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Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

European Technical Assessment ETA 12/0139 of 1/6/2017

I General Part

Technical Assessment Body issuing the ETA	VTT Expert Services LTD
Trade name of the construction product	MiTek palkkikengät MiTek joist hangers
Product family to which the construction product belongs	Naulauslevy rakenteelliseen käyttöön Three-dimensional nailing plates
Manufacturer	MiTek Finland Oy Sepänkatu 7-9 FI-11710 Riihimäki Finland
Manufacturing plants	According Annex N
This European Technical Assessment contains	26 pages including 2 Annexes that form an integral part of this assessment
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Three-dimensional nailing plates", ETAG 015, Edition November 2012, used as European Assessment Document (EAD)
This ETA replaces	ETA 12/0139, issued on May 8, 2012

II Specific Part

1 Technical description of the product

MiTek joist hangers are one-piece non-welded three-dimensional nailing plates manufactured from hot-dip zinc coated steel sheet of grade S250 GD Z 275 MA according to EN 10346 or cold formable galvanized steel DX51D-Z275 (EN 10346). The yield strength of the steel is at least 250 N/mm² and the tensile strength at least 330 N/mm². The connector may additionally have surface treatment by powder coating.

All joist hangers can alternatively be manufactured of 1.4301, 1.4401 (EN 10088) austenitic stainless steel or 1.4509, 1.4521 (EN 10088) ferritic stainless steel. The yield strength $R_{0,2}$ of the stainless steel 1.4301 is at least 230 N/mm², for 1.4401 at least 220 N/mm². For ferritic grades the yield strength $R_{0,2}$ shall be 250-350 N/mm² for 1.4509 and 275-350 N/mm² for 1.4521.

The steel material thickness for type 814 joist hanger is 3.00 $\pm$ 0.18 mm and for all other joist hangers 2.00 $\pm$ 0.14 mm. The product drawings are in Annex 1. The specified locations and respective distances for holes shall be within $\pm$ 1.00 mm tolerance.

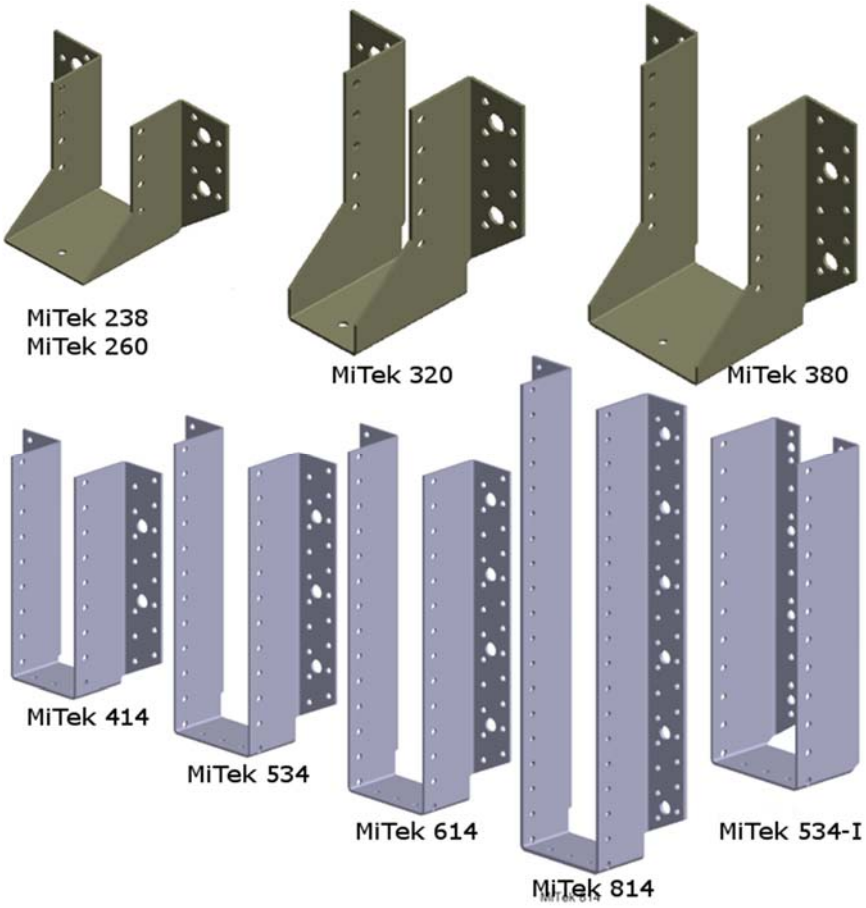


Figure 1

MiTek joist hangers types 238, 260, 320, 380, 414, 534, 614, 814 and type MiTek 534-I with inward flanges.

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

2.1 Intended uses

Intended use of MiTek joist hangers are timber constructions, where the primary and secondary members are strength graded timber according to EN 14081-1, glulam according to EN 14080, softwood- or laminated logs, laminated veneer lumber (LVL) according to EN 14374, plywood according to EN 13986, cross laminated timber (CLT) with edge glued lamellas, or corresponding timber material. The characteristic density ρ_k of the timber shall not be greater than 500 kg/m³.

The joist hanger makes the end support of the secondary beam. The secondary beam may be reinforced with Top-W punched metal plate fastener.

MiTek joist hangers shall be fixed to timber by anchor nails or anchor screws according to EN 14592. The diameter of the anchor nails shall be d = 4,0 mm and the profiled length at least 24 mm. The diameter of the smooth part of the anchor screws shall be d = 4,5…5,0 mm and the inner diameter of the threaded part $d_s \geq$ 3,0 mm. The length of the threaded part of the screw shall be at least 6d. Timber parts shall not be pre-drilled for the nails or screws that shall be perpendicular to the grain of the timber.

The primary beam may also be manufactured other applicable rigid material such as concrete or steel. In this case the joist hanger shall be fixed with CE-marked bolts, threaded bars, anchor bolts or other applicable connector with diameter 10 mm through the 11 mm holes to the concrete or with concrete screws with diameter of 6 mm through the 7mm holes. The concrete screws shall have been ETA assessed in accordance with ETAG 001.

For joist hangers made of hot dip coated steel, the intended service classes according to EN 1995-1-1 are classes 1 and 2. Joist hangers made of stainless steel can also be used in service class 3.

In service class 2, the nails or screws shall have an electroplated zinc coating according to EN ISO 2081 at least of type and thickness Fe/Zn 12c, or they shall be hot dip zinc coated according to EN ISO 1461, thickness at least 39 μm.

Figure 2

Example of an anchor screw and an anchor nail to be used with MiTek Joist Hangers.

When joist hangers made of stainless steel are used, the nails or screws shall also be made of stainless steel. Fasteners to concrete shall have an electroplated zinc coating according to EN ISO 2081 at least of type and thickness Fe/Zn 25c, or they shall be hot dip zinc coated according to EN ISO 1461, thickness at least 49 μm.

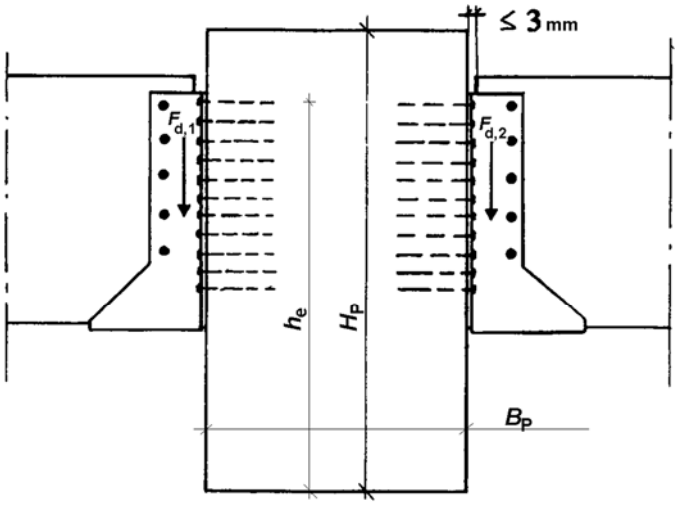


Figure 3

Typical use of MiTek Joist Hangers.

2.2 Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of MiTek Joist Hangers of 50 years[1].

2.3 Identification

MiTek Joist Hangers are identified having "Mii" stamped on each connector.

[1] This means that it is expected that when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements of the works. The indications given as to the working life of a building kit cannot be interpreted as a guarantee given by the producer or the technical assessment body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for building kits in relation to the expected, economically reasonable working life of the works.

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

Table 1. Basic requirements for construction works and essential characteristics

Basic requirement and essential characteristics	Performance
BWR 1. Mechanical resistance and stability	
Joint strength	Clause 3.1
Joint stiffness	No performance assessed
Joint ductility	No performance assessed
Resistance to corrosion and deterioration	Clause 3.1
Dimensional stability	No performance assessed
BWR 2. Safety in case of fire	
Reaction to fire	Clause 3.2
Resistance to fire	No performance assessed
BWR 3. Hygiene, health and the environment	
Content, emission and/or release of dangerous substances	Clause 3.3
BWR 7. Sustainable use of natural resources	
Sustainable use of natural resources	No performance assessed

3.1 Mechanical resistance and stability, BWR 1

3.1.1 Joint strength

Characteristic resistance values of MiTek Joist Hangers are given in Annex 2.

3.1.2 Resistance to corrosion and deterioration

MiTek Joist Hangers have been assessed as having satisfactory durability and serviceability when used in timber structures when the timber species (including timbers preserved with organic solvent, boron diffusion and related preservatives) described in Eurocode 5 (EN 1995-1-1: 2004) are used and the structures are subject to the dry, internal conditions defined by service classes 1 and 2.

3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

MiTek Joist Hangers are made of materials classified to have reaction to fire class A1 according to EN 13501-1.

3.3 Hygiene, health and environment, BWR 3

3.3.1 Content, emission and/or release of dangerous substances

The product does not contain harmful or dangerous substances listed in EOTA TR 34 dated May 2014.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, 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 Products Directive, these requirements need also to be complied with, when and where they apply.

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

According to the Decision 97/638/EC of the European Commission[2], the system of assessment and verification of constancy of performance (see Annex V to the regulation (EU) No 305/2011) is System 2+.

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at VTT Expert Services Ltd.

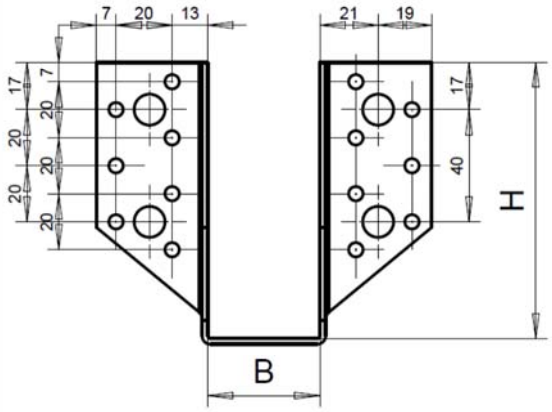
Issued in Espoo on June 1, 2017
by VTT Expert Services Ltd

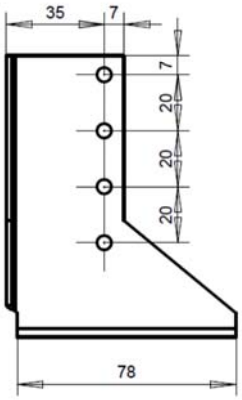
Pertti Jokinen
Product Manager

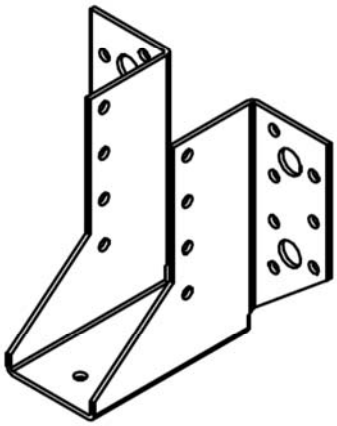
Ari Kevarinmäki
Leading Expert

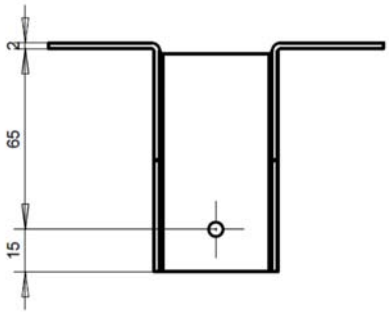
[2] Official Journal of the European Communities L 268 of 1/10/1997

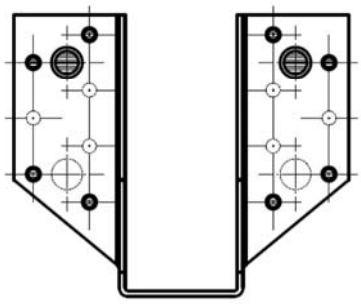
Mark	Revision	Date	Rev by	Acc











Fixing holes / primary + secondary beams	
Location	Diameter / Qty
Primary header	Ø11 (x4) + Ø5 (x7 x2)
Secondary / sides	Ø5 (x4 x2)
Secondary / base	Ø5 (x1)

Product variations		
Size	Product ID / Material	
B X H	S250GD-Z275MA	EN 1.4301
40 x 99	400066	401262
45 x 96	400068	401264
48 x 95	400073	401265
51 x 93	400077	401135

Partial nailing n_p : Ø 5 mm 8 pcs
Ø 11 mm 2 pcs

1		Steel strip		2x238-118	0.118		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale 1:2.5	Product Joist Hangers N Ref Project A03e	Joist Hanger BxH N Strip width 238 Annex 1 to ETA-12/0139
Mass 0.281 kg			
Design 2012-01-09 MER Check Acc		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New 400000_238c

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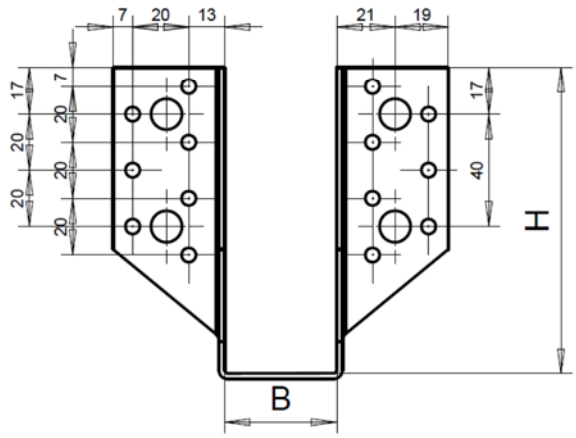

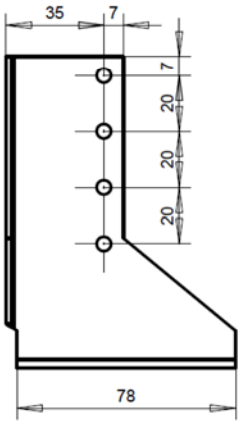

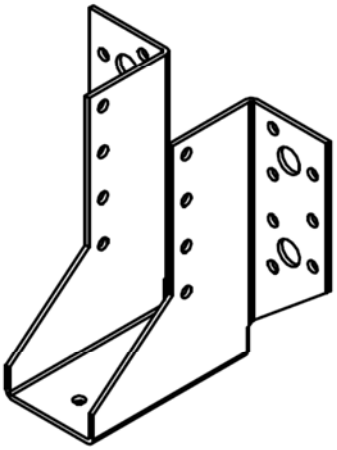

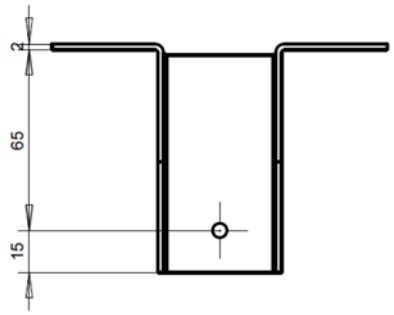

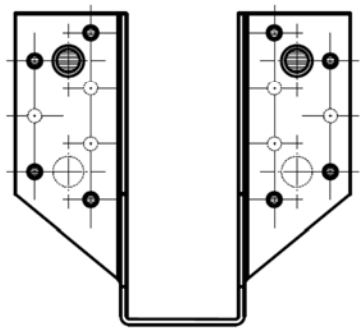

Partial nailing n_p : Ø 5 mm 8 pcs
Ø 11 mm 2 pcs

Fixing holes / primary + secondary beams	
Location	Diameter / Qty
Primary header	Ø11 (x4) + Ø5 (x7 x2)
Secondary / sides	Ø5 (x4 x2)
Secondary / base	Ø5 (x1)

Product variations		
Size	Product ID / Material	
B X H	S250GD-Z275MA	EN 1.4301
40 x 110	400067	401263
45 x 107	400069	401132
51 x 105	400078	401136
60 x 100	400082	401268
64 x 98	400087	401271

1		Steel Strip		2x260-118	0.118		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale 1:2.5	Product: Joist Hangers N Ref Project: A03e	Joist Hanger B x H N Strip Width 260 Annex 1 to ETA-12/0139
Mass 0.31 kg			
Design: 2012-01-09 MER Check Acc		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New 400000_260c

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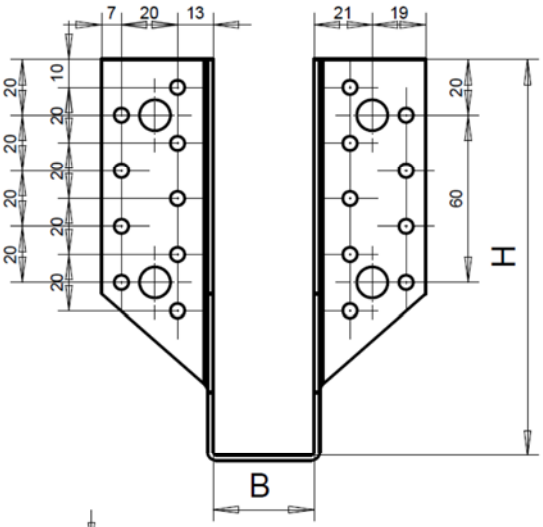

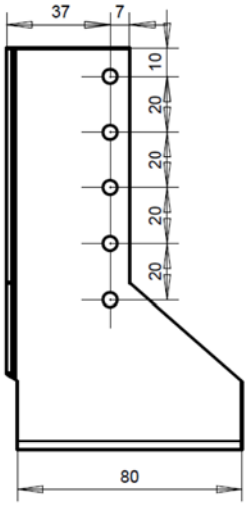

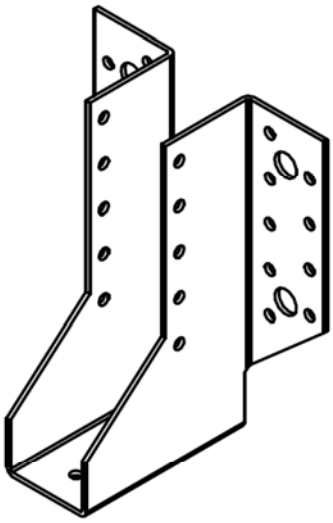

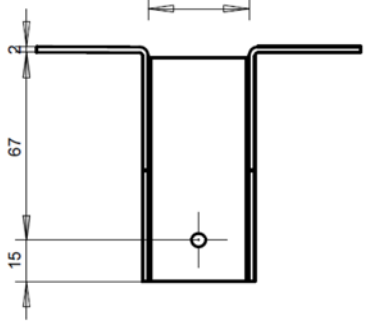

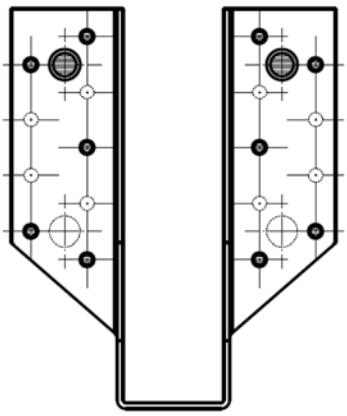

Partial nailing n_p : Ø 5 mm 10 pcs
Ø 11 mm 2 pcs

Fixing holes / primary + secondary beams	
Location	Diameter / Qty
Primary header	Ø11 (x4) + Ø5 (x9 x2)
Secondary / sides	Ø5 (x5 x2)
Secondary / base	Ø5 (x1)

Product variations		
Size	Product ID / Material	
B X H	S250GD-Z275MA	EN 1.4301
36 x 142	400065	401261
40 x 140	400118	401139
45 x 137	400070	401133
48 x 136	400074	401266
51 x 135	400079	401137
60 x 130	400083	401269
64 x 128	400088	401272
70 x 125	400089	401273
73 x 124	400091	401275
76 x 122	400094	401277
80 x 120	400097	401279

1		Steel Strip		2x320-120	0.120		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale	Product: Joist Hangers N	Joist Hanger B xH N
		Ref	Strip width 320
Mass: 0.392 kg	1:2.5	Project: A03e	Annex 1 to ETA-12/0139
Design: 2012-01-02 MER		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New
Check			400000_320c
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ANNEX 1: Product details and definitions

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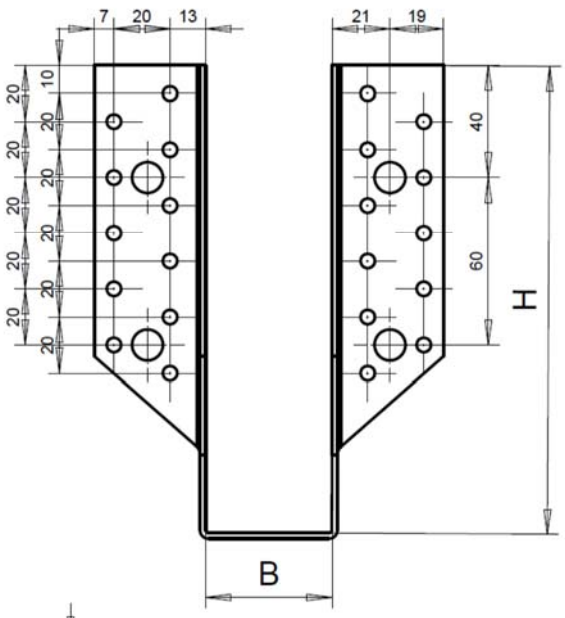

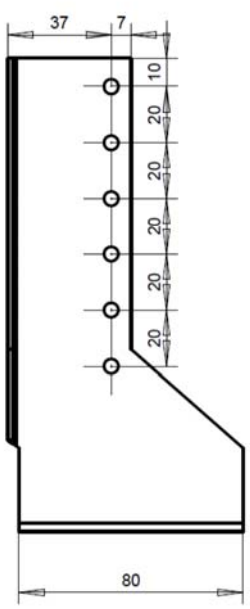

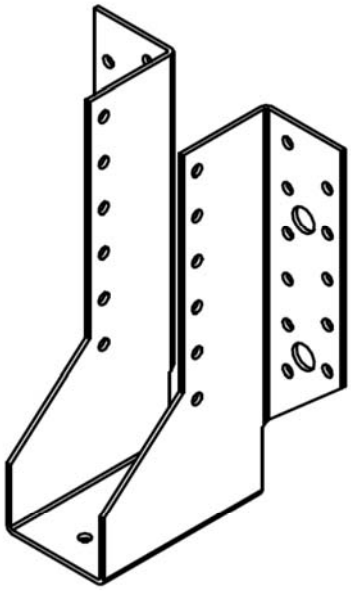

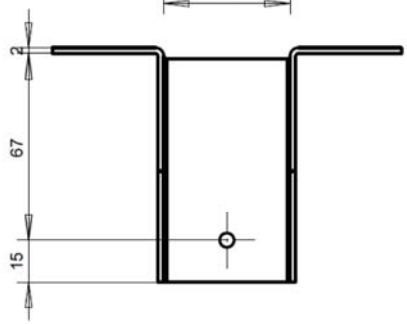

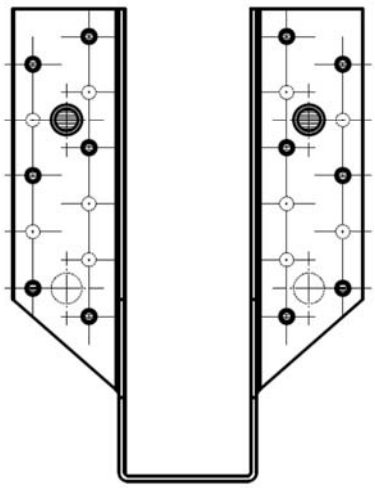

Partial nailing n_p : Ø 5 mm 12 pcs
Ø 11 mm 2 pcs

Fixing holes / primary + secondary beams	
Location	Diameter / Qty
Primary header	Ø11 (x4) + Ø5 (x11 x2)
Secondary / sides	Ø5 (x6 x2)
Secondary / base	Ø5 (x1)

Product variations		
Size	Product ID / Material	
B X H	S250GD-Z275MA	EN 1.4301
45 x 167	400071	401134
48 x 166	400075	401267
51 x 164	400080	401138
60 x 160	400084	401270
70 x 155	400090	401274
73 x 153	400092	401276
76 x 152	400095	401278
80 x 150	400098	401280
90 x 145	400101	401281
98 x 141	400103	401282
100 x 140	400105	401283

1		Steel Strip		2x380-120	0.120		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale	Product: Joist Hangers N	Joist Hanger B x H N RST Strip Width 380 Annex 1 to ETA-12/0139
Mass: 0.466 kg	1:2.5	Ref	
		Project: A03e	
Design: 2012-01-09 MER		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New
Check			400000_380c
Acc			

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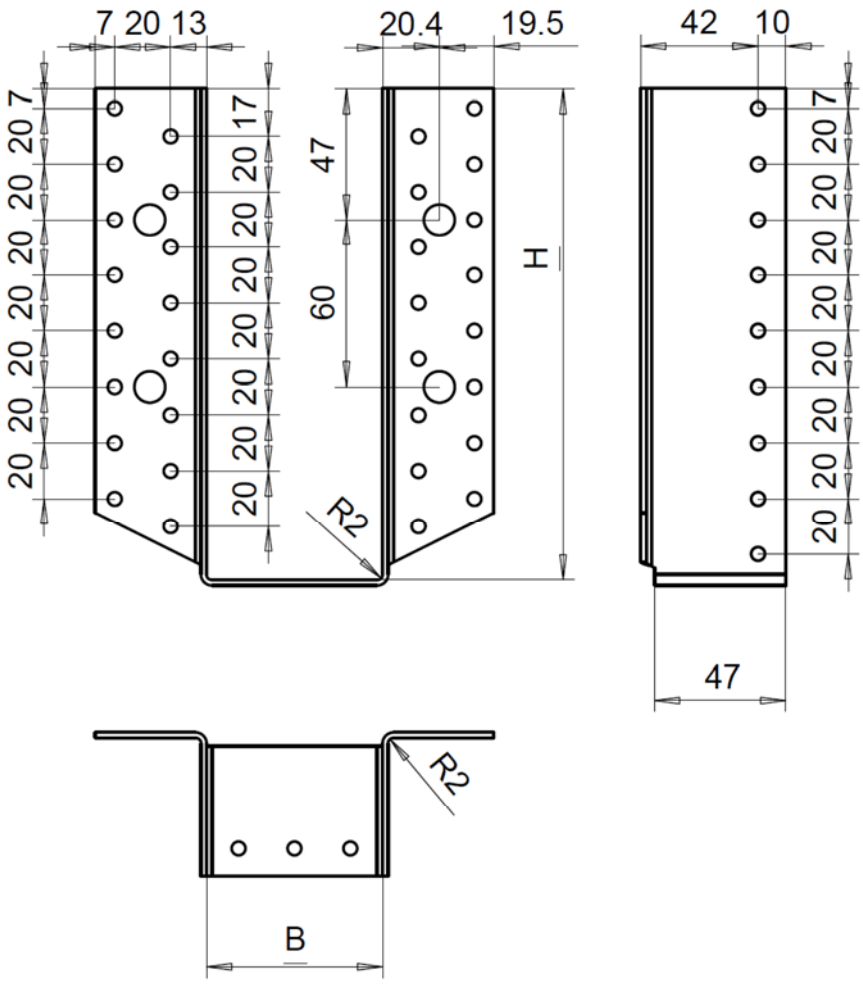

0	St-2	Steel 2mm		416.1x88.1x2	0.04		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale	Product MiTek Joist Hangers	MiTek N 414 Joist Hanger ETA-12/0139
Mass 0.5 kg	1:2.5	Ref	
Design 2016-12-01 MER		Project A03_LVL	
Check		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New
Acc			400000_414-ETA

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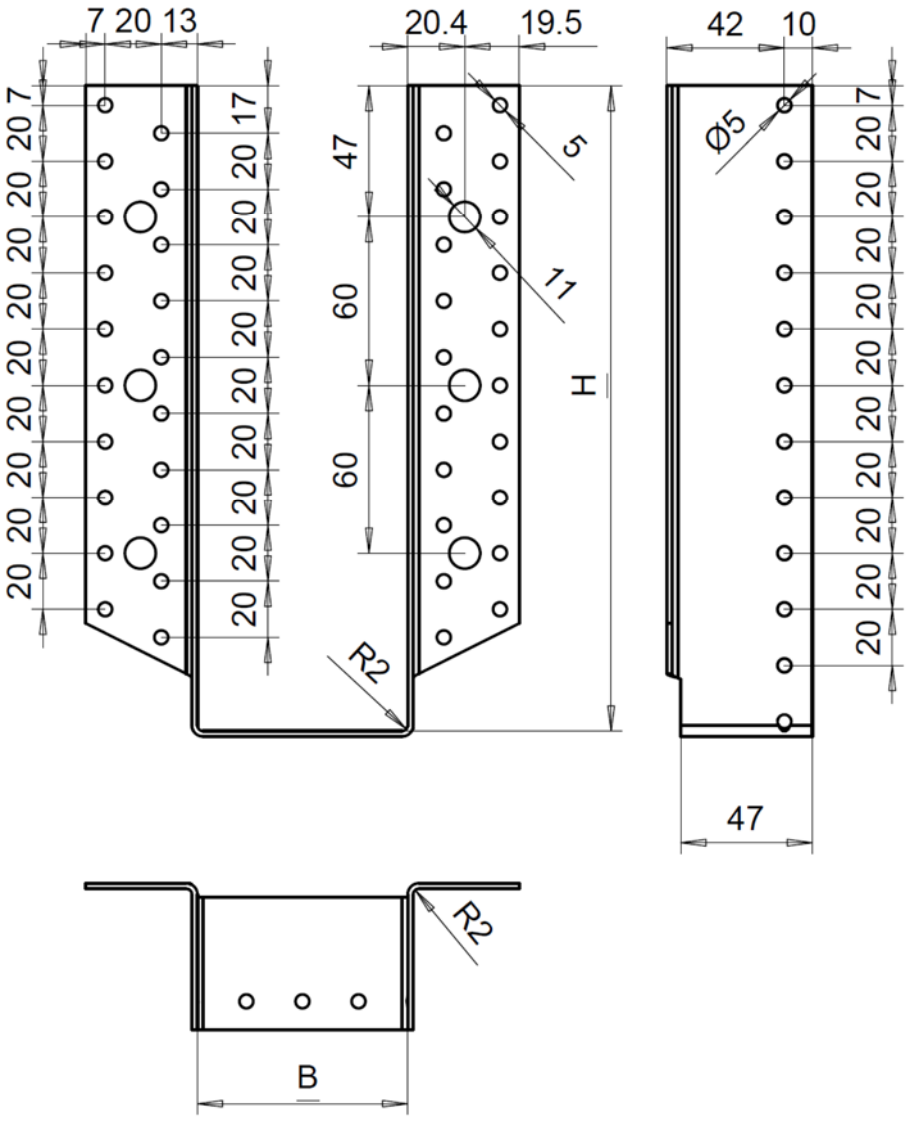

0	St-2	Steel 2mm		536.1x88.1x2	0.05		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale 1:2.5	Product MiTek Joist Hangers Ref Project A03_LVL	MiTek N 534 Joist Hanger ETA-12/0139
Mass 0.6 kg			
Design 2016-12-01 MER Check Acc		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New 400000_534-ETA

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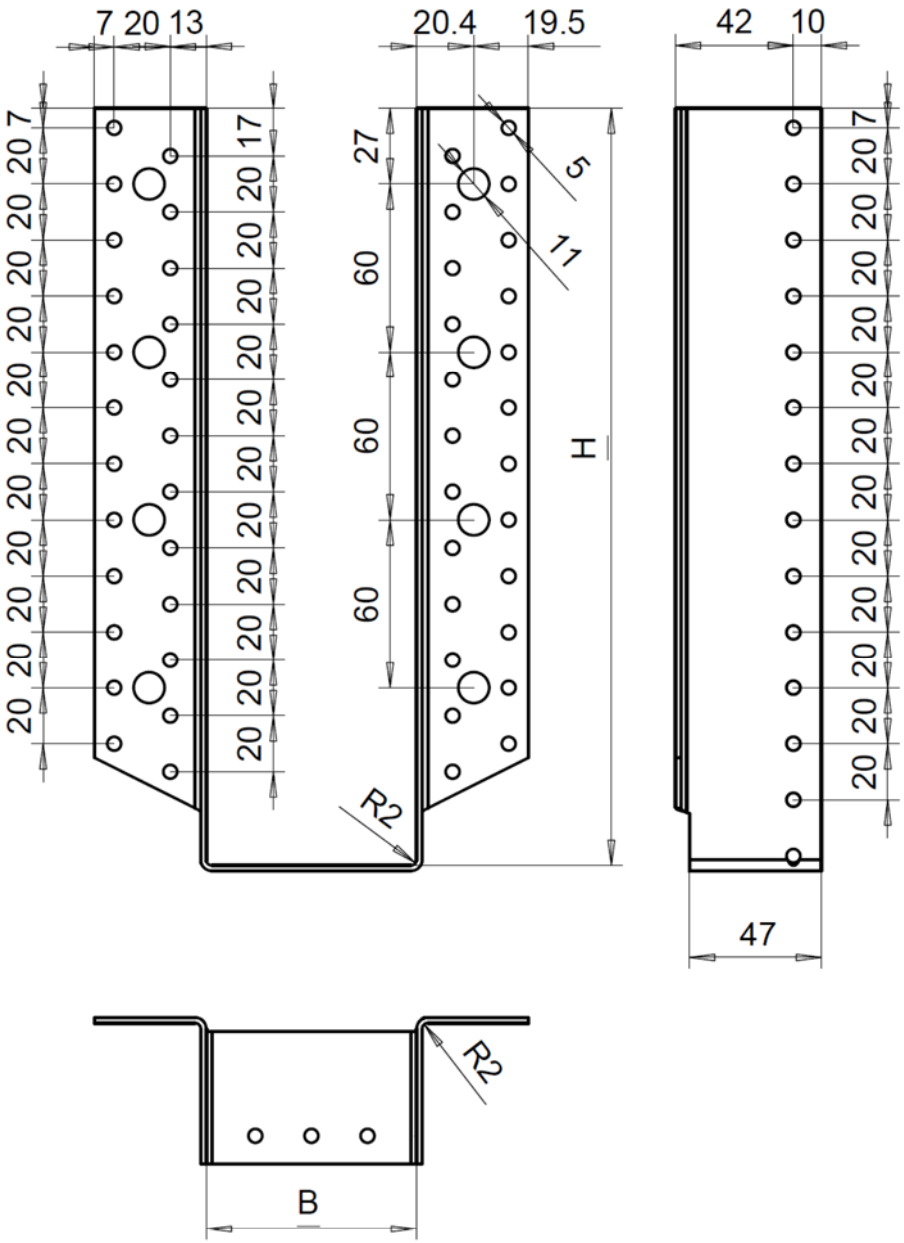
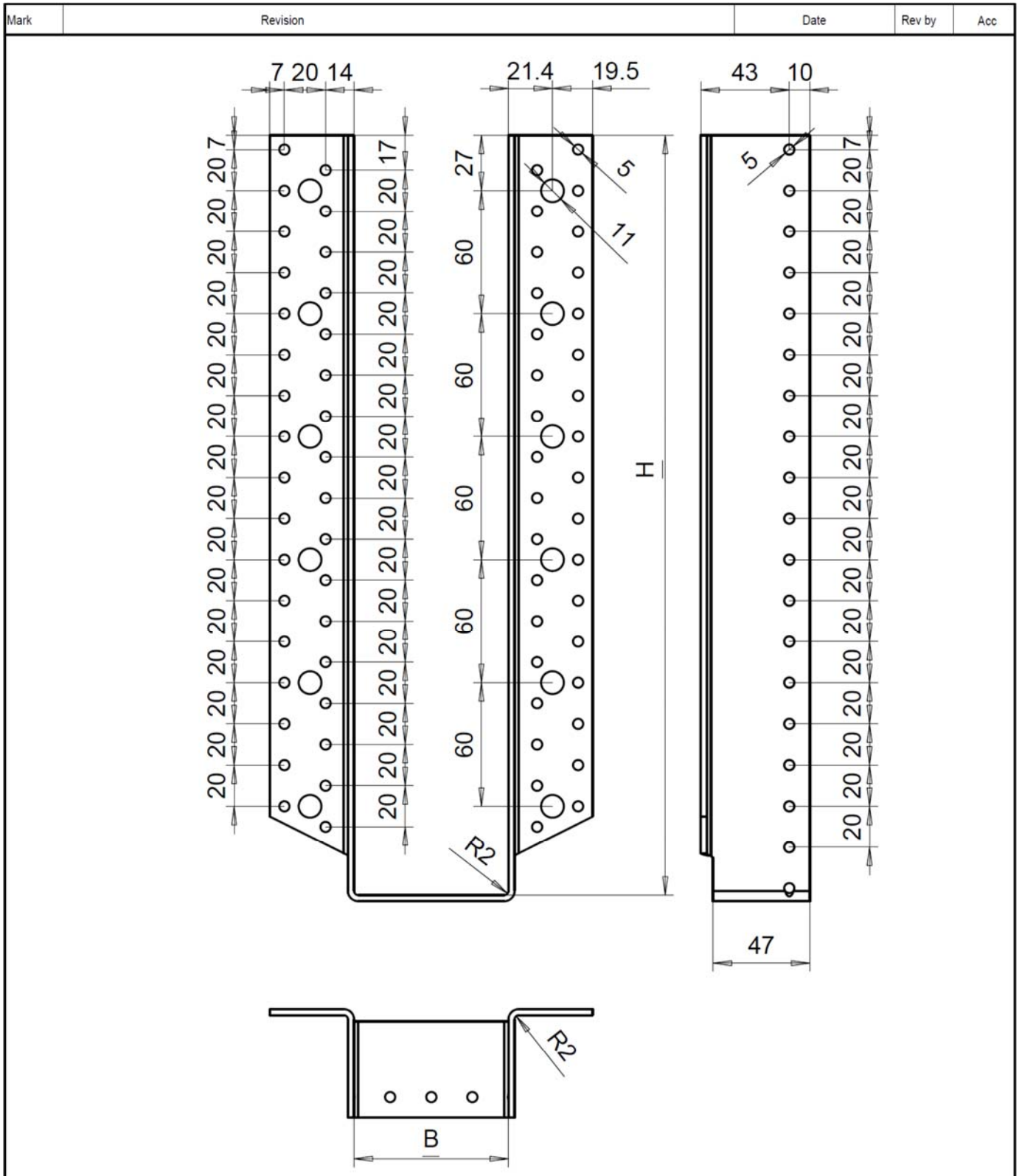


0	St-2	Steel 2mm		616.1x88.1x2	0.05		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale 1:2.5	Product MiTek Joist Hangers	MiTek N 614 Joist Hanger ETA-12/0139
Mass 0.7 kg		Ref	
		Project A03_LVL	
Design 2016-12-01 MER Check Acc		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New 400000_614-ETA



0	St-2	Steel 2mm		827.7x93.9x3	0.08		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale	Product: MiTek Joist Hangers	MiTek N 814 Joist Hanger
Mass: 1.5 kg	1:2.5	Ref: ETA-12/0139	ETA-12/0139
Design: 2016-12-01 MER		Project: A03_LVL	
Check		MiTek Finland Oy Sepänkatu 7-9 11710 Riihimäki, Finland tel. +358-19-77410	Prev / New
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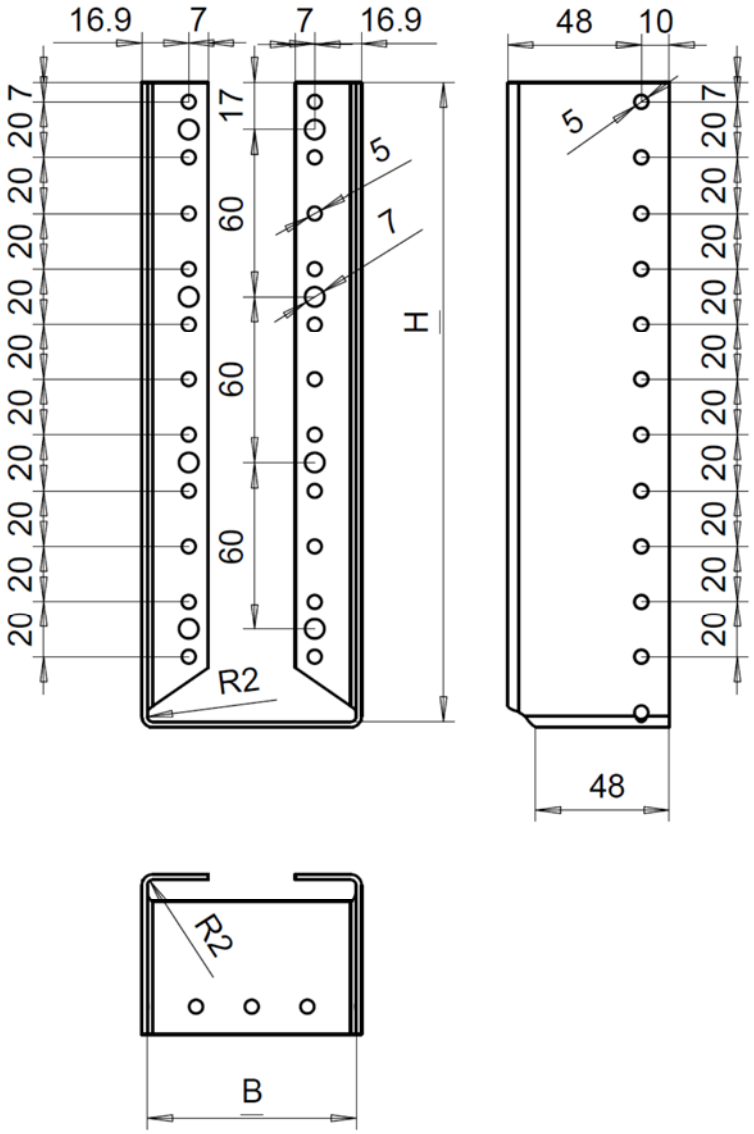

0	St-2	Steel 2mm		536.1x78.1x2	0.04		1
Part	Drawing number Item reference	Part or assembly group name	Standard or catalog	Shape, Dimension, Designation	Amount	Material	Qty

General tolerances	Scale	Product MiTek Joist Hangers	MiTek I 534 Joist Hanger ETA-12/0139
Mass 0.6 kg	1:2.5	Ref	
		Project A03_LVL	
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ANNEX 2: CHARACTERISTIC LOAD-CARRYING CAPACITIES

1 Partial nailing patterns for MiTek joist hangers

In addition to full nailing the MiTek Joist Hangers may be fixed using predefined nailing patterns. The nailing patterns vary according to each type and fastener.

Joist hanger types 238, 260, 320, 380 and 414

The partial nailing pattern is specified in figure 4 where fasteners shall be located in holes marked with grey colour. In timber connections only 5 mm holes are used. For concrete connections 11 mm or 7 mm holes are used, n_P = 2.

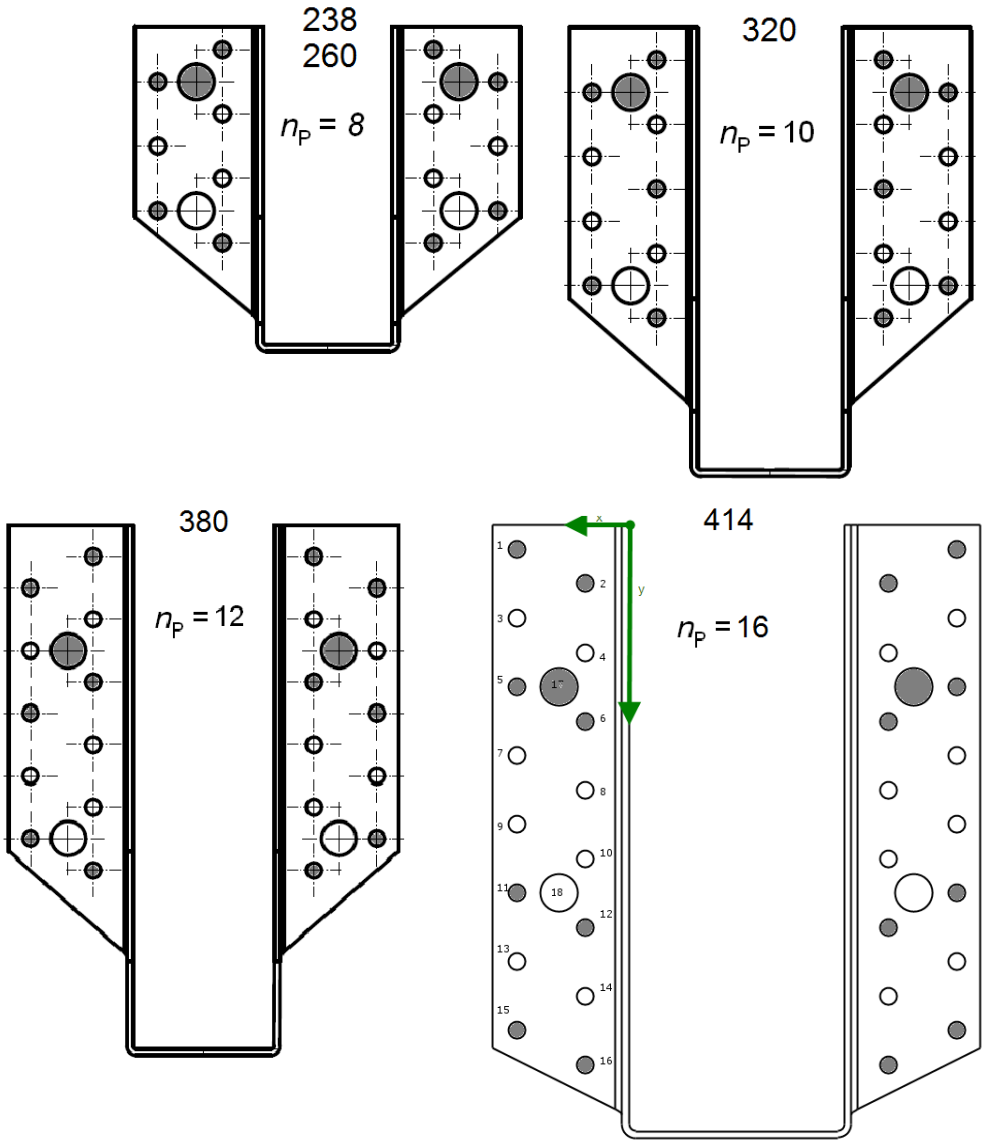

Figure 4. MiTek 238, 260, 320, 380 and 414 partial nailing patterns

Joist hanger types 534, 614 and 814

Joist hanger types 534, 614 and 814 may have two alternative nailing patterns, B and C. The partial nailing patterns are specified in Figure 5.

In nailing pattern B fasteners shall be located in holes marked with red and grey colour.

In nailing pattern C fasteners shall be located in holes marked with red colour.

In timber connections only 5 mm holes are used. For concrete connections 11 mm or 7 mm holes marked blue are used.

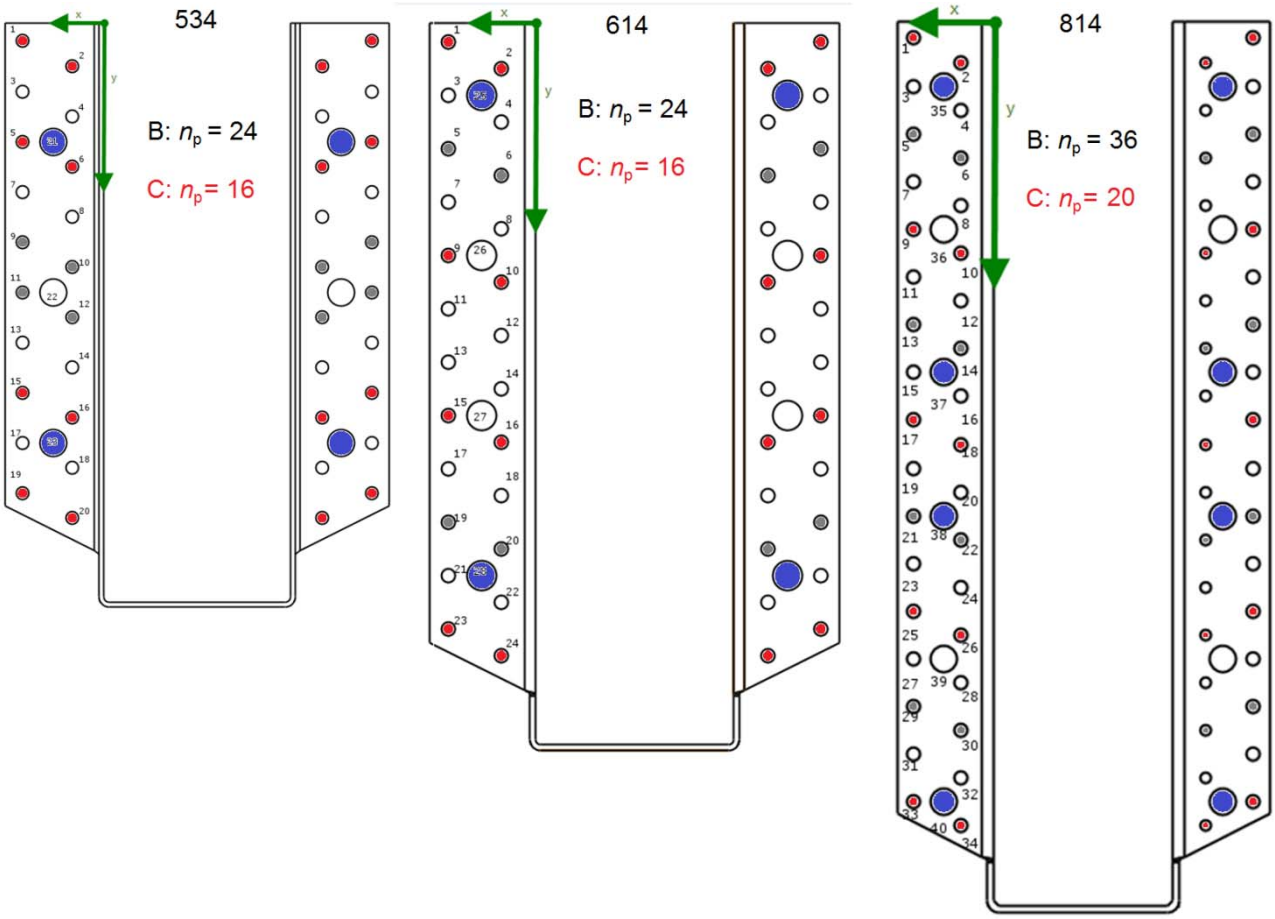

Figure 5. MiTek 534, 614, and 814 partial nailing patterns

Joist hanger type 534-I

Joist hanger types 534-I may have a partial nailing pattern. The partial nailing pattern is shown in Figure 6.

The partial anchor nail or -screws fasteners shall be fixed through 5 mm holes (n_P = 14) marked with grey colour.

The 11 mm or 7 mm holes to be used for partial concrete connection (n_P = 4) are marked with blue colour.

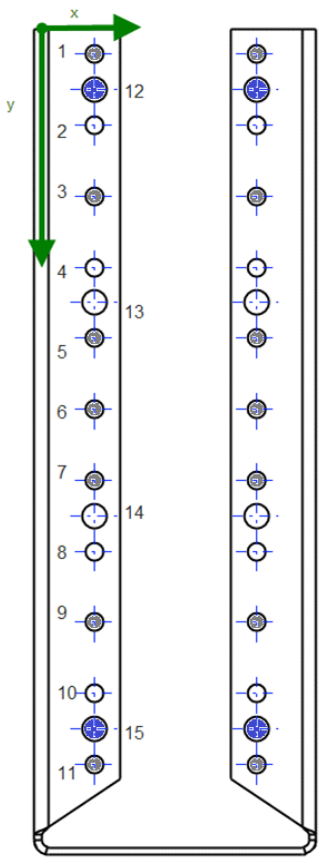

Figure 6. MiTek 543-I joist hanger partial nailing pattern.

2 Characteristic capacity for MiTek joist hangers

Simplified method

Simplified method can be used when the depth of the secondary beam is in the range 1,0..1,5*H,* where *H* is the height of the joist hanger, and when the shear capacity of the joint to primary beam is at least 20 % higher than shear capacity of the joint of the secondary beam. With MiTek Joist Hanger types 534, 614, 814 and 534-I the height of the secondary beam shall be maximum of 1,4*H*.

The design capacity R_d of the joist hanger in vertical direction is

$$R_{0,d} = k_{\mathrm{mod}} \frac{R_{0,k}}{\gamma_M} = k_{\mathrm{mod}} \frac{n_T F_{T,v,Rk}}{\gamma_M} \qquad (1)$$

and in the direction of the width B of the joist hanger

$$R_{90,d} = 0{,}8 \cdot \frac{B}{H_T} \cdot R_{0,d} \qquad (2)$$

where

$R_{0,k}$ is the characteristic capacity of the joint to secondary beam (see Tables A2.1 and A2.2),
k_{mod} is the modification factor according to Eurocode 5 taking into account the effect of the duration of the load and moisture content for the secondary beam,
γ_M is the partial factor for the resistance of connections according to the relevant National annex of EN1995-1-1,
n_T is the total number of the fasteners in the secondary beam
$F_{T,v,Rk}$ is the characteristic shear resistance of the fastener in the secondary beam
B is the width of the joist hanger as given in Tables A2.1 and A2.2
H_T is the depth of the secondary beam, less than *1,5H* and
H is the depth of the joist hanger as given in Tables A2.1 and A2.2.

The following equation shall be fulfilled:

$$\frac{F_{0,d}}{R_{0,d}} + \frac{F_{90,d}}{R_{90,d}} \leq 1 \qquad (3)$$

where

$F_{0,d}$ is the design value of the support reaction component of the secondary beam acting along the vertical symmetry line of the joist hanger and

$F_{90,d}$ is the design value of the support reaction component of the secondary beam acting in the direction of width B. $F_{90,d}$ may act eccentric with regard to the secondary beam, however not higher than at the upper side of the secondary beam.

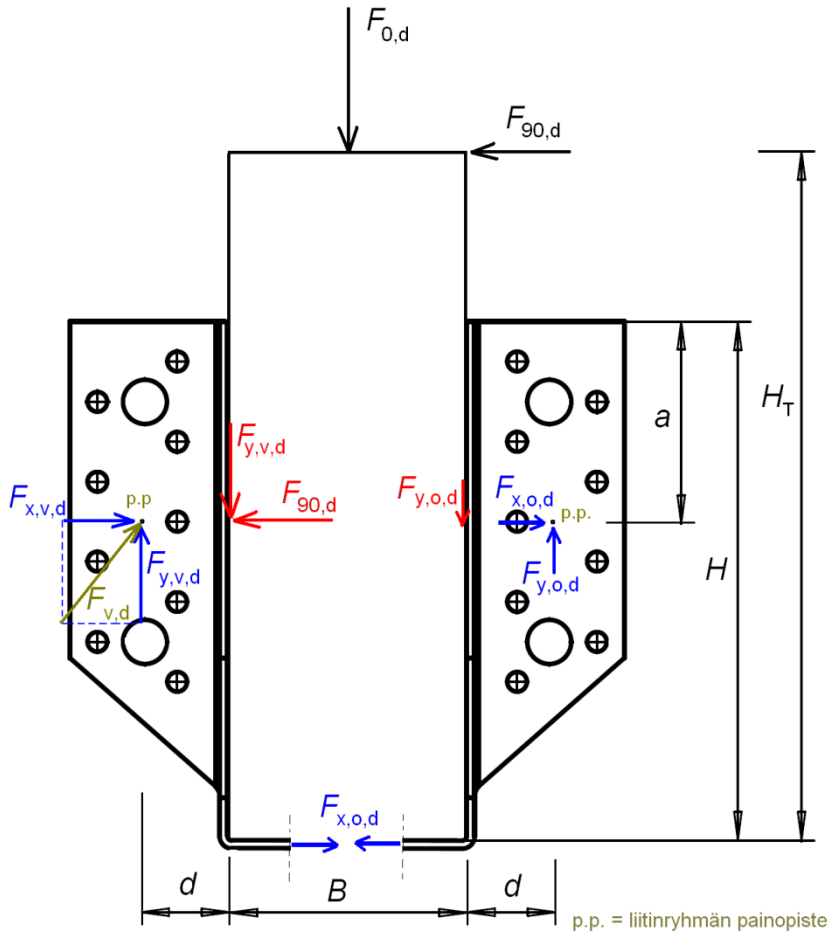

Figure 7. Definition of symbols used and the model for forces acting in the joist hanger. pp indicates centroid for the group of fasteners.

General design method

The load acting on the fastener group in the secondary beam shall fulfil the condition

$$F_{y,v,d} \leq \frac{R_{T,d}}{2} \tag{4}$$

Correspondingly, the load acting on the primary beam fasteners in one flange shall fulfil the condition

$$F_{v,d} \leq \frac{R_{P,d}}{2} \tag{5}$$

Design value of the resistance of the connection in the secondary beam is

$$R_{T,d} = k_{\text{mod}} \frac{n_T F_{T,v,Rk}}{\gamma_M} \tag{6}$$

and design value of the resistance of the connection in the primary beam is

$$R_{P,d} = k_{\text{mod}} \frac{n_P F_{P,v,Rk}}{\gamma_M} \tag{7}$$

when

$F_{T,v,Rk}$ is the characteristic lateral load-carrying capacity of one fastener in the secondary beam
$F_{P,v,Rk}$ is the characteristic lateral load-carrying capacity of one fastener in the primary beam
n_T is the total number of the fasteners in the secondary beam
n_P is the total number of the fasteners in the primary beam
k_{mod} is the modification factor according to EN1995-1-1 taking into account the effect of the duration of the load and moisture content for the secondary beam (for concrete k_{mod} = 1.0)
γ_M is the partial factor for the resistance of connections according to the relevant National annex of EN1995-1-1 and when the joist is attached to concrete the partial factor γ_c in accordance with the relevant national annex of standard EN 1992-1-1

Lateral load-carrying capacities $F_{T,v,Rk}$ and $F_{P,v,Rk}$ of the fasteners are calculated according to the relevant equation according to EN 1995-1-1, equation (8) for steel plate thickness t less than or equal to 0,5d, and (9) for steel plates of thickness greater than or equal to d.

$$F_{v,Rk} = \min\begin{cases} 0{,}4\, f_{h,k} t_1 d & \text{(a)} \\ 1{,}15\sqrt{2M_{y,Rk}\, f_{h,k} d} + \dfrac{F_{ax,Rk}}{4} & \text{(b)} \end{cases} \qquad (8)$$

$$F_{v,Rk} = \min\begin{cases} f_{h,k} t_1 d & \text{(a)} \\ f_{h,k} t_1 d\left[\sqrt{2 + \dfrac{4M_{y,Rk}}{f_{h,k} d\, t_1^2}} - 1\right] + \dfrac{F_{ax,Rk}}{4} & \text{(b)} \\ 2{,}3\sqrt{M_{y,Rk}\, f_{h,k} d} + \dfrac{F_{ax,Rk}}{4} & \text{(c)} \end{cases} \qquad (9)$$

where $t_1 = L - t$ when L is the length of the fastener, t is the thickness of steel plate, $M_{y,k}$ is the characteristic value of the yield moment of the fastener determined according to standards EN 14952 and EN 409, $F_{ax,k}$ is the withdrawal parameter determined according to standards EN 14592 and EN 1382 for the actual timber material limited so that $F_{ax,k}/4$ is not more than 1/3 times the lateral load-carrying capacity of the fastener $F_{v,Rk}$ and the characteristic value of the embedding strength is

$$f_{h,k} = 0{,}082\rho_k d^{-0{,}3} \quad \text{N/mm}^2 \qquad (10)$$

Eq. (9) may be used for angular ring shank nails, if the length of the conical part is at least 4 mm and the diameter of the cone at the head of the nail is at least 5,2 mm. Otherwise linear interpolation of equations (8) and (9) is used for steel plate thicknesses between 2 and 4 mm.

When the secondary beam is reinforced with Top-W punched metal plate fastener the value $F_{T,v,Rk}$ = 1940 N can be used when the characteristic density of the timber is at least 400 kg/m³ and 1730 N when the characteristic density of the timber is at least 320 kg/m³.

When the primary beam is a concrete construction, the characteristic resistance can be calculated according to the Eurocodes or a value given for the fastener in a European Technical Approval for a joint with a steel plate can be used. For joints in concrete, also the compression strength against the edge of the steel plate shall be checked according to EN 1993-1-8:

$$F_{v,d} \le \frac{n_P}{2} \cdot \frac{1{,}5\, f_{u,red}\, d\, t_d}{\gamma_{M2}} \qquad (12)$$

where

n_p is the number of fasteners in concrete (2 or 4)
$f_{u,red}$ for steel plate S250 GD / DX51D, the tensile strength R_m (= 330 N/mm^2) and for stainless steel the reduced tensile strength $0{,}5R_{02} + 0{,}6R_m$
d is the diameter of the fastener (10 mm or 6mm)
t_d is the thickness of the steel plate to be used in calculations (1,84 mm or 2,78mm) and
γ_{M2} is the partial factor for the resistance of connections according to the relevant National annex of EN1993-1-8.

The fasteners in the secondary beam are stressed by a load of

$$F_{y,v,d} = \frac{F_{0,d}}{2} + \frac{H_T - H + a}{B} F_{90,d} \qquad (13)$$

and the resulting shear force in the centroid of the fastener group of the primary beam is

$$F_{v,d} = \sqrt{F_{y,v,d}^2 + F_{x,v,d}^2} \qquad (14)$$

the component $F_{x,v,d}$ of it being

$$F_{x,v,d} = F_{90,d} - F_{x,o,d} = F_{90,d} - \frac{d_q}{H - a}\left(\frac{F_{0,d}}{2} + \frac{H_T - H + a}{B} F_{90,d}\right) \qquad (15)$$

when

$F_{0,d}$ design value of the support reaction of the secondary beam at the symmetry line of the joist hanger in the vertical direction of the joist hanger
$F_{90,d}$ design value of the support reaction of the secondary beam in the width direction of the joist hanger
H height of the joist hanger
B inner width of the joist hanger
H_T height of the secondary beam
a distance of the mass centre of the fasteners in the primary beam from the upper edge of the joist hanger
d_g distance of the centroid of the fastener group in the primary beam from the inner edge of the joist hanger

Table A2.1 Characteristic resistances $R_{0,k}$ of a joist hanger connection using anchor nails 4 x 40 [1] CE-marked in accordance with EN 14592.

Joist Hanger	type	Nails 4,0x40		$R_{0,k}$
B x H	no	n_T [2]	n_P [3]	(kN)
39x191	414	**8**	**16**	14,2
39x251	534	**12**	**16**	21,3
39x291	614	**14**	**24**	24,8
40x99	238	**4**	**8**	7,1
40x110	260	**4**	**8**	7,1
40x140	320	**4**	**10**	7,1
45x96	238	**4**	**8**	7,1
45x107	260	**4**	**8**	7,1
45x137	320	**4**	**10**	7,1
45x167	380	**6**	**12**	10,6
45x188	414	**8**	**16**	14,2
45x248	534	**10**	**16**	17,7
45x248	534-I	**12**	**14**	20,7
45x288	614	**12**	**16**	21,3
48x95	238	**4**	**8**	7,1
48x136	320	**4**	**10**	7,1
48x166	380	**6**	**12**	10,6
51x93	238	**4**	**8**	7,1
51x105	260	**4**	**8**	7,1
51x135	320	**4**	**10**	7,1
51x164	380	**6**	**12**	10,6
51x185	414	**8**	**16**	14,2
51x245	534	**10**	**16**	17,7
51x245	543-I	**10**	**14**	17,7
51x285	614	**12**	**16**	21,3
57x182	414	18	32	31,9
57x242	534	22	40	39,0
57x242	534-I	22	22	32,5
57x282	614	26	48	46,1
60x100	260	8	14	14,2
60x130	320	10	18	17,7
60x160	380	12	22	21,3
63x179	414	18	32	31,9
63x239	534	22	40	39,0
63x239	534-I	22	22	32,5
63x279	614	26	48	46,1
63x379	814	36	68	63,8

[1] minimum profiled length 24mm.
yield moment $M_{y,k}$ at least 6850 Nmm
withdrawal parameter $f_{ax,k}$ min 4.8 N/mm^2 (for softwood ρ_k = 350 kg/m^3)
header(n_P) and joist (n_T) are timber material with characteristic density ρ_k = 350 kg/m^3

[2] In cases with bold, partial nailing to secondary beam from each other hole staggered from the opposite sides.

[3] In cases with bold, partial nailing to primary beam as specified in images 4 and 5

Table A2.2 Characteristic resistances $R_{0,k}$ of a joist hanger connection using anchor nails 4 x 40 [1)] CE-marked in accordance with EN 14592.

Joist Hanger	type	Nails 4,0x40		$R_{0,k}$
B x H	nro	n_T	n_P	(kN)
64x98	260	8	14	14,2
64x128	320	10	18	17,7
70x125	320	10	18	17,7
70x155	380	12	22	21,3
73x124	320	10	18	17,7
73x153	380	12	22	21,3
75x233	534	22	40	39,0
75x233	534-I	22	22	32,5
75x273	614	26	48	46,1
75x373	814	36	68	63,8
76x122	320	10	18	17,7
76x152	380	12	22	21,3
80x120	320	10	18	17,7
80x150	380	12	22	21,3
90x145	380	12	22	21,3
91x225	534	20	**24** *)	35,4
91x265	614	24	48	42,5
91x365	814	34	68	60,2
98x141	380	12	22	21,3
100x140	380	12	22	21,3
103x219	534	20	**24** *)	35,4
103x259	614	24	48	42,5
103x359	814	34	68	60,2

*) Partial nailing as specified in Figure 5.

1) minimum profiled length 24mm.
yield moment $M_{y.k}$ at least 6850 Nmm
withdrawal parameter $f_{ax,k}$ min 4.8 N/mm^2 (for softwood ρ_k = 350 kg/m^3)
header($n_{P)}$ and joist ($n_{T)}$ are timber material with characteristic density ρ_k = 350 kg/m^3

Structural requirements

- Joist Hanger is an end support for the secondary joist. It is fixed from its flanges to primary header using anchor nails or –screws to a wood material header. As if the primary header is a column or beam made of concrete or other applicable rigid material the joist hanger shall be fixed using bolts, screw bar or concrete screws.
- Joints with Joist Hangers shall fulfil the minimum spacing and edge distance requirement specified in EN 1995-1-1, minimum spacings a_1 and a_2 in table 8.2 can be multiplied by a factor of 0,7 (nailed steel-to-timber connections).
- Joist hangers shall be fixed to secondary beam from both sides with same amount of identical fasteners. If the distance from opposite timber surface is less than 16 mm the fasteners shall be fixed from every second hole staggered from the opposing sides.
- The secondary beam may be reinforced with MiTek Top-W connector plates when fasteners are at least 40 mm long anchor nails. The connection may be utilized provided that the main direction of the reinforcement connector plate is same as the loading direction, the grip area of the connector plate is at least 1350 mm^2 per each anchor nail and that the minimum distance to connector plate edge from the fastener in all directions shall be minimum 20 mm.

- The gap between joist and header shall be max 3mm (see figure 8)
- The width of the secondary beam shall be max 3 mm less than the nominal width *B* and the height of the secondary beam shall be at least equal to joist hanger nominal height *H*.
- The fixing of the joists shall be made with identical fasteners from all holes or as specified in figures 5 or 7. The fasteners used for header side fixing shall all be identical. The joist hanger is fixed to header through all holes or partially as specified in figures 4, 5 or 7. If joist hangers are placed on both sides of the primary header the length of the fastener shall be at most B_P - 14 mm, where B_P is the thickness of the primary header.
- The splitting resistance shall be verified using equation (16).

$$F_{d,1} + F_{d,2} \le \frac{k_{\text{mod}} \cdot 14 \cdot B_P}{\gamma_M} \cdot \sqrt{\frac{h_e}{\left(1 - \frac{h_e}{H_P}\right)}} \qquad (16)$$

where $F_{d,1}$ and $F_{d,2}$ are the connectors design forces in direction perpendicular to header (see figure 8),
k_{mod} is the modification factor for load duration and moisture content according to EN 1995-1-1,
γ_M is the partial safety factor in accordance with the relevant national annex of standard EN 1995-1-1,
B_P is the width of the primary header (see figure 8),
h_e is the distance from the bottom edge of the header to topmost connector on the joist hanger (see figure 8) ja
H_P is the height of the primary header.

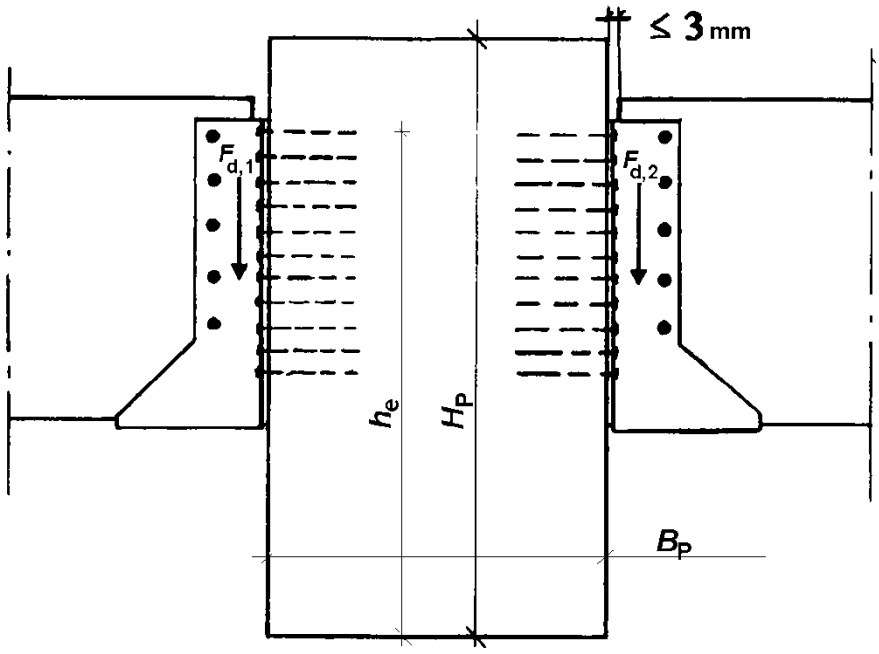

Figure 8. Joist hanger connection to primary beam header.

- The primary beam torsional resistance shall be verified against moment using equations (17) and (18).

Single sided joist hanger connection results a torsional moment on the primary header:

$$M_{V,d} = F_{d,1} \cdot \frac{B_P}{2} \qquad (17)$$

where $F_{d,1}$ is the design load on the joist hanger connection in direction perpendicular to grain (see figure 8) ja
B_P is the width of the primary beam.

The torsional moment must be accounted for if the difference between design loads on the opposing sides is

$$\left|F_{1,d} - F_{2,d}\right| > 0{,}2 \max(F_{d,1}; F_{d,2}) . \qquad (18)$$

- The distance between Joist hangers on the header shall be at least B + 180 mm, where B is the inner width of the joist hanger. If splitting per equation (17) is decisive the distance shall be at least B + 300 mm and the distance of the joist hanger from the end of beam shall be at least B + 150 mm.
- In service class 2 the anchor nails and –screws shall be corrosion protected with at least Fe/Zn 12c -class (ISO 2081) electroplating or at least 39 µm thick hot dip galvanizing.
- Galvanized joist hangers are not suitable for service class 3 applications.
- Galvanized joist hangers unprotected are not suitable for structural fire proof applications.
- In service class 3 connections anchor nails and –screws manufactured of applicable stainless steel shall be used. In conjunction with concrete bolts, anchors, screw bars or concrete screws with min. FeZn 25c class electroplating or at least 49 µm hot dip galvanized may be used.