ETA-Danmark A/S
Kollegievej 6
DK-2920 Charlottenlund
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet www.etadanmark.dk

Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

MEMBER OF EOTA

European Technical Approval ETA-13/0757

Trade name:	BB Joist Bearings
Holder of approval:	BB Stanz- und Umformtechnik Nordhäuser Str. 42 D-06536 Berga Tel. +49 34651 2988 0 Fax +49 34651 2988 20 Internet www.bb-berga.de
Generic type and use of construction product:	Three-dimensional nailing plate (concealed beam hangers)
Valid from: to:	2013-06-12 2018-06-12
Manufacturing plant:	BB Stanz- und Umformtechnik Nordhäuser Str. 42 D-06536 Berga
This European Technical Approval contains:	13 pages including 3 annexes which form an integral part of the document

I LEGAL BASIS AND GENERAL CONDITIONS

1 This European Technical Approval is issued by ETA-Danmark A/S in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1)], as amended by Council Directive 93/68/EEC of 22 July 1993[2)].

- Bekendtgørelse 559 af 27-06-1994 (afløser bekendtgørelse 480 af 25-06-1991) om ikrafttræden af EF direktiv af 21. december 1988 om indbyrdes tilnærmelse af medlemsstaternes love og administrative bestemmelser om byggevarer.

- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[3)].

- EOTA Guideline ETAG 015 *Three-dimensional nailing plates,* September 2002 edition.

2 ETA-Danmark A/S is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

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6 This European Technical Approval is issued by ETA-Danmark A/S in English.
This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1) Official Journal of the European Communities N° L40, 11 Feb 1989, p 12.
2) Official Journal of the European Communities N° L220, 30 Aug 1993, p 1.
3) Official Journal of the European Communities N° L 17, 20 Jan 1994, p 34.

II SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

Definition of the product
BB joist bearings are one-piece, face-fixed joist bearings to be used in timber to timber or timber to concrete or steel connections.

The joist bearings are made from aluminium alloy EN AW-6005A or EN AW-6060 according to EN 573-3:2007 with minimum yield strength R_{eH} = 260 N/mm². Dimensions, hole positions, aluminium alloy and typical installations are shown in Annexes A and C.

Intended use
The joist bearings 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 as well as connections between a timber joist and a concrete structure or a steel member, where requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106/EEC shall be fulfilled.

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

- Structural solid softwood timber according to EN 338 / EN 14081,
- Glulam according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Cross laminated timber.

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 bearings. 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 bearing connection are F_{up} or F_{down} or $F_{horizontal}$ perpendicular to the header axis. The forces F_{up} and F_{down} shall act in the symmetry plane of the joist bearing, the force $F_{horizontal}$ perpendicular to the symmetry plane. It is assumed that the forces are acting with an eccentricity e with regard to the side grain surface of the header.

It is assumed that the header beam is prevented from rotating. If the header beam only has installed a joist bearing on one side the eccentricity moment $M_v = F_d \cdot (B_H / 2 + e)$ shall be considered. The same applies when the header has joist bearing connections on both sides, but with vertical forces which differ more than 20%.

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

The aluminium bearings 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).

Assumed working life
The assumed intended working life of the joist bearings for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

The information on the working life should not be regarded as a guarantee provided by the manufacturer or ETA Danmark. An “assumed intended working life” means that it is expected that, when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

2 Characteristics of product and assessment

ETAG paragraph	Characteristic		Assessment of characteristic
	2.1	**Mechanical resistance and stability*)**	
6.1.1		Characteristic load-carrying capacity	See Annex B
6.1.2		Stiffness	No performance determined
6.1.3		Ductility in cyclic testing	No performance determined
	2.2	**Safety in case of fire**	
6.2.1		Reaction to fire	The joist bearings 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
	2.3	**Hygiene, health and the environment**	
6.3.1		Influence on air quality	No dangerous materials **)
	2.4	**Safety in use**	Not relevant
	2.5	**Protection against noise**	Not relevant
	2.6	**Energy economy and heat retention**	Not relevant
	2.7	**Related aspects of serviceability**	
6.7.1		Durability	The joist bearings 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
6.7.2		Serviceability	
6.7.3		Identification	See Annex A

*) See page 5 of this ETA

**) In accordance with http://europa.eu.int-/comm/enterprise/construction/internal/dangsub/dangmain.htm In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Safety principles and partial factors
The characteristic load-carrying capacities are based on the characteristic values of the connections with metal fasteners, the steel plates and the timber post.

In the case of timber failure or failure of the metal fasteners, the design values shall be calculated according to EN 1995-1-1 by dividing the characteristic values of the load-carrying capacities by different partial factors for the strength properties, and in addition multiplied with the coefficient k_{mod}.

In the case of steel failure, the design value shall be calculated according to EN 1993-1-1 by reducing the characteristic values of the load-carrying capacity with different partial factors.

The design value of the load-carrying capacity is the smaller value of all load-carrying capacities:

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

Therefore, for timber failure or failure of the metal fasteners the load duration class and the service class are included. The different partial factors γ_M for steel or timber failure, respectively, are also correctly taken into account.

2.1 Mechanical resistance and stability
See annex B for characteristic load-carrying capacities of the joist bearings.

The characteristic capacities of the joist bearings are determined by calculation as described in the EOTA Guideline 015 clause 5.1.1. 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 9 in Annex A:

- *Threaded nails (ringed shank nails), bolts and dowels in accordance with EN 14592*
- *Metal anchors in accordance with an ETA based on ETAG 001*

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 fastener load-carrying-capacity.

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.

2.7 Related aspects of serviceability

2.7.1 Corrosion protection in service class 1, 2 and 3.
In accordance with ETAG 015 the aluminium joist bearings are produced from aluminium alloys EN AW-6005A or EN AW-6060 according to EN 573-3:2007

3 Attestation of Conformity and CE marking

3.1 Attestation of Conformity system

The system of attestation of conformity is 2+ described in Council Directive 89/106/EEC (Construction Products Directive) Annex III.

a) Tasks for the manufacturer:

(1) Factory production control,
(2) Initial type testing of the product,

b) Tasks for the notified body:

(1) Initial inspection of the factory and the factory production control,
(2) Continuous surveillance

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan[4]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of materials, such as sheet metal, shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. chemical composition, mechanical properties and zinc coating thickness.

The manufactured components are checked visually and for dimensions.

The control plan, which is part of the technical documentation of this European Technical Approval, includes details of the extent, nature and frequency of testing and controls to be performed within the factory production control and has been agreed between the approval holder and ETA Danmark.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- Designation of the product, basic material and components;
- Type of control or testing;
- Date of manufacture of the product and date of testing of the product or basic material and components;
- Result of control and testing and, if appropriate, comparison with requirements;
- Signature of person responsible for factory production control.

The records shall be presented to ETA Danmark on request.

3.2.1.1 Initial type testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type testing has to be agreed between ETA Danmark and the notified body.

3.2.2. Tasks of notified bodies

3.2.2.1 Initial inspection of the factory and the factory production control

The approved body should ascertain that, in accordance with the control plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the post bases with the specifications given in part 2.

3.2.2.2 Continuous surveillance

The approved body shall visit the factory at least twice a year for routine inspections. It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the control plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body to ETA Danmark. Where the provisions of the European Technical Approval and the control plan are no longer fulfilled, the certificate

4 The control plan has been deposited at ETA-Danmark and is only made available to the approved bodies involved in the conformity attestation procedure.

of conformity shall be withdrawn by the approved body.

3.3 CE marking

The CE marking shall be affixed on each packaging of post bases. The initials "CE" shall be followed by the identification number of the notified body and shall be accompanied by the following information:

- Name or identifying mark of the manufacturer
- The last two digits of the year in which the marking was affixed
- Number of the European Technical Approval
- Name and size of product
- Number of the ETA Guideline (ETAG no. 015)
- Number of the EC Certificate of Conformity

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

BB joist bearings are manufactured in accordance with the provisions of this European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

4.2 Installation

Joist bearing connections

A joist bearing 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 bearing.

  If the header carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist}$ (b_{header}/2+86mm) shall be considered for the strength verification of the header.

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

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

Wood to wood connections

- Joist bearings are fastened to wood-based headers by nails and to wood-based joists by dowels.
- There shall be nails and dowels in all holes.
- The characteristic capacity of the joist bearing connection is calculated according to the manufacturer's technical documentation, dated 2013-02-11.
- The joist bearing 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 bearings the gap between the surface of the flaps and the end of the joist shall be maximum 8 mm.
- The groove in the joist and the surface of the header shall have a plane surface against the whole joist bearing.
- The depth of the joist shall be so large that the top (bottom) of the joist is at least $a_{4,t}$ above (below) the upper (lower) dowel in the joist.
- Nails to be used shall have a diameter and head shape, which fits the holes of the joist bearings.

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 bearing.

- The joist bearing connection is designed in accordance with Eurocodes 2, 3, 5 or 9 or an appropriate national code.
- The joist bearing 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 end grain surface of the joist and that of the concrete or steel shall be maximum 27 mm.
- The bolt or metal anchor shall have a diameter not less than the hole diameter minus 2 mm.
- The bolts or metal anchors 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.

4.3 Maintenance and repair

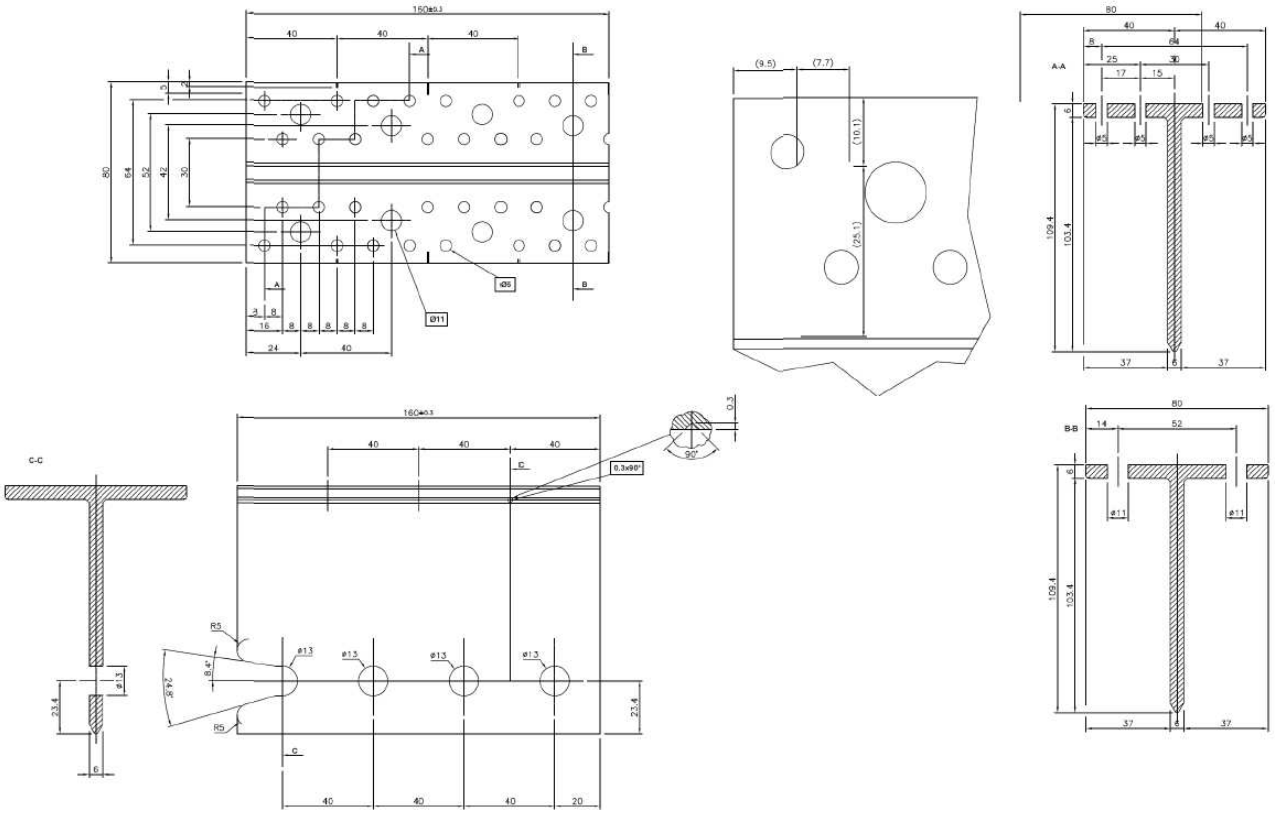
Maintenance is not required during the assumed intended working life. Should repair prove necessary, it is normal to replace the joist bearing.

Thomas Bruun
Manager, ETA-Danmark

Annex A
Product details and definitions

BB Joist bearing

Face mount hanger with flanges with or without pre-punched holes for the joist connection. 6.0 mm thick aluminium alloy EN AW 6005A according to EN 573-3:2007 or EN AW-6060 according to EN 573-3:2007 with minimum yield strength R_{eH} = 260 N/mm².



Drawing: BB Joist bearing 160 with pre-punched holes for the joist connection

Joist bearing	N° of nail holes		N° of dowel holes		N° of anchor/bolt holes	
	N°	d	N°	d	N°	d
120	22	5	3	13	6	11
160	30	5	4	13	8	11
200	38	5	5	13	10	11
240	46	5	6	13	12	11
280	54	5	7	13	14	11
320	62	5	8	13	16	11
360	70	5	9	13	18	11

For joist bearings without pre-punched holes, the distance of the centroid of the joist connection from the header surface must not exceed 86 mm.

Fastener types and sizes

NAIL diameter	Length	Nail type
4.0	50 - 100	Ringed shank nails according 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. The load bearing capacities of the joist bearings have been determined based on the use of connector nails 4,0 x L 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, paragraph 8.3.2 (head pull-through is not relevant):

$F_{ax,Rk} = f_{1,k} \times d \times t_{pen}$

Where:

$f_{1,k}$ Characteristic value of the withdrawal parameter in N/mm^2

d Nail diameter in mm

t_{pen} Penetration depth of the profiled shank in mm

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

$f_{1,k} = 50 \times 10^{-6} \times \rho_k^2$

Where:

ρ_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.

BOLTS, METAL ANCHORS or DOWELS diameter	Corresponding hole diameter in aluminium plate	Fastener type
10.0	Max. 1 mm larger than the bolt or dowel diameter	Bolts or dowels according to EN 14592, metal anchors according to manufacturer's specification
12.0		

Annex B
Characteristic values of load-carrying-capacities

The downward, upward or horizontally directed forces are assumed to act in the middle of the joist.

Only a full nailing pattern is specified, where there are nails in all the holes of the header connection. Also dowels are placed in all the dowel holes in the joist. For header connections with bolts or metal anchors, there must always be at least bolts or metal anchors in the two upper two holes for loading DOWN or in the two lower holes for loading UP.

B.1 Joist bearings fastened with nails and dowels in pre-punched holes for loading DOWN or UP

$$F_{Z,Rk} = \min \left\{ \begin{array}{l} n_{J,ef} \cdot F_{v,J,Rk} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{1}{k_H \cdot F_{ax,H,Rk}}\right)^2}} \end{array} \right. \qquad \text{(B.1)}$$

$n_{J,ef}$ effective number of dowels in the joist, see Table B.1;

n_H total number of nails in the side of the header;

$F_{v,J,Rk}$ Characteristic lateral load-carrying capacity of a dowel with two shear planes in the joist;

$F_{v,H,Rk}$ Characteristic lateral load-carrying capacity of a nail or screw in single shear in the header assuming a thick plate;

$F_{ax,H,Rk}$ Characteristic axial load-carrying capacity of a nail or screw in the header;

k_H form factor, see Table B.1;

Table B.1: BB joist bearings: Form factors k_H and effective number of dowels $n_{J,ef}$

BB Joist bearing	n_J	n_H	k_H	$n_{J,ef}$	k_H	$n_{J,ef}$
			Loading DOWN		Loading UP	
120	3	22	17,4	2,89	13,4	1,92
160	4	30	32,6	3,85	25,5	2,89
200	5	38	52,5	4,81	41,5	3,85
240	6	46	77,2	5,77	61,4	4,81
280	7	54	106,5	6,74	85,2	5,77
320	8	62	140,7	7,70	112,8	6,74
360	9	70	179,6	8,66	144,3	7,70

B.2 Joist bearings fastened with bolts or metal anchors and dowels in pre-punched holes for loading DOWN or UP

$$F_{Z,Rk} = \min \left\{ \begin{array}{l} n_{J,ef} \cdot F_{v,J,Rk} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{e \cdot z_{max}}{I_{p,H,ax} \cdot F_{ax,H,Rk}}\right)^2}} \end{array} \right. \qquad \text{(B.2)}$$

n_H Number of bolts or metal anchors in the header connection; there must always be at least bolts or metal anchors in the two upper to holes for loading DOWN or in the two lower holes for loading UP;

e Distance between the centroid of the joist connection and the header surface;

z_{max} Distance between the uppermost bolt or metal anchor and the lower end of the joist bearing for loading DOWN or distance between the lowermost bolt or metal anchor and the upper end of the joist bearing for loading UP;

$I_{p,H,ax}$ Polar moment of inertia of the header fasteners where the centre of rotation may be assumed at the lower or upper end of the joist bearing;

$F_{v,H,Rk}$ Characteristic value of the lateral load-carrying-capacity per bolt or metal anchor in the header connection;

$F_{ax,H,Rk}$ Characteristic value of the axial load-carrying-capacity per bolt or metal anchor in the header;

B.3 Joist bearings fastened with nails and dowels in non-pre-punched holes for loading DOWN or UP

$$F_{Z,Rk} = \min \begin{cases} \dfrac{F_{v,J,Rk}}{\sqrt{\left(\dfrac{1}{n_J}\right)^2 + \left(\dfrac{(86-e)\cdot r_{max}}{I_{p,J}}\right)^2}} \\ \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{1}{k_H \cdot F_{ax,H,Rk}}\right)^2}} \end{cases} \qquad \text{(B.3)}$$

n_J total number of dowels in the joist;

n_H total number of nails in the side of the header;

e Distance between the centroid of the joist connection and the header surface, $e \leq 86$ mm;

r_{max} Maximum distance between a dowel and the centroid of the joist connection;

$I_{p,J}$ Polar moment of inertia of the joist dowels;

$F_{v,J,Rk}$ Characteristic lateral load-carrying capacity of a dowel with two shear planes in the joist;

$F_{v,H,Rk}$ Characteristic lateral load-carrying capacity of a nail or screw in single shear in the header assuming a thick plate;

$F_{ax,H,Rk}$ Characteristic axial load-carrying capacity of a nail or screw in the header;

k_H form factor, see Table B.1;

B.4 Joist bearings fastened with nails and dowels in pre-punched holes for loading HORIZONTAL

Table B.1: Load-carrying capacity for loading perpendicular to the symmetry plane and $b \geq 80$ mm

Joist bearing		120	160	200	240	280	320	360
$F_{Y,Rk}$ [kN]	Aluminium:	3.1	4.2	5.2	6.2	7.3	8.3	9.4

Table B.2: Load-carrying capacity for loading perpendicular to the symmetry plane and $b < 80$ mm

Joist bearing		120	160	200	240	280	320	360
$F_{Y,Rk}$ [kN]	Aluminium:	3.1	4.2	5.2	6.2	7.3	8.3	9.4
	Timber:	4.0	5.0	6.0	7.0	8.0	9.0	10.0

B.5 Combined forces

If the forces F_Y and F_Z act at the same time, the following inequality shall be fulfilled:

$$\frac{F_{Y,Ed}}{F_{Y,Rd}} + \frac{F_{Z,Ed}}{F_{Z,Rd}} \leq 1$$

Annex C
Installation of joist bearings