ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet www.etadanmark.dk

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

European Technical Assessment ETA- 20/0598 of 2020/08/07

I General Part

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

Trade name of the construction product:	Soltech Concealed beam hangers type Steel 80x130, Steel 80x170, Steel 80x210, Steel 120x170, Steel 120x210, Steel 120x250, Steel 120x290, Steel 120x330, Steel 128x370, Steel-i 80x130, Steel-i 80x170, Steel-i 80x210, Steel-i 120x170, Steel-i 120x210 and Steel-i 120x250
Product family to which the above construction product belongs:	Three-dimensional nailing plate (concealed beam hangers)
Manufacturer:	Soltech S.r.l. Via F.lli Mengaroni, 5/7 61025 Montelabbate (PU) - Italy Tel. +39 0721 498461 Fax +39 0721 908245 Internet www.soltechonline.com
Manufacturing plant:	Soltech S.r.l. Via F.lli Mengaroni, 5/7 61025 Montelabbate (PU) - Italy
This European Technical Assessment contains:	19 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	Guideline for European Technical Approval (ETAG) No. 015 Three Dimensional Nailing Plates, used as European Assessment Document (EAD).

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
Soltech concealed beam hangers are one-piece, face-fixed concealed beam hangers to be used in timber to timber and concrete to timber connections.

The concealed beam hangers are made from steel grade S235JR according to EN10025-2 (f_{yk}=235N/mm^2, f_{tk}=360N/mm^2, KV=27J at 20°C), have a zinc coating grade Fe/Zn 12c according to ISO2081, with execution class EXC2 according to EN1090-2. Dimensions, hole positions and typical installations are shown in Annex A.

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

The concealed beam hangers are intended for use in making end-grain to side-grain connections in load bearing timber structures, as a connection between a wood based joist and a solid timber or wood based or concrete header or column, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

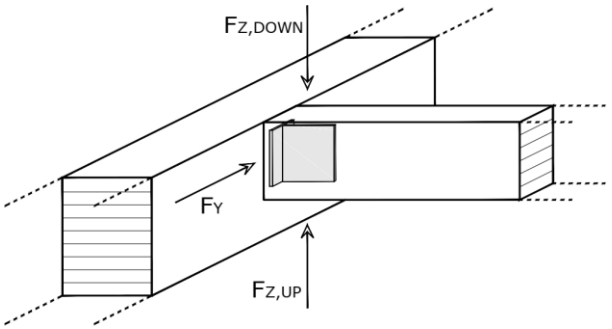
Soltech concealed beam hangers can be installed as connections between wood based members such as:

- Structural solid timber according to EN 14081,
- Glulam, block glued glulam and glued solid timber according to EN 14080,
- Cross laminated timber according to ETA,
- Solid wood panels according to EN 13353 and EN 13986,
- LVL according to EN 14374,
- FST according to ETA 14/0354,
- Parallam PSL,
- Intrallam LSL,
- Plywood according to EN 636.

However, the calculation methods are only allowed for a characteristic wood density of up to 460 kg/m^3. Even though the wood based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Annex B states the formulas for the load-carrying capacities of the connections with concealed beam hangers. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

It is assumed that the forces acting on the concealed beam hanger connection are $F_{Z,up}$ or $F_{Z,down}$ perpendicular to the header axis and F_Y perpendicular to the joist plate. The forces $F_{Z,up}$ and $F_{Z,down}$ shall act in the symmetry plane of the concealed beam hanger. It is assumed that the forces are acting with an eccentricity e_H with regard to the side grain surface of the header.



It is assumed that the header beam or column is prevented from rotating. If the header beam or column only has installed a concealed beam hanger on one side the eccentricity moment

$$M_v = F_d \cdot (B_H/2 + e_H \text{mm})$$

shall be considered; e_H=56,3mm for Steel 80, Steel 80-i, Steel 120 and Steel 120-i series; e_H=99,3mm for Steel 128 series; B_H is the width of the header beam or column. The same applies when the header or column has concealed beam hanger connections on both sides, but with vertical forces which differ more than 20%.

The concealed beam hangers are intended for use for connections subject to static or quasi static loading.

The zinc-coated hangers are for use in timber structures subject to the dry, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1:2014, (Eurocode 5).

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

The provisions made in this European Technical Assessment are based on an assumed intended working life of the connectors of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Product characteristics and methods of verification and assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance assessed
Ductility in cyclic testing	No performance assessed
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The concealed hangers are made from steel classified as **Euroclass A1** in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	No performance assessed
3.7 Sustainable use of natural resources (BWR7)	No performance assessed
3.8 General aspects related to the performance of the product	The concealed hangers have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
Identification	See Annex A

*) See additional information in section 3.9 – 3.11.

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3.9 Mechanical resistance and stability

The characteristic load-carrying capacities are based on the characteristic values of the connectors and the steel plates.

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity can be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Therefore, to obtain design values according to the Eurocodes or appropriate national codes of practice, the capacities have to be multiplied with different partial factors for the material properties and – for the connectors mounted in wood – also the coefficient k_{mod} that takes into account service class and load duration class.

Thus, the characteristic values of the load–carrying capacity are determined also for timber failure $F_{Z,Rk,H}$ (obtaining the embedment strength of connectors subjected to shear or the withdrawal capacity of the most loaded connector, respectively) as well as for steel plate failure $F_{Z,Rk,S}$. The design value of the load–carrying capacity is the smallest value of both load–carrying capacities.

$$F_{Z,Rd} = \min\left\{\frac{k_{mod} \cdot F_{Z,Rk,H}}{\gamma_{M,H}}; \frac{F_{Z,Rk,S}}{\gamma_{M,S}}\right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel ($\gamma_{M,S}$) or timber ($\gamma_{M,H}$), respectively, are also correctly taken into account.

For Soltech Steel concealed beam hangers, the timber failure always occurs before the steel failure, therefore it is sufficient to use the formula:

$$F_{Z,Rd} = \frac{k_{mod} \cdot F_{Z,Rk,H}}{\gamma_{M,H}}$$

See annex B for characteristic load-carrying capacities of the concealed beam hangers.

The characteristic capacities of the concealed beam hangers are determined by calculation assisted by testing as described in the EOTA Guideline 015 clause 2.4.1.1.2. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in the table in Annex A:

- *Threaded nails (ringed shank nails), screws, bolts, dowels or self-drilling dowels in accordance to EN 14592 or threaded nails (ringed shank nails) according to ETA*

In the formulas in Annex B the lateral load-carrying-capacity of threathed nails is calculated from the formulas of Eurocode 5 by assuming a thick steel plate.

No performance has been determined in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

No performance has been determined in relation to the joint's stiffness properties to be used for the analysis of the serviceability limit state.

3.10 Aspects related to the performance of the product

3.10.1 Corrosion protection in service class 1 and 2.

In accordance with ETAG 015 and Eurocode 5 the concealed beam hangers have a zinc coating grade Fe/Zn 12c according to ISO2081 and are suitable for service classes 1 and 2.

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

Concealed beam hanger connections

The performance given in this ETA are based on the following:

Header – support conditions

- The header beam or column shall be restrained against rotation and be free from wane under the concealed beam hanger.

  If the header or column carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist}$ ($b_{header}/2+e_H$) shall be considered at the strength verification of the header or column.
  R_{joist} Reaction force from the joists
  b_{header} Width of header or column
  e_H=56,3mm for Steel 80, Steel 80-i, Steel 120 and Steel 120-i series; e_H=99,3mm for Steel 128 series.

- For a header or column with joists from both sides but with different reaction forces a similar consideration applies.

Connections

- The characteristic capacity of the concealed beam hanger connection is calculated according to the manufacturer's technical documentation, dated 2020-05-12.

- The concealed beam hanger connection is designed in accordance with Eurocode 5 or an appropriate national code.

- The gap between the end of the joist and the surface, where contact stresses can occur during loading shall be limited. This means that for concealed beam

hangers the gap between the header plate and the end of the joist shall be maximum 5 mm.

- The header or column shall have a plane surface against the whole concealed beam hanger.
- The depth of the joist shall be so large that the top (bottom) of the joist is at least $a_{4,t}$ above (below) the upper (lower) dowel in the joist.

Timber to timber connections

- Concealed beam hangers are fastened to header or column wood-based members by nails or screws.
- There shall be nails or screws in all holes.
- Nails or screws to be used shall have a diameter which fits the holes of the concealed beam hangers.

Timber to concrete connections

- Concealed beam hangers are fastened to concrete header or column wood-based members by threaded rods with chemical or mechanical anchors.
- There shall be fixing rods in all holes (ϕ=13mm for Steel 80 and Steel 120 series; ϕ=17mm for Steel 128 series).
- The fixing rods to be used shall have a diameter not more than 1mm less than that of the holes of the concealed beam hangers.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/638/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

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

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

Issued in Copenhagen on 2020-08-07 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A

Product details and definitions

Concealed beam hanger

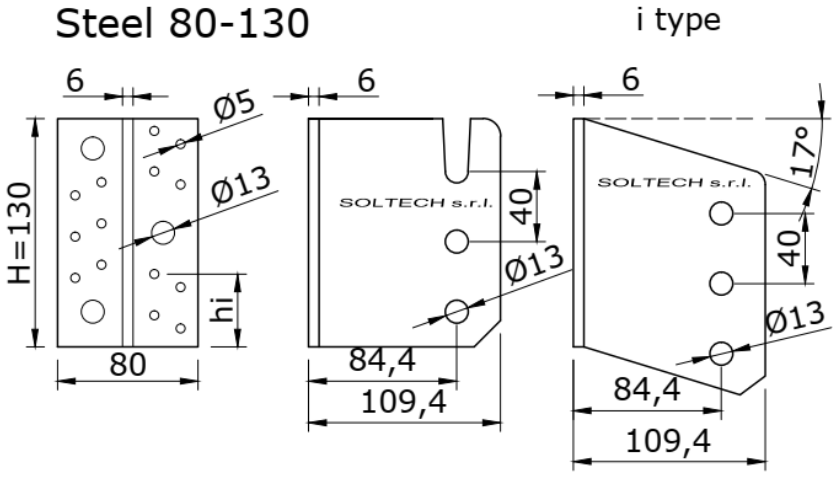
Face mount hanger with flanges.

6,0 mm thick steel grade S235JR EN10025-2 (Steel 80x170, Steel 80x210, Steel 120x170, Steel 120x210, Steel 120x250, Steel 120x290, Steel 120x330, Steel-i 80x130, Steel-i 80x170, Steel-i 80x210, Steel-i 120x170, Steel-i 120x210 and Steel-i 120x250).

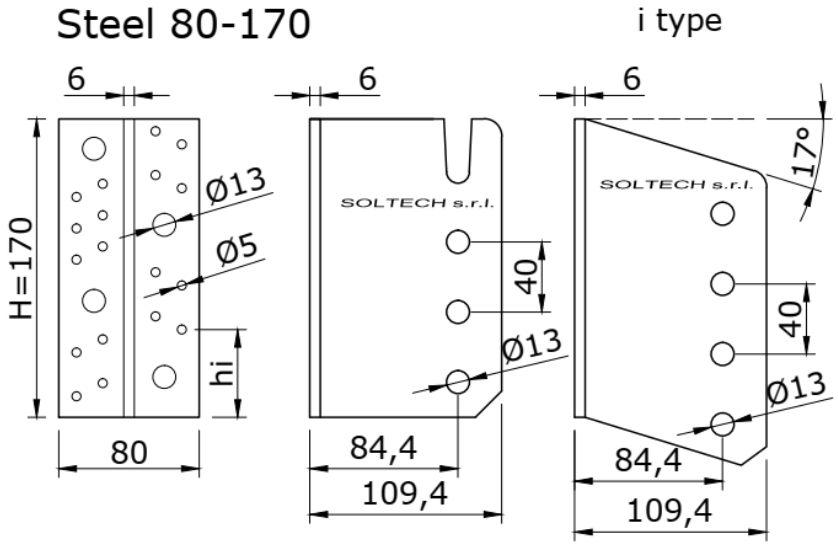
8,0 mm thick steel grade S235JR EN10025-2 (Steel 128x370).

Zinc-coating grade Fe/Zn 12c according to ISO2081.

Execution class EXC2 according to EN1090-2.



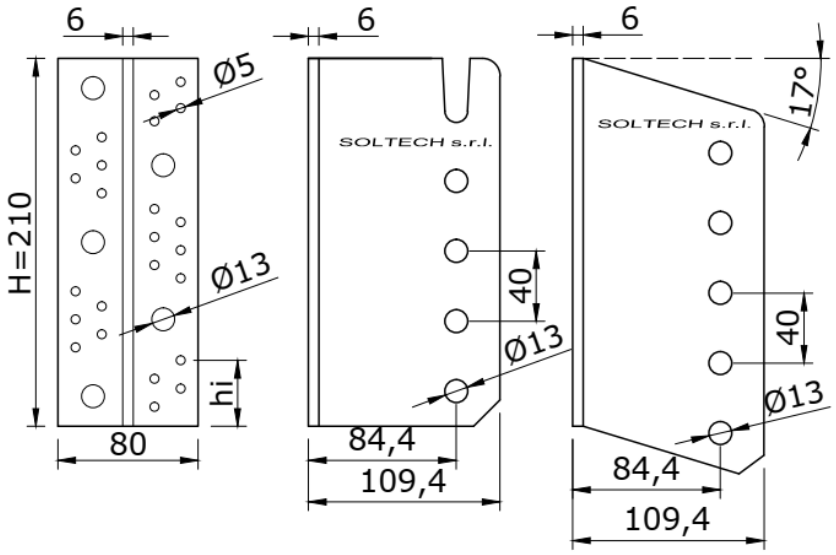
Ø5		Ø13	
n	hi	n	hi
1	10,5	1	20,0
1	18,0	1	65,0
1	34,0	1	113,0
1	39,3		
1	41,5		
1	46,8		
1	62,8		
1	70,3		
1	86,3		
1	92,5		
1	93,8		
1	100,0		
1	115,5		
1	123,0		



Ø5		Ø13	
n	hi	n	hi
1	11,9	1	23,0
1	19,4	1	66,3
1	36,9	1	109,7
1	44,4	1	153,0
1	50,1		
1	57,6		
1	75,1		
1	82,6		
1	89,8		
1	97,3		
1	107,6		
1	115,1		
1	125,5		
1	130,5		
1	133,0		
1	138,0		
1	155,5		
1	163,0		

Steel 80-210

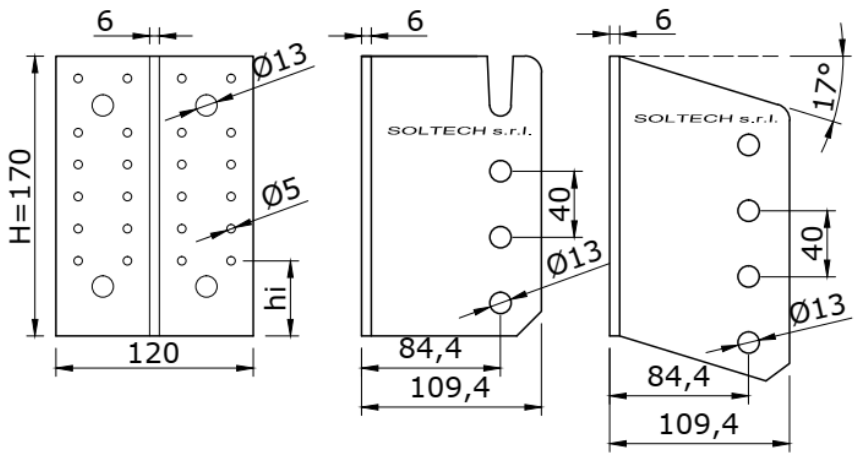
i type



Ø5		Ø13	
n	hi	n	hi
1	11,0	1	17,0
1	21,5	1	61,0
1	27,1	1	105,0
1	37,5	1	149,0
1	45,0	1	193,0
1	52,5		
1	61,0		
1	68,5		
1	77,0		
1	84,5		
1	92,0		
1	100,5		
1	108,0		
1	116,5		
1	124,0		
1	133,0		
1	141,5		
1	149,0		
1	157,5		
1	165,0		
1	174,0		
1	181,5		
1	189,0		
1	196,5		

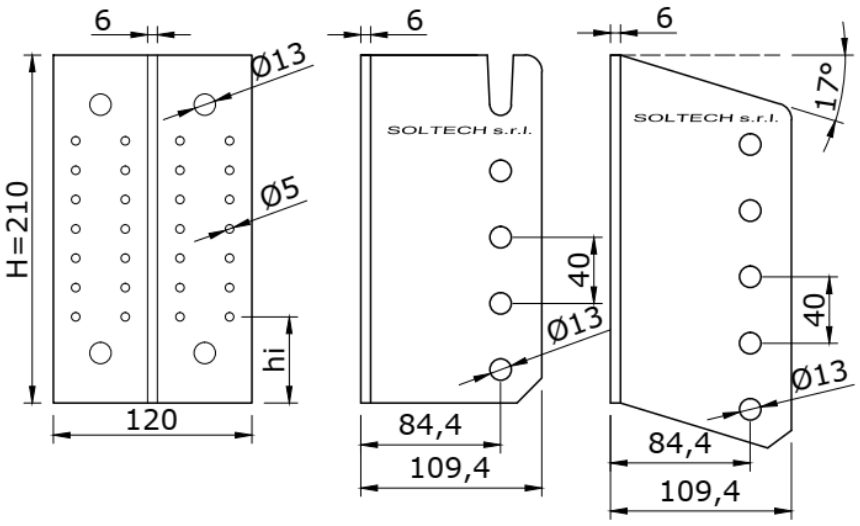
Steel 120 H170

i type



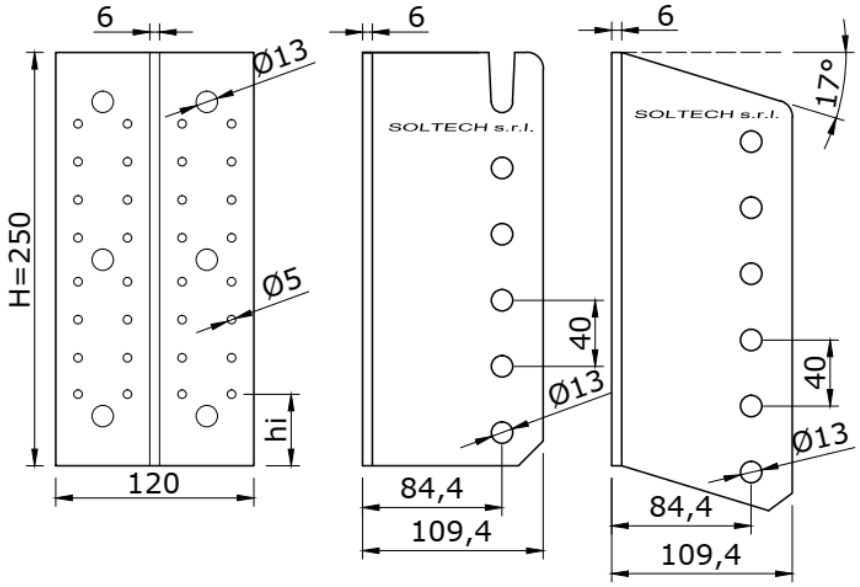
Ø5		Ø13	
n	hi	n	hi
4	45,6	2	30,0
4	65,1	2	140,0
4	84,6		
4	104,1		
4	123,6		
4	156,4		

Steel 120 H210



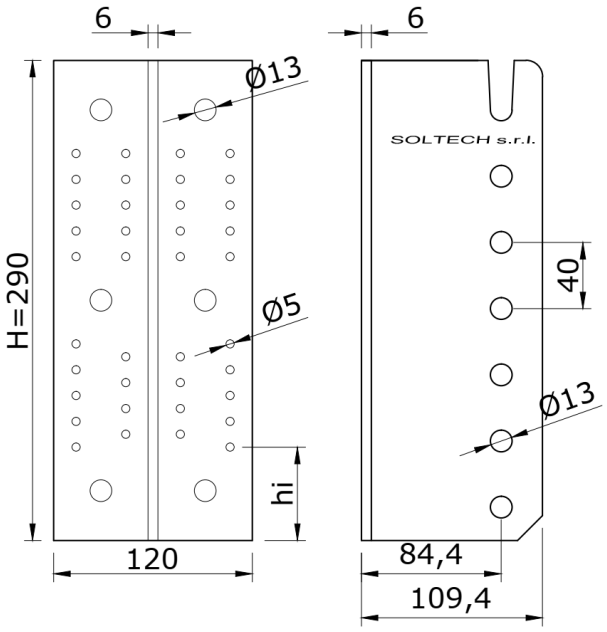
Ø5		Ø13	
n	hi	n	hi
4	51,8	2	30,0
4	69,9	2	180,0
4	87,3		
4	105,0		
4	122,7		
4	140,4		
4	158,2		

Steel 120 H250



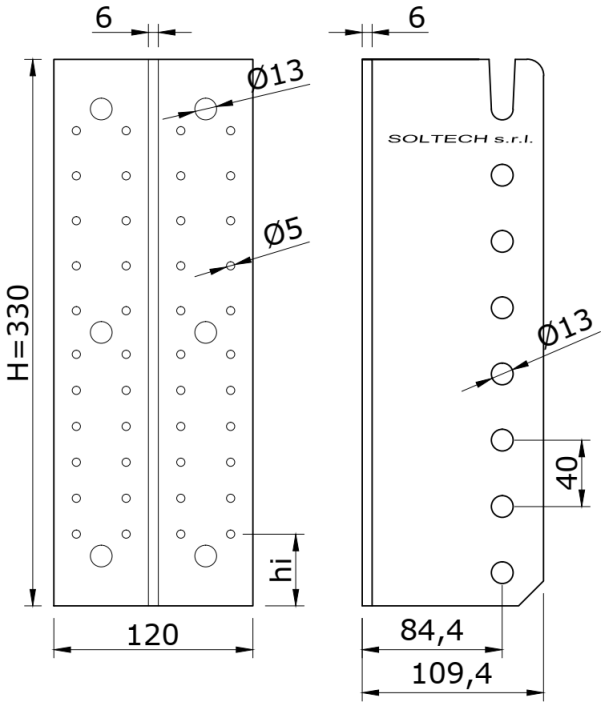
Ø5		Ø13	
n	hi	n	hi
4	43,2	2	30,0
4	65,2	2	124,5
4	88,2	2	220,0
4	111,3		
4	137,7		
4	160,7		
4	183,7		
4	206,8		

Steel 120 H290



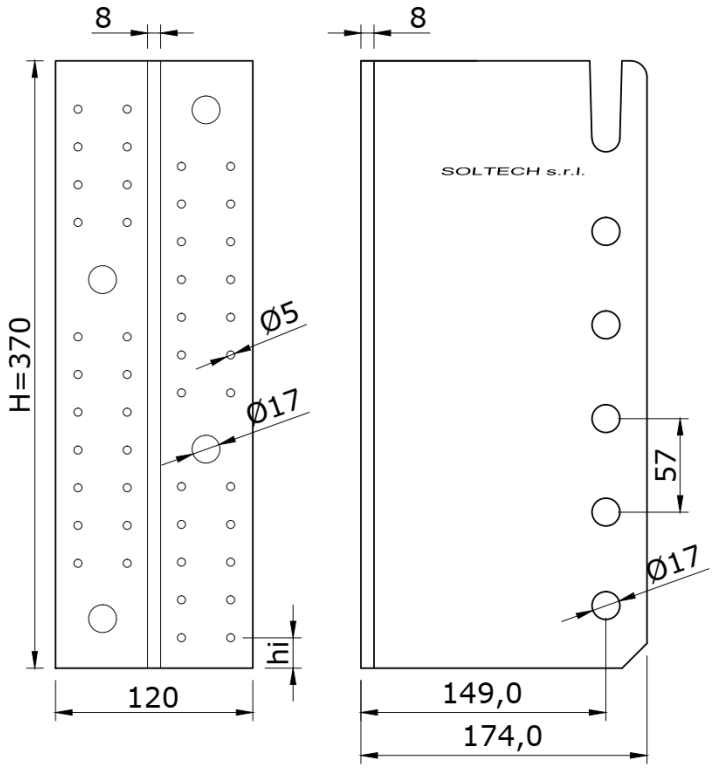
Ø5		Ø13	
n	hi	n	hi
2	56,3	2	30,0
2	64,1	2	145,0
2	71,9	2	260,0
2	79,7		
2	87,5		
2	95,3		
2	103,1		
2	110,9		
2	118,7		
4	171,3		
4	186,9		
4	202,5		
4	218,1		
4	233,7		

Steel 120 H330



Ø5		Ø13	
n	hi	n	hi
4	43,2	2	30,0
4	64,9	2	165,0
4	86,6	2	300,0
4	108,3		
4	130,1		
4	151,8		
4	178,2		
4	205,3		
4	232,5		
4	259,6		
4	286,8		

Steel 128 H370



Ø5		Ø17	
n	hi	n	hi
2	18,5	1	30,0
2	41,5	1	133,3
2	63,8	1	236,7
2	64,5	1	340,0
2	86,8		
2	87,5		
2	109,8		
2	110,5		
2	132,8		
2	155,8		
2	167,7		
2	178,8		
2	190,7		
2	201,8		
2	213,7		
2	236,7		
2	259,7		
2	271,5		
2	282,7		
2	294,5		
2	305,7		
2	317,5		
2	340,5		

Fastener specification

FASTENER	Length min – max	Nail type
Nail 4.0 mm	60 – 100 mm	Ringed shank nails according to EN 14592
Screw 5.0 mm	60 – 70 mm	Self-tapping screws according to EN 14592
GH-Nail 4.0 mm	40 – 100 mm	Ringed shank nails according to ETA-13/0523
GH-Screw 5.0 mm	60 – 70 mm	Self-tapping screws according to ETA-13/0523
In the load-carrying-capacities of the nailed or screwed connection in Annex B, the capacities calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral fastener load-carrying-capacity. The load-carrying-capacities of the concealed beam hangers have been determined based on the use of connector nails ø 4,0 mm or screws ø 5,0 mm according to the European Technical Assessment of nails and screws. The characteristic withdrawal capacity of the GH nails must be calculated according to ETA-13/0523, paragraph 3.9.1 (head pull-through is not relevant). For GH screws, the lateral load-carrying capacity and the withdrawal capacity must be calculated according to ETA-13/0523, paragraph 3.9.2. For nails and screws of other companies, the formulas in Eurocode 5 or in specific ETA must be used. The shape of the nails or screws directly under the head shall be in the form of a truncated cone with a diameter under the head which fits or exceeds the hole diameter.		

BOLTS or DOWELS diameter	Family product
12,0	Steel 80, Steel 120, Steel 80-i, Steel 120-i
16,0	Steel 128
Hole diameter in steel plate: Max. 1 mm larger than the bolt or dowel diameter. Bolt or dowels according to EN 14592	

Annex B

Load-carrying-capacities

The downward and the upward directed forces are assumed to act in the middle of the joist.

Nails or screws must be placed in all the holes of the header connection. Dowels must be placed in all the dowel holes in the joist.

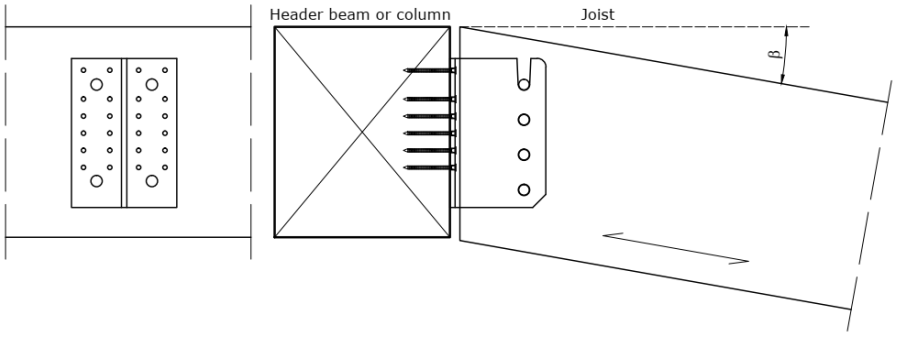
B.1 Soltech "Steel" concealed beam hangers - timber to timber

Loading down or up:

$$F_{Z,Rk} = \min\{\frac{k_J \cdot F_{v,J,\alpha,Rk}}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{1}{k_H \cdot F_{ax,H,Rk}}\right)^2}} \quad (B.1)$$

$F_{Z,Rk}$ Characteristic lateral load carrying capacity of the concealed beam hanger.

$F_{v,J,\alpha,Rk}$ Characteristic lateral load carrying capacity of a dowel with two shear planes in the joist (at the angle α to the grain, see tables B.1.1, B.1.2, B1.3 and B1.4; in the general case when the joist inclined of β angle, the table value α angle must be increased by β).



$F_{v,H,Rk}$ Characteristic lateral load carrying capacity of a nail or a screw in single shear in the header (perpendicular to the grain for header beam or parallel to the grain for column).

$F_{ax,H,Rk}$ Characteristic withdrawal capacity of a nail or a screw in the header beam or column.

k_J Form factor on the joist side, see tables B.1.1, B.1.2, B1.3 and B1.4.

n_H Total number of nails or screws in the side of the header beam, see tables B.1.1, B.1.2, B1.3 and B1.4.

k_H Form factor on the header beam or column side, see tables B.1.1, B.1.2, B1.3 and B1.4.

$$F_{Z,Rd} = \frac{F_{Z,Rk} \cdot k_{mod}}{\gamma_M} \quad (B.2)$$

$F_{Z,Rd}$ Design lateral load carrying capacity of the concealed beam hanger.

k_{mod} Modification factor for duration of load and service class, see Eurocode 5 or national code.

γ_M Partial safety factor for connections, see Eurocode 5 or national code.

As an alternative to formula B.1 the following formula can be used:

$$F_{Z,Rd} = \min\{\frac{k_J \cdot F_{v,J,\alpha,Rd}}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rd}}\right)^2 + \left(\frac{1}{k_H \cdot F_{ax,H,Rd}}\right)^2}} \quad (B.3)$$

$F_{v,J,\alpha,Rd}$ Design lateral load carrying capacity of a dowel with two shear planes in the joist

(at the angle α to the grain, see table B.1.1, B.1.2, B1.3 and B1.4; in the general case when the joist inclined of β angle, the table value α angle must be increased by β).

$F_{v,H,Rd}$ Design characteristic lateral load carrying capacity of a nail or a screw in single shear in the header (perpendicular to the grain for header beam or parallel to the grain for column).

$F_{ax,H,Rd}$ Design characteristic withdrawal capacity of a nail or a screw in the header beam or column.

Table B1.1: Soltech "**STEEL**"and "**STEEL-i**" concealed beam hangers, **timber to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading DOWN**.

Product family		**Height of plate [mm]**	$\mathbf{n_H}$	$\mathbf{k_H}$	$\mathbf{n_J}$	$\mathbf{k_J}$	α [°]
Steel 80	Steel 80-i	130	14	9,733	3	2,065	43,50
Steel 80	Steel 80-i	170	18	17,87	4	3,058	49,87
Steel 80	Steel 80-i	210	24	27,60	5	4,091	54,91
Steel 120	Steel 120-i	170	24	25,75	4	3,058	49,87
Steel 120	Steel 120-i	210	28	34,50	5	4,091	54,91
Steel 120	Steel 120-i	250	32	46,37	6	5,140	58,95
Steel 120		290	38	68,78	7	6,193	62,22
Steel 120		330	44	79,32	8	7,245	64,90
Steel 128		370	46	52,91	6	4,806	53,23

Table B1.2: Soltech "**STEEL**" concealed beam hangers, **timber to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading UP**.

Product family	**Height of plate [mm]**	$\mathbf{n_H}$	$\mathbf{k_H}$	$\mathbf{n_J}$	$\mathbf{k_J}$	α [°]
Steel 80	130	14	9,175	2	1,160	35,44
Steel 80	170	18	14,74	3	2,065	43,50
Steel 80	210	24	27,46	4	3,058	49,87
Steel 120	170	24	20,02	3	2,065	43,50
Steel 120	210	28	34,50	4	3,058	49,87
Steel 120	250	32	46,90	5	4,091	54,91
Steel 120	290	38	63,85	6	5,140	58,95
Steel 120	330	44	90,10	7	6,193	62,22
Steel 128	370	46	56,24	5	3,769	48,91

Table B1.3: Soltech "**STEEL-i**" concealed beam hangers, **timber to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading UP**.

Product family	**Height of plate [mm]**	$\mathbf{n_H}$	$\mathbf{k_H}$	$\mathbf{n_J}$	$\mathbf{k_J}$	α [°]
Steel 80-i	130	14	9,175	3	2,065	43,50
Steel 80-i	170	18	14,74	4	3,058	49,87
Steel 80-i	210	24	27,46	5	4,091	54,91
Steel 120-i	170	24	20,02	4	3,058	49,87
Steel 120-i	210	28	34,50	5	4,091	54,91
Steel 120-i	250	32	46,90	6	5,140	58,95

Loading perpendicular to the joist plate:

$$F_{Y,Rk} = \min\left\{ \frac{A_k \cdot H}{\frac{k_n \cdot f_{v,k} \cdot k_{cr} \cdot h_J \cdot b_J}{\sqrt{(b_J)} \cdot \left(1{,}5 + 3{,}18 \cdot \frac{x}{b_j}\right)}} \right. \quad \text{(B.4)}$$

$F_{Y,Rk}$ Characteristic lateral load carrying capacity of the concealed beam hanger for loading perpendicular to the joist plate in N.

A_k Characteristic parameter to take into account bending strength of the steel plate [N/mm] (see table B1.4).

H Height of the steel plate [mm] (see table B1.4).

k_n Parameter according to Eurocode 5 equation (6.63).

b_J Joist width [mm].

h_J Joist depth [mm].

x Eccentricity of load [mm] (see table B1.4).

k_{cr} Parameter according to Eurocode 5 §6.1.7

$f_{v,k}$ Characteristic joist shear strength [N/mm^2].

$$F_{Y,Rd} = \min\left\{ \frac{\frac{A_k \cdot H}{\gamma_{M,s}}}{\frac{k_n \cdot f_{v,k} \cdot k_{cr} \cdot h_J \cdot b_J}{\sqrt{(b_J)} \cdot \left(1{,}5 + 3{,}18 \cdot \frac{x}{b_j}\right)} \cdot \frac{k_{mod}}{\gamma_{M,T}}} \right. \quad \text{(B.5)}$$

$F_{Y,Rd}$ Design lateral load carrying capacity of the concealed beam hanger for loading perpendicular to the joist plate in N.

k_{mod} Modification factor for duration of load and service class, see Eurocode 5 or national code.

$\gamma_{M,T}$ Partial safety factor for connections, see Eurocode 5 or national code.

$\gamma_{M,s}$ Partial safety factor for steel, see Eurocode 3 or national code.

Table B1.4: Soltech "**STEEL**"and "**STEEL-i**" concealed beam hangers, parameters. **Loading perpendicular to the joist plate**.

Product family		**H [mm]**	**Ak [N/mm]**	**x [mm]**
Steel 80	Steel 80-i	130	62,7	68,9
Steel 80	Steel 80-i	170	62,7	68,9
Steel 80	Steel 80-i	210	62,7	68,9
Steel 120	Steel 120-i	170	62,7	68,9
Steel 120	Steel 120-i	210	62,7	68,9
Steel 120	Steel 120-i	250	62,7	68,9
Steel 120		290	62,7	68,9
Steel 120		330	62,7	68,9
Steel 128		370	69,4	110,7

Loading in more than one direction:

If $F_{Y,Ed}$ and $F_{Z,Ed}$ load the connection simultaneously, the following interaction equation shall be fulfilled:

$$\left(\frac{F_{Y,Ed}}{F_{Y,Rd}}\right)^2 + \left(\frac{F_{Z,Ed}}{F_{Z,Rd}}\right)^2 \leq 1 \qquad \text{(B.6)}$$

B.2 Soltech "Steel" concealed beam hangers - concrete to timber

$$F_{Z,Rd} = k_J \cdot F_{v,J,\alpha,Rd} \qquad \text{(B.7)}$$

$F_{Z,Rd}$ Design lateral load carrying capacity of the concealed beam hanger.

$F_{v,J,\alpha,Rd}$ Design lateral load carrying capacity of a dowel with two shear planes in the joist (at the angle α to the grain, see tables B.2.1, B2.2, B2.3 and B.2.4; in the general case when the joist inclined of β angle, the table value α angle must be increased by β).

k_J Form factor on the joist side, see tables B.2.1, B2.2, B2.3 and B.2.4.

On the concrete side, it is necessary to check that the stresses on the most stressed connector are compatible with the design resistance[1]:

$$\begin{cases} N_{Sd} = \dfrac{F_d}{k_H} & \text{Tension load in the most stressed rod.} \quad \text{(B.8)} \\ V_{Sd} = \dfrac{F_d}{n_H} & \text{Shear load in each rod.} \quad \text{(B.9)} \end{cases}$$

F_d External design lateral force on the joint.

n_H Total number of rods in the side of the concrete header beam or column, see tables B.2.1, B2.2, B2.3 and B.2.4.

k_H Form factor on the header beam or column side, see tables B.2.1, B2.2, B2.3 and B.2.4.

[1]For the load carrying capacity of the threaded rod with chemical or mechanical anchors fixed to concrete see EAD 330232-00-0601 or EN 1992-4.

Table B2.1: Soltech "**STEEL**" and "**STEEL-i**" concealed beam hangers, **concrete to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading DOWN**.

Product family		**Height of plate [mm]**	n_H	k_H	n_J	k_J	α [°]
Steel 80	Steel 80-i	130	3	2,368	3	2,065	43,50
Steel 80	Steel 80-i	170	4	4,189	4	3,058	49,87
Steel 80	Steel 80-i	210	5	6,259	5	4,091	54,91
Steel 120	Steel 120-i	170	4	4,727	4	3,058	49,87
Steel 120	Steel 120-i	210	4	6,123	5	4,091	54,91
Steel 120	Steel 120-i	250	6	9,745	6	5,140	58,95
Steel 120		290	6	11,53	7	6,193	62,22
Steel 120		330	6	13,29	8	7,245	64,90
Steel 128		370	4	5,368	6	4,806	53,23

Table B2.2: Soltech "**STEEL**" concealed beam hangers, **concrete to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading UP**.

Product family	**Height of plate [mm]**	n_H	k_H	n_J	k_J	α [°]
Steel 80	130	3	2,322	2	1,160	35,44
Steel 80	170	4	3,906	3	2,065	43,50
Steel 80	210	5	6,259	4	3,058	49,87
Steel 120	170	4	4,727	3	2,065	43,50
Steel 120	210	4	6,123	4	3,058	49,87
Steel 120	250	6	9,784	5	4,091	54,91
Steel 120	290	6	11,53	6	5,140	58,95
Steel 120	330	6	13,29	7	6,193	62,22
Steel 128	370	4	5,368	5	3,769	48,91

Table B2.3: Soltech "**STEEL-i**" concealed beam hangers, **concrete to timber** - Number of nails or screws, number of dowels, form factors and angle α. **Loading UP**.

Product family	**Height of plate [mm]**	n_H	k_H	n_J	k_J	α [°]
Steel 80-i	130	3	2,322	3	2,065	43,50
Steel 80-i	170	4	3,906	4	3,058	49,87
Steel 80-i	210	5	6,259	5	4,091	54,91
Steel 120-i	170	4	4,727	4	3,058	49,87
Steel 120-i	210	4	6,123	5	4,091	54,91
Steel 120-i	250	6	9,784	6	5,140	58,95

Annex C
Concealed beam hanger connection

Steel 120, height 250

Timber to timber

Concrete to timber