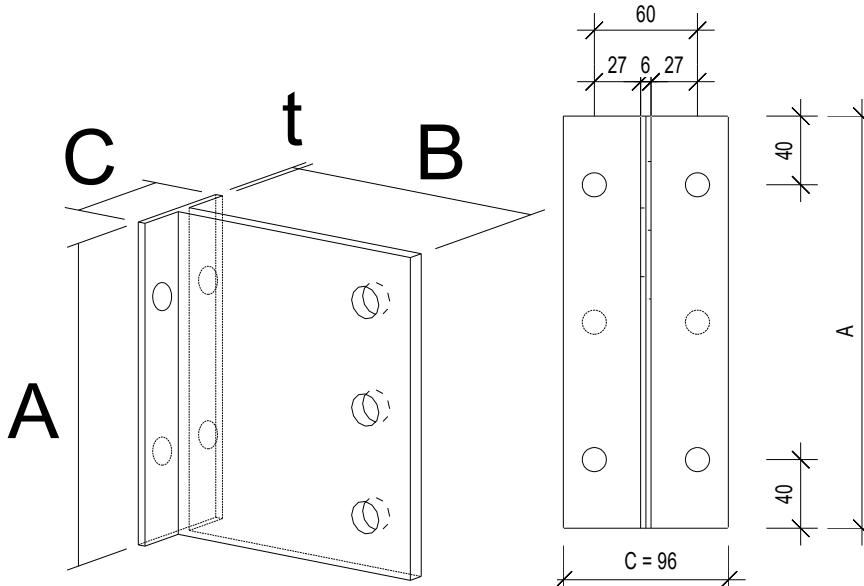
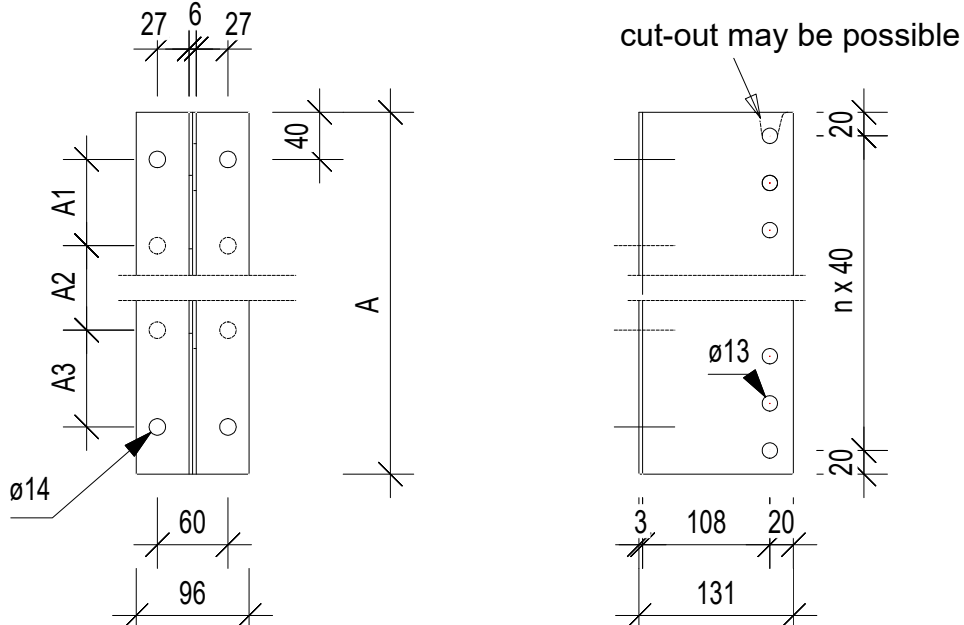


Figure D4-2: Size specification



**Table D4-1: Size specification**

Type	all size in [mm]							no of holes	
	A	A1	A2	A3	B	C	t	Ø14mm anchor	Ø13mm dowel
BTC120	120				128	96	3	2	3
BTC160	160	80			128	96	3	4	4
BTC200	200	120			128	96	3	4	5
BTC240	240	160			128	96	3	4	6
BTC280	280	100	100		128	96	3	6	7
BTC320	320	120	120		128	96	3	6	8
BTC360	360	140	140		128	96	3	6	9
BTC400	400	120	120	80	128	96	3	8	10
BTC440	440	120	120	120	128	96	3	8	11
BTC480	480	120	120	160	128	96	3	8	12
BTC520	520	160	160	120	128	96	3	8	13
BTC560	560	160	160	160	128	96	3	8	14
BTC600	600	160	160	200	128	96	3	8	15

**Table D4-2: Material specification**

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
3	stainless steel as desriped	

For installation for fire justification, see clause B6

**Table D4-3: Characteristic capacities  $R_{1,k}$  and  $R_{2,k}$** 

The tables are based on a slope of  $0^\circ$

For other configurations the following modification are necessary:

for different slope  $\beta$

$\beta$	$0^\circ$	$15^\circ$	$30^\circ$	$45^\circ$
factor	1	0,95	0,9	0,85

only for less as 7 SD, for 7 or more SD no reducing is necessary

Characteristic capacity  $R_{1,k}$  and  $R_{2,k}$  [kN]

b	3 SD	4 SD	5 SD	6 SD	7 SD	8 SD	9 SD	10 SD	11 SD	12 SD
80	11,5	18,5	26,7	35,8	45,6	56,0	66,8	77,9	89,1	100,5
100	12,7	20,4	29,4	39,4	50,1	61,4	73,1	85,1	97,2	109,5
120	14,2	22,8	32,7	43,8	55,6	68,1	80,9	94,0	107,3	120,7
140	15,8	25,3	36,4	48,6	61,7	75,5	89,6	104,1	118,7	133,4
160	17,2	27,8	40,3	53,8	68,3	83,4	99,0	114,8	130,9	147,0
180				54,3	69,4	85,5	102,2	119,5	133,3	147,0

b = min width [mm] of timber and length of the dowel

The topmost steel dowel in the cut out hole shall not be considered for  $R_{2,k}$

For using steel dowels with a length of 60mm the values for steel dowel with 80mm may be multiplied by 0,95.

The necessary capacity of the bolts should be calculated as:

$$R_{bolt,lat,d} \geq \frac{F_{1,d}}{n}$$

For the upper bolts additional:

$$R_{bolt,ax,d} \geq \frac{F_{1,d} \times 14,4}{d}$$

With:

$R_{bolt,lat,d}$  design capacity of one anchor bolt for shear load, but max. 14,0 kN

$R_{bolt,ax,d}$  design capacity of one anchor bolt for tension load

$d$  height of the BTC -10mm [mm]

$n$  number of anchor bolts



**Table D4-4: Characteristic capacities  $R_{3,k}$** 

It is assumed that the force  $F_3$  is action at the top of the BTC. For a force  $F_3$  with a lower distance to the middle of the BTC, the same capacities may be to use

Type	number of		Joist min b / h [mm]	$R_{3,k}$ [kN] for b = .. [mm] without screws						
	SD	bolts		60	80	100	120	140	160	180
BTC120	3	2	... / 160	2,6	2,9	3,5	4,0	4,5	5,2	5,3
BTC160	4	4	... / 200	3,2	3,9	4,4	5,0	5,9	6,5	7,0
BTC200	5	4	... / 240	4,0	4,9	5,5	6,3	7,2	7,8	8,8
BTC240	6	4	... / 280	4,8	5,7	6,6	7,5	8,4	9,1	10,4
BTC280	7	6	... / 320	5,6	6,5	7,6	8,7	9,6	10,4	11,9
BTC320	8	6	... / 360	6,4	7,3	8,6	9,7	10,8	11,8	13,4
BTC360	9	6	... / 400	7,2	8,1	9,5	10,8	12,0	13,2	14,9
BTC400	10	8	... / 440	8,0	8,9	10,5	11,9	13,2	14,7	16,4
BTC440	11	8	... / 480	8,8	9,7	11,4	13,0	14,4	16,1	17,8
BTC480	12	8	... / 520	9,6	10,6	12,4	14,1	15,6	17,6	19,3
BTC520	12	8	... / 560	10,4	11,4	13,3	15,1	16,8	19,1	20,8
BTC560	12	8	... / 600	11,2	12,3	14,3	16,2	18,0	20,5	22,3
BTC600	12	8	... / 640	12,0	13,2	15,2	17,3	19,2	22,0	23,8

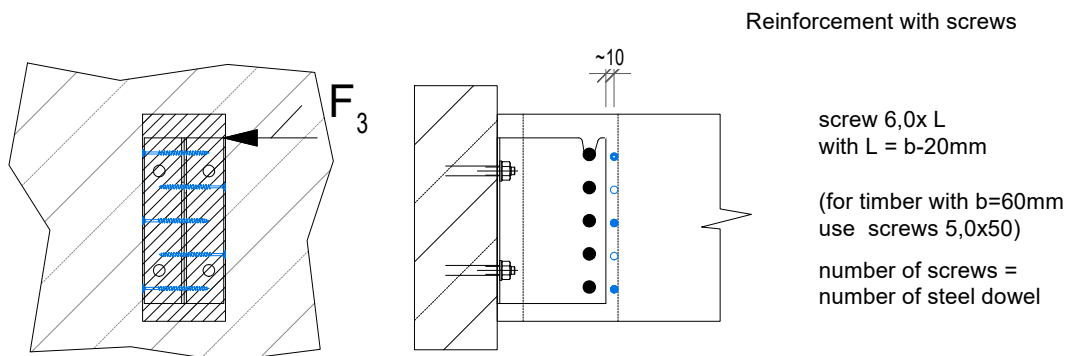
SD = steel dowel

**Table D4-5: Characteristic capacities  $R_{3,k}$  with screws for reinforcement**

It is assumed that the force  $F_3$  is in action at the top of the BTC. For a force  $F_3$  with a lower distance to the middle of the BTC, the same capacities may be to use

Type	number of		Joist min b / h [mm]	$R_{3,k}$ [kN] for b = .. [mm] with screws *						
	SD	bolts		60	80	100	120	140	160	180
BTC120	3	2	... / 160	2,6	2,9	4,4	5,3	5,3	5,3	5,3
BTC160	4	4	... / 200	3,2	4,3	6,6	7,0	7,0	7,0	7,0
BTC200	5	4	... / 240	4,0	5,5	8,6	8,8	8,8	8,8	8,8
BTC240	6	4	... / 280	4,8	6,3	8,8	10,6	10,6	10,6	10,6
BTC280	7	6	... / 320	5,6	6,8	9,6	12,3	12,3	12,3	12,3
BTC320	8	6	... / 360	6,4	7,5	10,1	14,1	14,1	14,1	14,1
BTC360	9	6	... / 400	7,2	8,1	11,0	15,2	15,8	15,8	15,8
BTC400	10	8	... / 440	8,0	8,9	11,0	15,2	17,6	17,6	17,6
BTC440	11	8	... / 480	8,8	9,7	12,1	16,1	19,3	19,3	19,3
BTC480	12	8	... / 520	9,6	10,6	12,8	17,1	21,1	21,1	21,1
BTC520	12	8	... / 560	10,4	11,4	13,3	17,1	22,9	22,9	22,9
BTC560	12	8	... / 600	11,2	12,3	14,3	17,6	24,6	24,6	24,6
BTC600	12	8	... / 640	12,0	13,2	15,2	18,8	24,6	26,4	26,4

\* See clause C.2



The connection of the bolts to the concrete must be checked:

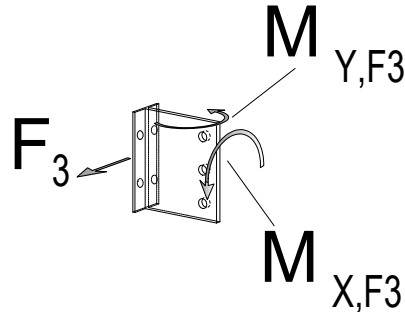
The bolt group must be able to resist the min :

$$F_{3,d} \text{ [kN]}$$

$$M_{Y,F3,d} = F_{3,d} \times 40 \text{ mm [kNmm]}$$

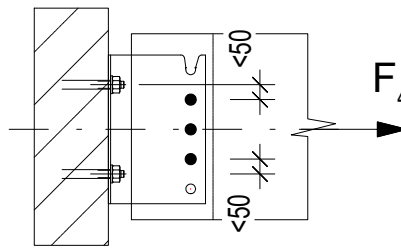
$$M_{X,F3,d} = F_{3,d} \times (A/2) \text{ [kNmm]} ,$$

with A = the height of the BTC [mm]



**Table D4-6: Characteristic capacities  $F_{4,k}$**

no of bolts	$R_{3,k}$ [kN]	min no of dowel
2	6,7/ $k_{mod}$	3
4	13,4/ $k_{mod}$	3
6	20,1/ $k_{mod}$	5
8	26,8/ $k_{mod}$	6



The force is acting in the middle of the joist.

The dowel and anchor bolts should be placed symmetrical to the centreline of the joist, and with a max distance of the anchor to the dowel of 50mm.

It should be checked, that the capacity of bolt is:  $R_{bolt,ax,d} \geq \frac{F_{4,d} \times 1,44}{n_b}$

Where:

$R_{bolt,ax,d}$  the axial design capacity of each anchor bolts / bolts

$n_b$  the number of anchor bolts / bolts

$F_{4,d}$  the design load in direction of the joist

For combination it should be checked:

$$\left( \frac{F_{1or2,d}}{R_{1or2,d}} \right)^2 + \left( \frac{F_{3,d}}{R_{3,d}} \right)^2 + \left( \frac{F_{4,d}}{R_{4,d}} \right)^2 \leq 1$$

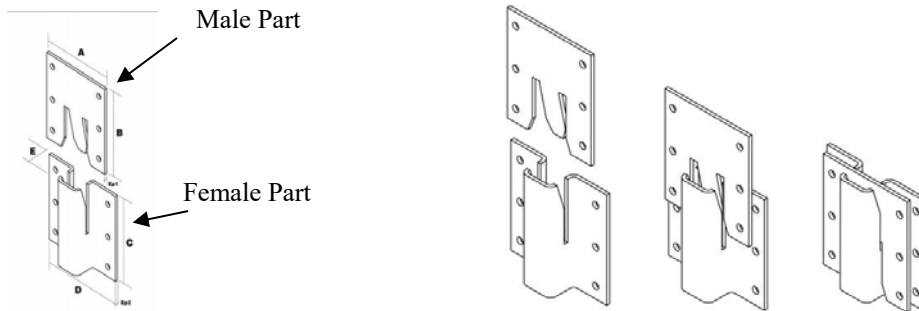
$$\left( \frac{F_{1,d}}{R_{1,d}} \right)^2 + \left( \frac{F_{2,d}}{R_{2,d}} \right)^2 + \left( \frac{F_{3,d}}{R_{3,d}} \right)^2 + \left( \frac{F_{4,d}}{R_{4,d}} \right)^2 \leq 1$$

$F_1$  and  $F_2$  have to be considered independently

The anchor bolts should be checked separately for the combination of loads.

**D5 ICS**

Product Name	Alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
ICS				

**Figure D5-1: Drawings****Table D5-2: Dimensions and number of fastener**

ICS	A	B	C	D	E	Thickness	Holes
Male Part	70	80	--	--	--	2.5	6 Ø5
Female Part	--	--	80	80	23.5	2.5	6 Ø5

**Table D5-3: Material specification**

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
3	stainless steel as described	

For installation for fire justification, see clause B6

**Table D5-4: Characteristic capacities :**

Characteristic capacities for single ICS and for timber grade C24:

	Fasteners		Characteristic Capacities C24 [kN]	
			Load direction	
	Male part	Female part	Shear	Withdrawal
ICS	6 screws CSA Ø5.0x35	6 screws CSA Ø5.0x35	7.21 <sup>(1)</sup>	4.17 <sup>(3)</sup>
			3.84 <sup>(2)</sup>	

(1) Shear capacity is given for a displacement of 15 mm.

(2) Shear capacity is given for a displacement of 5 mm

(3) Withdrawal capacity is given for a displacement of 3 mm.

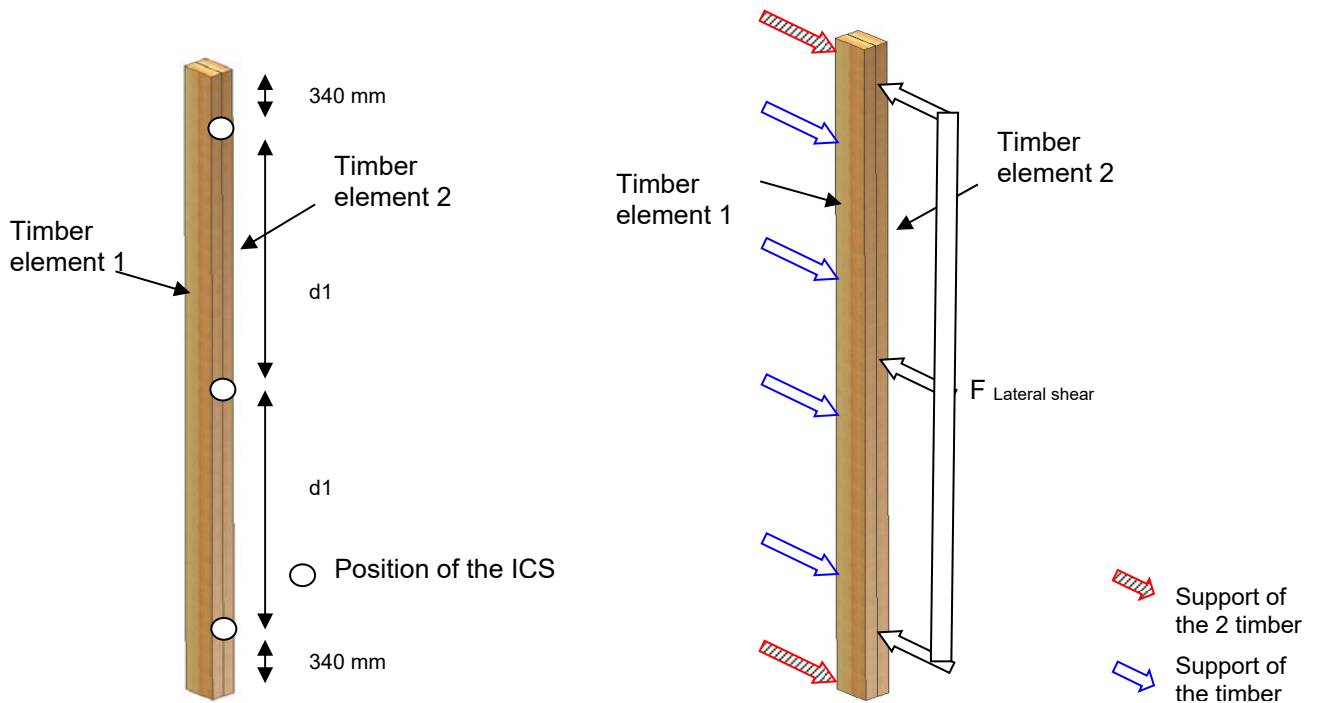
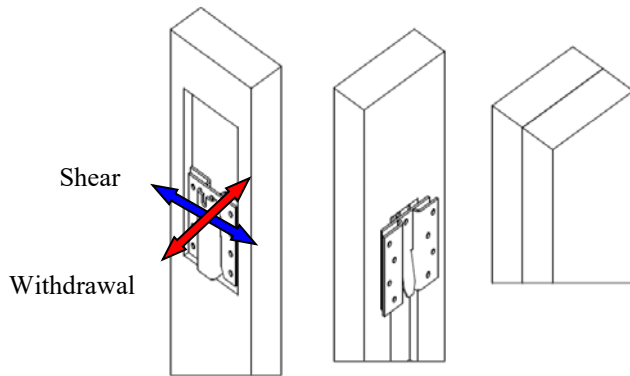


Figure 1 : Timber element and position of ICS

Figure 2: Lateral shear test

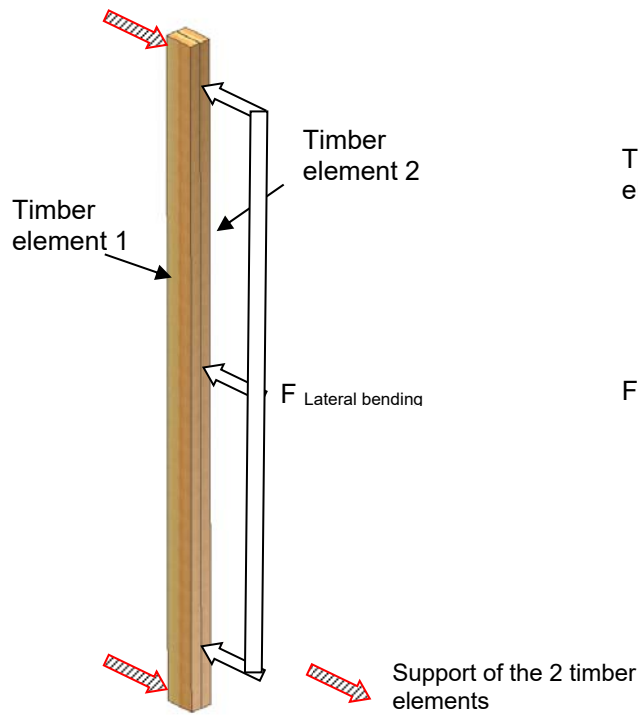


Figure 3 : Lateral bending tests

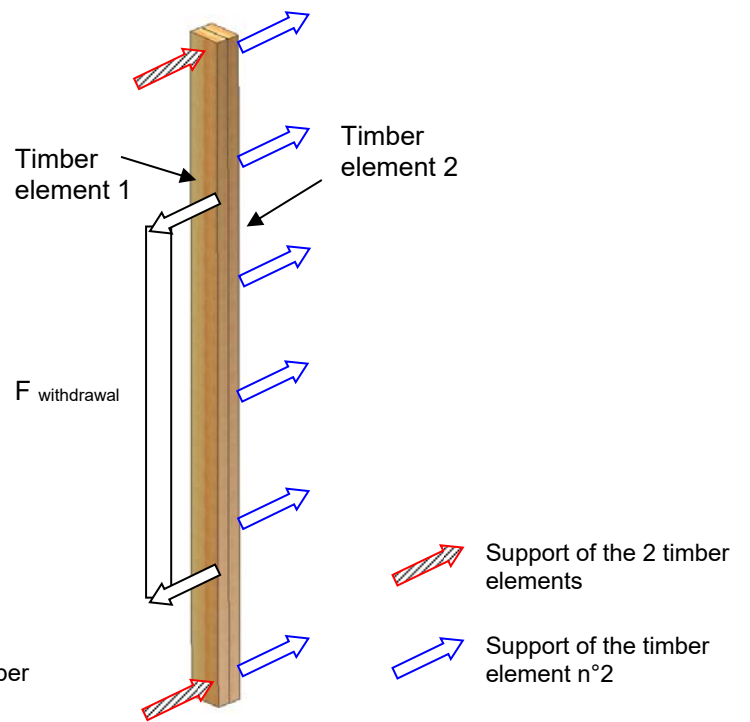


Figure 4: Withdrawal tests

	Fasteners		Characteristic Capacities C24 [kN]		
			Load direction / configuration		
	Male part	Female part	Lateral Shear	Lateral Bending	Withdrawal
3 ICS	3 x 6 screws CSA Ø5.0x35	3 x 6 screws CSA Ø5.0x35	24.3 <sup>(1)</sup>	13.83 <sup>(1)</sup>	5.57 <sup>(3)</sup>
			6.31 <sup>(2)</sup>	4.02 <sup>(2)</sup>	

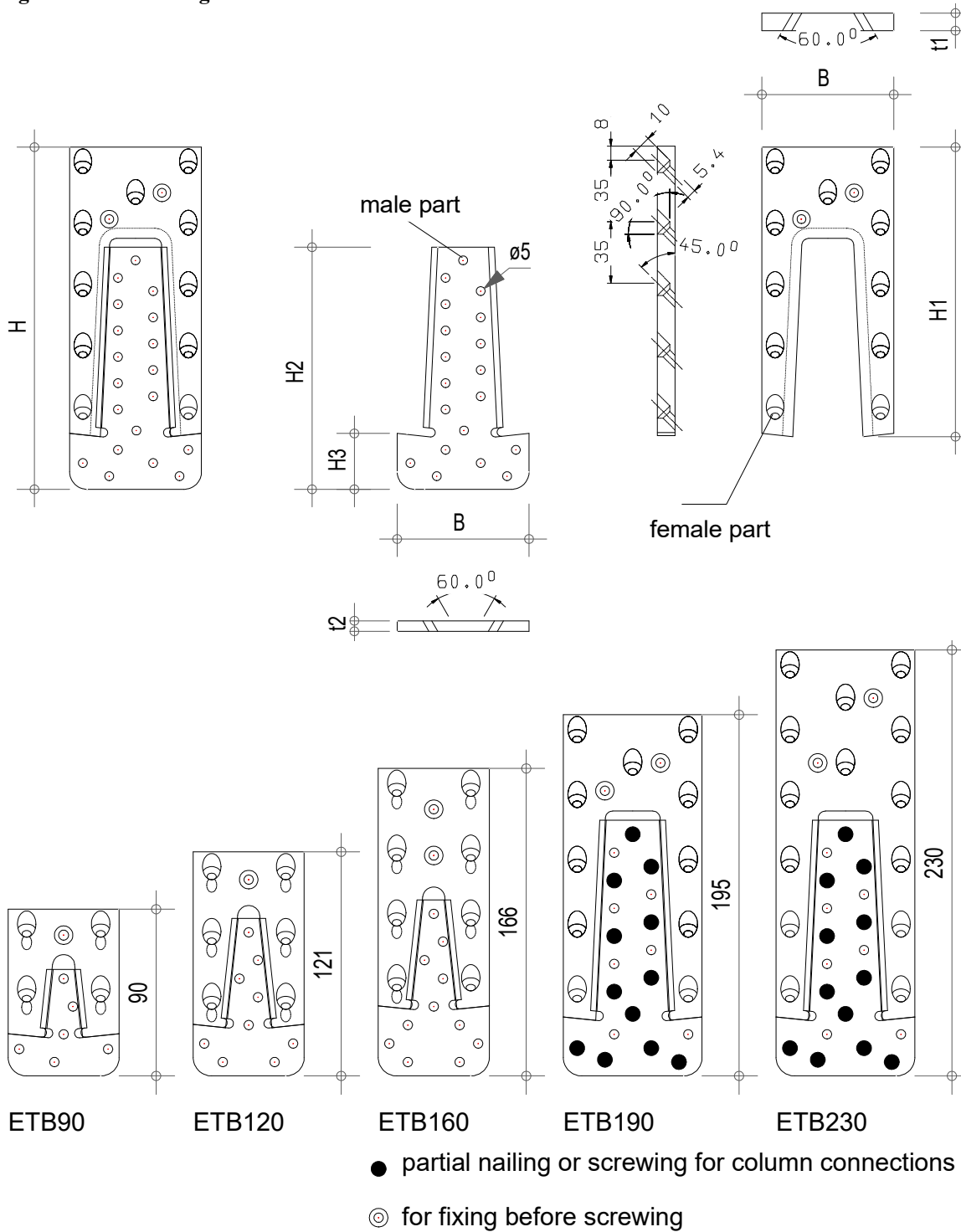
- (1) Lateral capacity is given for a displacement of 15 mm.
- (2) Lateral capacity is given for a displacement of 5 mm
- (3) Withdrawal capacity is given for a displacement of 3 mm.

For other timber grade with a lower density, the following  $k_{dens}$  ratio should be applied:  $k_{dens} = \left(\frac{\rho_k}{350}\right)^2$

### D6 ETB

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
ETB				

Figure D6-1: Drawings



● partial nailing or screwing for column connections

⊙ for fixing before screwing

**Table D6-1: dimensions and number of fastener**

Type	sizes [mm]						n Ø5,4	n Ø5
	H	B	H1	H2	H3	t1 / t2		
ETB90	90	60	69	58	22,8	10 / 6	4	6
ETB120	121	60	95	85	27,8	10 / 6	6	9
ETB160	166	60	130	95	37,8	10 / 6	8	11
ETB190	195	75	165	138	31,8	10 / 6	11	19
ETB230	230	75	200	138	31,8	10 / 6	14	19

**Table D6-2: Material specification**

Material thickness [mm]	Material Grades	Coating specification
6	Aluminium EN AW-6082 T6 according to EN 755-2 stainless steel as described	
10		

For installation for fire justification, see clause B6

**Table D6-3: Characteristic capacities :****ETB connectors - Force downward**

$$R_{1,k} = \min \left\{ \begin{array}{l} \frac{n_J^{0,9} \times R_{ax,\alpha,k}}{\sqrt{2}} \\ n_H \times R_{lat,k} \end{array} \right.$$

$n_J$  number of screws in the joist

$n_H$  number of screws or nails in the side grain of the header or column

$R_{lat,k}$  Characteristic value of the load-carrying-capacity of a laterally loaded header/column nail or screw in single shear in a steel-to-timber connection with a thick steel plate according to EN 1995-1-1 or ETA 04/0013 in N

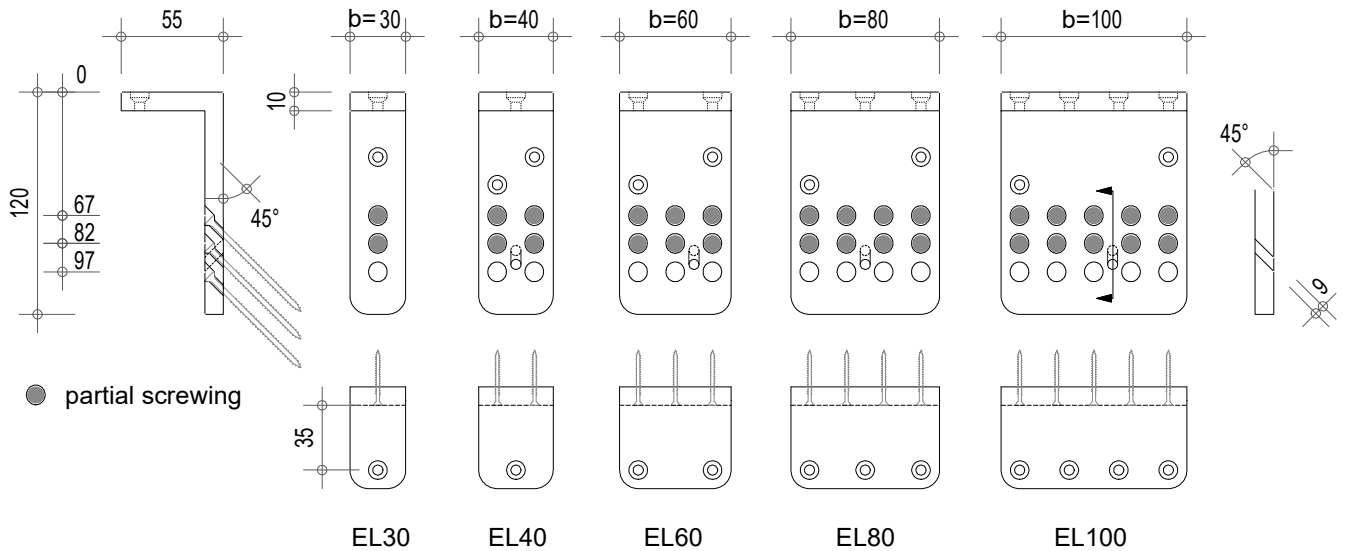
$R_{ax,\alpha,k}$  characteristic axial load-carrying capacity of the screws in the joist according to EN 1995-1-1:2004:2008+A1:2008(E) in N, for the angle between the fiber of timber and the axis of the screw.

### D7 EL

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
EL xx				

xx = size of EL

**Figure D7-1: Drawings**



**Table D7-1: dimensions and number of fastener**

type	number of holes Ø5,4mm	
	45°	top
EL30	3	1
EL40	6	1
EL60	9	2
EL80	12	3
EL100	15	4

**Table D7-2: Material specification**

Material thickness	Material Grades	Coating specification
6	Aluminium EN AW-6082 T6 according to EN 755-2 stainless steel as described	
10		

For installation for fire justification, see clause B6



**Table D7-3:Characteristic capacities :**

$$R_{1,k} = \min \left\{ \begin{array}{l} \frac{n_J^{0,9} \times R_{ax,\alpha,k}}{\sqrt{2}} \\ \frac{k_{c,90} \times f_{c,90ck} \times A_{ef} \times b}{A} \times \left( 11,25 + \sqrt{\frac{25 \times f_{y,k} \times A}{k_{c,90} \times f_{c,90,k} \times A_{ef}}} - 380 \right) \\ \frac{278 \times b}{k_{mod}} \end{array} \right.$$

$$R_{4,k} = \min \left\{ \begin{array}{l} 0,3 \times F_{1,d} \\ n_H \times R_{lat,k} \end{array} \right.$$

$n_J$  number of screws in the joist

$n_H$  number of screws in the upper surface of the header

$k_{c,90}$  Factor according to EN 1995-1-1:A1 taking into account the load configuration, the possibility of splitting and the degree of compressive deformation

$f_{c,90,k}$  Characteristic compressive strength perpendicular to the grain in N/mm<sup>2</sup>

$A_{ef}$  Effective contact area perpendicular to the grain in mm<sup>2</sup> according to EN 1995-1-1:A1

$A$  Actual contact area perpendicular to the grain in mm<sup>2</sup>

$b$  Width of the SIMPSON STRONG-TIE® EL hanger in mm

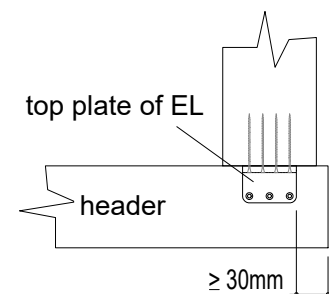
$f_{y,k}$  Aluminium minimum yield strength in N/mm<sup>2</sup>;  $f_{y,k} = 250$  N/mm<sup>2</sup>

$F_{1,d}$  design value of the joist support load perpendicular to the joist axis in N

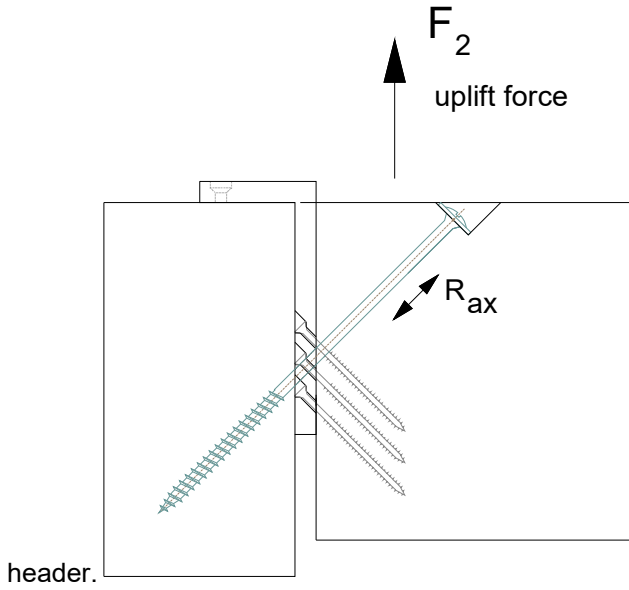
$R_{ax,\alpha,k}$  characteristic axial load-carrying capacity of the screws in the joist according to EN 1995-1-1:2004:2008+A1:2008(E) in N, for the angle between the fiber of timber and the axis of the screw.

$R_{lat,k}$  Characteristic value of the load-carrying-capacity of a laterally loaded header nail or screw in N

type	A [mm]	$A_{ef}$ [mm]	$A_{ef}/A$
EL30	1350	3600	2,67
EL40	1800	4500	2,5
EL60	2700	5400	2
EL80	3600	6300	1,75
EL100	4500	7200	1,6



The value  $A_{ef}$  based on minimum distance of 30mm between the EL and the end of



An uplift force may be adsorbed by an extra screw as shown above.

$$R_{2,k} = \frac{R_{ax,k}(Screw)}{\sqrt{2}}$$

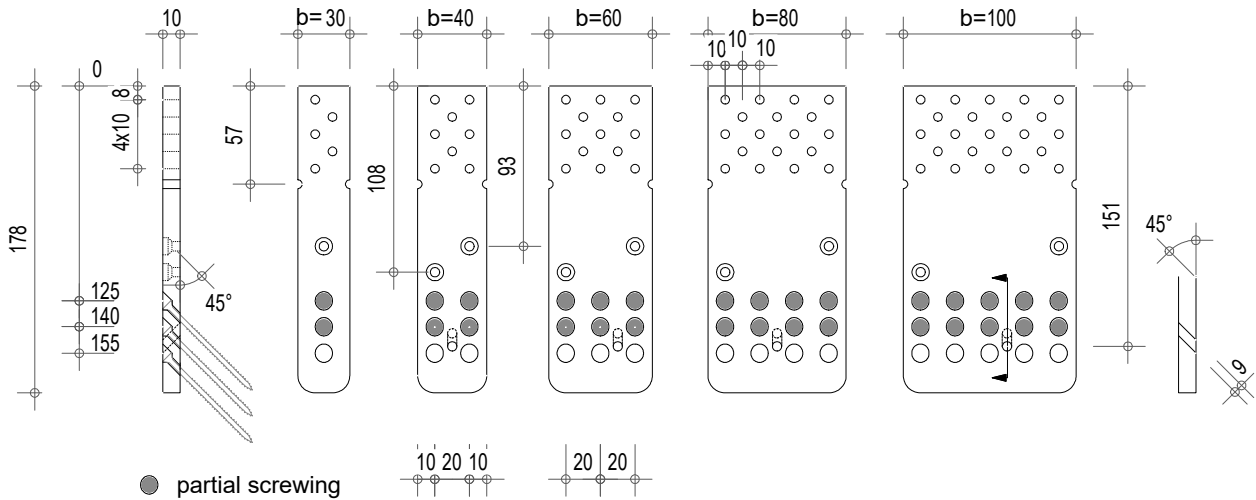
$R_{ax,k}(Screw)$  Characteristic axial load-carrying capacity of the extra screw as the min of threaded part and pull through capacity of the head.

**D8 ELS**

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
ELS xx				

xx = Size of ELS

**Figure D8-1: Drawings**



**Table D8-1: dimensions and number of fastener**

type	number of holes	
	Ø5,4 45°	Ø5,0 top
ELS30	3	5
ELS40	6	8
ELS60	9	13
ELS80	12	15
ELS100	15	19

**Table D8-2: Material specification**

Material thickness	Material Grades	Coating Specification
10	Aluminium EN AW-6082 T6 according to EN 755-2 stainless steel as described	

For installation for fire justification, see clause B6

**Table D8-3: Characteristic capacities :**

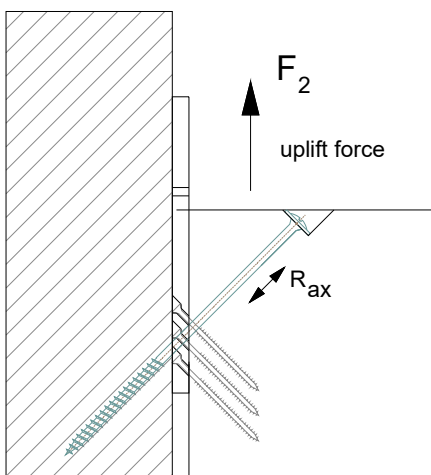
$$R_{1,k} = \min \begin{cases} \frac{n_J^{0,9} \times R_{ax,\alpha,k}}{\sqrt{2}} \\ n_H \times R_{lat,k} \end{cases}$$

$n_J$  number of screws in the joist

$n_H$  number of screws in the upper surface of the header

$R_{ax,\alpha,k}$  characteristic axial load-carrying capacity of the screws in the joist according to EN 1995-1-1:2004:2008+A1:2008(E)  
For a connection with a slope  $< 0^\circ$ , it shall be check the permission for angle between the fiber of timber and the axis of the screw.

$R_{lat,k}$  characteristic value of the load-carrying-capacity of a laterally loaded header nail or screw in N



An uplift force may be adsorbed by an extra screw as shown above.

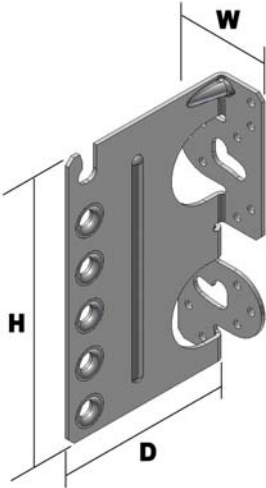
$$R_{2,k} = \frac{R_{ax,k}(Screw)}{\sqrt{2}}$$

$R_{ax,k}$  characteristic axial load-carrying capacity of the extra screw as the min of threaded part and pull through capacity of the head.

**D9 CBH**

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
CBH xxx / 2.5				

xxx = size of CBH

**Figure D9-1: Drawings****Table D9-1: Dimensions and number of fastener**

Model	[mm]				Angle	
	Width W	Height H	Depth D	Thickness	degree	Direction
CBH105/2,5	40	105	100	2,5	90°	~
CBH150/2,5	60	150	113,5	2,5	90°	~
CBH180/2,5	60	180	113,5	2,5	90°	~
CBH220/2,5	60	220	113,5	2,5	90°	~

Model	Header Fasteners		Joist Fasteners
	nails or screws *	Bolts Anchors Wood screws	Dowel Ø10 acc. To EN 14592
CBH105/2,5	8	2-Ø8	3
CBH150/2,5	14	2-Ø10	5
CBH180/2,5	16	2-Ø10	6
CBH220/2,5	22	2-Ø10	7

\* According to ETA 04/0013 or according to EN14592

Washer for a wood/ rigid support connection.

The minimum dimension has to be used:

Bolt Ø10 + Washer M10 (Øext = 20 – Øint = 11mm)

Bolt Ø8 + Washer M8 (Øext = 16 – Øint = 8,5mm) for CBH105

**Table D9-2: Material specification**

Material thickness	Material Grades	Coating specification
3	S 250 GD	Z275
3	stainless steel as described	

For installation for fire justification, see clause B6

**Table D9-3: Characteristic capacities  $R_{1,k}$  [kN] timber to timber:**

Characteristic value [kN] of a CBH concealed Joist hangers for connections between timber header beam and timber supported joist. Header fastener: CNA4,0x60.

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	0						5						10					
CBH150	18,0	18,6	20,7	22,4	24,0	24,0	17,8	18,4	20,3	22,0	23,8	23,8	17,5	18,1	20,0	21,6	23,4	23,5
CBH180	25,0	26,4	29,5	32,1	32,6	32,6	24,7	26,1	29,1	31,6	32,4	32,4	24,3	25,6	28,5	31,0	32,1	32,1
CBH220	32,6	34,2	37,9	41,1	42,8	42,8	32,2	33,7	37,3	40,4	42,4	42,4	31,8	33,2	36,6	39,7	42,0	42,0

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	15						20						25					
CBH150	17,3	17,9	19,6	21,2	22,9	23,3	17,1	17,6	19,3	20,8	22,4	23,0	16,9	17,4	19,0	20,4	22,0	22,7
CBH180	24,0	25,2	28,0	30,5	31,8	31,8	23,6	24,8	27,5	29,9	31,4	31,4	23,4	24,5	27,0	29,3	31,1	31,1
CBH220	31,4	32,7	35,9	38,9	41,6	41,6	31,0	32,3	35,3	38,2	41,1	41,1	30,7	31,8	34,8	37,5	40,4	40,7

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	30						35						40					
CBH150	16,7	17,2	18,7	20,1	21,6	22,5	16,6	17,0	18,4	19,8	21,2	22,3	16,5	16,8	18,2	19,5	20,9	22,1
CBH180	23,1	24,1	26,6	28,8	30,8	30,8	22,8	23,8	26,2	28,4	30,5	30,5	22,7	23,6	25,9	28,0	30,1	30,3
CBH220	30,4	31,5	34,3	37,0	39,7	40,4	30,1	31,2	33,9	36,5	39,1	40,0	30,0	31,0	33,6	36,1	38,7	39,8

Widths	60	80	100	120	140	160
Slope	45					
CBH150	16,3	16,7	18,0	19,3	20,6	21,9
CBH180	22,5	23,4	25,6	27,6	29,7	30,1
CBH220	29,8	30,8	33,3	35,7	38,3	39,5

**Table D9-4: Characteristic capacities  $R_{1,k}$  [kN] timber to steel/concrete:**

Characteristic values [kN] for connection where the CBH joist hanger is bolted to a steel or reinforced concrete structural member and carrying a timber supported joist.

### 1. Dowel characteristic capacity

$F_{k,dowels}$

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	0						5						10					
CBH150	12,4	13,2	15,6	17,7	19,5	19,5	12,2	13,0	15,2	17,3	19,3	19,3	12,0	12,7	14,9	16,9	19,0	19,0
CBH180	19,3	21,1	25,2	28,8	29,7	29,7	18,9	20,7	24,6	28,1	29,2	29,2	18,5	20,2	23,9	27,4	28,8	28,8
CBH220	23,8	25,9	30,6	34,9	37,1	37,1	23,4	25,4	29,8	34,0	36,6	36,6	22,9	24,8	29,0	33,0	36,0	36,0

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	15						20						25					
CBH150	11,7	12,4	14,5	16,4	18,4	18,7	11,5	12,1	14,1	15,9	17,9	18,3	11,3	11,8	13,7	15,4	17,3	18,0
CBH180	18,2	19,7	23,3	26,6	28,3	28,3	17,8	19,2	22,6	25,8	27,8	27,8	17,4	18,8	22,0	25,0	27,3	27,3
CBH220	22,4	24,2	28,2	32,1	35,3	35,3	22,0	23,6	27,4	31,1	34,7	34,7	21,5	23,0	26,7	30,2	34,0	34,1

Widths	60	80	100	120	140	160	60	80	100	120	140	160	60	80	100	120	140	160
Slope	30						35						40					
CBH150	11,0	11,6	13,4	15,0	16,8	17,7	10,8	11,3	13,0	14,6	16,3	17,4	10,7	11,1	12,7	14,2	15,9	17,1
CBH180	17,0	18,3	21,4	24,3	26,8	26,8	16,7	17,9	20,9	23,6	26,4	26,4	16,4	17,6	20,4	23,1	26,0	26,0
CBH220	21,1	22,5	26,0	29,4	33,0	33,5	20,7	22,1	25,4	28,6	32,2	33,0	20,4	21,7	24,9	28,0	31,4	32,6

Widths	60	80	100	120	140	160
Slope	45					
CBH150	10,5	10,9	12,5	13,9	15,5	16,9
CBH180	16,2	17,3	20,0	22,6	25,4	25,7
CBH220	20,1	21,3	24,4	27,4	30,8	32,2

### 2. Max characteristic capacity [kN] of the steel part $F_{k,steel}$

Model	$F_{k,steel}$
CBH150	15,9
CBH180	23,3
CBH220	26,1

### 3. Design capacity of the CBH – $F_{d,CBH}$

$$F_{d,CBH} = \min \left\{ \begin{array}{l} \frac{F_{k,dowels} \times k_{mod}}{\gamma_M} \\ \frac{F_{k,steel}}{\gamma_M} \end{array} \right.$$

**Table D9-5: Characteristic capacities timber to timber CBH105/2,5:**

R <sub>1,k</sub> [kN]	width of joist = length of steel dowel [mm]		
	45	50	60
CNA 4,0x40	8,9	8,9	9,2
CNA 4,0x50	9,6	9,6	9,9
CNA 4,0x60	min. of: 10,2 ; 11,2/kmod	min. of: 10,3 ; 11,2/kmod	min. of: 10,5 ; 11,2/kmod
CSA 5,0x35	min. of: 10,6 ; 11,2/kmod	min. of: 10,6 ; 11,2/kmod	min. of: 10,8 ; 11,2/kmod
CSA 5,0x40	min. of: 12 ; 11,2/kmod	min. of: 12 ; 11,2/kmod	min. of: 12,2 ; 11,2/kmod
CSA 5,0x50	min. of: 13,6 ; 11,2/kmod	min. of: 13,7 ; 11,2/kmod	min. of: 13,8 ; 11,2/kmod

**Table D9-6: Characteristic capacities timber to timber CBH105/2,5:**

R <sub>2,k</sub> [kN]	width of joist = length of steel dowel [mm]		
	45	50	60
CNA 4,0x40	6,4	6,5	6,6
CNA 4,0x50	7,1	7,2	7,3
CNA 4,0x60	7,7	7,8	7,9
CSA 5,0x35	8,4	8,5	8,6
CSA 5,0x40	9,8	9,8	9,9
CSA 5,0x50	min. of: 11,5 ; 11,2/kmod	min. of: 11,5 ; 11,2/kmod	min. of: 11,6 ; 11,2/kmod

**Table D9-7: Characteristic capacities timber to steel/concrete CBH105/2,5:**

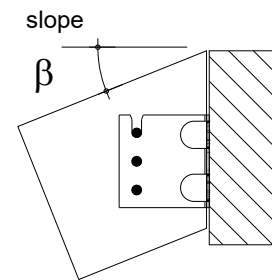
[kN]	width of joist = length of steel dowel [mm]
	≥ 45mm
R <sub>1,k</sub>	min. of: 13,6 ; 11,2/kmod
R <sub>2,k</sub>	min. of: 11,5 ; 11,2/kmod



For sloped connection shall be use the following factors for the values from Table D9-5 to D9-7:

for different slope  $\beta$

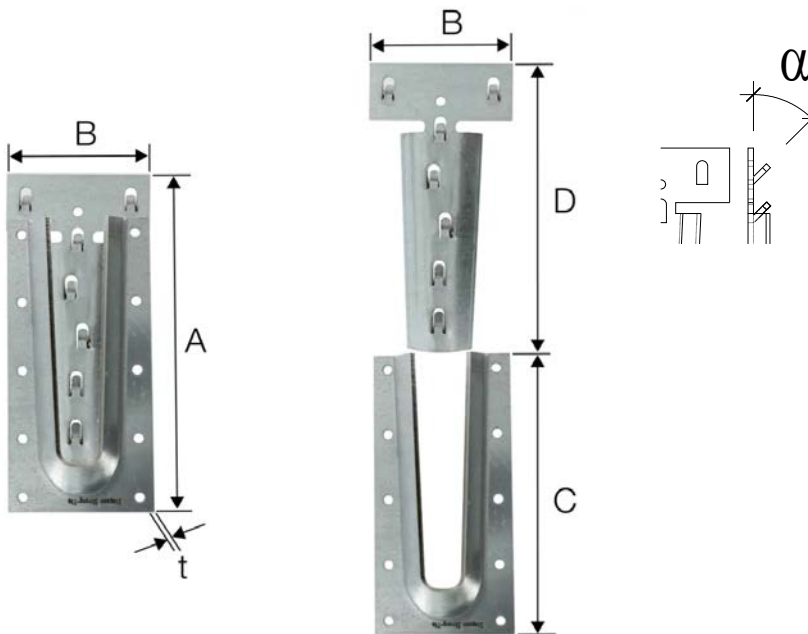
$\beta$	0°	15°	30°	45°
factor	1	0,95	0,9	0,85



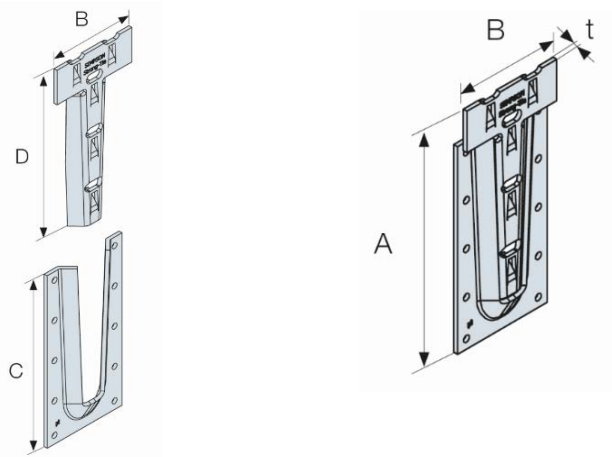
**D10 ETS / ETSN**

Product Name	alternative names			
	Branch 36	Branch 40	Branch 46	Branch 47
ETS				
ETSN				

**Figure D10-1: Drawings**



**ETS**



**ETSN**

**Table D10-1: Dimensions and number of fastener**

References	Product dimensions [mm]					angle $\alpha$	Joist Dimension			Header holes $\varnothing 5$	Joist holes $\varnothing 6$ Pan Holes
	A	B	C	D	t		Width		Height		
							Min.	Min.	Max.		
<b>ETS100</b>	100	65	70	70	3	45°	70			4	3
<b>ETS140</b>	140	65	100	100	3	45°	75			8	5
<b>ETS180</b>	180	75	150	150	3	45°	85			10	7
<b>ETSN100</b>	100	60	70	70	3	35°	70		Depends on screw length	4	3
<b>ETSN130</b>	130	65	100	100	3	35°	75			8	4
<b>ETSN180</b>	180	75	150	150	3	35°	85			10	5

**Table D10-2: Material specification**

Material thickness [mm]	Material Grades
3	Pre-galvanized steel Grade S250GD + Z (min Z275) according to EN 10346 with tolerances according to EN 10143 except if another material is specified. Or Stainless steel number 1.4401 or number 1.4404 according to EN 10088-2 with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa. If ETS are made using Stainless Steel, stainless fasteners need to be used.

For installation for fire justification, see clause B6

**Table D10-3: Characteristic capacities [kN] for ETS:  
ETS connectors - Force downward**

$$R_{1,k} = \min \left\{ \begin{array}{l} \frac{n_J^{0,9} \times R_{ax,\alpha,k}}{\sqrt{2}} \\ n_H \times R_{lat,k} \end{array} \right.$$

$n_J$  number of screws at 45° in the joist

$n_H$  number of screws in the side grain of the header

$R_{lat,k}$  Characteristic value of the load-carrying-capacity of a laterally loaded header/column nail or screw in single shear in a steel-to-timber connection with a thick steel plate according to EN 1995-1-1 or ETA 04/0013 in N

$R_{ax,\alpha,k}$  characteristic axial load-carrying capacity of the screws in the joist according to EN 1995-1-1:2004:2008+A1:2008(E) in N, for the angle between the fiber of timber and the axis of the screw.

**Table D10-4: Characteristic capacity [kN] for ETSN**

**ETSN connectors - Force downward**

ETSN100

$$R_{d,E} = \min \begin{cases} 2.45 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 4 \times R_{v,i,k} \end{cases}$$

ETSN130

$$R_{d,E} = \min \begin{cases} 3.27 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 8 \times R_{v,i,k} \end{cases}$$

ETSN180

$$R_{d,E} = \min \begin{cases} 4.09 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 10 \times R_{v,i,k} \end{cases}$$

**On column, fully screwed on the joist, partially screwed/nailed on the column:**

ETSN100

$$R_{d,E} = \min \begin{cases} 2.45 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 3.70 \times R_{v,i,k} \end{cases}$$

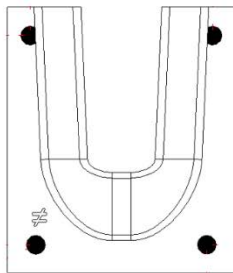
ETSN130

$$R_{d,E} = \min \begin{cases} 3.27 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 4.01 \times R_{v,i,k} \end{cases}$$

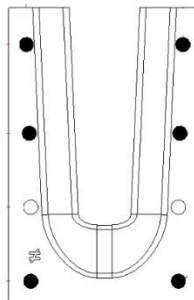
ETSN180

$$R_{d,E} = \min \begin{cases} 4.09 \times R_{ax,i,k} \\ 30.60 / k_{mod} \\ 5.75 \times R_{v,i,k} \end{cases}$$

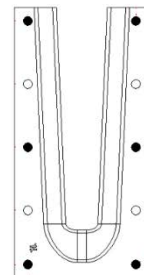
Corresponding nailing/screwing pattern:



**ETSN100/22-C**



**ETSN130/22-C**



**ETSN180/22-C**

With

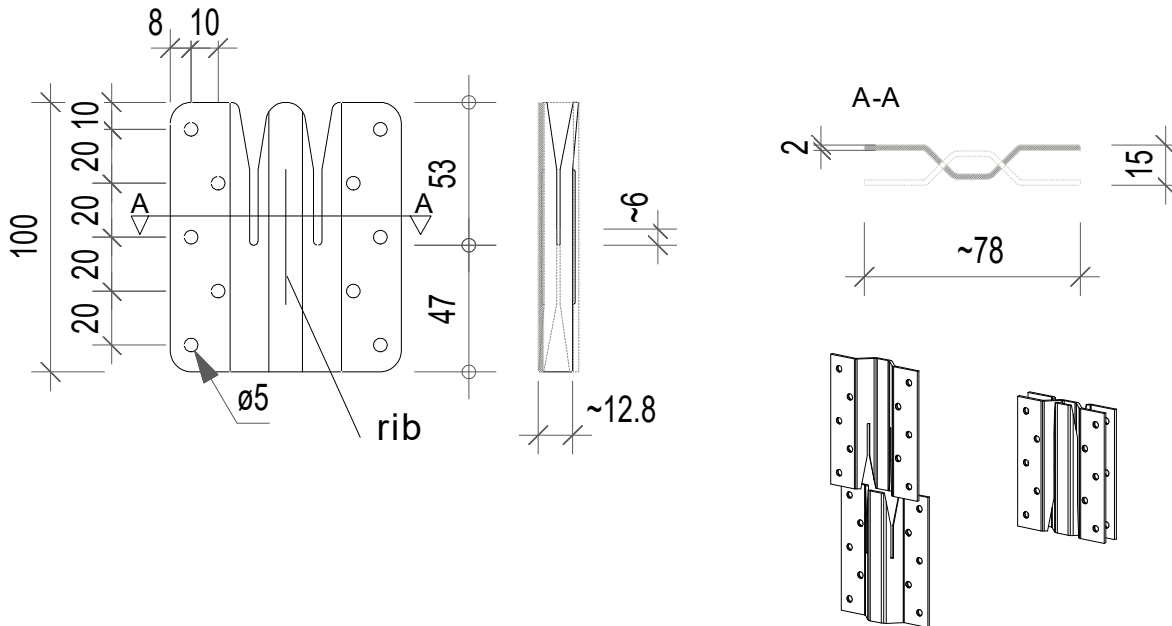
$R_{ax,i,k}$  characteristic axial capacity of the screws skewed in the supported member, based on the angle between screw and grain. Any slope of the supported member works if the screw approval allows an angle between screw axis and grain down to 0°. Otherwise, the slope shall be between -25 and +90°.

$R_{v,i,k}$  characteristic lateral capacity of the screw in the header  
 $k_{mod}$  partial safety factor depending on load duration

**D11 ICST**

Product Name	alternative names			
	UK	France	DK	D
ICST				

**Figure D11-1: Drawings**

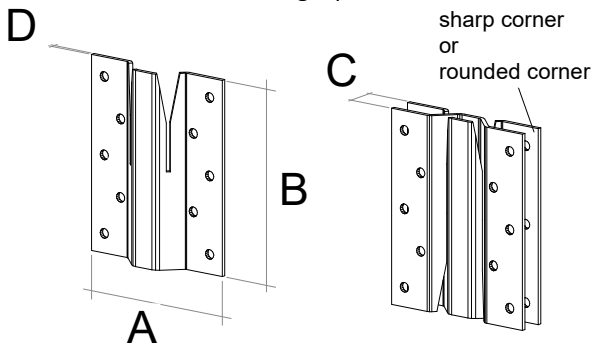


For a connection 2 single pieces have to be use as a pair

**Table D11-1: Size specification**

Dimensions				Number of Fasteners	
A	B	C	D	Supporting Member	Supported Member
78	100	15	2	10	10

The ICST consists of two single pieces



**Table D11-2: Material specification**

Material thickness	Material Grades	Coating specification
2	S250 GD according to EN 10326:2004	Z275 according to EN10326:2004

Or stainless steel according to clause II-1

For installation for fire justification, see clause B6

**Figure D11-2: Nail/screw pattern**

Full nailing

e.g. CNA 4,0xl nails , CSA5,0xl screws

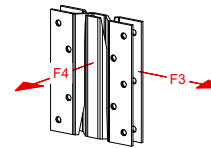
**Table D11-3: Characteristic capacity [kN]**

For one pair of ICST = two single pieces	characteristic capacities [kN] per connection (one pair)	
	$R_{3,k}$	$R_{4,k}$
min of:	$6,72 \cdot R_{lat,k}$	min of: $4 \times R_{ax,k}$
	$16,9/k_{mod}$	$5,35/k_{mod}$

With

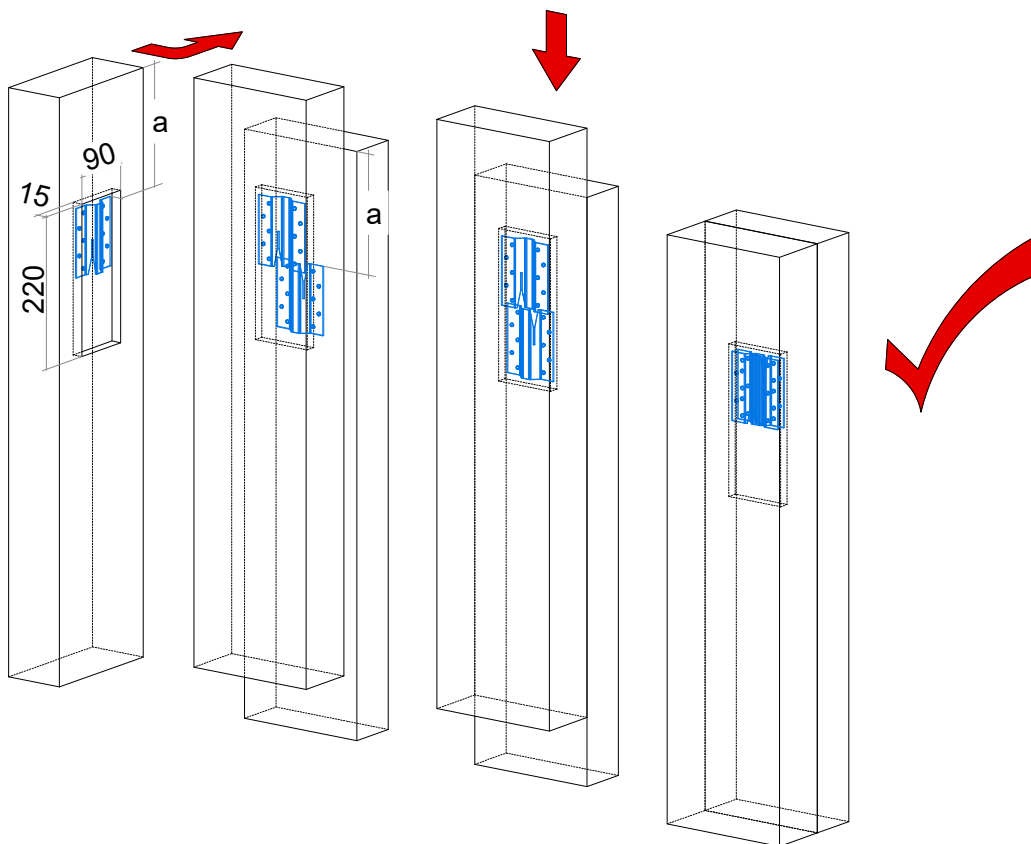
$R_{lat,k}$  = the lateral capacity of one single used fastener

$R_{ax,k}$  = the axial capacity of one single used fastener



For connection between timber elements (e.g. two wall elements) multiple ICST may be used.

The two single pieces are to place on the “same” high (for example same distance “a” from the top as described below), by the mounting the elements are to fit into each other.

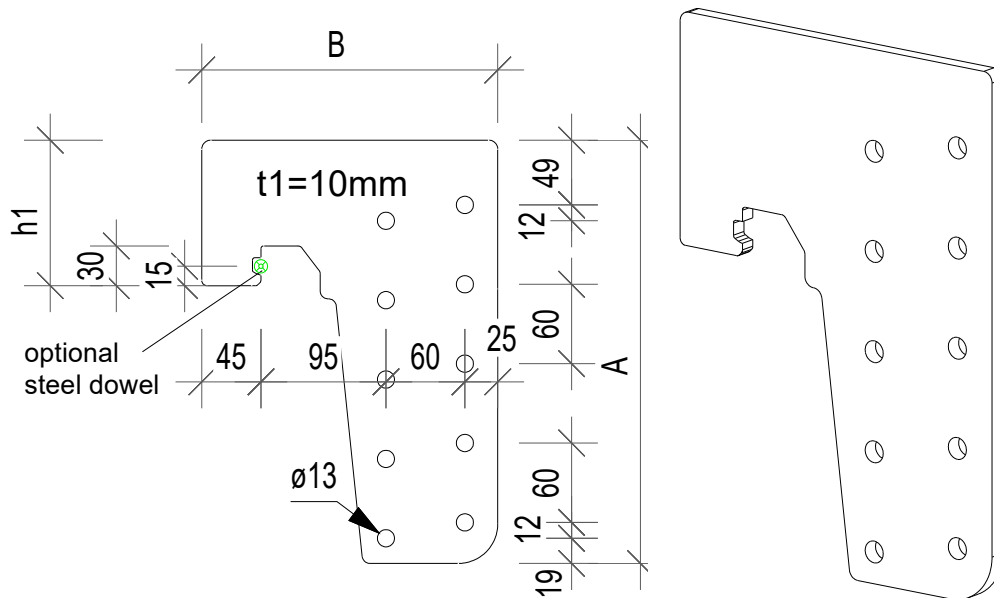


**D12 Janebo : JHHU, JHDU, JHGU, JHH, JHD, JHG**

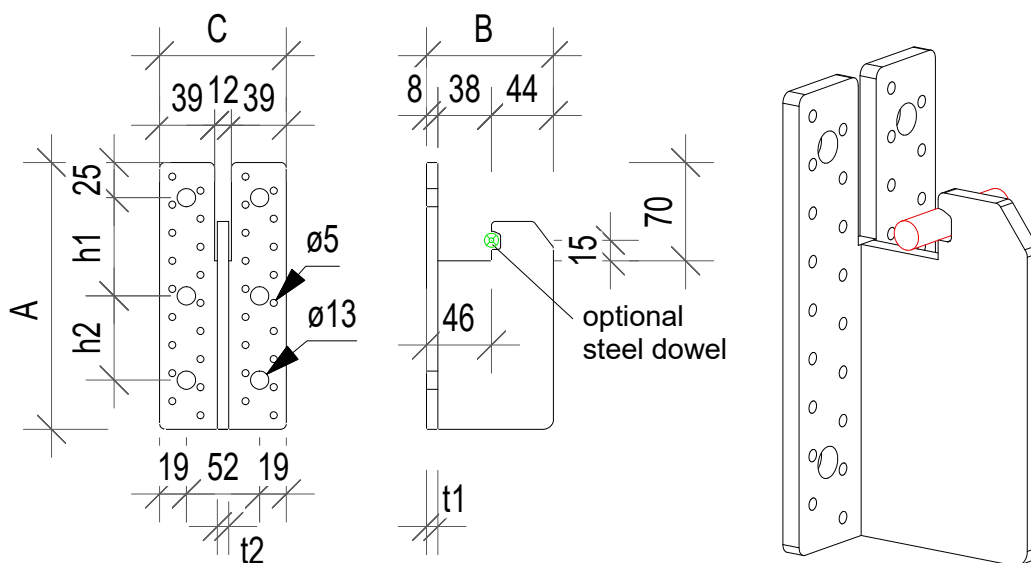
Product Name	alternative names			
	UK	France	DK	D
JHHxx				
JHD1-xx				JHDxx
JHGxx				
JHHUxx	-	-	-	
JHDUxx	-	-	-	
JHGUxx	-	-	-	-

Types with the “U” are for products with steel dowel for uplift;

**Drawings**

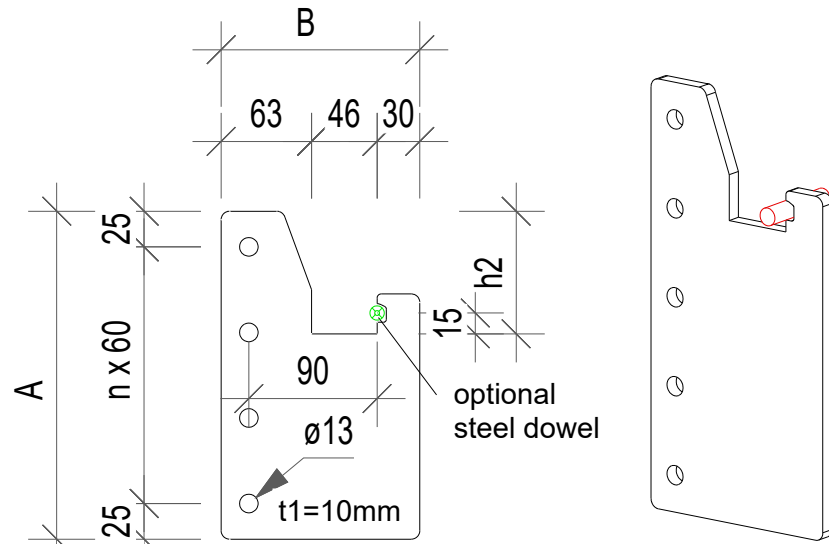


**Figure D12-1: Dimensioned drawings of JHHU**

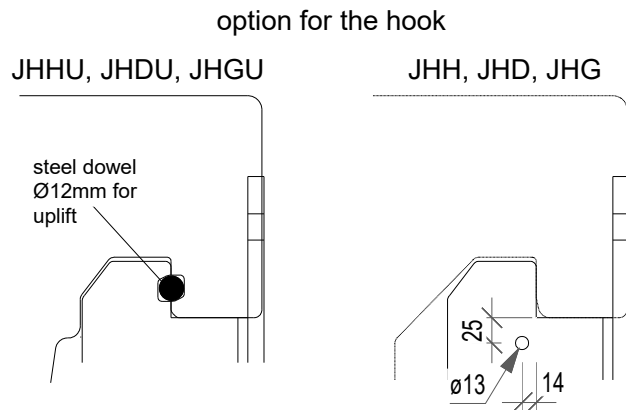


**Figure D12-2: Dimensioned drawings of JHDU**

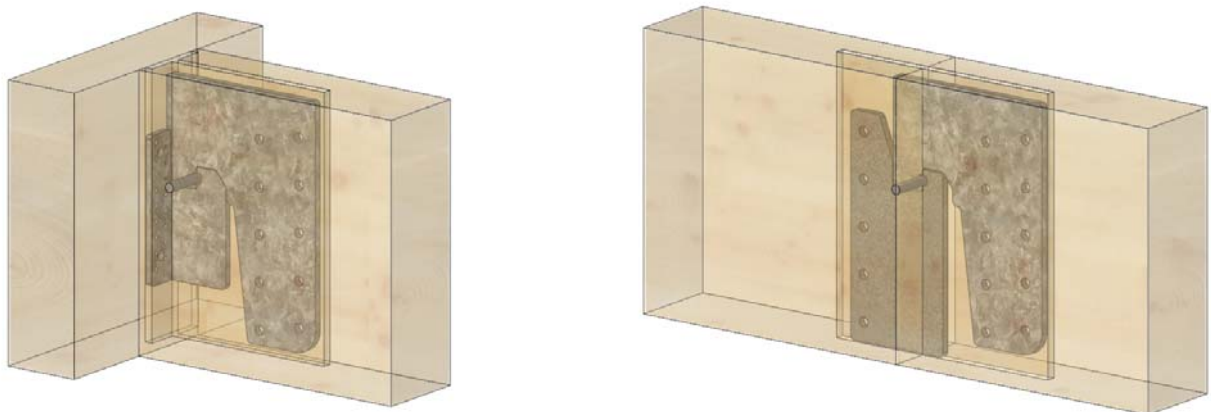




**Figure D12-3: Dimensioned drawings for JHGU**



**Figure D12-4: The hook for all types can be made in two different version, for an uplift force only the left one can be use.**



**Figure D12-5: example of use, for an uplift force ( $F_2$ ) the steel dowel as shown in figure D12-4 on the left one has to be installed**

**Table D12-1: Size specification**

	sizes [mm]							no of holes	
	A	B	C	t1	t2	h1	h2	Ø5mm	Ø13mm
JHH140/JHHU140	140	225		10		110			4
JHH180/JHHU180	180	225		10		110			6
JHH200/JHHU200	200	225		10		110			6
JHH260/JHHU260	260	225		10		110			8
JHH320/JHHU320	320	225		10		110			10
JHH380/JHHU380	380	225		10		140			12
JHHU440/JHH440	440	225		10		170			14
JHHU500/JHH500	500	225		10		170			16
JHHU560/JHH560	560	225		10		170			18
JHHU620/JHH620	620	225		10		170			20
JH DU20/JHD1-20	110	90	90	8	8	60		20	2
JH DU24/JHD1-24	130	90	90	8	8	80		24	2
JH DU36/JHD1-36	190	90	90	8	8	140		36	4
JHD1-48/JHD1-48	250	90	90	8	8	100	100	48	4
JH DU60/JHD1-60	310	90	90	8	9	130	130	60	6
JH DU72/JHD72	370	90	90	8	9	130	130	72	6
JH DU84/JHD84	430	90	90	8	9	130	130	84	6
JH DU96/JHD96	490	90	90	8	9	130	130	96	6
JH GU200/JHG200	170	139		10			86		3
JH GU260/JHG260	230	139		10			86		4
JH GU320/JHG320	290	139		10			86		5
JH GU380/JHG380	350	139		10			116		6
JH GU440/JHG440	410	139		10			146		7
JH GU500/JHG500	470	139		10			146		8
JH GU560/JHG560	530	139		10			146		9
JH GU620/JHG620	590	139		10			146		10

**Material specification**

Standard material:

S355JR according to EN10025 + electroplated zinc Fe/Zn12/B according to EN2081 or comparable

Alternative:

S235JR according to EN10025 + electroplated zinc Fe/Zn12/B according to EN2081 or comparable

The capacities [kN] in the tables are based on the application with the following fastener:

CNA-nails and CSA-screws according to ETA04/0013

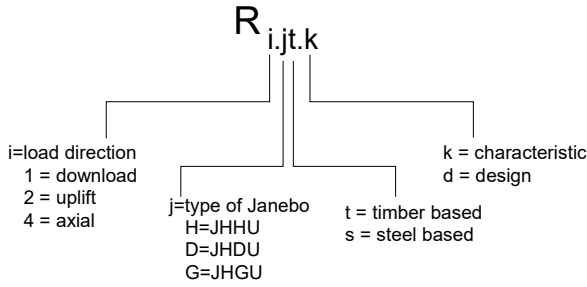
Steel dowel Ø12mm with  $f_{u,k} = 360 \text{ N/mm}^2$ 

For installation for fire justification, see clause B6

### Characteristic capacities

The checks below have to be made for both parts of a connection, eg: JHH with JHDU or JHHU with JHGU, the weakest part is decisive.

$$R_{i,j,d} = \min \left\{ R_{i,jt,k} ; \frac{R_{i,js,k}}{k_{\text{mod}}} \right\} \times k_{\text{mod}} / \gamma_M$$



$$R_{i,jt,d} = R_{i,jt,k} \times k_{\text{mod}} / \gamma_M$$

$$R_{i,js,d} = R_{i,js,k} / \gamma_M$$

$$\eta_{1,j,s} = \frac{F_{1,d}}{R_{1,js,d}}$$

$$\eta_{1,j,t} = \frac{F_{1,d}}{R_{1,jt,d}}$$

Or for uplift:

$$\eta_{1,j,s} = \frac{F_{2,d}}{R_{2,js,d}}$$

$$\eta_{1,j,t} = \frac{F_{2,d}}{R_{2,jt,d}}$$

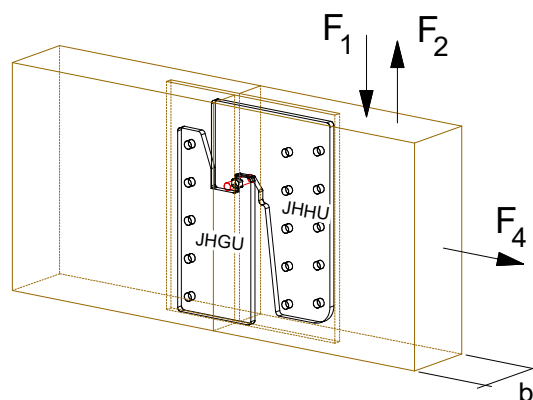
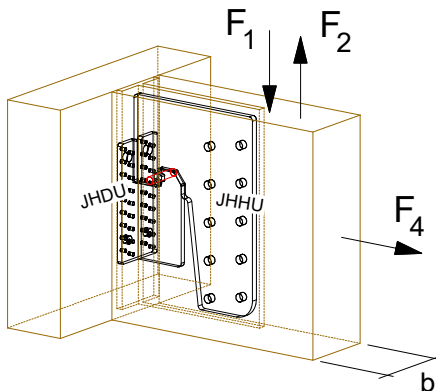
The factors  $k_{4,j,t}$  and  $k_{4,j,s}$  are given in the table for the respective values  $\eta_i$ .

Check:

$$\frac{F_{1,d}}{R_{1,j,d}} \leq 1 \quad \text{and} \quad \frac{F_{4,d}}{R_{4,jt,d}} \leq k_{4,jt} \quad \text{and} \quad \frac{F_{4,d}}{R_{4,js,d}} \leq k_{4,js}$$

Or for uplift (only for the types ...U/xx):

$$\frac{F_{2,d}}{R_{2,j,d}} \leq 1 \quad \text{and} \quad \frac{F_{4,d}}{R_{4,jt,d}} \leq k_{4,jt} \quad \text{and} \quad \frac{F_{4,d}}{R_{4,js,d}} \leq k_{4,js}$$



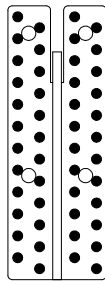
For timber elements with a density  $\rho_k > 350 \text{ kg/m}^3$ , values can be increased as shown by the following table:

R <sub>i,jt,k</sub> values may be increase:			
	to $\rho_k$ [kg/m <sup>3</sup> ]		
from $\rho$	380	410	430
350	<b>1,04</b>	<b>1,08</b>	<b>1,11</b>

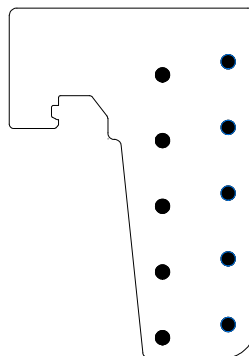
The values from the tables D12-2, D12-4 and D12-6 are based on a full nailing, using of all steel dowel holes.

standard connection  
to use all nailholes / all holes for steel dowel

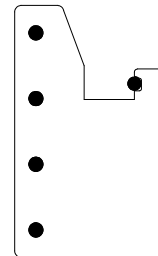
JHDUxx



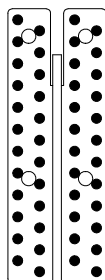
JHHUxx



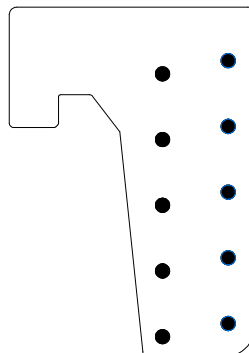
JHGUxx



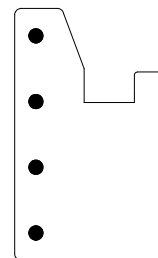
JHD1-xx  
JHDxx



JHHxx



JHGxx



The steel based capacities for products, made from the material S235JG, have to be multiply with the factor 0,65 .







**Connection to Column:**

It's possible to use the JH DU also for connection to column, in this case it is to use a nail pattern as shown following

In this case, the capacity for connection to beam shall be multiply with the factors are given in the following both tables.

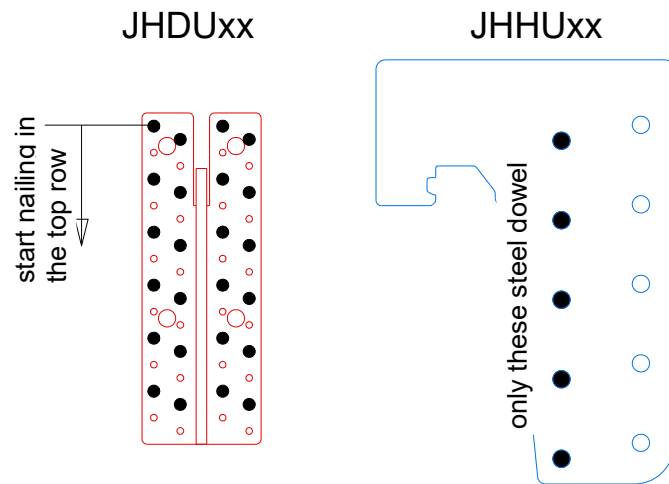
**Table D12-10: Column factors JH DU**  
factors for "column" nail pattern

for	JH DU20	JH DU24	JH DU36	JH DU48	JH DU60	JH DU72	JH DU84	JH DU96
R <sub>1,Dt.k</sub>	0,61	0,51	0,56	0,50	0,53	0,50	0,52	0,50
R <sub>4,Dt.k</sub>	0,25	0,57	0,58	0,54	0,55	0,53	0,53	0,52
R <sub>2,Dt.k</sub>	0,62	0,54	0,56	0,51	0,53	0,50	0,52	0,50

**Table Dx-11: Column factors JH HU**  
factors for "column" dowel pattern

for	JH HU 140	JH HU 180	JH HU 200	JH HU 260	JH HU 320	JH HU 380	JH HU 440	JH HU 500	JH HU 560	JH HU 620
R <sub>1,Ht.k</sub>	0,47	0,51	0,51	0,54	0,56	0,57	0,59	0,61	0,62	0,64
R <sub>4,Ht.k</sub>	0,78	0,76	0,73	0,64	0,62	0,64	0,62	0,61	0,61	0,60

column / partial connection





### Connection to concrete / rigid support

#### Force direction F<sub>1</sub> / F<sub>2</sub>

The anchorage has to have a capacity, to absorb the following described forces.

Download:

Each of the both upper bolts has to have a axial capacity of min:

$$R_{ax.bolt.d} \geq F_{1,d} \times 24mm / (e_{bolt} \times 2)$$

Uplift (only for connection with minimum 4 bolts):

Both lower bolts have to have an axial capacity of min:

$$R_{ax.bolt.d} \geq F_{2,d} \times 64mm / (e_{bolt} \times 2)$$

Each of the bolts must have a lateral capacity of min:

$$R_{lat.bolt.d} \geq F_{1,d} / n_{bolt}$$

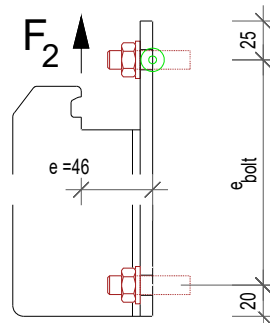
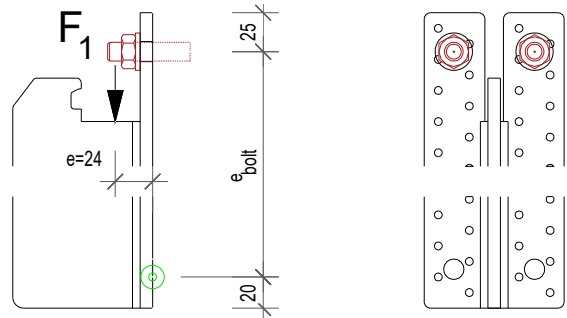
or

$$R_{lat.bolt.d} \geq F_{2,d} / n_{bolt}$$

with:

$e_{bolt}$  = size A – 50mm

$n_{bolt}$  = number of all bolts



The limit for the axial force is given with 5,3 kN for each of the upper bolts, and a limit for the lateral force in each bolt with 30,0 kN.



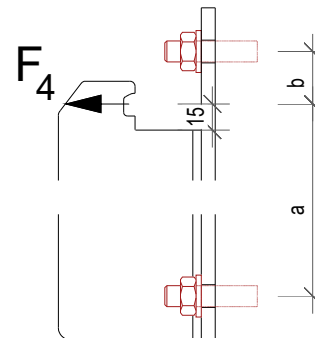
The active force in the bolts can be determined also with software, e.g. anchor designer

#### Force direction F<sub>4</sub>

The force in the upper bolts have to be calculate as following:

$$F_{upper.bolt.ax.d} = F_{4,d} \times a / ((a+b) \times 2)$$

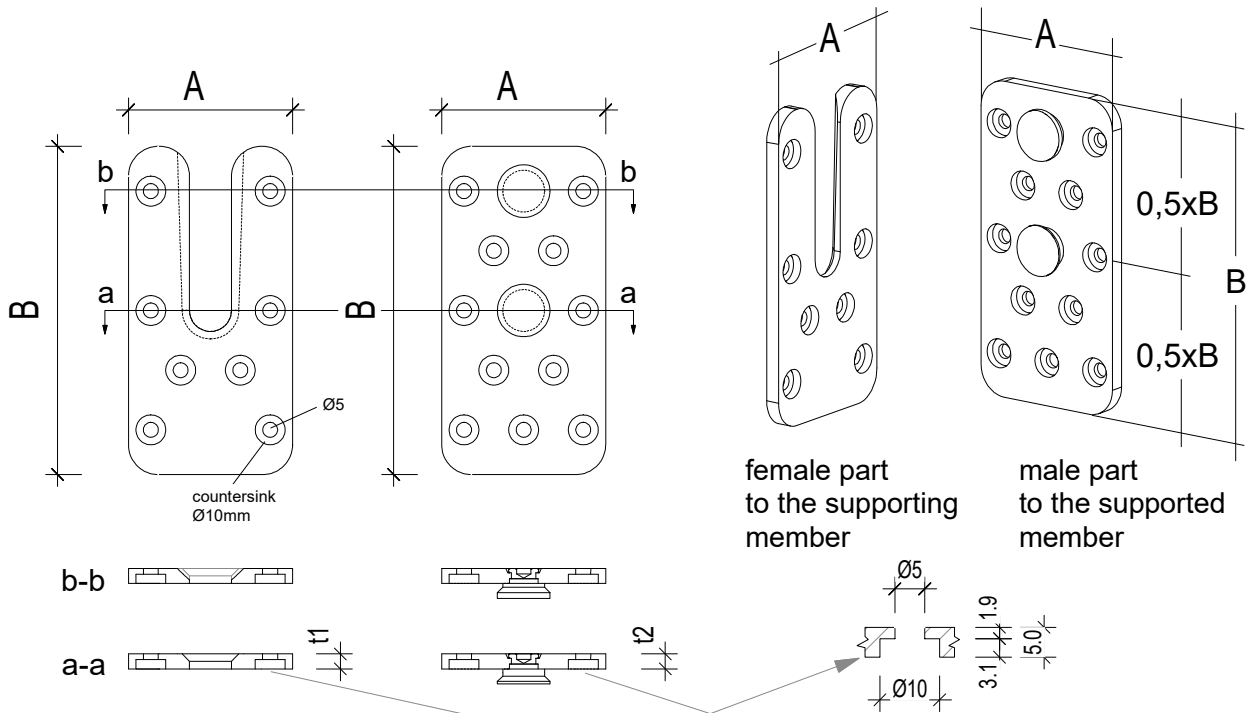
The limit for the axial force is also given with 5,3 kN for each of the upper bolts.



**D13 ATFN**

Product Name	UK	France	DK	D
	ATFN			

**Drawings**



type	dimension [mm]				number of holes	
	A	B	t1	t2	female part	male part
ATFN55/110	55	110	5	5	8	11
ATFN55/150	55	150	5	5	11	15
ATFN55/190	55	190	5	5	14	21
ATFN75/150	75	150	5	5	17	22
ATFN75/190	75	190	5	5	21	28

**Material specification**

Plates: S355MC according to EN10149 + -Fe/Zn12/A or Fe/Zn12/B acc. to EN 2081

Pins: steel with a minimum yield strength of 580N/mm<sup>2</sup> a minimum tensile strength of 610 N/mm<sup>2</sup> and a minimum ultimate strain of 16%. The pins are connected with the plates by compression strain

Connection to the supporting member: CNA-nails and CSA-screws according to ETA04/0013

Connection to the supported member: CSA-screws according to ETA04/0013

For installation for fire justification, see clause B6

**Characteristic capacities**

For connection, where the header is prevented for rotation:

$$R_{1,k} = \min (R_{1,J,k} ; R_{1,H,k})$$

$$R_{3,k} = 0,5 \times R_{1,k}$$

$$R_{4,k} = 0,25 \times R_{1,k}$$

For connection, where the header is free to rotate:

$$R^e_{1,k} = \min (R^e_{1,J,k} ; R^e_{1,H,k})$$

$$R^e_{3,k} = 0,5 \times R^e_{1,k}$$

$$R^e_{4e,k} = 0,25 \times R^e_{1,k}$$

For load combination:

$$\left( \frac{F_{1,d}}{R_{1,d}} \right)^2 + \left( \frac{F_{3,d}}{R_{3,d}} \right)^2 + \left( \frac{F_{4,d}}{R_{4,d}} \right)^2 \leq 1,0$$

For  $R^e_{i,d}$  correspondingly

Where:

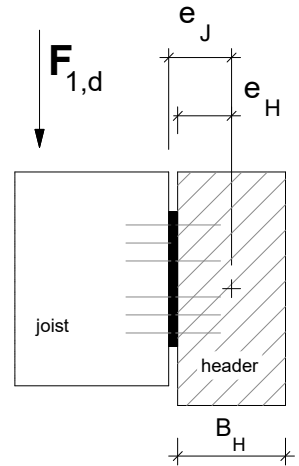
$$R_{1,J,k} = \min \begin{cases} 240 \times f_{h,J,k} \left[ \sqrt{2 + \frac{1,84}{f_{h,J,k}}} - 1 \right] + 2 \times \rho_{k,J}^{0,8} \\ 375 \sqrt{f_{h,J,k}} + 2 \times \rho_{k,J}^{0,8} \\ 240 \times f_{h,J,k} \end{cases}$$

$$R_{1,H,k} = \frac{1}{\sqrt{\left( \frac{1}{n_H \times R_{lat,H,k}} \right)^2 + \left( \frac{10 \times z_{max,H}}{I_{p,H} \times R_{ax,H,k}} \right)^2}}$$

$$R^e_{1,J,k} = \frac{1}{\sqrt{\left( \frac{1}{R_{1,J,k}} \right)^2 + \left( \frac{e_J \times z_{max,J}}{I_{p,J} \times 7,5 \times \rho_{k,J}} \right)^2}}$$

$$R^e_{1.H.k} = \frac{1}{\sqrt{\left(\frac{1}{n_H \times R_{lat.H.k}}\right)^2 + \left(\frac{e_H \times z_{max.H}}{I_{p.H} \times R_{ax.H.k}}\right)^2}}$$

- $n_J$  number of screws in the joist
- $n_H$  number of screws/nails in the header/column
- $f_{h.J.k}$  joist embedding strength in N/mm<sup>2</sup>;  $f_{h.J.k} = 0,0047 * \rho_{k.J}^{1.24}$
- $\rho_{k.J}$  characteristic density of joist in kg/m<sup>3</sup>;  $\rho_{k.J} \leq 460 \text{ kg/m}^3$
- $R_{lat.H.k}$  the characteristic lateral capacity of the fastener in the header
- $R_{lat.J.k}$  the characteristic lateral capacity of the fastener in the joist
- $R_{ax.H.k}$  the characteristic axial capacity of the fastener in the header
- $R_{ax.J.k}$  the characteristic axial capacity of the fastener in the joist
- $e_J$  eccentricity of the joist connection in mm , generally  $e_J = 0,5 B_H + 10 \text{ mm}$
- $e_H$  eccentricity of the header connection in mm; generally  $e_H = 0,5 B_H$
- $B_H$  header width in mm



type	$I_{p.H} / z_{max.H}$	$I_{p.J} / z_{max.J}$
ATFN55/110	156	260
ATFN55/150	286	474
ATFN55/190	436	752
ATFN75/150	424	619
ATFN75/190	910	1000