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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

MEMBER OF EOTA

European Technical Assessment ETA-08/0171 of 14/05/2014

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:	GAH Joist Hangers Type A, 1,5 mm and 2,0 mm and type B
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:	Gust. Alberts GmbH & Co KG Gewerbegebiet Grünenthal D-55845 Herscheid Tel. +49 2357 907 0 Fax +49 2357 907 189 Internet www.gah.de
Manufacturing plant:	Gust. Alberts GmbH & Co KG Gewerbegebiet Grünenthal D-55845 Herscheid
This European Technical Assessment contains:	18 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, April 2013, used as European Assessment Document (EAD).
This version replaces:	The ETA with the same number issued on 2013-06-28 and expiry on 2018-06-28

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

GAH joist hangers type A, 1,5 mm and 2,0 mm and type B are one-piece non-welded, face-fixed joist hangers to be used in timber to timber connections as well as connections between a timber joist and a concrete structure or a steel member. Type B is for timber to timber connections only.

The joist hangers are made from pre-galvanized steel DX51D + 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 10143:2006.

Additionally, all the joist hangers can be made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 provided that the yield strength f_y for these steel grades is at least the same as the minimum yield strength of the zinc coated steel normally used for the brackets. The ultimate strength f_u and the ultimate strain A_{80} shall exceed the corresponding minimum values for the zinc coated steel.

Dimensions, hole positions, steel type and typical installations are shown in Annex A.

2 Specification of the intended use in accordance with the applicable 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 305/2011 (EU) shall be fulfilled. They are also intended for use in making an end-grain connection between a timber joist and a concrete structure or a steel member.

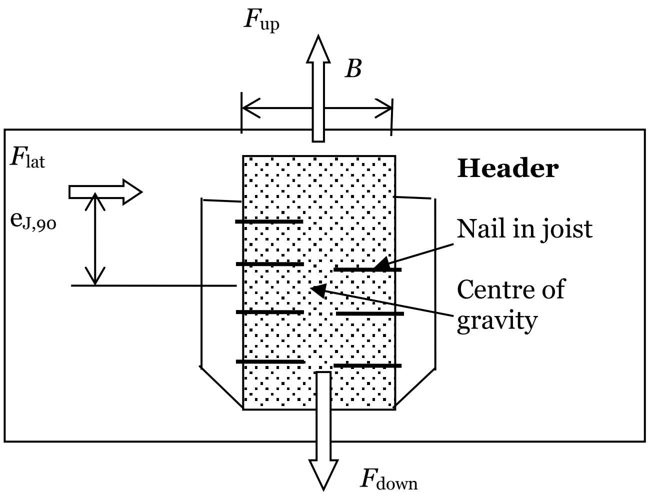
The joist hangers can be installed as connections between wood based members such as:

- Structural solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glulam classified to GL24-GL36 according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Layered wood plates,
- 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 when calculating the load-carrying capacities of the fasteners.

Annex B states the formulas for the characteristic load-carrying capacities of the joist hanger connections. 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 F_{up}, F_{down} and F_{lat}, 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 nails in the joist. It is assumed that the forces are acting right at the end of the joist.



It is assumed that the header 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 $M_v = F_d \cdot (B_H / 2 + 30\text{mm})$ 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_{up}, F_{down} and F_{lat} that the joist hanger is connected to a wood-based header with nails either in all holes (full nailing) or in all holes marked for partial nailing.

The joist hangers are intended for use in connections subject to static or quasi static loading.

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. Section 3.11of this ETA contains the corrosion protection for GAH Alberts joist hangers made from carbon steel and the material number of the stainless steel.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the angle brackets 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)*)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance determined
Ductility in cyclic testing	No performance determined
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The angle brackets are made from steel classified as **Euroclass A1** in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	No dangerous materials
3.7 Sustainable use of natural resources (BWR7)	No Performance Determined
3.8 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, 2 and 3
Identification	See Annex A

*) See additional information in section 3.9 – 3.12.

In addition to the specific clauses relating to dangerous substances contained in this European technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). n order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

3.9 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the nail connections and the joist hangers. To obtain design values the capacities have to 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 taken into account.

3.10 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 the EOTA Guideline 015 clause 5.1.2. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in the table on page 10 in Annex A.

Threaded nails (ringed shank nails) in accordance to EN 14592

In the formulas in Annex B the capacities for threaded nails 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 type A 2,0 mm may be fastened to a concrete structure or steel member by bolts with a diameter of 8 mm in holes with a diameter of 10mm and by bolts with a diameter of 10 mm in holes with a diameter of 11 mm, respectively. The joist hangers type A 1,5 mm can be fastened to a concrete structure or steel member by bolts with a diameter of 10 mm in holes with a diameter up to 2 mm larger than the bolt.

The load bearing capacities of the brackets has been determined based on the use of connector nails 4,0 x 40 mm in accordance with the German national approval for the nails.

The characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1: 2004, paragraph 8.3.2 (head pull-through is not relevant):

$$F_{ax,Rk} = f_{ax,k} \times d \times t_{pen}$$

Where:

$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2

d Nail diameter in mm

t_{pen} Penetration depth of the profiles shank in mm $t_{pen} \geq 31$ mm for 2,0 mm brackets and $t_{pen} \geq 25$ mm for 1,5 mm brackets

Based on tests by Versuchsanstalt für Stahl, Holz und Steine, University of Kalrsruhe, the characteristic value of the withdrawal resistance for the threaded nails used can be calculated as:

$$f_{ax,k} = 50 \times 10^{-6} \times \sigma_k^2$$

Where:

σ_k Characteristic density of the timber in kg/m^3

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

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.

3.11 Aspects related to the performance of the product

3.11.1 Corrosion protection in service class 1 and 2.

In accordance with ETAG 015 the angle brackets are made from pre-galvanized steel DX 51 D / Z 275 according to EN 10346:2009 with minimum yield strength R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A_{80} of 22 %

3.11.2 Corrosion protection in service class 3.
In accordance with Eurocode 5 the angle brackets are made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 and the nails shall be produced from stainless steel.

3.12 General aspects related to the use of the product

GAH joist hangers A 1,5 mm and 2,0 mm and type B 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.

Joist hanger connections

A joist hanger connection is deemed fit 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 $M_{ec} = R_{joist}\,(b_{header}/2+e_{nail})$ shall be considered at the strength verification of the header.

R_{joist}	Reaction force from the joists
b_{header}	Width of header
e_{nail}	Distance from 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 may be fastened to wood-based members by nails.
- There shall be nails in all holes or a partial nailing pattern as prescribed in Annex A-D can be used.
- The characteristic capacity of the joist hanger connection is calculated according to the manufacturer’s technical documentation, dated 2008- 07-15, 2009-05-02 and 2014-01-02.
- 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 inward flaps shall the gap between the surface of the nail heads in the inward flaps and the end of the joist be maximum 8 mm.
- For GAH joist hangers type A 2,0 mm with overlapping nails in the joist (see figure 8.5 in EN 1995-1-1) the width of the joist shall be at least l+4d, where l is the length of the nails and d is the diameter of the nails in the joist.
- For joist hangers with staggered nails in the joist the width shall be at least the penetration length of the nails.
- For joist hangers type A 1.5 mm and type B the width of the joist 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 fit the holes of the joist hangers. Nails shall have a diameter which is not smaller than the diameter of the hole minus 1 mm.

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 not exceed 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 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

Issued in Charlottenlund on 2014-05-14 by

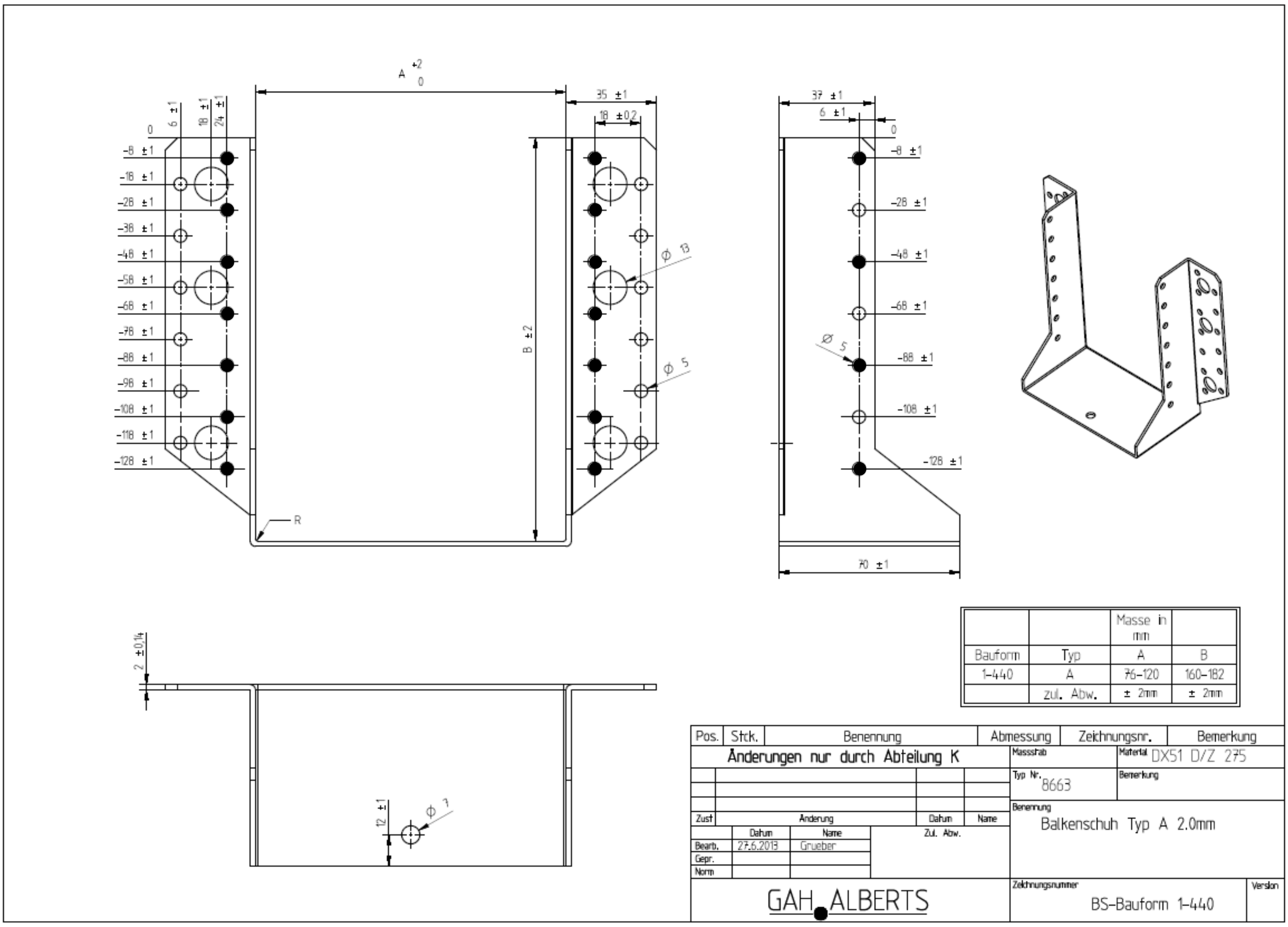
Thomas Bruun
Managing Director, ETA-Danmark

Annex A

Product details and definitions

Joist hangers 260 A, 320 A, 380 A, 440 A and 500 A: Face mount hanger with exterior flanges
2.0 mm thick pre-galvanised steel DX51D + Z (min Z275) according to EN 10346:2009 with a minimum yield strength R_{eH} 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 10143:1993.

Additionally, the joist hanger can be made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 with tolerances according to EN 10143:2006 provided that the yield strength f_y for these steel grades is at least the same as the minimum yield strength of the zinc coated steel normally used for the brackets. The ultimate strength f_u and the ultimate strain A_{80} shall exceed the corresponding minimum values for the zinc coated steel.

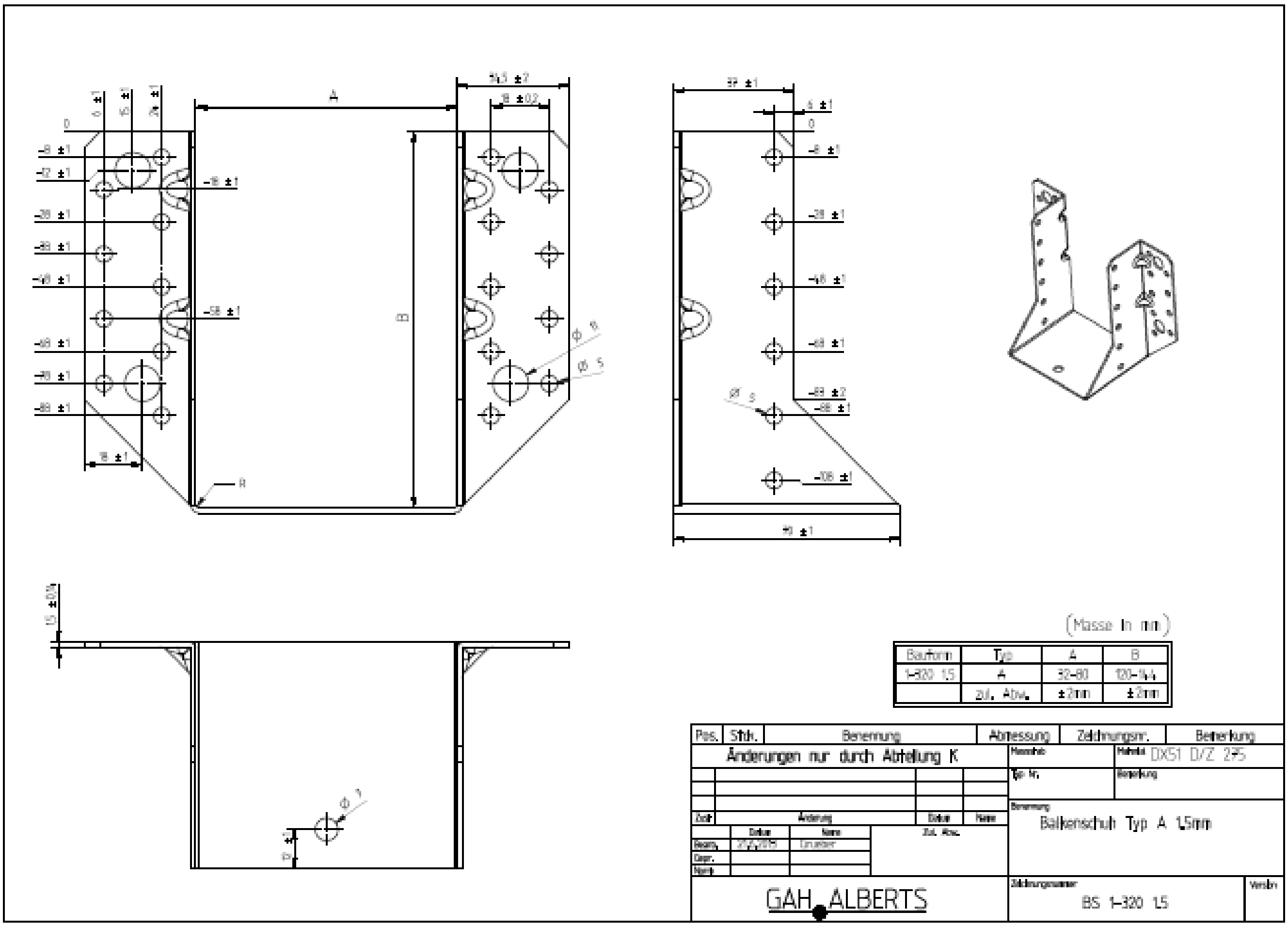


• Partial nailing; Drawing: Blank 440 A

Blank	Total n° of nail holes		Width interval		Height interval	
	n_H	n_J	min	max	min	max
260	14	8	32	65	96	114
320	18	10	32	80	120	143
380	22	12	54	100	140	163
440	26	14	76	120	160	182
500	30	16	100	140	180	200

Joist hanger type A 1.5 mm: Face mount hanger with external flanges
1,5 mm thick pre-galvanised steel DX51D + Z (min Z275) according to EN 10346:2009 with a minimum yield strength R_{eH} 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 10143:1993.

Additionally, the joist hanger can be made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 with tolerances according to EN 10143:2006 provided that the yield strength f_y for these steel grades is at least the same as the minimum yield strength of the zinc coated steel normally used for the brackets. The ultimate strength f_u and the ultimate strain A_{80} shall exceed the corresponding minimum values for the zinc coated steel.



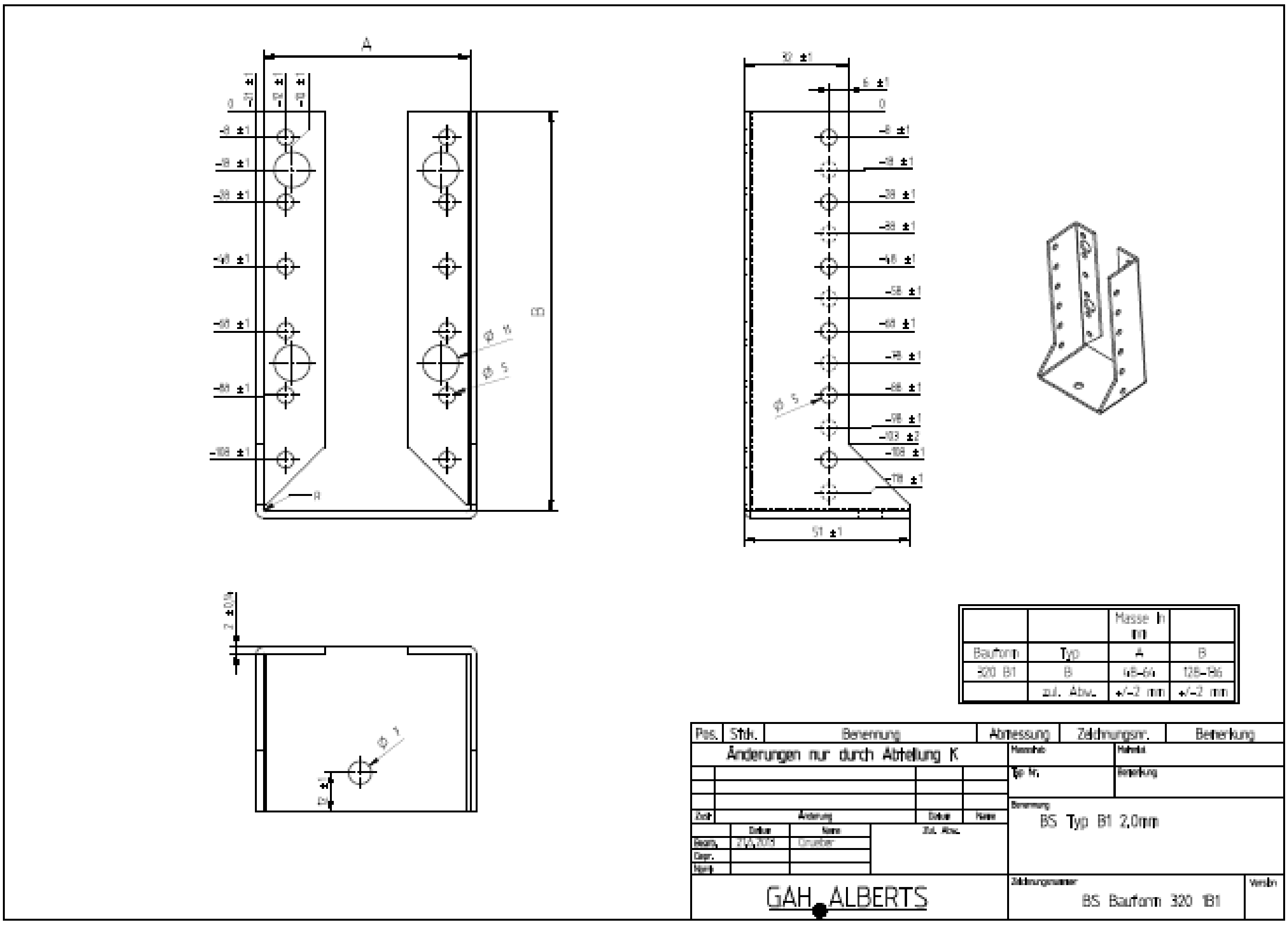
- Partial nailing; Drawing: blank 320;

Blank	Total n° of holes		Width interval		Height interval		A
	n_H	n_J	min	max	min	max	
260	14	8	32	65	98	114	= B + 69
320	18	10	32	80	120	144	= B + 69
380	22	12	60	100	140	160	= B + 69

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

Joist hangers 238 B, 260 B and 320 1B1: Face mount hanger with interior flanges
2.0 mm thick pre-galvanized steel DX51D according to EN 10346:2009 with minimum yield strength R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A80 of 22 % with tolerances according to EN 10143:1993.

Additionally, the joist hanger can be made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 with tolerances according to EN 10143:2006 provided that the yield strength f_y for these steel grades is at least the same as the minimum yield strength of the zinc coated steel normally used for the brackets. The ultimate strength f_u and the ultimate strain A_{80} shall exceed the corresponding minimum values for the zinc coated steel.



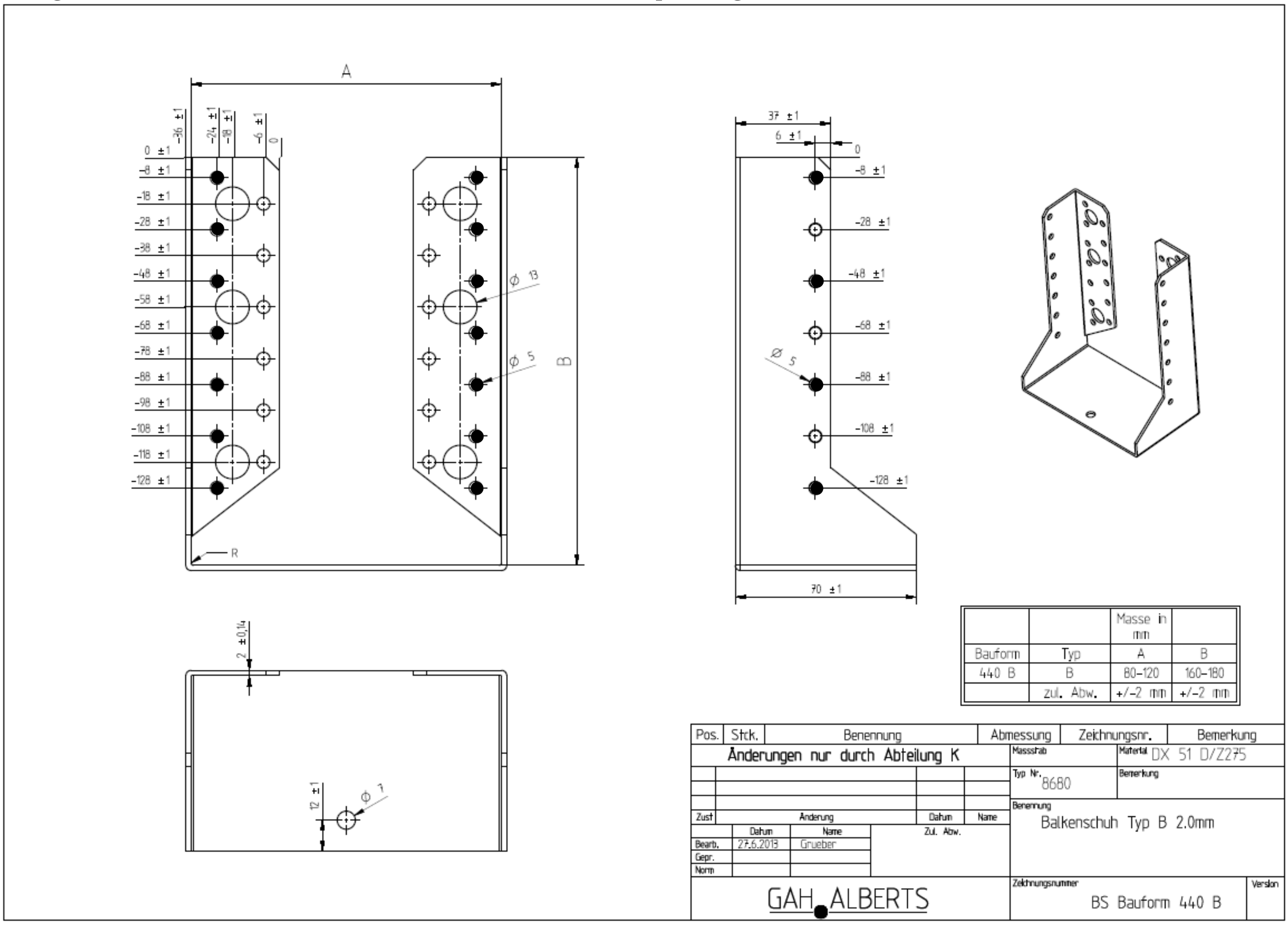
• Partial nailing; Drawing: Blank 320 1B1

Blank	Total n° of nail holes		Width interval		Height interval	
	n_H	n_J	min	max	min	max
238	8	8	45	51	93	96
260	8	8	40	64	98	110
320	12	12	48	64	128	136

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

Joist hangers 320 B, 380 B, 440 B and 500 B: Face mount hanger with interior flanges
2.0 mm thick pre-galvanized steel DX51D according to EN 10346:2009 with minimum yield strength R_e of 250 MPa, a minimum tensile strength R_m of 330 MPa and a minimum ultimate strain A80 of 22 % with tolerances according to EN 10143:1993.

Additionally, the joist hanger can be made from stainless steel 1.4016, 1.4301, 1.4401, 1.4541 or 1.4571 according to EN 10088-2:2005 with tolerances according to EN 10143:2006 provided that the yield strength f_y for these steel grades is at least the same as the minimum yield strength of the zinc coated steel normally used for the brackets. The ultimate strength f_u and the ultimate strain A_{80} shall exceed the corresponding minimum values for the zinc coated steel.



• Partial nailing; Drawing: Blank 440

Blank	Total n° of nail holes		Width interval		Height interval	
	n_H	n_J	min	max	min	max
320	18	12	70	80	120	125
380	22	12	70	100	140	155
440	26	14	80	120	160	180
500	30	16	80	140	180	210

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

Fastener types and sizes

NAIL diameter	Length Min – max	Nail type
4.0	40 - 100	Ringed shank nails according to EN 14592

Annex B
Characteristic values of load-carrying-capacities

B.1 Characteristic capacities of timber-to-timber joist hanger connections.

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 fasteners in the joist. The axial force is assumed to act in the centre of gravity of the header connection.

For joist hangers with nail holes, two nailing 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 GAH joist hangers the width of the joist shall be at least the penetration length of the nails.

Joist hangers with inward flaps and fastened with nails in torsionally restrained timber header beams

Force downward toward the bottom plate:

$$F_{Z,Rd} = \min \begin{cases} (n_J + n_p) \cdot F_{v,J,Rd} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rd}}\right)^2 + \left(\dfrac{1}{k_{H,1} \cdot F_{ax,H,Rd}}\right)^2}} \end{cases} \qquad \text{(B.1.1)}$$

Force upward away from the bottom plate:

$$F_{Z,Rd} = \min \begin{cases} n_J \cdot F_{v,J,Rd} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rd}}\right)^2 + \left(\dfrac{1}{k_{H,2} \cdot F_{ax,H,Rd}}\right)^2}} \end{cases} \qquad \text{(B.1.2)}$$

Lateral force:

$$F_{Y,Rd} = \min \begin{cases} \dfrac{n_J \cdot F_{v,J,Rd}}{\sqrt{\left(\dfrac{2 \cdot \sqrt{e_{J,0}^2 + e_{J,90}^2}}{b_J}\right)^2 + \left(\dfrac{F_{v,J,Rd}}{F_{ax,J,Rd}}\right)^2}} \\ \dfrac{F_{v,H,Rd}}{\sqrt{\left(\dfrac{1}{n_H} + \dfrac{e_H}{e_1}\right)^2 + \left(\dfrac{e_H}{e_2}\right)^2}} \end{cases} \qquad \text{(B.1.3)}$$

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_p fictitious number of fastener shear planes to account for the bottom plate (see Table B.1)

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

$F_{ax,Rd}$ Design 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.

$e_{J,90}$ 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
e_2 joist hanger dimension
$k_{H,1}$ form factor
$k_{H,2}$ form factor

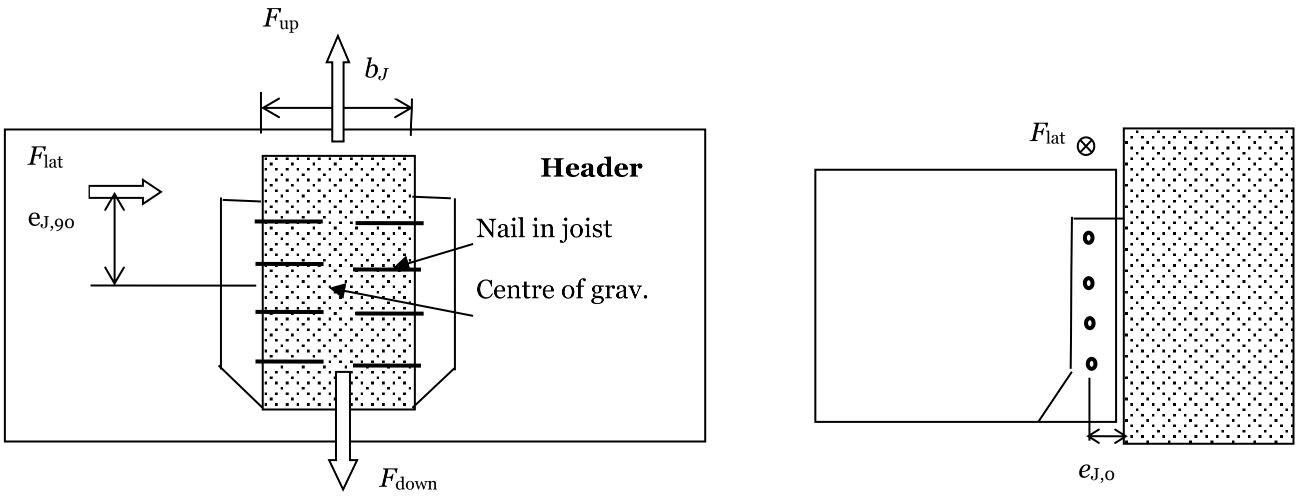


Figure B.1: Definition of $e_{J,90}$ and $e_{J,0}$

Table B.1: Number n_p of additional nails in equation B.1.1

Joist hanger GAH	Bottom plate length ℓ [mm]	n_p
238 B, 260 B, 320 1B1	51	3
260 A, 320 A, 380 A, 440 A, 500 A	70	4
320 B, 380 B, 440 B, 500 B	70	4

Combined forces

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

$$\left(\frac{F_{Y,Ed}}{F_{Y,Rd}}\right)^2 + \left(\frac{F_{Z,Ed}}{F_{Z,Rd}}\right)^2 \leq 1 \qquad \text{(B.1.4)}$$

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

Table C1: Joist hanger 440 A with exterior flanges:
Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2; $e_{J,0}$ = 31 mm

B [mm]	H [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]	n_H	n_J	$k_{H,1}$	$k_{H,2}$	e_1 [mm]	e_2 [mm]
		Full nailing						Partial nailing					
76	182	26	14	62,5	34,9	2065	1849	14	8	34,2	19,6	934	1143
78	181	26	14	61,8	34,9	2115	1866	14	8	33,8	19,6	957	1148
80	180	26	14	61,1	34,9	2166	1883	14	8	33,5	19,6	980	1153
82	179	26	14	60,4	34,9	2218	1901	14	8	33,1	19,6	1004	1159
84	178	26	14	59,8	34,9	2270	1919	14	8	32,7	19,6	1029	1165
86	177	26	14	59,1	34,9	2324	1937	14	8	32,4	19,6	1054	1171
88	176	26	14	58,4	34,9	2378	1955	14	8	32,0	19,6	1079	1177
90	175	26	14	57,7	34,9	2434	1973	14	8	31,7	19,6	1105	1184
92	174	26	14	57,1	34,9	2490	1992	14	8	31,3	19,6	1131	1191
94	173	26	14	56,4	34,9	2547	2011	14	8	31,0	19,6	1158	1198
96	172	26	14	55,7	34,9	2605	2030	14	8	30,6	19,6	1186	1206
98	171	26	14	55,1	34,9	2663	2049	14	8	30,3	19,6	1213	1213
100	170	26	14	54,4	34,9	2723	2068	14	8	29,9	19,6	1242	1221
102	169	26	14	53,8	34,9	2784	2088	14	8	29,6	19,6	1270	1229
104	168	26	14	53,1	34,9	2845	2107	14	8	29,2	19,6	1299	1238
106	167	26	14	52,5	34,9	2907	2127	14	8	28,9	19,6	1329	1246
108	166	26	14	51,8	34,9	2970	2147	14	8	28,5	19,6	1359	1255
110	165	26	14	51,2	34,9	3034	2167	14	8	28,2	19,6	1390	1263
112	164	26	14	50,5	34,9	3099	2188	14	8	27,8	19,6	1421	1272
114	163	26	14	49,9	34,9	3165	2208	14	8	27,5	19,6	1452	1281
116	162	26	14	49,3	34,9	3231	2229	14	8	27,1	19,6	1484	1291
118	161	26	14	48,6	34,9	3299	2249	14	8	26,8	19,6	1517	1300
120	160	26	14	48,0	34,9	3367	2270	14	8	26,5	19,6	1550	1309

Table C1 (contd.): Joist hanger 500 A with exterior flanges:
Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2; $e_{J,0}$ = 31 mm

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**
		Full nailing						Partial nailing					
100	200	30	16	76,6	46,8	2899	2568	16	8	41,5	25,8	1331	1527
102	199	30	16	75,9	46,8	2959	2589	16	8	41,1	25,8	1359	1534
104	198	30	16	75,1	46,8	3019	2609	16	8	40,7	25,8	1387	1541
106	197	30	16	74,3	46,8	3081	2630	16	8	40,3	25,8	1416	1549
108	196	30	16	73,6	46,8	3144	2651	16	8	39,9	25,8	1446	1557
110	195	30	16	72,8	46,8	3207	2672	16	8	39,5	25,8	1476	1565
112	194	30	16	72,0	46,8	3271	2694	16	8	39,1	25,8	1506	1573
114	193	30	16	71,3	46,8	3336	2715	16	8	38,7	25,8	1537	1582
116	192	30	16	70,5	46,8	3402	2737	16	8	38,3	25,8	1568	1591
118	191	30	16	69,8	46,8	3469	2759	16	8	37,9	25,8	1600	1600
120	190	30	16	69,0	46,8	3536	2781	16	8	37,5	25,8	1632	1609
122	189	30	16	68,3	46,8	3605	2804	16	8	37,1	25,8	1665	1619
124	188	30	16	67,6	46,8	3674	2826	16	8	36,7	25,8	1698	1628
126	187	30	16	66,8	46,8	3744	2849	16	8	36,3	25,8	1732	1638
128	186	30	16	66,1	46,8	3816	2872	16	8	36,0	25,8	1766	1648
130	185	30	16	65,3	46,8	3887	2895	16	8	35,6	25,8	1800	1658
132	184	30	16	64,6	46,8	3960	2918	16	8	35,2	25,8	1835	1668
134	183	30	16	63,9	46,8	4034	2941	16	8	34,8	25,8	1871	1679
136	182	30	16	63,2	46,8	4108	2965	16	8	34,4	25,8	1907	1689
138	181	30	16	62,4	46,8	4184	2988	16	8	34,0	25,8	1943	1700
140	180	30	16	61,7	46,8	4260	3012	16	8	33,7	25,8	1980	1711

Table C2: Joist hanger 440 B with interior flanges:
Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2; $e_{J,0}$ = 31 mm

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**
		Full nailing						Partial nailing					
80	180	26	14	61,1	34,9	827	1711	14	8	33,5	19,6	570	1178
82	179	26	14	60,4	34,9	845	1691	14	8	33,1	19,6	583	1167
84	178	26	14	59,8	34,9	865	1674	14	8	32,7	19,6	598	1157
86	177	26	14	59,1	34,9	885	1659	14	8	32,4	19,6	612	1148
88	176	26	14	58,4	34,9	906	1647	14	8	32,0	19,6	627	1141
90	175	26	14	57,7	34,9	928	1637	14	8	31,7	19,6	643	1135
92	174	26	14	57,1	34,9	950	1629	14	8	31,3	19,6	659	1130
94	173	26	14	56,4	34,9	974	1623	14	8	31,0	19,6	676	1126
96	172	26	14	55,7	34,9	998	1619	14	8	30,6	19,6	693	1123
98	171	26	14	55,1	34,9	1024	1616	14	8	30,3	19,6	710	1121
100	170	26	14	54,4	34,9	1050	1615	14	8	29,9	19,6	728	1120
102	169	26	14	53,8	34,9	1077	1615	14	8	29,6	19,6	747	1120
104	168	26	14	53,1	34,9	1105	1617	14	8	29,2	19,6	766	1120
106	167	26	14	52,5	34,9	1133	1619	14	8	28,9	19,6	785	1121
108	166	26	14	51,8	34,9	1163	1623	14	8	28,5	19,6	805	1123
110	165	26	14	51,2	34,9	1194	1628	14	8	28,2	19,6	825	1125
112	164	26	14	50,5	34,9	1225	1633	14	8	27,8	19,6	846	1128
114	163	26	14	49,9	34,9	1257	1640	14	8	27,5	19,6	867	1131
116	162	26	14	49,3	34,9	1290	1647	14	8	27,1	19,6	889	1135
118	161	26	14	48,6	34,9	1324	1655	14	8	26,8	19,6	911	1139
120	160	26	14	48,0	34,9	1359	1664	14	8	26,5	19,6	934	1143

Table C2 (cont.): Joist hanger 500 B with interior flanges:
Form factors $k_{H,1}$ and $k_{H,2}$ and dimensions e_1, e_2; $e_{J,0}$ = 31 mm

B [mm]	**H [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**	**n_H**	**n_J**	**$k_{H,1}$**	**$k_{H,2}$**	**e_1 [mm]**	**e_2 [mm]**
		Full nailing						Partial nailing					
80	210	30	16	84,4	46,8	1016	2453	16	8	45,7	25,8	672	1623
82	209	30	16	83,6	46,8	1035	2414	16	8	45,2	25,8	686	1600
84	208	30	16	82,9	46,8	1053	2379	16	8	44,8	25,8	700	1580
86	207	30	16	82,1	46,8	1073	2348	16	8	44,4	25,8	714	1562
88	206	30	16	81,3	46,8	1094	2320	16	8	44,0	25,8	729	1546
90	205	30	16	80,5	46,8	1115	2296	16	8	43,6	25,8	744	1532
92	204	30	16	79,7	46,8	1138	2276	16	8	43,2	25,8	760	1520
94	203	30	16	78,9	46,8	1161	2258	16	8	42,8	25,8	776	1509
96	202	30	16	78,2	46,8	1185	2242	16	8	42,3	25,8	793	1500
98	201	30	16	77,4	46,8	1210	2229	16	8	41,9	25,8	810	1492
100	200	30	16	76,6	46,8	1236	2218	16	8	41,5	25,8	828	1486
102	199	30	16	75,9	46,8	1263	2209	16	8	41,1	25,8	846	1480
104	198	30	16	75,1	46,8	1290	2202	16	8	40,7	25,8	864	1476
106	197	30	16	74,3	46,8	1318	2197	16	8	40,3	25,8	883	1472
108	196	30	16	73,6	46,8	1348	2194	16	8	39,9	25,8	903	1469
110	195	30	16	72,8	46,8	1378	2192	16	8	39,5	25,8	923	1468
112	194	30	16	72,0	46,8	1409	2191	16	8	39,1	25,8	943	1467
114	193	30	16	71,3	46,8	1440	2192	16	8	38,7	25,8	964	1466
116	192	30	16	70,5	46,8	1473	2194	16	8	38,3	25,8	985	1467
118	191	30	16	69,8	46,8	1507	2197	16	8	37,9	25,8	1007	1468
120	190	30	16	69,0	46,8	1541	2201	16	8	37,5	25,8	1029	1470
122	189	30	16	68,3	46,8	1576	2207	16	8	37,1	25,8	1051	1472
124	188	30	16	67,6	46,8	1612	2213	16	8	36,7	25,8	1075	1475
126	187	30	16	66,8	46,8	1649	2220	16	8	36,3	25,8	1098	1478
128	186	30	16	66,1	46,8	1687	2228	16	8	36,0	25,8	1122	1482
130	185	30	16	65,3	46,8	1726	2237	16	8	35,6	25,8	1147	1486
132	184	30	16	64,6	46,8	1765	2247	16	8	35,2	25,8	1171	1491
134	183	30	16	63,9	46,8	1806	2257	16	8	34,8	25,8	1197	1496
136	182	30	16	63,2	46,8	1847	2268	16	8	34,4	25,8	1223	1501
138	181	30	16	62,4	46,8	1889	2280	16	8	34,0	25,8	1249	1507
140	180	30	16	61,7	46,8	1932	2292	16	8	33,7	25,8	1276	1513