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European Technical Assessment

ETA-07/0137
of 24/10/2014

English translation prepared by CSTB - Original version in French language

General Part

Nom commercial *Trade name*	Simpson Strong-Tie Universal brackets Purlin anchors Joist anchors
Famille de produit *Product family*	*Equerres universelles et pattes de solivage pour accrochage d'éléments bois massif ou à base de bois sur des supports en bois massif ou à base de bois.* **Universal brackets, purlin and joist anchors for connection of solid wood or wood based elements to solid wood or wood based support.**
Titulaire *Manufacturer*	**SIMPSON Strong-Tie** ZAC des quatres chemins 85400 SAINTE GEMME LA PLAINE
Usine de fabrication *Manufacturing plants*	Plant UK – Winchester Road, Tamworth, B78 3HG, UK Plant DK – Boulstrup, DK-8300 Odder, Denmark Plant F – ZAC des Quatre Chemins, 85400 Sainte Gemme la Plaine, France Plant US1 – NW USA Division, 5151 S Airport Way, Stockton, CA95206, USA Plant US2 – NE USA Division, 2600 International Street, Colombus, OH43228, USA
Cette evaluation contient: *This Assessment contains*	38 pages incluant 26 annexes qui font partie intégrante de cette évaluation *38 pages including 26 annexes which form an integral part of this assessment*
Base de l'ETE *Basis of ETA*	ETAG 015, Version April 2013, utilisée en tant que DEE *ETAG 015, Edition April 2013 used as EAD*

Specific part

1   Technical description of the product

Simpson Strong-Tie Universal brackets, Purlin anchors and Joist anchors are three dimensional nailing plates made of pre-galvanized steel Grade S250GD+Z275 or S350GD+Z275 according to EN 10346:2009 of thickness 1.5 mm to 2.5 mm or 1.2-1.5 mm pre-galvanized mild steel or 1.5 mm G20 pre-galvanized steel Grade 33 according to ASTM A653. The range addressed by this Assessment consists of : Universal brackets UNI; Purlin anchors SPF, Joist anchors PFE, PFU, PSG/PSD, PSTG/PSTD, MTS, LTS, A and H. They are intended for connection of solid wood or wood based elements to solid wood or wood based support. The geometry and standard dimensions are given in Annexes 1 to 13.

All Strong-Tie Universal brackets, Purlin anchors and Joist anchors can also be produced from stainless steel number 1.4401, 1.4404, 1.4301, 1.4509 or 1.4521 according to EN 10088-2:2005 or other grades of stainless steel with a minimum characteristic 0.2% yield stress of 230 MPa, a minimum 1.0% yield stress of 250 MPa and a minimum ultimate tensile strength of 430 MPa.

2   Specification of the intended use

The SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors are intended to be used for connections of joists with rectangular cross sections or I-joists to their support. The joist may be either of solid sawn or Engineering Wood Product listed in Annex 14. This support may be either a solid sawn element, or an Engineering Wood Product as listed in Annex 14. With regard to moisture behaviour of the support, the use is possible in service classes 1 and 2 defined in EN 1995-1-1:2004.

The SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors can also be used in outdoor timber structures, service class 3, when stainless steel with similar or better characteristic yield and ultimate strength is employed.

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 15.

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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

The SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors in the range covered by this ETA corresponds to the drawings and provisions given in Annexes 1 to 13. The characteristic material values, dimensions and tolerances of the Universal brackets, Purlin anchors and Joist anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation[1] of this European Technical Assessment. The mechanical properties of the SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors are given in Annexes 16 to 26.

3.1   Mechanical resistance and stability (BWR 1)

The mechanical properties of the Simpson Strong-Tie Universal brackets, Purlin anchors and Joist anchors are given in Annexes 16 to 25.

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[1] The technical documentation of this European Technical Assesment is deposited at the Centre Scientifique et Technique du Bâtiment and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

The mechanical capacities are determined by calculation and 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 determined (NPD) towards seismic action.

Fasteners

Connector nails and screws in accordance to ETA-04/0013

The formulas for the load-carrying capacities of the connectors have been determined based on the use of connector nails or connector screws in accordance with ETA-04/0013.

The load-carrying capacities for Universal bracket UNI100, UNI130 and UNI190 have been determined based on the use of connector nails with a diameter of 4.0 mm according to ETA-04/0013. To obtain these values it is also allowed to use connector nails with a diameter of 4.2 mm or connector screws with a diameter of 5 mm according to ETA-04/0013 with similar or better performance than connector nails with a diameter of 4.0 mm.

Threaded nails in accordance to EN 14592

The design models on which the formulas for load-carrying capacity for Universal bracket UNI96, Purlin anchors and Joist anchors are based, also allows the use of threaded nails in accordance to EN 14592 with a diameter in the range 4,0 – 4,2 mm (UNI96: 3.1 mm) and a minimum length of 35 mm, assuming a thick steel plate when calculating the lateral nail load-carrying capacity. For the load-carrying capacities for universal bracket UNI100, UNI130 and UNI190 a reduction factor equal to the ratio between the characteristic withdrawal capacity of the actual used threaded nail and the characteristic lateral capacity of the corresponding connector nail according to table B1 in ETA-04/0013 is applicable.

Square Twist nails in accordance to EN 14592

In the formulas given in relevant Annexes the capacities for square twist nails calculated from the formulas of EN 1995-1-1 (Eurocode 5) are used assuming a thick steel plate when calculating the lateral nail load bearing capacity.

Round smooth nails in accordance to EN 14592

In the formulas given in relevant Annexes, the capacities for round smooth nails calculated from the formulas of EN 1995-1-1 (Eurocode 5) are used assuming a thin steel plate when calculating the lateral nail load bearing capacity.

Stainless steel

For Universal brackets, Purlin anchors and Joist anchors produced from stainless steel number 1.4401, 1.4404, 1.4301, 1.4509 or 1.4521 according to EN 10088-2:2005, or other grades of stainless steel with similar or increased characteristic yield and ultimate strengths, 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 covered by the ETA-04/0013 or stainless threaded nails in accordance to the standard EN 14592 respecting the rules given in the paragraph "fasteners" above. When using stainless screws, load carrying capacities can be considered as the same as those published in this document for connector nails covered by the ETA-04/0013 subject to the lateral and withdrawal capacities of the stainless screws are at least equal to those of CNA connector nails covered by the ETA-04/0013.

3.2 Safety in case of fire (BWR 2)

The SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors are made of steel classified to have reaction to fire Class A1.

No performance determined (NPD) for resistance to fire.

3.3 Hygiene, health and the environment (BWR 3)

Based on the declaration of the manufacturer, the SIMPSON Strong-Tie Universal brackets, Purlin anchors and Joist anchors do not contain harmful or dangerous substances as defined in the EU database.

Lead

Due to the declaration of dangerous substances, the product does not contain lead or lead compounds.

Note: In some member states the content of lead or of lead compounds shall be is restricted, e.g. in Norway (products with more than 0,01%) are proposed prohibited.

Poland: The content of lead as a pigment in construction products is prohibited. Use of lead as an anti-corrosive agent is admissible in industrial buildings, except in the agricultural & food industry.

Cadmium:

Due to the declaration of dangerous substances the product does not contain cadmium.

Note:

The content of cadmium and cadmium compounds contained in plastics, paints, lacquers, varnishes, zinc or zinc coatings and used as a coating shall meet the re-spective regulations, e.g in Norway products containing more than 0,01 cadmium or cadmium compounds are proposed prohibited.

Poland: The content of cadmium as a pigment in construction products is in Poland prohibited

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 EU Construction Product Regulation, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

For Basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.5 Protection against noise (BWR 5)

Not relevant.

3.6 Energy economy and heat retention (BWR 6)

Not relevant.

3.7 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.8 General aspects relating to fitness for use

3.8.1 Corrosion protection in service class 1 and 2.

In accordance with ETAG 015 shall the Universal brackets, joist anchors and Purlin anchors have a zinc coating weight of Z275. The steel employed is S250 GD with Z275 according to EN 10346.

3.8.2 Corrosion protection in service class 3.

In accordance with Eurocode 5, the Universal brackets, joist anchors and Purlin anchors shall be produced from stainless steel.

Serviceability of the Universal brackets, Purlin anchors and Joist anchors is understood as their ability to resist loads without unacceptable deformations.

4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 97/638/EC of the European Commission, as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	Intended use	Level or class	System
STRUCTURAL TIMBER PRODUCTS/ELEMENTS AND ANCILLARIES	For fixing and/or supporting to concrete or wood, structural elements which contributes to the stability of the works.	—	2+

5   Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of three dimensional nailing plates for issuing the certificate of conformity CE based on the control plan.
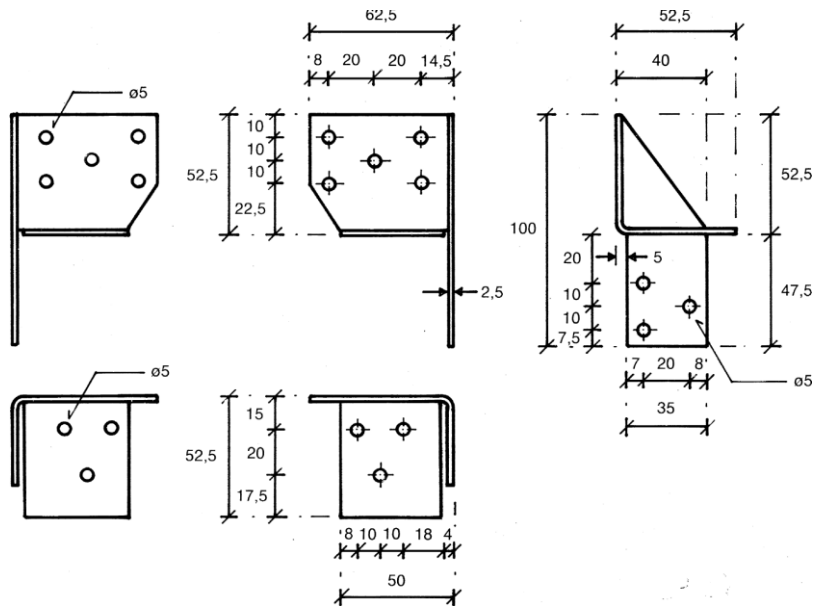
Issued in Marne La Vallée on 24/10/2014 by

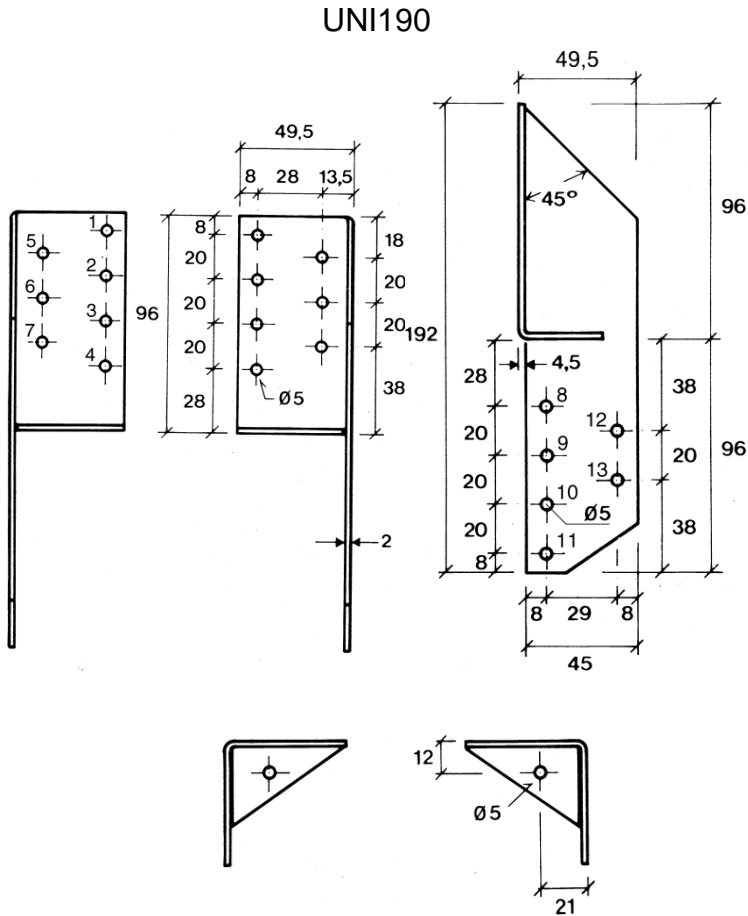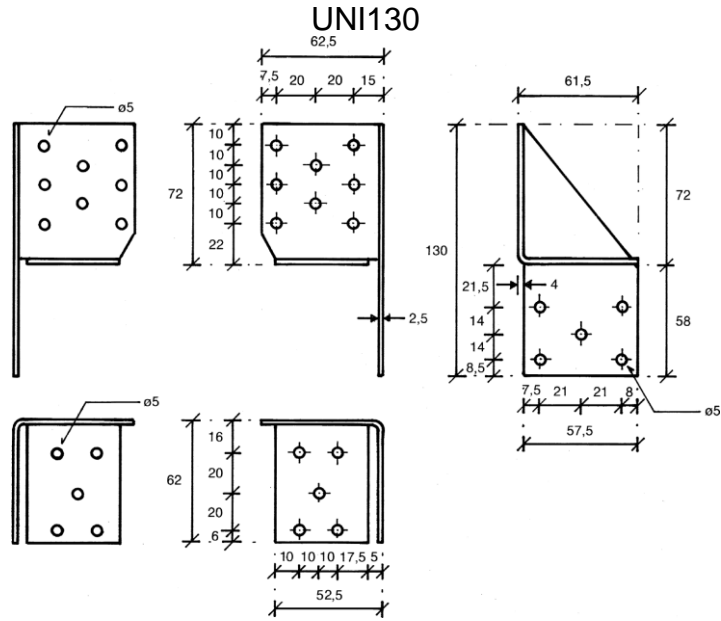Charles Baloche   *The original French version is signed*

Directeur technique
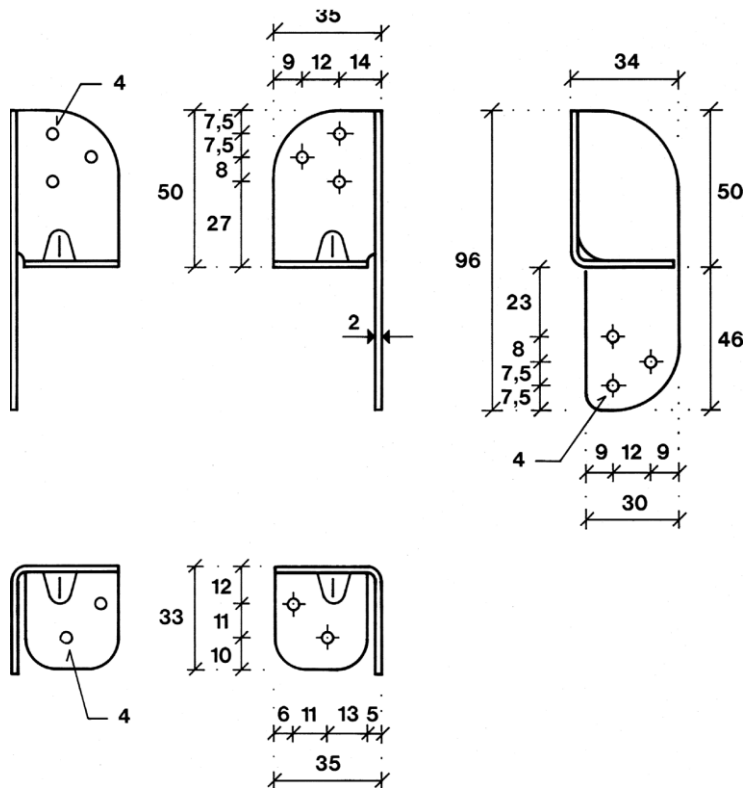
UNI96

UNI100

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 1
Universal brackets UNI96 / UNI100 **Geometry and drawings**	Of European Technical Assessment **ETA-07/0137**

UNI130

UNI190

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 2
	Of European Technical Assessment
Universal brackets UNI130 / UNI190 **Geometry and drawings**	**ETA-07/0137**

## 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:

When there is only one anchor, the calculatios are made for this anchor
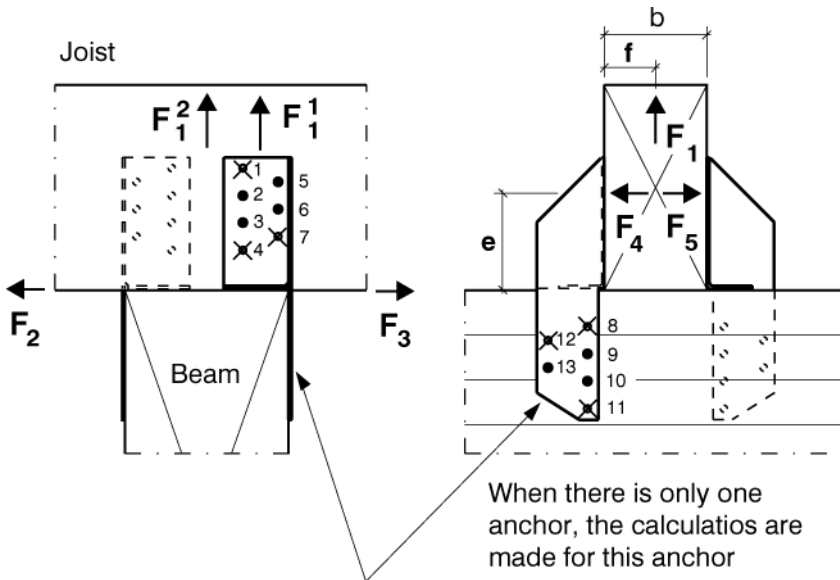
Nail pattern:

✕ 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
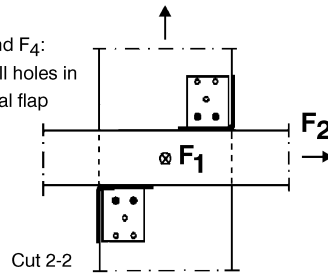   1, 2, 3, 5, 6, 7 / 8, 9, 10, 11, 12, 13

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 3
Universal brackets **Direction and combination of forces**	of European Technical Assessment **ETA-07/0137**

UNI130
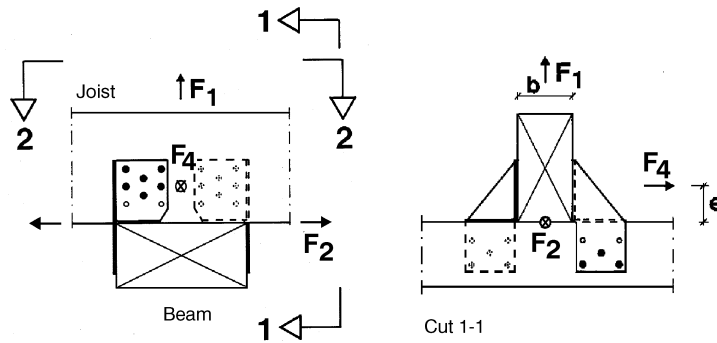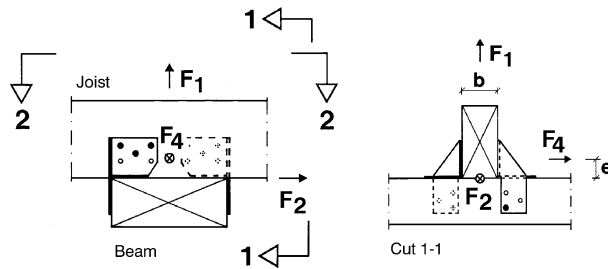

$F_2 = F_3$
$F_4 = F_5$

For F_2 and F_4:
Nails in all holes in the vertical flap

Cut 2-2

○ holes

● nails

UNI100

$F_2 = F_3$
$F_4 = F_5$

Cut 2-2
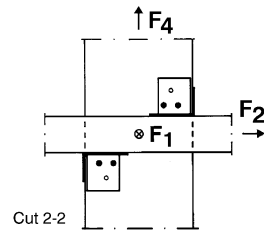
○ holes

● nails

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 3
	of European
Universal brackets	Technical Assessment
Direction and Combination of forces	**ETA-07/0137**
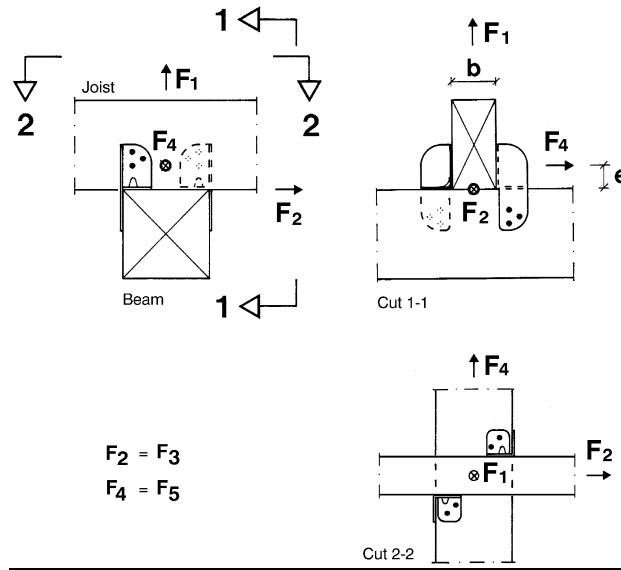
UNI96

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.

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 3
	of European
Universal brackets	Technical Assessment
Direction and Combination of forces	**ETA-07/0137**

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.

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 3
	of European
Universal brackets	Technical Assessment
Direction and Combination of forces	**ETA-07/0137**

Joist anchors type PFE
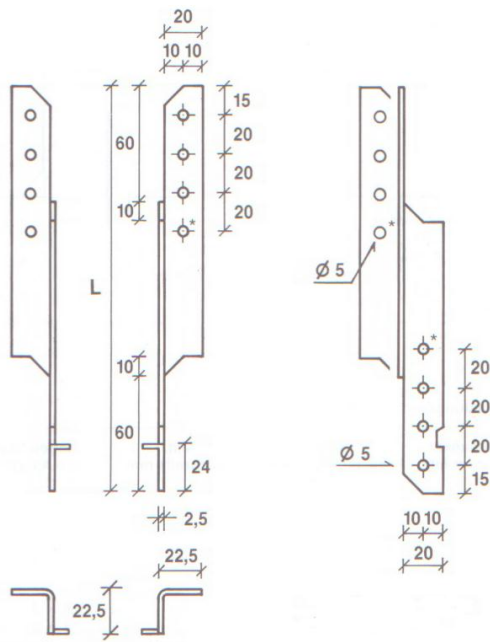
Model No (type PFE)	L (mm)	Thick (mm)	Number of holes ø5 mm
PFE170	170	2.5	6
PFE210	210	2.5	8

Joists anchors type PFU
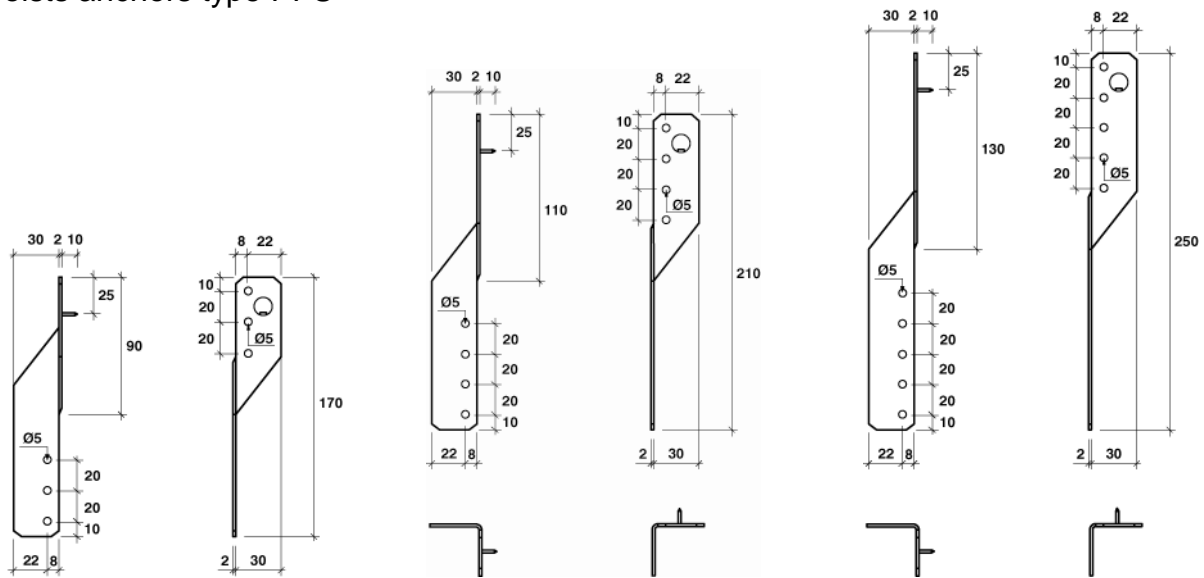
PFU 170 PFU 210 PFU 250

Model No (type PFU)	L (mm)	Thick (mm)	Number of holes ø5 mm
PFU170	170	2.0	6
PFU210	210	2.0	8
PFU250	250	2.0	10

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 4
Joist anchors PFE and PFU Geometry and drawings	of European Technical Assessment ETA-07/0137
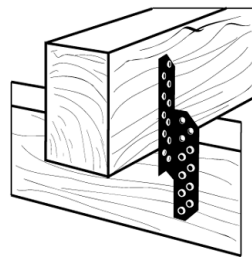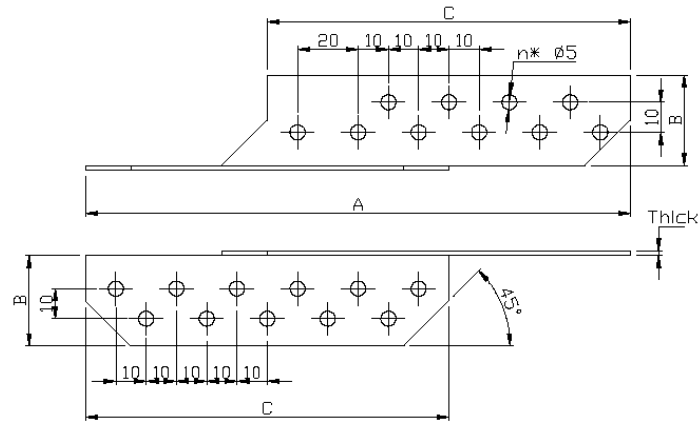
Joist anchor PSG and PSD

Joist anchor PSTG or PSTD 180/30/1.5

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 5
	of European
Joist anchors PSG / PSD / PSTG / PSTD	Technical Assessment
Geometry	ETA-07/0137

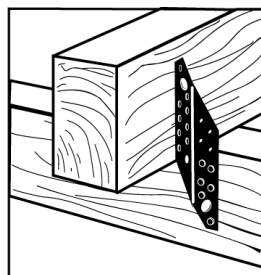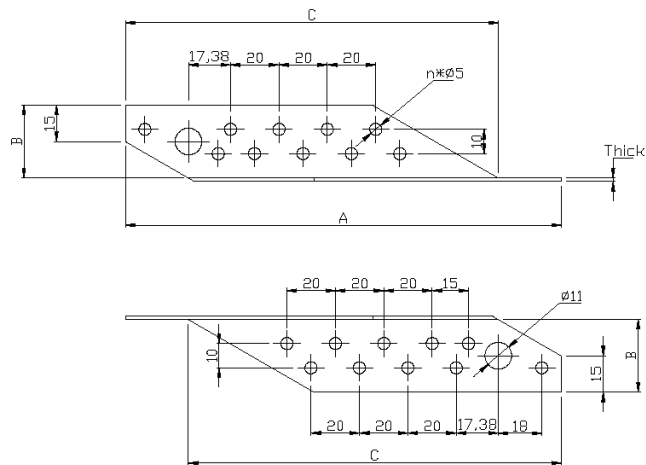| Model No./Type	A (mm)	B (mm)	C (mm)	Thick (mm)	Number of holes ø5 mm
PSD200/30/1.5	200	30	140	1.5	26
PSG200/30/1.5	200	30	140	1.5	26
PSD200/45/2	200	45	140	2	39
PSG200/45/2	200	45	140	2	39
PSD200/30/2	200	30	140	2	26
PSG200/30/2	200	30	140	2	26
PSD220/45/2	220	45	160	2	45
PSG220/45/2	220	45	160	2	45
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.

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 5
	of European
Joist anchors PSG / PSD / PSTG / PSTD	Technical Assessment
Geometry	ETA-07/0137
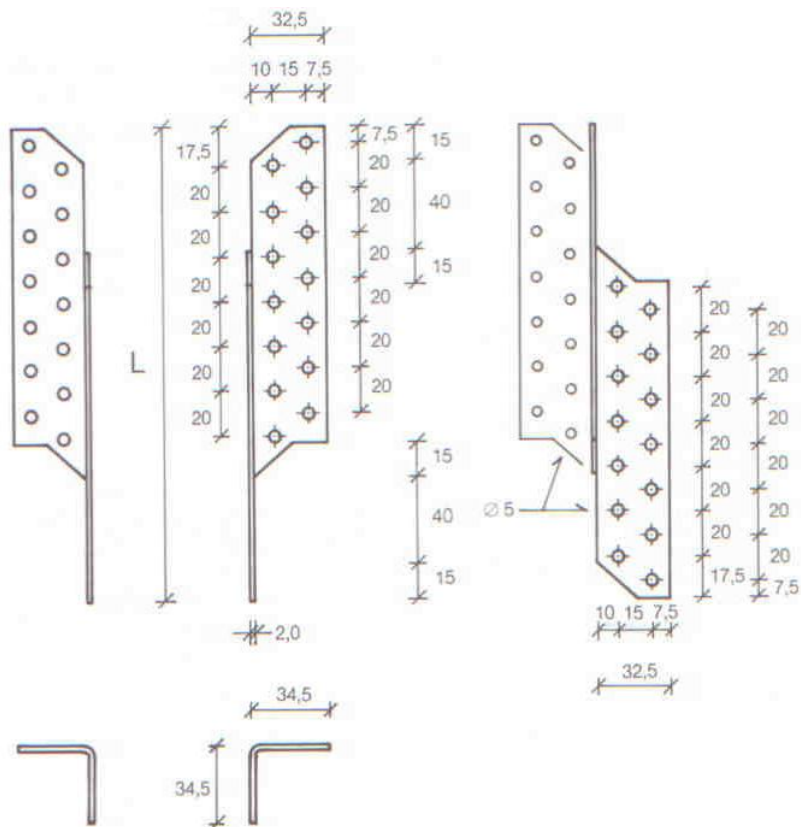
Purlin anchors SPF 170 to 370

. Model N°	Type	L (mm)	Thickness (mm)	Number of holes ø5 mm
SPF170L	Left	170	2	20
SPF170R	Right	170	2	20
SPF210L	Left	210	2	28
SPF210R	Right	210	2	28
SPF250L	Left	250	2	36
SPF250R	Right	250	2	36
SPF290L	Left	290	2	44
SPF290R	Right	290	2	44
SPF330L	Left	330	2	52
SPF330R	Right	330	2	52
SPF370L	Left	370	2	60
SPF370R	Right	370	2	60

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

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 6
Purlin anchors SPF **Geometry and drawings**	of European Technical Assessment **ETA-07/0137**
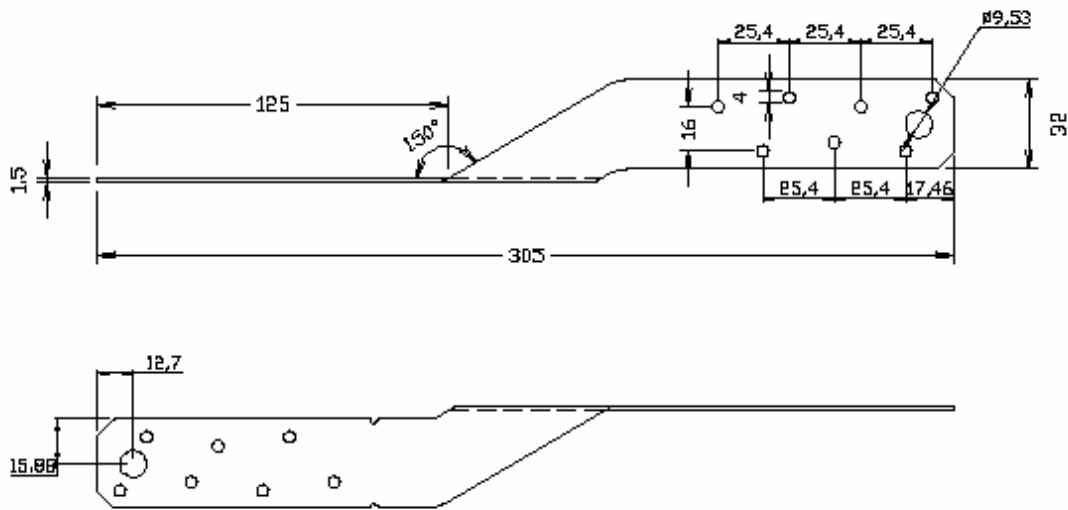
Joist anchor MTS 12
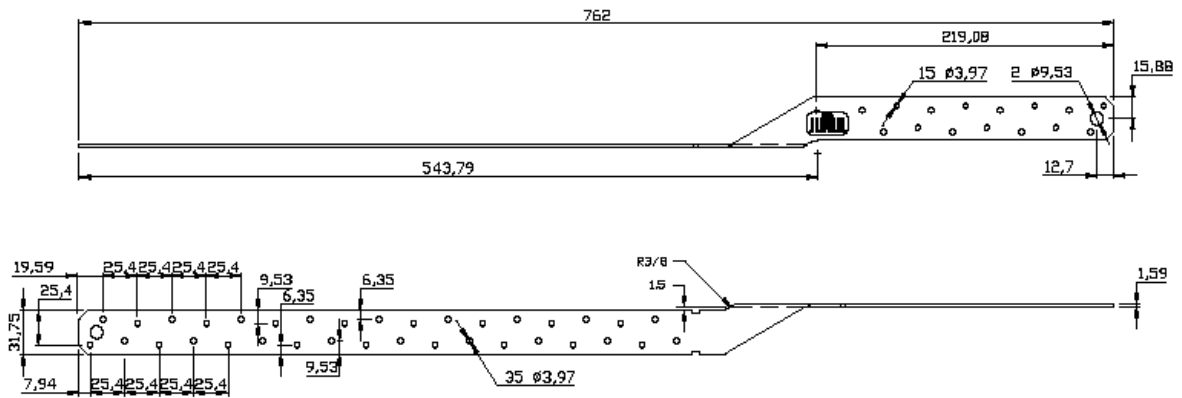
FOR MTS30Z

Joist anchor MTS 30
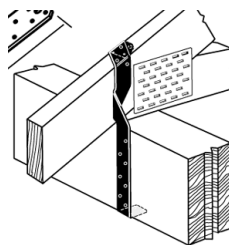
SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 7
	of European
Joist anchors MTS **Geometry and drawings**	Technical Assessment
	ETA-07/0137
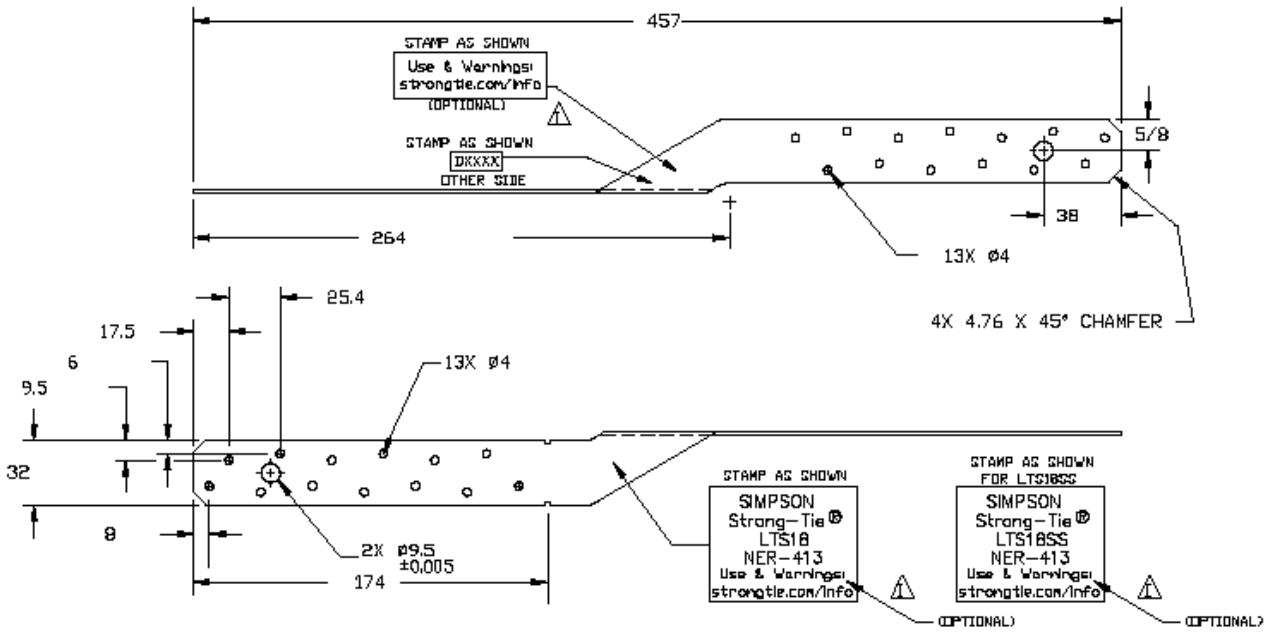
Joist anchor LTS 18

Joist LTS 18 – 3 dimensional view

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 8
	of European
Joist anchors LTS Geometry and drawings	Technical Assessment ETA-07/0137

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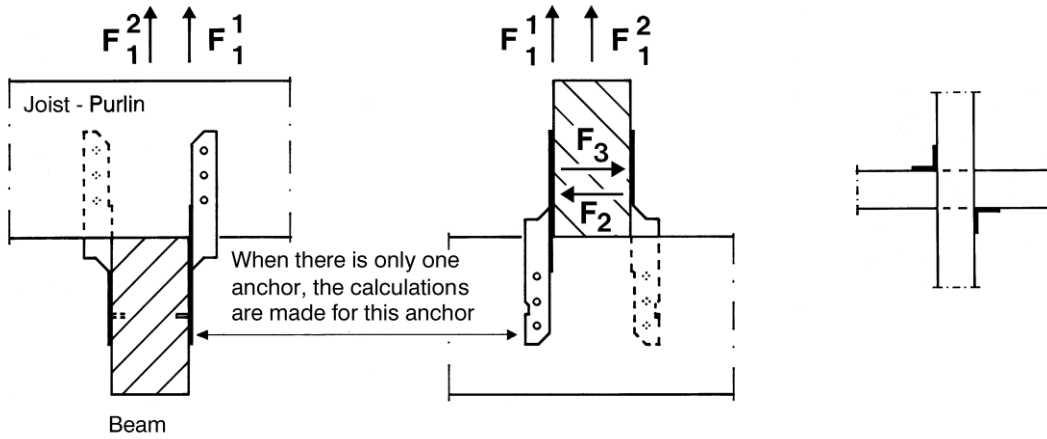
Purlin and joist anchors Direction and definition of forces on a single bracket. The 2 anchors a placed diagonally.

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.

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 9
	of European
Joist anchors and purlin anchors	Technical Assessment
Direction and combination of forces	ETA-07/0137

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

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 9
	of European
Joist anchors and purlin anchors	Technical Assessment
Direction and combination of forces	**ETA-07/0137**
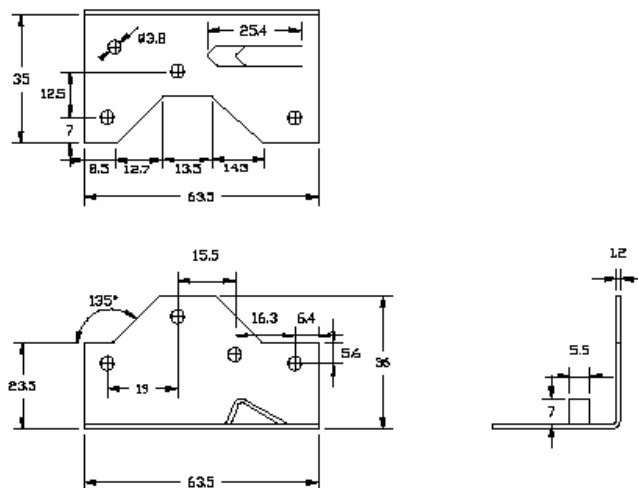
Joist anchor A34
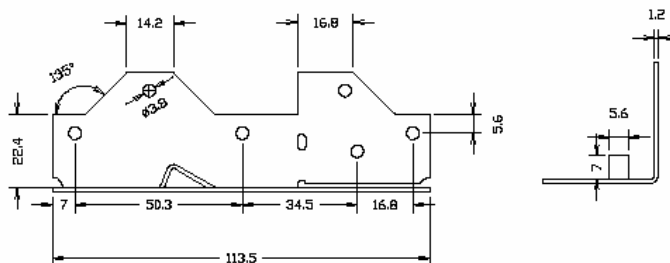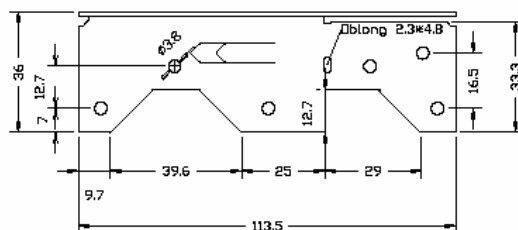
Joist anchor A35

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 10
	of European
Joist anchors A34 and A35	Technical Assessment
Geometry and drawings	**ETA-07/0137**

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.
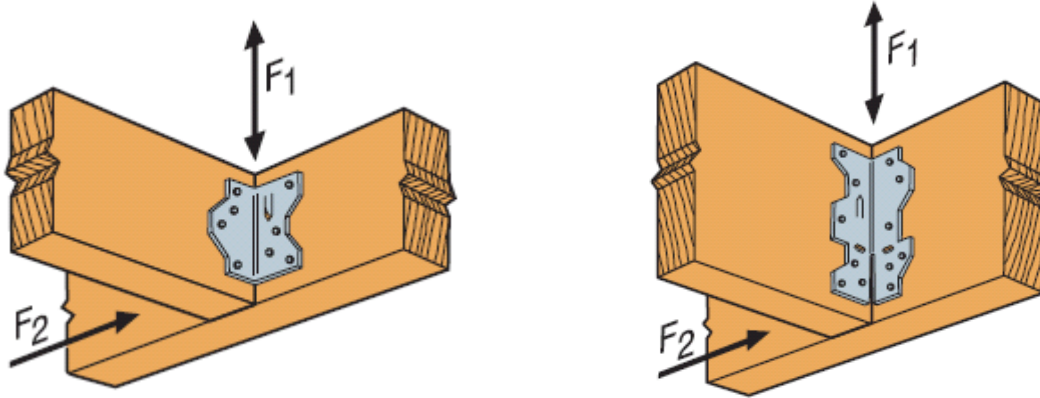
For joist to beam connections F1 will be the uplift and download. For A34 the connection can be made with one joist anchor, where F2 will be the horisontal force acting parallel to the header and toward the joist anchor. For A35 the connection should be made with two joist anchors one on each side of the joist.
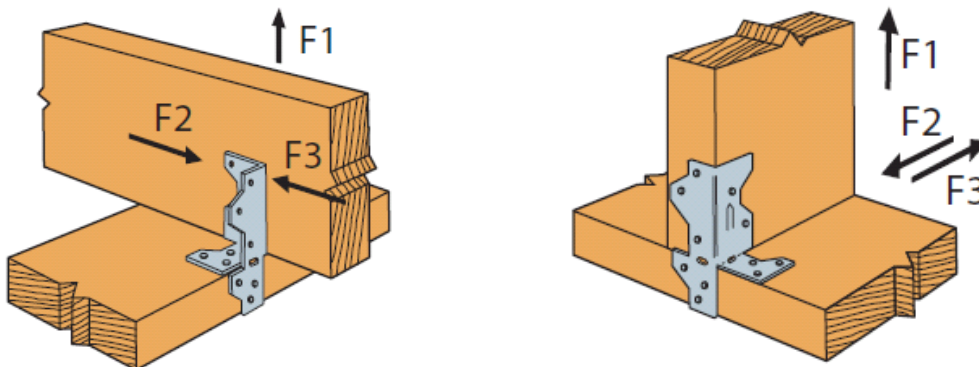
Joist anchor A35 can also be used for connection between a column, joist or beam and a plate. The connections should be made with two A35 joist anchors placed diagonally across from eachother. The horizontal forces F2 and F3 are acting perpendicular to the plate. F1 will for this connection be the uplift 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:

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

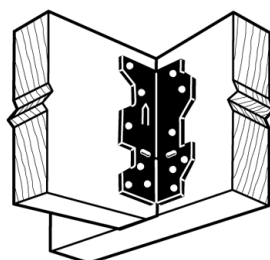| SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 11
Joist anchors A34 and A35	of European
Direction and combination of forces	Technical Assessment
	ETA-07/0137

Joist anchor H2.5A

Joist anchor

H4

H4 Left
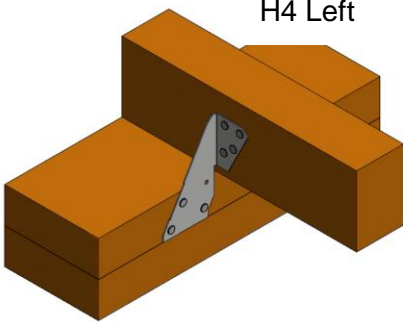
H4 Right

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 13
Joist anchors H2.5A and H4	of European
Direction and combination of forces	Technical Assessment
	ETA-07/0137

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.
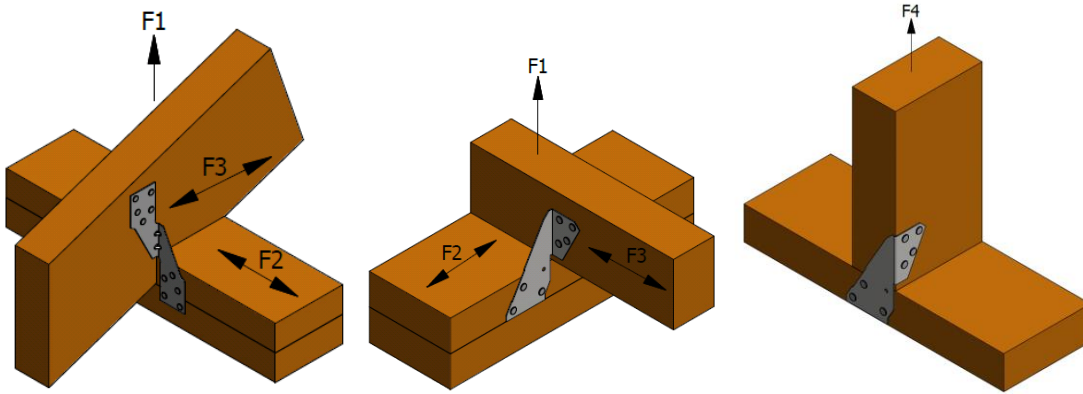
F1 and F4 are uplift forces.

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

F3 is horizontal force acting parallel to the rafter and perpendicullar 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 naling pattern.
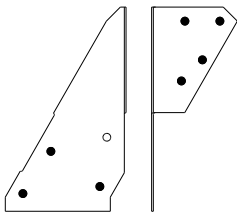
Combination of forces

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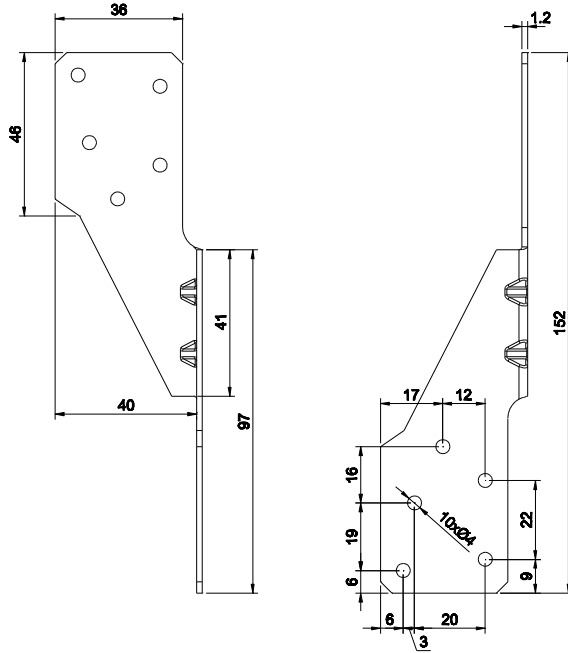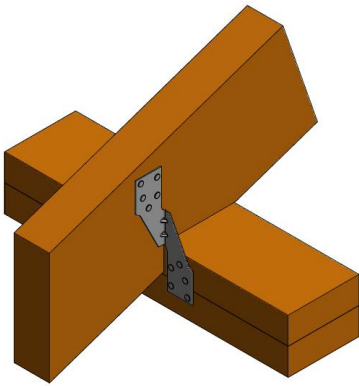
$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{2,d}}{R_{2,d}} + \frac{F_{3,d}}{R_{3,d}} \leq 1,0$$

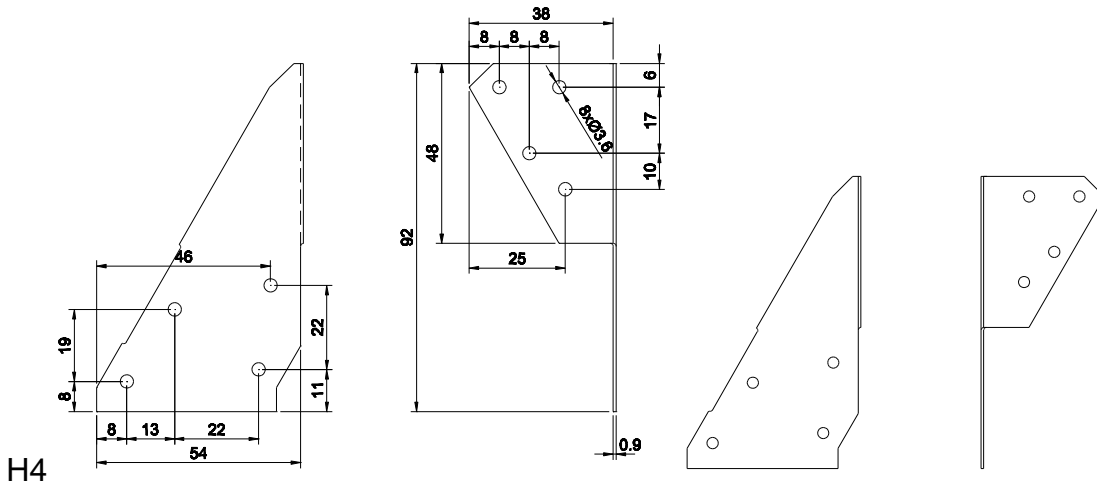| **SIMPSON Strong Tie brackets, purlin and joist anchors**	**Annex 13**
	of European
Joist anchors H2.5A and H4	Technical Assessment
Direction and combination of forces	**ETA-07/0137**

6 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/m^3.

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

Universal bracket UNI100, UNI130 and UNI190 :

Characteristic capacities are based on a characteristic density of the wood members of 350 kg/m^3. 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/m^3.

Universal bracket Micro96, purlin anchors and joist anchors :

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.

SIMPSON Strong Tie brackets, purlin and joist anchors	**Annex 14**
	of European
Requirements for the wood members	Technical Assessment **ETA-07/0137**

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.

SIMPSON Strong Tie brackets, purlin and joist anchors	**Annex 15**
	of European
Fasteners	Technical Assessment
Fastening combinations	**ETA-07/0137**

$R_{1,k}$ 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.

$R_{1,k} = 2{,}38 \cdot k_{mod} \cdot R_{lat,k}$
$R_{2,k} = R_{3,k} = 1{,}37 \cdot k_{mod} \cdot R_{lat,k}$
$R_{4,k} = R_{5,k} = Min\ (\ 2{,}74 \cdot k_{mod} \cdot R_{lat,k}\ ;\ k_1 \cdot (b + k_2)\ /\ e\ )$

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 $k_1 = Min\ (2 \cdot k_{mod} \cdot R_{ax,k}\ ;\ 0{,}48) + 1{,}19 \cdot k_{mod} \cdot R_{lat,k}$
And with $k_2 = [\ Min\ (2 \cdot k_{mod} \cdot R_{ax,k}\ ;\ 0{,}48) \cdot 22{.}5 + 7{.}1 \cdot k_{mod} \cdot R_{lat,k}\ ]\ /\ k_1$

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.

$R_{1,k}$:

Load duration	Perm.	Long	Medium	Short	Inst.
Nail 4.0 x 40	3,7	4,3	4,9	5,4	6,3
Nail 4.0 x 50	4,6	5,3	5,7	6,2	7,3

$R_{2,k} = R_{3,k} = 2{,}56 \cdot k_{mod} \cdot R_{lat,k}$
$R_{4,k} = R_{5,k} = Min\ (\ 4 \cdot k_{mod} \cdot R_{lat,k}\ ;\ k_1 \cdot (b + k_2)\ /\ e\ )$

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 :

Load duration		Perm.	Long	Medium	Short	Inst.
With nail 4.0 x 40 : k_1	[kN]	1,7	2,0	2,3	2,6	3,5
With nail 4.0 x 50 : k_1	[kN]	1,9	2,2	2,6	3,0	3,8
With nail 4.0 x 40 : k_2	[mm]	16	16	16	16	16
With nail 4.0 x 50 : k_2	[mm]	16	16	16	16	16

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 16
Universal brackets capacities **UNI96 and UNI100**	of European Technical Assessment **ETA-07/0137**

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.

$R_{1,k}$:

Load duration	Perm.	Long	Medium	Short	Inst.
Nail 4.0 x 40	6,7	7,8	8,9	9,9	11,8
Nail 4.0 x 50	8,8	10,3	11,5	12,7	15,3

$R_{2,k} = R_{3,k} = 4{,}31 \cdot k_{mod} \cdot R_{lat,k}$
$R_{4,k} = R_{5,k} = \text{Min} (4{,}33 \cdot k_{mod} \cdot R_{lat,k} ; k_1 \cdot (b + k_2) / e)$

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 :

Load duration		Perm.	Long	Medium	Short	Inst.
With nail 4.0 x 40 : k_1	[kN]	3,5	4,0	4,6	5,2	6,4
With nail 4.0 x 50 : k_1	[kN]	4,0	4,7	5,4	6,0	7,4
With nail 4.0 x 40 : k_2	[mm]	21	21	21	21	21
With nail 4.0 x 50 : k_2	[mm]	23	22	22	22	23

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 17
	of European
Universal brackets capacities **UNI130**	Technical Assessment **ETA-07/0137**

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**

Load duration	Perm.	Long	Medium	Short	Inst.
Nail 4.0 x 40	4,8 (9,6)	5,6 (11,2)	6,4 (12,9)	7,2 (14,5)	8,8 (17,7)
Nail 4.0 x 50	5,9 (9,9)	6,8 (11,5)	7,8 (13,2)	8,8 (14,8)	10,7 (18,1)

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

Load duration	Perm.	Long	Medium	Short	Inst.
Nail 4.0 x 40	2,9 (3,4)	3,3 (4,0)	3,7 (4,5)	4,1 (5,0)	5,0 (6,0)
Nail 4.0 x 50	3,4 (4,1)	3,9 (4,7)	4,4 (5,3)	4,9 (5,9)	5,9 (7,2)

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

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 :**

Load duration		Perm.	Long	Medium	Short	Inst.
With nail 4.0 x 40 : k_1	[kN]	2,5 (4,8)	2,9 (5,6)	3,3 (6,4)	3,7 (7,2)	4,5 (8,8)
With nail 4.0 x 50 : k_1	[kN]	3,0 (5,1)	3,5 (6,0)	4,0 (6,8)	4,5 (7,7)	5,5 (9,4)
With nail 4.0 x 40 : k_2	[mm]	7 (7)	7 (7)	7 (7)	7 (7)	7 (7)
With nail 4.0 x 50 : k_2	[mm]	7 (5)	7 (5)	7 (5)	7 (5)	7 (5)

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 18
	of European
Universal brackets capacities **UNI190 (2 brackets per connection)**	Technical Assessment **ETA-07/0137**

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:

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

$R_{1,k} = k_3 \cdot k_{mod} / f$ 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) :

Load duration	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

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

With k_1 from the table below :

Load duration	k_1
3 nails	2,26
6 nails	2,76

$R_{4,k} = k_1 \cdot k_{mod} / (k_2 + e)$

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 : $R_{4,k} = 257 / (47 + e)$

	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)

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

$R_{5,k} = k_2 \cdot k_{mod} / e$ for $e > e_{lim}$

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

Load duration	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)

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 19
	of European
Universal brackets capacities **UNI190 (1 bracket per connection)**	Technical Assessment **ETA-07/0137**

$R_{1,k}$ 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.

Joist anchors type PFE170 and PFE210 :

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

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

With k_1 factor without dimension given in the table below.

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

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.

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

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 $R_{3,k}$

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 20
	of European
Joist anchors capacities	Technical Assessment
Joist anchors type PFE	**ETA-07/0137**

Joist anchors type PFU170 to PFU250 :

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

$R_{1,k} = $ Min ($k_1 \cdot k_{mod} \cdot R_{lat,k}$; 5,2 kN) PFU170
$R_{1,k} = $ Min ($k_1 \cdot k_{mod} \cdot R_{lat,k}$; 7,3 kN) PFU 210 and PFU250

With k_1 factor without dimension given in the table below.

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

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

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 $R_{3,k}$

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 21
	of European
Joist anchors capacities	Technical Assessment
Joist anchors type PFU	**ETA-07/0137**

Joist anchors type PS 180 to PS 220 and PST :

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

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

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

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

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).

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 22
	of European
Joist anchors capacities	Technical Assessment
Joist anchors PS180 to 220 and PST	**ETA-07/0137**

$R_{1,k}$ 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 SPF 170 to 370 :

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

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

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

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

With k_1, k_2 and k_3 factors without dimensions depending on the type of purlin and the number of nail according to the following table:

Purlin anchor SPF	Number of nails	k_1	k_2 and k_3
170	4	2,33	0,77
	5	3,13	1,19
210	6	4,30	1,32
	7	5,26	1,83
250	8	6,45	2,05
	9	7,45	2,53
290	10	8,63	2,62
	11	9,64	3,25
330	12	10,80	3,97
	13	11,81	4,00
370	14	12,82	4,07
	15	13,94	4,77

In the case where two purlin 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 $R_{3,k}$.

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 23
	of European
Purlin anchors capacities	Technical Assessment
Purlin anchors SPF	**ETA-07/0137**

Joist anchors type MTS and LTS :

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

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

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	
	5	3,54	4,02
	6	4,68	
	7	5,64	
LTS 18	4	2,43	
	5	3,25	2,89
	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.**

| SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 24
	of European
Joist anchors capacities	Technical Assessment
Joist anchors MTS and LTS	**ETA-07/0137**

Joist anchors type A34 :

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

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

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

Joist anchors type A35 :

All capacities given in kN for a connection with two joist anchors one on each side of the joist
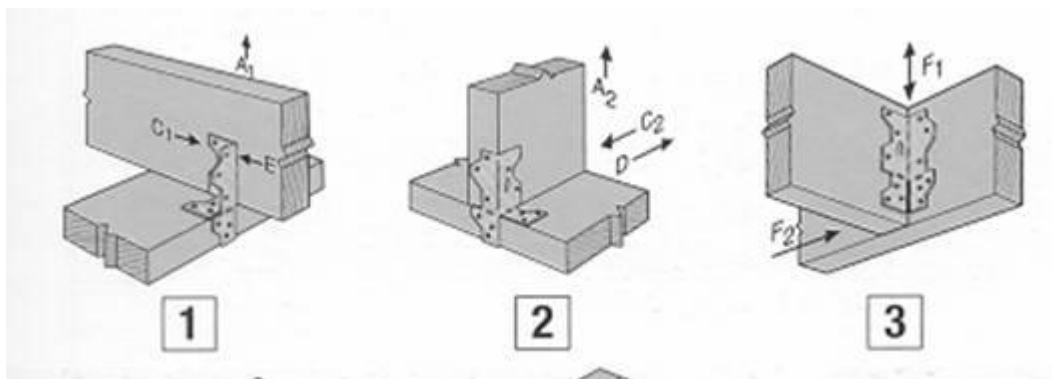
Uplift : A_1 joist-joist or A_2 column-joist

$R_{A1,k} = R_{A2,k} = 2{,}81 \cdot k_{mod} \cdot R_{lat,k} + Min\ (\ 2 \cdot k_{mod} \cdot R_{ax,k}\ ;\ 0{,}78\ kN\ )$

Horizontal load : C_1 joist-joist or D column-joist or E joist-joist

$R_{C1,k} = R_{D2,k} = R_{E,k} = 2{,}21 \cdot k_{mod} \cdot R_{lat,k}$

Horizontal load : C_2 column-joist

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

Shear load : F_1 joist-header

$R_{F1,k} = 10{,}5 \cdot k_{mod} \cdot R_{lat,k}$

Horizontal load: F2 joist-header

$R_{F2,k} = Min\ (\ 9{,}2 \cdot k_{mod}\ ;\ 23 \cdot k_{mod} \cdot R_{ax,k}\ ;\ 8 \cdot k_{mod} \cdot R_{lat,k})$

SIMPSON Strong Tie brackets, purlin and joist anchors	Annex 25
	of European
Joist anchors capacities	Technical Assessment
Joist anchors A34 and A35	**ETA-07/0137**

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.