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



European Technical Assessment ETA-21/0482 of 2021/07/05

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 Universal brackets, Purlin anchors,
Joist anchors
See type numbers in section II.1 of the ETA

Product family to which the above construction product belongs:

Three-dimensional nailing plate (timber-to-timber/timber-to-concrete brackets/anchors)

Manufacturer:

Simpson Strong-Tie Int. Ltd
For local branch addresses refer to www.strongtie.eu

Manufacturing plant:

SIMPSON STRONG-TIE Manufacturing facilities

This European Technical Assessment contains:

45 pages including 25 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:

EAD 130186-00-0603 for Three-dimensional nailing plates

This version replaces:

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II SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

This ETA covers the following connectors:

A34, A35, H2.5, H2.5A, H4, LTS, MTS, PFE 170 to 250, PFU 170 to 250, PSD, PSG, PSTD, PSTG, SPF170 to 370, UNI96, UNI100, UNI130, UNI190.

The brackets/anchors are one piece, non-welded, timber-to-timber brackets/anchors /timber to support (concrete, steel) brackets/anchors. They are connected to the timber elements/support by a range of nails, screws or bolts.

The brackets/anchors are made from pre-galvanized steel Grade S250GD + Z275 according to EN 10346 with tolerances according to EN 10143 except if another material is stated. Material, dimensions and nail positions are shown in Annex D and typical installations are shown in Annex B.

All the brackets/anchors can also be produced from stainless steel number 1.4401, 1.4404, 1.4521, 1.4301 or 1.4509 according to EN 10088-2 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.

In the rest of this document, the steel types will be named as:

Steel ref. 1: S250GD + Z275

Steel ref. 2: Stainless Steel 1.4401, 1.4404, 1.4521

Steel ref. 3: Stainless Steel 1.4301, 1.4509

Steel ref. 4: SS Grade 33 + G90 (~Z275) or G185 (~Z600)

Steel ref. 5: S350GD + Z275

Steel ref. 6: S250GD + Z800 or ZM310 or similar coatings acc. to EN 10346, that has been tested to ISO 11997-1 Cyclic Corrosion Testing In artificial Atmosphere.

Steel ref. 7: Similar to steel ref. 6 but S350GD + Z800.

The connectors can be applied with a coloured top paint.

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

The brackets/anchors are intended for use in making connections in load bearing structures, as a connection between two timber beams or a timber beam and a timber post or between a timber member and a concrete/steel member, 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 connection may be with a single angle bracket/anchor or with a bracket/anchors on each side of the fastened timber member.

The static and kinematic behaviour of the timber members or the supports shall be as described in Annex C.

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a characteristic density from 290 kg/m³ to 420 kg/m³.

This 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 C14-C40 according to EN 338 / EN 14081 when structural adhesives are used.
- Glued laminated 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
- Laminated Strand Lumber, e.g. Parallam and Timber Strand
- Plywood according to EN 636
- Oriented Strand Board, OSB according to EN 300
- Cross Laminated Timber (CLT) acc. to EN 16351 or ETA

Annex D states the load-carrying capacities of the Brackets/anchors connections for a characteristic

density of 350 kg/m³.

For timber or wood-based material with a lower characteristic density than 350 kg/m³ the load-carrying capacities shall be reduced by the k_{dens} factor (see Annex C)

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code. The wood members shall have a thickness, which is larger than the penetration depth of the nails into the members

The brackets/anchors may also be used for connections between a timber member and a member of concrete, steel or masonry.

The brackets/anchors are primarily for use in timber structures subject to the dry, internal conditions defined by service class 1 and 2 of Eurocode 5 and for connections subject to static or quasi-static loading.

The brackets/anchors can also be used in outdoor timber structures, service class 3, when a corrosion protection in accordance with Euro Code 5 is applied, or when stainless steel with similar or better characteristic yield and ultimate strength is employed (steel ref. 2, 3 and 6)

The scope of the hangers regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2

The provisions made in this European Technical Assessment are based on an assumed intended working life of the brackets/anchors 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 **Characteristics of product and assessment**

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex D
Stiffness	No performance assessed
Ductility in cyclic testing	No performance assessed
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The brackets/connectors are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
3.4 General aspects related to the performance of the product	
	The brackets/anchors 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 dry internal conditions defined by service class 1, 2 and 3
3.5 Identification	
	See Annex D

*) See additional information in section 3.6 – 3.9.

3.6 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities have been calculated considering different ratios between the partial factors for timber connections and steel cross sections.

According to clause 6.3.5 of EN 1990 (Eurocode – Basis of structural design) the characteristic resistance for structural members that comprise more than one material acting in association should be calculated as

$$R_d = \frac{1}{\gamma_{M,1}} R \left\{ \eta_1 X_{k,1}; \eta_i X_{k,i(i>1)} \frac{\gamma_{m,1}}{\gamma_{m,i}}; a_d \right\}$$

where $\gamma_{M,1}$ is the global partial factor for material 1 (in this case wood), $\gamma_{m,1}$ is the partial factor on the material and $\gamma_{m,i}$ are material partial factors for the other materials, i.e. the calculations are made with material parameters modified by multiplication by

$$k_{modi} = \gamma_{m,1} / \gamma_{m,i}$$

The characteristic load-carrying capacities have been calculated considering a ratio between the partial factor for timber connections and steel cross sections

$$k_{modi} = 1,18 \quad (EC5: k_{modi} = \frac{1,30}{1,10} = 1,18)$$

For $k_{modi} > 1,18$ the load-carrying capacities stated in Annex D are valid (on the safe side).

For $k_{modi} < 1,18$ the load-carrying capacities stated in Annex D have to be multiplied by a factor

$$f = \frac{k_{modi}}{1,18}$$

3.7 Mechanical resistance and stability

See annex D for characteristic load-carrying capacity in the different directions F_1 to F_5 .

The characteristic capacities of the brackets/anchors 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 Eurocode 5 or a similar national Timber Code.

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.

For some Brackets/anchors, the performance has been determined in relation to the joint's stiffness properties - to be used for the analysis of the serviceability limit state.

Fasteners

The load bearing capacities of the brackets have been determined based on the use of Connector nails CNA or connector screws CSA in accordance with ETA-04/0013.

It is allowed to use other connector nails or connector screws in accordance with the standard EN 14592 with the same or better performance than the used 4,0 mm CNA Connector nails and still achieve the same load-bearing capacity of the connection.

For some brackets the load bearing capacities have been determined based on the use of bolts or powder actuated pins or wood screws – see Annex C3 for complete list.

For any other information about fasteners or characteristic capacity modification method for different fasteners, please see Annex C.

The brackets/anchors can be mounted using different nail/screw patterns. The nail/screw patterns for each angle bracket and different connection type is described and shown in annex D.

Stainless steel

All the Brackets/anchors can also be produced from stainless steel number 1.4401, 1.4404, 1.4521 (Steel ref. 2) and 1.4301, 1.4509 (Steel ref. 3) according to EN 10088-2 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. The characteristic load carrying capacities can be considered as the same as those published in this document subject to the use of stainless CNA connector nails or CSA connector screws covered by the ETA-04/0013 or stainless threaded nails or screws in accordance to the standard EN 14592 respecting the rules given in the paragraph "fasteners" above.

3.8 Aspects related to the performance of the product

3.8.1 Corrosion protection in service class 1 and 2.

In accordance with EAD 130186-00-0603 shall the brackets/anchors have a zinc coating weight of Z275. The steel employed is S250 GD with Z275 (Steel ref. 1 or 4) according to EN 10346.

3.8.2 Corrosion protection in service class 3.

In accordance with Eurocode 5 the Brackets/anchors shall be produced from stainless steel (Steel ref. 2 or 3).

3.9 General aspects related to the use of the product

Simpson Strong-Tie Universal brackets, Purlin anchors and Joist anchors 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.

4 Assessment and verification of constancy of performance (AVCP)

AVCP system

According to the decision 97/638/EC of the European Commission¹, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 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 2021-07-05 by



Thomas Bruun
Managing Director, ETA-Danmark A/S

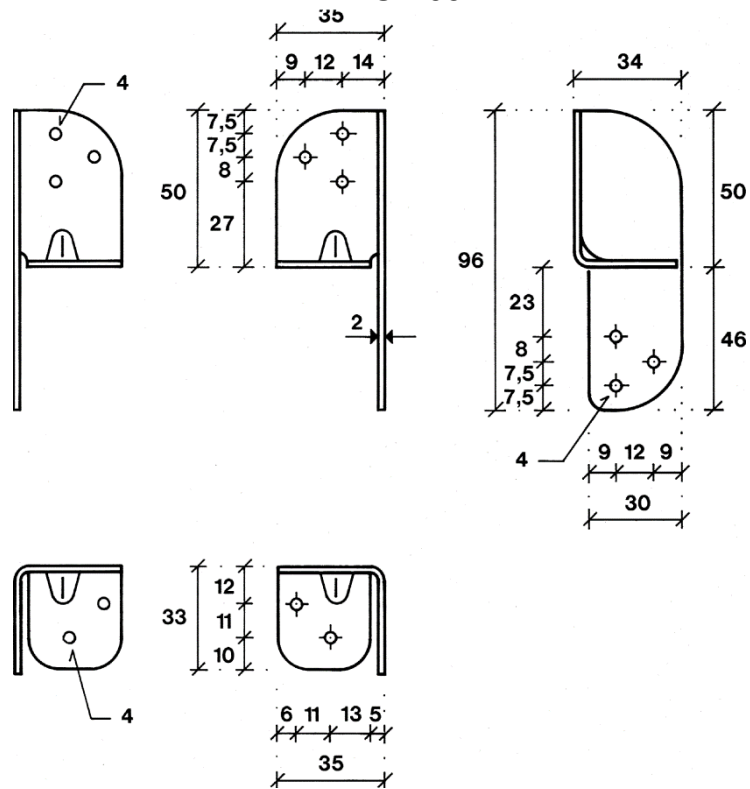
Annex A - Revision History

Modifications and additions to the previous ETA-07/0137	
Page/chapter	Update
All	Minor typing errors and table formatting corrected.
4	Add the option for a colored top point for all products, as option
4	Addition of ZM310
All	Rename the products according to the current "article" names
21/ 41	SPF with bolt holes
44	A35 additional capacity with N3.75x30

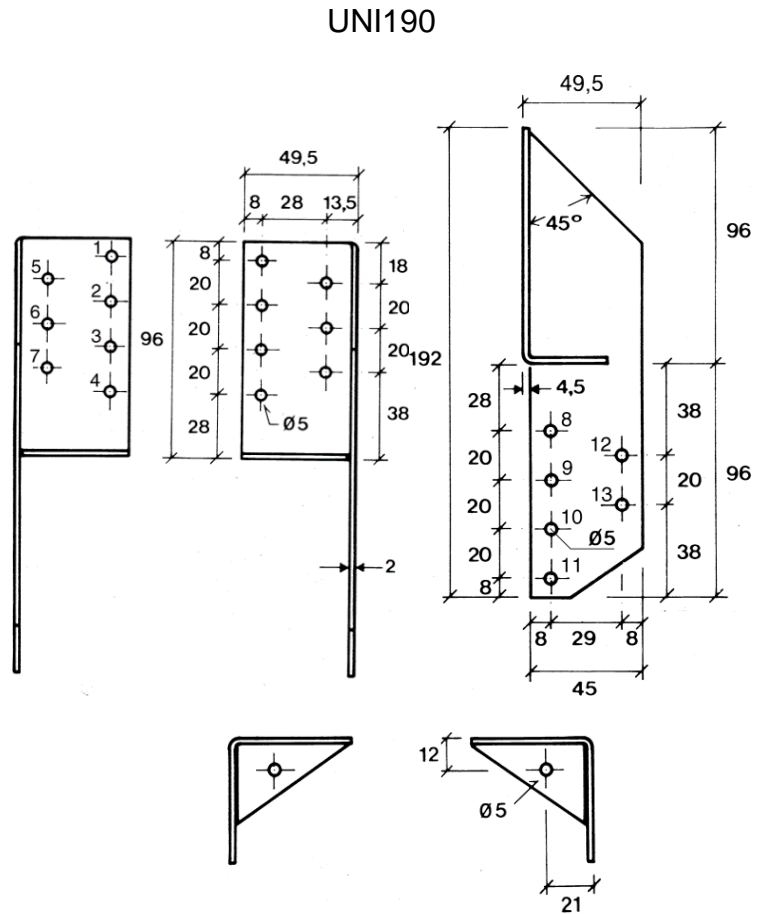
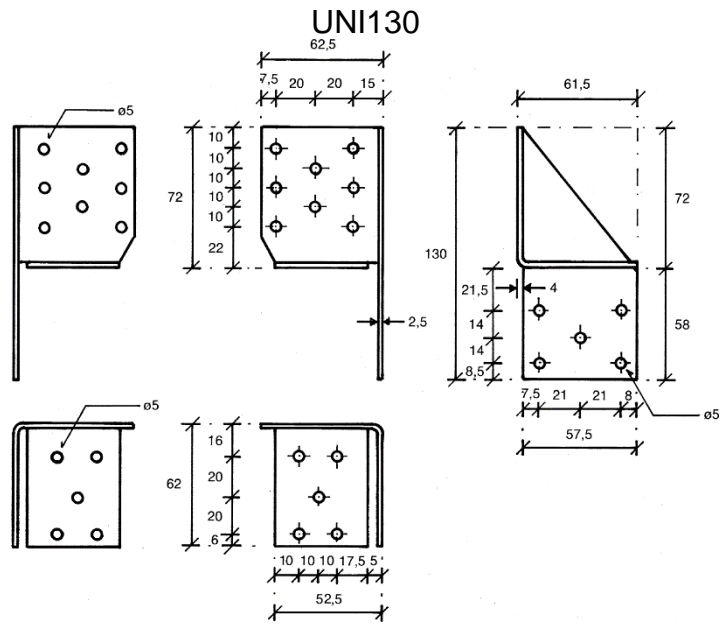
Annex B - Products and description

B 1. Universal bracket Typ UNI

UNI96



UNI100



Direction of forces nails patterns and other assumptions

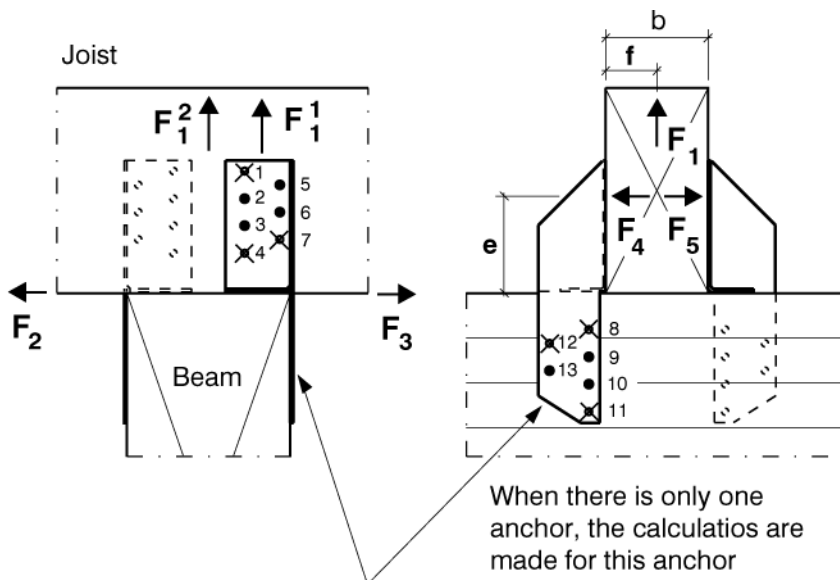
Universal brackets

For the brackets: UNI190, UNI130, UNI100 and UNI96 the calculations cover the load-carrying capacities of the connections for nail patterns and forces in the directions shown in the figures below:

UNI190

Directions of forces, nail numbers and definition of forces on a single bracket. The 2 brackets are placed diagonally.

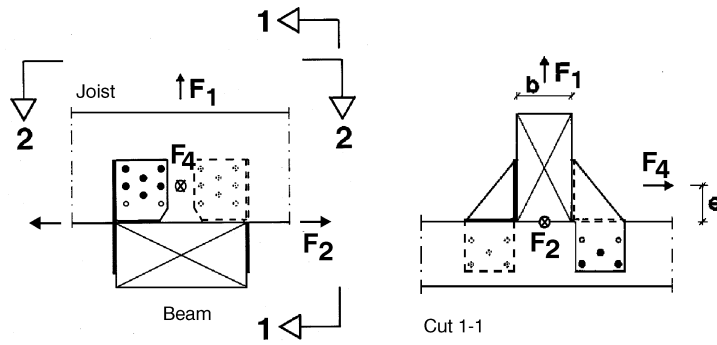
Nails pattern:



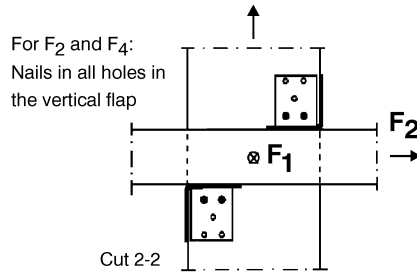
Nail pattern:

- ✕ 3 nails in each end of the bracket: nails in hole no
1, 4, 7 / 8, 11, 12
- 6 nails in each end of the bracket: nails in hole no
1, 2, 3, 5, 6, 7 / 8, 9, 10, 11, 12, 13

UNI130

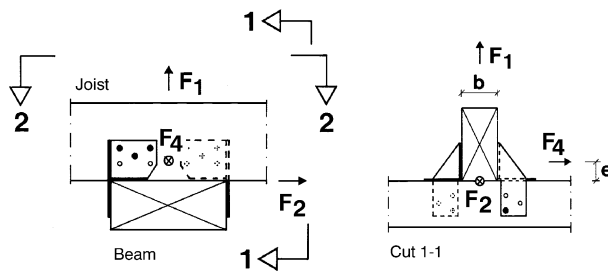


$F_2 = F_3$
 $F_4 = F_5$

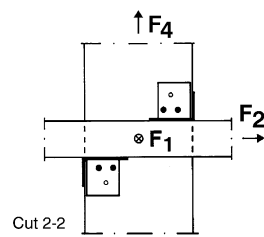


- holes
- nails

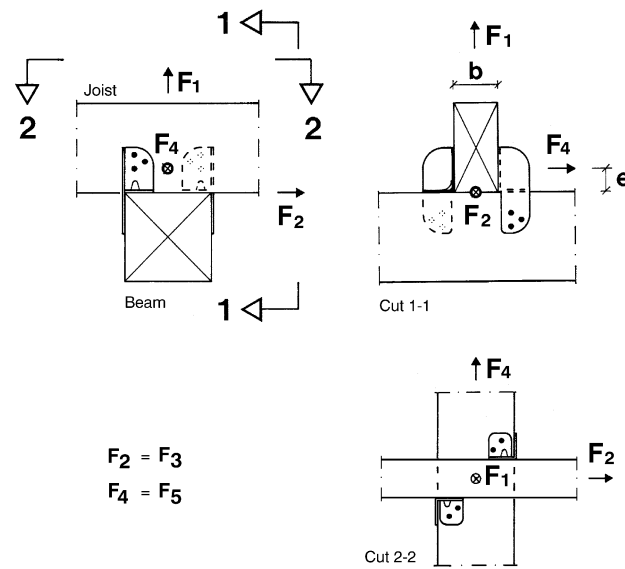
UNI100



$F_2 = F_3$
 $F_4 = F_5$



- holes
- nails

UNI96**UNI96:** direction of forces and nail pattern

It is assumed that forces are positioned in the following way in relation to the connection:

- F_1 - Lifting force
Typically 2 brackets are used, one on each side of the joist. Therefore, it is assumed that the lifting force is acting at the bending line of the bracket.
If there is only 1 bracket in the connection but it is secured by the static behaviour of the structure, that the force is acting in the bending line of the bracket then the lifting capacity is half that of a connection with 2 brackets. An example: A single bracket connecting a post to a sill.
- **UNI190:** F_1 - Lifting force acting with a horizontal eccentricity f .
If the lifting force is acting on a single bracket, as assumed for UNI190, then the capacity depends on the eccentricity f .
- F_2 or F_3 - Axial force in the direction of the purlin.
It is assumed that the purlin is supported at each end so the force will act at the bottom of the joist.
- F_4 or F_5 - Force perpendicular to the purlin.
Typically 2 brackets are used, one on each side of the joist. But also only one bracket can be used. The capacity depends on the eccentricity e .
For a single bracket it also depends on whether the force is compressed against the bracket (F_4) or if it results in tension in the nails (F_5). Capacities for a single bracket is stated for UNI190.

Combination of forces

When the bracket connection is subjected to more than one of the forces the strength verification can be made by verifying that the following inequalities are valid:

For UNI96, UNI100 and UNI130 subjected to F_1 , F_2 or F_4 :

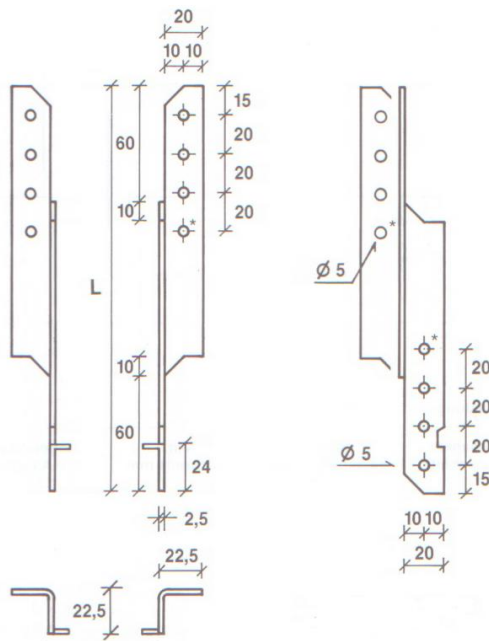
$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{2,d}}{R_{2,d}} + \frac{F_{4,d}}{R_{4,d}} \leq 1,0$$

For UNI190:

$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{2,d}}{R_{2,d}} + \frac{F_{3,d}}{R_{3,d}} + \frac{F_{4,d}}{R_{4,d}} + \frac{F_{5,d}}{R_{5,d}} \leq 1,0$$

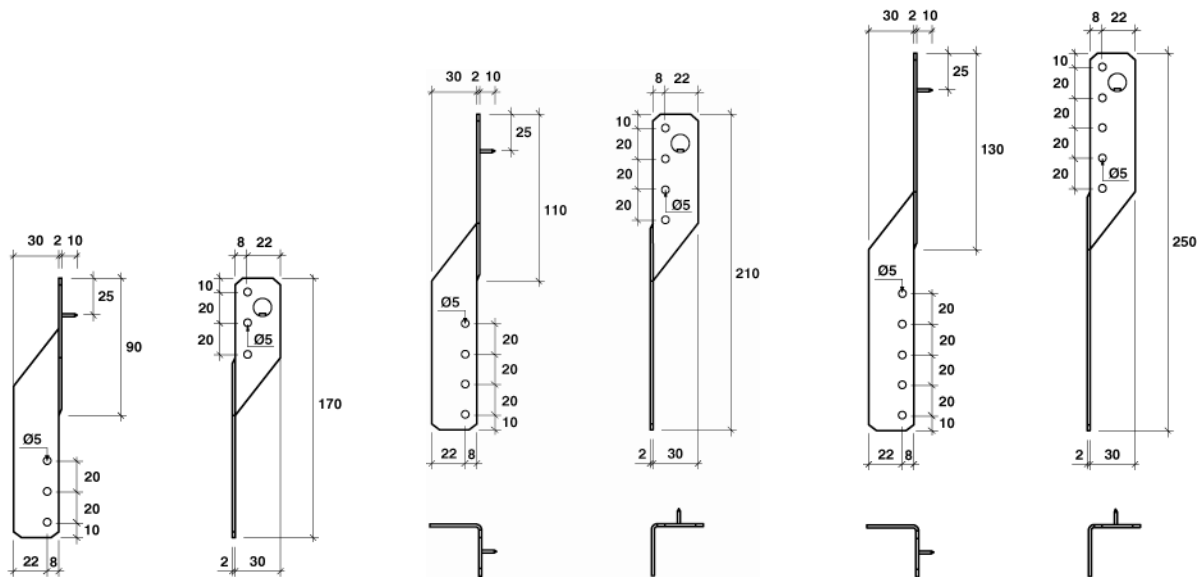
If F_{2d} has a value then $F_3 = 0$ and the other way around. Similary for F_4 and F_5 .

B 2. Joist anchors type PFE



Model No (type PFE)	L (mm)	Thick (mm)	Number of holes $\varnothing 5$ mm
PFE170	170	2.5	6
PFE210	210	2.5	8

B 3. Joists anchors type PFU



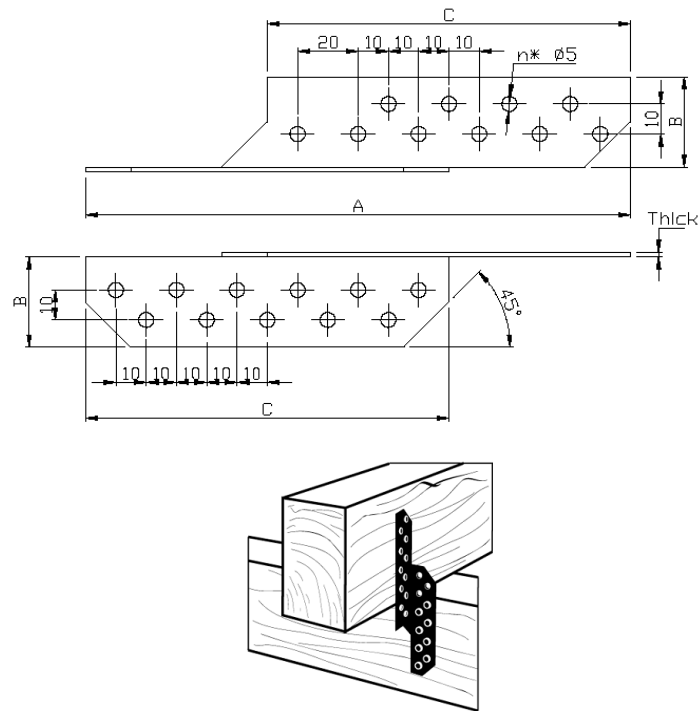
PFU 170

PFU 210

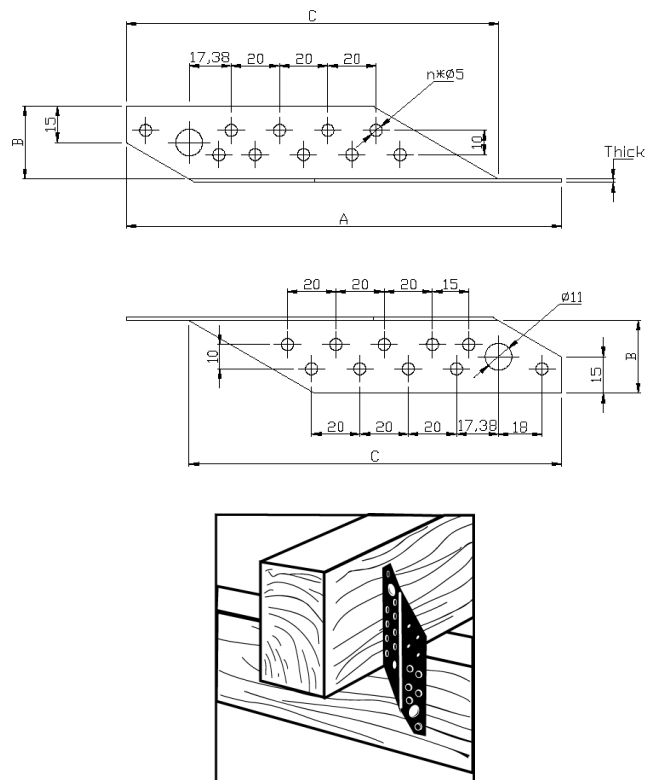
PFU 250

Model No (type PFU)	L (mm)	Thick (mm)	Number of holes $\varnothing 5$ mm
PFU170	170	2.0	6
PFU210	210	2.0	8
PFU250	250	2.0	10

B 4. Joist anchors type PSG / PSD



Joist anchor PSG and PSD



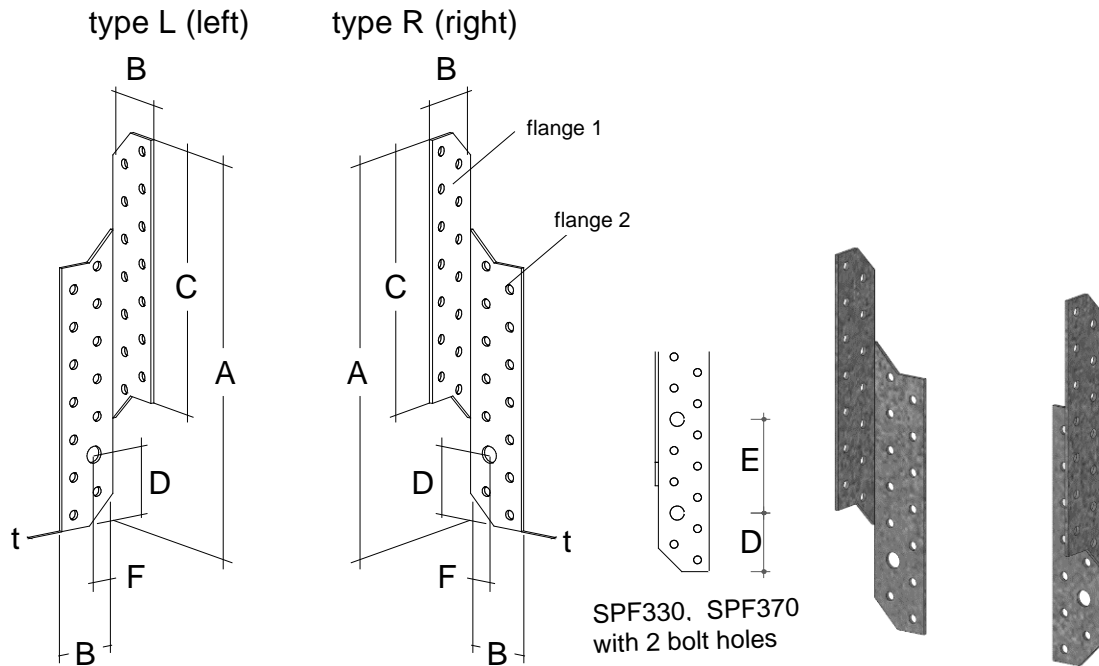
B 5. Joist anchor PSTG or PSTD 180/30/1.5

Model No./Type	A (mm)	B (mm)	C (mm)	Thick (mm)	Number of holes $\varnothing 5$ mm
PSD200/30/1.5	200	30	140	1.5	26

PSG200/30/1.5	200	30	140	1.5	26
PSD200/45/2	200	45	140	2	39
PSG200/45/2	200	45	140	2	39
PSD200/30/2	200	30	140	2	26
PSG200/30/2	200	30	140	2	26
PSD220/45/2	220	45	160	2	45
PSG220/45/2	220	45	160	2	45
PSD180/30/1.5	180	30	120	1.5	22
PSG180/30/1.5	180	30	120	1.5	22
PSTD180/30/1.5	180	30	154	1.5	20
PSTG180/30/1.5	180	30	154	1.5	20

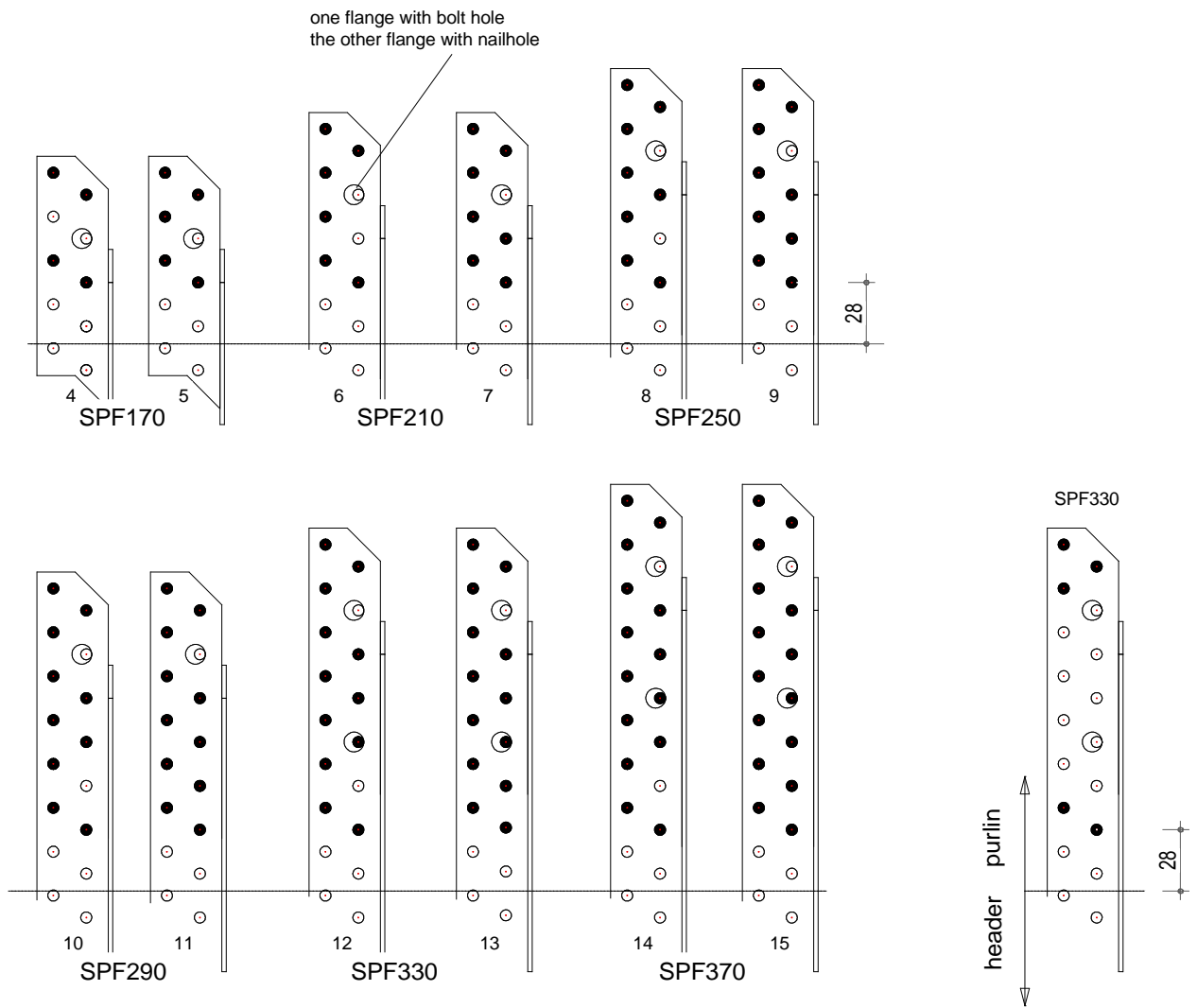
Table 3 : Joist anchors PSG / PSD / PSTG / PSTD – Dimensions A, B and C.

B 6. Purlin anchors SPF 170 to 370



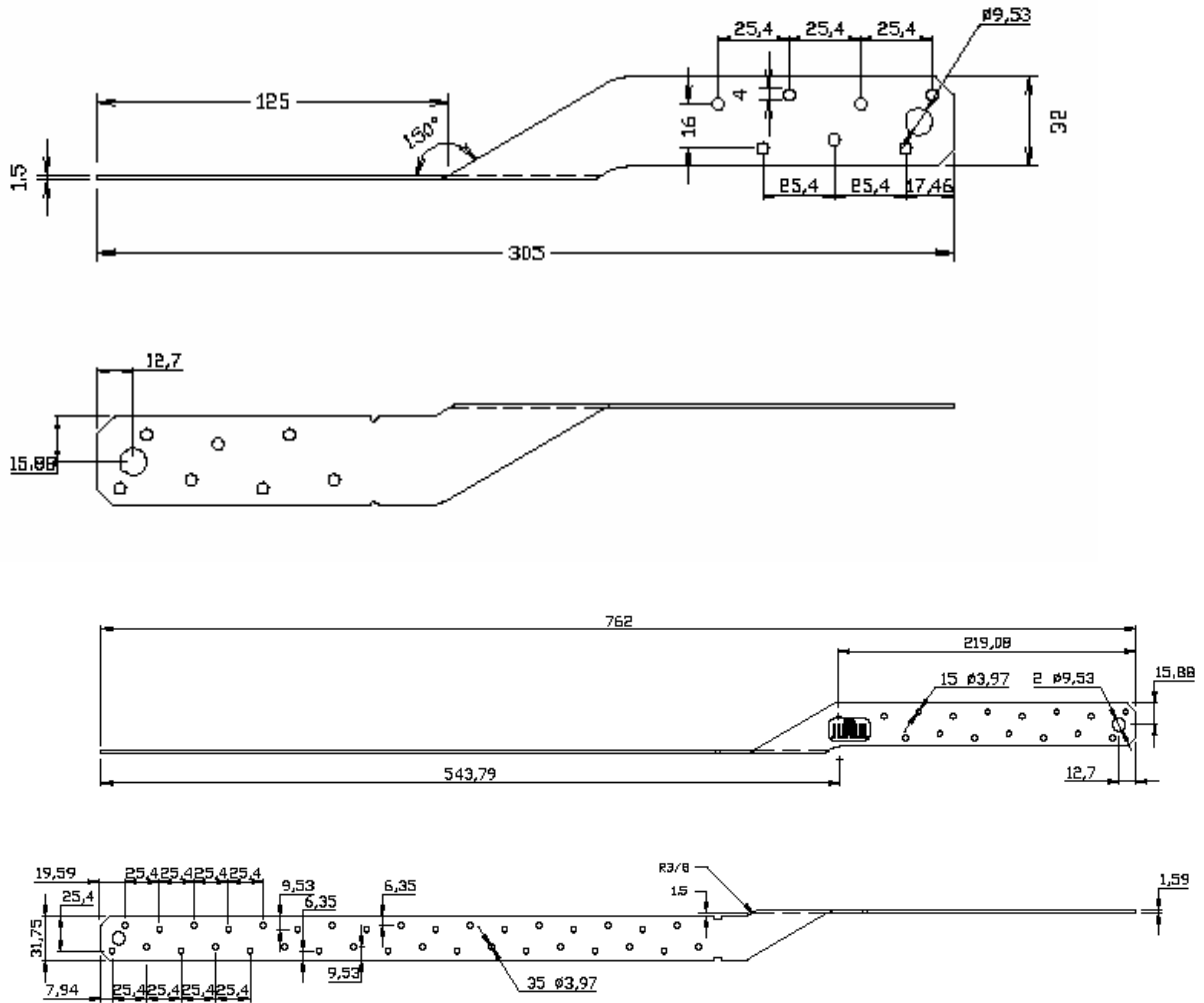
type	sizes [mm]							holes		
								Flange 1		Flange 2
	A	B	C	D	E	F	t	∅5	∅5	∅9
SPF170L	170	34,5	100	37,5		14	2	10	9	1
SPF170R	170	34,5	100	37,5		14	2	10	9	1
SPF210L	210	34,5	140	37,5		14	2	14	13	1
SPF210R	210	34,5	140	37,5		14	2	14	13	1
SPF250L	250	34,5	180	37,5		14	2	18	17	1
SPF250R	250	34,5	180	37,5		14	2	18	17	1
SPF290L	290	34,5	220	37,5		14	2	22	21	1
SPF290R	290	34,5	220	37,5		14	2	22	21	1
SPF330L	330	34,5	260	40	60	14	2	26	24	2
SPF330R	330	34,5	260	40	60	14	2	26	24	2
SPF370L	370	34,5	300	40	60	14	2	30	28	2
SPF370R	370	34,5	300	40	60	14	2	30	28	2

Table 4 : Purlin anchors SPF 170 to 370 – Dimensions A, B and C



e.g. for large SPF with a small number of nails, in this sample with 5 nails, 2 nails have to be placed on the lower side, the other starting on the top up to the number of need. For the force directions F2 to F5 have to be considered the distance of the lowermost nails with ~28mm to the lower side of the purlin, and to the upper side of the header. For the load direction F1 the distance shall be $\geq 28\text{mm}$.

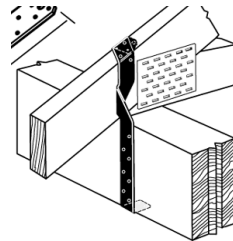
B 7. Joist anchor MTS 12



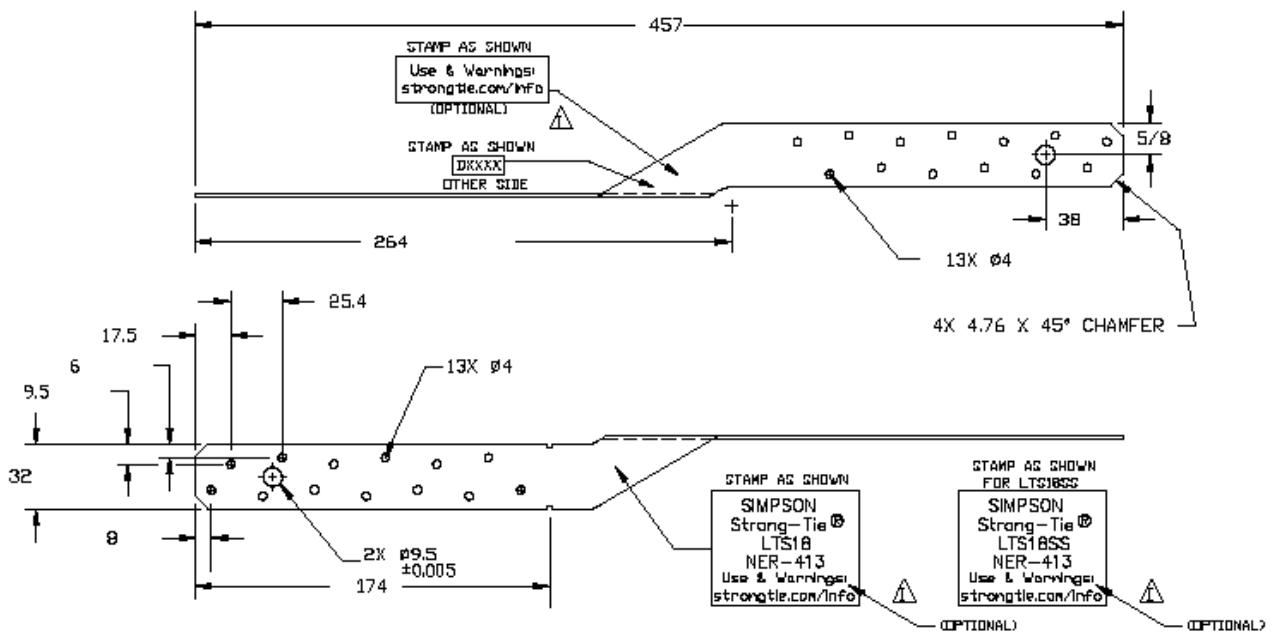
FOR MTS30Z

 APPLY STICKER
 ON JOIST LABEL
 OVER THE EXIST-
 ING PART STAMP

B 8. Joist anchor MTS 30

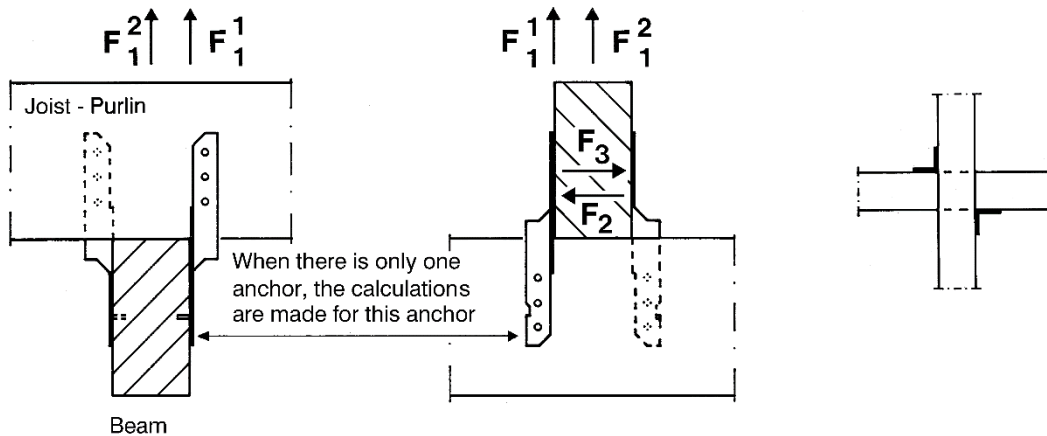


B 9. **Joist anchor LTS 18**



Joist LTS 18 – 3 dimensional view

For the purlin and joist anchors the calculations cover the load-carrying capacities of the connections for forces in the directions shown in the figure below.



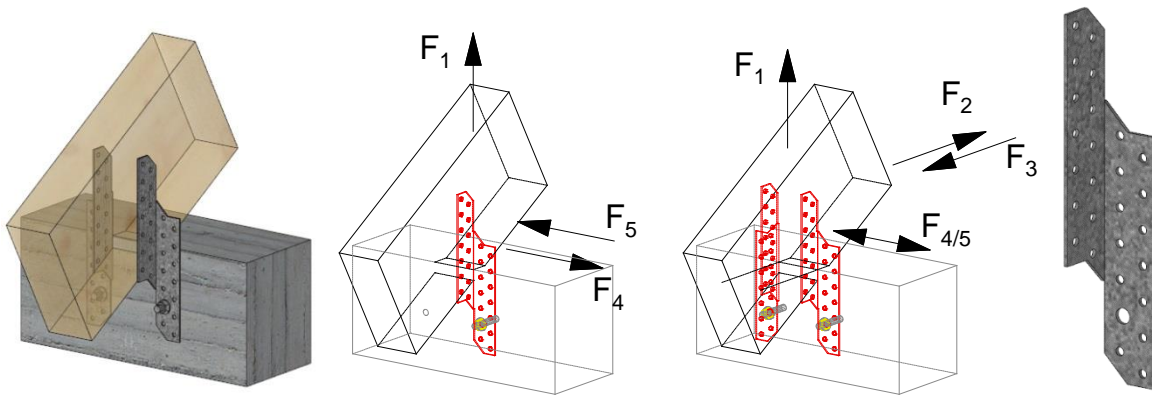
Purlin and joist anchors Direction and definition of forces on a single bracket. The 2 anchors are placed diagonally.

It is assumed that forces are positioned in the following way in relation to the connection:

- F_1 - Lifting force
Typically 2 anchors are used, one on each side of the joist, placed diagonally. Therefore, it is assumed that the lifting force is acting at the bending line of the anchor.
If there is only 1 anchor in the connection but it is secured by the static behaviour of the structure, that the force is acting in the bending line of the anchor then the lifting capacity is half that of a connection with 2 anchors. An example: A single anchor connecting a post to a sill.
- F_2 - Horizontal force perpendicular to the purlin toward the anchor
- F_3 - Horizontal force perpendicular to the purlin away from the anchor
- It is assumed that the purlin is supported at each end so the force will act at the bottom of the joist. It is assumed that the forces are acting not more than 20 mm above the surface of the beam member.
- Nail pattern: For a force F_1 the minimum nail distances to loaded and unloaded edge of the timber member shall be respected.

For a force F_2 or F_3 the nails shall be put as close to the joint as possible respecting the minimum nail distance to the edge, the beam and the joist.

For type SPF, connection to concrete

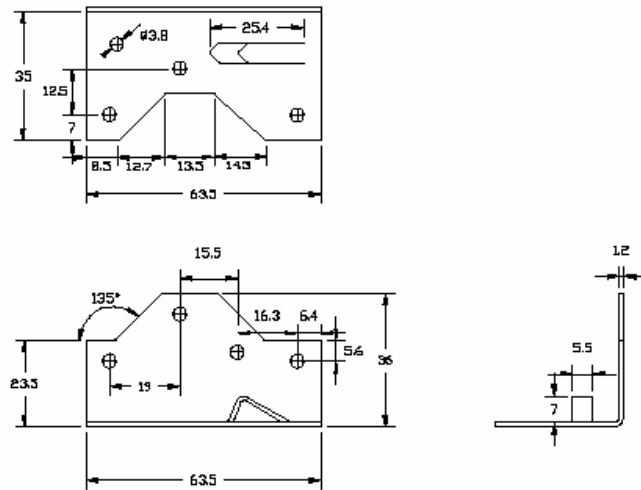


Combination of forces

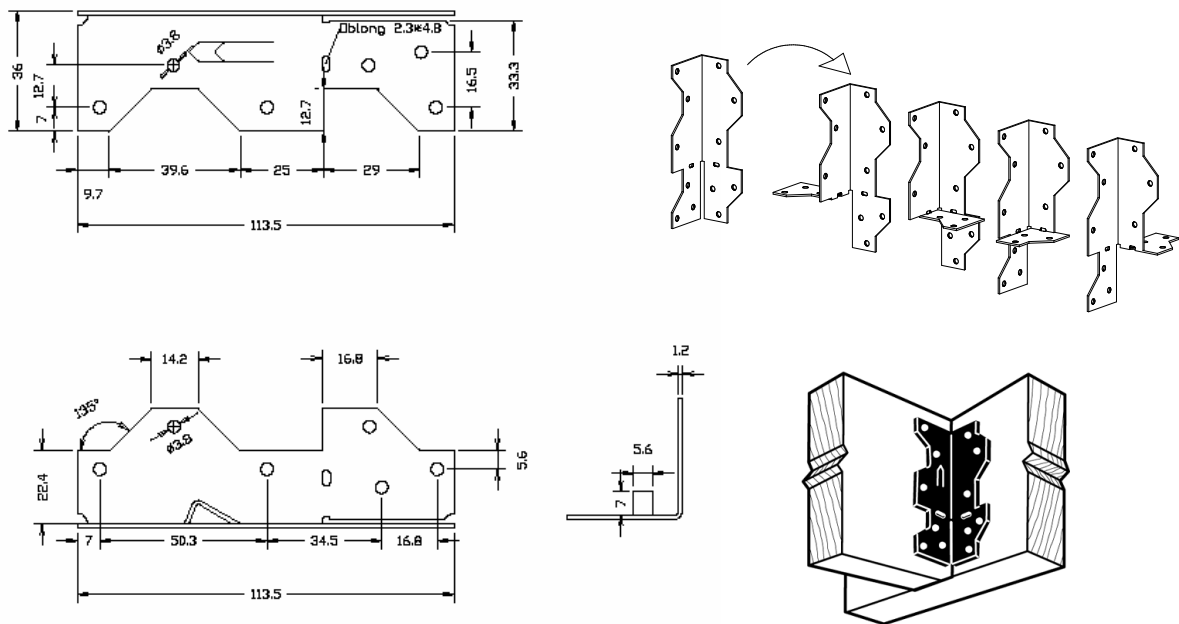
When the anchor connection is subjected to more than one of the forces the strength verification can be made by verifying that the following inequalities are valid:

For all purlin and joist anchors:
$$\sum \frac{F_{i,d}}{R_{i,d}} \leq 1.0$$

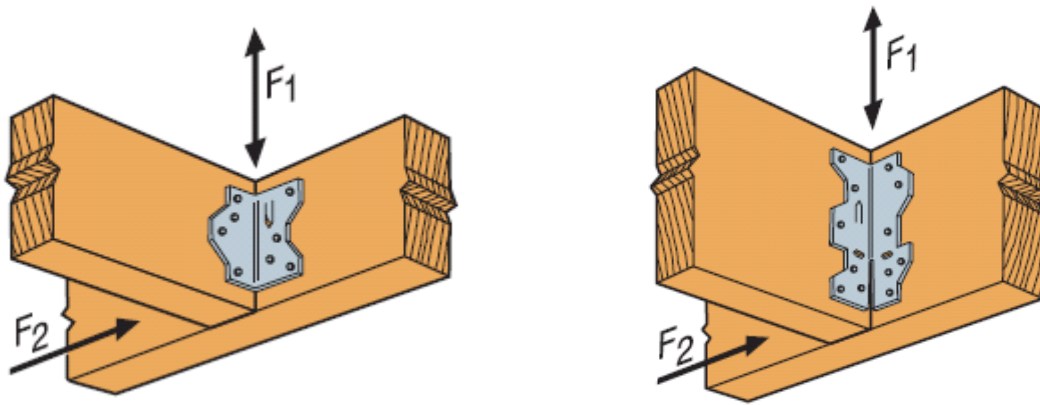
B 10. Joist anchor A34



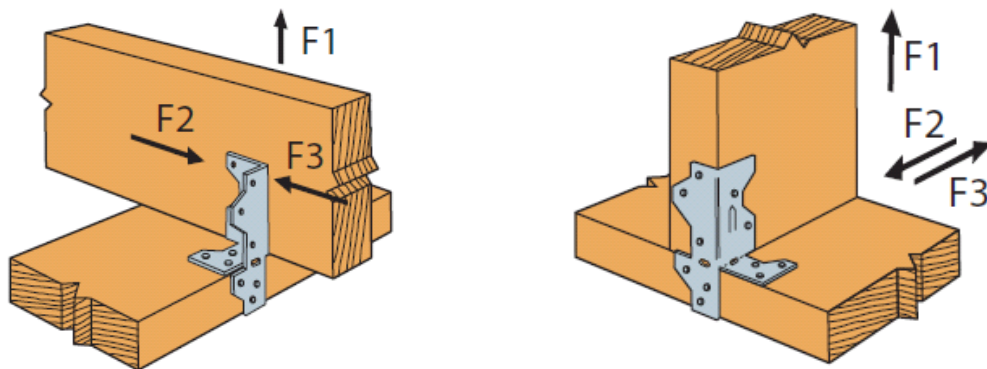
B 11. Joist anchor A35E



For the A34 and A35 joist anchors the calculations cover the load-carrying capacities of the connections for forces in the directions shown in the figure below.



For joist to beam connections F1 will be the uplift and download. For A34 the connection can be made with one joist anchor, where F2 will be the horizontal force acting parallel to the header and toward the joist anchor. For A35 the connection should be made with two joist anchors one on each side of the joist.



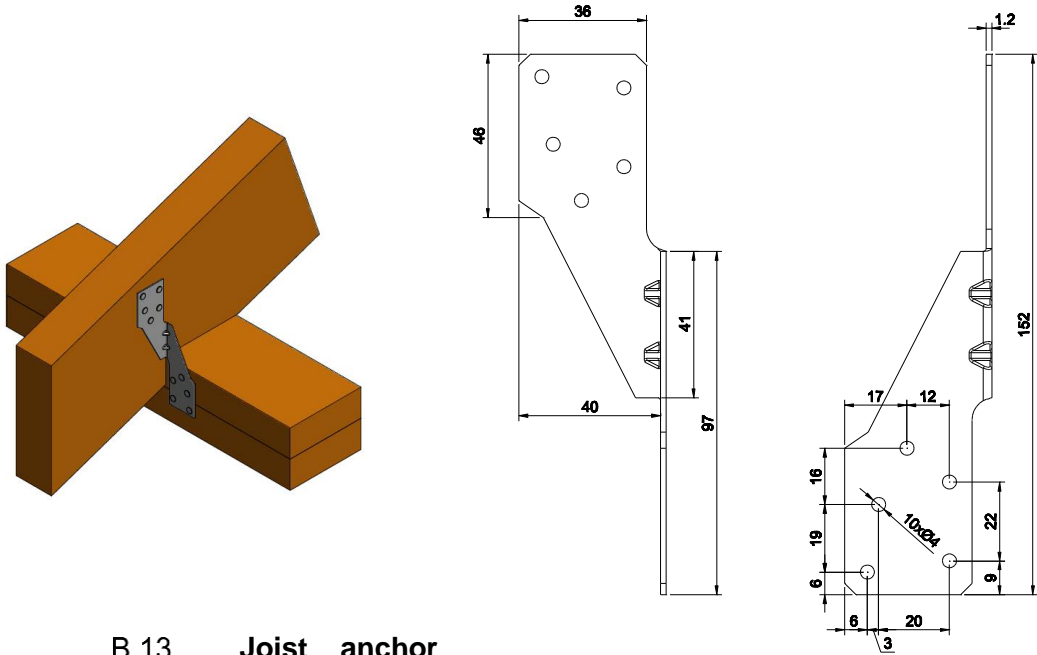
Joist anchor A35 can also be used for connection between a column, joist or beam and a plate. The connections should be made with two A35 joist anchors placed diagonally across from each other. The horizontal forces F2 and F3 are acting perpendicular to the plate. F1 will for this connection be the uplift force.

Combination of forces

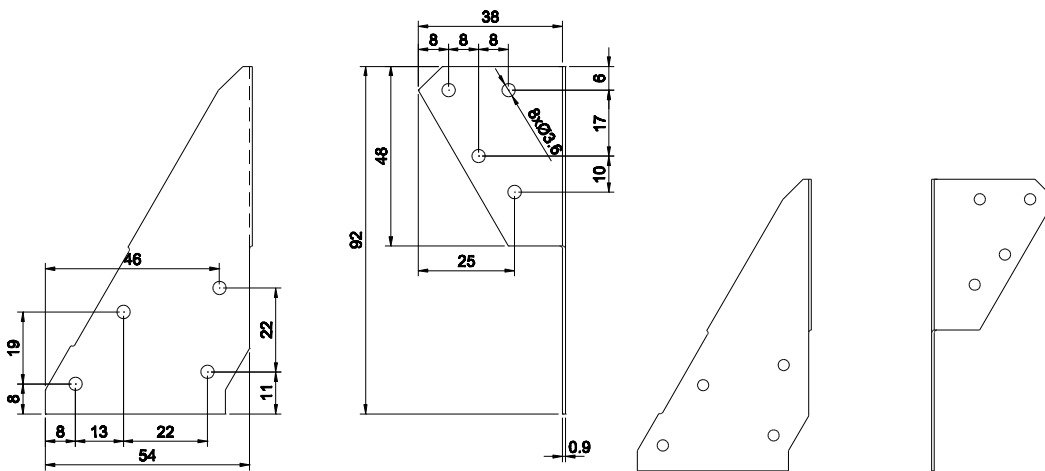
When the anchor connection is subjected to more than one of the forces the strength verification can be made by verifying that the following inequalities are valid:

$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{2,d}}{R_{2,d}} + \frac{F_{3,d}}{R_{3,d}} \leq 1,0$$

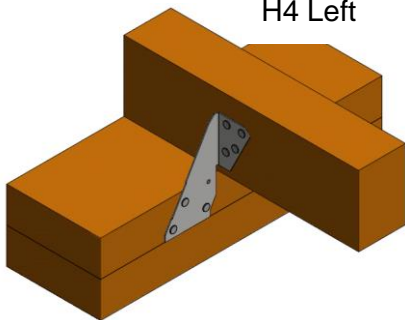
B 12. Joist anchor H2.5A



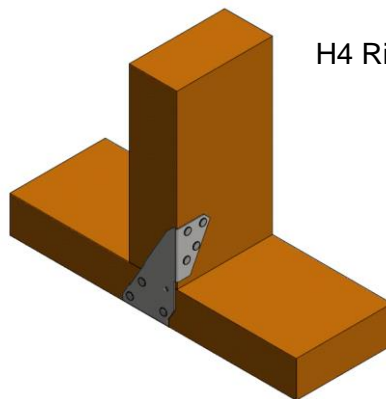
B 13. Joist anchor
H4



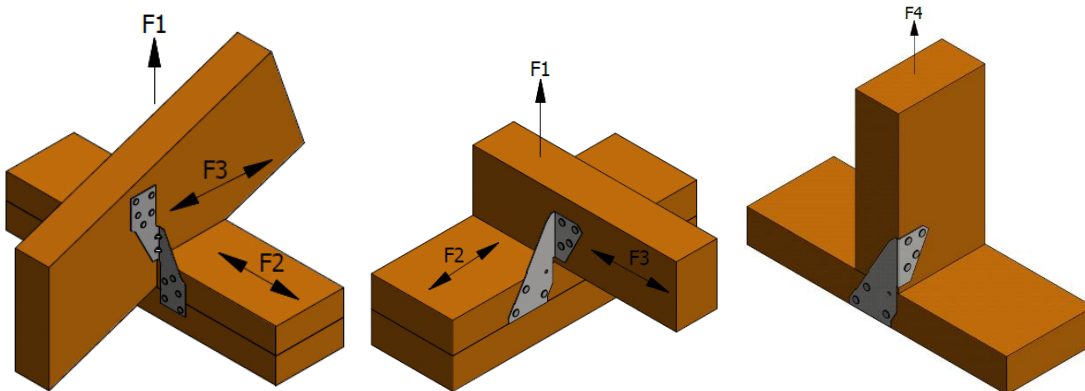
H4 Left



H4 Right



For the H4 and H2.5A joist anchors the calculations cover the load-carrying capacities of the connections for forces in the directions shown in the figure below.



F1 and F4 are uplift forces.

F2 is horizontal force acting parallel to the plate and perpendicular to the rafter.

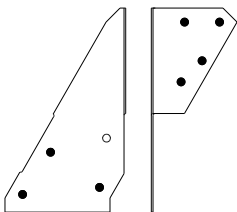
F3 is horizontal force acting parallel to the rafter and perpendicular to the plate.

The connections can be made with one connector if the rafter is prevented from rotation.

H2.5A are only used with full nailing.

H4 can be used with full nailing if only horizontal forces F2 and F3 occurs. Due the small distance of the nearest nail to the edge of the plate, the installation of this nail has to be done with a particular care.

For uplift F1 in the different connections only three nails in the plate are allowed – see below for nailing pattern.



Combination of forces

When the anchor connection is subjected to more than one of the forces the strength verification can be made by verifying that the following inequalities are valid:

$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{2,d}}{R_{2,d}} + \frac{F_{3,d}}{R_{3,d}} \leq 1,0$$

Annex C – Basis of Design

Requirements for the wood members

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a minimum density of 290 kg/m³.

The moisture content of wood by the time of installation shall be close to expected equilibrium moisture content in service.

These requirements to the material of the wood members can be fulfilled by using the following materials:

- Solid timber classified to C16-C40 or better according to EN 338
- Glued members of timber classified to C16-C40 or better according to EN 338/EN14081 when structural adhesives are used.
- Glued laminated timber classified to GL24c or better according to EN 1194/EN14080
- Laminated Veneer Lumber LVL according to EN 14374
- Other Engineering Wood products classified for their resistance and with certified mechanical performances for fasteners

Characteristic capacities are based on a characteristic density of the wood members of 350 kg/m³. 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 ρ_k is the characteristic density of the timber in kg/m³.

The calculation method for deciding characteristic capacities is only allowed for a characteristic wood density of up to 460 kg/m³. Even though the wood based material may have a greater density, this must not be used in the formulas for the load-carrying capacity of the connectors.

Basic of design

All of the capacities stated in the Annex 15 and following are characteristic capacities R_k . Therefore, the design capacities are obtained according to the following formula:

$$R_d = \frac{R_k \times k_{mod}}{\gamma_M}$$

Applicable fasteners types and sizes in the cases where the load carrying capacities are expressed by a formula

Nails diameter	Length Min-Max	Correspondent Hole Diameter Min-Max	Nail Type
3.1	40 – 60	3.4 – 4.0	Connector nails in accordance with ETA 04/0013
4.0	35 – 100	4.4 – 5.0	Connector nails in accordance with ETA 04/0013
4.2	35 – 60	4.7 – 5.3	Connector nails in accordance with ETA 04/0013
3.1	35	3.4 – 4.0	Ring shank nails in accordance to EN 14592
4.0	35 – 100	4.4 – 5.0	Ring shank nails in accordance to EN 14592
3.75	30 – 32	3.8 – 5.0	Square twist nails in accordance to EN 14592
3.35	65	3.4 – 4.0	Ring shank nails in accordance to EN 14592

Screw diameter	Length Min-Max	Correspondent Hole Diameter Min-Max	Screw Type
5.0	35 - 50	5.0	Connector screws in accordance with ETA 04/0013

The applicable fastener types and sizes in the cases where the load carrying capacities are expressed by a number i.e Universal Bracket UNI100, UNI130 and UNI190 are stated together with the load carrying capacity of the connector.

Annex D - Capacities

D 1. Universal bracket UNI

$R_{1,k}$ is the characteristic lifting capacity for two brackets.

$R_{2,k}$ and $R_{3,k}$ are the characteristic axial capacities in the direction of the joist for two brackets.

$R_{4,k}$ and $R_{5,k}$ are the characteristic capacities in the direction perpendicular to the joist and for two brackets.

UNI96 :

All capacities given in kN for a connection with two brackets, one on each side of the purlin.

$$R_{1,k} = 2,38 R_{lat,k}$$

$$R_{2,k} = R_{3,k} = 1,37 R_{lat,k}$$

$$R_{4,k} = R_{5,k} = \text{Min} (2,74 \cdot R_{lat,k} ; k_1 \cdot (b + k_2) / e / k_{mod})$$

With b the joist width, e the eccentricity of the horizontal load acting perpendicular to the joist and k_{mod} the appropriate modification factor.

$$\text{With } k_1 = \text{Min} (2 \cdot R_{ax,k} ; 0,48) + 1,19 \cdot R_{lat,k}$$

$$\text{And with } k_2 = [\text{Min} (2 \cdot R_{ax,k} ; 0,48 / k_{mod}) \cdot 22,5 + 7,1 \cdot R_{lat,k}] / k_1$$

UNI100 :

All capacities are given in kN for a connection with two brackets, one on each side of the purlin and only for connector nails in accordance with ETA-04/0013 with the dimensions 4.0 x 40 and 4.0 x 50 mm or with the dimensions 4.2 x 40 and 4.2 x 50 mm.

$R_{1,k}$:

Nail 4.0 x 40	6,0
Nail 4.0 x 50	7,2

$$R_{2,k} = R_{3,k} = 2,56 \cdot R_{lat,k}$$

$$R_{4,k} = R_{5,k} = \text{Min} (4 \cdot R_{lat,k} ; k_1 \cdot (b + k_2) / e / k_{mod})$$

With b the joist width, e the eccentricity of the horizontal load acting perpendicular to the joist and k_{mod} the appropriate modification factor.

With k_1 and k_2 resp. in kN and mm from the table below :

With nail 4.0 x 40 : k_1	[kN]	2,9
With nail 4.0 x 50 : k_1	[kN]	3,3
With nail 4.0 x 40 : k_2	[mm]	16
With nail 4.0 x 50 : k_2	[mm]	16

UNI130 :

All capacities are given in kN for a connection with two brackets, one on each side of the purlin and only for connector nails in accordance with ETA-04/0013 with the dimensions 4.0 x 40 and 4.0 x 50 mm or with the dimensions 4.2 x 40 and 4.2 x 50 mm.

$R_{1,k}$:

	[kN]
CNA4,0x40	11,0
CNA4,0x50	14,4

$$R_{2,k} = R_{3,k} = 4,31 \cdot R_{lat,k}$$

$$R_{4,k} = R_{5,k} = \text{Min} (4,33 \cdot R_{lat,k} ; k_1 \cdot (b + k_2) / e)$$

With b the joist width, e the eccentricity of the horizontal load acting perpendicular to the joist and k_{mod} the appropriate modification factor.

With k_1 and k_2 resp. in kN and mm from the Table below :

With nail 4.0 x 40 : k_1	[kN]	5,8
With nail 4.0 x 50 : k_1	[kN]	6,7
With nail 4.0 x 40 : k_2	[mm]	21
With nail 4.0 x 50 : k_2	[mm]	22

UNI190 (2 brackets per connection) :

All capacities are given in kN for a connection with two brackets, one on each side of the purlin and only for connector nails in accordance with ETA-04/0013 with the dimensions 4.0 x 40 and 4.0 x 50 mm or with the dimensions 4.2 x 40 and 4.2 x 50 mm.

$R_{1,k}$: values given for 3 nails (or 6 nails) in each end of the brackets + 1 nail in the horizontal flap

Nail 4.0 x 40	8,0 (16,1)
Nail 4.0 x 50	9,8 (16,5)

$R_{2,k}$ and $R_{3,k}$: values given for 3 nails (or 6 nails) in each end of the bracket + 1 nail in the horizontal flap

Nail 4.0 x 40	4,7 (5,6)
Nail 4.0 x 50	5,5 (6,7)

$R_{4,k} = R_{5,k} = \text{Min} (2,3 \cdot R_{lat,k} \text{ if 3 nails ; } 3,2 \cdot R_{lat,k} \text{ if 6 nails ; } k_1 \cdot (b + k_2) / e / k_{mod}$)

With k_1 and k_2 resp. in kN and mm, given for 3 nails (or 6 nails) + 1 nail in the horizontal flap from the table below :

With nail 4.0 x 40 : k_1	[kN]	4,2 (8,0)
With nail 4.0 x 50 : k_1	[kN]	5,0 (8,5)
With nail 4.0 x 40 : k_2	[mm]	7 (7)
With nail 4.0 x 50 : k_2	[mm]	7 (5)

UNI190 (1 bracket per connection) :

All capacities are given in kN for a connection one bracket and only for connector nails in accordance with ETA-04/0013 with the dimensions 4.0 x 40 and 4.0 x 50 mm or with the dimensions 4.2 x 40 and 4.2 x 50 mm.

$R_{1,k}$: values calculated as follows:

$$R_{1,k} = k_1 / (k_2 + f) \quad \text{for } f < f_{lim}$$

$$R_{1,k} = k_3 / f \quad \text{for } f > f_{lim}$$

With k_1 , k_2 , k_3 and f_{lim} given in the following table for 3 nails (or 6 nails) :

	k_1	k_2	k_3	f_{lim}
Unit	[kN]	[mm]	[kN]	[mm]
Nail 4.0 x 40	94 (89)	24 (13)	63 (66)	48 (37)
Nail 4.0 x 50	121 (118)	25 (14)	80 (86)	49 (38)

With f the horizontal eccentricity of the uplift load.

$R_{2,k} = 0,42$ kN for all load durations

$$R_{3,k} = (1 + k_1) \cdot R_{lat,k}$$

With k_1 from the table below :

	k_1
3 nails	2,26
6 nails	2,76

$$R_{4,k} = k_1 / (k_2 + e)$$

With k_1 and k_2 for 3 nails (or 6 nails) from the table below and e the vertical eccentricity of the force ; except for 6 nails 4.0 x 50 and instantaneous load duration : $R_{4,k} = 233 / (47 + e)$

	k_1	k_2
Unit	[kN]	[mm]
Nail 4.0 x 40	193 (264)	78 (65)
Nail 4.0 x 50	235 (321)	78 (65)

$$R_{5,k} = k_1 / (93 - e) \quad \text{for } e < e_{lim}$$

$$R_{5,k} = k_2 / e \quad \text{for } e > e_{lim}$$

With k_1 , k_2 and e_{lim} for 3 nails (or 6 nails) from the Table below :

	k_1	k_2	e_{lim}
Unit	[kN]	[mm]	[mm]
Nail 4.0 x 40	63 (67)	41 (67)	56 (47)
Nail 4.0 x 50	83 (88)	54 (88)	56 (47)

$R_{1,k}$ is the characteristic lifting capacity for one joist anchor with the assumption that two joist anchors are placed diagonally.

$R_{2,k}$ is the horizontal characteristic capacity toward the joist anchor.

$R_{3,k}$ is the horizontal characteristic away from the joist anchor.

D 2. Capacities: Joist anchors type PFE170 and PFE210 :

All capacities given in kN for a connection with one joist anchor.

$$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; 4,53 \text{ kN} / k_{mod})$$

With k_1 factor without dimension given in the table below.

$$R_{2,k} = \text{Min} (k_2 \cdot R_{lat,k} ; 81 / e / k_{mod})$$

With e the internal eccentricity (50 mm for the maximum number of nails and 70 mm for fewer) and k_2 factor without dimension given in the table below.

$$R_{3,k} = \text{Min} (k_3 \cdot R_{lat,k} ; 81 / e / k_{mod})$$

With e the internal eccentricity (60 mm for the maximum number of nails and 80 mm for fewer) and k_3 factor without dimension given in the table below.

Joist anchor	Number of nails	k_1	k_2	k_3
PFE 170	2	1,35	0,22	0,2
	3	2,49	0,57	0,5
PFE 210	3	2,47	0,44	0,4
	4	3,58	0,89	0,8

In the case where two joists anchors (one on each side of the joist) are loaded with a horizontal force, the capacity is the sum of the above stated capacities $R_{2,k}$ and $R_{3,k}$

D 3. Capacities: Joist anchors type PFU170 to PFU250 :

All capacities given in kN for a connection with one joist anchor.

$$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; 5,2 \text{ kN} / k_{mod}) \text{ PFU170}$$

$$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; 7,3 \text{ kN} / k_{mod}) \text{ PFU 210 and PFU250}$$

With k_1 factor without dimension given in the table below.

$$R_{2,k} = \text{Min} (k_2 \cdot R_{lat,k} ; A / e / k_{mod})$$

With e the internal eccentricity (50 mm for the maximum number of nails and 70 mm for fewer) and k_2 factor without dimension given in the table below.

$$R_{3,k} = \text{Min} (k_3 \cdot R_{lat,k} ; A / e / k_{mod})$$

With:

e = the distance from the action force to the contact surface. The distance should equal or be less than 20 mm.

$R_{lat,k}$ = the characteristic lateral capacity of the CNA-Nail / CSA-Screw in [kN]

k_1 , k_2 , k_3 factor and A without dimension given in the table below.

Joist anchor	Number of nails	k_1	k_2	k_3	A
PFU 170	2	1,49	0,22	0,20	174
	3	2,62	0,57	0,50	
PFU 210	3	2,62	0,44	0,40	244
	4	3,70	0,89	0,80	
PFU 250	4	3,70	0,73	0,67	
	5	4,76	1,27	1,17	

In the case where two joist anchors (one on each side of the joist) are loaded with a horizontal force, the capacity is the sum of the above stated capacities $R_{2,k}$ and $R_{3,k}$

D 4. Capacities: Joist anchors type PS and PST :**Joist anchors type PS 180 to PS 220 and PST :**

All capacities given in kN for a connection with one joist anchor for uplift characteristics ($R_{k,1}$) and two joist anchors for horizontal characteristics ($R_{k,2}$).

$$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; R_{steel} / k_{mod})$$

With k_1 factor without dimension and R_{steel} given in the table below.

$$R_{2,k} = \text{Min} (k_2 \cdot R_{lat,k} ; [(55 \cdot R_{ax,k}) + M_y / k_{mod}] / e) + \text{Min} (k_2 \cdot R_{lat,k} ; 2 \cdot R_{ax,k} ; M_y / 60 / k_{mod})$$

With k_2 factor without dimension given in the table below.

Joist anchor	k_1	k_2	R_{steel}	M_y
Unit	-	-	[kN]	[kN.mm]
PS180 / 30 / 1,5	4,21	1,57	4,92	92,0
PS200 / 30 / 1,5	5,36	1,91	4,92	92,0
PS200 / 30 / 2,0	5,32	1,91	6,54	122
PS200 / 45 / 2,0	6,40	2,97	9,97	205
PS220 / 45 / 2,0	8,32	3,82	9,97	205
PST	3,63	1,53	4,79	94,4

The values given for PS are valid for PSG and PSD joist anchors.

The values given for PST are valid for PSTG and PSDG joist anchors.

$R_{1,k}$ is the characteristic lifting capacity for one joist anchor with the assumption that two joist anchors are placed diagonally.

$R_{2,k}$ is the horizontal characteristic capacity with two joist anchors (one on each side).

D 6. Capacities: Purlin anchors type SPF :

$R_{1,k}$ is the characteristic lifting capacity for one purlin anchor with the assumption that two purlin anchors are placed diagonally.

$R_{2,k}$ is the horizontal characteristic capacity toward the purlin anchor for one purlin anchor.

$R_{3,k}$ is the horizontal characteristic capacity away from the purlin anchor, perpendicular to the purlin for one purlin anchor.

Purlin anchor SPF 170 to 370 :

All capacities given in kN for a connection with one purlin anchor.

Connection timber to timber:

$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; 6 \text{ kN} / k_{mod} \text{ in the flat cross section} ; 13,4 \text{ kN} / k_{mod} \text{ in the folded cross section})$

$R_{2,k} = \text{Min} (k_2 \cdot R_{lat,k} ; 2,60 / k_{mod} + 1,82 \cdot R_{lat,k})$

$R_{3,k} = \text{Min} (k_3 \cdot R_{lat,k} ; 2 \cdot R_{ax,k} ; 2,60 / k_{mod} + 1,81 \cdot R_{ax,k})$

Connection timber to concrete:

$R_{1b,k} = \text{min} (k_1 \times R_{lat,k} , 6,0 \text{ kN} / k_{mod})$

for type SPF330 and SPF370 with 2 bolt: $R_{1b,k} = \text{min} (k_1 \times R_{lat,k} , 12,0 \text{ kN} / k_{mod})$

$R_{2b,k} = \text{min} (k_{2b} \times R_{lat,k} , 2,6 \text{ kN} / k_{mod})$

$R_{3b,k} = \text{min} (k_{3b} \times R_{lat,k} , 0,93 \text{ kN} / k_{mod})$

$R_{4b,k} = k_{4b} \times R_{lat,k}$

$R_{5b,k} = k_{5b} \times R_{lat,k}$

For connection to rigid support, the anchoring and the load combinations shall be checked , under consideration of the distances of the bolt(s).

With

$R_{lat,k}$ = the lateral capacity of the fastener , shear load (e.g. CNA or CSA)

$R_{ax,k}$ = the axial capacity of the fastener , tension load (e.g. CNA or CSA)

The bolt group (1 or 2) have to have a minimum capacity equal to the acting load.

The capacities for the load directions F4 and F5 (connection with bolt) shall be limited by the capacity of the nail CNA4,0x60. A stronger fastener shall not be considered for these capacities.

With k_i factors without dimensions depending on the type of purlin and the number of nail according to the following table:

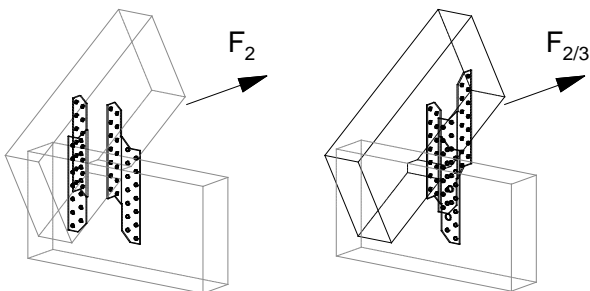
Min. size	no nails* of	k_1	k_2 and k_3	K_{2b}	K_{3b}	k_{4b}	k_{5b}
SPF170	4	2,33	0,77	1,19	0,78	0,91	n/a
	5	3,13	1,19	1,35	0,85		
SPF210	6	4,30	1,32	1,71	1,03	0,75	0,29
	7	5,26	1,83	2,08	1,24		
SPF250	8	6,45	2,05	2,42	1,34	0,64	0,47
	9	7,45	2,53	2,86	1,54		
SPF290	10	8,63	2,62	3,1	1,61	0,56	0,58
	11	9,64	3,25	3,58	1,83		
SPF330	12	10,80	3,97	3,78	1,89	0,5	0,65
	13	11,81	4	4,31	2,12		
SPF370	14	12,82	4,07	4,49	2,18	0,45	0,7
	15	13,94	4,77	5,06	2,42		

* per flange

In the case where two purlin anchors (one on each side of the joist) are loaded with a force, the capacity is the sum of the above stated capacities $2 \times R_{1,k}$, $R_{2,k}$ and $R_{3,k}$, respectively $R_{4,k}$ and $R_{5,k}$

Sample:

The capacity for F_2 has to calculate with $2 \times R_{2,k}$
 The capacity for $F_{2/3}$ has to calculate as $(R_{2,k} + R_{3,k})$



D 7. Capacities: Joist anchors type MTS and LTS :**Joist anchors type MTS and LTS :**

Capacity given in kN for a connection with one joist anchor for uplift characteristics ($R_{1,k}$)

$$R_{1,k} = \text{Min} (k_1 \cdot R_{lat,k} ; R_{steel} / k_{mod})$$

With k_1 factor without dimension and steel capacity R_{steel} given in the following table

Joist anchor	Number of nails	k_1	R_{steel}
Unit	-	-	[kN]
MTS 12 and MTS 30	4	3,10	4,02
	5	3,54	
	6	4,68	
	7	5,64	
LTS 18	4	2,43	2,89
	5	3,25	
	6	4,30	
	7	5,42	

$R_{1,k}$ is the characteristic lifting capacity for one joist anchor with the assumption that two joist anchors are placed diagonally.

$R_{2,k}$ is the horizontal characteristic capacity for one joist anchors.

D 10. Capacities: Joist anchors type A34 and A35E:

Joist anchors type A34 :

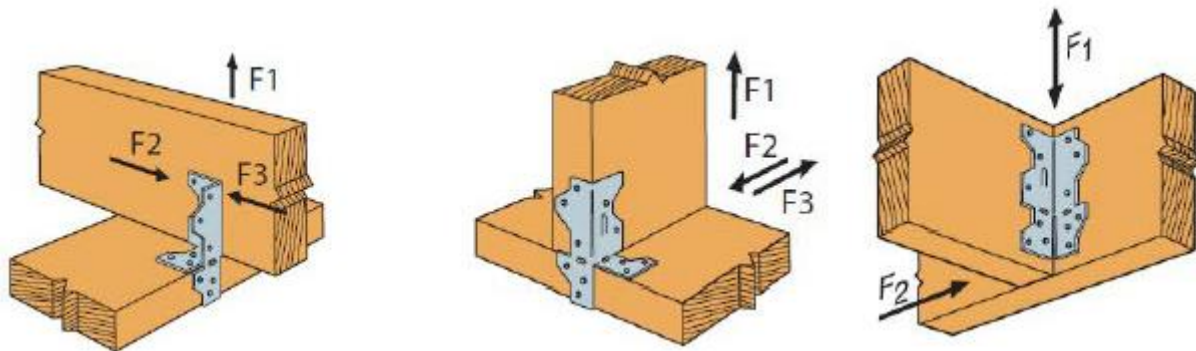
All capacities given in kN for a connection with one joist anchor for uplift characteristics ($R_{1,k}$) and for horizontal characteristics ($R_{2,k}$).

$$R_{1,k} = 2,04 \cdot R_{lat,k}$$

$$R_{2,k} = \text{Min} (3 \cdot R_{lat,k} ; 3,4)$$

Joist anchors type A35E :

All capacities given in kN for a connection with two joist anchors one on each side of the joist
joist-joist column-joist joist-header



Uplift : F_1 joist-joist or column-joist

$$R_{1,k} = 2,81 \cdot R_{lat,k} + \text{Min} (2 \cdot R_{ax,k} ; 0,78 \text{ kN} / k_{mod})$$

Horizontal load : F_2 joist-joist or F_3 column-joist or F_3 joist-joist

$$R_{2,k} = R_{3,k} = 2,21 \cdot R_{lat,k}$$

Horizontal load : F_2 column-joist

$$R_{C2,k} = 2,21 \cdot R_{lat,k} + 0,24 \text{ kN} / k_{mod}$$

Shear load : F_1 joist-header

$$R_{1,k} = 10,5 \cdot R_{lat,k}$$

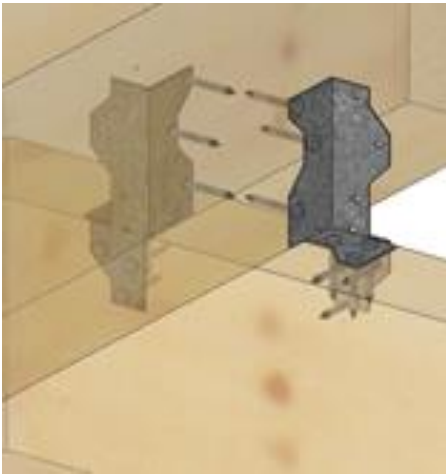
Horizontal load: F_2 joist-header

$$R_{2,k} = \text{Min} (9,2; 23 \cdot R_{ax,k} ; 8 \cdot R_{lat,k})$$

Uplift: F_1 joist-joist

$R_{1,k}=5.26\text{kN}$ for full nailing N3.75x30, timber C24 and installed per pair.

This value can only be used for short or instant loads.



D 12. Capacities: Joist anchors type H2.5 and H4:**Joist anchors type H2.5 :**

All capacities given in kN for a connection with one joist anchor for uplift characteristics ($R_{1,k}$) and two joist anchors for horizontal characteristics ($R_{2,k}$).

Characteristic capacity

e capacities are for connections with one connector where the rafter is prevented from rotation. The connectors may be installed in pairs to achieve twice the stated capacity. The connectors can also be installed diagonally across from each.

The hangers shall only be used with the fasteners specified in the relevant table in Annex 15

Model No.	Number of Fasteners ^[1] (Use 3,75 mm x 30 mm)		Characteristic Capacities ^[2] [kN]			
	To Rafters	To Plates	F1	F2	F3	F4
H2.5A ^[3]	5	5	2,39	0,59	0,59	4,65

[1] - N3.75x30 Square Twist Nails - CE marked in accordance with EN14592.

[2] - Characteristic Capacities have been determined in accordance with TR16 and EN14358 for use with Eurocode 5. Values are based on C24 timbers.

[3] - Values are for one anchor. H2.5A may be installed in pairs installed diagonally across from each other to achieve twice the stated loads. Be aware of the timber sizes.

Model No.	Number of Fasteners ^[1] (Use CNA3,1x35 mm)		Characteristic Capacities ^[2] [kN]			
	To Rafters	To Plates	F1	F2	F3	F4
H2.5A ^[3]	5	5	2,71	0,61	0,61	2,25

[1] - CNA3,1x35 Ring Shank Nails - CE marked in accordance with EN14592

[2] - Characteristic Capacities have been determined in accordance with TR16 and EN14358. for use with Eurocode 5. Values are based on C24 timbers.

[3] - Values are for one anchor. H2.5A may be installed in pairs installed diagonally across from each other to achieve twice the stated loads. Be aware of the timber sizes.

Joist anchors type H4 :

All capacities given in kN for a connection with one joist anchor for uplift characteristics ($R_{1,k}$) and two joist anchors for horizontal characteristics ($R_{2,k}$).

Characteristic capacity

The capacities are for connections with one connector where the rafter is prevented from rotation. The connectors may be installed in pairs to achieve twice the stated capacity. The connectors can also be installed diagonally across from each.

The hangers shall only be used with the fasteners specified in the relevant table in Annex 15

Model No.	Number of Fasteners ^[1] (Use 3,75 mm x 30 mm)		Characteristic Capacities ^[2] [kN]			
	To Rafters	To Plates	F1	F2	F3	F4
H4 ^[3]	4	4		0,72	0,52	
H4 ^[3]	4	3	0,53	0,63	0,46	1,53

[1] - N3.75x30 Square Twist Nails - CE marked in accordance with EN14592.

[2] - Characteristic Capacities have been determined in accordance with TR16 and EN14358 for use with Eurocode 5. Values are based on C24 timbers.

[3] - Values are for one anchor. H4 may be installed in with 2 connectors installed either diagonally across from each other or on the same side of the plate to achieve twice the stated loads. It is also possible to install 4 connectors and achieve forth the stated loads.

Be aware of the timber sizes.

Model No.	Number of Fasteners ^[1] (Use CNA3,1x35 mm)		Characteristic Capacities ^[2] [kN]			
	To Rafters	To Plates	F1	F2	F3	F4
H4 ^[3]	4	4		0,40	0,26	
H4 ^[3]	4	3	0,70	0,35	0,23	1,52

[1] - CNA3,1x35 Ring Shank Nails - CE marked in accordance with EN14592

[2] - Characteristic Capacities have been determined in accordance with TR16 and EN14358. for use with Eurocode 5. Values are based on C24 timbers.

[3] - Values are for one anchor. H4 may be installed in with 2 connectors installed either diagonally across from each other or on the same side of the plate to achieve twice the stated loads.

It is also possible to install 4 connectors and achieve forth the stated loads.

Be aware of the timber sizes.