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

European Technical Assessment ETA-24/0282 of 2024/05/23

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:	BREKAR Joist Hangers Type DEV EN 2.5MM, DEV EN 4MM and DEV SP EN 4MM
Product family to which the above construction product belongs:	Three-dimensional nailing plate (Joist hanger for wood to wood connections and wood to concrete or steel connections)
Manufacturer:	BREKAR S.A.S 2 rue Marthe Aureau F-77400 LAGNY SUR MARNE
Manufacturing plant:	BREKAR S.A.S 1-3 Impasse Dorothée Le Maitre F-77700 SERRIS
This European Technical Assessment contains:	40 pages including 4 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

BREKAR joist hangers type DEV EN 2.5MM, DEV EN 4MM and DEV SP EN 4MM are one-piece non-welded, face-fixed joist hangers to be used in timber-to-timber connections. BREKAR joist hangers are also used for connections between a timber joist and a concrete structure or a steel member.

The joist hangers are made from hot-dipped-coated steel grade SD250GD + Z (min Z275) according to EN 10346 with a minimum R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A_{80} of 22 % with tolerances according to EN 10143. Dimensions, hole positions, steel type and typical installations are shown in Annex A.

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

The joist 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 header, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled. The joist hangers type A are also intended for use in making an end-grain connection between a timber joist and a concrete structure or a steel member.

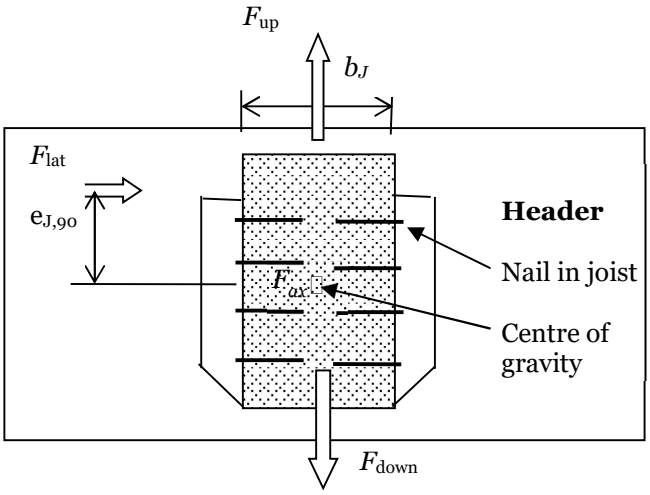
The joist hangers can be installed as connections between wood-based members such as:

- Structural solid timber according to EN 338 / EN 14081,
- Glulam according to EN 14080 or ETA,
- Glued solid timber according to EN 14080 or ETA,
- Cross laminated timber according to ETA,
- LVL according to EN 14374 or ETA,
- Parallam PSL,
- Intrallam LSL,
- I-beams with backer blocks on both sides of the web in the header and web stiffeners in the joist,
- 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 characteristic load-carrying capacities of the connections with joist 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 joist hanger connection are the following F_{up}, F_{down}, F_{lat}, and F_{ax} as shown in the figure below. The forces F_{up} and F_{down} shall act in the middle of the joist hanger. The force F_{lat} is assumed to act $e_{J,90}$ above the centre of gravity of the joist fasteners, the force F_{ax} is assumed to act in the centre of gravity of the joist fasteners. It is assumed that the forces are acting right at the end of the joist.



It is assumed that the header beam is prevented from rotating. Similarly, it is assumed that the concrete structure or the steel member to which the joist hanger is bolted does not rotate. If the header beam only has installed a joist hanger on one side the eccentricity moment $M_v = F_d \cdot (B_H / 2 + e_{J,0})$ shall be considered. The same applies when the header has joist hanger connections on both sides, but with vertical forces which differ more than 20%.

It is a condition for a force F_{lat} perpendicular to the vertical symmetry line that the joist hanger is connected to a wood-based header with fasteners in all holes (full nailing) or in all holes marked for partial nailing.

The joist 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 1995-1-1:2004, (Eurocode 5).

The joist hangers can also be used in outdoor timber structures, service class 3, when a corrosion protection

in accordance with Eurocode 5 is applied, or when stainless steel with similar or better characteristic yield and ultimate strength is employed

The scope of the joist 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 hold downs of 50 years.

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

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The joist hangers are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed
3.3 General aspects related to the performance of the product	The joist 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

*) See additional information in section 3.8 – 3.9.

3.4 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the nail or screw connections and the joist hangers. To obtain design values the capacities must be divided by different partial factors for the material properties, the nail connection in addition multiplied with the coefficient k_{mod}.

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

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

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

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber, respectively, are also correctly considered.

3.5 Mechanical resistance and stability

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

The characteristic capacities of the joist hangers are determined by calculation assisted by testing as described in EAD 130186-00-0603. 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 on page 11 in Annex A:

Threaded nails (ringed shank nails) or screws in accordance to EN 14592 or ETA

In the formulas in Annex B the capacities for threaded nails or screws calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral nail load-carrying-capacity.

Further, the joist hangers may be fastened to a concrete structure or steel member by bolts with a diameter of 12 mm in holes with a diameter up to 2 mm larger than the bolt.

The shape of the nail or screw directly under the head shall be in the form of a truncated cone with a diameter under the head which exceeds the hole diameter.

4,0 mm threaded nails or 5,0 mm screws with a truncated cone below the head are used as fasteners, which are particularly suitable for steel-to-timber connections. The specific shape below the head causes a clamping of fasteners in the 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.

3.6 Aspects related to the performance of the product

3.6.1 Corrosion protection in service class 1 and 2.
The joist hangers have a zinc coating weight of min Z275. The steel employed is S250 GD with min Z275 according to EN 10346:2009.

3.6.2 Corrosion protection in service class 3.
In accordance with Eurocode 5 connectors shall be made from stainless steel.

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

The joist hangers are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation

The nailing pattern used shall be either the maximum or the minimum pattern as defined in Annex A.

The following provisions concerning product performance apply:

Joist hanger connections

A joist hanger connection is assessed for its intended use provided:

Header – support conditions

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

  If the header carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist}$ $(b_{header}/2+e_{J,0})$ shall be considered at the strength verification of the header.

  R_{joist} Reaction force from the joists
  b_{header} Width of header

$e_{J,0}$ Distance from the centroid of the nails in the joist to the surface of the header

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

Wood to wood connections

- Joist hangers are fastened to wood-based members by nails or screws.
- There shall be nails or screws in all holes or a partial nailing pattern as prescribed in Annex A-D may be used.
- The characteristic capacity of the joist hanger connection is calculated according to the manufacturer's technical documentation, dated 2024-01-12.
- The joist 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 joist hangers with outward flaps the gap between the surface of the end of the joist and that of the header shall be maximum 3 mm.
- The width of the joist shall be at least l+15 mm, where l is the length of the fasteners in the joist, for full and partial fastener pattern without staggering the fasteners in the joist. For staggered fasteners in the joist the width shall be at least the penetration length of the fasteners.
- The cross section of the joist at the joist hanger connection shall have sharp edges at the lower side against the bottom plate, i.e. it shall be without wane.
- The cross section of the header shall have a plane surface against the whole joist hanger.
- The width b_J of the joist shall correspond to that of the joist hanger. b_J shall not be smaller than B-3 mm, where B is the inner width of the joist hanger.
- The depth of the joist shall be so large that the top of the joist is at least 20 mm above the upper fastener in the joist.
- Nails to be used shall have a diameter, which fits the holes of the joist hangers.

Wood to concrete or steel

The above-mentioned rules for wood-to-wood connections are applicable also for the connection between the joist and the joist hanger.

- The joist hanger shall be in close contact with the concrete or steel over the whole face. There shall be no intermediate layers in between.
- The gap between the end of the joist and the surface, where contact stresses can occur during loading shall be limited. This means that the gap between the surface of the end of the joist and that of the concrete or steel shall be maximum 3 mm.
- The bolt shall have a diameter not less than the hole diameter minus 2 mm.
- The bolts shall be placed symmetrically about the vertical symmetry line. There shall always be bolts in the 2 upper holes.
- The upper bolts shall have washers according to EN ISO 7094.

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

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 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 ETA-Danmark prior to CE marking.

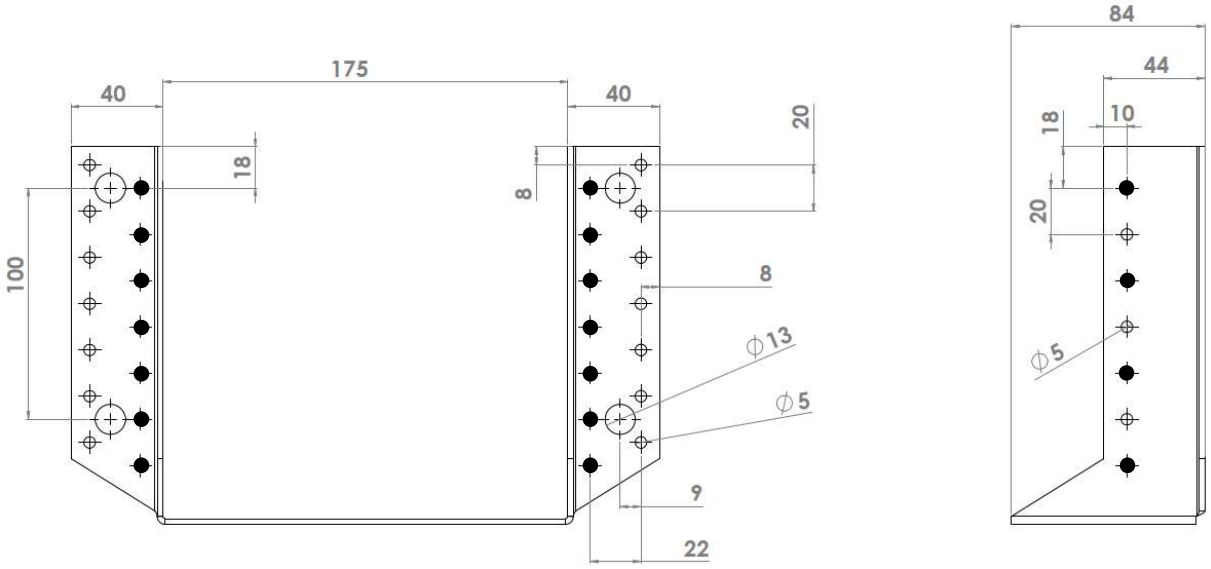
Issued in Copenhagen on 2024-05-23 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details and definitions

Joist hanger type DEV EN 2.5MM

Face mount hanger with external flanges. 2.5 mm thick hot-dipped coated steel SD250GD+Z (min Z275) according to EN 10346:2009 with a minimum R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A_{80} of 22 % with tolerances according to EN 10143.



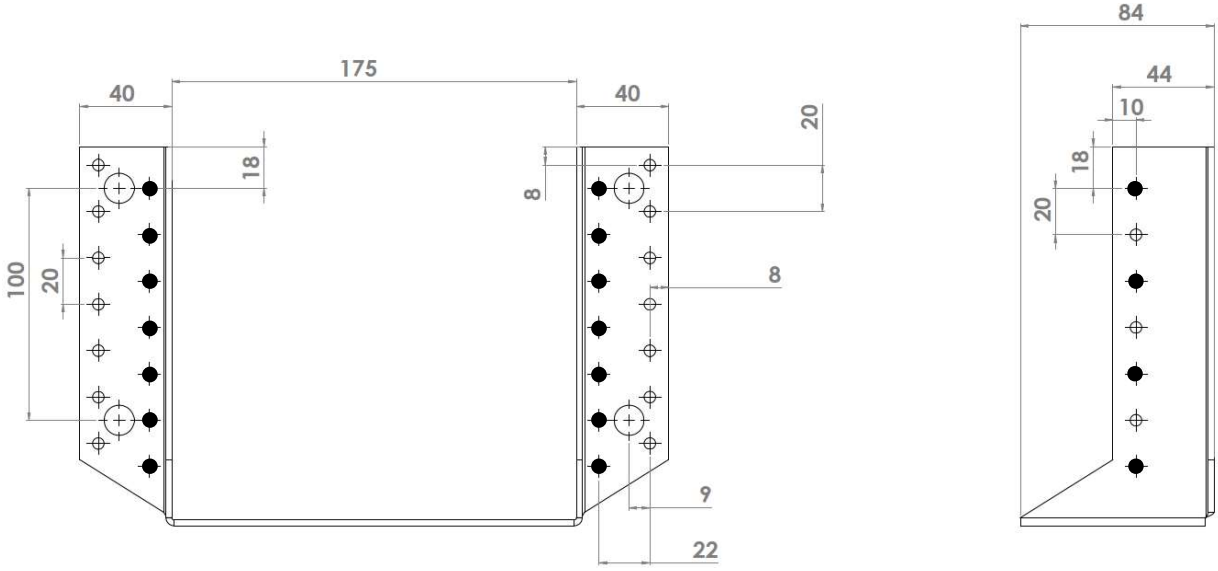
- Partial nailing; Drawing: Blank 500, 2,5 mm steel

Blank	Total n° of nail holes		Width interval		Height interval		Bolt holes		
	n_H	n_J	min	max	min	max	n°	d	A
500	28	14	40	175	162,5	230	4	13	= B + 80
580	32	16	40	195	192,5	270	6	13	= B + 80
640	40	18	40	195	222,5	300	6	13	= B + 80
710	48	22	40	175	267,5	335	6	13	= B + 80
760	50	24	40	175	292,5	360	6	13	= B + 80
840	56	28	40	175	332,5	400	6	13	= B + 78
920	68	36	40	175	372,5	440	8	13	= B + 78
1000	72	36	40	215	392,5	480	8	13	= B + 78

Joist hanger's height = (blank – width)/2

Joist hanger type DEV EN 4MM

Face mount hanger with external flanges. 4.0 mm thick hot-dipped coated steel SD250GD+Z (min Z275) according to EN 10346:2009 with a minimum R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A_{80} of 22 % with tolerances according to EN 10143.



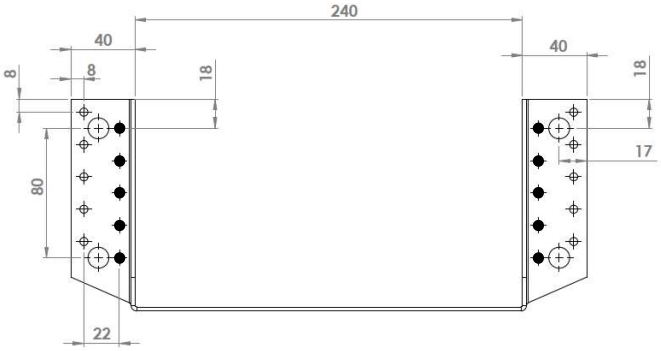
- Partial nailing; Drawing: Blank 500, 4,0 mm steel

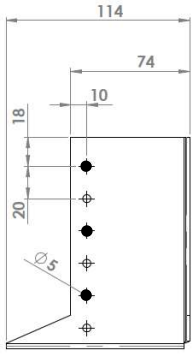
Blank	Total n° of nail holes		Width interval		Height interval		Bolt holes		
	n_H	n_J	min	max	min	max	n°	d	A
320	18	8	40	85	117,5	140	4	13	= B + 80
380	20	10	40	105	137,5	170	4	13	= B + 80
440	28	14	40	105	167,5	200	4	13	= B + 80
500	28	14	40	175	162,5	230	4	13	= B + 80
580	32	16	40	195	192,5	270	6	13	= B + 80
640	40	18	40	195	222,5	300	6	13	= B + 80
710	48	22	40	175	267,5	335	6	13	= B + 80
760	50	24	40	175	292,5	360	6	13	= B + 80
840	56	28	40	175	332,5	400	6	13	= B + 78
920	68	36	40	175	372,5	440	8	13	= B + 78
1000	72	36	40	215	392,5	480	8	13	= B + 78
1240	100	48	40	175	532,5	600	10	13	= B + 78

Joist hanger's height = (blank – width)/2

Joist hanger type DEV SP EN 4MM

Face mount hanger with external flanges. 4.0 mm thick hot-dipped coated steel SD250GD+Z (min Z275) according to EN 10346:2009 with a minimum R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A_{80} of 22 % with tolerances according to EN 10143.





- Partial nailing; Drawing: Blank 500, 4,0 mm steel

Blank	Total n° of nail holes		Width interval		Height interval		Bolt holes		
	n_H	n_J	min	max	min	max	n°	d	A
500	20	12	40	240	130	230	4	13	= B + 80
640	34	12	40	245	197,5	300	6	13	= B + 80
710	34	12	40	280	215	335	6	13	= B + 80

Joist hanger's height = (blank – width)/2

Fastener types and sizes

Fastener	Minimum Length	Minimum Threaded Length	Fastener type
Nail 4.0 mm	35 mm	25 mm	Ringed shank nails according to EN 14592 or ETA
Screw 5.0 mm	25 mm	20 mm	Self-tapping screws according to EN 14592 or ETA

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 characteristic withdrawal capacity of the nails or screws must be determined by calculation in accordance with EN 1995-1-1:2010, paragraph 8.3.2 (head pull-through is not relevant):

$F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen}$ for the nails 4.0 mm

$$F_{ax,\alpha,Rk} = \min\left\{ f_{tens,k}\,; \frac{n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef}}{k_{\beta}} \left(\frac{\rho_k}{\rho_a} \right)^{0,8} \right\}$$ for the screws 5.0 mm

where:

n_{ef} Effective number of fasteners
$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm²
d Nail or screw diameter in mm
t_{pen} Penetration depth of the ring shank in mm
ℓ_{ef} Penetration depth of the thread in mm
ρ_k Characteristic density of the timber in kg/m³
ρ_a Characteristic density of the timber in kg/m³ according to $f_{ax,k}$

$f_{ax,k}$, $f_{tens,k}$, ρ_a, k_{ax} and k_{β} see relevant ETA or ITT report.

The shape of the nail or screw 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 diameter	Correspondence Hole diameter	Bolts type
12.0	Max. 2 mm. larger than the bolt diameter	See specification of the manufacturer

Annex B
Characteristic values of load-carrying-capacities

Characteristic capacities of the joist hanger connections with nails or screws only

The downward and the upward directed forces are assumed to act in the middle of the joist. The lateral force is assumed to act at a distance $e_{J,90}$ above the centre of gravity of the joist fasteners, the axial force is assumed to act in the centre of gravity of the joist fasteners.

Two nails patterns are specified. A full nailing pattern, where there are nails in all the holes and a partial nailing pattern, where the number of nails in the joist and the header are at least half the numbers specified for full nailing. The nails in the joist may be staggered. The nails in the header shall be put in the holes closest to the bend line.

For BREKAR joist hangers the width of the joist shall be at least l+15 mm, where l is the length of the fasteners in the joist, for full nailing and partial nailing without staggering the nails in the joist. For partial nailing with staggered nails in the joist the width shall be at least the penetration length of the nails.

B.1 Joist hangers types fastened with nails or screws

Force downward toward the bottom plate:

$$F_{Z,Rk} = \min \begin{cases} n_J \cdot F_{v,J,Rk} + \min \begin{cases} 0,01 \cdot b_J \cdot (\ell + 30) \cdot \rho_k \\ 3,24 \cdot t \cdot \sqrt{\ell \cdot (\ell + 30) \cdot \rho_k} \end{cases} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{1}{k_{H,1} \cdot F_{ax,H,Rk}}\right)^2}} \end{cases} \quad \text{(B.1.1.1)}$$

Force upward away from the bottom plate:

$$F_{Z,Rk} = \min \begin{cases} n_J \cdot F_{v,J,Rk} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{1}{k_{H,2} \cdot F_{ax,H,Rk}}\right)^2}} \end{cases} \quad \text{(B.1.1.2)}$$

Lateral force:

$$F_{Y,Rk} = \min \begin{cases} \dfrac{n_J \cdot F_{v,J,Rk}}{\sqrt{\left(\dfrac{2 \cdot \sqrt{e_{J,0}^2 + e_{J,90}^2}}{b_J}\right)^2 + \left(\dfrac{F_{v,J,Rk}}{F_{ax,J,Rk}}\right)^2}} \\ \dfrac{F_{v,H,Rk}}{\sqrt{\left(\dfrac{1}{n_H} + \dfrac{e_H}{e_1}\right)^2 + \left(\dfrac{e_H}{e_2}\right)^2}} \end{cases} \quad \text{(B.1.1.3)}$$

Axial force (only DEV 640 to 1000 EN 2.5MM, DEV 580 to 1240 EN 4MM and DEV SP EN 4MM):

$$F_{X,Rk} = \min \left\{ n_J \cdot F_{v,J,Rk}; 0,7 \cdot n_H^p \cdot F_{ax,H,Rk}; 187 \cdot (0,5 \cdot n_H^p - 1) \cdot t^2 \right\} \quad \text{(B.1.1.4)}$$

n_J total number of nails in both sides of the joist

n_H total number of nails in the side of the header

n_H^p Number of header fasteners for partial nailing

$F_{v,Rd}$ Characteristic lateral load-carrying capacity of the fasteners in the joist or in the header indicated by the indices J or H

$F_{ax,Rd}$ Characteristic axial load-carrying capacity of the fasteners in the joist or in the header indicated by the indices J or H

b_J width of the joist hanger, see figure B1.
t Steel plate thickness
ℓ Bottom plate length
ρ_k Characteristic joist density
$e_{J,90}$ distance of the lateral force above the centre of gravity of the nails in the joist, see figure B1.
$e_{J,0}$ distance from the nails in the joist to the surface of the header, see figure B1.
e_H distance of the lateral force above the centre of gravity of the nails in the header.
e_1 joist hanger dimension, see Annex C
e_2 joist hanger dimension, see Annex C
$k_{H,1}$ form factor, see Annex C
$k_{H,2}$ form factor, see Annex C

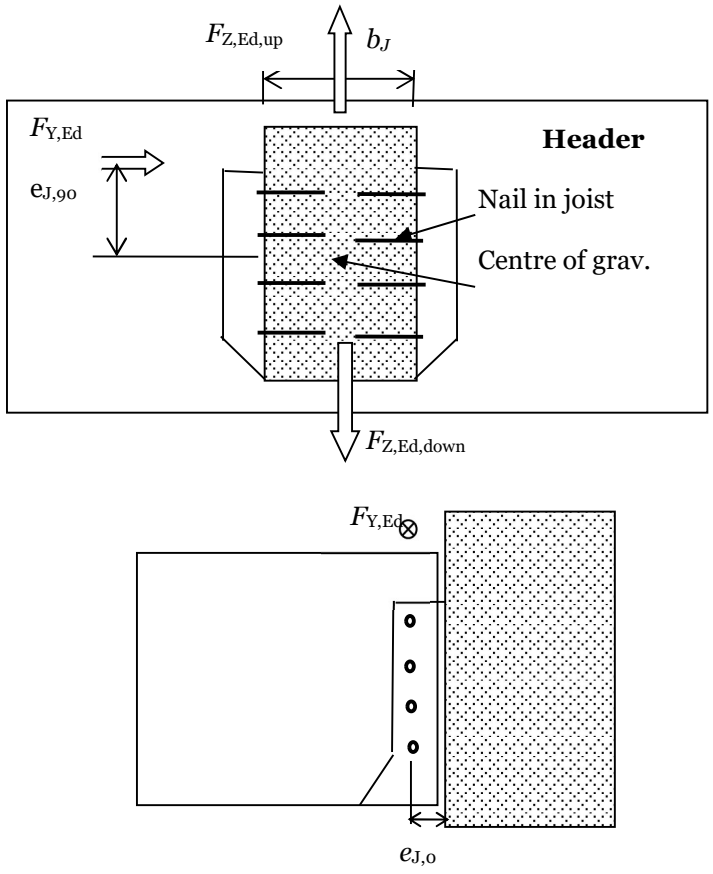


Figure B1: Definition of $e_{J,90}$ and $e_{J,0}$

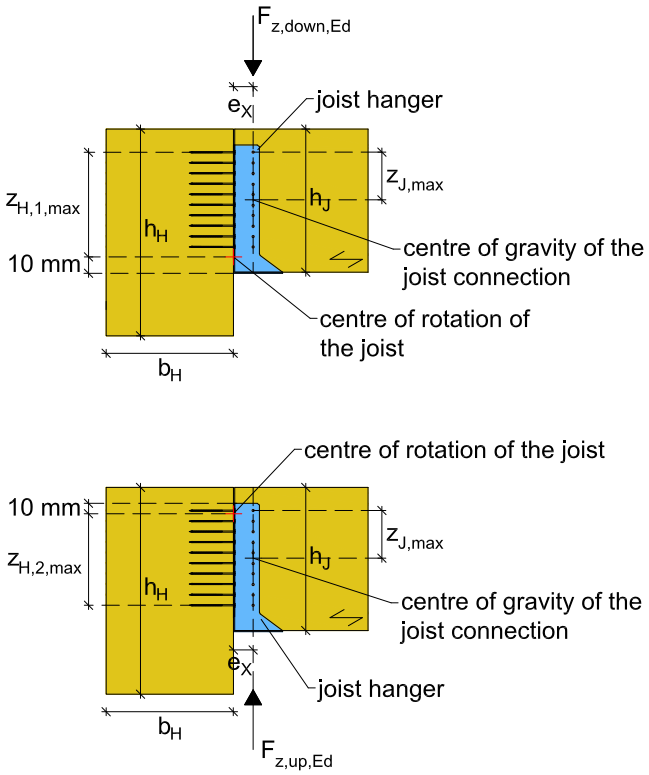


Figure B2: Load direction Z: notation and joist hanger dimensions

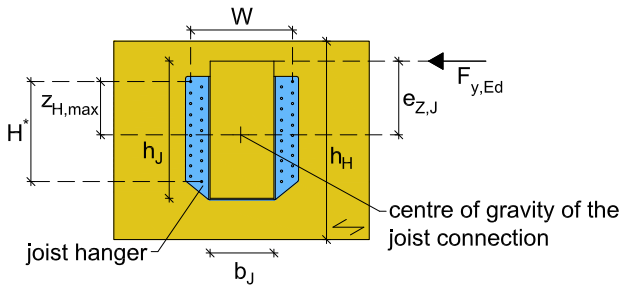


Figure B3: Load direction Y: notation and joist hanger dimensions

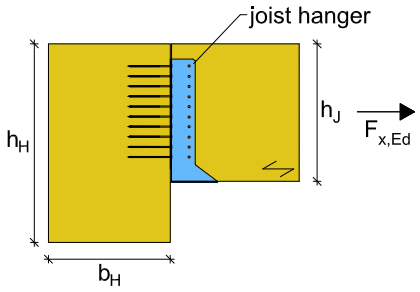


Figure B4: Load direction X: notation and joist hanger dimensions

B.1.2 Combined forces

In case of combined forces the following inequality shall be fulfilled:

$$\left(\frac{F_{X,Ed}}{F_{X,Rd}}\right)^2+\left(\frac{F_{Y,Ed}}{F_{Y,Rd}}\right)^2+\left(\frac{F_{Z,Ed}}{F_{Z,Rd}}\right)^2\le 1 \qquad \text{(B.1.2.1)}$$

B.2 Characteristic capacities of the joist hanger connections with bolts

For joist hangers type A connected to a wall of concrete, lightweight concrete or to a steel member the assumptions for the calculation of the load-carrying capacity of the connection are:

- The transfer of force from the joist to the joist hanger is as for a wood-wood connection, see clause B.1
- The bolts shall always be positioned symmetrically about the vertical axis of the joist hanger
- Washers according to EN ISO 7094 shall be installed at least under the upper 2 bolt heads or nuts.

Description of the static model

For a downward directed force toward the bottom plate the static behaviour is basically the same as for a wood-wood connection with nails.

The joist fasteners are subjected to a lateral force, which is equally distributed over all joist fasteners.

Since the concrete and steel have a larger compressive strength than timber subjected perpendicular to the grain the rotation point may be assumed positioned at the top of the bottom plate.

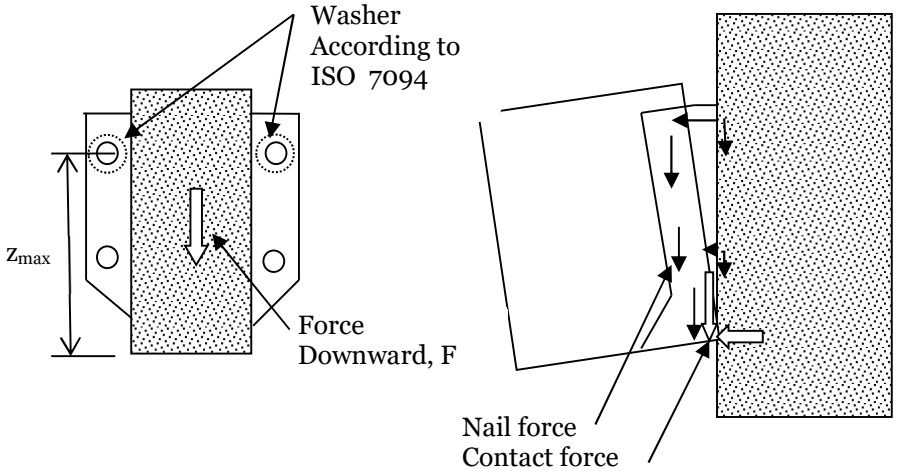


Figure B2 Left: Cross section in joist. Right: The joist will deflect and rotate, at the bottom a contact force will occur at the bottom plate, and the withdrawal forces in the bolts in the wall will vary linearly as assumed for nailed connections in the header.

The forces in the bolts will be partly lateral forces, partly withdrawal forces. The lateral forces are distributed evenly over all bolts. The withdrawal forces are on the safe side assumed to be taken by the 2 upper bolts with washers. The maximum withdrawal force in a upper bolt can be calculated from

$$F_{ax,bolt} = \frac{F \cdot e_{J,0}}{2 \cdot z_{max}} \quad (B.2.1)$$

Where

F downward directed force toward the bottom plate

$e_{J,0}$ eccentricity = distance from the nail column in the joist to the surface of the header

z_{max} max distance from upper bolt to the bottom plate (rotation point).

The upper 2 bolts are critical. They are subjected to a lateral force and a withdrawal force. The lateral force is determined assuming an even distribution of the downward force F.

$$F_{lat,bolt} = F / n_{bolt} \quad (B.2.2)$$

Characteristic capacities of a bolted joist hanger connection

The characteristic capacity of the connection between the joist and the joist hanger may be calculated from the same assumptions and formulas as for joist hangers nailed to a wooden header beam.

$$F_{Z,Rk} = n_J \cdot F_{v,J,Rk} + \min \begin{cases} 0,01 \cdot b_J \cdot (\ell + 30) \cdot \rho_k \\ 3,24 \cdot t \cdot \sqrt{\ell \cdot (\ell + 30) \cdot \rho_k} \end{cases} \text{ for threaded nails or screws} \qquad (B.2.3)$$

The upper 2 bolts are critical. They are subjected to a lateral force calculated from formula (B.2.2).

The withdrawal force in an upper bolt is calculated from (B.2.1).

Where:

F downward directed force toward the bottom plate

n_{bolt} total number of bolts in the joist hanger

$e_{J,0}$ eccentricity = distance from the nail column in the joist to the surface of the header

z_{max} max distance from the upper bolt to the bottom plate (rotation point)

It shall be verified by the design of the bolted connection that the upper bolts have sufficient load-carrying capacity to carry the combined lateral and axial forces.

From the characteristic load-carrying-capacity of the bearing resistance between the bolt and the plate of the joist hanger the following maximum characteristic capacity of the joist hanger connection can be determined.

$$F_{bear,Rk} = n_{bolt} \cdot f_{u,k} \cdot d \cdot t \qquad (B.2.4)$$

Where:

n_{bolt} total number of bolts in the 2 flaps

$f_{u,k}$ characteristic ultimate tensile strength of the steel

d diameter of the bolt

t thickness of the steel plate of the joist hanger

The characteristic load-carrying capacity of the joist hanger connections is the minimum of:

- The capacity determined from (B.2.3) from the fasteners in the joist
- The capacity determined from (B.2.4) from the embedding strength of the steel plate against the bolt
- The capacity controlled by the bolt forces given by (B.2.1) and (B.2.2).

Annex C
Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

Table C1: BREKAR joist hanger type DEV 500 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	230	28	14	90,3	37,1	1476	1845	34	14	8	44,4	17,8	583	1167	34
45	227,5	28	14	88,5	37,1	1567	1869	34	14	8	43,5	17,8	620	1144	34
50	225	28	14	86,7	37,1	1664	1897	34	14	8	42,6	17,8	659	1130	34
55	222,5	28	14	84,9	37,1	1765	1929	34	14	8	41,7	17,8	701	1122	34
60	220	28	14	83,1	37,1	1873	1963	34	14	8	40,8	17,8	747	1120	34
65	217,5	28	14	81,4	37,1	1985	2000	34	14	8	39,9	17,8	795	1122	34
70	215	28	14	79,6	37,1	2103	2040	34	14	8	39,0	17,8	846	1128	34
75	212,5	28	14	77,9	37,1	2226	2082	34	14	8	38,2	17,8	900	1137	34
80	210	28	14	76,2	37,1	2355	2126	34	14	8	37,3	17,8	957	1148	34
85	207,5	28	14	74,4	37,1	2489	2172	34	14	8	36,4	17,8	1016	1162	34
90	205	28	14	72,7	37,1	2629	2219	34	14	8	35,6	17,8	1079	1177	34
95	202,5	28	14	71,0	37,1	2773	2268	34	14	8	34,7	17,8	1145	1195	34
100	200	28	14	69,3	37,1	2924	2318	34	14	8	33,9	17,8	1213	1213	34
105	197,5	28	14	67,6	37,1	3079	2369	34	14	8	33,0	17,8	1285	1233	34
110	195	28	14	65,9	37,1	3240	2421	34	14	8	32,2	17,8	1359	1255	34
115	192,5	28	14	64,3	37,1	3407	2474	34	14	8	31,3	17,8	1436	1277	34
120	190	28	14	62,6	37,1	3578	2528	34	14	8	30,5	17,8	1517	1300	34
125	187,5	28	14	61,0	37,1	3756	2583	34	14	8	29,7	17,8	1600	1324	34
130	185	28	14	59,3	37,1	3938	2639	34	14	8	28,9	17,8	1686	1349	34
135	182,5	28	14	57,7	37,1	4126	2695	34	14	8	28,1	17,8	1775	1374	34
140	180	28	14	56,1	37,1	4319	2753	34	14	8	27,3	17,8	1867	1400	34
145	177,5	28	14	54,5	37,1	4518	2810	34	14	8	26,5	17,8	1961	1427	34
150	175	28	14	52,9	37,1	4722	2869	34	14	8	25,7	17,8	2059	1454	34
155	172,5	28	14	51,4	37,1	4932	2927	34	14	8	24,9	17,8	2160	1481	34
160	170	28	14	49,8	37,1	5146	2987	34	14	8	24,1	17,8	2263	1509	34
165	167,5	28	14	48,3	37,1	5367	3047	34	14	8	23,4	17,8	2370	1537	34
170	165	28	14	46,8	37,1	5592	3107	34	14	8	22,6	17,8	2479	1566	34
175	162,5	28	14	45,3	37,1	5823	3167	34	14	8	21,9	17,8	2591	1595	34

Table C2: BREKAR joist hanger type DEV 580 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	270	32	16	69,6	27,1	1676	2417	61	16	8	34,3	13,1	686	1600	61
45	267,5	32	16	68,5	27,1	1766	2430	61	16	8	33,8	13,1	721	1554	61
50	265	32	16	67,3	27,1	1861	2449	61	16	8	33,2	13,1	760	1520	61
55	262,5	32	16	66,2	27,1	1962	2473	61	16	8	32,6	13,1	801	1496	61
60	260	32	16	65,1	27,1	2068	2502	61	16	8	32,0	13,1	846	1480	61
65	257,5	32	16	63,9	27,1	2180	2534	61	16	8	31,5	13,1	893	1471	61
70	255	32	16	62,8	27,1	2296	2571	61	16	8	30,9	13,1	943	1467	61
75	252,5	32	16	61,7	27,1	2418	2610	61	16	8	30,3	13,1	996	1467	61
80	250	32	16	60,5	27,1	2546	2652	61	16	8	29,8	13,1	1051	1472	61
85	247,5	32	16	59,4	27,1	2679	2697	61	16	8	29,2	13,1	1110	1480	61
90	245	32	16	58,3	27,1	2817	2744	61	16	8	28,7	13,1	1171	1491	61
95	242,5	32	16	57,2	27,1	2960	2793	61	16	8	28,1	13,1	1236	1504	61
100	240	32	16	56,1	27,1	3109	2844	61	16	8	27,5	13,1	1303	1520	61
105	237,5	32	16	55,0	27,1	3263	2896	61	16	8	27,0	13,1	1373	1538	61
110	235	32	16	53,9	27,1	3423	2951	61	16	8	26,4	13,1	1446	1557	61
115	232,5	32	16	52,8	27,1	3588	3006	61	16	8	25,9	13,1	1521	1578	61
120	230	32	16	51,7	27,1	3758	3063	61	16	8	25,4	13,1	1600	1600	61
125	227,5	32	16	50,6	27,1	3933	3122	61	16	8	24,8	13,1	1681	1623	61
130	225	32	16	49,5	27,1	4114	3181	61	16	8	24,3	13,1	1766	1648	61
135	222,5	32	16	48,5	27,1	4300	3241	61	16	8	23,7	13,1	1853	1674	61
140	220	32	16	47,4	27,1	4492	3303	61	16	8	23,2	13,1	1943	1700	61
145	217,5	32	16	46,3	27,1	4688	3365	61	16	8	22,7	13,1	2036	1727	61
150	215	32	16	45,3	27,1	4890	3428	61	16	8	22,1	13,1	2131	1755	61
155	212,5	32	16	44,2	27,1	5098	3492	61	16	8	21,6	13,1	2230	1784	61
160	210	32	16	43,2	27,1	5311	3556	61	16	8	21,1	13,1	2331	1813	61
165	207,5	32	16	42,2	27,1	5529	3622	61	16	8	20,6	13,1	2436	1843	61
170	205	32	16	41,2	27,1	5752	3687	61	16	8	20,1	13,1	2543	1874	61
175	202,5	32	16	40,1	27,1	5981	3754	61	16	8	19,6	13,1	2653	1905	61
180	200	32	16	39,1	27,1	6215	3821	61	16	8	19,1	13,1	2766	1936	61
185	197,5	32	16	38,1	27,1	6455	3888	61	16	8	18,6	13,1	2881	1968	61
190	195	32	16	37,1	27,1	6700	3956	61	16	8	18,1	13,1	3000	2000	61
195	192,5	32	16	36,2	27,1	6950	4025	61	16	8	17,6	13,1	3121	2033	61

Table C3: BREKAR joist hanger type DEV 640 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	300	40	18	84,9	40,6	2159	3944	64	20	10	41,8	19,8	933	2800	64
45	297,5	40	18	83,6	40,6	2248	3918	64	20	10	41,2	19,8	968	2681	64
50	295	40	18	82,2	40,6	2342	3903	64	20	10	40,5	19,8	1006	2586	64
55	292,5	40	18	80,9	40,6	2441	3898	64	20	10	39,9	19,8	1046	2510	64
60	290	40	18	79,6	40,6	2546	3901	64	20	10	39,2	19,8	1089	2450	64
65	287,5	40	18	78,3	40,6	2656	3912	64	20	10	38,6	19,8	1135	2403	64
70	285	40	18	77,0	40,6	2771	3930	64	20	10	37,9	19,8	1183	2367	64
75	282,5	40	18	75,7	40,6	2892	3953	64	20	10	37,3	19,8	1235	2339	64
80	280	40	18	74,5	40,6	3018	3982	64	20	10	36,6	19,8	1289	2320	64
85	277,5	40	18	73,2	40,6	3149	4015	64	20	10	36,0	19,8	1346	2307	64
90	275	40	18	71,9	40,6	3285	4053	64	20	10	35,4	19,8	1406	2300	64
95	272,5	40	18	70,6	40,6	3427	4095	64	20	10	34,7	19,8	1468	2298	64
100	270	40	18	69,4	40,6	3573	4140	64	20	10	34,1	19,8	1533	2300	64
105	267,5	40	18	68,1	40,6	3726	4189	64	20	10	33,5	19,8	1601	2306	64
110	265	40	18	66,9	40,6	3883	4240	64	20	10	32,8	19,8	1672	2315	64
115	262,5	40	18	65,6	40,6	4046	4294	64	20	10	32,2	19,8	1746	2328	64
120	260	40	18	64,4	40,6	4213	4351	64	20	10	31,6	19,8	1822	2343	64
125	257,5	40	18	63,2	40,6	4387	4410	64	20	10	31,0	19,8	1901	2360	64
130	255	40	18	61,9	40,6	4565	4471	64	20	10	30,4	19,8	1983	2380	64
135	252,5	40	18	60,7	40,6	4749	4534	64	20	10	29,8	19,8	2068	2402	64
140	250	40	18	59,5	40,6	4938	4599	64	20	10	29,2	19,8	2156	2425	64
145	247,5	40	18	58,3	40,6	5132	4665	64	20	10	28,6	19,8	2246	2450	64
150	245	40	18	57,1	40,6	5331	4733	64	20	10	28,0	19,8	2339	2476	64
155	242,5	40	18	55,9	40,6	5536	4803	64	20	10	27,4	19,8	2435	2504	64
160	240	40	18	54,8	40,6	5746	4874	64	20	10	26,8	19,8	2533	2533	64
165	237,5	40	18	53,6	40,6	5961	4946	64	20	10	26,2	19,8	2635	2564	64
170	235	40	18	52,4	40,6	6182	5019	64	20	10	25,6	19,8	2739	2595	64
175	232,5	40	18	51,3	40,6	6408	5094	64	20	10	25,1	19,8	2846	2627	64
180	230	40	18	50,2	40,6	6639	5170	64	20	10	24,5	19,8	2956	2660	64
185	227,5	40	18	49,0	40,6	6875	5246	64	20	10	24,0	19,8	3068	2694	64
190	225	40	18	47,9	40,6	7117	5323	64	20	10	23,4	19,8	3183	2729	64
195	222,5	40	18	46,8	40,6	7363	5402	64	20	10	22,8	19,8	3301	2764	64

Table C4: BREKAR joist hanger type DEV 710 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	335	48	22	107,9	58,8	2752	6086	64	24	12	53,2	28,8	1236	4533	64
45	332,5	48	22	106,3	58,8	2840	5993	64	24	12	52,5	28,8	1270	4300	64
50	330	48	22	104,8	58,8	2934	5919	64	24	12	51,7	28,8	1307	4109	64
55	327,5	48	22	103,3	58,8	3032	5861	64	24	12	50,9	28,8	1347	3951	64
60	325	48	22	101,8	58,8	3136	5817	64	24	12	50,2	28,8	1389	3820	64
65	322,5	48	22	100,3	58,8	3245	5786	64	24	12	49,4	28,8	1434	3712	64
70	320	48	22	98,7	58,8	3359	5766	64	24	12	48,7	28,8	1482	3622	64
75	317,5	48	22	97,2	58,8	3479	5756	64	24	12	47,9	28,8	1532	3548	64
80	315	48	22	95,7	58,8	3604	5756	64	24	12	47,2	28,8	1585	3488	64
85	312,5	48	22	94,3	58,8	3734	5763	64	24	12	46,4	28,8	1641	3439	64
90	310	48	22	92,8	58,8	3869	5778	64	24	12	45,7	28,8	1700	3400	64
95	307,5	48	22	91,3	58,8	4009	5799	64	24	12	44,9	28,8	1761	3370	64
100	305	48	22	89,8	58,8	4155	5827	64	24	12	44,2	28,8	1825	3347	64
105	302,5	48	22	88,4	58,8	4305	5859	64	24	12	43,5	28,8	1892	3330	64
110	300	48	22	86,9	58,8	4461	5897	64	24	12	42,8	28,8	1962	3320	64
115	297,5	48	22	85,5	58,8	4623	5940	64	24	12	42,0	28,8	2034	3315	64
120	295	48	22	84,0	58,8	4789	5986	64	24	12	41,3	28,8	2109	3314	64
125	292,5	48	22	82,6	58,8	4961	6037	64	24	12	40,6	28,8	2187	3318	64
130	290	48	22	81,2	58,8	5138	6091	64	24	12	39,9	28,8	2267	3325	64
135	287,5	48	22	79,8	58,8	5320	6148	64	24	12	39,2	28,8	2350	3336	64
140	285	48	22	78,4	58,8	5507	6209	64	24	12	38,5	28,8	2436	3350	64
145	282,5	48	22	77,0	58,8	5699	6272	64	24	12	37,8	28,8	2525	3367	64
150	280	48	22	75,6	58,8	5897	6338	64	24	12	37,1	28,8	2616	3386	64
155	277,5	48	22	74,2	58,8	6100	6407	64	24	12	36,4	28,8	2710	3407	64
160	275	48	22	72,8	58,8	6308	6477	64	24	12	35,7	28,8	2807	3431	64
165	272,5	48	22	71,5	58,8	6522	6550	64	24	12	35,1	28,8	2907	3457	64
170	270	48	22	70,1	58,8	6740	6625	64	24	12	34,4	28,8	3009	3484	64
175	267,5	48	22	68,8	58,8	6964	6702	64	24	12	33,7	28,8	3114	3513	64

Table C5: BREKAR joist hanger type DEV 760 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	360	50	24	124,3	61,9	2826	6794	64	26	12	61,8	33,9	1408	5633	64
45	357,5	50	24	122,7	61,9	2910	6674	64	26	12	61,0	33,9	1442	5325	64
50	355	50	24	121,0	61,9	2999	6576	64	26	12	60,2	33,9	1479	5070	64
55	352,5	50	24	119,4	61,9	3092	6496	64	26	12	59,4	33,9	1518	4858	64
60	350	50	24	117,8	61,9	3191	6433	64	26	12	58,5	33,9	1560	4680	64
65	347,5	50	24	116,2	61,9	3294	6385	64	26	12	57,7	33,9	1605	4531	64
70	345	50	24	114,6	61,9	3403	6349	64	26	12	56,9	33,9	1652	4406	64
75	342,5	50	24	113,1	61,9	3517	6325	64	26	12	56,1	33,9	1702	4300	64
80	340	50	24	111,5	61,9	3635	6311	64	26	12	55,3	33,9	1755	4212	64
85	337,5	50	24	109,9	61,9	3759	6307	64	26	12	54,5	33,9	1811	4138	64
90	335	50	24	108,3	61,9	3888	6311	64	26	12	53,7	33,9	1869	4077	64
95	332,5	50	24	106,8	61,9	4021	6323	64	26	12	52,9	33,9	1930	4027	64
100	330	50	24	105,2	61,9	4160	6341	64	26	12	52,1	33,9	1993	3987	64
105	327,5	50	24	103,6	61,9	4303	6366	64	26	12	51,3	33,9	2060	3955	64
110	325	50	24	102,1	61,9	4452	6397	64	26	12	50,5	33,9	2129	3930	64
115	322,5	50	24	100,6	61,9	4606	6432	64	26	12	49,7	33,9	2201	3912	64
120	320	50	24	99,0	61,9	4764	6473	64	26	12	49,0	33,9	2275	3900	64
125	317,5	50	24	97,5	61,9	4928	6518	64	26	12	48,2	33,9	2352	3893	64
130	315	50	24	96,0	61,9	5096	6568	64	26	12	47,4	33,9	2432	3891	64
135	312,5	50	24	94,5	61,9	5270	6621	64	26	12	46,6	33,9	2515	3894	64
140	310	50	24	93,0	61,9	5449	6677	64	26	12	45,9	33,9	2600	3900	64
145	307,5	50	24	91,5	61,9	5632	6737	64	26	12	45,1	33,9	2688	3910	64
150	305	50	24	90,0	61,9	5821	6800	64	26	12	44,4	33,9	2779	3923	64
155	302,5	50	24	88,5	61,9	6015	6866	64	26	12	43,6	33,9	2872	3939	64
160	300	50	24	87,0	61,9	6213	6934	64	26	12	42,9	33,9	2968	3958	64
165	297,5	50	24	85,6	61,9	6417	7005	64	26	12	42,1	33,9	3067	3979	64
170	295	50	24	84,1	61,9	6625	7078	64	26	12	41,4	33,9	3169	4003	64
175	292,5	50	24	82,7	61,9	6839	7154	64	26	12	40,7	33,9	3273	4028	64

Table C6: BREKAR joist hanger type DEV 840 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	400	56	28	152	79,0	3421	9054	65	28	14	75,3	38,8	1581	7088	65
45	397,5	56	28	151	79,0	3506	8847	65	28	14	74,4	38,8	1614	6660	65
50	395	56	28	149	79,0	3597	8671	65	28	14	73,6	38,8	1649	6305	65
55	392,5	56	28	147	79,0	3693	8522	65	28	14	72,7	38,8	1687	6008	65
60	390	56	28	145	79,0	3794	8396	65	28	14	71,8	38,8	1728	5759	65
65	387,5	56	28	143	79,0	3900	8292	65	28	14	70,9	38,8	1771	5548	65
70	385	56	28	142	79,0	4012	8206	65	28	14	70,0	38,8	1817	5368	65
75	382,5	56	28	140	79,0	4128	8136	65	28	14	69,1	38,8	1866	5216	65
80	380	56	28	138	79,0	4250	8081	65	28	14	68,3	38,8	1917	5086	65
85	377,5	56	28	136	79,0	4377	8040	65	28	14	67,4	38,8	1971	4976	65
90	375	56	28	135	79,0	4509	8010	65	28	14	66,5	38,8	2028	4882	65
95	372,5	56	28	133	79,0	4647	7991	65	28	14	65,7	38,8	2088	4803	65
100	370	56	28	131	79,0	4789	7982	65	28	14	64,8	38,8	2150	4737	65
105	367,5	56	28	130	79,0	4937	7982	65	28	14	63,9	38,8	2215	4681	65
110	365	56	28	128	79,0	5090	7990	65	28	14	63,1	38,8	2282	4636	65
115	362,5	56	28	126	79,0	5248	8006	65	28	14	62,2	38,8	2352	4599	65
120	360	56	28	124	79,0	5412	8028	65	28	14	61,4	38,8	2425	4570	65
125	357,5	56	28	123	79,0	5580	8057	65	28	14	60,5	38,8	2501	4547	65
130	355	56	28	121	79,0	5754	8091	65	28	14	59,7	38,8	2579	4531	65
135	352,5	56	28	119	79,0	5933	8131	65	28	14	58,8	38,8	2660	4521	65
140	350	56	28	118	79,0	6117	8176	65	28	14	58,0	38,8	2744	4516	65
145	347,5	56	28	116	79,0	6306	8225	65	28	14	57,2	38,8	2831	4515	65
150	345	56	28	114	79,0	6501	8279	65	28	14	56,4	38,8	2920	4519	65
155	342,5	56	28	113	79,0	6700	8337	65	28	14	55,5	38,8	3012	4526	65
160	340	56	28	111	79,0	6905	8398	65	28	14	54,7	38,8	3106	4537	65
165	337,5	56	28	109	79,0	7115	8463	65	28	14	53,9	38,8	3203	4551	65
170	335	56	28	108	79,0	7330	8531	65	28	14	53,1	38,8	3303	4568	65
175	332,5	56	28	106	79,0	7551	8602	65	28	14	52,3	38,8	3406	4588	65

Table C7: BREKAR joist hanger type DEV 920 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	440	68	36	188	117	4676	15128	65	34	18	93	57,5	2219	12241	65
45	437,5	68	36	186	117	4761	14683	65	34	18	92	57,5	2251	11433	65
50	435	68	36	183	117	4851	14293	65	34	18	91	57,5	2286	10756	65
55	432,5	68	36	181	117	4946	13951	65	34	18	90	57,5	2323	10183	65
60	430	68	36	179	117	5047	13651	65	34	18	89	57,5	2363	9695	65
65	427,5	68	36	177	117	5152	13388	65	34	18	88	57,5	2406	9276	65
70	425	68	36	175	117	5263	13158	65	34	18	87	57,5	2451	8914	65
75	422,5	68	36	173	117	5379	12957	65	34	18	86	57,5	2499	8600	65
80	420	68	36	171	117	5500	12782	65	34	18	85	57,5	2550	8327	65
85	417,5	68	36	169	117	5626	12631	65	34	18	84	57,5	2604	8089	65
90	415	68	36	167	117	5758	12500	65	34	18	82,6	57,5	2660	7880	65
95	412,5	68	36	165	117	5894	12389	65	34	18	81,6	57,5	2718	7698	65
100	410	68	36	163	117	6036	12295	65	34	18	80,6	57,5	2780	7538	65
105	407,5	68	36	161	117	6183	12217	65	34	18	79,6	57,5	2844	7398	65
110	405	68	36	159	117	6335	12154	65	34	18	78,7	57,5	2910	7276	65
115	402,5	68	36	157	117	6492	12103	65	34	18	77,7	57,5	2980	7169	65
120	400	68	36	155	117	6654	12065	65	34	18	76,7	57,5	3052	7076	65
125	397,5	68	36	153	117	6822	12038	65	34	18	75,7	57,5	3126	6996	65
130	395	68	36	151	117	6994	12021	65	34	18	74,8	57,5	3204	6927	65
135	392,5	68	36	149	117	7172	12014	65	34	18	73,8	57,5	3284	6868	65
140	390	68	36	148	117	7355	12015	65	34	18	72,8	57,5	3366	6818	65
145	387,5	68	36	146	117	7543	12025	65	34	18	71,9	57,5	3451	6776	65
150	385	68	36	144	117	7736	12042	65	34	18	70,9	57,5	3539	6742	65
155	382,5	68	36	142	117	7934	12066	65	34	18	70,0	57,5	3630	6714	65
160	380	68	36	140	117	8138	12097	65	34	18	69,0	57,5	3723	6693	65
165	377,5	68	36	138	117	8346	12134	65	34	18	68,1	57,5	3819	6678	65
170	375	68	36	136	117	8560	12176	65	34	18	67,2	57,5	3918	6668	65
175	372,5	68	36	134	117	8779	12224	65	34	18	66,3	57,5	4019	6663	65

Table C8: BREKAR joist hanger type DEV 1000 EN 2.5MM made of 2,5 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	480	72	36	223	131	5148	17665	65	36	18	111	64,6	2458	14410	65
45	477,5	72	36	221	131	5233	17117	65	36	18	110	64,6	2490	13439	65
50	475	72	36	219	131	5323	16634	65	36	18	108	64,6	2525	12624	65
55	472,5	72	36	217	131	5418	16208	65	36	18	107	64,6	2562	11933	65
60	470	72	36	214	131	5518	15831	65	36	18	106	64,6	2602	11342	65
65	467,5	72	36	212	131	5624	15499	65	36	18	105	64,6	2645	10834	65
70	465	72	36	210	131	5734	15205	65	36	18	104	64,6	2690	10393	65
75	462,5	72	36	208	131	5850	14945	65	36	18	103	64,6	2738	10009	65
80	460	72	36	206	131	5971	14717	65	36	18	102	64,6	2788	9674	65
85	457,5	72	36	204	131	6097	14516	65	36	18	101	64,6	2842	9380	65
90	455	72	36	201	131	6228	14341	65	36	18	99,6	64,6	2898	9122	65
95	452,5	72	36	199	131	6364	14188	65	36	18	98,6	64,6	2956	8894	65
100	450	72	36	197	131	6506	14056	65	36	18	97,5	64,6	3017	8693	65
105	447,5	72	36	195	131	6652	13942	65	36	18	96,4	64,6	3081	8516	65
110	445	72	36	193	131	6804	13845	65	36	18	95,3	64,6	3147	8360	65
115	442,5	72	36	191	131	6961	13765	65	36	18	94,3	64,6	3216	8223	65
120	440	72	36	188	131	7123	13698	65	36	18	93,2	64,6	3288	8101	65
125	437,5	72	36	186	131	7290	13645	65	36	18	92,1	64,6	3363	7995	65
130	435	72	36	184	131	7462	13603	65	36	18	91,1	64,6	3440	7902	65
135	432,5	72	36	182	131	7640	13573	65	36	18	90,0	64,6	3519	7821	65
140	430	72	36	180	131	7822	13554	65	36	18	89,0	64,6	3602	7750	65
145	427,5	72	36	178	131	8010	13544	65	36	18	87,9	64,6	3687	7690	65
150	425	72	36	176	131	8203	13543	65	36	18	86,9	64,6	3774	7638	65
155	422,5	72	36	174	131	8401	13550	65	36	18	85,9	64,6	3864	7595	65
160	420	72	36	172	131	8604	13565	65	36	18	84,8	64,6	3957	7559	65
165	417,5	72	36	170	131	8812	13587	65	36	18	83,8	64,6	4053	7530	65
170	415	72	36	168	131	9026	13616	65	36	18	82,8	64,6	4151	7507	65
175	412,5	72	36	166	131	9244	13652	65	36	18	81,8	64,6	4252	7491	65
180	410	72	36	164	131	9468	13693	65	36	18	80,8	64,6	4356	7479	65
185	407,5	72	36	162	131	9697	13741	65	36	18	79,8	64,6	4462	7473	65
190	405	72	36	160	131	9931	13793	65	36	18	78,8	64,6	4570	7471	65
195	402,5	72	36	158	131	10170	13850	65	36	18	77,8	64,6	4682	7473	65
200	400	72	36	156	131	10414	13912	65	36	18	76,8	64,6	4796	7480	65
205	397,5	72	36	154	131	10664	13979	65	36	18	75,8	64,6	4913	7490	65
210	395	72	36	152	131	10918	14049	65	36	18	74,8	64,6	5032	7504	65
215	392,5	72	36	150	131	11178	14124	65	36	18	73,8	64,6	5154	7521	65

Table C9: BREKAR joist hanger type DEV 320 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	140	18	8	31,7	14,4	987	854	34	10	4	15,7	8,82	425	567	34
45	137,5	18	8	30,6	14,4	1069	883	34	10	4	15,1	8,82	464	571	34
50	135	18	8	29,5	14,4	1156	913	34	10	4	14,5	8,82	506	579	34
55	132,5	18	8	28,4	14,4	1248	944	34	10	4	14,0	8,82	552	588	34
60	130	18	8	27,4	14,4	1345	976	34	10	4	13,4	8,82	600	600	34
65	127,5	18	8	26,3	14,4	1447	1010	34	10	4	12,8	8,82	652	613	34
70	125	18	8	25,3	14,4	1554	1044	34	10	4	12,3	8,82	706	628	34
75	122,5	18	8	24,2	14,4	1666	1079	34	10	4	11,7	8,82	764	643	34
80	120	18	8	23,2	14,4	1783	1115	34	10	4	11,2	8,82	825	660	34
85	117,5	18	8	22,2	14,4	1905	1151	34	10	4	10,7	8,82	889	677	34

Table C10: BREKAR joist hanger type DEV 380 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	170	20	10	47,5	18,6	1168	1010	34	10	6	23,2	8,82	425	567	34
45	167,5	20	10	46,2	18,6	1261	1042	34	10	6	22,6	8,82	464	571	34
50	165	20	10	44,9	18,6	1361	1074	34	10	6	21,9	8,82	506	579	34
55	162,5	20	10	43,7	18,6	1466	1109	34	10	6	21,3	8,82	552	588	34
60	160	20	10	42,4	18,6	1576	1144	34	10	6	20,6	8,82	600	600	34
65	157,5	20	10	41,1	18,6	1693	1181	34	10	6	20,0	8,82	652	613	34
70	155	20	10	39,9	18,6	1814	1219	34	10	6	19,4	8,82	706	628	34
75	152,5	20	10	38,6	18,6	1941	1257	34	10	6	18,8	8,82	764	643	34
80	150	20	10	37,4	18,6	2074	1296	34	10	6	18,1	8,82	825	660	34
85	147,5	20	10	36,2	18,6	2213	1336	34	10	6	17,5	8,82	889	677	34
90	145	20	10	35,0	18,6	2356	1377	34	10	6	16,9	8,82	956	695	34
95	142,5	20	10	33,8	18,6	2506	1418	34	10	6	16,3	8,82	1027	714	34
100	140	20	10	32,6	18,6	2661	1460	34	10	6	15,7	8,82	1100	733	34
105	137,5	20	10	31,4	18,6	2821	1503	34	10	6	15,1	8,82	1177	753	34

Table C11: BREKAR joist hanger type DEV 440 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	200	28	14	69,3	37,1	1476	1845	34	14	8	33,9	17,8	583	1167	34
45	197,5	28	14	67,6	37,1	1567	1869	34	14	8	33,0	17,8	620	1144	34
50	195	28	14	65,9	37,1	1664	1897	34	14	8	32,2	17,8	659	1130	34
55	192,5	28	14	64,3	37,1	1765	1929	34	14	8	31,3	17,8	701	1122	34
60	190	28	14	62,6	37,1	1873	1963	34	14	8	30,5	17,8	747	1120	34
65	187,5	28	14	61,0	37,1	1985	2000	34	14	8	29,7	17,8	795	1122	34
70	185	28	14	59,3	37,1	2103	2040	34	14	8	28,9	17,8	846	1128	34
75	182,5	28	14	57,7	37,1	2226	2082	34	14	8	28,1	17,8	900	1137	34
80	180	28	14	56,1	37,1	2355	2126	34	14	8	27,3	17,8	957	1148	34
85	177,5	28	14	54,5	37,1	2489	2172	34	14	8	26,5	17,8	1016	1162	34
90	175	28	14	52,9	37,1	2629	2219	34	14	8	25,7	17,8	1079	1177	34
95	172,5	28	14	51,4	37,1	2773	2268	34	14	8	24,9	17,8	1145	1195	34
100	170	28	14	49,8	37,1	2924	2318	34	14	8	24,1	17,8	1213	1213	34
105	167,5	28	14	48,3	37,1	3079	2369	34	14	8	23,4	17,8	1285	1233	34

Table C12: BREKAR joist hanger type DEV 500 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	230	28	14	90,3	37,1	1476	1845	34	14	8	44,4	17,8	583	1167	34
45	227,5	28	14	88,5	37,1	1567	1869	34	14	8	43,5	17,8	620	1144	34
50	225	28	14	86,7	37,1	1664	1897	34	14	8	42,6	17,8	659	1130	34
55	222,5	28	14	84,9	37,1	1765	1929	34	14	8	41,7	17,8	701	1122	34
60	220	28	14	83,1	37,1	1873	1963	34	14	8	40,8	17,8	747	1120	34
65	217,5	28	14	81,4	37,1	1985	2000	34	14	8	39,9	17,8	795	1122	34
70	215	28	14	79,6	37,1	2103	2040	34	14	8	39,0	17,8	846	1128	34
75	212,5	28	14	77,9	37,1	2226	2082	34	14	8	38,2	17,8	900	1137	34
80	210	28	14	76,2	37,1	2355	2126	34	14	8	37,3	17,8	957	1148	34
85	207,5	28	14	74,4	37,1	2489	2172	34	14	8	36,4	17,8	1016	1162	34
90	205	28	14	72,7	37,1	2629	2219	34	14	8	35,6	17,8	1079	1177	34
95	202,5	28	14	71,0	37,1	2773	2268	34	14	8	34,7	17,8	1145	1195	34
100	200	28	14	69,3	37,1	2924	2318	34	14	8	33,9	17,8	1213	1213	34
105	197,5	28	14	67,6	37,1	3079	2369	34	14	8	33,0	17,8	1285	1233	34
110	195	28	14	65,9	37,1	3240	2421	34	14	8	32,2	17,8	1359	1255	34
115	192,5	28	14	64,3	37,1	3407	2474	34	14	8	31,3	17,8	1436	1277	34
120	190	28	14	62,6	37,1	3578	2528	34	14	8	30,5	17,8	1517	1300	34
125	187,5	28	14	61,0	37,1	3756	2583	34	14	8	29,7	17,8	1600	1324	34
130	185	28	14	59,3	37,1	3938	2639	34	14	8	28,9	17,8	1686	1349	34
135	182,5	28	14	57,7	37,1	4126	2695	34	14	8	28,1	17,8	1775	1374	34
140	180	28	14	56,1	37,1	4319	2753	34	14	8	27,3	17,8	1867	1400	34
145	177,5	28	14	54,5	37,1	4518	2810	34	14	8	26,5	17,8	1961	1427	34
150	175	28	14	52,9	37,1	4722	2869	34	14	8	25,7	17,8	2059	1454	34
155	172,5	28	14	51,4	37,1	4932	2927	34	14	8	24,9	17,8	2160	1481	34
160	170	28	14	49,8	37,1	5146	2987	34	14	8	24,1	17,8	2263	1509	34
165	167,5	28	14	48,3	37,1	5367	3047	34	14	8	23,4	17,8	2370	1537	34
170	165	28	14	46,8	37,1	5592	3107	34	14	8	22,6	17,8	2479	1566	34
175	162,5	28	14	45,3	37,1	5823	3167	34	14	8	21,9	17,8	2591	1595	34

Table C13: BREKAR joist hanger type DEV 580 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	270	32	16	66,4	25,8	1676	2417	64	16	8	32,7	12,5	686	1600	64
45	267,5	32	16	65,3	25,8	1766	2430	64	16	8	32,2	12,5	721	1554	64
50	265	32	16	64,2	25,8	1861	2449	64	16	8	31,6	12,5	760	1520	64
55	262,5	32	16	63,1	25,8	1962	2473	64	16	8	31,1	12,5	801	1496	64
60	260	32	16	62,0	25,8	2068	2502	64	16	8	30,5	12,5	846	1480	64
65	257,5	32	16	60,9	25,8	2180	2534	64	16	8	30,0	12,5	893	1471	64
70	255	32	16	59,9	25,8	2296	2571	64	16	8	29,5	12,5	943	1467	64
75	252,5	32	16	58,8	25,8	2418	2610	64	16	8	28,9	12,5	996	1467	64
80	250	32	16	57,7	25,8	2546	2652	64	16	8	28,4	12,5	1051	1472	64
85	247,5	32	16	56,6	25,8	2679	2697	64	16	8	27,8	12,5	1110	1480	64
90	245	32	16	55,6	25,8	2817	2744	64	16	8	27,3	12,5	1171	1491	64
95	242,5	32	16	54,5	25,8	2960	2793	64	16	8	26,8	12,5	1236	1504	64
100	240	32	16	53,5	25,8	3109	2844	64	16	8	26,3	12,5	1303	1520	64
105	237,5	32	16	52,4	25,8	3263	2896	64	16	8	25,7	12,5	1373	1538	64
110	235	32	16	51,4	25,8	3423	2951	64	16	8	25,2	12,5	1446	1557	64
115	232,5	32	16	50,3	25,8	3588	3006	64	16	8	24,7	12,5	1521	1578	64
120	230	32	16	49,3	25,8	3758	3063	64	16	8	24,2	12,5	1600	1600	64
125	227,5	32	16	48,2	25,8	3933	3122	64	16	8	23,6	12,5	1681	1623	64
130	225	32	16	47,2	25,8	4114	3181	64	16	8	23,1	12,5	1766	1648	64
135	222,5	32	16	46,2	25,8	4300	3241	64	16	8	22,6	12,5	1853	1674	64
140	220	32	16	45,2	25,8	4492	3303	64	16	8	22,1	12,5	1943	1700	64
145	217,5	32	16	44,2	25,8	4688	3365	64	16	8	21,6	12,5	2036	1727	64
150	215	32	16	43,2	25,8	4890	3428	64	16	8	21,1	12,5	2131	1755	64
155	212,5	32	16	42,2	25,8	5098	3492	64	16	8	20,6	12,5	2230	1784	64
160	210	32	16	41,2	25,8	5311	3556	64	16	8	20,1	12,5	2331	1813	64
165	207,5	32	16	40,2	25,8	5529	3622	64	16	8	19,6	12,5	2436	1843	64
170	205	32	16	39,2	25,8	5752	3687	64	16	8	19,1	12,5	2543	1874	64
175	202,5	32	16	38,3	25,8	5981	3754	64	16	8	18,7	12,5	2653	1905	64
180	200	32	16	37,3	25,8	6215	3821	64	16	8	18,2	12,5	2766	1936	64
185	197,5	32	16	36,3	25,8	6455	3888	64	16	8	17,7	12,5	2881	1968	64
190	195	32	16	35,4	25,8	6700	3956	64	16	8	17,2	12,5	3000	2000	64
195	192,5	32	16	34,5	25,8	6950	4025	64	16	8	16,8	12,5	3121	2033	64

Table C14: BREKAR joist hanger type DEV 640 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**
		Full nailing							Partial nailing						
40	300	40	18	84,9	40,6	2159	3944	64	20	10	41,8	19,8	933	2800	64
45	297,5	40	18	83,6	40,6	2248	3918	64	20	10	41,2	19,8	968	2681	64
50	295	40	18	82,2	40,6	2342	3903	64	20	10	40,5	19,8	1006	2586	64
55	292,5	40	18	80,9	40,6	2441	3898	64	20	10	39,9	19,8	1046	2510	64
60	290	40	18	79,6	40,6	2546	3901	64	20	10	39,2	19,8	1089	2450	64
65	287,5	40	18	78,3	40,6	2656	3912	64	20	10	38,6	19,8	1135	2403	64
70	285	40	18	77,0	40,6	2771	3930	64	20	10	37,9	19,8	1183	2367	64
75	282,5	40	18	75,7	40,6	2892	3953	64	20	10	37,3	19,8	1235	2339	64
80	280	40	18	74,5	40,6	3018	3982	64	20	10	36,6	19,8	1289	2320	64
85	277,5	40	18	73,2	40,6	3149	4015	64	20	10	36,0	19,8	1346	2307	64
90	275	40	18	71,9	40,6	3285	4053	64	20	10	35,4	19,8	1406	2300	64
95	272,5	40	18	70,6	40,6	3427	4095	64	20	10	34,7	19,8	1468	2298	64
100	270	40	18	69,4	40,6	3573	4140	64	20	10	34,1	19,8	1533	2300	64
105	267,5	40	18	68,1	40,6	3726	4189	64	20	10	33,5	19,8	1601	2306	64
110	265	40	18	66,9	40,6	3883	4240	64	20	10	32,8	19,8	1672	2315	64
115	262,5	40	18	65,6	40,6	4046	4294	64	20	10	32,2	19,8	1746	2328	64
120	260	40	18	64,4	40,6	4213	4351	64	20	10	31,6	19,8	1822	2343	64
125	257,5	40	18	63,2	40,6	4387	4410	64	20	10	31,0	19,8	1901	2360	64
130	255	40	18	61,9	40,6	4565	4471	64	20	10	30,4	19,8	1983	2380	64
135	252,5	40	18	60,7	40,6	4749	4534	64	20	10	29,8	19,8	2068	2402	64
140	250	40	18	59,5	40,6	4938	4599	64	20	10	29,2	19,8	2156	2425	64
145	247,5	40	18	58,3	40,6	5132	4665	64	20	10	28,6	19,8	2246	2450	64
150	245	40	18	57,1	40,6	5331	4733	64	20	10	28,0	19,8	2339	2476	64
155	242,5	40	18	55,9	40,6	5536	4803	64	20	10	27,4	19,8	2435	2504	64
160	240	40	18	54,8	40,6	5746	4874	64	20	10	26,8	19,8	2533	2533	64
165	237,5	40	18	53,6	40,6	5961	4946	64	20	10	26,2	19,8	2635	2564	64
170	235	40	18	52,4	40,6	6182	5019	64	20	10	25,6	19,8	2739	2595	64
175	232,5	40	18	51,3	40,6	6408	5094	64	20	10	25,1	19,8	2846	2627	64
180	230	40	18	50,2	40,6	6639	5170	64	20	10	24,5	19,8	2956	2660	64
185	227,5	40	18	49,0	40,6	6875	5246	64	20	10	24,0	19,8	3068	2694	64
190	225	40	18	47,9	40,6	7117	5323	64	20	10	23,4	19,8	3183	2729	64
195	222,5	40	18	46,8	40,6	7363	5402	64	20	10	22,8	19,8	3301	2764	64

Table C15: BREKAR joist hanger type DEV 710 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**
		Full nailing							Partial nailing						
40	335	48	22	108	58,8	2752	6086	64	24	12	53,2	28,8	1236	4533	64
45	332,5	48	22	106	58,8	2840	5993	64	24	12	52,5	28,8	1270	4300	64
50	330	48	22	105	58,8	2934	5919	64	24	12	51,7	28,8	1307	4109	64
55	327,5	48	22	103	58,8	3032	5861	64	24	12	50,9	28,8	1347	3951	64
60	325	48	22	102	58,8	3136	5817	64	24	12	50,2	28,8	1389	3820	64
65	322,5	48	22	100	58,8	3245	5786	64	24	12	49,4	28,8	1434	3712	64
70	320	48	22	98,7	58,8	3359	5766	64	24	12	48,7	28,8	1482	3622	64
75	317,5	48	22	97,2	58,8	3479	5756	64	24	12	47,9	28,8	1532	3548	64
80	315	48	22	95,7	58,8	3604	5756	64	24	12	47,2	28,8	1585	3488	64
85	312,5	48	22	94,3	58,8	3734	5763	64	24	12	46,4	28,8	1641	3439	64
90	310	48	22	92,8	58,8	3869	5778	64	24	12	45,7	28,8	1700	3400	64
95	307,5	48	22	91,3	58,8	4009	5799	64	24	12	44,9	28,8	1761	3370	64
100	305	48	22	89,8	58,8	4155	5827	64	24	12	44,2	28,8	1825	3347	64
105	302,5	48	22	88,4	58,8	4305	5859	64	24	12	43,5	28,8	1892	3330	64
110	300	48	22	86,9	58,8	4461	5897	64	24	12	42,8	28,8	1962	3320	64
115	297,5	48	22	85,5	58,8	4623	5940	64	24	12	42,0	28,8	2034	3315	64
120	295	48	22	84,0	58,8	4789	5986	64	24	12	41,3	28,8	2109	3314	64
125	292,5	48	22	82,6	58,8	4961	6037	64	24	12	40,6	28,8	2187	3318	64
130	290	48	22	81,2	58,8	5138	6091	64	24	12	39,9	28,8	2267	3325	64
135	287,5	48	22	79,8	58,8	5320	6148	64	24	12	39,2	28,8	2350	3336	64
140	285	48	22	78,4	58,8	5507	6209	64	24	12	38,5	28,8	2436	3350	64
145	282,5	48	22	77,0	58,8	5699	6272	64	24	12	37,8	28,8	2525	3367	64
150	280	48	22	75,6	58,8	5897	6338	64	24	12	37,1	28,8	2616	3386	64
155	277,5	48	22	74,2	58,8	6100	6407	64	24	12	36,4	28,8	2710	3407	64
160	275	48	22	72,8	58,8	6308	6477	64	24	12	35,7	28,8	2807	3431	64
165	272,5	48	22	71,5	58,8	6522	6550	64	24	12	35,1	28,8	2907	3457	64
170	270	48	22	70,1	58,8	6740	6625	64	24	12	34,4	28,8	3009	3484	64
175	267,5	48	22	68,8	58,8	6964	6702	64	24	12	33,7	28,8	3114	3513	64

Table C16: BREKAR joist hanger type DEV 760 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	360	50	24	124	61,9	2826	6794	64	26	12	61,8	33,9	1408	5633	64
45	357,5	50	24	123	61,9	2910	6674	64	26	12	61,0	33,9	1442	5325	64
50	355	50	24	121	61,9	2999	6576	64	26	12	60,2	33,9	1479	5070	64
55	352,5	50	24	119	61,9	3092	6496	64	26	12	59,4	33,9	1518	4858	64
60	350	50	24	118	61,9	3191	6433	64	26	12	58,5	33,9	1560	4680	64
65	347,5	50	24	116	61,9	3294	6385	64	26	12	57,7	33,9	1605	4531	64
70	345	50	24	115	61,9	3403	6349	64	26	12	56,9	33,9	1652	4406	64
75	342,5	50	24	113	61,9	3517	6325	64	26	12	56,1	33,9	1702	4300	64
80	340	50	24	111	61,9	3635	6311	64	26	12	55,3	33,9	1755	4212	64
85	337,5	50	24	110	61,9	3759	6307	64	26	12	54,5	33,9	1811	4138	64
90	335	50	24	108	61,9	3888	6311	64	26	12	53,7	33,9	1869	4077	64
95	332,5	50	24	107	61,9	4021	6323	64	26	12	52,9	33,9	1930	4027	64
100	330	50	24	105	61,9	4160	6341	64	26	12	52,1	33,9	1993	3987	64
105	327,5	50	24	104	61,9	4303	6366	64	26	12	51,3	33,9	2060	3955	64
110	325	50	24	102	61,9	4452	6397	64	26	12	50,5	33,9	2129	3930	64
115	322,5	50	24	101	61,9	4606	6432	64	26	12	49,7	33,9	2201	3912	64
120	320	50	24	99,0	61,9	4764	6473	64	26	12	49,0	33,9	2275	3900	64
125	317,5	50	24	97,5	61,9	4928	6518	64	26	12	48,2	33,9	2352	3893	64
130	315	50	24	96,0	61,9	5096	6568	64	26	12	47,4	33,9	2432	3891	64
135	312,5	50	24	94,5	61,9	5270	6621	64	26	12	46,6	33,9	2515	3894	64
140	310	50	24	93,0	61,9	5449	6677	64	26	12	45,9	33,9	2600	3900	64
145	307,5	50	24	91,5	61,9	5632	6737	64	26	12	45,1	33,9	2688	3910	64
150	305	50	24	90,0	61,9	5821	6800	64	26	12	44,4	33,9	2779	3923	64
155	302,5	50	24	88,5	61,9	6015	6866	64	26	12	43,6	33,9	2872	3939	64
160	300	50	24	87,0	61,9	6213	6934	64	26	12	42,9	33,9	2968	3958	64
165	297,5	50	24	85,6	61,9	6417	7005	64	26	12	42,1	33,9	3067	3979	64
170	295	50	24	84,1	61,9	6625	7078	64	26	12	41,4	33,9	3169	4003	64
175	292,5	50	24	82,7	61,9	6839	7154	64	26	12	40,7	33,9	3273	4028	64

Table C17: BREKAR joist hanger type DEV 840 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	400	56	28	152	79,0	3421	9054	65	28	14	75,3	38,8	1581	7088	65
45	397,5	56	28	151	79,0	3506	8847	65	28	14	74,4	38,8	1614	6660	65
50	395	56	28	149	79,0	3597	8671	65	28	14	73,6	38,8	1649	6305	65
55	392,5	56	28	147	79,0	3693	8522	65	28	14	72,7	38,8	1687	6008	65
60	390	56	28	145	79,0	3794	8396	65	28	14	71,8	38,8	1728	5759	65
65	387,5	56	28	143	79,0	3900	8292	65	28	14	70,9	38,8	1771	5548	65
70	385	56	28	142	79,0	4012	8206	65	28	14	70,0	38,8	1817	5368	65
75	382,5	56	28	140	79,0	4128	8136	65	28	14	69,1	38,8	1866	5216	65
80	380	56	28	138	79,0	4250	8081	65	28	14	68,3	38,8	1917	5086	65
85	377,5	56	28	136	79,0	4377	8040	65	28	14	67,4	38,8	1971	4976	65
90	375	56	28	135	79,0	4509	8010	65	28	14	66,5	38,8	2028	4882	65
95	372,5	56	28	133	79,0	4647	7991	65	28	14	65,7	38,8	2088	4803	65
100	370	56	28	131	79,0	4789	7982	65	28	14	64,8	38,8	2150	4737	65
105	367,5	56	28	130	79,0	4937	7982	65	28	14	63,9	38,8	2215	4681	65
110	365	56	28	128	79,0	5090	7990	65	28	14	63,1	38,8	2282	4636	65
115	362,5	56	28	126	79,0	5248	8006	65	28	14	62,2	38,8	2352	4599	65
120	360	56	28	124	79,0	5412	8028	65	28	14	61,4	38,8	2425	4570	65
125	357,5	56	28	123	79,0	5580	8057	65	28	14	60,5	38,8	2501	4547	65
130	355	56	28	121	79,0	5754	8091	65	28	14	59,7	38,8	2579	4531	65
135	352,5	56	28	119	79,0	5933	8131	65	28	14	58,8	38,8	2660	4521	65
140	350	56	28	118	79,0	6117	8176	65	28	14	58,0	38,8	2744	4516	65
145	347,5	56	28	116	79,0	6306	8225	65	28	14	57,2	38,8	2831	4515	65
150	345	56	28	114	79,0	6501	8279	65	28	14	56,4	38,8	2920	4519	65
155	342,5	56	28	113	79,0	6700	8337	65	28	14	55,5	38,8	3012	4526	65
160	340	56	28	111	79,0	6905	8398	65	28	14	54,7	38,8	3106	4537	65
165	337,5	56	28	109	79,0	7115	8463	65	28	14	53,9	38,8	3203	4551	65
170	335	56	28	108	79,0	7330	8531	65	28	14	53,1	38,8	3303	4568	65
175	332,5	56	28	106	79,0	7551	8602	65	28	14	52,3	38,8	3406	4588	65

Table C18: BREKAR joist hanger type DEV 920 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	440	68	36	188	117	4676	15128	65	34	18	92,8	57,5	2219	12241	65
45	437,5	68	36	186	117	4761	14683	65	34	18	91,8	57,5	2251	11433	65
50	435	68	36	183	117	4851	14293	65	34	18	90,7	57,5	2286	10756	65
55	432,5	68	36	181	117	4946	13951	65	34	18	89,7	57,5	2323	10183	65
60	430	68	36	179	117	5047	13651	65	34	18	88,7	57,5	2363	9695	65
65	427,5	68	36	177	117	5152	13388	65	34	18	87,7	57,5	2406	9276	65
70	425	68	36	175	117	5263	13158	65	34	18	86,7	57,5	2451	8914	65
75	422,5	68	36	173	117	5379	12957	65	34	18	85,6	57,5	2499	8600	65
80	420	68	36	171	117	5500	12782	65	34	18	84,6	57,5	2550	8327	65
85	417,5	68	36	169	117	5626	12631	65	34	18	83,6	57,5	2604	8089	65
90	415	68	36	167	117	5758	12500	65	34	18	82,6	57,5	2660	7880	65
95	412,5	68	36	165	117	5894	12389	65	34	18	81,6	57,5	2718	7698	65
100	410	68	36	163	117	6036	12295	65	34	18	80,6	57,5	2780	7538	65
105	407,5	68	36	161	117	6183	12217	65	34	18	79,6	57,5	2844	7398	65
110	405	68	36	159	117	6335	12154	65	34	18	78,7	57,5	2910	7276	65
115	402,5	68	36	157	117	6492	12103	65	34	18	77,7	57,5	2980	7169	65
120	400	68	36	155	117	6654	12065	65	34	18	76,7	57,5	3052	7076	65
125	397,5	68	36	153	117	6822	12038	65	34	18	75,7	57,5	3126	6996	65
130	395	68	36	151	117	6994	12021	65	34	18	74,8	57,5	3204	6927	65
135	392,5	68	36	149	117	7172	12014	65	34	18	73,8	57,5	3284	6868	65
140	390	68	36	148	117	7355	12015	65	34	18	72,8	57,5	3366	6818	65
145	387,5	68	36	146	117	7543	12025	65	34	18	71,9	57,5	3451	6776	65
150	385	68	36	144	117	7736	12042	65	34	18	70,9	57,5	3539	6742	65
155	382,5	68	36	142	117	7934	12066	65	34	18	70,0	57,5	3630	6714	65
160	380	68	36	140	117	8138	12097	65	34	18	69,0	57,5	3723	6693	65
165	377,5	68	36	138	117	8346	12134	65	34	18	68,1	57,5	3819	6678	65
170	375	68	36	136	117	8560	12176	65	14	8	67,2	57,5	3918	6668	34
175	372,5	68	36	134	117	8779	12224	65	14	8	66,3	57,5	4019	6663	34

Table C19: BREKAR joist hanger type DEV 1000 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**$e_{J,0}$ [mm]**
		Full nailing							Partial nailing						
40	480	72	36	223	131	5148	17665	65	36	18	111	64,6	2458	14410	65
45	477,5	72	36	221	131	5233	17117	65	36	18	110	64,6	2490	13439	65
50	475	72	36	219	131	5323	16634	65	36	18	108	64,6	2525	12624	65
55	472,5	72	36	217	131	5418	16208	65	36	18	107	64,6	2562	11933	65
60	470	72	36	214	131	5518	15831	65	36	18	106	64,6	2602	11342	65
65	467,5	72	36	212	131	5624	15499	65	36	18	105	64,6	2645	10834	65
70	465	72	36	210	131	5734	15205	65	36	18	104	64,6	2690	10393	65
75	462,5	72	36	208	131	5850	14945	65	36	18	103	64,6	2738	10009	65
80	460	72	36	206	131	5971	14717	65	36	18	102	64,6	2788	9674	65
85	457,5	72	36	204	131	6097	14516	65	36	18	101	64,6	2842	9380	65
90	455	72	36	201	131	6228	14341	65	36	18	99,6	64,6	2898	9122	65
95	452,5	72	36	199	131	6364	14188	65	36	18	98,6	64,6	2956	8894	65
100	450	72	36	197	131	6506	14056	65	36	18	97,5	64,6	3017	8693	65
105	447,5	72	36	195	131	6652	13942	65	36	18	96,4	64,6	3081	8516	65
110	445	72	36	193	131	6804	13845	65	36	18	95,3	64,6	3147	8360	65
115	442,5	72	36	191	131	6961	13765	65	36	18	94,3	64,6	3216	8223	65
120	440	72	36	188	131	7123	13698	65	36	18	93,2	64,6	3288	8101	65
125	437,5	72	36	186	131	7290	13645	65	36	18	92,1	64,6	3363	7995	65
130	435	72	36	184	131	7462	13603	65	36	18	91,1	64,6	3440	7902	65
135	432,5	72	36	182	131	7640	13573	65	36	18	90,0	64,6	3519	7821	65
140	430	72	36	180	131	7822	13554	65	36	18	89,0	64,6	3602	7750	65
145	427,5	72	36	178	131	8010	13544	65	36	18	87,9	64,6	3687	7690	65
150	425	72	36	176	131	8203	13543	65	36	18	86,9	64,6	3774	7638	65
155	422,5	72	36	174	131	8401	13550	65	36	18	85,9	64,6	3864	7595	65
160	420	72	36	172	131	8604	13565	65	36	18	84,8	64,6	3957	7559	65
165	417,5	72	36	170	131	8812	13587	65	36	18	83,8	64,6	4053	7530	65
170	415	72	36	168	131	9026	13616	65	36	18	82,8	64,6	4151	7507	65
175	412,5	72	36	166	131	9244	13652	65	36	18	81,8	64,6	4252	7491	65
180	410	72	36	164	131	9468	13693	65	36	18	80,8	64,6	4356	7479	65
185	407,5	72	36	162	131	9697	13741	65	36	18	79,8	64,6	4462	7473	65
190	405	72	36	160	131	9931	13793	65	36	18	78,8	64,6	4570	7471	65
195	402,5	72	36	158	131	10170	13850	65	36	18	77,8	64,6	4682	7473	65
200	400	72	36	156	131	10414	13912	65	36	18	76,8	64,6	4796	7480	65
205	397,5	72	36	154	131	10664	13979	65	36	18	75,8	64,6	4913	7490	65
210	395	72	36	152	131	10918	14049	65	36	18	74,8	64,6	5032	7504	65
215	392,5	72	36	150	131	11178	14124	65	36	18	73,8	64,6	5154	7521	65

Table C20: BREKAR joist hanger type DEV 1240 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	600	100	48	355	254	9202	44208	65	50	24	176	126	4509	37312	65
45	597,5	100	48	352	254	9287	42528	65	50	24	175	126	4540	34591	65
50	595	100	48	349	254	9376	41020	65	50	24	173	126	4574	32288	65
55	592,5	100	48	347	254	9470	39662	65	50	24	172	126	4611	30318	65
60	590	100	48	344	254	9570	38436	65	50	24	170	126	4650	28617	65
65	587,5	100	48	341	254	9674	37326	65	50	24	169	126	4692	27135	65
70	585	100	48	338	254	9784	36320	65	50	24	168	126	4737	25836	65
75	582,5	100	48	335	254	9899	35405	65	50	24	166	126	4784	24691	65
80	580	100	48	332	254	10019	34572	65	50	24	165	126	4834	23674	65
85	577,5	100	48	329	254	10144	33813	65	50	24	163	126	4886	22769	65
90	575	100	48	326	254	10274	33120	65	50	24	162	126	4941	21959	65
95	572,5	100	48	324	254	10409	32487	65	50	24	160	126	4998	21232	65
100	570	100	48	321	254	10549	31909	65	50	24	159	126	5059	20577	65
105	567,5	100	48	318	254	10695	31380	65	50	24	158	126	5121	19986	65
110	565	100	48	315	254	10845	30897	65	50	24	156	126	5187	19450	65
115	562,5	100	48	312	254	11001	30455	65	50	24	155	126	5255	18964	65
120	560	100	48	309	254	11162	30051	65	50	24	153	126	5325	18522	65
125	557,5	100	48	307	254	11327	29682	65	50	24	152	126	5398	18120	65
130	555	100	48	304	254	11498	29345	65	50	24	151	126	5474	17754	65
135	552,5	100	48	301	254	11674	29038	65	50	24	149	126	5553	17420	65
140	550	100	48	298	254	11856	28758	65	50	24	148	126	5634	17115	65
145	547,5	100	48	296	254	12042	28505	65	50	24	146	126	5717	16836	65
150	545	100	48	293	254	12233	28275	65	50	24	145	126	5803	16581	65
155	542,5	100	48	290	254	12429	28067	65	50	24	144	126	5892	16348	65
160	540	100	48	288	254	12631	27879	65	50	24	142	126	5984	16135	65
165	537,5	100	48	285	254	12838	27711	65	50	24	141	126	6078	15941	65
170	535	100	48	282	254	13049	27561	65	50	24	140	126	6174	15764	65
175	532,5	100	48	279	254	13266	27428	65	50	24	138	126	6273	15602	65

Table C21: BREKAR joist hanger type DEV SP 500 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

B [mm]	**H [mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**	$\mathbf{n_H}$	$\mathbf{n_J}$	$\mathbf{k_{H,1}}$	$\mathbf{k_{H,2}}$	$\mathbf{e_1}$ **[mm]**	$\mathbf{e_2}$ **[mm]**	$\mathbf{e_{J,0}}$ **[mm]**
		Full nailing							Partial nailing						
40	230	20	12	42,3	9,90	1168	1010	64	10	6	20,9	4,69	425	567	64
45	227,5	20	12	41,6	9,90	1261	1042	64	10	6	20,6	4,69	464	571	64
50	225	20	12	40,9	9,90	1361	1074	64	10	6	20,2	4,69	506	579	64
55	222,5	20	12	40,1	9,90	1466	1109	64	10	6	19,8	4,69	552	588	64
60	220	20	12	39,4	9,90	1576	1144	64	10	6	19,5	4,69	600	600	64
65	217,5	20	12	38,7	9,90	1693	1181	64	10	6	19,1	4,69	652	613	64
70	215	20	12	38,0	9,90	1814	1219	64	10	6	18,7	4,69	706	628	64
75	212,5	20	12	37,2	9,90	1941	1257	64	10	6	18,4	4,69	764	643	64
80	210	20	12	36,5	9,90	2074	1296	64	10	6	18,0	4,69	825	660	64
85	207,5	20	12	35,8	9,90	2213	1336	64	10	6	17,6	4,69	889	677	64
90	205	20	12	35,1	9,90	2356	1377	64	10	6	17,3	4,69	956	695	64
95	202,5	20	12	34,4	9,90	2506	1418	64	10	6	16,9	4,69	1027	714	64
100	200	20	12	33,6	9,90	2661	1460	64	10	6	16,6	4,69	1100	733	64
105	197,5	20	12	32,9	9,90	2821	1503	64	10	6	16,2	4,69	1177	753	64
110	195	20	12	32,2	9,90	2988	1545	64	10	6	15,8	4,69	1256	773	64
115	192,5	20	12	31,5	9,90	3159	1588	64	10	6	15,5	4,69	1339	794	64
120	190	20	12	30,8	9,90	3336	1632	64	10	6	15,1	4,69	1425	814	64
125	187,5	20	12	30,1	9,90	3519	1676	64	10	6	14,8	4,69	1514	835	64
130	185	20	12	29,4	9,90	3708	1720	64	10	6	14,4	4,69	1606	857	64
135	182,5	20	12	28,7	9,90	3901	1764	64	10	6	14,1	4,69	1702	878	64
140	180	20	12	28,0	9,90	4101	1809	64	10	6	13,7	4,69	1800	900	64
145	177,5	20	12	27,3	9,90	4306	1854	64	10	6	13,4	4,69	1902	922	64
150	175	20	12	26,6	9,90	4516	1899	64	10	6	13,0	4,69	2006	944	64
155	172,5	20	12	25,9	9,90	4733	1945	64	10	6	12,7	4,69	2114	966	64
160	170	20	12	25,2	9,90	4954	1991	64	10	6	12,3	4,69	2225	989	64
165	167,5	20	12	24,6	9,90	5181	2036	64	10	6	12,0	4,69	2339	1011	64
170	165	20	12	23,9	9,90	5414	2082	64	10	6	11,6	4,69	2456	1034	64
175	162,5	20	12	23,2	9,90	5653	2129	64	10	6	11,3	4,69	2577	1057	64
180	160	20	12	22,5	9,90	5896	2175	64	10	6	11,0	4,69	2700	1080	64
185	157,5	20	12	21,9	9,90	6146	2221	64	10	6	10,6	4,69	2827	1103	64
190	155	20	12	21,2	9,90	6401	2268	64	10	6	10,3	4,69	2956	1126	64
195	152,5	20	12	20,5	9,90	6661	2315	64	10	6	10,0	4,69	3089	1149	64
200	150	20	12	19,9	9,90	6928	2362	64	10	6	9,64	4,69	3225	1173	64
205	147,5	20	12	19,2	9,90	7199	2409	64	10	6	9,31	4,69	3364	1196	64
210	145	20	12	18,6	9,90	7476	2456	64	10	6	8,99	4,69	3506	1220	64
215	142,5	20	12	17,9	9,90	7759	2503	64	10	6	8,67	4,69	3652	1243	64
220	140	20	12	17,3	9,90	8048	2550	64	10	6	8,35	4,69	3800	1267	64
225	137,5	20	12	16,7	9,90	8341	2598	64	10	6	8,03	4,69	3952	1290	64
230	135	20	12	16,0	9,90	8641	2645	64	10	6	7,72	4,69	4106	1314	64
235	132,5	20	12	15,4	9,90	8946	2693	64	10	6	7,42	4,69	4264	1338	64
240	130	20	12	14,8	9,90	9256	2740	64	10	6	7,11	4,69	4425	1362	64

Table C22: BREKAR joist hanger type DEV SP 640 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

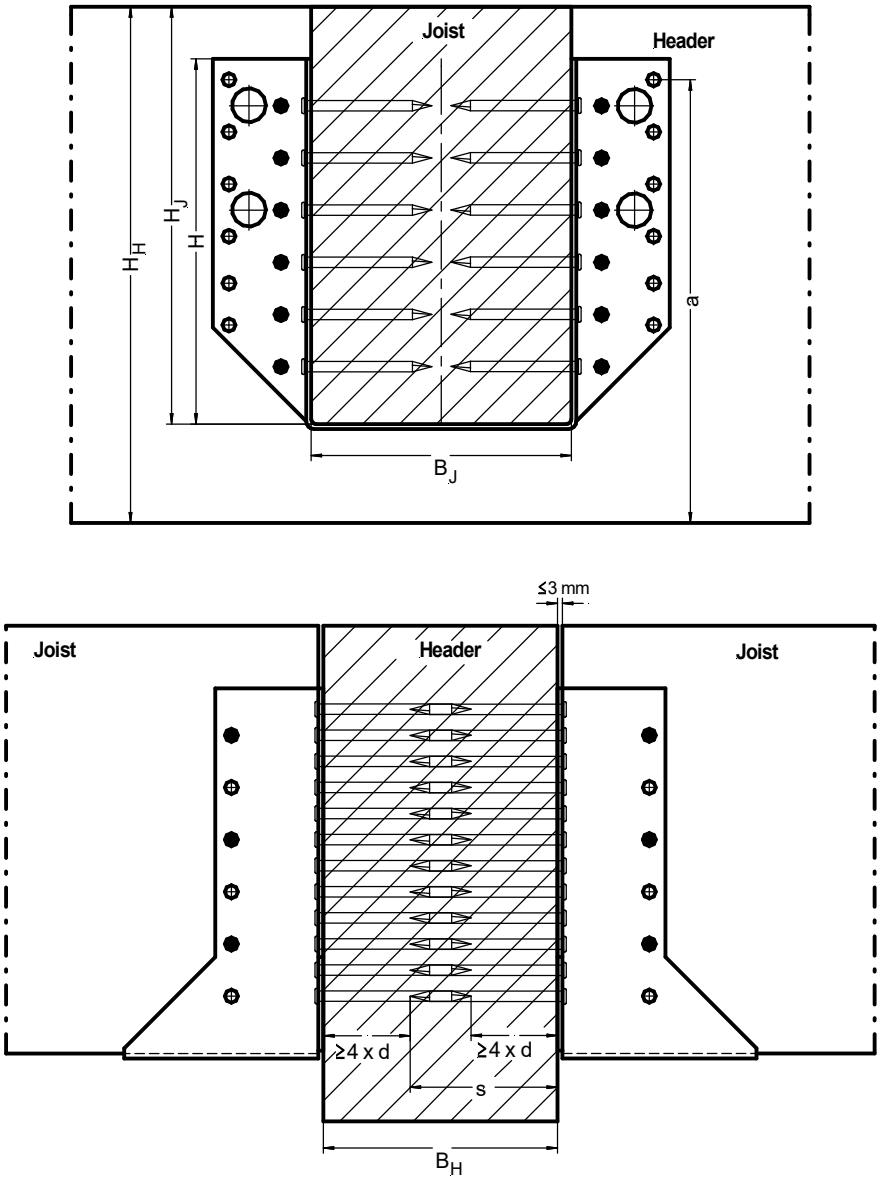
B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	300	34	12	81,1	28,1	1699	2778	64	18	6	40,9	15,9	803	2140	64
45	297,5	34	12	80,0	28,1	1783	2780	64	18	6	40,3	15,9	838	2062	64
50	295	34	12	78,8	28,1	1871	2790	64	18	6	39,6	15,9	876	2001	64
55	292,5	34	12	77,6	28,1	1964	2806	64	18	6	39,0	15,9	916	1955	64
60	290	34	12	76,4	28,1	2062	2827	64	18	6	38,4	15,9	960	1920	64
65	287,5	34	12	75,3	28,1	2165	2854	64	18	6	37,8	15,9	1006	1894	64
70	285	34	12	74,1	28,1	2274	2885	64	18	6	37,2	15,9	1056	1877	64
75	282,5	34	12	73,0	28,1	2387	2919	64	18	6	36,6	15,9	1108	1866	64
80	280	34	12	71,8	28,1	2505	2957	64	18	6	36,0	15,9	1163	1860	64
85	277,5	34	12	70,6	28,1	2628	2999	64	18	6	35,4	15,9	1220	1859	64
90	275	34	12	69,5	28,1	2756	3043	64	18	6	34,8	15,9	1281	1863	64
95	272,5	34	12	68,4	28,1	2890	3090	64	18	6	34,2	15,9	1344	1870	64
100	270	34	12	67,2	28,1	3028	3139	64	18	6	33,6	15,9	1410	1880	64
105	267,5	34	12	66,1	28,1	3171	3190	64	18	6	33,0	15,9	1479	1893	64
110	265	34	12	64,9	28,1	3319	3243	64	18	6	32,4	15,9	1551	1908	64
115	262,5	34	12	63,8	28,1	3473	3298	64	18	6	31,8	15,9	1625	1926	64
120	260	34	12	62,7	28,1	3631	3354	64	18	6	31,2	15,9	1703	1946	64
125	257,5	34	12	61,6	28,1	3794	3413	64	18	6	30,7	15,9	1783	1967	64
130	255	34	12	60,4	28,1	3962	3472	64	18	6	30,1	15,9	1866	1990	64
135	252,5	34	12	59,3	28,1	4135	3533	64	18	6	29,5	15,9	1951	2014	64
140	250	34	12	58,2	28,1	4314	3595	64	18	6	28,9	15,9	2040	2040	64
145	247,5	34	12	57,1	28,1	4497	3658	64	18	6	28,4	15,9	2131	2067	64
150	245	34	12	56,0	28,1	4685	3722	64	18	6	27,8	15,9	2226	2095	64
155	242,5	34	12	54,9	28,1	4878	3787	64	18	6	27,2	15,9	2323	2124	64
160	240	34	12	53,8	28,1	5076	3853	64	18	6	26,7	15,9	2423	2153	64
165	237,5	34	12	52,8	28,1	5280	3919	64	18	6	26,1	15,9	2525	2184	64
170	235	34	12	51,7	28,1	5488	3987	64	18	6	25,5	15,9	2631	2215	64
175	232,5	34	12	50,6	28,1	5701	4055	64	18	6	25,0	15,9	2739	2247	64
180	230	34	12	49,5	28,1	5919	4124	64	18	6	24,4	15,9	2850	2280	64
185	227,5	34	12	48,5	28,1	6142	4194	64	18	6	23,9	15,9	2964	2313	64
190	225	34	12	47,4	28,1	6371	4264	64	18	6	23,4	15,9	3081	2347	64
195	222,5	34	12	46,4	28,1	6604	4335	64	18	6	22,8	15,9	3200	2382	64
200	220	34	12	45,3	28,1	6842	4406	64	18	6	22,3	15,9	3323	2416	64
205	217,5	34	12	44,3	28,1	7085	4478	64	18	6	21,8	15,9	3448	2452	64
210	215	34	12	43,3	28,1	7333	4550	64	18	6	21,2	15,9	3576	2487	64
215	212,5	34	12	42,3	28,1	7587	4623	64	18	6	20,7	15,9	3706	2524	64
220	210	34	12	41,3	28,1	7845	4696	64	18	6	20,2	15,9	3840	2560	64
225	207,5	34	12	40,3	28,1	8108	4769	64	18	6	19,7	15,9	3976	2597	64
230	205	34	12	39,3	28,1	8376	4843	64	18	6	19,2	15,9	4116	2634	64
235	202,5	34	12	38,3	28,1	8649	4918	64	18	6	18,7	15,9	4258	2671	64
240	200	34	12	37,3	28,1	8928	4992	64	18	6	18,2	15,9	4403	2709	64
245	197,5	34	12	36,4	28,1	9211	5067	64	18	6	17,7	15,9	4550	2747	64

Table C23: BREKAR joist hanger type DEV SP 710 EN 4MM made of 4,0 mm steel plates: Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2 and $e_{J,0}$

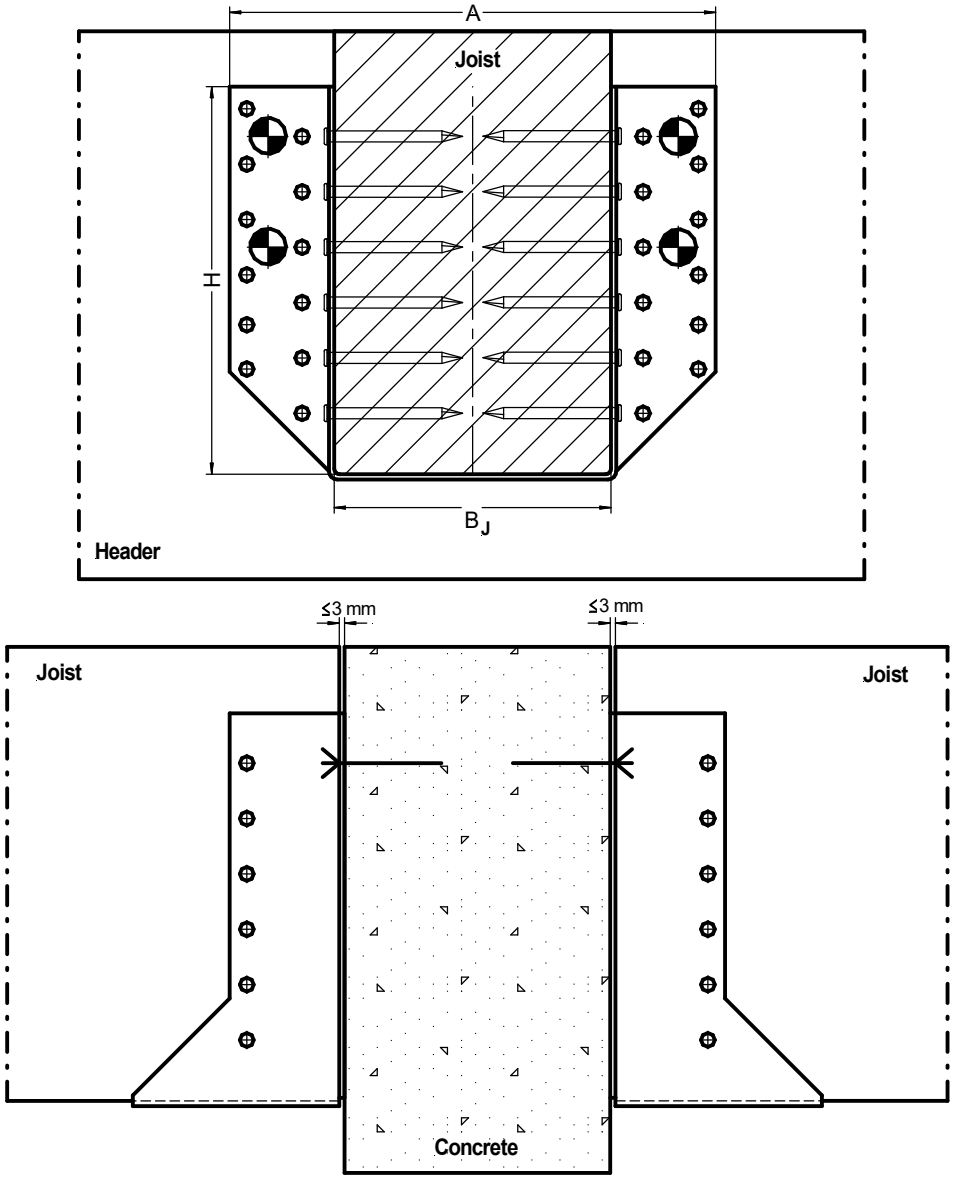
B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	$e_{J,0}$ [mm]
		Full nailing							Partial nailing						
40	335	34	12	97,9	28,1	1699	2778	64	18	6	49,6	15,9	803	2140	64
45	332,5	34	12	96,6	28,1	1783	2780	64	18	6	49,0	15,9	838	2062	64
50	330	34	12	95,4	28,1	1871	2790	64	18	6	48,4	15,9	876	2001	64
55	327,5	34	12	94,2	28,1	1964	2806	64	18	6	47,7	15,9	916	1955	64
60	325	34	12	93,0	28,1	2062	2827	64	18	6	47,1	15,9	960	1920	64
65	322,5	34	12	91,8	28,1	2165	2854	64	18	6	46,5	15,9	1006	1894	64
70	320	34	12	90,6	28,1	2274	2885	64	18	6	45,9	15,9	1056	1877	64
75	317,5	34	12	89,4	28,1	2387	2919	64	18	6	45,2	15,9	1108	1866	64
80	315	34	12	88,2	28,1	2505	2957	64	18	6	44,6	15,9	1163	1860	64
85	312,5	34	12	87,1	28,1	2628	2999	64	18	6	44,0	15,9	1220	1859	64
90	310	34	12	85,9	28,1	2756	3043	64	18	6	43,4	15,9	1281	1863	64
95	307,5	34	12	84,7	28,1	2890	3090	64	18	6	42,7	15,9	1344	1870	64
100	305	34	12	83,5	28,1	3028	3139	64	18	6	42,1	15,9	1410	1880	64
105	302,5	34	12	82,3	28,1	3171	3190	64	18	6	41,5	15,9	1479	1893	64
110	300	34	12	81,1	28,1	3319	3243	64	18	6	40,9	15,9	1551	1908	64
115	297,5	34	12	80,0	28,1	3473	3298	64	18	6	40,3	15,9	1625	1926	64
120	295	34	12	78,8	28,1	3631	3354	64	18	6	39,6	15,9	1703	1946	64
125	292,5	34	12	77,6	28,1	3794	3413	64	18	6	39,0	15,9	1783	1967	64
130	290	34	12	76,4	28,1	3962	3472	64	18	6	38,4	15,9	1866	1990	64
135	287,5	34	12	75,3	28,1	4135	3533	64	18	6	37,8	15,9	1951	2014	64
140	285	34	12	74,1	28,1	4314	3595	64	18	6	37,2	15,9	2040	2040	64
145	282,5	34	12	73,0	28,1	4497	3658	64	18	6	36,6	15,9	2131	2067	64
150	280	34	12	71,8	28,1	4685	3722	64	18	6	36,0	15,9	2226	2095	64
155	277,5	34	12	70,6	28,1	4878	3787	64	18	6	35,4	15,9	2323	2124	64
160	275	34	12	69,5	28,1	5076	3853	64	18	6	34,8	15,9	2423	2153	64
165	272,5	34	12	68,4	28,1	5280	3919	64	18	6	34,2	15,9	2525	2184	64
170	270	34	12	67,2	28,1	5488	3987	64	18	6	33,6	15,9	2631	2215	64
175	267,5	34	12	66,1	28,1	5701	4055	64	18	6	33,0	15,9	2739	2247	64
180	265	34	12	64,9	28,1	5919	4124	64	18	6	32,4	15,9	2850	2280	64
185	262,5	34	12	63,8	28,1	6142	4194	64	18	6	31,8	15,9	2964	2313	64
190	260	34	12	62,7	28,1	6371	4264	64	18	6	31,2	15,9	3081	2347	64
195	257,5	34	12	61,6	28,1	6604	4335	64	18	6	30,7	15,9	3200	2382	64
200	255	34	12	60,4	28,1	6842	4406	64	18	6	30,1	15,9	3323	2416	64
205	252,5	34	12	59,3	28,1	7085	4478	64	18	6	29,5	15,9	3448	2452	64
210	250	34	12	58,2	28,1	7333	4550	64	18	6	28,9	15,9	3576	2487	64
215	247,5	34	12	57,1	28,1	7587	4623	64	18	6	28,4	15,9	3706	2524	64
220	245	34	12	56,0	28,1	7845	4696	64	18	6	27,8	15,9	3840	2560	64
225	242,5	34	12	54,9	28,1	8108	4769	64	18	6	27,2	15,9	3976	2597	64
230	240	34	12	53,8	28,1	8376	4843	64	18	6	26,7	15,9	4116	2634	64
235	237,5	34	12	52,8	28,1	8649	4918	64	18	6	26,1	15,9	4258	2671	64
240	235	34	12	51,7	28,1	8928	4992	64	18	6	25,5	15,9	4403	2709	64
245	232,5	34	12	50,6	28,1	9211	5067	64	18	6	25,0	15,9	4550	2747	64
250	230	34	12	49,5	28,1	9499	5143	64	18	6	24,4	15,9	4701	2786	64
255	227,5	34	12	48,5	28,1	9792	5218	64	18	6	23,9	15,9	4854	2824	64
260	225	34	12	47,4	28,1	10090	5294	64	18	6	23,4	15,9	5010	2863	64
265	222,5	34	12	46,4	28,1	10394	5371	64	18	6	22,8	15,9	5169	2902	64
270	220	34	12	45,3	28,1	10702	5447	64	18	6	22,3	15,9	5331	2941	64
275	217,5	34	12	44,3	28,1	11015	5524	64	18	6	21,8	15,9	5495	2980	64
280	215	34	12	43,3	28,1	11333	5601	64	18	6	21,2	15,9	5663	3020	64

Annex D
Installation of joist hangers

Joist hanger in wood/wood connection



Joist hanger connected to concrete, lightweight concrete or a steel member by bolts



Bolts M12
Washer according to EN ISO 7094