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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-06/0106 of 2020/01/29

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:	Simpson Strong-Tie Angle Brackets See type numbers in section II.1 of the ETA
Product family to which the above construction product belongs:	Three-dimensional nailing plate (timber-to-timber/timber-to-concrete angle bracket)
Manufacturer:	Simpson Strong-Tie Int. Ltd For local branch addresses refer to www.strongtie.eu
Manufacturing plant:	SIMPSON STRONG-TIE Manufacturing facilities
This European Technical Assessment contains:	407 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:	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 2018-12-18

II SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
This ETA covers the following angle bracket types: ABR90, AB90, ABR105, AB105, ABR70, AB70, E20/3, E9/2.5, E9S/2.5, ABR9015, ABR9020, ABR100, AA60280, ABB40390, AE48, AE76, AE116, AG40312, AG40412, AG40314, AG40414, AH9035, AJ60416, AJ80416, AJ99416, ES, LS, TAZ, KNAG, ABR170, ABR220, AB6983, AB36125, BNV33, E5, AT1, E4, E6, E7, E8, E14, E17, E18, E19, ADR6090, ADR6035, ABAI, AG922, ABR10525, ABR7015, ABR7020, ACR, MAXIMUS, AT2, ABR865, ANP, A-bracket, ACFET, ABR98, ABRL98, AB105/513, ABR255, ADD45100, ABDW45100, ADR6090L, ABTR120/180/240, ACW155, AE90-RW, AH9055, CCWR, CCWR, ABGU360, SC2P-V100, SC2P-H180, ABR255SO, AB255HD, AB255SSH, AB3560.

The angle brackets are one piece, non-welded, timber-to-timber angle brackets/timber to support (concrete, steel) angle brackets. They are connected to the timber elements/support by a range of nails, screws or bolts.

The Angle Brackets are made from pre-galvanized steel Grade S250GD + Z275 according to EN 10346 with tolerances according to EN 10143 except if another material is stated. Material, dimensions and nail positions are shown in Annex D and typical installations are shown in Annex B.
All the angle brackets can also be produced from stainless steel number 1.4401, 1.4404, 1.4521, 1.4301 or 1.4509 according to EN 10088-2 or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa.
In the rest of this document, the steel types will be named as:
Steel ref. 1: S250GD + Z275
Steel ref. 2: Stainless Steel 1.4401, 1.4404, 1.4521
Steel ref. 3: Stainless Steel 1.4301, 1.4509
Steel ref. 4: SS Grade 33 + G90 (~Z275) or G185 (~Z600)
Steel ref. 5: S350GD + Z275
Steel ref. 6: S250GD + Z800 or ZM310 or similar coatings acc. to EN 10346, that has been tested to ISO 11997-1 Cyclic Corrosion Testing In artificial Atmosphere.
Steel ref. 7: Similar to steel ref. 6 but S350GD + Z800.

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

The angle brackets are intended for use in making connections in load bearing structures, as a connection between two timber beams or a timber beam and a timber post or between a timber member and a concrete/steel member, 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 connection may be with a single angle bracket or with an angle bracket on each side of the fastened timber member.

The static and kinematic behaviour of the timber members or the supports shall be as described in Annex C.

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a characteristic density from 290 kg/m^3 to 420 kg/m^3.

This requirement to the material of the wood members can be fulfilled by using the following materials:
- Solid timber classified to C14-C40 according to EN 338 / EN 14081
- Glued members of timber classified to C14-C40 according to EN 338 / EN 14081 when structural adhesives are used.
- Glued laminated timber classified to GL24c or better according to EN 1194 / EN 14080.
- Solid Wood Panels, SWP according to EN 13353.
- Laminated Veneer Lumber LVL according to EN 14374
- Laminated Strand Lumber, e.g. Parallam and Timber Strand
- Plywood according to EN 636
- Oriented Strand Board, OSB according to EN 300
- Cross Laminated Timber (CLT) acc. to EN 16351 or ETA

Annex D states the load-carrying capacities of the Angle Bracket connections for a characteristic density of 350 kg/m^3.
For timber or wood-based material with a lower characteristic density than 350 kg/m^3 the load-

carrying capacities shall be reduced by the k_{dens} factor (see Annex C4-2)

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code. The wood members shall have a thickness, which is larger than the penetration depth of the nails into the members

The angle brackets may also be used for connections between a timber member and a member of concrete, steel or masonry.

The angle brackets are primarily for use in timber structures subject to the dry, internal conditions defined by service class 1 and 2 of Eurocode 5 and for connections subject to static or quasi-static loading.

The angle brackets can also be used in outdoor timber structures, service class 3, when a corrosion protection in accordance with Euro Code 5 is applied, or when stainless steel with similar or better characteristic yield and ultimate strength is employed (steel ref. 2, 3 and 6)

The scope of the hangers regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2

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 Characteristics of product and assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex D
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 13501-1 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	The product does not contain/release dangerous substances specified in TR 034, dated March 2012
3.7 Sustainable use of natural resources (BWR7)	Not relevant
3.8 General aspects related to the performance of the product	The angle brackets 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 dry internal conditions defined by service class 1, 2 and 3
Identification	See Annex D

*) See additional information in section 3.9 – 3.12.

3.9 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities have been calculated considering different ratios between the partial factors for timber connections and steel cross sections.

According to clause 6.3.5 of EN 1990 (Eurocode – Basis of structural design) the characteristic resistance for structural members that comprise more than one material acting in association should be calculated as

$$R_d = \frac{1}{\gamma_{M,1}} R\left\{\eta_1 X_{k,1}; \eta_i X_{k,i(i>1)} \frac{\gamma_{m.1}}{\gamma_{m,i}}; a_d\right\}$$

where $\gamma_{M,1}$ is the global partial factor for material 1 (in this case wood), $\gamma_{m,1}$ is the partial factor on the material and $\gamma_{m,i}$ are material partial factors for the other materials, i.e. the calculations are made with material parameters modified by multiplication by

$k_{modi} = \gamma_{m,1} / \gamma_{m,i}$

The characteristic load-carrying capacities have been calculated considering a ratio between the partial factor for timber connections and steel cross sections

$$k_{modi} = 1{,}18 \qquad (EC5: \quad k_{modi} = \frac{1{,}30}{1{,}10} = 1{,}18)$$

For k_{modi}> 1,18 the load-carrying capacities stated in Annex D are valid (on the safe side).
For k_{modi}<1,18 the load-carrying capacities stated in Annex D have to be multiplied by a factor

$$f = \frac{k_{modi}}{1{,}18}$$

3.10 Mechanical resistance and stability

See annex D for characteristic load-carrying capacity in the different directions F_1 to F_5.

The characteristic capacities of the angle brackets 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.

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.

For some Angle Brackets, the performance has been determined in relation to the joint's stiffness properties - to be used for the analysis of the serviceability limit state.

Fasteners

The load bearing capacities of the brackets have been determined based on the use of Connector nails CNA or connector screws CSA in accordance with ETA-04/0013.
It is allowed to use other connector nails or connector screws in accordance with the standard EN 14592 with the same or better performance than the used 4,0 mm CNA Connector nails and still achieve the same load-bearing capacity of the connection.

For some brackets the load bearing capacities have been determined based on the use of bolts or powder actuated pins or wood screws – see Annex C3 for complete list.

For any other information about fasteners or characteristic capacity modification method for different fasteners, please see Annex C4-1.

The angle brackets can be mounted using different nail/screw patterns. The nail/screw patterns for each angle bracket and different connection type is described and shown in annex D.

Stainless steel

All the Angle Brackets can also be produced from stainless steel number 1.4401, 1.4404, 1.4521 (Steel ref. 2) and 1.4301, 1.4509 (Steel ref. 3) according to EN 10088-2 or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa. The characteristic load carrying capacities can be considered as the same as those published in this document subject to the use of stainless CNA connector nails or CSA connector screws covered by the ETA-04/0013 or stainless threaded nails or screws in accordance to the standard EN 14592 respecting the rules given in the paragraph "fasteners" above.

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 shall the angle bracket have a zinc coating weight of Z275. The steel employed is S250 GD with Z275 (Steel ref. 1 or 4) according to EN 10346.

3.11.2 Corrosion protection in service class 3.

In accordance with Eurocode 5 the Angle Brackets shall be produced from stainless steel (Steel ref. 2 or 3).

3.12 General aspects related to the use of the product

Simpson Strong-Tie angle brackets types ABR90, AB90, ABR105, AB105, ABR70, AB70, E20/3, E9/2.5, E9S/2.5, ABR9015, ABR9020, ABR100, AA60280, ABB40390, AE48, AE76, AE116, AG40312, AG40412, AG40314, AG40414, AH9035, AJ60416, AJ80416, AJ99416, ES, LS, TAZ, KNAG, ABR170, ABR220, AB6983, AB36125, BNV33, E5, AT1, E4, E6, E7, E8, E14, E17, E18, E19, ADR6090, ADR6035, ABAI, AG922, ABR10525, ABR7015, ABR7020, ACR, MAXIMUS, AT2, ABR865, ANP, A-bracket, ACFET, ABRL98, AB105/513, ABR255, ADD45100, ABDW45100, ADR6090L, ABTR120/180/240, ACW155, AE90-RW, AH9055, CCWL, CCWR, ABGU360, SC2P-V100, SC2P-H180, ABR255SO, AB255HD, AB255SSH, AB3560 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.

4 Assessment and verification of constancy of performance (AVCP)

4.1 AVCP system

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

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

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

Issued in Copenhagen on 2020-01-29 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A - Revision History

Modifications and additions to the previous ETA-06/0106 valid from 2018/12/18	
Page/chapter	Update
All	Minor typing errors corrected.
192	D31 Add capacities column to rigid support
211	D33 Add capacities column to rigid support
286	D42 Add F4/F5 for E19/3
303	D45 ABAI105 - additional lengths of screws
317	D48 Add ABR7020 – as alternative version of ABR7015 with same capacities
337	D54 Add ANP with thickness of 2mm
352	D58 Add F4 and F5 for ABR255
352	D58 to add capacities for ABR255 with interim layer
391	D66 Add option for connection to timber for SC2P
394	D67 Add ABR255SO
398	D68 Add AB255HD
402	D69 Add AB255SSH
406	D70 Add AB3560

Modifications and additions to the previous ETA-06/0106 valid from 2017-05-24	
Page	Update
All	Minor typing errors corrected.
All	Steel ref. 5+6 introduced (page 5 and product pages)
All	Updates to tables or addition of tables
-	D3, D7, D12, D17, D31, D33, D46, D58 Addition of large screws SS-H
175	D27 Addition of nailing pattern and tables
183-189	D28, 29 & 30 – adjustment to forms
373	D63 Adjustment of drawing, nailing pattern
375	D64 Addition of CCWR & CCWL
379	D65 Addition of ABGU360
382	D66 Addition of SC2P-V100, SC2P-H180

Modifications and additions to the previous ETA-06/0106 valid from 2016-12-16	
Page	Update
All	Revision of layout, 2D drawings exchanged into 3D (simplified models). Minor typing errors corrected. Steel ref. 1-4 introduced (page 5 and Annex D). No load carrying capacities are changed.
84	D10 ABR9015: Addition of value for ABR9015 fire shot on concrete
333	D63 Addition of AE90-RW

Modifications and additions to the previous ETA-06/0106 valid from 2014-10-14	
Page	Update

1	Changing Manufacturing plant
5	II 2: Addition of CLT
15-16	Annex B: Addition of ACFET200, ABTR, ACW155
23	Annex C4-1: Clarification of how to interpolate
77	D8 E9/2,5: Oblong hole changed into 34,0 instead of 33,5
83	D9 E9S/2,5: Oblong hole changed into 34,0 instead of 33,5
90-91	D10 ABR9015: Values with Screws updated.
95-100	D11 ABR9020: Values with Screws updated. Addition of slip modulus
102-106	D12 ABR100: Values with Screws updated. Addition of slip modulus
114-	D15 AE48: New capacities and add. of nail pattern
120-	D16 AE76: New capacities and add of nail pattern
126	D17 AE116: Modification of capacities (add. of one nail pattern) and addition of slip modulus
168	D27 ABR170/220: No of nails in table D27-3 is corrected (typing error)
191-	D33 AT1: Values for (new) Table 33-4 updated
249	D44 ADR6035: CNA changed into Bolt (typing error)
253-255	D46 AG922: Addition of slip modulus
296-297	D56 ABR98: Addition of ABRL98 and addition of values
300	D58 Addition of ABR255
306	D59 Addition of ABD45100 & ABDW45100
309	D60 Addition of ADR6090L
312	D61 Addition of ABTR
317	D62 Addition of ACW155

Modifications and additions to the previous ETA-06/0106 valid from 2013-05-28 to 2018-05-28	
Pages	Update
	Adjustment from “approval” to “assessment”
	Annex C: added the description for using of one angle bracket
	Annex C4: added the possibility for interpolation by interim values
22ff	D1, D2, D3, D4: ABR90, AB90, ABR105, AB105 added capacities for connection to rigid support
52	Table D4-2: AB105 correction e to f , by $R_{1,k}$ for maximum nailing
97	D11: ABR9020, added values for beam-column
101ff	D12: ABR100, added values for nails 4,0x35, added minimum nailing
111ff	Figure D15-3, D16-3, D17-3, Type AE…: washer for force direction F2/3
129ff	D18:modified the values R2/3 for AG40312 and AG40412
148	D24: ES11: modified the drawing for size 40 to 80 and 100 to 200
159ff	D27, ABR170/220: connections/ values also valid for column to beam/rigid support, added values for B<60mmt
164ff	D28, D29, D30: AB6983, AB36125, BNV33, correction of k_{mod} in the formulas, insert as “/k_{mod}” for –values determine by the bolt
249	D47: ABR10525, material S350GD instead of S550DG (typing error)
253	D47: ABR10525 added values for beam-column
272	D51: AT2, long hole modified to 9x17mm (before with 8x16mm)
278ff	D-52 to D57: added ABR865, ACFET200 / ACFET200PP, ANP, A-brackets, ABR98, AB105/513
diverse	Annex: D-7, D-18, D-19, D-31 to D-44, D-51: Addition of bolt-factors

Modifications and additions to the previous ETA-06/0106 valid from 2012-09-07 to 2016-10-13	
Pages	Update
85+88+90	Table D11-3 + D11-5 minimum nailing of ABR9020
86+90	New table D11-6 ABR9020 fastening on steel with PAT pins
242+244	New table D47-3 ABR10525 fastening on steel with PAT pins
91+97	New table D12-7 ABR100 fastening on steel with PAT pins
254+255	Table D49-1 + D49-2 ACR7015/ACR9020/ACR10525 – other load directions
88+243+246+255	R1,k for connections with 2 angle brackets have been changed from calculated values to values based on tests for ABR9020, ABR10525, ABR7015 and ACR

Modifications and additions to the previous ETA-06/0106 valid from 2011-10-13 to 2016-10-13	
Pages	Update
	Table headings updated with “modified characteristic capacities” and old table no. deleted
86+87	Revision of capacity table D11-3 and D11-4 for ABR9020
230	Change measurement B on figure D44-1, ADR6035
237	Addition of ABR10525
241	Addition of ABR7015
244	Addition of ACR
250	Addition of MAXIMUS
254	Addition of AT2

Modifications and additions to the previous ETA-06/0106 valid from 2011-05-25 to 2014-08-12	
Pages	Update
	Merging of ETA-06/0106 + ETA-07/0055 + ETA-07/0194
25	Update of table D1-1 - 2 angle brackets ABR90
27	Update of Ø4.0x40 capacities in table D1-4 for ABR90 for minimum nailing
34	Update of table D2-1 - 2 angle brackets AB90
49	Update of table D4-1 - 2 angle brackets AB105
95	Update of table D12-3 – 2 angle brackets ABR100 with addition of $R_{4/5,k}$ capacities
96	Update of table D12-4 – 1 angle bracket ABR100 with addition of $R_{4,k}$ and $R_{5,k}$ capacities
156	Addition of Fk capacities for ABR170 and ABR220 for timber to concrete connection (table D28-2)
162 - 229	Revision of capacity tables according to ETA-04/0013 for annex D32 to D43
230	Update of capacity tables D44-2 for ADR6090 $R_{1,k}$ for concrete structure
234	Addition of ABAI105
236	Addition of AG922

Modifications and additions to the previous ETA-06/0106 valid from 2009-08-12 to 2014-08-12	
Pages	Update
87	ABR100 nail for use in concrete have been added

Modifications and additions to the previous ETA-06/0106 valid from 2008-10-27 to 2013-10-27	
Pages	Update
6,9	Add of the possible production of the brackets in stainless steel.
13	4.0x35 and 4.2x35 connector nails have been added.
13,16	Angle bracket ABR100 have been added
27	ABR100 nail pattern have been added.
28	The formulas for combined forces have been revised.
75, 76, 79,	F_4 and F_5 have been added for ABR9015 and ABR9020 for screws

80	
77, 78, 81, 82	F1, F2/F3 have been added for ABR9015 and ABR9020 for nails
83, 84, 85, 86	F1, F2/F3 have been added for ABR100 for nails and screws (1 and 2 brackets)

Modifications and additions to the previous ETA-06/0106 valid from 2007-08-22 to 2012-08-22	
Pages	Update
6	The formula for k_{dens} has been changed from the power of 2 to the power of 1
16, 27, 75, 76	Angle Bracket 9015 has been added
16, 27, 77, 78	Angle Bracket 9020 has been added
32-74	Revision of capacity tables according to ETA-04/0013

Annex B - Typical Installation

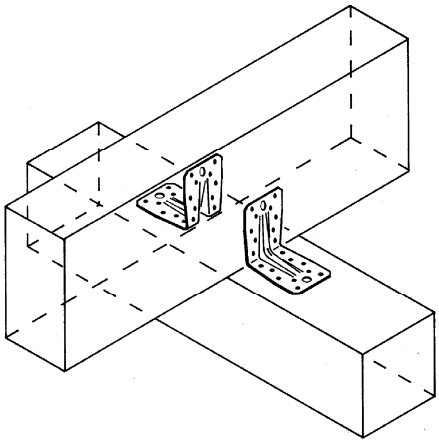


FIGURE B1 - BEAM TO BEAM CONNECTION

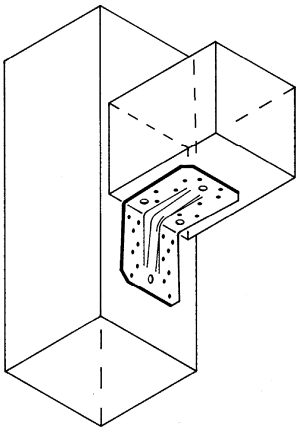


FIGURE B2 - BEAM TO COLUMN CONNECTION

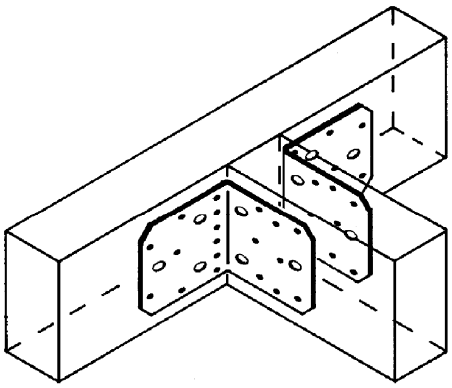
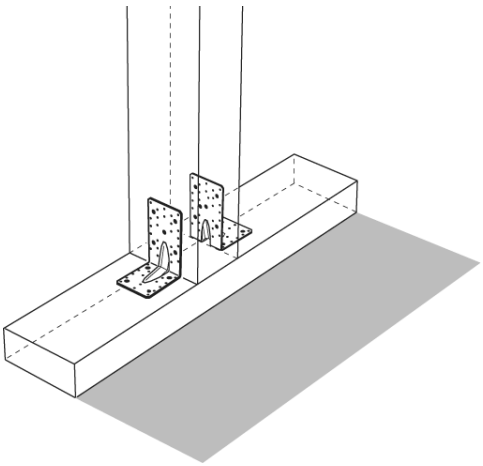


FIGURE B3 - TRIMMER CONNECTION



FIGURER B4 - POST TO BEAM CONNECTION

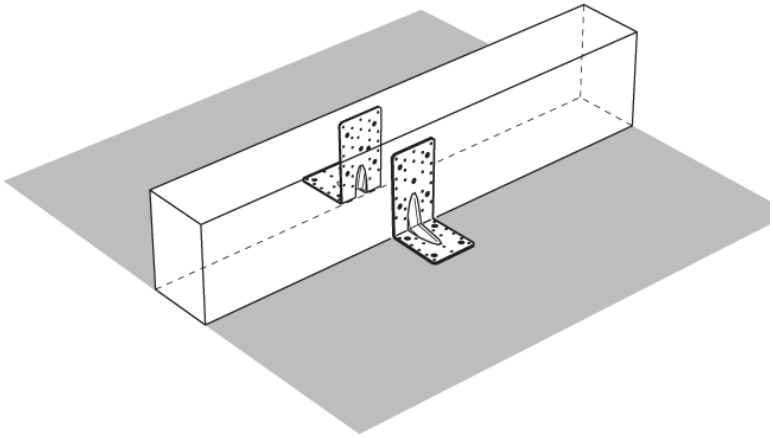


FIGURE B5 - BEAM TO RIGID SUPPORT WITH BOLTS

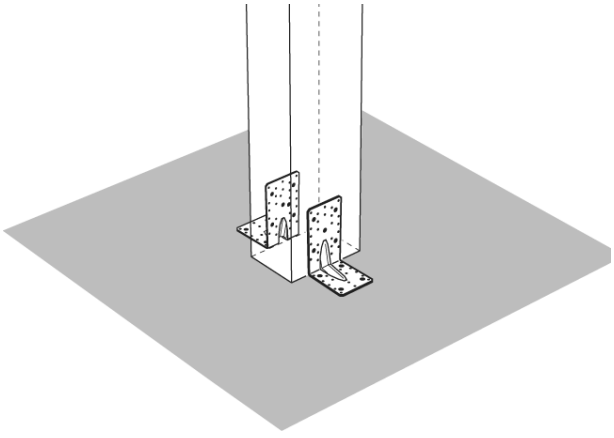
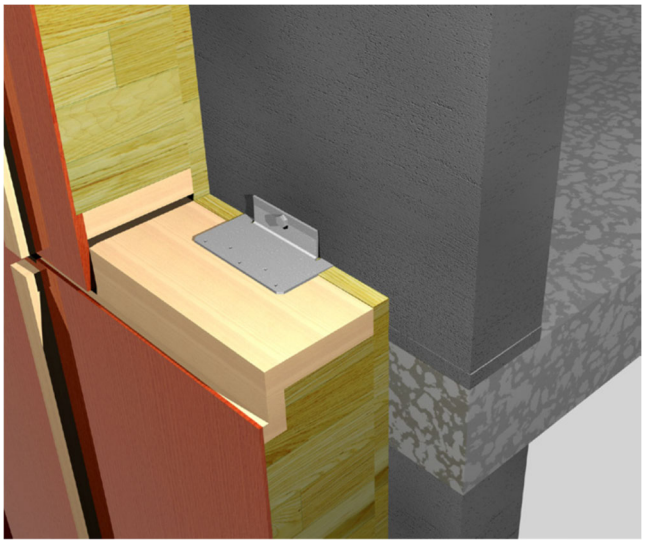
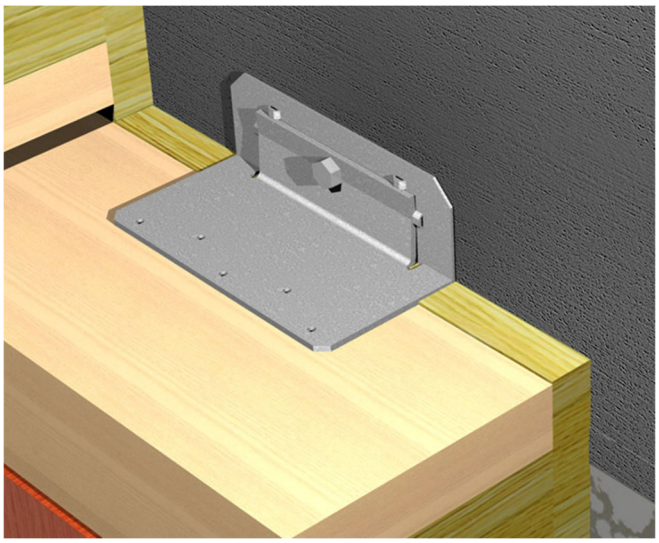


FIGURE B6 - POST TO RIGID SUPPORT WITH BOLTS

Typical installation of ACFET200 & ACFET200PP:

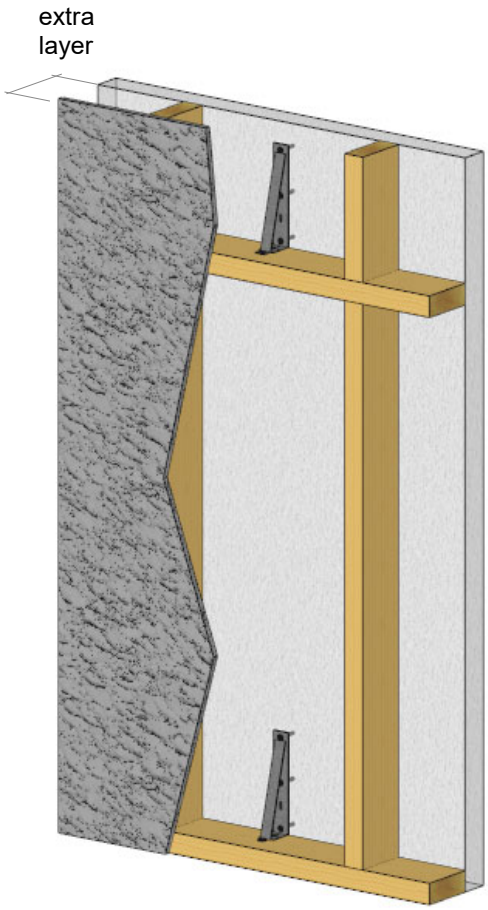


ACFET200 attached on a concrete wall



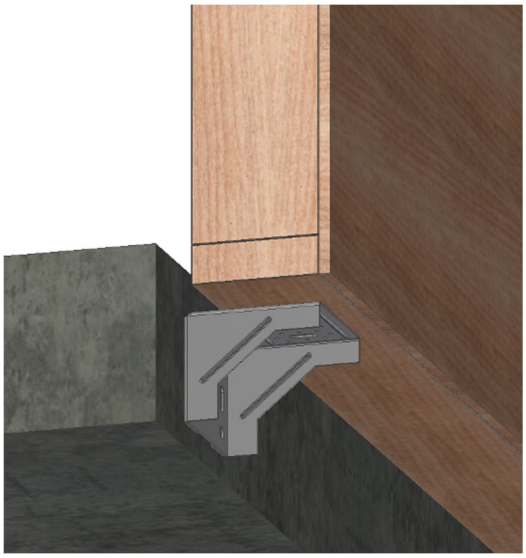
ACFET200PP attached on a Lightweight Aggregate Concrete (LAC) wall

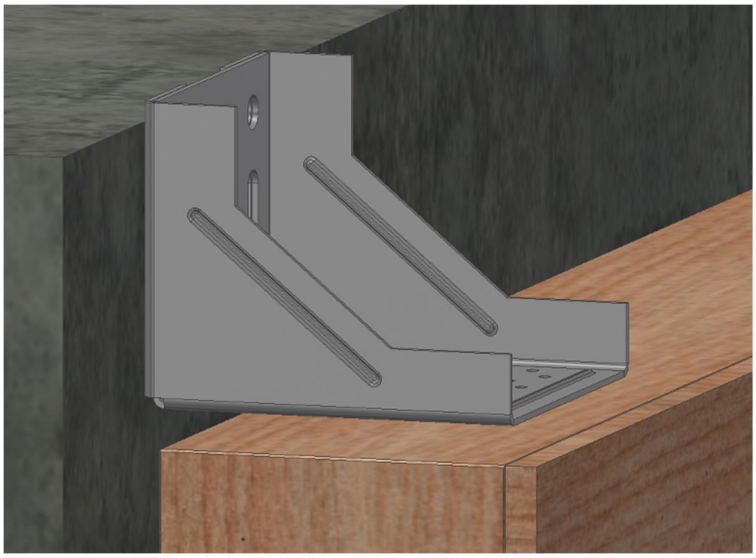
Typical installation of ABTR:



Typical installation of ACW155:

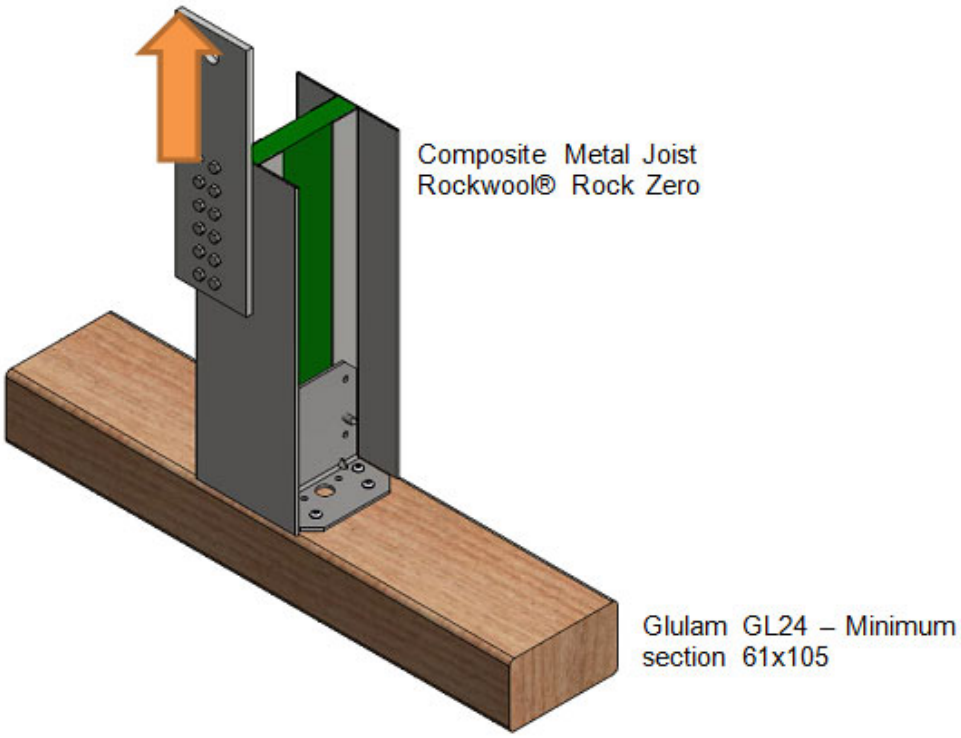
- **on front of concrete floor:**



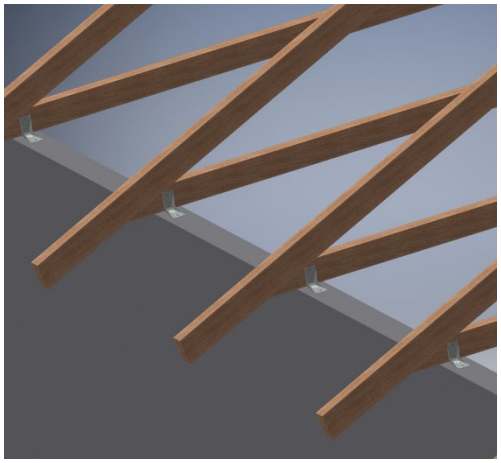


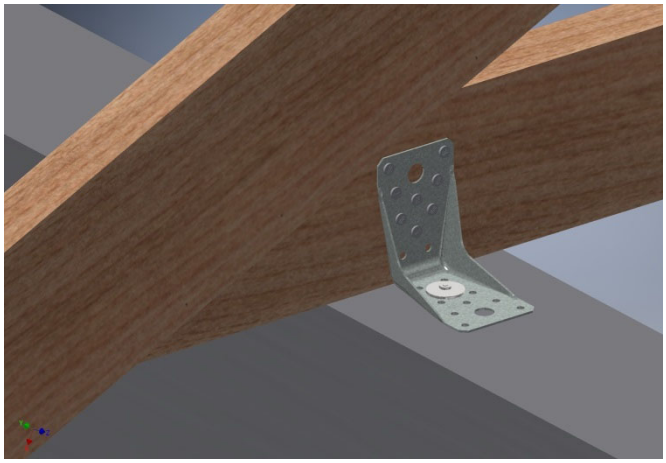
- **on top of concrete floor:**

Typical installation of AE90-RW:



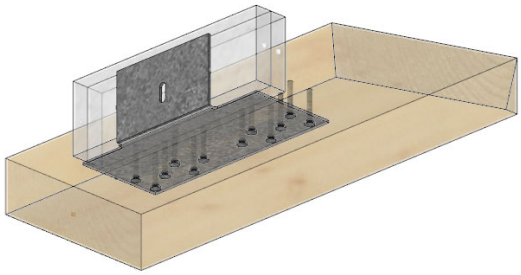
Typical installation of ABR9015 fire shot on concrete:



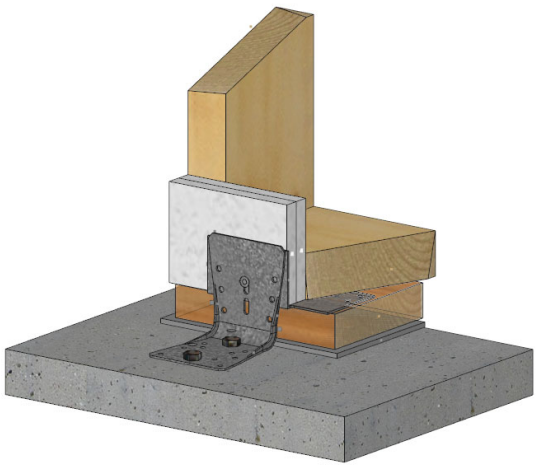


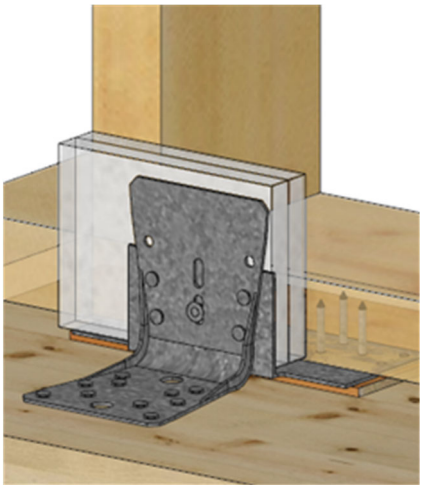
Typical installation of SC2P-H180 & SC2P-V100:

The typical installation of the SC2P is a connection of a wall plate to a concrete floor.

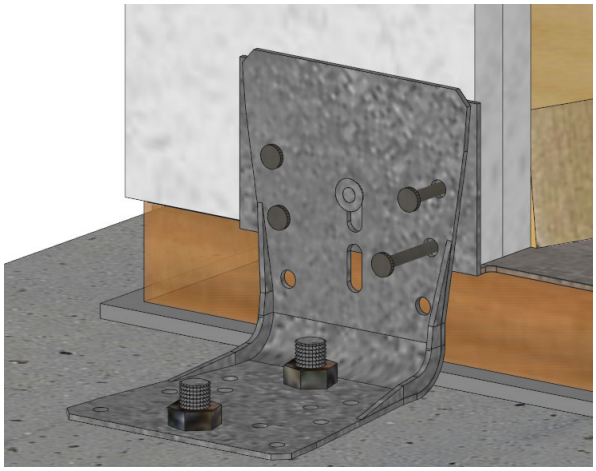


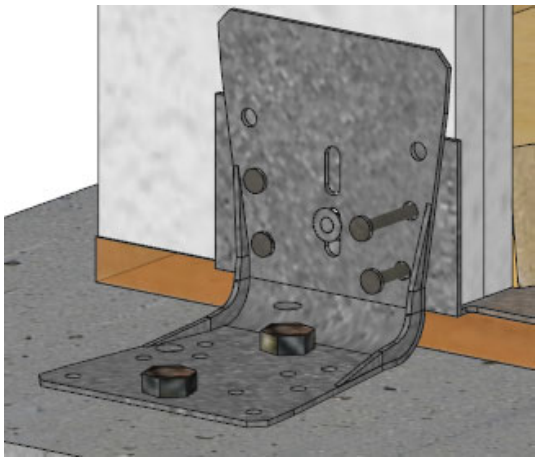
The SC2P-H180 is to fix with 12 CNA4,0x40 on the bottom side of the wall plate.





The SC2P-V100 is fixed with the Ø6mm screw through the oblong holes tothe wall element, and with 1 (or 2) bolt(s) to the floor or with CNA4,0x50.



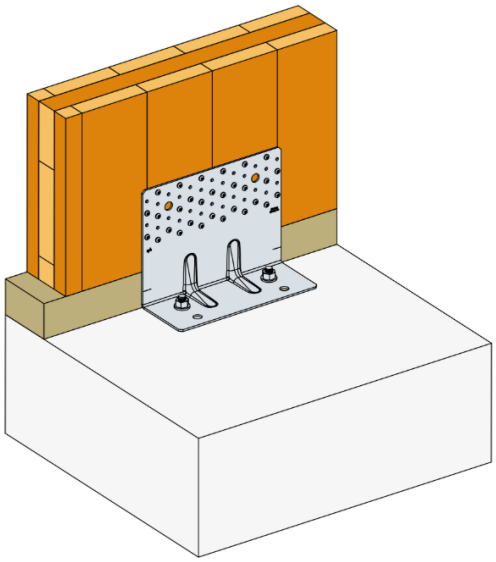


The both part elements are connected with 4 selfdrilling screws

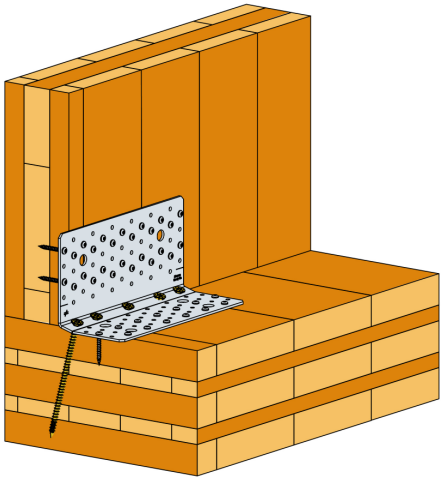
Above are shown all the typical installation. Any other particular installation is described in the Annex D for the specific product.

Typical installation of:

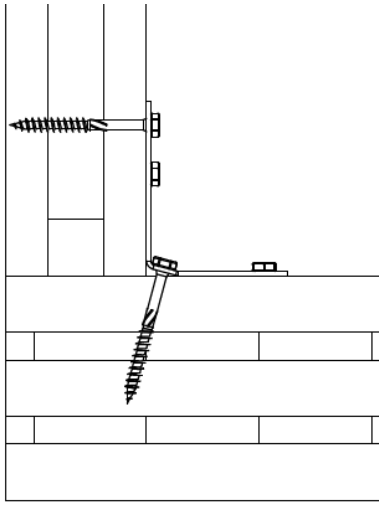
ABR255SO

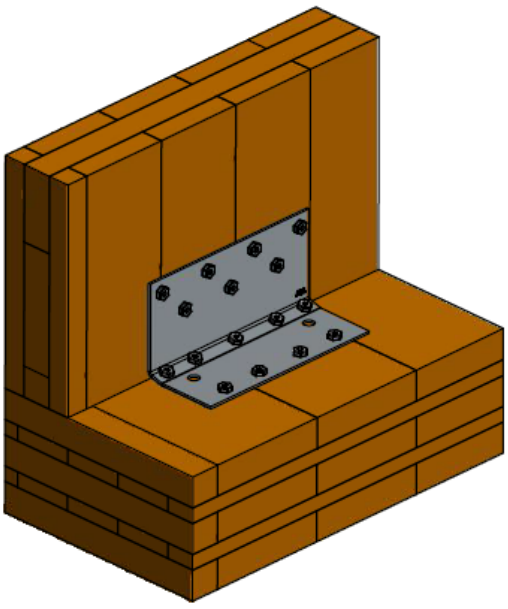


ABR255HD



ABR255SSH





Annex C - Basis of design

Annex C1 – Basis of Design

All the general basis of design are given here. These rules applied to all products listed in this ETA except if something else is stated in Annex D for a particular product.

Most of the capacities stated in the Annex D tables are **modified characteristic capacities** "$R_{i,k}$ x k_{mod}" It means that the capacity given for a specific load duration category (P, L, M, S or I) already takes into account the k_{mod} factor. The design capacities are obtained according to the following formula.

$$R_d = \frac{"R_k \times k_{\mathrm{mod}}"}{\gamma_M}$$

Some of the capacities stated in the Annex D tables are **characteristic capacities** R_k. Therefore, the design capacities are obtained according to the following formula:

$$R_d = \frac{R_k \times k_{\mathrm{mod}}}{\gamma_M}$$

Combined forces
For practical purposes, the strength verification is always carried out for design forces and design capacities.

For all Angle Brackets included in this ETA, the following inequalities shall be fulfilled:

F_1 combined with F_2 or F_3:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^2 + \left(\frac{F_{2or3,d}}{R_{2or3,d}}\right)^2 \leq 1$$

F_1 combined with F_4 or F_5:

$$\frac{F_{1,d}}{R_{1,d}} + \frac{F_{4or5,d}}{R_{4or5,d}} \leq 1$$

F_1 combined with F_2 or F_3 and F_4 or F_5:

$$\sqrt{\left[\frac{F_{1,d}}{R_{1,d}} + \frac{F_{4or5,d}}{R_{4or5,d}}\right]^2 + \left[\frac{F_{2or3,d}}{R_{2or3,d}}\right]^2} \leq 1{,}0$$

Timber splitting
For forces acting perpendicular to the grain in the timber it must be checked that splitting will not occur in accordance with Eurocode 5 or a similar national Timber Code.

Annex C2 – Definition of forces direction

C2-1: Forces - Beam to beam connection, beam to support with bolts

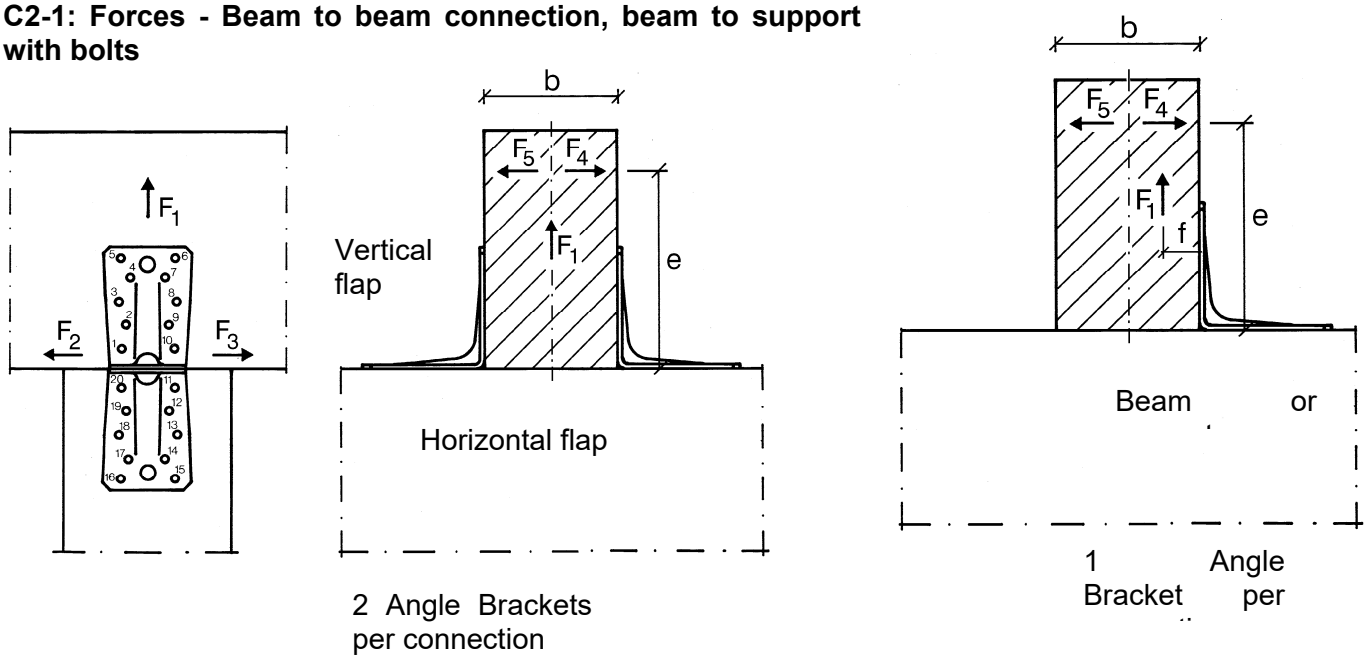


Figure C2-1: Beam to beam connection, beam to support with bolts

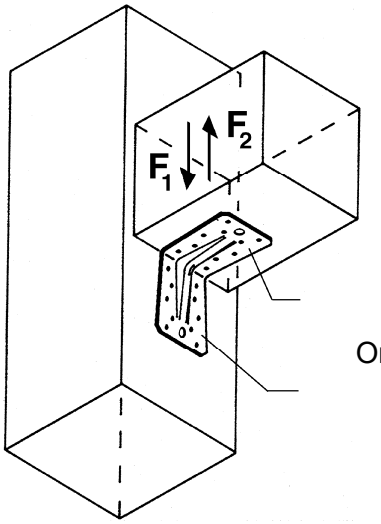
2 angle brackets per connection
The Angle Brackets must be placed at each side opposite to each other.

Acting forces
F_1 Lifting force acting along the central axis of the joint.
F_2 and F_3 Lateral force acting in the joint between the purlin and beam in the purlin direction.
F_4 and F_5 Lateral force acting in the beam direction along the central axis of the joint but elevated e above the beam.

1 angle bracket per connection
Acting forces
F_1 Lifting force acting in the central axis of the angle bracket but in a distance f from the vertical flap of the angle bracket.
If the purlin is prevented from rotation the load-carrying capacity will be half that of a connection with 2 angle brackets.
F_2 and F_3 Lateral force acting in the joint between the purlin and the beam in the purlin direction, the purlin have to be prevented from twisting.
F_4 Lateral force acting in the beam direction perpendicular to the vertical flap elevated e above the beam directed towards the angle brackets vertical flap.
F_5 Lateral force acting in the beam direction perpendicular to the vertical flap elevated e above the beam directed away from the angle brackets vertical flap.

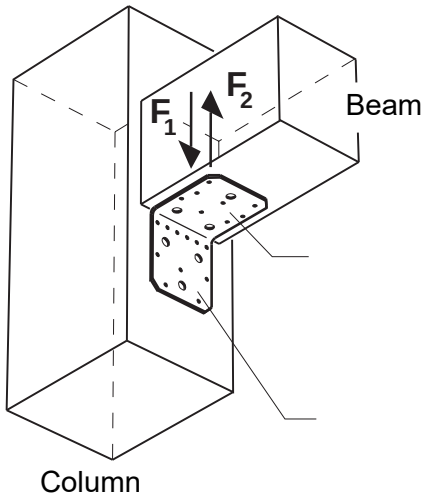
Wane on under the flap towards the purlin
For most of the Angle Brackets, wane under the flap towards the purlin is allowed provided it does not occur under the fasteners.
Under each table in Annex D is indicated weather wane is allowed or not allowed.

C2-2: Forces – Beam to column connection

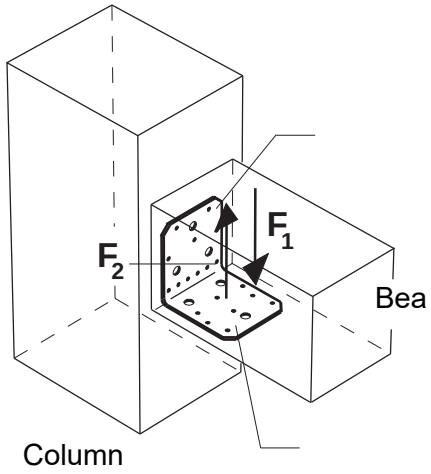


One Angle Bracket per connection

Figure C2-2-1: Beam to column connection – Angle Bracket with a rib



Flap turned downwards



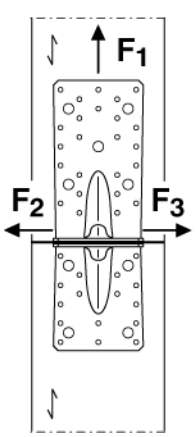
Flap turned upwards

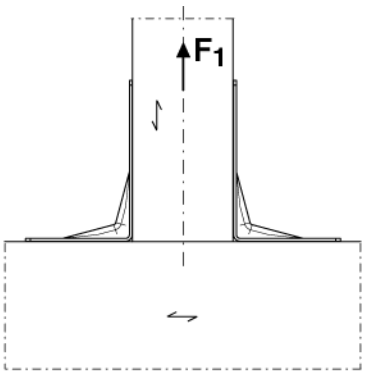
Figure C2-2-2: Beam to column connection – Angle bracket without a rib

1 angle bracket per connection
Acting forces

F_1	Downward force acting along the central axis of the Angle Bracket.
F_2	Lifting force acting along the central axis of the Angle Bracket.

C2-3: Forces – Post to beam connection, post to support with bolts





Timber, Steel or Concrete

2 Angle Brackets per connection

Figure C2-3: Post to beam connection, post to support with bolts

2 angle brackets per connection
The angle brackets must be placed at each side opposite to each other.

Acting forces

F_1	Lifting force acting along the central axis of the joint.
F_2 and F_3	Lateral force acting in the joint between the post and the beam parallel to the bend line in the Angle Bracket.

1 angle bracket per connection
The load-carrying capacities will be half of that of a connection with two Angle Brackets per connection, the post have to be prevented from twisting.

Wane
The timber shall have plane surfaces under the Angle Bracket, which means that wane may not occur under the angle bracket.

C2-4: Forces – Trimmer connection

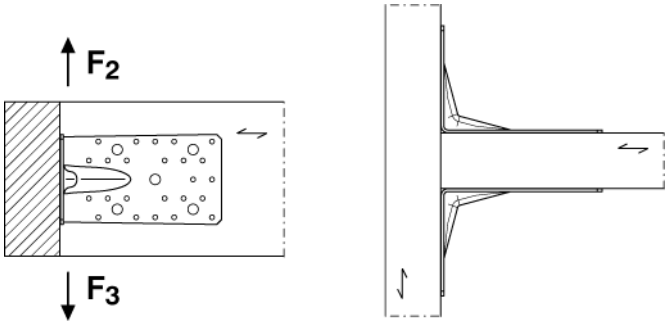


Figure B3: Trimmer connection

2 angle brackets per connection
The angle brackets must be placed at each side opposite to each other.

Acting forces
F_2 and F_3 Lateral force parallel to the bend line in the Angle Bracket in the joint between the joist and the header.

1 angle bracket per connection
The load-carrying capacities will be half of that of a connection with 2 angle brackets per connection, the post has to be prevented from twisting.

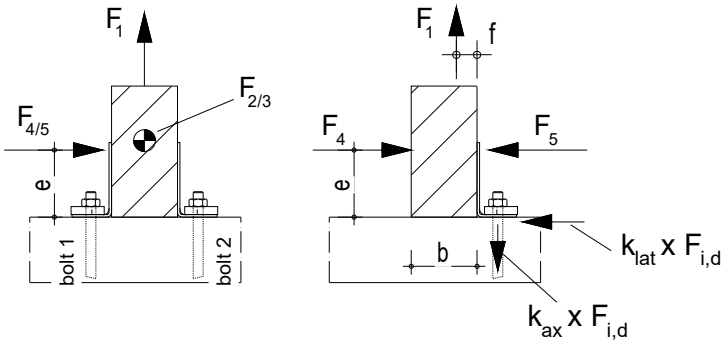
Wane
The timber shall have plane surfaces under the Angle Bracket, which means that wane may not occur under the angle bracket.

C2-5 : Connection with bolts

Below the load-tables for connection with bolts are given factors.
It has to be checked, that the bolt has a capacity to absorb the resultant overlapping forces.

$R_{bolt\ ax/lat} \geq$ factor $_{ax/lat}$ x acting load.

The factor k_{lat} is given to determine the shear load for the bolt
The factor k_{ax} is given to determine the axial load for the bolt



Each bolt shall have a capacity to sustain a lateral force of: $\geq k_{lat}$ x Fi,d
Each bolt shall have a capacity to sustain a axial force of: $\geq k_{ax}$ x Fi,d

Combinations of loads have to be considered.

Annex C3 – Fasteners specification and capacities

CNA connector nails and CSA connector screws according to ETA-04/0013:

Nail and screw type	Nail and screw size (mm)		Finish
According to ETA-04/0013 annex A drawing 1 and 2	Diameter	Length	
Connector nail	3,1	--	Electroplated zinc
Connector nail	3,7	50	Electroplated zinc
Connector nail	4,0	35	Electroplated zinc
Connector nail	4,0	40	Electroplated zinc
Connector nail	4,0	50	Electroplated zinc
Connector nail	4,0	60	Electroplated zinc
Connector screw	5,0	35	Electroplated zinc
Connector screw	5,0	40	Electroplated zinc
Connector screw	5,0	50	Electroplated zinc
Connector nail	4,2	35	Electroplated zinc
Connector nail	4,2	50	Electroplated zinc
Connector nail	4,2	60	Electroplated zinc

Other fasteners:

Nail, screw and bolt type	Nail, screw and bolt size (mm)		Finish
	Diameter	Length	
Threaded nail according to EN 14592	3,1	--	Electroplated zinc
Smooth nail according to EN 14592	3,75	75	Hot-dip galvanized
Threaded nail according to EN 14592	4,0	--	Electroplated zinc
PDPA-75	4,0	19	Electroplated zinc
Wood screw	6,0	45	Electroplated zinc
Wood screw	8,0	120	Electroplated zinc
Wood screw SD25600	6,4	152	Double-barrier coating
Bolt M8	8		For relevant angle brackets see the assumed characteristic capacities of the bolt connection and compare with the specification of the manufacturer
Bolt M10	10		
Bolt M12	12		
Timber Screws SS-H	8	40	Impreg +
Timber Screws SS-H	10	40	Impreg +
Timber Screws SS-H	10	80	Impreg +
Timber Screws SS-H	12	80	Impreg +

Annex C4 – Characteristic capacity modification methods for nails and timber types

C4 – 1: Characteristic capacity modification method for different nails

CNA Connector nails and CSA Connector screws in accordance to ETA-04/0013

When the load bearing capacity of a bracket have been determined based on the use of Connector nails CNA 4,0x35, CNA4,0x40, CNA4,0x50 or CNA4,0x60 in accordance with ETA-04/0013 it is allowed to use longer 4,0 mm CNA Connector nails or Connector screws CSA5,0x35, CSA5,0x40, CSA 5,0x50 or Connector nails CNA4,2x35, CNA4,2x50, CNA4,2x60 in accordance with ETA-04/0013 with the same or better performance than the used 4,0 mm CNA Connector nails and still achieve the same load-bearing capacity of the connection.

When the load bearing capacity of a bracket have been determined based on the use of Connector screws it is always allowed to use a longer screw and the capacities will still be valid. If shorter Connector screws are used and no calculations are made a reduction factor equal to the ratio between the withdrawal capacity of the short screw and the withdrawal capacity of the long screw is applicable for all loadbearing capacities of the connection.

It is always allowed to interpolate between two sizes of nails or screws. For example the capacity of Connector nails CNA 4,0x50 in accordance with ETA-04/0013 can be calculated as the mean value of the capacity of the connection when Connector nails CNA4,0x40 and CNA4,0x60 are used:
To calculate the capacity with CNA4.0x50, the value of the capacity with CNA4.0x40 must be multiply by a factor k and must be limited to the value with CNA4.0x60.

For F_1 load direction on timber $k = R_{ax,CNA4.0x50} / R_{ax,CNA4.0x40}$
For F_1 load direction on rigid support $k = R_{lat,CNA4.0x50} / R_{lat,CNAx4.0x40}$
For F_2 and F_3 load direction on all support $k = R_{lat,CNA4.0x50} / R_{lat,CNAx4.0x40}$
For F_4 and F_5 load direction on all support $k = R_{ax,CNA4.0x50} / R_{ax,CNA4.0x40}$

Threaded nails in accordance to EN 14592

For all Angle Brackets the design models also allow the use of threaded nails in accordance to EN 14592 with a diameter in the range 4,0 – 4,2 mm and a minimum length of 35 mm, assuming a thick steel plate when calculating the lateral nail load-bearing capacity. If no calculations are made a reduction factor equal to the ratio between the characteristic withdrawal capacity of the actual used threaded nail and the characteristic withdrawal capacity of the corresponding Connector nail according to table B1 in ETA-04/0013 is applicable for all load bearing capacities of the connection.

Other fasteners

For some Angle Brackets, the load bearing capacities have been determined for a connection between a timber member and its support to a 6 mm steel member using PDPA-75 nails, which are powder actuated pins. The pins have been fastened through the existing holes in the Angle Brackets.
Some Angle Brackets gives the loadbearing capacity for a connection between a timber member and a 6 mm steel quality S355. For this connection, there is no proportionality for other steel grades or thicknesses.

Stainless steel

For the Angle Brackets produced from stainless steel number 1.4401, 1.4404, 1.4521 (Steel ref. 2) and 1.4301, 1.4509 (Steel ref. 3) according to EN 10088-2:2005 or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa., the characteristic load carrying capacities can be considered as the same as those published in this document subject to the use of stainless CNA connector nails or CSA connector screws covered by the ETA-04/0013 or stainless threaded nails or screws in accordance to the standard EN 14592 respecting the rules given in the paragraph above for nails and screws according to ETA-04/0013 and EN14592.

C4 – 2: Characteristic capacity modification method for different timber types

Annex D states the load-carrying capacities of the Angle Bracket connections for a characteristic density of 350 kg/m^3.

For timber or wood-based material with a lower characteristic density than 350 kg/m^3 the load-carrying capacities shall be reduced by the k_{dens} factor:

$$k_{dens} = \left(\frac{\rho_k}{350} \right)$$ Where ρ_k is the characteristic density of the timber in kg/m^3.

For interim value, e.g. distances, it´s allowed to determine the values by interpolation if nothing else is named by the current table.

Annex D - Product definition and capacities

Annex D1 – ABR90

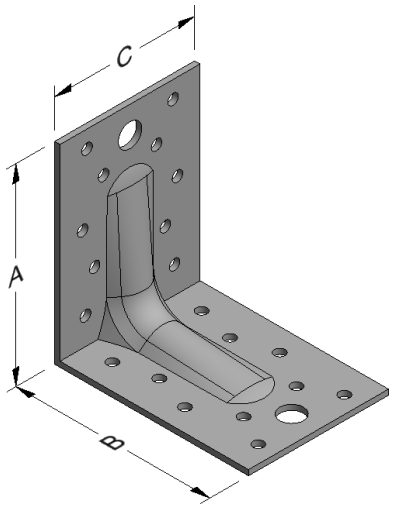
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR90	Steel ref. 1	UK: E2/2.5/7090, France: E2/2.5/7090, Germany: 90 m/R
ABR90S	Steel ref. 2	France: E2IX
ABR90S2	Steel ref. 3	-
ABR90Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
ABR90	90	90	65	2,5	10	1	10	1

Drawing:



Nailing pattern:

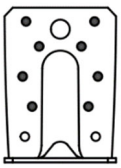
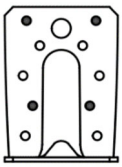
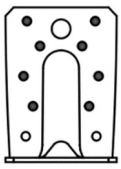
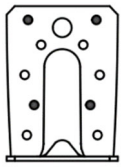
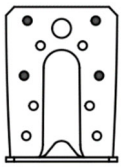
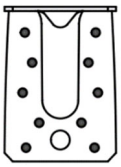
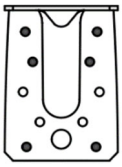
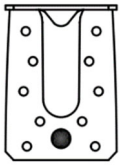
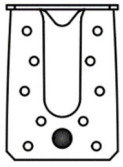
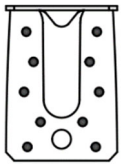
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Maximum nailing	Beam to beam Minimum nailing	Beam (A) to steel (B) Maximum nailing	Beam (A) to steel (B) Minimum nailing	Beam (A) to column (B)

Table D1-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR90 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	6	P	3,2	5,3	3,4	4,4	$\frac{6,1 \cdot b+431}{e-10,7}$ max 5,1	$\frac{6,84 \cdot b+430}{e-10,7}$ max 7,2
				1,0	2,3				
			L	3,7	6,2	4,0	5,1	$\frac{6,2 \cdot b+431}{e-10,7}$ max 5,6	$\frac{7,17 \cdot b+430}{e-10,7}$ max 8,0
				1,3	3,0				
			M	4,3	7,1	4,6	5,9	$\frac{6,4 \cdot b+431}{e-10,7}$ max 6,1	$\frac{7,5 \cdot b+430}{e-10,7}$ max 8,9
				1,6	3,7				
			S	4,8	8,0	5,1	6,6	$\frac{6,6 \cdot b+431}{e-10,7}$ max 6,7	$\frac{7,83 \cdot b+429}{e-10,7}$ max 9,8
				2,0	4,5				
			I	5,9	9,7	6,3	8,1	$\frac{7,0 \cdot b+430}{e-10,7}$ max 7,7	$\frac{8,49 \cdot b+429}{e-10,7}$ max 11,5
				2,7	6,4				
Nailing pattern 1	8	10	P	4,8	8,0	5,6	7,1	$\frac{6,3 \cdot b+431}{e-10,7}$ max 7,8	$\frac{7,2 \cdot b+430}{e-10,7}$ max 11,7
				1,4	3,2				
			L	5,6	9,3	6,5	8,3	$\frac{6,5 \cdot b+431}{e-10,7}$ max 8,8	$\frac{7,59 \cdot b+429}{e-10,7}$ max 13,4
				1,8	4,2				
			M	6,4	10,6	7,4	9,5	$\frac{6,7 \cdot b+430}{e-10,7}$ max 9,7	$\frac{7,98 \cdot b+429}{e-10,7}$ max 15,0
				2,2	5,3				
			S	7,1	12,0	8,3	10,6	$\frac{7,0 \cdot b+430}{e-10,7}$ max 10,7	$\frac{8,37 \cdot b+429}{e-10,7}$ max 16,6
				2,7	6,5				
			I	8,7	14,6	10,2	13,0	$\frac{7,4 \cdot b+430}{e-10,7}$ max 12,7	$\frac{9,15 \cdot b+428}{e-10,7}$ max 19,9
				3,8	9,0				

b and e are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square is valid.

Table D1-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration P

<table>
<tr><th colspan="4">1 Angle Bracket ABR90 per connection</th><th colspan="8">Modified characteristic capacity per connection (kN)</th></tr>
<tr><th rowspan="3">Nailing pattern</th><th colspan="2">Number of fasteners</th><th rowspan="3">Load duration</th><th colspan="2">$R_{1,k} \times k_{mod}$</th><th colspan="2">$R_{2/3,k} \times k_{mod}$</th><th colspan="2">$R_{4,k} \times k_{mod}$</th><th colspan="2">$R_{5,k} \times k_{mod}$</th></tr>
<tr><th rowspan="2">Flange A</th><th rowspan="2">Flange B</th><th colspan="6">CNA Connector nail</th></tr>
<tr><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th></tr>
<tr><td rowspan="5">Nailing pattern 2</td><td rowspan="5">4</td><td rowspan="5">6</td><td rowspan="5">P</td><td rowspan="3">f≤ 40:
$\frac{78}{f+60}$</td><td rowspan="3">f≤ 49:
$\frac{114}{f+60}$</td><td rowspan="5">1,7</td><td rowspan="5">2,2</td><td>e<37,5:
$\frac{30,6}{37,5-e}$</td><td>e<37,5:
$\frac{50,9}{37,5-e}$</td><td>e≤ 58:
$\frac{31}{68-e}$</td><td>e≤ 55:
$\frac{52}{68-e}$</td></tr>
<tr><td>e≤ 37: 2,2</td><td>e≤ 42: 2,83</td><td>58<e≤ 1,83·b:
3,3</td><td>55<e≤ 1,62·b+3:
4,2</td></tr>
<tr><td rowspan="2">37<e≤ 101:
$\frac{81}{e}$</td><td rowspan="2">42<e≤ 109:
$\frac{119,8}{e}$</td><td rowspan="2">e>1,83·b:
$\frac{6,1 \cdot b-225}{e-68}$</td><td rowspan="2">e>1,62·b+3:
$\frac{6,84 \cdot b-271}{e-68}$</td></tr>
<tr><td>f>40:
$\frac{31,1}{f}$</td><td>f>49:
$\frac{51,7}{f}$</td></tr>
<tr><td>e>101:
$\frac{28,9}{e-65}$</td><td>e>109:
$\frac{48}{e-65}$</td></tr>
<tr><td rowspan="5">Nailing pattern 1</td><td rowspan="5">8</td><td rowspan="5">10</td><td rowspan="5">P</td><td rowspan="3">f≤ 34:
$\frac{85}{f+60}$</td><td rowspan="3">f≤ 41:
$\frac{127}{f+60}$</td><td rowspan="5">2,8</td><td rowspan="5">3,5</td><td>e<37,5:
$\frac{37,5}{37,5-e}$</td><td>e<37,5:
$\frac{62,7}{37,5-e}$</td><td>e≤ 57:
$\frac{46,3}{68-e}$</td><td>e≤ 54:
$\frac{77,5}{68-e}$</td></tr>
<tr><td>e≤ 20: 4,4</td><td>e≤ 23: 5,66</td><td>57<e≤ 1,47·b+10:
4,3</td><td>54<e≤ 1,23·b+15:
5,8</td></tr>
<tr><td rowspan="2">20<e≤ 96:
$\frac{89}{e}$</td><td rowspan="2">23<e≤ 102:
$\frac{133,1}{e}$</td><td rowspan="2">e>1,47·b+10:
$\frac{6,3 \cdot b-247}{e-68}$</td><td rowspan="2">e>1,23·b+15:
$\frac{7,2 \cdot b-308}{e-68}$</td></tr>
<tr><td>f>34:
$\frac{30,9}{f}$</td><td>f>41:
$\frac{51,7}{f}$</td></tr>
<tr><td>e>96:
$\frac{28,7}{e-65}$</td><td>e>102:
$\frac{48}{e-65}$</td></tr>
</table>

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D1-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration L

1 Angle Bracket ABR90 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
				CNA Connector nail							
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	6	L	f≤43: $\frac{87}{f+60}$	f≤52: $\frac{130}{f+60}$	2,0	2,6	e<37,5: $\frac{35,7}{37,5-e}$	e<37,5: $\frac{59,4}{37,5-e}$	e≤57: $\frac{36}{68-e}$	e≤54: $\frac{69}{68-e}$
								e≤36: 2,6	e≤41: 3,3	57<e≤1,77·b+1: 3,5	54<e≤1,51·b+5: 5,0
								36<e≤103: $\frac{91}{e}$	41<e≤111: $\frac{135,8}{e}$		
				f>43: $\frac{36,3}{f}$	f>52: $\frac{60,3}{f}$					e>1,77·b+1: $\frac{6,2 \cdot b-236}{e-68}$	e>1,51·b+5: $\frac{7,52 \cdot b-310}{e-68}$
								e>103: $\frac{33,7}{e-65}$	e>111: $\frac{56}{e-65}$		
Nailing pattern 1	8	10	L	f≤36: $\frac{96}{f+60}$	f≤43: $\frac{144}{f+60}$	3,2	4,1	e<37,5: $\frac{43,7}{37,5-e}$	e<37,5: $\frac{73,2}{37,5-e}$	e≤56: $\frac{54}{68-e}$	e≤54: $\frac{90,4}{68-e}$
								e≤19: 5,1	e≤23: 6,61	56<e≤1,39·b+11: 4,7	54<e≤1,17·b+16: 6,5
								19<e≤99: $\frac{100}{e}$	23<e≤103: $\frac{151,3}{e}$		
				f>36: $\frac{36}{f}$	f>43: $\frac{60,3}{f}$					e>1,39·b+11: $\frac{6,5 \cdot b-262}{e-68}$	e>1,17·b+16: $\frac{7,59 \cdot b-333}{e-68}$
								e>99: $\frac{33,4}{e-65}$	e>103: $\frac{56}{e-65}$		

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D1-4 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration M

<table>
<tr><th colspan="4">1 Angle Bracket ABR90 per connection</th><th colspan="8">Modified characteristic capacity per connection (kN)</th></tr>
<tr><th rowspan="3">Nailing pattern</th><th colspan="2">Number of fasteners</th><th rowspan="3">Load duration</th><th colspan="2">$R_{1,k} \times k_{mod}$</th><th colspan="2">$R_{2/3,k} \times k_{mod}$</th><th colspan="2">$R_{4,k} \times k_{mod}$</th><th colspan="2">$R_{5,k} \times k_{mod}$</th></tr>
<tr><th rowspan="2">Flange A</th><th rowspan="2">Flange B</th><th colspan="8">CNA Connector nail</th></tr>
<tr><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th></tr>
<tr><td rowspan="5">Nailing pattern 2</td><td rowspan="5">4</td><td rowspan="5">6</td><td rowspan="5">M</td><td rowspan="3">f≤45:
96
f+60</td><td rowspan="3">f≤55:
145
f+60</td><td rowspan="5">2,3</td><td rowspan="5">2,9</td><td>e<37,5:
40,8
37,5-e</td><td>e<37,5:
67,9
37,5-e</td><td>e≤56:
41
68-e</td><td>e≤54:
69
68-e</td></tr>
<tr><td>e≤34: 2,9</td><td>e≤40: 3,78</td><td>56<e≤1,71·b+2:
3,8</td><td>54<e≤1,51·b+5:
5,0</td></tr>
<tr><td rowspan="2">34<e≤105:
101
e</td><td rowspan="2">40<e≤112:
151,9
e</td><td rowspan="2">e>1,71·b+2:
6,4·b-248
e-68</td><td rowspan="2">e>1,51·b+5:
7,5·b-309
e-68</td></tr>
<tr><td>f>45:
41,4
f</td><td>f>55:
68,9
f</td></tr>
<tr><td>e>105:
38,5
e-65</td><td>e>112:
64
e-65</td></tr>
<tr><td rowspan="5">Nailing pattern 1</td><td rowspan="5">8</td><td rowspan="5">10</td><td rowspan="5">M</td><td rowspan="3">f≤38:
106
f+60</td><td rowspan="3">f≤45:
161
f+60</td><td rowspan="5">3,7</td><td rowspan="5">4,7</td><td>e<37,5:
50
37,5-e</td><td>e<37,5:
83,6
37,5-e</td><td>e≤55:
62
68-e</td><td>e≤53:
103
68-e</td></tr>
<tr><td>e≤19: 5,9</td><td>e≤22: 7,55</td><td>55<e≤1,33·b+13:
5,0</td><td>53<e≤1,12·b+17:
7,1</td></tr>
<tr><td rowspan="2">19<e≤99:
111
e</td><td>22<e≤92:
169,6
e</td><td rowspan="2">e>1,33·b+13:
6,7·b-277
e-68</td><td rowspan="2">e>1,12·b+17:
7,98·b-359
e-68</td></tr>
<tr><td>f>38:
41,2
f</td><td>f>45:
68,9
f</td><td>92<e≤111:
109,5
e-32,5</td></tr>
<tr><td></td><td></td><td>e>99:
38,2
e-65</td><td>e>111:
64
e-65</td></tr>
</table>

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D1-5 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration S

<table>
<tr><th colspan="4">1 Angle Bracket ABR90 per connection</th><th colspan="8">Modified characteristic capacity per connection (kN)</th></tr>
<tr><th rowspan="3">Nailing</th><th colspan="2">Number of fasteners</th><th rowspan="3">Load duration</th><th colspan="2">$R_{1,k} \times k_{mod}$</th><th colspan="2">$R_{2/3,k} \times k_{mod}$</th><th colspan="2">$R_{4,k} \times k_{mod}$</th><th colspan="2">$R_{5,k} \times k_{mod}$</th></tr>
<tr><th rowspan="2">Flange A</th><th rowspan="2">Flange B</th><th colspan="6">CNA Connector nail</th></tr>
<tr><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th></tr>
<tr><td rowspan="4">Nailing pattern 2</td><td rowspan="4">4</td><td rowspan="4">6</td><td rowspan="4">S</td><td rowspan="2">f≤45:
$\frac{106}{f+60}$</td><td rowspan="2">f≤57:
$\frac{160}{f+60}$</td><td rowspan="4">2,6</td><td rowspan="4">3,3</td><td>e<37,5:
$\frac{40,8}{37,5-e}$</td><td>e<37,5:
$\frac{76,4}{37,5-e}$</td><td>e≤56:
$\frac{47}{68-e}$</td><td>e≤53:
$\frac{77}{68-e}$</td></tr>
<tr><td>e≤34: 3,3</td><td>e≤40: 4,25</td><td>56<e≤1,67·b+3:
4,0</td><td>53<e≤1,46·b+6:
5,3</td></tr>
<tr><td rowspan="2">f>45:
$\frac{46,6}{f}$</td><td rowspan="2">f>57:
$\frac{77,5}{f}$</td><td>34<e≤105:
$\frac{110}{e}$</td><td>40<e≤93:
$\frac{167,9}{e}$</td></tr>
<tr><td></td><td>93<e≤127:
$\frac{109,5}{e-32,5}$</td><td rowspan="2">e>1,67·b+3:
$\frac{6,6 \cdot b-259}{e-68}$</td><td rowspan="2">e>1,46·b+6:
$\frac{7,83 \cdot b-328}{e-68}$</td></tr>
<tr><td>e>105:
$\frac{43,3}{e-65}$</td><td>e>127:
$\frac{72}{e-65}$</td></tr>
<tr><td rowspan="4">Nailing pattern 1</td><td rowspan="4">8</td><td rowspan="4">10</td><td rowspan="4">S</td><td rowspan="2">f≤40:
$\frac{116}{f+60}$</td><td rowspan="2">f≤46:
$\frac{179}{f+60}$</td><td rowspan="4">4,2</td><td rowspan="4">5,3</td><td>e<37,5:
$\frac{76,1}{37,5-e}$</td><td>e<37,5:
$\frac{94,1}{37,5-e}$</td><td>e≤55:
$\frac{69}{68-e}$</td><td>e≤53:
$\frac{116}{68-e}$</td></tr>
<tr><td>e≤18: 6,6</td><td>e≤22: 8,5</td><td>55<e≤1,28·b+14:
5,4</td><td>53<e≤1,08·b+18:
7,8</td></tr>
<tr><td rowspan="2">f>40:
$\frac{46,3}{f}$</td><td rowspan="2">f>46:
$\frac{77,5}{f}$</td><td>18<e≤101:
$\frac{122}{e}$</td><td>22<e≤79:
$\frac{186,5}{e}$</td></tr>
<tr><td></td><td>79<e≤127:
$\frac{109,5}{e-32,5}$</td><td rowspan="2">e>1,28·b+14:
$\frac{7,0 \cdot b-292}{e-68}$</td><td rowspan="2">e>1,08·b+18:
$\frac{8,37 \cdot b-384}{e-68}$</td></tr>
<tr><td>e>101:
$\frac{43}{e-65}$</td><td>e>127:
$\frac{72}{e-65}$</td></tr>
</table>

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D1-6 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration I

1 Angle Bracket ABR90 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	6	I	f≤51: $\frac{124}{f+60}$	f≤60: $\frac{190}{f+60}$	3,1	4,0	e<37,5: $\frac{56,2}{37,5-e}$	e<37,5: $\frac{93,4}{37,5-e}$	e≤55: $\frac{57}{68-e}$	e≤52: $\frac{95}{68-e}$
								e≤32: 4,0	e≤36: 5,19	55<e≤1,58·b+4: 4,4	52<e≤1,39·b+7: 6,1
								32<e≤95: $\frac{130}{e}$	36<e≤79: $\frac{186,5}{e}$		
				f>51: $\frac{57}{f}$	f>60: $\frac{94,7}{f}$			95<e≤110: $\frac{109}{e-32,5}$	79<e≤198: $\frac{109,5}{e-32,5}$	e>1,58·b+4: $\frac{7,0 \cdot b-282}{e-68}$	e>1,39·b+7: $\frac{8,49 \cdot b-366}{e-68}$
								e>110: $\frac{52,9}{e-65}$	e>198: $\frac{87,9}{e-65}$		
Nailing pattern 1	8	10	I	f≤42: $\frac{137}{f+60}$	f≤48: $\frac{213}{f+60}$	5,1	6,5	e<37,5: $\frac{68,7}{37,5-e}$	e<37,5: $\frac{115}{37,5-e}$	e≤54: $\frac{85}{68-e}$	e≤52: $\frac{142}{68-e}$
								e≤18: 8,1	e≤18: 10,38	54<e≤1,20·b+16: 6,2	52<e≤1,01·b+20: 9,1
								18<e≤103: $\frac{144}{e}$	18<e≤79: $\frac{186,5}{e}$		
				f>42: $\frac{56,6}{f}$	f>48: $\frac{94,7}{f}$			e>103: $\frac{52,6}{e-65}$	79<e≤200: $\frac{109,5}{e-32,5}$	e>1,20·b+16: $\frac{7,4 \cdot b-322}{e-68}$	e>1,01·b+20: $\frac{9,15 \cdot b-435}{e-68}$
									e>200: $\frac{87,9}{e-65}$		

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D1-7 Modified characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket ABR90 per connection				Modified characteristic capacities (kN) - timber to timber			
				$R_{1,k} \times k_{mod}$		$R_{2,k} \times k_{mod}$	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x40	CNA4,0x60	CNA4,0x40	CNA4,0x60
	Flange A (beam)	Flange B (column)					
Nailing pattern 5	4	10	P	5,4	6,6	0,9	1,5
			L	6,3	7,7	1,0	1,7
			M	7,2	8,8	1,2	2,0
			S	8,1	9,9	1,3	2,2
			I	9,9	12,1	1,6	2,7

End gab: max. 5 mm

Table D1-8 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

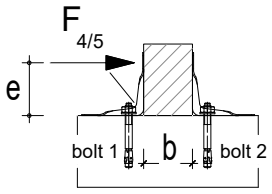
2 Angle Brackets ABR90 per connection			Characteristic capacities per connection (kN)								
			$R_{1,k}$				$R_{2/3,k}$				$R_{4/5,k}$
			CNA connector nails								
Nailing pattern	Number of fasteners										
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35 to 4,0x60
Nailing pattern 3	8	1 Bolt	min of:				1,64	1,96	2,6	3,2	$\max \left\{ \begin{array}{l} R_4{}^{1)} + R_5{}^{1)} \\ \min \left\{ \frac{2,17}{k_{mod}}; \frac{R_1}{2} \times \frac{b}{e} \right\} \end{array} \right.$
			3,1	3,7	4,94	6,14					
			$3,2/k_{mod}$								
Nailing pattern 4	4	1 Bolt	0,74	0,9	1,2	1,48	0,13	0,16	0,22	0,27	

1) see table D1-9

Connection with bolt

2 Angle Bracket ABR90 per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt1}$	$F_{4/5,bolt2}$
k_{ax}	0,50	-	0,50	0,10
k_{lat}	-	0,5	-	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.



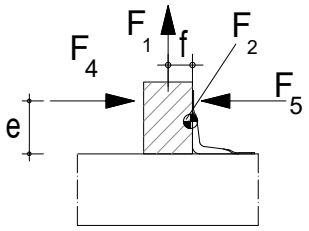


Table D1-9 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket ABR90 per connection			Characteristic capacities per connection (kN)						
			$R_{1,k}$	$R_{4,k}$	$R_{2/3,k}$	$R_{5,k}$			
Nailing pattern	Number of fasteners		CNA connector nails						
	Flange A	Flange B	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 3	8	1 Bolt	21,7 / ((f+16) x k_{mod})	21,7 / (e x k_{mod})	Half of the values for a connection with 2 ABR90, if the timber is prevented from rotation, otherwise R_2/3=0,0kN	X1= 222	266	355	443
Nailing pattern 4	4	1 Bolt				X2= 107	128	171	213
						$\min\left(\frac{X1}{e-9{,}99mm};\frac{X2}{85mm-e};\frac{110}{e\times k_{mod}}\right)$			

e is to insert in [mm]; e≥ 10mm

negativ values shall not be considered

Connection with bolt

1 Angle Bracket ABR90 per connection				
factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1,00	-	e/20	e/95
k_{lat}	-	-	1,00	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Annex D2 – AB90

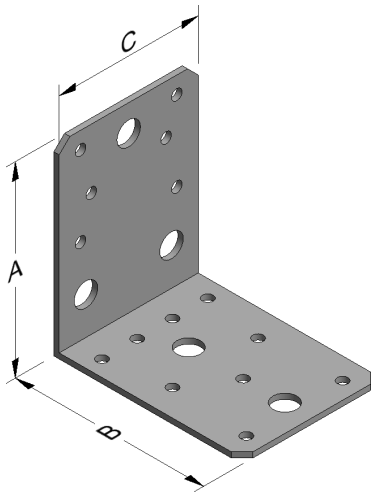
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB90	Steel ref. 1	France: E2/2.5/7091, Germany: 90 o/R
AB90S	Steel ref. 2	-
AB90S2	Steel ref. 3	-
AB90Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
AB90	88	88	65	2,5	6	3	9	2

Drawing:



Nailing pattern:

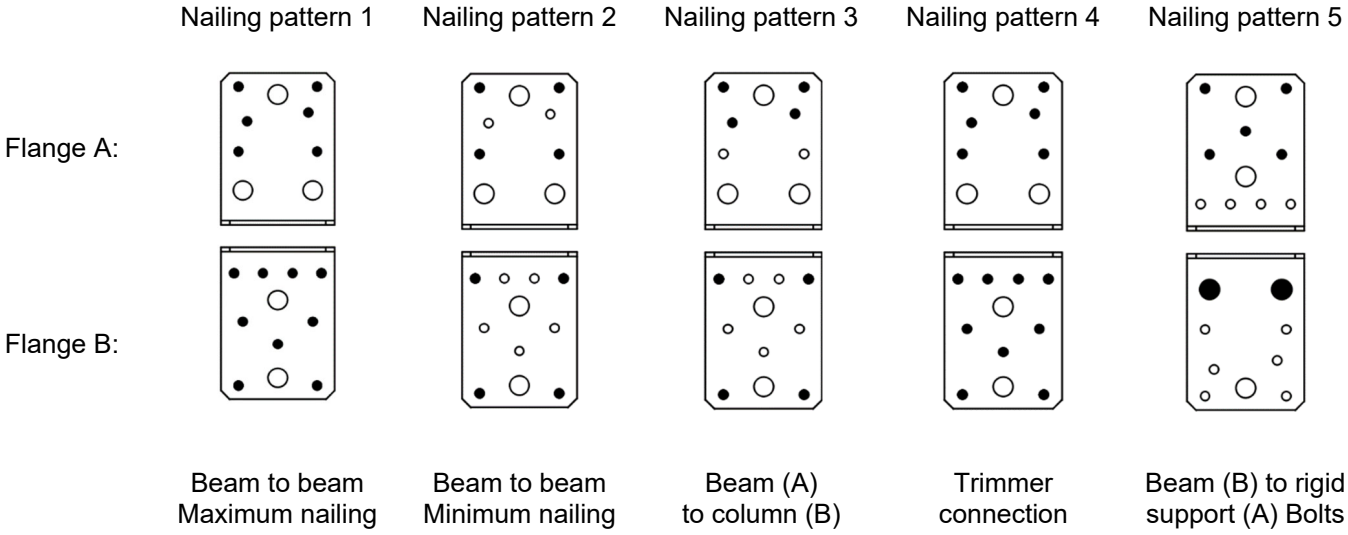


Table D2-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AB90 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing Pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	P	2,2	3,1	3,3	4,4	$\frac{1,1 \cdot b+38}{e-2,5}$ max 4,4	$\frac{1,5 \cdot b+41}{e-2,5}$ max 4,9
			L	2,4	3,4	3,9	5,2	$\frac{1,2 \cdot b+39}{e-2,5}$ max 5,1	$\frac{1,7 \cdot b+43}{e-2,5}$ max 5,3
			M	2,7	3,8	4,5	5,9	$\frac{1,3 \cdot b+40}{e-2,5}$ max 5,7	$\frac{1,9 \cdot b+44}{e-2,5}$ max 5,7
			S	2,9	4,1	5,0	6,6	$\frac{1,4 \cdot b+41}{e-2,5}$ max 6,0	$\frac{2,1 \cdot b+45}{e-2,5}$ max 6,0
			I	3,3	4,8	6,1	8,1	$\frac{1,6 \cdot b+42}{e-2,5}$ max 6,7	$\frac{2,4 \cdot b+48}{e-2,5}$ max 6,7
Nailing pattern 1	6	9	P	3,5	5,2	4,3	6,3	$\frac{1,8 \cdot b+43}{e-2,5}$ max 4,9	$\frac{2,6 \cdot b+49}{e-2,5}$ max 4,9
			L	3,9	5,9	5,0	7,3	$\frac{2,0 \cdot b+45}{e-2,5}$ max 5,3	$\frac{3,0 \cdot b+52}{e-2,5}$ max 5,3
			M	4,4	6,6	5,8	8,4	$\frac{2,2 \cdot b+46}{e-2,5}$ max 5,7	$\frac{3,3 \cdot b+55}{e-2,5}$ max 5,7
			S	4,8	6,9	6,5	9,4	$\frac{2,4 \cdot b+48}{e-2,5}$ max 6,0	$\frac{3,5 \cdot b+56}{e-2,5}$ max 6,0
			I	5,6	6,9	7,9	11,5	$\frac{2,8 \cdot b+51}{e-2,5}$ max 6,7	$\frac{3,5 \cdot b+56}{e-2,5}$ max 6,7

b and e are in mm

Wane may not occur under the angle brackets.

Table D2-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AB90 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	P	f≤ 93: 26,6 / f+43 f>93: 20,8 / f+13	f≤ 14: 44,3 / f+43 f>14: 20,8 / f+13	1,7	2,2	20,8 / e-2,5 max 3,6	5,2
			L	f≤47: 31,1 / f+43 f>47: 20,8 / f+13	f≤7: 51,7 / f+43 f>7: 20,8 / f+13	2,0	2,6	20,8 / e-2,5 max 4,4	6,2
			M	f≤29: 35,5 / f+43 f>29: 20,8 / f+13	f≤3: 59 / f+43 f>3: 20,8 / f+13	2,2	3,0	20,8 / e-2,5 max 5,2	7,1
			S	f≤ 20: 40,0 / f+43 f>20: 20,8 / f+13	f>0: 20,8 / f+13	2,5	3,3	20,8 / e-2,5 max 5,9	8,1
			I	f≤ 9: 48,8 / f+43 f>9: 20,8 / f+13	f>0: 20,8 / f+13	3,1	4,1	20,8 / e-2,5 max 7,4	10,0
Nailing pattern 1	6	9	P	20,8 / f+13		2,2	3,1	20,8 / e-2,5 max 9,7	12,6
			L			2,5	3,7	20,8 / e-2,5 max 11,3	14,7
			M			2,9	4,2	20,8 / e-2,5 max 12,9	16,8
			S			3,2	4,7	20,8 / e-2,5 max 14,6	19,0
			I			4,0	5,7	20,8 / e-2,5 max 17,9	23,2

e and f are in mm

Wane may not occur under the angle brackets.

Table D2-3 Modified characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket AB90 per connection				**Modified characteristic capacity per connection (kN)**		
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2,k} \times k_{mod}$
	Flange A (beam)	Flange B (column)		Flap turned downwards	Flap turned upwards	
				CNA 4,0x40 / CNA 4,0x60		
Nailing pattern 3	4	4	P	3,8	3,4	0,7
			L	4,5	3,6	
			M	4,7	3,8	
			S	4,9	3,9	
			I	5,3	4,2	

End gab: max. 5 mm

Table D2-4 Modified characteristic capacity trimmer connection – 2 Angle Brackets

2 Angle Brackets AB90 per connection				**Modified characteristic capacities (kN)**	
				$R_{2,3k} \times k_{mod}$	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x40	CNA4,0x60
	Joist flange (A)	Header flange (B)			
Nailing pattern 4	6	9	P	4,3	6,2
			L	5,0	7,2
			M	5,8	8,2
			S	6,5	9,2
			I	7,9	11,5

Wane may not occur under the angle brackets.

Table D2-5 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

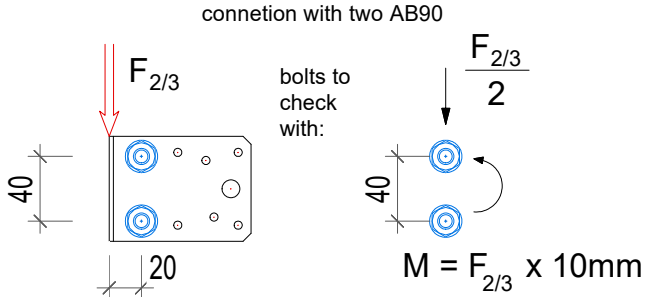
2 Angle Brackets AB90 per connection			**Characteristic capacities per connection (kN)**					
			$R_{1,k}$	$R_{2/3,k}$				$R_{4/5,k}$
Nailing pattern	Number of fasteners			CNA connector nails				
	Flange A	Flange B	4,0x35 to 4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35 to 4,0x60
Nailing pattern 5	5	2 Bolts	$5,4/k_{mod}$	4,73	5,03	6,25	6,66	$\max \left\{ R_4^{1)} + R_5^{1)} ; \min \left\{ \frac{4,5}{k_{mod}} ; \frac{R_1}{2} \times \frac{b}{e} \right\} \right.$ 1) for e

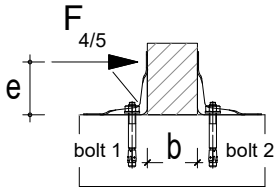
Connection with bolt

2 Angle Bracket AB90 per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt1}$	$F_{4/5,bolt2}$
k_{ax}	0,77	-	1,53xe/b	0,33
k_{lat}	-	see description	-	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

The connections with bolts has to be checked as following:





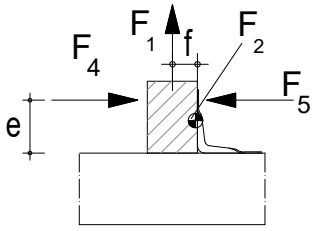


Table D2-6 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

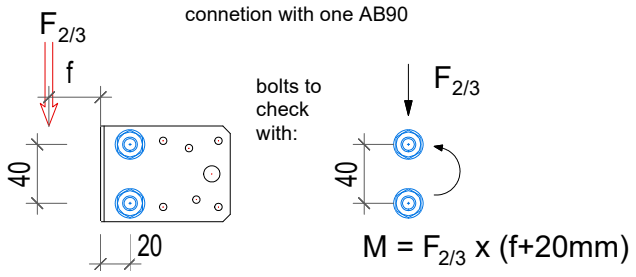
1 Angle Bracket AB90 per connection			Characteristic capacities per connection (kN)						
			$R_{1,k}$	$R_{4,k}$	$R_{2/3,k}$	$R_{5,k}$			
Nailing pattern	Number of fasteners				CNA connector nails				
	Flange A	Flange B	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 5	5	2 bolts	19,9 / ((f +16) x k_{mod})	45,2 / (e x k_{mod})	Half of the values for a connection with 2 AB90, if the timber is prevented from rotation, otherwise R_2/3=0,0kN	X1=			
						123	148	197	246
						X2=			
						63	75	100	125
						$\min\left(\frac{X1}{e-9{,}99mm};\frac{X2}{85mm-e};\frac{110}{e\times k_{mod}}\right)$			

e is to insert in [mm]; e≥ 10mm
negativ values shall not be considered

Connection with bolt

1 Angle Bracket AB90 per connection				
factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1,53	-	e/30	e/26
k_{lat}	-	see description	1,00	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination



Annex D3 – ABR105

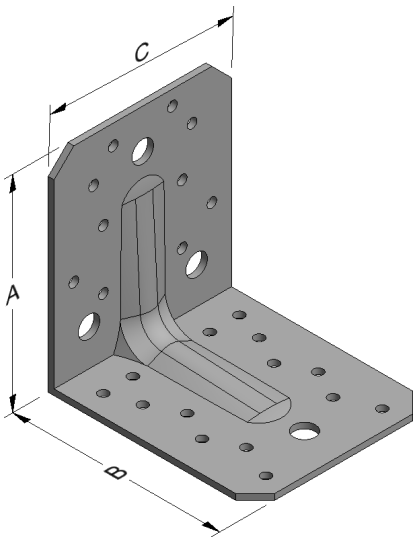
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR105	Steel ref. 1	UK: ABR105-R, France: ABR105-R, Germany: 105 m/R
ABR105S	Steel ref. 2	France: E3IX
ABR105S2	Steel ref. 3	-
ABR105Z	Steel ref. 6	-

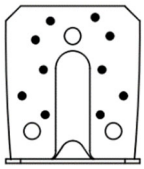
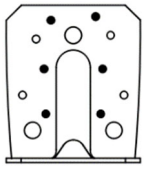
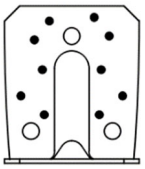
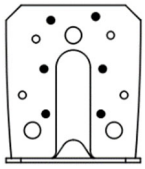
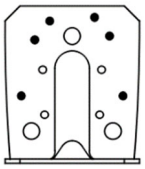
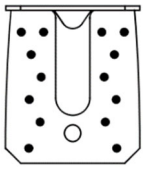
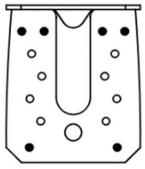
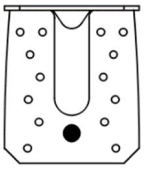
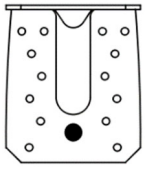
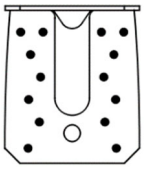
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
ABR105	105	105	90	3,0	10	3	14	1

Drawing:



Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Maximum nailing	Beam to beam Minimum nailing	Beam (A) to rigid support (B) Maximum nailing	Beam (A) to rigid support (B) Minimum nailing	Beam (A) to column (B)

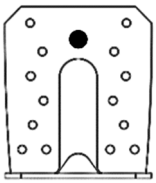
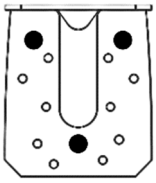
	Nailing pattern 6
Flange A:	
Flange B:	
	Beam to beam with large connector screws type SS-H

Table D3-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR105 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	6	6	P	3,6	5,9	4,6	7,0	$\frac{10,2 \cdot b+601}{e-10,7}$ max 6,8	$\frac{11,5 \cdot b+599}{e-10,7}$ max 9,0
				3,6	5,9				
			L	4,1	6,9	5,4	8,1	$\frac{10,6 \cdot b+601}{e-10,7}$ max 7,3	$\frac{12,0 \cdot b+598}{e-10,7}$ max 10,0
				4,1	6,9				
			M	4,7	7,9	6,2	9,3	$\frac{10,9 \cdot b+600}{e-10,7}$ max 7,9	$\frac{12,5 \cdot b+597}{e-10,7}$ max 10,9
				4,7	7,9				
			S	5,3	8,9	6,9	10,5	$\frac{11,2 \cdot b+599}{e-10,7}$ max 8,5	$\frac{13,0 \cdot b+596}{e-10,7}$ max 11,9
				5,3	8,9				
			I	6,5	10,8	8,5	12,8	$\frac{11,8 \cdot b+598}{e-10,7}$ max 9,6	$\frac{14,1 \cdot b+595}{e-10,7}$ max 13,7
				6,5	10,4				
Nailing pattern 1	10	14	P	6,5	10,7	8,7	12,2	$\frac{11,0 \cdot b+568}{e-10,7}$ max 9,7	$\frac{12,8 \cdot b+562}{e-10,7}$ max 14,0
				2,8	6,5				
			L	7,5	12,5	10,2	14,2	$\frac{11,5 \cdot b+566}{e-10,7}$ max 10,8	$\frac{13,5 \cdot b+559}{e-10,7}$ max 15,8
				3,6	8,4				
			M	8,6	14,3	11,6	16,2	$\frac{11,9 \cdot b+565}{e-10,7}$ max 11,9	$\frac{14,3 \cdot b+557}{e-10,7}$ max 17,5
				4,5	10,6				
			S	9,7	16,1	13,1	18,2	$\frac{12,4 \cdot b+563}{e-10,7}$ max 12,9	$\frac{15,0 \cdot b+554}{e-10,7}$ max 19,3
				5,5	11,7				
			I	11,9	19,7	16,0	22,3	$\frac{13,3 \cdot b+560}{e-10,7}$ max 15,1	$\frac{16,5 \cdot b+549}{e-10,7}$ max 22,8
				7,7	13,8				

b and e are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square is valid.

Table D3-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration P

<table>
<tr><th colspan="4">1 Angle Bracket ABR105 per connection</th><th colspan="8">Modified characteristic capacity per connection (kN)</th></tr>
<tr><th rowspan="3">Nailing pattern</th><th colspan="2">Number of fasteners</th><th rowspan="3">Load duration</th><th colspan="2">$R_{1,k} \times k_{mod}$</th><th colspan="2">$R_{2/3,k} \times k_{mod}$</th><th colspan="2">$R_{4,k} \times k_{mod}$</th><th colspan="2">$R_{5,k} \times k_{mod}$</th></tr>
<tr><th>Flange A</th><th>Flange B</th><th colspan="8">CNA Connector nail</th></tr>
<tr><th></th><th></th><th></th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th><th>4,0x40</th><th>4,0x60</th></tr>
<tr><td rowspan="5">Nailing pattern 2</td><td rowspan="5">6</td><td rowspan="5">6</td><td rowspan="5">P</td><td rowspan="3">f≤ 25:
$\frac{162}{f+60}$</td><td rowspan="3">f≤ 35:
$\frac{215}{f+60}$</td><td rowspan="5">2,3</td><td rowspan="5">3,5</td><td>e<37,5:
$\frac{52}{37,5-e}$</td><td>e<37,5:
$\frac{87}{37,5-e}$</td><td>e≤ 76:
$\frac{47}{85-e}$</td><td>e≤ 74:
$\frac{77}{85-e}$</td></tr>
<tr><td>e≤ 74: 2,2</td><td>e≤ 76: 2,8</td><td>76<e≤ 1,89·b+3:
5,4</td><td>74<e≤ 1,69·b+8:
6,8</td></tr>
<tr><td>74<e≤ 127:
$\frac{162}{e}$</td><td>76<e≤ 137:
$\frac{215}{e}$</td><td rowspan="2">e>1,89·b+3:
$\frac{10,2 \cdot b-446}{e-85}$</td><td rowspan="2">e>1,69·b+8:
$\frac{11,5 \cdot b-525}{e-85}$</td></tr>
<tr><td>f>25:
$\frac{47}{f}$</td><td>f>35:
$\frac{77}{f}$</td><td>127<e≤500:
$\frac{47}{e-85}$</td><td>137<e≤500:
$\frac{77}{e-85}$</td></tr>
<tr><td rowspan="5">Nailing pattern 1</td><td rowspan="5">10</td><td rowspan="5">14</td><td rowspan="5">P</td><td rowspan="3">f≤ 40:
$\frac{188}{f+60}$</td><td rowspan="3">f≤ 55:
$\frac{259}{f+60}$</td><td rowspan="5">4,4</td><td rowspan="5">6,1</td><td>e<37,5:
$\frac{92}{37,5-e}$</td><td>e<37,5:
$\frac{153}{37,5-e}$</td><td>e≤ 72:
$\frac{82}{85-e}$</td><td>e≤ 68:
$\frac{137}{85-e}$</td></tr>
<tr><td>e≤ 29: 6,6</td><td>e≤ 31: 8,5</td><td>72<e≤ 1,78·b+2:
6,2</td><td>68<e≤ 1,59·b+6:
8,1</td></tr>
<tr><td>29<e≤ 166:
$\frac{190}{e}$</td><td>31<e≤ 187:
$\frac{261}{e}$</td><td rowspan="2">e>1,78·b+2:
$\frac{11,0 \cdot b-513}{e-85}$</td><td rowspan="2">e>1,59·b+6:
$\frac{12,8 \cdot b-636}{e-85}$</td></tr>
<tr><td>f>40:
$\frac{73}{f}$</td><td>f>55:
$\frac{122}{f}$</td><td>166<e≤500:
$\frac{82}{e-85}$</td><td>e>187:
$\frac{137}{e-85}$</td></tr>
</table>

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D3-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration L

1 Angle Bracket ABR105 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	6	6	L	f≤28: $\frac{175}{f+60}$	f≤39: $\frac{237}{f+60}$	2,7	4,1	e<37,5: $\frac{61}{37,5-e}$	e<37,5: $\frac{101}{37,5-e}$	e≤76: $\frac{54}{85-e}$	e≤73: $\frac{90}{85-e}$
								e≤68: 2,6	e≤72: 3,3	76<e≤1,83·b+4: 5,8	73<e≤1,62·b+9: 7,4
								68<e≤132: $\frac{175}{e}$	72<e≤142: $\frac{237}{e}$		
				f>28: $\frac{54}{f}$	f>39: $\frac{90}{f}$					e>1,83·b+4: $\frac{10,6 \cdot b-466}{e-85}$	e>1,62·b+9: $\frac{12,0 \cdot b-558}{e-85}$
								132<e≤500: $\frac{54}{e-85}$	142<e≤500: $\frac{90}{e-85}$		
Nailing pattern 1	10	14	L	f≤44: $\frac{206}{f+60}$	f≤60: $\frac{289}{f+60}$	5,1	7,1	e<37,5: $\frac{107}{37,5-e}$	e<37,5: $\frac{179}{37,5-e}$	e≤71: $\frac{96}{85-e}$	e≤67: $\frac{159}{85-e}$
								e≤27: 7,7	e≤29: 9,9	71<e≤1,72·b+3: 6,7	67<e≤1,53·b+7: 8,9
								27<e≤175: $\frac{208}{e}$	29<e≤136: $\frac{291}{e}$		
				f>44: $\frac{85}{f}$	f>60: $\frac{142}{f}$				136<e≤245: $\frac{245}{e-32,5}$	e>1,72·b+3: $\frac{11,5 \cdot b-544}{e-85}$	e>1,53·b+7: $\frac{13,5 \cdot b-688}{e-85}$
								175<e≤500: $\frac{96}{e-85}$	e>245: $\frac{159}{e-85}$		

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D3-4 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration M

1 Angle Bracket ABR105 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	6	6	M	f≤31: $\frac{118}{f+60}$	f≤42: $\frac{259}{f+60}$	3,1	4,7	e<37,5: $\frac{70}{37,5-e}$	e<37,5: $\frac{116}{37,5-e}$	e≤75: $\frac{62}{85-e}$	e≤72: $\frac{103}{85-e}$
								e≤64: 2,9	e≤69: 3,8	75<e≤1,77·b+6: 6,1	72<e≤1,57·b+11: 8,0
								64<e≤135: $\frac{188}{e}$	69<e≤146: $\frac{259}{e}$		
				f>31: $\frac{62}{f}$	f>42: $\frac{103}{f}$					e>1,77·b+6: $\frac{10,9 \cdot b-486}{e-85}$	e>1,57·b+11: $\frac{12,5 \cdot b-591}{e-85}$
								135<e≤500: $\frac{62}{e-85}$	146<e≤500: $\frac{103}{e-85}$		
Nailing pattern 1	10	14	M	f≤48: $\frac{224}{f+60}$	f≤65: $\frac{318}{f+60}$	5,8	8,1	e<37,5: $\frac{123}{37,5-e}$	e<37,5: $\frac{204}{37,5-e}$	e≤70: $\frac{110}{85-e}$	e≤66: $\frac{182}{85-e}$
								e≤26: 8,8	e≤28: 11,3	70<e≤1,67·b+4: 7,1	66<e≤1,48·b+8: 9,6
								26<e≤183: $\frac{226}{e}$	28<e≤104: $\frac{321}{e}$		
				f>48: $\frac{97}{f}$	f>65: $\frac{162}{f}$					e>1,67·b+4: $\frac{11,9 \cdot b-575}{e-85}$	e>1,48·b+8: $\frac{14,3 \cdot b-739}{e-85}$
								183<e≤500: $\frac{110}{e-85}$	104<e≤500: $\frac{245}{e-32,5}$		

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D3-5 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration S

1 Angle Bracket ABR105 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	6	6	S	f≤33: 202 f+60	f≤44: 281 f+60	3,5	5,2	e<37,5: 78 37,5-e	e<37,5: 130 37.5-e	e≤74: 70 85-e	e≤71: 116 85-e
								e≤61: 3,3	e≤66: 4,2	74<e≤1,73·b+7: 6,5	71<e≤1,53·b+12: 8,5
								61<e≤139: 202 e	66<e≤149: 281 e		
				f>33: 70 f	f>44: 116 f			139<e≤500: 70 e-85	149<e≤500: 116 e-85	e>1,73·b+7: 11,2·b-506 e-85	e>1,53·b+12: 13,0·b-624 e-85
Nailing pattern 1	10	14	S	f≤52: 242 f+60	f≤69: 348 f+60	6,5	9,1	e<37,5: 138 37,5-e	e<37,5: 230 37,5-e	e≤69: 123 85-e	e≤65: 205 85-e
								e≤25: 9,9	e≤27: 12,9	69<e≤1,63·b+5: 7,6	65<e≤1,44·b+9: 10,4
								25<e≤179: 244 e	27<e≤87: 351 e		
				f>52: 110 f	f>69: 182 f			195<e≤300: 245 e-32,5	87<e≤500: 245 e-32,5	e>1,63·b+5: 12,4·b-606 e-85	e>1,44·b+9: 15,0·b-791 e-85
								300<e≤500: 123 e-85			

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D3-6 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration I

1 Angle Bracket ABR105 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	6	6	I	f≤38: 228 / f+60	f≤49: 325 / f+60	4,2	6,4	e<37,5: 96 / 37,5-e	e<37,5: 159 / 37,5-e	e≤73: 85 / 85-e	e≤70: 142 / 85-e
								e≤57: 4	e≤63: 5,2	73<e≤1,65·b+9: 7,2	70<e≤1,45·b+14: 9,7
								57<e≤145: 228 / e	63<e≤101: 325 / e		
				f>38: 85 / f	f>49: 142 / f			145<e≤500: 85 / e-85	101<e≤190: 245 / e-32,5	e>1,65·b+9: 11,8·b-545 / e-85	e>1,45·b+14: 14,1·b-690 / e-85
									190<e≤500: 142 / e-85		
Nailing pattern 1	10	14	I	f≤59: 277 / f+60	f≤76: 407 / f+60	8,0	11,2	e<37,5: 169 / 37,5-e	e<37,5: 281 / 37,5-e	e≤67: 151 / 85-e	e≤64: 250 / 85-e
								e≤23: 12,1	e≤26: 15,8	67<e≤1,55·b+7: 8,6	63<e≤1,37·b+11: 12,0
								23<e≤110: 280 / e	26<e≤82: 407 / e		
				f>59: 134 / f	f>76: 223 / f			110<e≤335: 245 / e-32,5	82<e≤500: 245 / e-32,5	e>1,55·b+7: 13,3·b-668 / e-85	e>1,37·b+11: 16,5·b-894 / e-85
								335<e≤500: 151 / e-85			

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D3-7 Modified characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket ABR105 per connection				**Modified characteristic capacity per connection (kN)**			
				$R_{1,k}$ x k_{mod}		**$R_{2,k}$ x k_{mod}**	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x40	CNA4,0x60	CNA4,0x40	CNA4,0x60
	Flange A (beam)	Flange B (column)					
Nailing pattern 5	6	14	P	9,6	10,2	0,9	1,5
			L	11,2	11,9	1,0	1,7
			M	12,8	13,6	1,2	2,0
			S	14,4	15,3	1,3	2,2
			I	17,6	18,7	1,6	2,7

Table D3-8 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

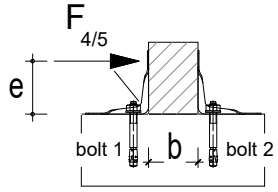
2 Angle Brackets ABR105 per connection			**Characteristic capacities per connection (kN)**								
			$R_{1,k}$				**$R_{2/3,k}$**				**$R_{4/5,k}$**
Nailing pattern	Number of fasteners		CNA connector nails								
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35 to 4,0x60
Nailing pattern 3	10	1 Bolt	min of: 4,08	4,88	6,48	8,08	2,25	2,68	3,55	4,37	$\max \left\{ R_4^{1)} + R_5^{1)} ; \min \left\{ \frac{4,6}{k_{mod}} ; \frac{R_1}{2} \times \frac{b}{e} \right\} \right.$
			$7,7/k_{mod}$								
Nailing pattern 4	6	1 Bolt	1,9	2,28	3,02	3,78	1,6	1,9	2,52	3,09	

1) See table D3-9

Connection with bolt

2 Angle Brackets ABR105 per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt1}$	$F_{4/5,bolt2}$
k_{ax}	0,50	-	e/b	0,13
k_{lat}	-	0,5	-	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.



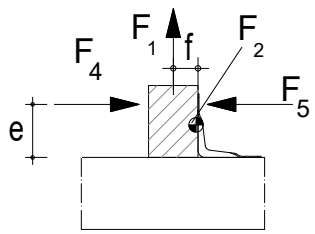


Table D3-9 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket ABR105 per connection			Characteristic capacities per connection (kN)										
			$R_{1,k}$	$R_{4,k}$	$R_{2/3,k}$				$R_{5,k}$				
Nailing pattern	Number of fasteners		CNA connector nails										
	Flange A	Flange B	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 3	10	1 Bolt	45,8 / ((f +81) x k_{mod})	45,28/ (e x k_{mod})	Half of the values for a connection with 2 ABR105, if the timber is prevented from rotation, otherwise R_2/3=0,0kN				X1= 245		X1= 392	490
Nailing pattern 4	6	1 Bolt							X2= 173		X2= 277	347
									$\min\left(\frac{X1}{e-9{,}99mm};\frac{X2}{101mm-e};\frac{265}{e\times k_{mod}}\right)$			

e is to insert in [mm]; e≥ 10mm
negativ values shall not be considered

Connection with bolt

1 Angle Bracket ABR105 per connection				
factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1,00	-	e/15	e/80
k_{lat}	-	-	1,00	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Table D3-10 Characteristic capacity timber beam to timber beam – 2 Angle Bracket ABR105 – Nailing pattern 6

Timber to timber connection		2 angle brackets per connection							
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24			
		Header		Joist		$R_{1,k}$		$R_{2,k}$	
		Qty	Type	Qty	Type	SS-H Ø10x40	SS-H Ø10x80	SS-H Ø10x40	SS-H Ø10x80
ABR105	Nailing pattern 6	3	SS-H	1	SS-H	6,3	12,2	5,7	9,9

Table D3-11 ABR105 Slip modulus k_{ser}

Configuration	Nailing pattern	R_1 load direction		R_2 load direction	
		k_{ser} [kN/mm]		k_{ser} [kN/mm]	
		SS-H Ø10x40	SS-H Ø10x80	SS-H Ø10x40	SS-H Ø10x80
Timber to timber (with SS-H screws)	6	1,12	1,027	0,385	0,545

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Annex D4 – AB105

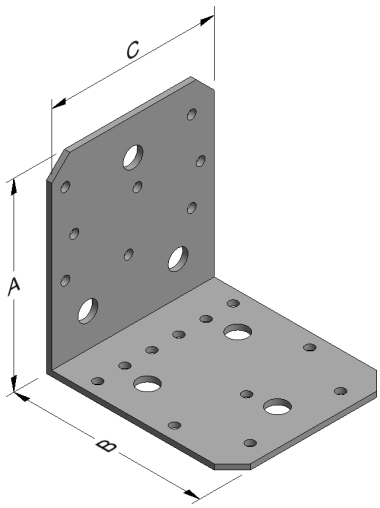
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB105	Steel ref. 1	France: AB105-R, Germany: 105 o/R
AB105S	Steel ref. 2	-
AB105S2	Steel ref. 3	-
AB105Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
AB105	103	103	90	3,0	8	3	11	3

Drawing:



Nailing pattern:

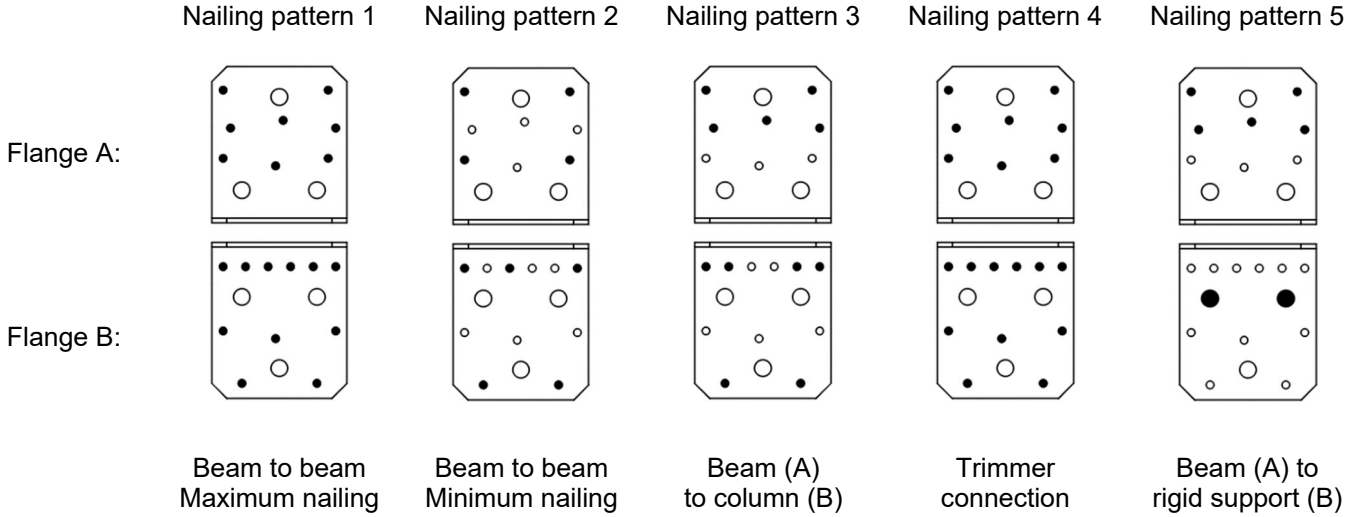


Table D4-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AB105 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	5	P	3,6	5,1	2,4	4,5	$\frac{1,9 \cdot b+75}{e-2,5}$ max 5,5	$\frac{2,6 \cdot b+80}{e-2,5}$ max 7,1
			L	4,1	5,7	2,8	5,3	$\frac{2,0 \cdot b+76}{e-2,5}$ max 6,4	$\frac{2,9 \cdot b+83}{e-2,5}$ max 8,3
			M	4,4	6,3	3,2	6,1	$\frac{2,2 \cdot b+77}{e-2,5}$ max 7,3	$\frac{3,2 \cdot b+85}{e-2,5}$ max 9,4
			S	4,8	6,9	3,6	6,8	$\frac{2,4 \cdot b+79}{e-2,5}$ max 8,2	$\frac{3,4 \cdot b+87}{e-2,5}$ max 10,3
			I	5,5	8,1	4,5	8,3	$\frac{2,7 \cdot b+82}{e-2,5}$ max 10,1	$\frac{4,0 \cdot b+92}{e-2,5}$ max 11,4
Nailing pattern 1	8	11	P	5,8	8,7	8,0	10,9	$\frac{2,9 \cdot b+83}{e-2,5}$ max 8,4	$\frac{4,3 \cdot b+94}{e-2,5}$ max 8,4
			L	6,6	9,8	9,3	12,7	$\frac{3,3 \cdot b+86}{e-2,5}$ max 9,1	$\frac{4,9 \cdot b+99}{e-2,5}$ max 9,1
			M	7,3	11,0	10,6	14,6	$\frac{3,6 \cdot b+89}{e-2,5}$ max 9,7	$\frac{5,5 \cdot b+104}{e-2,5}$ max 9,7
			S	8,0	12,2	12,0	16,4	$\frac{4,0 \cdot b+92}{e-2,5}$ max 10,3	$\frac{6,1 \cdot b+108}{e-2,5}$ max 10,3
			I	9,4	13,6	14,6	20,0	$\frac{4,7 \cdot b+97}{e-2,5}$ max 11,4	$\frac{6,8 \cdot b+114}{e-2,5}$ max 11,4

b and e are in mm

Wane may not occur under the angle brackets.

Table D4-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AB105 per connection				**Modified characteristic capacity per connection (kN)**					
ailing patte	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	5	P	f≤ 80: 59/(f+58); f>80: 40/(f+14)	f≤ 17: 97/(f+58); f>17: 40/(f+14)	1,2	2,3	39,9/(e-3,0) max 5,2	39,9/(e-3,0) max 6,9
			L	f≤48: 68/(f+58); f>48: 40/(f+14)	f≤10: 114/(f+58); f>10: 40/(f+14)	1,4	2,7	39,9/(e-3,0) max 6,1	39,9/(e-3,0) max 8,1
			M	f≤32: 78/(f+58); f>32: 40/(f+14)	f≤6: 130/(f+58); f>6: 40/(f+14)	1,6	3,0	39,9/(e-3,0) max 7,1	39,9/(e-3,0) max 9,3
			S	f≤ 23: 88/(f+58); f>23: 40/(f+14)	f≤3: 146/(f+58); f>3: 40/(f+14)	1,8	3,4	39,9/(e-3,0) max 8,0	39,9/(e-3,0) max 10,5
			I	f≤ 12: 107/(f+58); f>12: 40/(f+14)	f>0: 40/(f+14)	2,2	4,2	39,9/(e-3,0) max 9,8	39,9/(e-3,0) max 12,8
Nailing pattern 1	8	11	P	39,9/(e+14)		4,0	5,5	39,9/(e-3,0) max 12,0	39,9/(e-3,0) max 15,5
			L			4,7	6,4	39,9/(e-3,0) max 14,0	39,9/(e-3,0) max 18,1
			M			5,3	7,3	39,9/(e-3,0) max 16,0	39,9/(e-3,0) max 20,7
			S			6,0	8,2	39,9/(e-3,0) max 18,0	39,9/(e-3,0) max 23,3
			I			7,3	10,0	39,9/(e-3,0) max 22,1	39,9/(e-3,0) max 28,5

e and f are in mm

Wane may not occur under the angle brackets.

Table D4-3 Modified characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket AB105 per connection				**Modified characteristic capacities per connection (kN)**				
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2,k} \times k_{mod}$
	Flange A (beam)	Flange B (column)		Flange turned downwards		Flange turned upwards		
				CNA 4,0x40	CNA 4,0x60	CNA 4,0x40	CNA 4,0x60	CNA4,0x40 & 60
Nailing pattern 3	5	6	P	6,0	7,7	6,9	6,9	1,4
			L	7,0	8,2	7,3	7,3	
			M	8,1	8,6	7,6	7,6	
			S	9,1	9,1	7,9	7,9	
			I	9,8	9,8	8,4	8,4	

End gab: max. 5 mm

Table D4-4 Modified characteristic capacity trimmer connection – 2 Angle Brackets

2 Angle Brackets AB105 per connection				Modified characteristic capacity per connection (kN)	
				$R_{2,3k} \times k_{mod}$	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x40	CNA4,0x60
	Joist flange (A)	Header flange (B)			
Nailing pattern 4	8	11	P	8,0	10,9
			L	9,3	12,7
			M	10,6	14,6
			S	12,0	16,4
			I	14,6	20,0

Wane may not occur under the angle brackets.

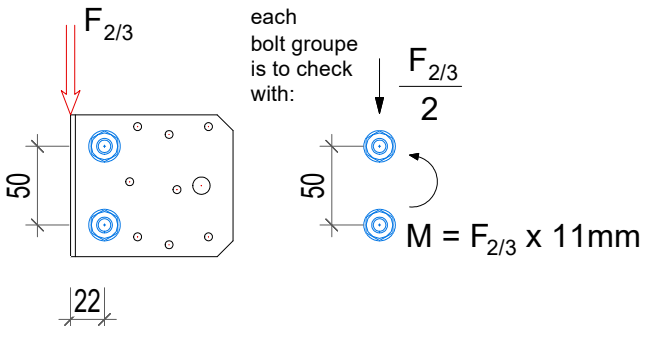
Table D4-5 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets AB105 per connection			Characteristic capacities per connection (kN)								
			$R_{1,k}$				$R_{2/3,k}$				$R_{4/5,k}$
Nailing pattern	Number of fasteners		CNA connector nails								
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35 to 4,0x60
Nailing pattern 5	5	2 Bolts	min of:				4,86	5,18	6,43	6,85	$\max \left\{ R_4{}^{1)} + R_5{}^{1)} ; \min \left\{ \frac{2,0}{k_{mod}} ; \frac{R_1}{2} \times \frac{b}{e} \right\} \right\}$
			12,3	13,76	17,58	19,76					
			$11,3/k_{mod}$								1) for e

Connection with bolt

2 Angle Brackets AB105 per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt1}$	$F_{4/5,bolt2}$
k_{ax}	0,79	-	1,58 x e/b	0,47
k_{lat}	-	see description	-	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.



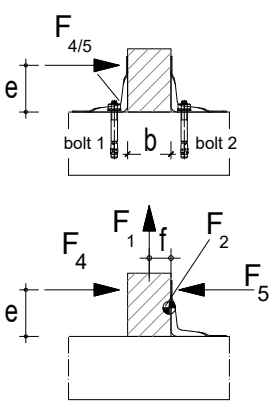


Table D4-6 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

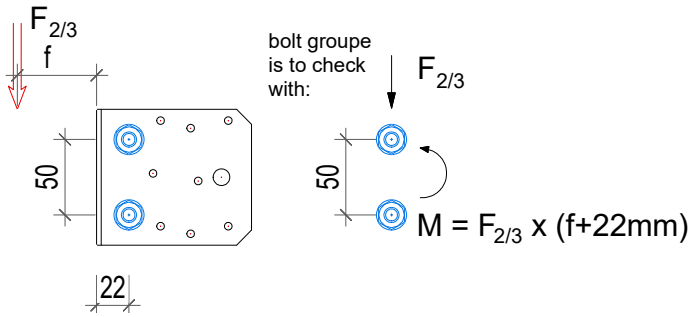
1 Angle Bracket AB105 per connection			Characteristic capacities per connection (kN)						
			$R_{1,k}$	$R_{4,k}$	$R_{2/3,k}$	$R_{5,k}$			
Nailing pattern	Number of fasteners		CNA connector nails						
	Flange A	Flange B	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35 to 4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 5	5	2 bolts	19,9 / ((f +18) x k_{mod})	19,9 / (e x k_{mod})	Half of the values for a connection with 2 AB105, if the timber is prevented from rotation, otherwise R_2/3=0,0kN	X1= 158	190	253	316
						X2= 123	148	197	246
						$\min\left(\frac{X1}{e-9{,}99mm};\frac{X2}{101mm-e};\frac{45{,}2}{e\times k_{mod}}\right)$			

e is to insert in [mm]; e≥ 10mm
negativ values shall not be considered

Connection with bolt

1 Angle Bracket AB105 per connection				
factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1,58	0,00	e/21	e/28
k_{lat}	-	see description	1,00	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.



Annex D5 – ABR70

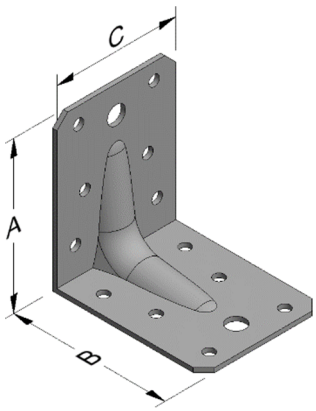
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR70	Steel ref. 1	France: EB/7070, Germany: 70 m/R
ABR70S	Steel ref. 2	-
ABR70S2	Steel ref. 3	-
ABR70Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø8,5	Ø5	Ø8,5
ABR70	70	70	55	2,0	6	1	6	1

Drawing:



Nailing pattern:

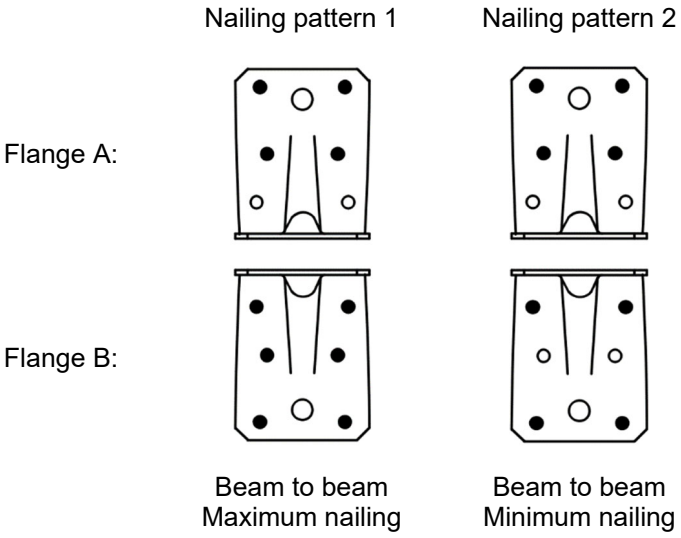


Table D5-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR70 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	P	2,1 2,1	3,0 3,0	2,9	4,1	1,04·b+155 e max 3,5	1,48·b+161 e max 5,0
			L	2,4 2,4	3,4 3,4	3,4	4,8	1,18·b+157 e max 4,0	1,72·b+165 e max 5,9
			M	2,4 2,4	3,9 3,9	3,9	5,5	1,18·b+157 e max 4,0	1,97·b+169 e max 6,7
			S	2,7 2,7	4,4 4,3	4,4	6,2	1,33·b+159 e max 4,5	2,21·b+172 e max 7,5
			I	3,3 3,3	5,4 5,1	5,3	7,5	1,63·b+164 e max 5,5	2,71·b+180 e max 9,2
Nailing pattern 1	4	6	P	3,2 2,5	5,3 4,1	3,0	4,4	1,60·b+179 e max 6,0	2,66·b+206 e max 9,9
			L	3,7 3,1	6,2 4,6	3,5	5,1	1,86·b+186 e max 7,0	3,10·b+217 e max 11,6
			M	4,3 3,4	7,1 5,2	4,0	5,8	2,13·b+192 e max 8,0	3,54·b+228 e max 13,2
			S	4,8 3,7	8,0 5,8	4,5	6,6	2,40·b+199 e max 9,0	3,99·b+239 e max 14,9
			I	5,9 4,4	9,7 6,9	5,5	8,0	2,93·b+212 e max 10,9	4,87·b+261 e max 18,2

b and e are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square is valid.

Table D5-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration P

1 Angle Bracket ABR70 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	P	f≤ 26: 54 / f+62,5 f>26: 15,5 / f	f≤ 24: 76 / f+62,5 f>24: 21 / f	1,5	2,1	e<40: 28,5 / 40-e e≤ 26: 2,2 26<e≤ 53: 54 / e e>53: 21 / e-35	e<40: 40,6 / 40-e e≤ 27: 2,8 27<e≤ 48: 76 / e e>48: 21 / e-35	Min: 21 / 55-e 1,5 1,0·b+10 / e	Min: 30 / 55-e 2,1 1,5·b+15 / e
Nailing pattern 1	4	6	P	f≤ 16: 66 / f+62,5 f>16: 13,3 / f	f≤ 15: 109 / f+62,5 f>15: 21 / f	1,5	2,2	e<40: 24,4 / 40-e e≤ 29: 2,2 29<e≤ 52: 64 / e e>52: 21 / e-35	e<40: 40,6 / 40-e e≤ 28: 2,8 28<e≤ 48: 79 / e e>48: 21 / e-35	Min: 18 / 55-e 1,5 1,6·b+32 / e	Min: 30 / 55-e 2,5 2,7·b+53 / e

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D5-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration L

1 Angle Bracket ABR70 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	L	f≤ 26: 61 / f+62,5 f>26: 17,8 / f	f≤ 19: 89 / f+62,5 f>19: 21 / f	1,7	2,4	e<40: 32,6 / 40-e e≤ 24: 2,6 24<e≤ 49: 61 / e e>49: 21 / e-35	e<40: 47,4 / 40-e e≤ 24: 3,3 24<e≤ 48: 79 / e e>48: 21 / e-35	Min: 24 / 55-e 1,7 1,2·b+12 / e	Min: 34 / 55-e 2,4 1,7·b+17 / e
Nailing pattern 1	4	6	L	f≤ 16: 77 / f+62,5 f>16: 15,5 / f	f≤ 12: 127 / f+62,5 f>12: 21 / f	1,7	2,6	e<40: 28,5 / 40-e e≤ 29: 2,6 29<e≤ 49: 74 / e e>49: 21 / e-35	e<40: 47,4 / 40-e e≤ 24: 3,3 24<e≤ 48: 79 / e e>48: 21 / e-35	Min: 21 / 55-e 1,8 1,9·b+37 / e	Min: 34 / 55-e 3,0 3,1·b+62 / e

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D5-4 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration M

1 Angle Bracket ABR70 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	M	f≤ 26: $\frac{61}{f+62,5}$ f>26: $\frac{17,8}{f}$	f≤ 16: $\frac{102}{f+62,5}$ f>16: $\frac{21}{f}$	1,9	2,7	e<40: $\frac{32,6}{40-e}$ e≤ 21: 2,9 21<e≤ 48: $\frac{61}{e}$ e>48: $\frac{21}{e-35}$	e<40: $\frac{54,1}{40-e}$ e≤ 21: 3,8 21<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	Min: $\frac{24}{55-e}$ 1,7 $\frac{1,2 \cdot b+12}{e}$	Min: $\frac{39}{55-e}$ 2,8 $\frac{2,0 \cdot b+20}{e}$
Nailing pattern 1	4	6	M	f≤ 16: $\frac{88}{f+62,5}$ f>16: $\frac{17,8}{f}$	f≤ 11: $\frac{146}{f+62,5}$ f>11: $\frac{21}{f}$	2	2,9	e<40: $\frac{32,6}{40-e}$ e≤ 27: 2,9 27<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	e<40: $\frac{54,1}{40-e}$ e≤ 21: 3,8 21<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	Min: $\frac{24}{55-e}$ 2 $\frac{2,1 \cdot b+43}{e}$	Min: $\frac{39}{55-e}$ 3,4 $\frac{3,5 \cdot b+71}{e}$

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the gray square shall be checked additionelly.

Table D5-5 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration S

1 Angle Bracket ABR70 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	S	f≤ 26: $\frac{69}{f+62,5}$ f>26: $\frac{20}{f}$	f≤ 14: $\frac{115}{f+62,5}$ f>14: $\frac{21}{f}$	2,2	3,1	e<40: $\frac{36,6}{40-e}$ e≤ 21: 3,3 21<e≤ 48: $\frac{69}{e}$ e>48: $\frac{21}{e-35}$	e<40: $\frac{60,9}{40-e}$ e≤ 19: 4,2 19<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	Min: $\frac{27}{55-e}$ 1,9 $\frac{1,3 \cdot b+13}{e}$	Min: $\frac{44}{55-e}$ 3,1 $\frac{2,2 \cdot b+22}{e}$
Nailing pattern 1	4	6	S	f≤ 16: $\frac{99}{f+62,5}$ f>16: $\frac{20}{f}$	f≤ 9: $\frac{164}{f+62,5}$ f>9: $\frac{21}{f}$	2,2	3,3	e<40: $\frac{36,6}{40-e}$ e≤ 24: 3,3 24<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	e<40: $\frac{60,9}{40-e}$ e≤ 19: 4,2 19<e≤ 48: $\frac{79}{e}$ e>48: $\frac{21}{e-35}$	Min: $\frac{27}{55-e}$ 2,3 $\frac{2,4 \cdot b+48}{e}$	Min: $\frac{44}{55-e}$ 3,8 $\frac{4,0 \cdot b+80}{e}$

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Table D5-6 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket Load duration I

1 Angle Bracket ABR70 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
				CNA Connector nail							
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	4	4	I	f≤ 21: 84 / f+62,5 f>21: 21 / f	f≤ 11: 139 / f+62,5 f>11: 21 / f	2,7	3,8	e<40: 44,8 / 40-e e≤ 20: 4,0 20<e≤ 48: 79 / e e>48: 21 / e-35	e<40: 74,4 / 40-e e≤ 15: 5,2 15<e≤ 48: 79 / e e>48: 21 / e-35	Min: 33 / 55-e 2,3 1,6·b+16 / e	Min: 54 / 55-e 3,8 2,7·b+27 / e
Nailing pattern 1	4	6	I	f≤ 13: 120 / f+62,5 f>13: 21 / f	f≤ 7: 199 / f+62,5 f>7: 21 / f	2,7	4,0	e<40: 44,8 / 40-e e≤ 20: 4,0 20<e≤ 48: 79 / e e>48: 21 / e-35	e<40: 74,4 / 40-e e≤ 15: 5,2 15<e≤ 48: 79 / e e>48: 21 / e-35	Min: 33 / 55-e 2,8 2,9·b+59 / e	Min: 54 / 55-e 4,7 4,9·b+97 / e

b, e and f are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the formula in the grey square shall be checked additionelly.

Annex D6 – AB70

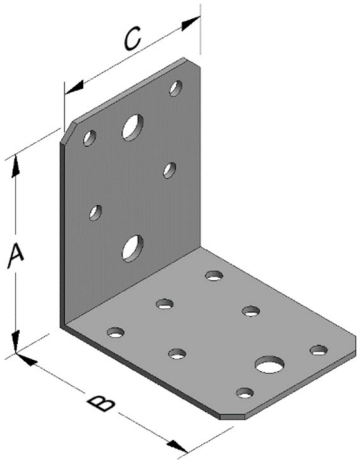
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB70	Steel ref. 1	Germany: 70 o/R
AB70S	Steel ref. 2	-
AB70S2	Steel ref. 3	-
AB70Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø8,5	Ø5	Ø8,5
AB70	70	70	55	2,0	4	2	7	1

Drawing:



Nailing pattern:

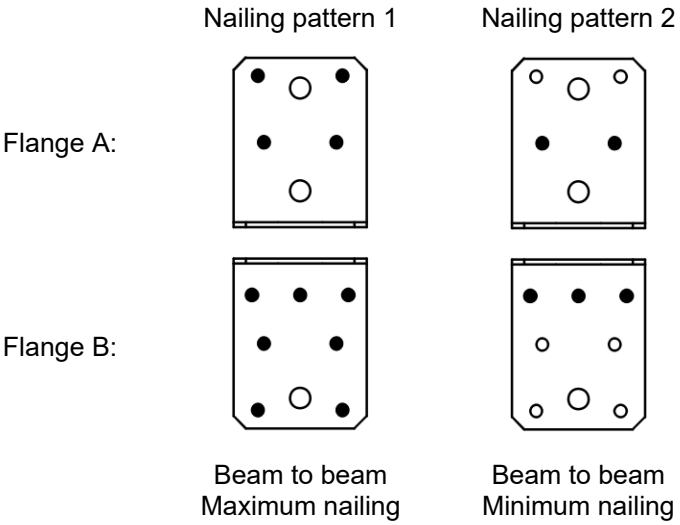


Table D6-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AB70 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	2	3	P	2,7	4,0	2,3	3,4	1,33·b+26 e-2 max 3,3	1,98·b+30 e-2 max 3,5
			L	3,0	4,5	2,7	3,9	1,50·b+27 e-2 max 3,8	2,25·b+32 e-2 max 3,8
			M	3,3	4,7	3,1	4,5	1,66·b+28 e-2 max 3,8	2,34·b+33 e-2 max 4,0
			S	3,6	4,7	3,5	5,1	1,82·b+29 e-2 max 4,3	2,34·b+33 e-2 max 4,3
			I	4,3	4,7	4,2	6,2	2,14·b+31 e-2 max 4,7	2,34·b+33 e-2 max 4,7
Nailing pattern 1	4	7	P	2,7 2,5	4,0 3,8	3,2	4,5	1,33·b+26 e-2 max 3,5	1,98·b+30 e-2 max 3,5
			L	2,9 2,8	4,5 4,2	3,8	5,3	1,45·b+26 e-2 max 3,8	2,25·b+32 e-2 max 3,8
			M	3,3 3,2	4,7 4,2	4,3	6,0	1,66·b+28 e-2 max 4,0	2,34·b+33 e-2 max 4,0
			S	3,6 3,5	4,7 4,2	4,9	6,8	1,82·b+29 e-2 max 4,3	2,34·b+33 e-2 max 4,3
			I	4,2 4,0	4,7 4,2	5,9	8,3	2,07·b+31 e-2 max 4,7	2,34·b+33 e-2 max 4,7

b and e are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square shalle be checked additionelly.

Annex D7 – E20/3

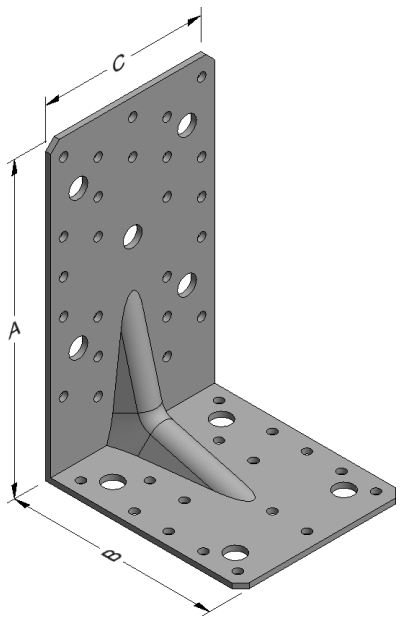
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E20/3	Steel ref. 1	-
E20/3S	Steel ref. 2	-
E20/3S2	Steel ref. 3	-
E20/3Z	Steel ref. 6	-

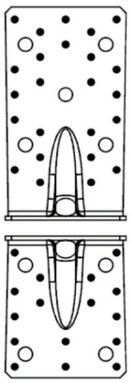
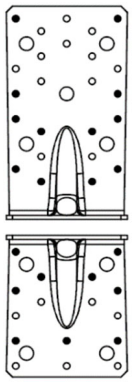
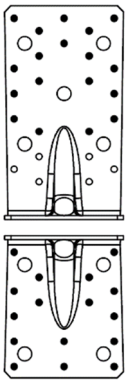
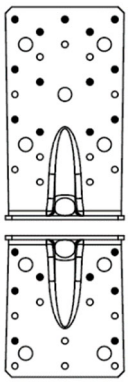
Connector Size Range:

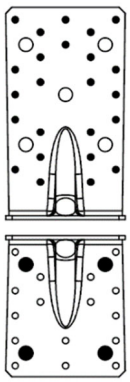
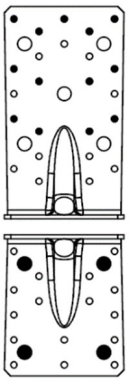
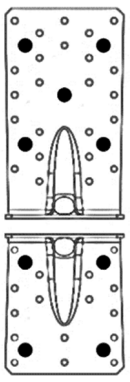
Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
E20/3	170	113	95	3,0	24	5	16	4

Drawing:



Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A: / Flange B:				
	Beam to beam Maximum nailing	Beam to beam Minimum nailing	Trimmer connection	Column (A) to beam (B)

	Nailing pattern 5	Nailing pattern 6	Nailing pattern 7
Flange A: / Flange B:			
	Beam (A) to rigid support (B)	Column (A) to rigid support (B)	Beam to beam with large connector screws type SS-H

Nailing pattern 5 to 7:

In case of a pure tension load (F1) it may be an option, to connected the E20/3 only with the 2 bolts near the flange A

Table D7-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets E20/3 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
				CNA Connector nail			
	Flange A	Flange B		4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	12	9	P	3,3	5,3	9,0	12,1
			L	3,9	6,2	10,5	14,2
			M	4,4	7,1	12,0	16,2
			S	5,0	7,9	13,5	18,2
			I	6,1	9,7	16,5	22,2
Nailing pattern 1	24	16	P	4,4	7,1	11,9	15,9
				3,2	5,2		
			L	5,1	8,2	13,9	18,6
				3,8	6,1		
			M	5,9	9,4	15,9	21,2
				4,3	7,0		
			S	6,6	10,6	17,9	23,9
				4,9	7,8		
			I	8,1	12,9	21,8	29,2
				6,0	9,6		

b and e are in mm.

When the purlin has a wane on the side towards the Angle Bracket with an extent form the bottom up to the lower nail the value in the gray square is valid.

Table D7-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets E20/3 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	12	9	P	f≤ 58: $\frac{119}{f+73}$ f>58: $\frac{53}{f}$	f≤ 80: $\frac{162}{f+73}$ f>80: $\frac{85}{f}$	4,5	6,1
			L	f≤ 65: $\frac{131}{f+73}$ f>65: $\frac{62}{f}$	f≤ 88: $\frac{181}{f+73}$ f>88: $\frac{99}{f}$	5,3	7,1
			M	f≤ 71: $\frac{143}{f+73}$ f>71: $\frac{71}{f}$	f≤ 94: $\frac{200}{f+73}$ f>94: $\frac{113}{f}$	6,0	8,1
			S	f≤ 77: $\frac{155}{f+73}$ f>77: $\frac{79}{f}$	f≤ 101: $\frac{219}{f+73}$ f>101: $\frac{127}{f}$	6,8	9,1
			I	f≤ 87: $\frac{179}{f+73}$ f>87: $\frac{97}{f}$	f≤ 112: $\frac{257}{f+73}$ f>112: $\frac{155}{f}$	8,3	11,1

f are in mm.

Wane may not occur under the angle bracket.

Table D7-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets E20/3 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	FlangeB		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 1	24	16	P	f≤ 58: 119/(f+73); f>58: 53/f	f≤ 80: 162/(f+73); f>80: 85/f	6,0	8,0
			L	f≤ 65: 131/(f+73); f>65: 62/f	f≤ 90: 181/(f+73); f>90: 99/f	6,9	9,3
			M	f≤ 71: 143/(f+73); f>71: 71/f	f≤ 95: 200/(f+73); f>95: 113/f	7,9	10,6
			S	f≤ 77: 155/(f+73); f>77: 79/f	f≤ 101: 219/(f+73); f>101: 127/f	8,9	11,9
			I	f≤ 87: 179/(f+73); f>87: 97/f	f≤ 112: 257/(f+73); f>112: 155/f	10,9	14,6

f are in mm.
Wane may not occur under the angle bracket.

Table D7-4 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets

2 Angle Brackets E20/3 per connection				Modified characteristic capacity per connection (kN)			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 4	13	8	P	3,3	5,3	7,1	9,5
			L	3,9	6,2	8,2	11,1
			M	4,4	7,1	9,4	12,7
			S	5,0	7,9	10,6	14,3
			I	6,1	9,7	12,9	17,5

Table D7-5 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets E20/3 per connection				Modified characteristic capacity per connection (kN)			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 5	24	4 Bolts	P	32,2	42,6	23,4	26,8
				22,0	33,6		
			L	37,5	49,7	27,3	31,3
				25,6	39,2		
			M	42,9	56,8	31,2	35,8
				29,3	44,8		
			S	48,3	63,9	35,1	40,2
				33,0	50,4		
			I	59,0	78,1	42,9	49,2
				40,3	61,6		

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square is valid.

Requirement for bolts - see declaration under table D7-6.

Table D7-6 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Brackets E20/3 per connection				Modified characteristic capacity per connection (kN)			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
				CNA Connector nail			
	Flange A	Flange B		4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 5	24	4 Bolts	P	f≤ 4: $\frac{336}{f+19,1}$ f>4: $\frac{53}{f}$	f≤ 6: $\frac{336}{f+19,1}$ f>6: $\frac{85}{f}$	11,7	14,2
			L	f≤ 4: $\frac{336}{f+19,1}$ f>4: $\frac{62}{f}$	f≤ 8: $\frac{336}{f+19,1}$ f>8: $\frac{99}{f}$	13,7	16,5
			M	f≤ 5: $\frac{336}{f+19,1}$ f>5: $\frac{71}{f}$	f≤ 10: $\frac{336}{f+19,1}$ f>10: $\frac{113}{f}$	15,6	18,9
			S	f≤ 6: $\frac{336}{f+19,1}$ f>6: $\frac{79}{f}$	f≤ 12: $\frac{336}{f+19,1}$ f>12: $\frac{127}{f}$	17,6	21,3
			I	f≤ 8: $\frac{336}{f+19,1}$ f>8: $\frac{97}{f}$	f≤ 16: $\frac{336}{f+19,1}$ f>16: $\frac{155}{f}$	21,5	26,0

f are in mm.

Force direction F_1: the two bolts in the first row, next to the bending line, shall have a capacity to sustain an axial force of $1,1 \times F_{1,d}$.

Force direction F_2: the bolt group shall have a capacity to sustain the followings:

$F_{2,d}$; $M_{X,F2}=F_{2,d} \times 59mm$; $M_{Y,F2}=F_{2,d} \times 89mm$ see picture

The force F_2 must be applied to each E20/3. So for a connection with two E20/3, the bolt group for one angle bracket has to be calculated for $F_2/2$, same for force direction F_1.

Wane may not occur under the angle brackets.

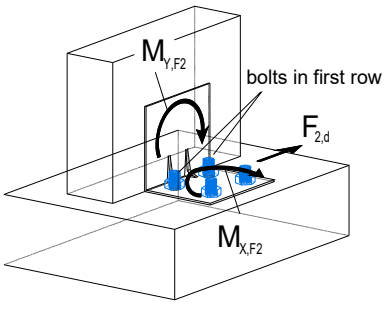


Table D7-7 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets

1 Angle Bracket E20/3 per connection				**Modified characteristic capacities per connection (kN) [1)]**			
				$R_{1,k}$ x k_{mod}		**$R_{2/3,k}$ x k_{mod}**	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A	Flange B					
Nailing pattern 6	13	4 bolts	P	18,1	24,0	15,3	17,5
			L	21,1	28,0	17,8	20,4
			M	24,1	32,0	20,4	23,3
			S	27,2	36,0	22,9	26,2
			I	33,2	44,0	28,0	32,0

Wane may not occur under the angle bracket.

[1)] The capacities are based on the assumption that the bolts have a characteritic lateral capacitt of 20 kN and a characteristic axial capacity of 22 kN. If one of the characteristic capacities of the choosen bolts is smaller, the cpacity of the connection shall be reduced proportionally.

Table D7-8 Modified characteristic capacity timber to timber – trimmer connection

1 or 2 Angle Bracket(-s) E20/3 per connection				**Modified characteristic capacity per connection (kN)**			
				2 Angle Brackets E20/3 per connection		**1 Angle Bracket E20/3 per connection**	
				$R_{2/3,k}$ x k_{mod}		**$R_{2/3,k}$ x k_{mod}**	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A	Flange B					
Nailing pattern 3	18	16	P	7,6	11,6	3,8	5,8
			L	8,9	13,5	4,4	6,7
			M	10,1	15,4	5,1	7,7
			S	11,4	17,4	5,7	8,7
			I	13,9	21,2	7,0	10,6

Wane may not occur under the angle brackets.

Table D7-9 Characteristic capacity CLT timber beam to CLT timber beam – 2 Angle Bracket E20/3 – Nailing pattern 6

CLT to CLT connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - CLT	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø10x80	SS-H Ø10x80
E20/3	Nailing pattern 7	4	SS-H	5	SS-H	29	26

CLT density was considered as C24 - ρ_k = 350 kg/m³

Table D7-10 E20/3 Slip modulus k_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
		SS-H Ø10x80	SS-H Ø10x80
CLT to CLT (with SS-H screws)	7	2,54	1,97

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Annex D8 – E9/2.5

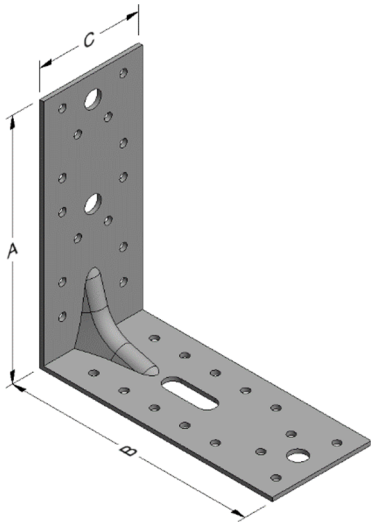
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E9/2.5	Steel ref. 1	-
E9/2.5S	Steel ref. 2	-
E9/2.5S2	Steel ref. 3	-
E9/2.5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
E9/2.5	154	152,5	65	2,5	14	2	14	2

Drawing:



Nailing pattern:

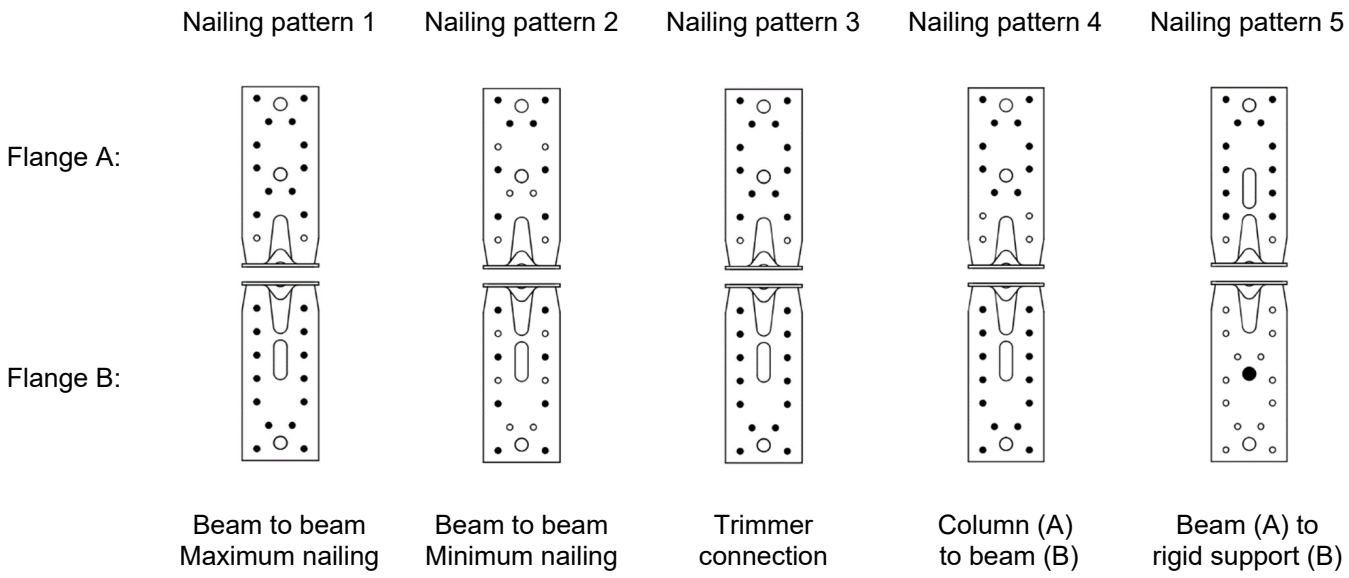


Table D8-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets E9/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
ailing patte	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	8	8	P	1,1	1,9	4,0	5,3
				1,0	1,6		
			L	1,3	2,3	4,6	6,2
				1,1	1,8		
			M	1,5	2,6	5,3	7,1
				1,3	2,1		
			S	1,7	3,0	5,9	8,0
				1,5	2,3		
			I	2,2	3,9	7,2	9,7
				1,8	2,9		
Nailing pattern 1	12	14	P	2,9	4,8	5,7	7,8
				2,2	3,6		
			L	3,4	5,7	6,6	9,1
				2,6	4,2		
			M	3,9	6,7	7,6	10,4
				3,0	4,8		
			S	4,5	7,6	8,5	11,7
				3,4	5,4		
			I	5,6	9,5	10,4	14,3
				4,1	6,6		

When the purlin has a wane on the side towards the Angle Bracket with an extent form the bottom up to the lower nail the value in the grey square is valid.

Table D8-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets E9/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	8	8	P	f≤ 24: $\frac{45}{f+62,5}$ f>24: $\frac{12}{f}$	f≤ 31: $\frac{60}{f+62,5}$ f>31: $\frac{20}{f}$	2,0	2,7
			L	f≤ 26: $\frac{49}{f+62,5}$ f>26: $\frac{15}{f}$	f≤ 27: $\frac{67}{f+62,5}$ f>27: $\frac{20}{f}$	2,3	3,1
			M	f≤ 28: $\frac{53}{f+62,5}$ f>28: $\frac{17}{f}$	f≤ 24: $\frac{74}{f+62,5}$ f>24: $\frac{20}{f}$	2,6	3,5
			S	f≤ 30: $\frac{58}{f+62,5}$ f>30: $\frac{19}{f}$	f≤ 21: $\frac{80}{f+62,5}$ f>21: $\frac{20}{f}$	3,0	4,0
			I	f≤ 28: $\frac{66}{f+62,5}$ f>28: $\frac{20}{f}$	f≤ 17: $\frac{94}{f+62,5}$ f>17: $\frac{20}{f}$	3,6	4,9

f are in mm.
Wane may not occur under the angle bracket.

Table D8-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets E9/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
				CNA Connector nail			
	Flange A	Flange B		4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 1	12	14	P	f≤ 25: 35 / f+44 f>25: 12 / f	f≤ 38: 43 / f+44 f>38: 20 / f	2,8	3,9
			L	f≤ 29: 37 / f+44 f>29: 15 / f	f≤ 33: 47 / f+44 f>33: 20 / f	3,3	4,5
			M	f≤ 32: 39 / f+44 f>32: 17 / f	f≤ 29: 51 / f+44 f>29: 20 / f	3,8	5,2
			S	f≤ 35: 42 / f+44 f>35: 19 / f	f≤ 26: 55 / f+44 f>26: 20 / f	4,3	5,8
			I	f≤ 34: 47 / f+44 f>34: 20 / f	f≤ 21: 62 / f+44 f>21: 20 / f	5,2	7,1

f are in mm.

Wane may not occur under the angle bracket.

Table D8-4 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket

2 Angle Brackets E9/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
				$R_{1,k}$ x k_{mod}		$R_{2,k}$ x k_{mod}	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A (column)	Flange B (beam)					
Nailing pattern 4	10	14	P	1,8	3,0	3,3	5,1
			L	2,1	3,5	3,9	6,0
			M	2,4	4,1	4,4	6,8
			S	2,8	4,7	5,0	7,7
			I	3,5	5,9	6,1	9,4

Table D8-5 Modified characteristic capacity trimmer connection

1 or 2 Angle Bracket(-s) E9/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
				2 Angle Brackets E9/2.5 per connection		**1 Angle Bracket E9/2.5 per connection**	
				$R_{2/3,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A	Flange B					
Nailing pattern 3	12	14	P	5,7	7,8	2,8	3,9
			L	6,6	9,1	3,3	4,5
			M	7,6	10,4	3,8	5,2
			S	8,5	11,7	4,3	5,8
			I	10,4	14,3	5,2	7,1

Table D8-6 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets E9/2.5 per connection			**Characteristic capacities per connection (kN)**
			$R_{1,k}$
Nailing pattern	Number of fasteners		CNA4,0x35
	Flange A	Flange B	
Nailing pattern 5	12	1 Bolt	6,0

The bolt group must be able to resist to $R_{1,\text{tension of bolt},d} = F_{1,d}$ x 2,7

Annex D9 – E9S/2.5

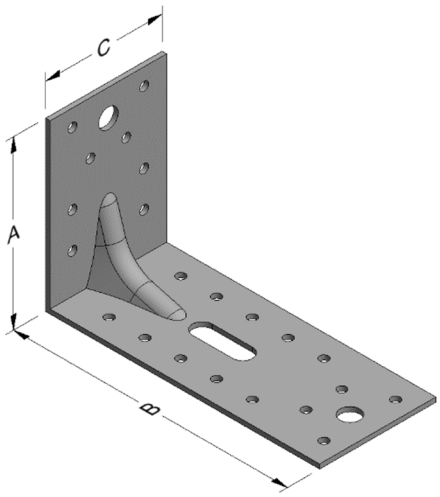
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E9S/2.5	Steel ref. 1	-
E9S/2.5S	Steel ref. 2	-
E9S/2.5S2	Steel ref. 3	-
E9S/2.5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø11
E9S/2.5	94	152,5	65	2,5	8	1	14	2

Drawing:



Nailing pattern:

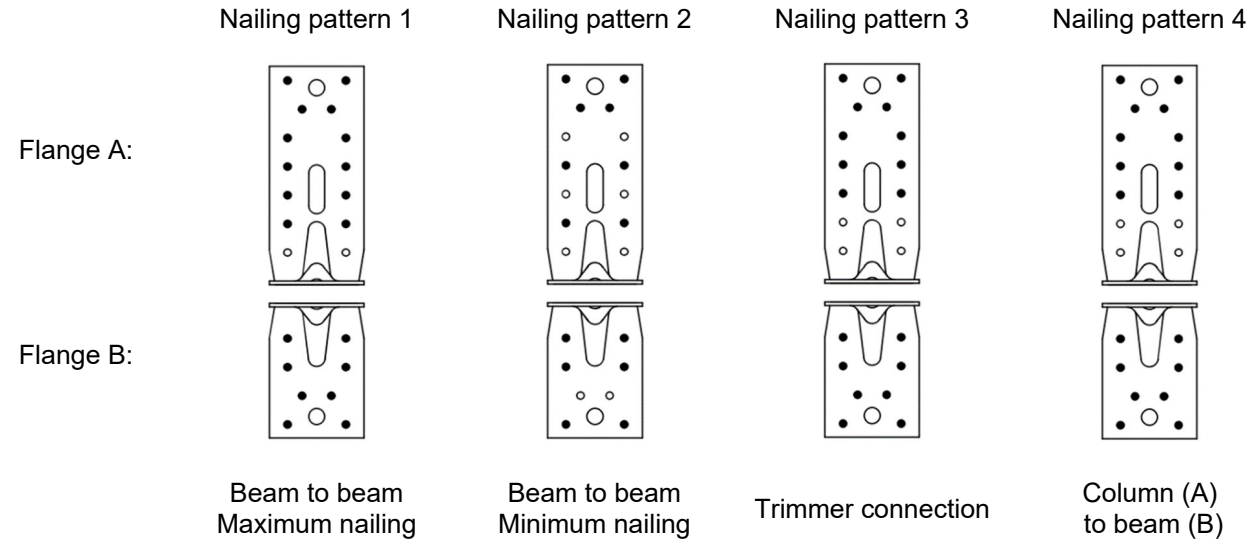


Table D9-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets E9S/2.5 per connection				Modified characteristic capacity per connection (kN)			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	8	6	P	1,0	1,7	4,1	5,2
				0,6	1,0		
			L	1,2	2,1	4,8	6,1
				0,8	1,2		
			M	1,4	2,4	5,4	7,0
				0,9	1,4		
			S	1,6	2,8	6,1	7,9
				1,0	1,6		
			I	2,0	3,5	7,5	9,6
				1,2	1,9		
Nailing pattern 1	12	8	P	2,7	4,5	5,3	7,1
				2,1	3,4		
			L	3,2	5,4	6,2	8,3
				2,5	4,0		
			M	3,7	6,2	7,0	9,5
				2,9	4,6		
			S	4,2	7,1	7,9	10,7
				3,2	5,2		
			I	5,3	8,9	9,7	13,0
				3,9	6,3		

When the purlin has a wane on the side towards the Angle Bracket with an extent form the bottom up to the lower nail the value in the grey square is valid.

Table D9-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket E9S/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 2	8	6	P	f≤ 28: $\frac{83}{f+84}$ f>28: $\frac{20}{f}$	f≤ 17: $\frac{120}{f+84}$ f>17: $\frac{20}{f}$	2,0	2,6
			L	f≤ 24: $\frac{93}{f+84}$ f>24: $\frac{20}{f}$	f≤ 15: $\frac{137}{f+84}$ f>15: $\frac{20}{f}$	2,4	3,1
			M	f≤ 21: $\frac{103}{f+84}$ f>21: $\frac{20}{f}$	f≤ 13: $\frac{154}{f+84}$ f>13: $\frac{20}{f}$	2,7	3,5
			S	f≤ 18: $\frac{114}{f+84}$ f>18: $\frac{20}{f}$	f≤ 11: $\frac{170}{f+84}$ f>11: $\frac{20}{f}$	3,1	3,9
			I	f≤ 15: $\frac{134}{f+84}$ f>15: $\frac{20}{f}$	f≤ 9: $\frac{204}{f+84}$ f>9: $\frac{20}{f}$	3,7	4,8

f are in mm.
Wane may not occur under the angle bracket.

Table D9-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket E9S/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x35	4,0x50	4,0x35	4,0x50
Nailing pattern 1	12	8	P	f≤ 27: $\frac{33}{f+44}$ f>27: $\frac{12}{f}$	f≤ 43: $\frac{40}{f+44}$ f>43: $\frac{20}{f}$	2,6	3,6
			L	f≤ 32: $\frac{35}{f+44}$ f>32: $\frac{15}{f}$	f≤ 38: $\frac{44}{f+44}$ f>38: $\frac{20}{f}$	3,1	4,2
			M	f≤ 36: $\frac{37}{f+44}$ f>36: $\frac{17}{f}$	f≤ 34: $\frac{47}{f+44}$ f>34: $\frac{20}{f}$	3,5	4,7
			S	f≤ 41: $\frac{39}{f+44}$ f>41: $\frac{19}{f}$	f≤ 30: $\frac{50}{f+44}$ f>30: $\frac{20}{f}$	4,0	5,3
			I	f≤ 39: $\frac{43}{f+44}$ f>39: $\frac{20}{f}$	f≤ 25: $\frac{57}{f+44}$ f>25: $\frac{20}{f}$	4,8	6,5

f are in mm.

Wane may not occur under the angle bracket.

Table D9-4 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket

2 Angle Brackets E9S/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
				$R_{1,k}$ x k_{mod}		**$R_{2,k}$ x k_{mod}**	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A (beam)	Flange B (column)					
Nailing pattern 4	8	10	P	1,7	2,8	4,2	5,8
			L	2,0	3,3	4,9	6,8
			M	2,3	3,9	5,6	7,7
			S	2,6	4,4	6,3	8,7
			I	3,3	5,5	7,7	10,6

Table D9-5 Modified characteristic capacity trimmer connection

1 or 2 Angle Bracket(-s) E9S/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
				2 Angle Brackets E9S/2.5 per connection		**1 Angle Bracket E9S/2.5 per connection**	
				$R_{2/3,k}$ x k_{mod}		**$R_{2/3,k}$ x k_{mod}**	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x35	CNA4,0x50	CNA4,0x35	CNA4,0x50
	Flange A	Flange B					
Nailing pattern 3	8	10	P	4,1	5,2	2,0	2,6
			L	4,8	6,1	2,4	3,1
			M	5,4	7,0	2,7	3,5
			S	6,1	7,9	3,1	3,9
			I	7,5	9,6	3,7	4,8

Annex D10 – ABR9015

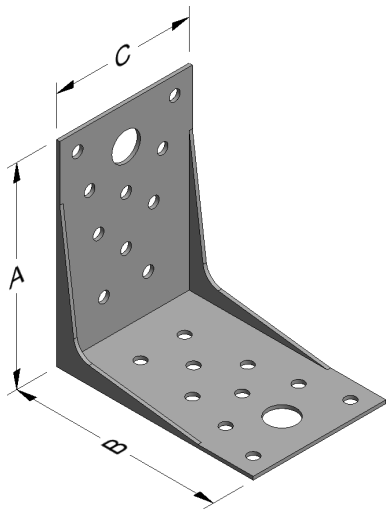
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR9015	Steel ref. 1	-
ABR9015S	Steel ref. 2	-
ABR9015S2	Steel ref. 3	-
ABR9015Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
ABR9015	89	89	60	1,5	10	1	10	1

Drawing:



Nailing pattern:

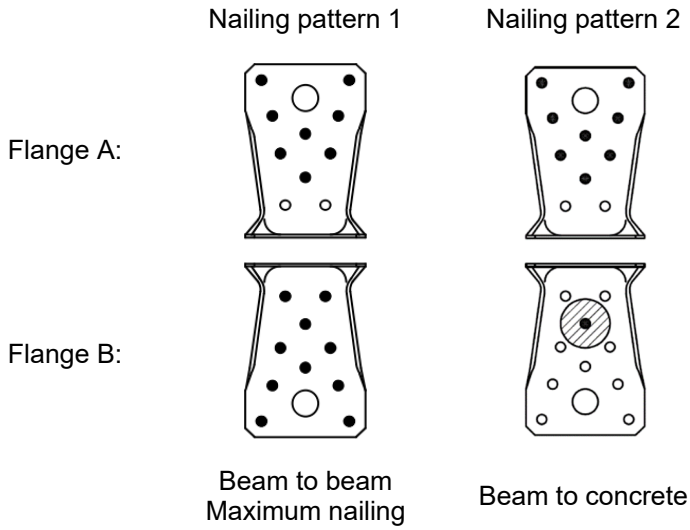


Table D10-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Bracket ABR9015 per connection				**Modified characteristic capacity per connection (kN)**		
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4/5,k} \times k_{mod}$
	Flange A	Flange B		CSA Connector screw 5,0x40		
Nailing pattern 1	8	10	P	8,0	6,3	$\frac{4,1 \cdot b+210}{e}$ max 19,4
			L	9,3	7,3	$\frac{4,5 \cdot b+215}{e}$ max 22,6
			M	10,6	8,4	$\frac{4,9 \cdot b+219}{e}$ max 25,7
			S	11,8	9,4	$\frac{5,3 \cdot b+224}{e}$ max 28,8
			I	14,4	11,5	$\frac{6,2 \cdot b+227}{e}$ max 35,1

Wane may occur under the angle brackets.

Table D10-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR9015 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4,k} \times k_{mod}$	$R_{5,k} \times k_{mod}$
	Flange A	Flange B		CSA Connector screw 5,0x40			
Nailing pattern 1	8	10	P	f ≤ 29: $\frac{93,1}{f+32}$ f > 29: $\frac{44,6}{f}$	3,1	e≤ 7: 10,8 7<e≤ 85: $\frac{71,3}{e}$ e>85: $\frac{44,6}{e-32}$	e≤ 49: $\frac{110}{63-e}$ 49<e≤ 0,54·b+32: 7,6 e>0,54·b+32: $\frac{4,1 \cdot b-233}{e-63}$
			L	f ≤ 25: $\frac{101,2}{f+32}$ f > 25: $\frac{44,6}{f}$	3,7	e≤ 6: 12,9 6<e≤ 85: $\frac{71,3}{e}$ e>85: $\frac{44,6}{e-32}$	e≤ 48: $\frac{128}{63-e}$ 48<e≤ 0,52·b+33: 8,7 e>0,52·b+33: $\frac{4,5 \cdot b-264}{e-63}$
			M	f ≤ 20: $\frac{109,3}{f+32}$ f > 20: $\frac{44,6}{f}$	4,2	e≤ 5: 14,4 5<e≤ 85: $\frac{71,3}{e}$ e>85: $\frac{44,6}{e-32}$	e≤ 48: $\frac{146}{63-e}$ 48<e≤ 0,50·b+33: 9,9 e>0,50·b+33: $\frac{4,9 \cdot b-295}{e-63}$
			S	f ≤ 14: $\frac{117,4}{f+32}$ 14<e≤ 23: 71,3/(f+14) f > 23: $\frac{71,3}{f}$	4,7	e≤ 4: 16,2 4<e≤ 85: $\frac{71,3}{e}$ e>85: $\frac{44,6}{e-32}$	e≤ 48: $\frac{164}{63-e}$ 48<e≤ 0,48·b+33: 11 e>0,48·b+33: $\frac{5,3 \cdot b-326}{e-63}$
			I	f ≤ 7: $\frac{133,6}{f+32}$ 7<e≤ 23: 71,3/(f+14) f > 23: $\frac{44,6}{f}$	5,7	e≤ 4: 19,8 4<e≤ 85: $\frac{71,3}{e}$ e>85: $\frac{44,6}{e-32}$	e≤ 48: $\frac{201}{63-e}$ 48<e≤ 0,46·b+34: 13,3 e>0,46·b+34: $\frac{6,2 \cdot b-388}{e-63}$

f is in mm.

Wane may occur under the angle bracket.

Table D10-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Bracket

2 Angle Bracket ABR9015 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
	Flange A	Flange B		CNA Connector nail							
				4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	8	10	P	2,2	2,6	3,3	4,1	3,8	4,3	4,8	5,8
			L	2,5	2,9	3,8	4,7	4,4	5,0	5,6	6,8
			M	2,8	3,3	4,3	5,4	5,0	5,7	6,5	7,8
			S	3,1	3,7	4,8	6,0	5,7	6,4	7,3	8,7
			I	3,7	4,5	5,9	7,3	6,9	7,8	8,9	10,7

Wane may occur under the angle brackets.

Table D10-4 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR9015 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
				CNA Connector nail							
	Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	8	10	P	$f \le 8: \frac{57}{f+32}$ $f > 8: \frac{11,3}{f}$	$f \le 10: \frac{59}{f+32}$ $f > 10: \frac{13,8}{f}$	$f \le 13: \frac{64}{f+32}$ $f > 13: \frac{18,2}{f}$	$f \le 16: \frac{69}{f+32}$ $f > 16: \frac{22,9}{f}$	1,9	2,1	2,4	2,9
			L	$f \le 9: \frac{59}{f+32}$ $f > 9: \frac{13,2}{f}$	$f \le 12: \frac{62}{f+32}$ $f > 12: \frac{16,1}{f}$	$f \le 15: \frac{67}{f+32}$ $f > 15: \frac{21,3}{f}$	$f \le 19: \frac{73}{f+32}$ $f > 19: \frac{26,7}{f}$	2,2	2,5	2,8	3,4
			M	$f \le 10: \frac{61}{f+32}$ $f > 10: \frac{15,1}{f}$	$f \le 13: \frac{64}{f+32}$ $f > 13: \frac{18,4}{f}$	$f \le 17: \frac{70}{f+32}$ $f > 17: \frac{24,3}{f}$	$f \le 21: \frac{77}{f+32}$ $f > 21: \frac{30,5}{f}$	2,5	2,8	3,2	3,9
			S	$f \le 12: \frac{62,6}{f+32}$ $f > 12: \frac{17}{f}$	$f \le 15: \frac{66,4}{f+32}$ $f > 15: \frac{20,6}{f}$	$f \le 19: \frac{73}{f+32}$ $f > 19: \frac{27,3}{f}$	$f \le 24: \frac{81}{f+32}$ $f > 24: \frac{34,3}{f}$	2,8	3,2	3,6	4,4
			I	$f \le 15: \frac{66,6}{f+32}$ $f > 15: \frac{20,8}{f}$	$f \le 17: \frac{71,2}{f+32}$ $f > 17: \frac{25,2}{f}$	$f \le 23: \frac{80}{f+32}$ $f > 23: \frac{33,4}{f}$	$f \le 29: \frac{89}{f+32}$ $f > 29: \frac{41,9}{f}$	3,5	3,9	4,4	5,3

Wane may occur under the angle bracket.

Table D10-5 Characteristic capacity timber beam to concrete – 2 Angle Brackets

2 Angle Brackets ABR9015 per connection			**Characteristic capacity per connection (kN)**
Nailing pattern	Number of fasteners		$R_{1,k}$
	Flange A	Flange B	
Nailing pattern 2	8 x CNA4,0x40	1 x PHNW-37 *)	13,2

*) In pre-drilled hole Ø5 x 18 mm

Annex D11 – ABR9020

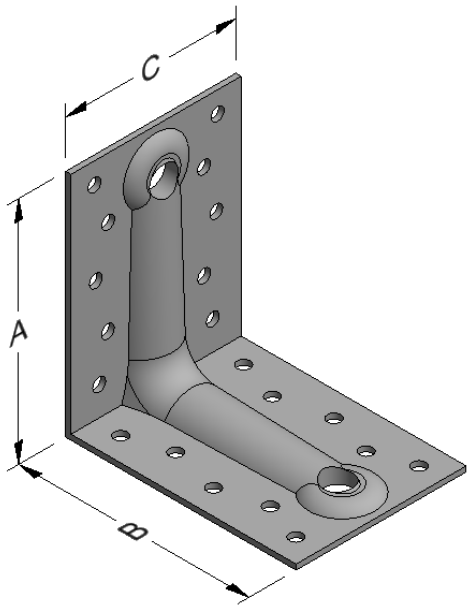
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR9020	Steel ref. 1	-
ABR9020S	Steel ref. 2	-
ABR9020S2	Steel ref. 3	-
ABR9020Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø5	Ø13
ABR9020	88	88	65	2,0	10	1	10	1

Drawing:



Nailing pattern:

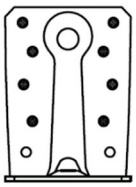
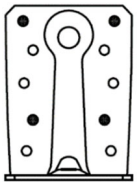
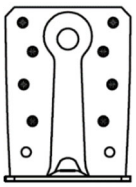
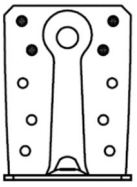
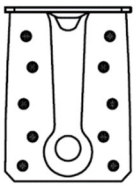
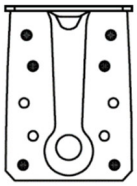
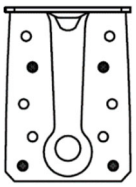
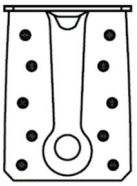
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	Beam to beam Maximum nailing	Beam to beam Minimum nailing	Beam (A) to steel (B)	Beam (A) to column (B)

Table D11-1 Modified characteristic capacity timber beam to timber beam - 2 Angle Brackets

2 Angle Brackets ABR9020 per connection				**Modified characteristic capacity per connection (kN)**		
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4/5,k} \times k_{mod}$
	Flange A	Flange B		CSA Connector Screw 5,0x40		
Nailing pattern 1	8	10	P	9,6	7,4	$\frac{5,3 \cdot b+263}{e}$ max 19,9
			L	11,2	8,6	$\frac{5,8 \cdot b+267}{e}$ max 23,1
			M	12,8	9,9	$\frac{6,4 \cdot b+271}{e}$ max 26,3
			S	14,0	11,1	$\frac{6,9 \cdot b+275}{e}$ max 29,4
			I	16,1	13,6	$\frac{8 \cdot b+282}{e}$ max 35,8

Table D11-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR9020 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4,k} \times k_{mod}$	$R_{5,k} \times k_{mod}$
	Flange A	Flange B		CSA Connector Screw 5,0x40			
Nailing pattern 1	8	10	P	f ≤ 100: $\frac{62,8}{f+29}$ f > 100: $\frac{49,1}{f+1}$	3,7	e≤ 8: 10,8 8<e≤ 63: $\frac{90,9}{e}$ e>63: $\frac{49,1}{e-29}$	e≤ 48: $\frac{134}{65-e}$ 48<e≤ 0,66·b+28: 8 e>0,66·b+28: $\frac{5,3 \cdot b-298}{e-65}$
			L	f ≤ 61: $\frac{71,2}{f+29}$ f > 61: $\frac{49,1}{f+1}$	4,3	e≤ 7: 12,6 7<e≤ 63: $\frac{90,9}{e}$ e>63: $\frac{49,1}{e-29}$	e≤ 48: $\frac{156}{65-e}$ 48<e≤ 0,63·b+29: 9,2 e>0,63·b+29: $\frac{5,8 \cdot b-337}{e-65}$
			M	f ≤ 44: $\frac{79,6}{f+29}$ f > 44: $\frac{49,1}{f+1}$	4,9	e≤ 6: 14,4 6<e≤ 63: $\frac{90,9}{e}$ e>63: $\frac{49,1}{e-29}$	e≤ 48: $\frac{178}{65-e}$ 45<e≤ 0,61·b+29: 10,5 e>0,61·b+29: $\frac{6,4 \cdot b-376}{e-65}$
			S	f ≤ 34: $\frac{88}{f+29}$ f > 34: $\frac{49,1}{f+1}$	5,6	e≤ 6: 16,2 6<e≤ 63: $\frac{90,9}{e}$ e>63: $\frac{49,1}{e-29}$	e≤ 48: $\frac{200}{65-e}$ 48<e≤ 0,59·b+29: 11,7 e>0,59·b+29: $\frac{6,9 \cdot b-415}{e-65}$
			I	f ≤ 24: $\frac{104,8}{f+29}$ f > 24: $\frac{49,1}{f+1}$	6,8	e≤ 5: 19,8 5<e≤ 63: $\frac{90,9}{e}$ e>63: $\frac{49,1}{e-29}$	e≤ 48: $\frac{245}{65-e}$ 48<e≤ 0,57·b+30: 14,1 e>0,57·b+30: $\frac{8 \cdot b-493}{e-65}$

f is in mm.

Table D11-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR9020 per connection				**Modified characteristic capacity per connection (kN)**								
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$			$R_{4/5,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail								
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	8	10	P	5,8	6,5	8,9	5,7	6,2	7,8	3,6·b+259 e max 5,9	3,9·b+261 e max 6,8	4,8·b+269 e max 10,7
			L	6,8	7,6	10,4	6,6	7,2	9,1	3,8·b+260 e max 6,7	4,1·b+263 e max 7,8	5,2·b+273 e max 12,4
			M	7,8	8,6	11,9	7,5	8,3	10,4	4,0·b+262 e max 7,5	4,3·b+265 e max 8,8	5,5·b+276 e max 14,0
			S	8,7	9,7	13,4	8,5	9,3	11,7	4,2·b+264 e max 8,3	4,5·b+267 e max 9,8	5,9·b+279 e max 15,6
			I	10,7	11,9	16,4	10,4	11,4	14,4	4,6·b+267 e max 9,9	5,0·b+271 e max 11,7	6,7·b+286 e max 18,9
Nailing pattern 2	4	6	P	2,9	3,5	5,9	3,5	3,8	4,9	3,6·b+259 e max 3,7	3,9·b+261 e max 4,2	4,8·b+269 e max 6,3
			L	3,4	4,1	6,9	4,1	4,5	5,7	3,8·b+260 e max 4,1	4,1·b+263 e max 4,7	5,2·b+273 e max 7,2
			M	3,9	4,7	7,8	4,7	5,1	6,5	4,0·b+262 e max 4,5	4,3·b+265 e max 5,3	5,5·b+276 e max 8,1
			S	4,4	5,3	8,8	5,3	5,8	7,3	4,2·b+264 e max 5,0	4,5·b+267 e max 5,8	5,9·b+279 e max 9,0
			I	5,4	6,5	10,8	6,5	7,1	9,0	4,6·b+267 e max 5,9	5,0·b+271 e max 6,9	6,7·b+286 e max 10,8

b and e are in mm.

Table D11-4 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, maximum nailing

Table D11-4.1 R_1 & $R_{2/3}$

1 Angle Bracket ABR9020 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k}$ x k_{mod}			$R_{2/3,k}$ x k_{mod}		
	Flange A	Flange B		CNA Connector nail					
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	8	10	P	f≤ 27: 63/(f+40) f>27: 26,5/(f+1)	f≤ 32: 69/(f+40) f>32: 31,8/(f+1)	f≤ 46: 90/(f+40) f>46: 49,4/(f+1)	2,8	3,1	3,9
			L	f≤ 32: 68/(f+40) f>32: 30,9/(f+1)	f≤ 38: 74/(f+40) f>38: 37/(f+1)	f≤ 38: 99/(f+40) f>38: 49,4/(f+1)	3,3	3,6	4,6
			M	f≤ 36: 72/(f+40) f>36: 35,3/(f+1)	f≤ 44: 79/(f+40) f>44: 42,3/(f+1)	f≤ 32: 107/(f+40) f>32: 49,4/(f+1)	3,8	4,1	5,2
			S	f≤ 41: 77/(f+40) f>41: 39,7/(f+1)	f≤ 49: 84/(f+40) f>49: 47,6/(f+1)	f≤ 28: 116/(f+40) f>28: 49,4/(f+1)	4,2	4,7	5,9
			I	f≤ 50: 85/(f+40) f>50: 48,5/(f+1)	f≤ 41: 95/(f+40) f>41: 49,4/(f+1)	f≤ 22: 134/(f+40) f>22: 49,4/(f+1)	5,2	5,7	7,2

f, e and b are in mm.

Table D11-4.2 R_4 & R_5

1 Angle Bracket ABR9020 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{4,k} \times k_{mod}$			$R_{5,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	8	10	P	e≤ 10: 6,0	e≤ 10: 6,6	e≤ 10: 8,5	e≤ 51: 39 / 65-e	e≤ 50: 46,7 / 65-e	e≤ 48: 77,9 / 65-e
				10<e≤ 145: 60 / e	10<e≤ 120: 65 / e	10<e≤ 70: 84 / e	51<e≤ 1,18·b+14: 2,8	50<e≤ 1,09·b+16: 3,1	48<e≤ 0,89·b+20: 4,6
				e>145: 49 / e-29	e>120: 49 / e-29	e>70: 49 / e-29	e>1,18·b+14: 3,3·b-140 / e-65	e>1,09·b+16: 3,4·b-153 / e-65	e>0,89·b+20: 4,1·b-204 / e-65
			L	e≤ 9: 7,0	e≤ 9: 7,7	e≤ 9: 9,9	e≤ 50: 45,5 / 65-e	e≤ 49: 54,5 / 65-e	e≤ 47: 90,9 / 65-e
				9<e≤ 130: 64 / e	9<e≤ 100: 70 / e	9<e≤ 62: 91 / e	50<e≤ 1,11·b+16: 3,1	49<e≤ 1,03·b+18: 3,5	47<e≤ 0,84·b+21: 5,2
				e>130: 49 / e-29	e>100: 49 / e-29	e>62: 49 / e-29	e>1,11·b+16: 3,4·b-151 / e-65	e>1,03·b+18: 3,6·b-166 / e-65	e>0,84·b+21: 4,4·b-226 / e-65
			M	e≤ 8: 8,0	e≤ 8: 8,8	e≤ 9: 11,3	e≤ 50: 52 / 65-e	e≤ 49: 62 / 65-e	e≤ 47: 104 / 65-e
				8<e≤ 105: 68 / e	8<e≤ 85: 74 / e	9<e≤ 57: 99 / e	50<e≤ 1,05·b+17: 3,4	49<e≤ 0,97·b+19: 3,9	47<e≤ 0,80·b+22: 5,8
				e>105: 49 / e-29	e>85: 49 / e-29	e>57: 49 / e-29	e>1,05·b+17: 3,5·b-162 / e-65	e>0,97·b+19: 3,8·b-179 / e-65	e>0,80·b+22: 4,6·b-247 / e-65
			S	e≤ 8: 9,1	e≤ 8: 9,9	e≤ 8: 12,8	e≤ 49: 58 / 65-e	e≤ 48: 70 / 65-e	e≤ 47: 117 / 65-e
				8<e≤ 92: 72 / e	8<e≤ 77: 79 / e	8<e≤ 56: 101 / e	49<e≤ 1,00·b+18: 3,7	48<e≤ 0,93·b+20: 4,2	47<e≤ 0,77·b+23: 6,4
				e>92: 49 / e-29	e>77: 49 / e-29	e>56: 49 / e-29	e>1,00·b+18: 3,7·b-173 / e-65	e>0,93·b+20: 3,9·b-192 / e-65	e>0,77·b+23: 4,9·b-268 / e-65
			I	e≤ 7: 11,1	e≤ 7: 12,1	e≤ 6: 15,6	e≤ 48: 71 / 65-e	e≤ 48: 86 / 65-e	e≤ 46: 143 / 65-e
				7<e≤ 75: 80 / e	7<e≤ 65: 88 / e	6<e≤ 56: 101 / e	48<e≤ 0,92·b+20: 4,3	48<e≤ 0,86·b+21: 4,9	46<e≤ 0,72·b+24: 7,6
				e>75: 49 / e-29	e>65: 49 / e-29	e>56: 49 / e-29	e>0,92·b+20: 3,9·b-194 / e-65	e>0,86·b+21: 4,2·b-217 / e-65	e>0,72·b+24: 5,4·b-311 / e-65

f, e and b are in mm.

Table D11-5 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, minimum nailing

Table D11-5.1 R_1 & $R_{2/3}$

1 Angle Bracket ABR9020 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k}$ x k_{mod}			$R_{2/3,k}$ x k_{mod}		
	Flange A	Flange B		CNA Connector nail					
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 2	4	6	P	f≤ 27: 63 f+40 f>27: 26,5 f+1	f≤ 33: 69 f+40 f>33: 31,8 f+1	f≤ 46: 90 f+40 f>46: 49,4 f+1	1,8	1,9	2,4
			L	f≤ 32: 68 f+40 f>32: 30,9 f+1	f≤ 38: 74 f+40 f>38: 37,0 f+1	f≤ 38: 99 f+40 f>38: 49,4 f+1	2,1	2,2	2,9
			M	f≤ 36: 72 f+40 f>36: 35,3 f+1	f≤ 44: 79 f+40 f>44: 42,3 f+1	f≤ 32: 107 f+40 f>32: 49,4 f+1	2,4	2,6	3,3
			S	f≤ 41: 77 f+40 f>41: 39,7 f+1	f≤ 49: 84 f+40 f>49: 47,6 f+1	f≤ 28: 116 f+40 f>28: 49,4 f+1	2,7	2,9	3,7
			I	f≤ 50: 85 f+40 f>50: 48,5 f+1	f≤ 41: 95 f+40 f>41: 49,4 f+1	f≤ 22: 134 f+40 f>22: 49,4 f+1	3,2	3,5	4,5

f, e and b are in mm.

Table D11-5.2 R_4 & R_5

1 Angle Bracket ABR9020 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{4,k} \times k_{mod}$			$R_{5,k} \times k_{mod}$		
				CNA Connector nail					
	Flange A	Flange B		4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 2	4	6	P	e≤ 30: 2,0	e≤ 29: 2,2	e≤ 29: 2,8	e≤ 55: 26,5 65-e	e≤ 55: 31,8 65-e	e≤ 53: 52,9 65-e
				30<e≤ 150: 60 e	29<e≤ 120: 65 e	29<e≤ 70: 84 e	55<e≤ 1,18·b+2: 2,8	55<e≤ 1,09·b+3: 3,1	53<e≤ 0,89·b+5: 4,6
				e>150: 49 e-29	e>120: 49 e-29	e>70: 49 e-29	e>1,18·b+2: 3,3·b-176 e-65	e>1,09·b+3: 3,4·b-196 e-65	e>0,89·b+5: 4,1·b-275 e-65
			L	e≤ 27: 2,3	e≤ 27: 2,6	e≤ 28: 3,3	e≤ 55: 30,9 65-e	e≤ 54: 37,0 65-e	e≤ 53: 61,7 65-e
				27<e≤ 120: 64 e	27<e≤ 97: 70 e	28<e≤ 62: 91 e	55<e≤ 1,11·b+3: 3,1	54<e≤ 1,03·b+3: 3,5	53<e≤ 0,84·b+5: 5,2
				e>120: 49 e-29	e>97: 49 e-29	e>62: 49 e-29	e>1,11·b+3: 3,4·b-192 e-65	e>1,03·b+3: 3,6·b-215 e-65	e>0,84·b+5: 4,4·b-308 e-65
			M	e≤ 25: 2,7	e≤ 25: 2,9	e≤ 26: 3,8	e≤ 55: 35 65-e	e≤ 54: 42,0 65-e	e≤ 53: 71,0 65-e
				25<e≤ 105: 68 e	25<e≤ 85: 74 e	26<e≤ 57: 99 e	55<e≤ 1,05·b+3: 3,4	54<e≤ 0,97·b+4: 3,9	53<e≤ 0,80·b+6: 5,8
				e>105: 49 e-29	e>85: 49 e-29	e>57: 49 e-29	e>1,05·b+3: 3,5·b-209 e-65	e>0,97·b+4: 3,8·b-235 e-65	e>0,80·b+6: 4,6·b-341 e-65
			S	e≤ 24: 3,0	e≤ 24: 3,3	e≤ 24: 4,3	e≤ 54: 40 65-e	e≤ 54: 48,0 65-e	e≤ 53: 79,0 65-e
				24<e≤ 92: 72 e	24<e≤ 77: 79 e	24<e≤ 56: 101 e	54<e≤ 1,00·b+4: 3,7	54<e≤ 0,93·b+4: 4,2	53<e≤ 0,77·b+6: 6,4
				e>92: 49 e-29	e>77: 49 e-29	e>56: 49 e-29	e>1,00·b+4: 3,7·b-225 e-65	e>0,93·b+4: 3,9·b-255 e-65	e>0,77·b+6: 4,9·b-374 e-65
			I	e≤ 22: 3,7	e≤ 22: 4,0	e≤ 19: 5,2	e≤ 54: 49 65-e	e≤ 53: 58,0 65-e	e≤ 52: 97,0 65-e
				22<e≤ 75: 80 e	22<e≤ 65: 88 e	19<e≤ 56: 101 e	54<e≤ 0,92·b+5: 4,3	53<e≤ 0,86·b+5: 4,9	52<e≤ 0,72·b+7: 7,6
				e>75: 49 e-29	e>65: 49 e-29	e>56: 49 e-29	e>0,92·b+5: 3,9·b-259 e-65	e>0,86·b+5: 4,2·b-295 e-65	e>0,72·b+7: 5,4·b-441 e-65

Table D11-6 Characteristic capacity timber beam to 6 mm steel beam – 2 Angle Brackets

2 Angle Brackets ABR9020 per connection			**Characteristic capacity per connection (kN)**
Nailing pattern	Number of fasteners		**$R_{1,k}$**
	Flange A	Flange B	
Nailing pattern 3	8 x CNA4,0x60	4 x PDPA-75	12,1

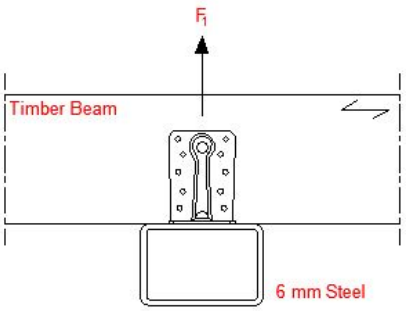


Table D11-7 1 angle brackets ABR9020, beam to column

1 ABR9020	**Characteristic capacity per connection [kN]**			
	$R_{1,k}$		**$R_{2,k}$**	
	4,0x40	4,0x60	4,0x40	4,0x60
Nailing 4+10 see fig. 11-5	7,7	10,4	1,5	2,5

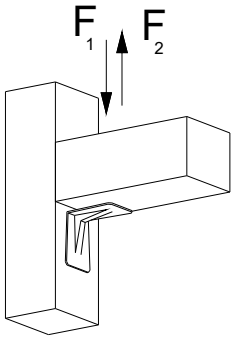


Table D11-8 ABR9020 Slip modulus K_{ser}

2 ABR9020		K_{ser} [kN/mm]			
For force	Nailing	CNA4.0x35	CNA4.0x40	CNA4.0x50	CNA4.0x60
F1	Nailing pattern 1	3,9	4,3	5,1	5,9
	Nailing pattern 2	1,9	2,3	3,1	3,9
F2	Nailing pattern 1	1,2	1,4	1,5	1,7
	Nailing pattern 2	0,6	0,7	0,8	0,9

Table D11-9 Modified characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket ABR9020 per connection				**Modified characteristic capacity per connection (kN)**			
				$R_{1,k}$ x k_{mod}		**$R_{2,k}$ x k_{mod}**	
Nailing pattern	Number of Fasteners		Load duration	CNA4,0x40	CNA4,0x60	CNA4,0x40	CNA4,0x60
	Flange A (beam)	Flange B (column)					
Nailing pattern 4	4	10	P	4,6	6,2	0,9	1,5
			L	5,4	7,3	1,1	1,8
			M	6,2	8,3	1,2	2,0
			S	6,9	9,4	1,4	2,3
			I	8,5	11,4	1,7	2,8

General note to capacity tables:

b, e and f are in mm.

Wane may not occur under the angle bracket.

Annex D12 – ABR100

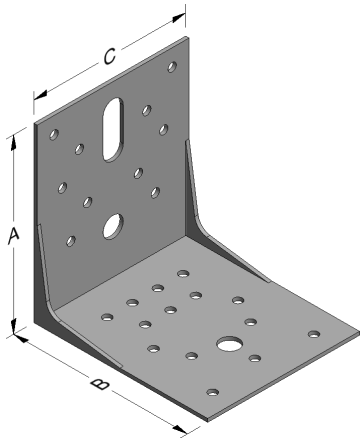
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR100	Steel ref. 1	-
ABR100S	Steel ref. 2	-
ABR100S2	Steel ref. 3	-
ABR100Z	Steel ref. 6	-

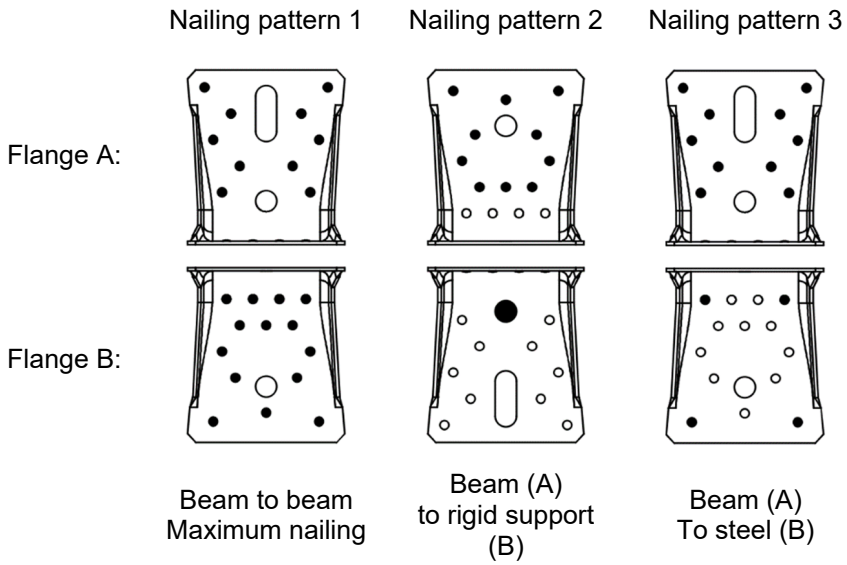
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø12	Ø5	Ø11
ABR100	103	103	90	2,0	10	2	14	1

Drawing:



Nailing pattern:



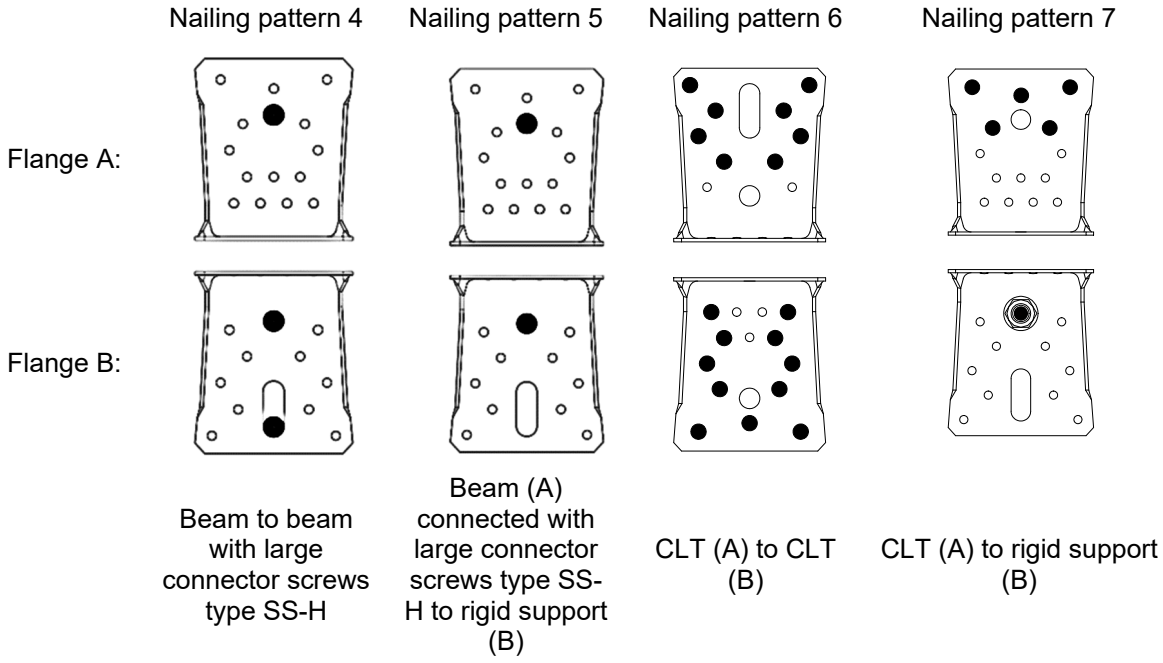


Table D12-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR100 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
				CSA Connector screw			
	Flange A	Flange B		5,0x35	5,0x40	5,0x35	5,0x40
Nailing pattern 1	10	14	P	15,0	17,6	10,5	12,0
			L	17,5	20,5	12,3	14,0
			M	20,0	22,5	14,0	16,0
			S	22,0	24,0	15,8	18,0
			I	24,6	27,0	19,3	22,0

Characteristic loads for CSA 5.0x50 have not been evaluated. You can consider capacities for CSA 5.0x40 in a safe way.
Wane may not occur under the angle brackets.

Table D12-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR100 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CSA Connector screw			
				5,0x35	5,0x40	5,0x35	5,0x40
Nailing pattern 1	10	14	P	f ≤ 30 : $\frac{239,8}{f + 55,5}$ f > 30 : $\frac{84,5}{f}$	f ≤ 21 : $\frac{277,3}{f + 55,5}$ 21 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	5,3	6,0
			L	f ≤ 21 : $\frac{276,4}{f + 55,5}$ 21 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	f ≤ 12 : $\frac{320,1}{f + 55,5}$ 12 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	6,1	7
			M	f ≤ 13 : $\frac{313}{f + 55,5}$ 13 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	f ≤ 6 : $\frac{363}{f + 55,5}$ 6 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	7,0	8
			S	f ≤ 8 : $\frac{349,6}{f + 55,5}$ 8 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	f ≤ 2 : $\frac{405,9}{f + 55,5}$ 2 < f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	7,9	9
			I	f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	f ≤ 26 : $\frac{140,8}{f + 18}$ f > 26 : $\frac{84,5}{f}$	9,7	11

Wane may not occur under the angle bracket.

Table D12-3 Characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR100 per connection			**Characteristic capacity per connection (kN)**												
Nailing pattern	Number of fasteners		$R_{1,k}$				$R_{2/3,k}$				$R_{4/5,k}$				
			CNA Connector nail												
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	e [mm]=	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	10,00	14,00	9,70	11,70	15,70	19,70	9,60	12,80	14,20	16,70	0	14,19	15,45	16,10	16,76
											20	11,55	13,71	18,04	19,18
											50	8,20	8,93	10,38	10,99
											100	2,40	4,20	5,14	5,14
											150	0,83	2,15	2,73	2,94

Wane may not occur under the angle brackets.

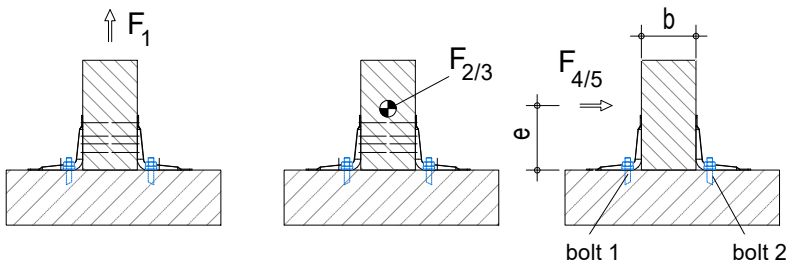
Table D12-4 Characteristic capacity timber beam to timber beam – 1 Angle Bracket

2 Angle Brackets ABR100 per connection			**Characteristic capacity per connection (kN)**																
Nailing pattern	Number of fasteners		$R_{1,k}$				$R_{2/3,k}$ *)				$R_{4,k}$					$R_{5,k}$			
			CNA Connector nail																
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	e [mm]=	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	10	14	a = 140	a = 164	a = 212	a = 256	4,8	6,4	7,1	8,3	0	12,55	12,55	12,55	12,55	1,64	1,97	2,62	3,28
			$\min\left\{\frac{a}{f+56};\ \frac{121}{(f+18)\times k_{mod}};\ \frac{84}{f\times k_{mod}}\right.$								20	8,70	10,29	12,55	12,55	2,85	3,42	4,56	5,70
											50	3,70	4,43	5,22	5,51	4,50	4,50	4,50	4,50
											100	-	$0,77/k_{mod}$			1,63	1,96	2,25	2,25
											150	-	$0,29/k_{mod}$			0,54	0,65	0,87	1,09

*) the timber is prevented from rotation
Wane may not occur under the angle bracket.

Table D12-5 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets ABR100 per connection				**Modified characteristic capacity per connection (kN)**							
				$R_{1,k}$ x k_{mod}			$R_{2/3,k}$ x k_{mod}			$R_{4/5,k}$ x k_{mod}	
Nailing pattern	Number of fasteners		Load duration	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x40 to CNA4,0x60	
	Vertical flange (A)	Horizontal flange (B)									
Nailing pattern 2	10	1 bolt	P	12,4	16,0	18,7	5,2	6,5	7,4	6,24	1)
			L	14,5	18,6	21,6	6,1	7,6	8,6	7,28	1)
			M	16,5	21,3	21,6	6,9	8,7	9,8	8,32	1)
			S	18,6	21,6	21,6	7,8	9,8	11,1	9,36	1)
			I	21,6	21,6	21,6	9,5	12,0	13,5	11,44	1)



1) it is to check:
the bolt 1: $R_{bolt,ax,d} \geq F_{4/5,d}$ x e / b
the bolt 2: $R_{bolt,lat,d} \geq F_{4/5,d}$
and: $R_{4/5,d} \leq R_{1,d}$ x b/(2xe)

for R_1: $R_{bolt,ax,d} \geq F_{1,d}/2$

for $R_{2/3}$: $R_{bolt,lat,d} \geq F_{2/3,d}/2$

Table D12-6 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket ABR100 per connection			Characteristic capacity per connection (kN)						
Nailing pattern	Number of fasteners		$R_{1,k}$ 4)	$R_{2,k}$		$R_{4,k}$ 3)		$R_{5,k}$ 3)	
	Flange A	Flange B	CNA Connector nail size 4,0x40 to 4,0x60						
Nailing pattern 2	10	1 Bolt	$R_{1,k} = \min \begin{cases} \frac{22,45}{f^{0,7} \times k_{mod}} \\ \frac{4,49}{k_{mod}} \end{cases}$	2)	e [mm]	steel	timber	steel	timber
					0	-	9,0	-	2,26
					20	-		-	4,53
					50	4,55		4,50	8,40
					100	0,77		2,25	1,77
					150	0,29		1,50	0,56

2) the timber must free from turn away, also the half of capacity of 2 ABR100 it to use the values for timber may be to use with k_{mod}, the values for steel alltimes with k_{mod} =1 the minimum of both are available

3) it is to check for the bolt:
$R_{bolt,ax,d} \geq F_{4 \text{ or } 5,d} \times e / 40$
$R_{bolt,lat,d} \geq F_{4 \text{ or } 5,d}$
4) $R_{bolt.ax.d} \geq F_{1.d} \times (f+75)/50$

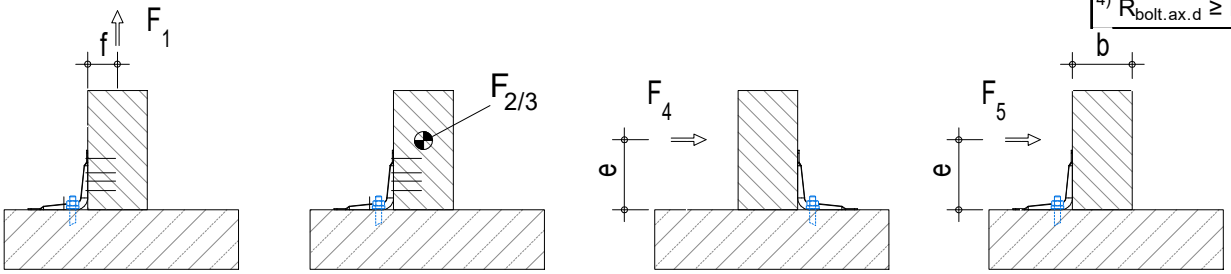


Table D12-7 Characteristic capacity timber beam to 6 mm steel beam connection – 2 Angle Brackets

2 Angle Brackets ABR100 per connection			Characteristic capacity per connection (kN)
			$R_{1,k}$
Nailing pattern	Number of fasteners		CNA Connector nail 4,0x60
	Flange A	Flange B	
Nailing pattern 3	10	4 PDPA-75	21,5

Table D12-8 ABR100 Slip modulus k_{ser}, Nailing pattern 1

2 ABR100 per Connection	For R_1 K_{ser} [kN/mm]	For $R_{2/3}$ k_{ser} [kN/mm]
CNA4,0x35	1,45	1,37
CNA4,0x40	1,75	1,82
CNA4,0x50	2,35	2,02
CNA4,0x60	2,95	2,38
CSA5,0x40	5,06	5,82

Table D12-9 Characteristic capacity timber beam to timber beam – 2 Angle Bracket ABR100 – Nailing pattern 4

Timber to timber connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2/3,k}$
		Qty	Type	Qty	Type	SS-H Ø10x40	SS-H Ø10x40
ABR100	Nailing pattern 4	2	SS-H	1	SS-H	5,2	2,7

Table D12-10 Characteristic capacity timber beam to rigid support – 2 Angle Bracket ABR100 – Nailing pattern 5

Timber to rigid connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2/3,k}$
		Qty	Type	Qty	Type	SS-H Ø10x40	SS-H Ø10x40
ABR100	Nailing pattern 5	1	Bolt Ø10	1	SS-H	5,7	4,1

Table D12-11 Characteristic capacity CLT to CLT – 1 Angle Bracket – Nailing pattern 6

CLT to CLT connection				1 angle bracket per connection					
Item	Nailing Pattern	Fastener				characteristic capacities [kN] - Timber C24			
		Header		Joist		$R_{1.k}$	$R_{2/3.k}$	$R_{4.k}$	$R_{5.k}$
		Qty	Type	Qty	Type	CNAØ4,0x50	CNAØ4,0x50	CNAØ4,0x50	CNAØ4,0x50
ABR100	6	8	CNA	11	CNA	7,9	8,7	12,6	4,6

Table D12-12 Characteristic capacity CLT to rigid support – 1 Angle Bracket – Nailing pattern 7

CLT to rigid support				1 angle bracket per connection					
Item	Nailing Pattern	Fastener				characteristic capacities [kN] - Timber C24			
		Header		Joist		$R_{1.k}$	$R_{2/3.k}$	$R_{4.k}$	$R_{5.k}$
		Qty	Type	Qty	Type	CNAØ4,0x50	CNAØ4,0x50	CNAØ4,0x50	CNAØ4,0x50
ABR100	7	1	Bolt Ø10	5	CNA	8,3	4,1	7,5	$3,4/k_{mod}^{0,7}$

bolt factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1	0,43	-	1,2
k_{lat}	-	1,1	1	1,2

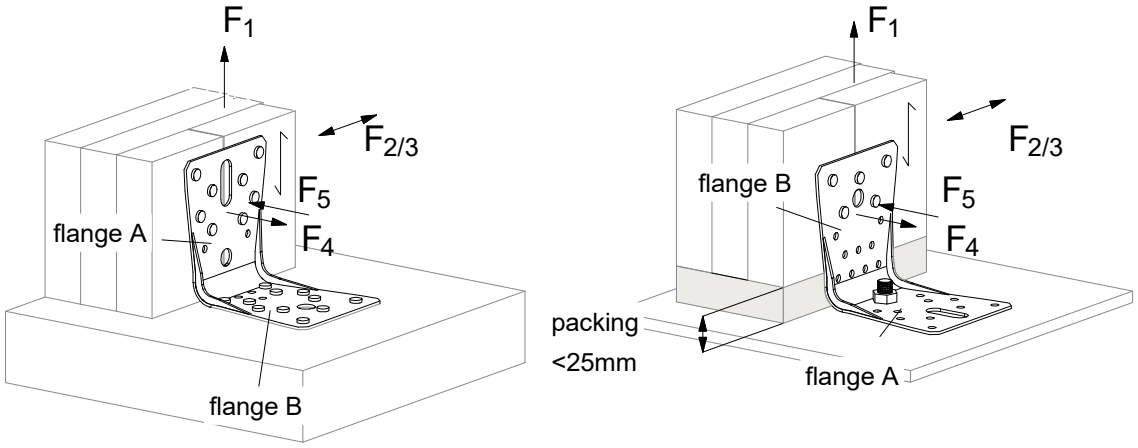
For connection to rigid support the packing below the CLT element shall not exceed 25mm.

The connected CLT element has to be free of any rotation.

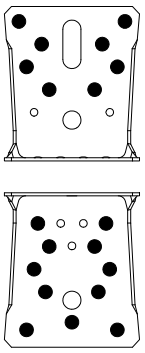
Table D12-13 ABR100 Slip modulus k_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
Timber to timber (with SS-H screws Ø10x40)	4	0,56	0,195
Timber to rigid (with SS-H screws Ø10x40)	5	0,685	0,22
CLT to CLT (with CNA Ø4,0x50)	6	2,6	0,9
CLT to rigid support (with CNA Ø4,0x50)	7	9,2	1,5

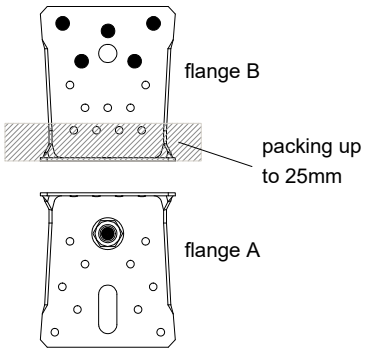
These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.



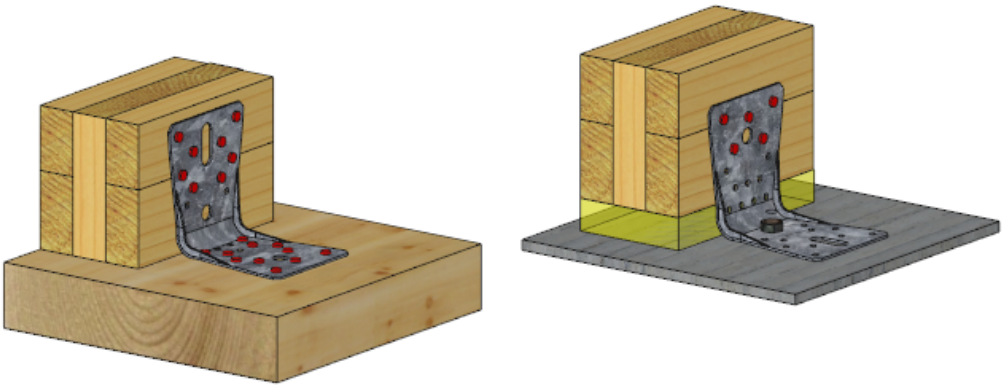
CLT - CLT



CLT - rigid support



The direction of the outer layer may be also as shown below. (horizontal or vertical)
The edge distances (perpendicular and in direction of the grain) has to considered and checked for application with solid timber.



Annex D13 – AA60280

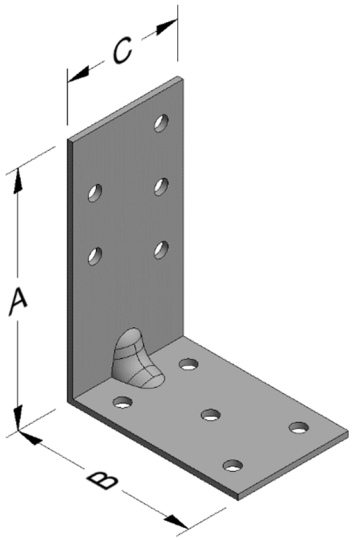
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AA60280	Steel ref. 1	-
AA60280S	Steel ref. 2	-
AA60280S2	Steel ref. 3	-
AA60280Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AA60280	83	62	40	2,0	5	5

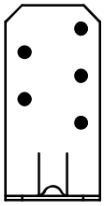
Drawing:



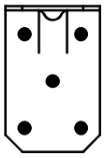
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Beam to beam
Maximum nailing

Table D13-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AA60280 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 1	5	5	S	2,6	4,0	3,7	5,5	e≤ 0,40b+14: 3,2 e> 0,40b+14: 1,32b+36 / e-2,0	e≤ 0,70b+19: 3,2 e> 0,70b+19: 2,21b+52 / e-2,0
			M	2,3	3,6	3,3	4,9	e≤ 0,40b+14: 3,0 e> 0,40b+14: 1,18b+33 / e-2,0	e≤ 0,66b+19: 3,0 e> 0,66b+19: 1,96b+47 / e-2,0

b and e are in mm

Factors for other load durations	$R_{1,k}$		$R_{2/3,k}$		$R_{4/5,k}$	
	CNA Connector nail					
	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,19	1,20	1,22	1,22	1,10	1,10
L multiply M by	0,88	0,89	0,88	0,88	0,89	0,88
P multiply M by	0,75	0,78	0,75	0,75	0,77	0,76

Table D13-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AA60280 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 1	5	5	P	min: 37 / f + 52, 12 / f + 10	12 / f + 10	1,2	1,8
			L	min: 43 / f + 52, 12 / f + 10	12 / f + 10	1,4	2,1
			M	12 / f + 10	12 / f + 10	1,7	2,4
			S	12 / f + 10	12 / f + 10	1,9	2,7
			I	12 / f + 10	12 / f + 10	2,3	3,3

f is in mm

Annex D14 – ABB40390

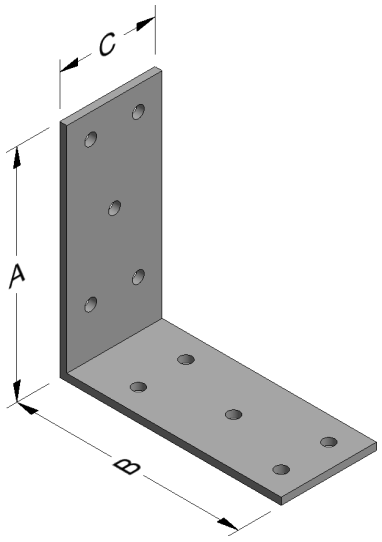
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABB40390	Steel ref. 1	-
ABB40390S	Steel ref. 2	-
ABB40390S2	Steel ref. 3	-
ABB40390Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AA40390	93	93	40	3,0	5	5

Drawing:



Nailing pattern:

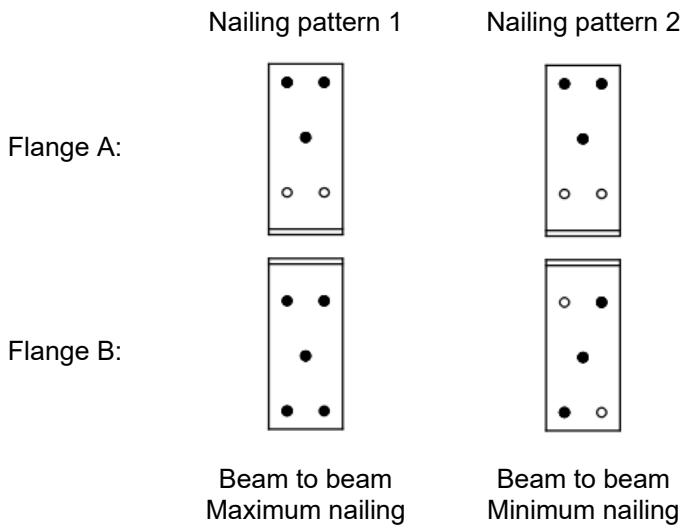


Table D14-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABB40390 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail					
				4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	3	3	S	1,9	2,8	1,5	2,0	e≤ 0,21b+14: 4,5 e> 0,21b+14: 0,96b+48 e-3,0	e≤ 0,30b+15: 4,6 e> 0,30b+15: 1,38b+57 e-3,0
			M	1,8	2,5	1,4	1,8	e≤ 0,24b+16: 3,6 e> 0,24b+16: 0,88b+46 e-3,0	e≤ 0,29b+16: 4,3 e> 0,29b+16: 1,26b+54 e-3,0
Nailing pattern 1	3	5	S	2,7	4,4	1,8	2,5	e≤ 0,32b+16: 4,5 e> 0,32b+16: 1,46b+59 e-3,0	e≤ 0,49b+19: 4,6 e> 0,49b+19: 2,22b+75 e-3,0
			M	2,4	3,9	1,6	2,2	e≤ 0,37b+18: 3,6 e> 0,37b+18: 1,34b+56 e-3,0	e≤ 0,47b+19: 4,3 e> 0,47b+19: 2,01b+71 e-3,0

b and e are in mm

Factors for other load durations	$R_{1,k}$		$R_{2/3,k}$		$R_{4/5,k}$	
	CNA Connector nail					
	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,15	1,00	1,22	1,22	1,10	1,06
L multiply M by	0,88	0,88	0,88	0,88	0,84	0,90
P multiply M by	0,75	0,75	0,75	0,75	0,78	0,80

Table D14-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABB40390 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ Upper member may rotate		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 2	3	3	P	14 / f + 53	min: 24 / f + 53 20 / f + 21	0,5	0,7
			L	17 / f + 53	min: 28 / f + 53 20 / f + 21	0,6	0,8
			M	19 / f + 53	min: 31 / f + 53 20 / f + 21	0,7	0,9
			S	min: 21 / f + 53 20 / f + 21	min: 35 / f + 53 20 / f + 21	0,8	1,0
			I	min: 26 / f + 53 20 / f + 21	min: 43 / f + 53 20 / f + 21	0,9	1,2

Table D14-3 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABB40390 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x40	4,0x60	4,0x40	4,0x60
Nailing pattern 1	3	5	P	min: 28 f + 53 20 f + 21	20 f + 21	0,6	0,8
			L	min: 33 f + 53 20 f + 21	20 f + 21	0,7	1,0
			M	20 f + 21	20 f + 21	0,8	1,1
			S	20 f + 21	20 f + 21	0,9	1,2
			I	20 f + 21	20 f + 21	1,1	1,5

Annex D15 – AE48

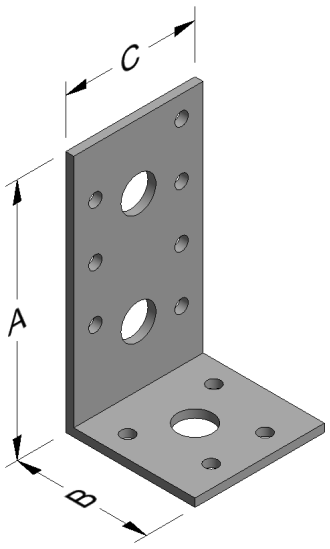
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AE48	Steel ref. 1	France: EB/7048
AE48S	Steel ref. 2	-
AE48S2	Steel ref. 3	-
AE48Z	Steel ref. 6	-

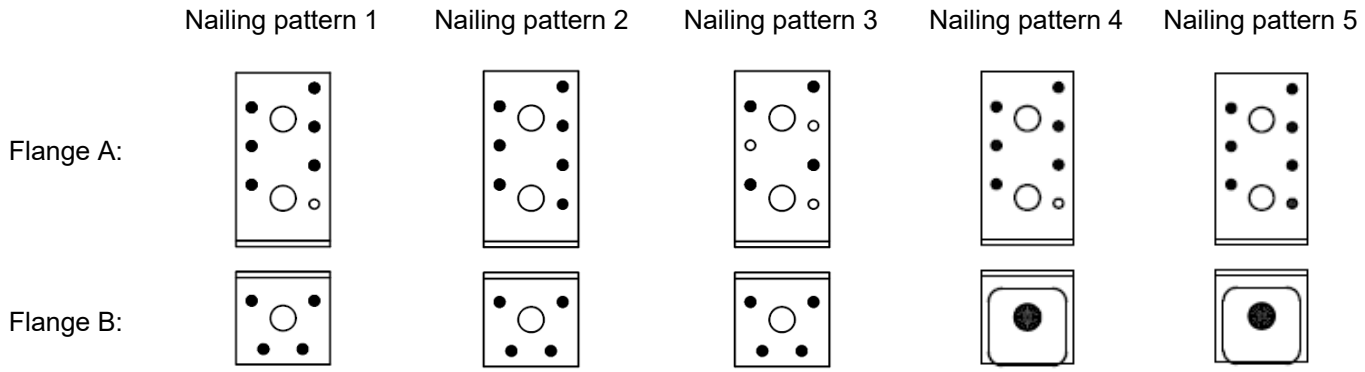
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
AE48	90	48	48	3,0	7	2	4	1

Drawing:



Nailing pattern:



Nailing pattern	No of fasteners		Description
	Flange A	Flange B	
1	6	4	Max. nailing with force F1 , F2, F3, F4 and F5
2	7	4	Max. nailing with force F2 and F3
3	4	4	Min. nailing with force F1 , F2, F3, F4 and F5
4	6	1 x M12	Max. nailing with force F1 , F2, F3, F4 and F5
5	7	1 x M12	Max. nailing with force F2 and F3

Square washer (US40/40/10G or US40/50/10G) can be replaced by standard washer of the bolts (bolt Ø12 – washer Ø24). In this case, the value of k_{lat} and k_{ax} must be adapted (see tables below D15-4 and D15-5).

Table D15-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AE48 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
				CNA Connector nail					
	Flange A	Flange B		4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 1	6	4	P	1,8	2,9	2,4	3,6	3,39 0.88b+38 e-3	3,39 1.47b+42 e-3
			L	2,1	3,4	2,8	4,2	3,66 1.03b+39 e-3	3,66 1.72b+44 e-3
			M	2,4	3,9	3,2	4,8	3,91 1.18b+40 e-3	4,04 1.96b+46 e-3
			S	2,6	4,4	3,6	5,4	4,15 1.32b+41 e-3	5,29 2.21b+47 e-3
			I	3,2	5,4	4,4	6,6	5,36 1.62b+43 e-3	5,85 2.70b+51 e-3
Nailing Pattern 2	7	4	P	-	-	2,4	3,7	-	-
			L	-	-	2,8	4,3	-	-
			M	-	-	3,2	4,9	-	-
			S	-	-	3,6	5,5	-	-
			I	-	-	4,5	6,8	-	-
Nailing Pattern 3	4	4	P	1,8	2,9	2,4	3,3	3,39 0.88b+38 e-3	3,39 1.47b+42 e-3
			L	2,1	3,4	2,8	3,8	3,66 1.03b+39 e-3	3,66 1.72b+44 e-3
			M	2,4	3,9	3,2	4,4	3,91 1.18b+40 e-3	4,04 1.96b+46 e-3
			S	2,6	4,4	3,6	4,9	4,15 1.32b+41 e-3	5,29 2.21b+47 e-3
			I	3,2	5,4	4,3	6	5,36 1.62b+43 e-3	5,85 2.70b+51 e-3

Table D15-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets AE48 per connection				**Modified characteristic capacity**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ *(Minimum between values - Purlin may rotate)*		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		**CNA Connector nail**			
				4.0x40	**4.0x60**	**4.0x40**	**4.0x60**
Nailing pattern 1	6	4	P	24/(f+40) 25/(f+13)	40/(f+40) 25/(f+13)	1,2	1,8
			L	28/(f+40) 25/(f+13)	46/(f+40) 25/(f+13)	1,4	2,1
			M	32/(f+40) 25/(f+13)	53/(f+40) 25/(f+13)	1,6	2,4
			S	36/(f+40) 25/(f+13)	60/(f+40) 25/(f+13)	1,8	2,7
			I	44/(f+40) 25/(f+13)	25/(f+13)	2,2	3,3
Nailing Pattern 2	7	4	P	-	-	1,2	1,8
			L	-	-	1,4	2,2
			M	-	-	1,6	2,5
			S	-	-	1,8	2,8
			I	-	-	2,2	3,4
Nailing Pattern 3	4	4	P	24/(f+40) 25/(f+13)	40/(f+40) 25/(f+13)	1,2	1,6
			L	28/(f+40) 25/(f+13)	46/(f+40) 25/(f+13)	1,4	1,9
			M	32/(f+40) 25/(f+13)	53/(f+40) 25/(f+13)	1,6	2,2
			S	36/(f+40) 25/(f+13)	60/(f+40) 25/(f+13)	1,8	2,5
			I	44/(f+40) 25/(f+13)	25/(f+13)	2,2	3

Table D15-3 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets AE48 per connection				**Modified characteristic capacity**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
	Flange A	Flange B		CNA Connector nail					
				4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nail pattern 4	6	1 Bolt Ø12	P	4,4 8,9	7,1 12,6	1,3	2,1	3,39 4.45b+63 e-3	3,39 6.28b+76 e-3
			L	5,2 10,5	8,3 12,6	1,5	2,5	3,66 5.23b+68 e-3	3,66 6.28b+76 e-3
			M	5,9 11,9	9,5 12,6	1,7	2,8	3,91 5.95b+73 e-3	3,91 6.28b+76 e-3
			S	6,6 12,6	10,6 12,6	1,9	3,2	4,15 6.28b+76 e-3	4,89 6.28b+76 e-3
			I	8,1 12,6	10,6 12,6	2,4	3,9	4,82 6.28b+76 e-3	5,96 6.28b+76 e-3
Nail Pattern 5	7	1 Bolt Ø12	P	-	-	1,3	2,1	-	-
			L	-	-	1,5	2,5	-	-
			M	-	-	1,7	2,8	-	-
			S	-	-	1,9	3,2	-	-
			I	-	-	2,4	3,9	-	-

e and b are in [mm]

When the purlin has a wane on the side towards the Angle Bracket the value in the grey square is valid.

AE48	**connection with 2 angle brackets**			
factor:	**for F_1**	**for $F_{2/3}$**	**for $F_{4/5,\ bolt\ 1}$**	**for $F_{4/5,\ bolt\ 2}$**
$k_{ax\ square\ washer}$	0,62	-	1,24 x e/(b+7)	-
$k_{lat\ square\ washer}$	-	0,50	-	1,00
$k_{ax\ round\ washer}$	0,66	-	1,33 x e/(b+7)	-
$k_{lat\ round\ washer}$	-	0,50	-	1,00

e and b are in [mm]

For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Table D15-4 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket AE48 per connection				Modified characteristic capacity			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k}$ x k_{mod} *(Purlin may rotate)*		$R_{2/3,k}$ x k_{mod}	
	Flange A	Flange B		CNA Connector nail			
				4.0x40	4.0x60	4.0x40	4.0x60
Nail pattern 4	6	1 Bolt Ø12	P	20/(f+9)	20/(f+9)	0,6	1,1
			L	20/(f+9)	20/(f+9)	0,7	1,2
			M	20/(f+9)	20/(f+9)	0,9	1,4
			S	20/(f+9)	20/(f+9)	1	1,6
			I	20/(f+9)	20/(f+9)	1,2	2
Nail Pattern 5	7	1 Bolt Ø12	P	-	-	0,6	1,1
			L	-	-	0,7	1,2
			M	-	-	0,9	1,4
			S	-	-	1	1,6
			I	-	-	1,2	2

f is in [mm]

When the purlin has a wane on the side towards the Angle Bracket the value in the grey square is valid.

AE48	connection with 1 angle brackets	
factor:	for F_1	for $F_{2/3}$
$K_{ax\ square}$	(f+48)/27	2,08
$K_{lat\ square}$	-	1,00
$K_{ax\ round}$	(f+48)/27	2,08
$K_{lat\ round}$	-	1,00

f is in [mm]

For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Annex D16 – AE76

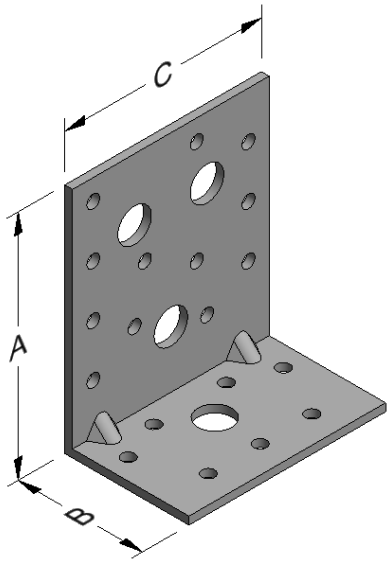
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AE76	Steel ref. 1	France: EB/7076
AE76S	Steel ref. 2	-
AE76S2	Steel ref. 3	-
AE76Z	Steel ref. 6	-

Connector Size Range:

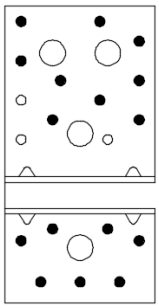
Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
AE76	90	48	76	3,0	12	3	7	1

Drawing:

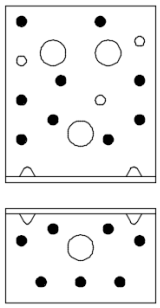


Nailing pattern:

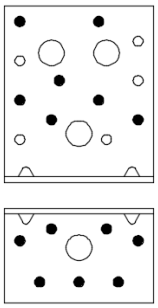
Nailing pattern 1



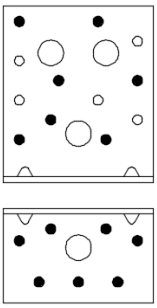
Nailing pattern 2



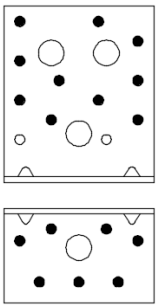
Nailing pattern 3



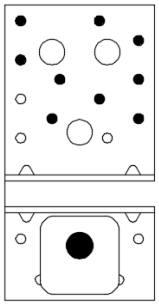
Nailing pattern 4



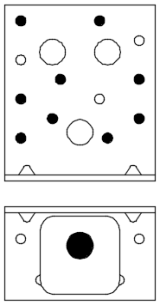
Nailing pattern 5



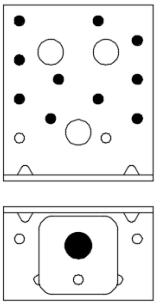
Nailing pattern 6



Nailing pattern 7



Nailing pattern 8



Square washer (US40/40/10G or US40/50/10G) can be replaced by standard washer of the bolts (bolt Ø12 – washer Ø24). In this case, the value of k_{lat} and k_{ax} must be adapted (see tables below D16-4 and D16-5)

Nailing pattern	No of fasteners		Description
	Flange A	Flange B	
1	9	7	Nailing with force F1 , F2, F3, F4 and F5
2	9	7	Max. nailing with force F2 and F3
3	7	7	Min. nailing with force F1 , F2, F3, F4 and F5
4	7	7	Min. nailing with force F2 and F3
5	10	7	Nailing with force F1 , F2, F3, F4 and F5
6	9	1 x M12	Max. nailing with force F1 , F2, F3, F4 and F5
7	9	1 x M12	Max. nailing with force F2 and F3
8	10	1 x M12	Max. nailing with force F1 , F2, F3, F4 and F5

Table D16-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AE76 per connection				**Modified characteristic capacity (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
	Flange A	Flange B		CNA Connector nail					
				4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 1	9	7	P	3,5	5,9	7	9,4	7 1.76b+98 e-3	7 2.94b+107 e-3
			L	4,1	6,9	8,1	11	7,56 2.06b+100 e-3	7,56 3.43b+110 e-3
			M	4,7	7,8	9,3	12,5	8,09 2.35b+102 e-3	8,09 3.92b+113 e-3
			S	5,3	8,8	10,4	14,1	8,58 2.65b+105 e-3	8,58 4.41b+117 e-3
			I	6,5	10,8	12,8	17,2	9,48 3.24b+109 e-3	11,25 5.39b+124 e-3
Nailing Pattern 2	9	7	P	-	-	7,2	10,4	-	-
			L	-	-	8,4	12,2	-	-
			M	-	-	9,6	13,9	-	-
			S	-	-	10,8	15,6	-	-
			I	-	-	13,2	19,1	-	-
Nailing Pattern 3	7	7	P	3,5	5,9	5,7	7,9	7 1.76b+98 e-3	7 2.94b+107 e-3
			L	4,1	6,9	6,7	9,2	7,56 2.06b+100 e-3	7,56 3.43b+110 e-3
			M	4,7	7,8	7,6	10,5	8,09 2.35b+102 e-3	8,09 3.92b+113 e-3
			S	5,3	8,8	8,6	11,8	8,58 2.65b+105 e-3	8,58 4.41b+117 e-3
			I	6,5	10,8	10,5	14,5	9,48 3.24b+109 e-3	9,48 5.39b+124 e-3
Nailing Pattern 4	7	7	P	-	-	6,3	8,6	-	-
			L	-	-	7,3	10	-	-
			M	-	-	8,4	11,4	-	-
			S	-	-	9,4	12,9	-	-
			I	-	-	11,5	15,7	-	-
Nailing Pattern 5	10	3	P	3,53		7,3	10,1	7 1.76b+98 e-3	7 2.94b+107 e-3
			L	4,12		8,5	11,8	7,56 2.06b+100 e-3	7,56 3.43b+110 e-3
			M	4,7		9,7	13,4	8,09 2.35b+102 e-3	8,09 3.92b+113 e-3
			S	5,3		10,9	15,1	8,58 2.65b+105 e-3	8,58 4.41b+117 e-3
			I	6,5		13,4	18,5	9,48 3.24b+109 e-3	11,25 5.39b+124 e-3

b and e are in [mm]

Table D16-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AE76 per connection				**Modified characteristic capacity (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k}$ x k_{mod} *(Minimum between values - Purlin may rotate)*		$R_{2/3,k}$ x k_{mod}	
	Flange A	Flange B		CNA Connector nail			
				4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 1	9	7	P	42/(f+40) 35/(f+8.5)	69/(f+40) 35/(f+8.5)	3,5	4,7
			L	49/(f+40) 35/(f+8.5)	81/(f+40) 35/(f+8.5)	4,1	5,5
			M	56/(f+40) 35/(f+8.5)	93/(f+40) 35/(f+8.5)	4,6	6,3
			S	63/(f+40) 35/(f+8.5)	104/(f+40) 35/(f+8.5)	5,2	7,1
			I	76/(f+40 35/(f+8.5)	127/(f+40 35/(f+8.5)	6,4	8,6
Nailing Pattern 2	9	7	P	-	-	3,6	5,2
			L	-	-	4,2	6,1
			M	-	-	4,8	7
			S	-	-	5,4	7,8
			I	-	-	6,6	9,6
Nailing Pattern 3	7	7	P	42/(f+40) 35/(f+8.5)	69/(f+40) 35/(f+8.5)	2,9	3,9
			L	49/(f+40) 35/(f+8.5)	81/(f+40) 35/(f+8.5)	3,3	4,6
			M	56/(f+40) 35/(f+8.5)	93/(f+40) 35/(f+8.5)	3,8	5,3
			S	63/(f+40) 35/(f+8.5)	104/(f+40) 35/(f+8.5)	4,3	5,9
			I	76/(f+40 35/(f+8.5)	127/(f+40 35/(f+8.5)	5,2	7,2
Nailing Pattern 4	7	7	P	-	-	3,1	4,3
			L	-	-	3,7	5
			M	-	-	4,2	5,7
			S	-	-	4,7	6,4
			I	-	-	5,8	7,9
Nailing Pattern 5	10	3	P	42/(f+40) 35/(f+8.5)	69/(f+40) 35/(f+8.5)	3,6	5
			L	49/(f+40) 35/(f+8.5)	81/(f+40) 35/(f+8.5)	4,3	5,9
			M	56/(f+40) 35/(f+8.5)	93/(f+40) 35/(f+8.5)	4,9	6,7
			S	63/(f+40) 35/(f+8.5)	104/(f+40) 35/(f+8.5)	5,5	7,6
			I	76/(f+40 35/(f+8.5)	127/(f+40 35/(f+8.5)	6,7	9,2

f is in [mm]

Table D16-3 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets AE76 per connection				Modified characteristic capacity (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
	Flange A	Flange B		CNA Connector nail					
				4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 6	9	1 Bolt Ø12	P	4,8 13,6	7,9 16,8	4,5	6,7	7 6.81b+134 e-3	7 8.41b+145 e-3
			L	5,7 16,0	9,2 16,8	5,3	7,8	7,56 7.99b+142 e-3	7,56 8.41b+145 e-3
			M	6,4 16,8	10,5 16,8	6,1	8,9	8,09 8.41b+145 e-3	8,09 8.41b+145 e-3
			S	7,2 16,8	11,7 16,8	6,8	10	8,58 8.41b+145 e-3	8,58 8.41b+145 e-3
			I	8,8 16,8	14,4 16,8	8,3	12,3	9,48 8.41b+145 e-3	9,48 8.41b+145 e-3
Nailing Pattern 7	9	1 Bolt Ø12	P	-	-	4,6	7,1	-	-
			L	-	-	5,3	8,2	-	-
			M	-	-	6,1	9,4	-	-
			S	-	-	6,9	10,6	-	-
			I	-	-	8,4	12,9	-	-
Nailing Pattern 8	10	1 Bolt Ø12	P	4,8 13,6	7,9 16,8	4,6	7,6	7 6.81b+134 e-3	7 8.41b+145 e-3
			L	5,7 16,0	9,2 16,8	5,3	8,9	7,56 7.99b+142 e-3	7,56 8.41b+145 e-3
			M	6,4 16,8	10,5 16,8	6,1	10,2	8,09 8.41b+145 e-3	8,09 8.41b+145 e-3
			S	7,2 16,8	11,7 16,8	6,9	11,5	8,58 8.41b+145 e-3	8,58 8.41b+145 e-3
			I	8,8 16,8	14,4 16,8	8,4	14	9,48 8.41b+145 e-3	9,48 8.41b+145 e-3

e and b are in [mm]

When the purlin has a wane on the side towards the Angle Bracket the value in the grey square is valid.

AE76	Connection with 2 Angle Brackets			
factor:	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
$k_{ax\ square\ washer}$	0,54	-	1,08 x e/(b+7)	-
$k_{lat\ square\ washer}$	-	0,5	-	1,00
$k_{ax\ round\ washer}$	0,58	-	1,16 x e/(b+7)	-
$k_{lat\ round\ washer}$	-	0,5	-	1,00

e and b are in [mm]

For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Table D16-4 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket AE76 per connection				**Modified characteristic capacity (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ *(Purlin may rotate)*		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 6	9	1 Bolt Ø12	P	34/(f+5)	34/(f+5)	2,3	3,3
			L	34/(f+5)	34/(f+5)	2,7	3,9
			M	34/(f+5)	34/(f+5)	3	4,5
			S	34/(f+5)	34/(f+5)	3,4	5
			I	34/(f+5)	34/(f+5)	4,2	6,1
Nailing Pattern 7	9	1 Bolt Ø12	P	-	-	2,3	3,5
			L	-	-	2,7	4,1
			M	-	-	3	4,7
			S	-	-	3,4	5,3
			I	-	-	4,2	6,5
Nailing Pattern 8	10	1 Bolt Ø12	P	34/(f+5)	34/(f+5)	2,3	3,8
			L	34/(f+5)	34/(f+5)	2,7	4,5
			M	34/(f+5)	34/(f+5)	3	5,1
			S	34/(f+5)	34/(f+5)	3,4	5,7
			I	34/(f+5)	34/(f+5)	4,2	7

f is in [mm]

AE76	**Connection with 1 Angle Bracket**	
factor:	**for F_1**	**for $F_{2/3}$**
$k_{ax\ square\ washer}$	(f+45)/28	0,74
$k_{lat\ square\ washer}$	-	1
$k_{ax\ round\ washer}$	(f+45)/28	0,74
$k_{lat\ round\ washer}$	-	1

f is in [mm]

For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Annex D17 – AE116

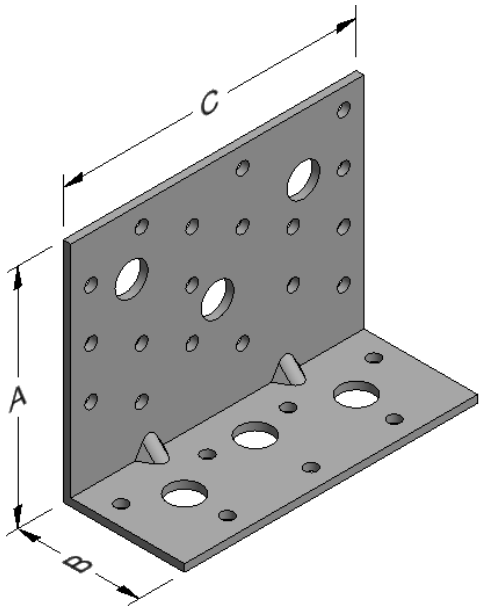
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AE116	Steel ref. 1	-
AE116S	Steel ref. 2	-
AE116S2	Steel ref. 3	-
AE116Z	Steel ref. 6	-

Connector Size Range:

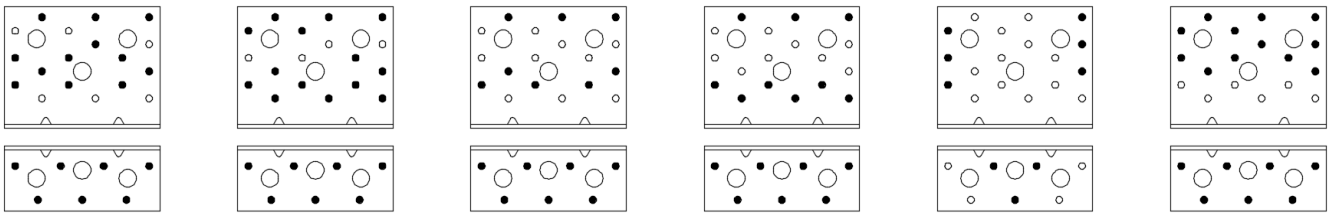
Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
AE116	90	48	116	3,0	18	3	7	3

Drawing:

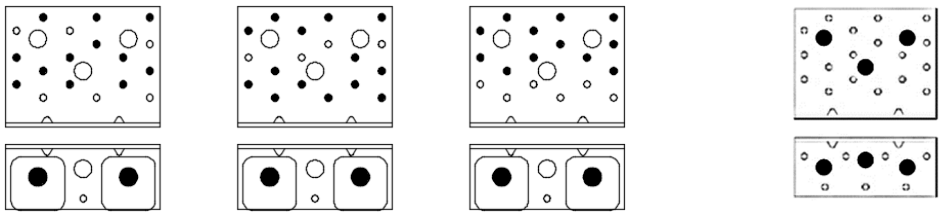


Nailing pattern:

Nailing pattern 1 Nailing pattern 2 Nailing pattern 3 Nailing pattern 4 Nailing pattern 5 Nailing pattern 6



Nailing pattern 7 Nailing pattern 8 Nailing pattern 9 Nailing pattern 10



Square washer (US40/40/10G or US40/50/10G) can be replaced by standard washer of the bolts (bolt Ø12 – washer Ø24). In this case, the value of k_{lat} and k_{ax} must be adapted (see tables below D17-4 and D17-5).

Nailing pattern	No of fasteners		Description
	Flange A	Flange B	
1	12	7	Nailing with force F1 , F2, F3, F4 and F5
2	14	7	Max. nailing with force F2 and F3
3	8	7	Min. nailing with force F1 , F2, F3, F4 and F5
4	9	7	Min. nailing with force F2, F3
5	6	3	Specific nailing for timber beam to rafter connection
6	12	7	Nailing with force F1, F2 and F3
7	12	2 x M12	Max. nailing with force F1 , F2, F3 F4 and F5
8	14	2 x M12	Max. nailing with force F2 and F3
9	12	2 x M12	Nailing with force F1, F2 and F3
10	3	3	Beam to beam with large connector screws type SS-H

Table D17-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AE116 per connection				**Modified characteristic capacity (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
	Flange A	Flange B		CNA Connector nail					
				4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 1	12	7	P	3,5	5,9	9,9	13,9	7,6 1.76b+139 e-3	9,9 2.94b+147 e-3
			L	4,1	6,9	11,6	16,2	8,9 2.06b+141 e-3	11,3 3.43b+150 e-3
			M	4,7	7,8	13,2	18,5	10,1 2.35b+143 e-3	12,1 3.92b+154 e-3
			S	5,3	8,8	14,9	20,8	11,4 2.65b+145 e-3	12,8 4.41b+157 e-3
			I	6,5	10,8	18,2	25,5	13,9 3.24*149 e-3	17,6 5.39b+164 e-3
Nailing Pattern 2	14	7	P	-	-	11,5	16	-	-
			L	-	-	13,4	18,6	-	-
			M	-	-	15,3	21,3	-	-
			S	-	-	17,2	23,9	-	-
			I	-	-	21	29,2	-	-
Nailing Pattern 3	8	7	P	3,5	5,9	8,3	11,6	7,6 1.76b+139 e-3	9,9 2.94b+147 e-3
			L	4,1	6,9	9,7	13,5	8,9 2.06b+141 e-3	11,3 3.43b+150 e-3
			M	4,7	7,8	11	15,5	10,1 2.35b+143 e-3	12,1 3.92b+154 e-3
			S	5,3	8,8	12,4	17,4	11,4 2.65b+145 e-3	12,8 4.41b+157 e-3
			I	6,5	10,8	15,2	21,3	13,9 3.24*149 e-3	17,6 5.39b+164 e-3
Nailing Pattern 4	9	7	P			10	13,6	-	-
			L			11,6	15,9	-	-
			M			13,3	18,2	-	-
			S			15	20,4	-	-
			I			18,3	25	-	-
Nailing Pattern 6			P	3,5	5,9	9,6	12,8	-	-
			L	4,1	6,9	11,2	14,9	-	-
			M	4,7	7,8	12,8	17,1	-	-
			S	5,3	8,8	14,4	19,2	-	-
			I	6,5	10,8	17,6	23,5	-	-

Table D17-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Brackets AE116 per connection				**Modified characteristic capacity (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ *(Minimum between values - Purlin may rotate)*		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 1	12	7	P	48/(f+40) 42/(f+13)	79/(f+40) 42/(f+13)	5	6,9
			L	56/(f+40) 42/(f+13)	93/(f+40) 42/(f+13)	5,8	8,1
			M	64/(f+40) 42/(f+13)	106/(f+40) 42/(f+13)	6,6	9,3
			S	71/(f+40) 42/(f+13)	42/(f+13)	7,4	10,4
			I	87/(f+40) 42/(f+13)	42/(f+13)	9,1	12,7
Nailing Pattern 2	14	7	P	-	-	5,7	8
			L	-	-	6,7	9,3
			M	-	-	7,6	10,6
			S	-	-	8,6	12
			I	-	-	10,5	14,6
Nailing Pattern 3	8	7	P	48/(f+40) 42/(f+13)	79/(f+40) 42/(f+13)	4,1	5,8
			L	56/(f+40) 42/(f+13)	93/(f+40) 42/(f+13)	4,8	6,8
			M	64/(f+40) 42/(f+13)	106/(f+40) 42/(f+13)	5,5	7,7
			S	71/(f+40) 42/(f+13)	42/(f+13)	6,2	8,7
			I	87/(f+40) 42/(f+13)	42/(f+13)	7,6	10,6
Nailing Pattern 4	9	7	P	-	-	5	6,8
			L	-	-	5,8	7,9
			M	-	-	6,6	9,1
			S	-	-	7,5	10,2
			I	-	-	9,1	12,5
Nailing Pattern 6			P	48/(f+40) 42/(f+13)	79/(f+40) 42/(f+13)	4,8	6,4
			L	56/(f+40) 42/(f+13)	93/(f+40) 42/(f+13)	5,6	7,5
			M	64/(f+40) 42/(f+13)	106/(f+40) 42/(f+13)	6,4	8,5
			S	71/(f+40) 42/(f+13)	42/(f+13)	7,2	9,6
			I	87/(f+40) 42/(f+13)	42/(f+13)	8,8	11,7

Table D17-3 Modified characteristic capacity timber beam to rigid support connection - 2 Angle Brackets

2 Angle Brackets AE116 per connection				Modified characteristic capacity					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$ *(Minimum between values)*	
	Flange A	Flange B		CNA Connector nail					
				4.0x40	4.0x60	4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 7	12	2 Bolts Ø12	P	5,6 15,1	9,3 23,0	15,5	16,7	10,5 7.5b+179 e-3	10,5 11.5b+207 e-3
			L	6,6 17,8	10,8 26,7	18,1	19,4	11,3 8.9b+188 e-3	11,3 13.3b+220 e-3
			M	7,5 20,2	12,3 28,1	20,7	22,2	12,1 10.1b+197 e-3	12,1 14b+225 e-3
			S	8,4 22,6	13,8 28,1	23,3	25	12,8 11.3b+206 e-3	12,8 14b+225 e-3
			I	10,3 27,7	16,9 28,1	28,4	30,5	14,2 13.9b+223 e-3	17,6 14b+225 e-3
Nailing Pattern 8	14	2 Bolts Ø12	P	-	-	16,5	17,1	-	-
			L	-	-	19,2	19,9	-	-
			M	-	-	22	22,8	-	-
			S	-	-	24,7	25,6	-	-
			I	-	-	30,2	31,3	-	-
Nailing Pattern 9	12	2 Bolts Ø12	P	8,6 17,1	13,9 25,4	14,8	16,3	-	-
			L	10,1 20,1	16,2 28,1	17,2	19,1	-	-
			M	11,5 22,9	18,5 28,1	19,7	21,8	-	-
			S	12,9 25,6	20,8 28,1	22,1	24,5	-	-
			I	15,8 28,1	25,5 28,1	27,1	30	-	-

e and b are in [mm]

When the purlin has a wane on the side towards the Angle Bracket the value in the grey square is valid.

AE116	connection with 2 angle brackets			
factor:	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
$k_{ax\ square\ washer}$	0,65	-	1,3 x e/(b+7)	-
$k_{lat\ square\ washer}$	-	0,5 and M=F2x12mm*1	-	1,00
$k_{ax\ round\ washer}$	0,70	-	1,39 x e/(b+7)	-
$k_{lat\ round\ washer}$	-	0,5 and M=F2x12mm*1	-	1,00

e and b are in [mm]

For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Table D17-4 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket AE116 per connection				**Modified characteristic capacity**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ *(Purlin may rotate)*		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4.0x40	4.0x60	4.0x40	4.0x60
Nailing pattern 7	12	2 Bolts Ø12	P	42/(f+9)	42/(f+9)	7,8	8,3
			L	42/(f+9)	42/(f+9)	9	9,7
			M	42/(f+9)	42/(f+9)	10,3	11,1
			S	42/(f+9)	42/(f+9)	11,6	12,5
			I	42/(f+9)	42/(f+9)	14,2	15,3
Nailing Pattern 8	14	2 Bolts Ø12	P	-	-	8,2	8,5
			L	-	-	9,6	10
			M	-	-	11	11,4
			S	-	-	12,4	12,8
			I	-	-	15,1	15,7
Nailing Pattern 9	12	2 Bolts Ø12	P	42/(f+9)	42/(f+9)	7,4	8,2
			L	42/(f+9)	42/(f+9)	8,6	9,5
			M	42/(f+9)	42/(f+9)	9,8	10,9
			S	42/(f+9)	42/(f+9)	11,1	12,3
			I	42/(f+9)	42/(f+9)	13,5	15

f is in [mm]

AE116	**connection with 1 angle brackets**	
factor:	**for F_1**	**for $F_{2/3}$**
$K_{ax\ square}$	(f+44)/23	0,18
$K_{lat\ square}$	-	1,00
$K_{ax\ round}$	(f+44)/23	0,18
$K_{lat\ round}$	-	1,00

f is in [mm]

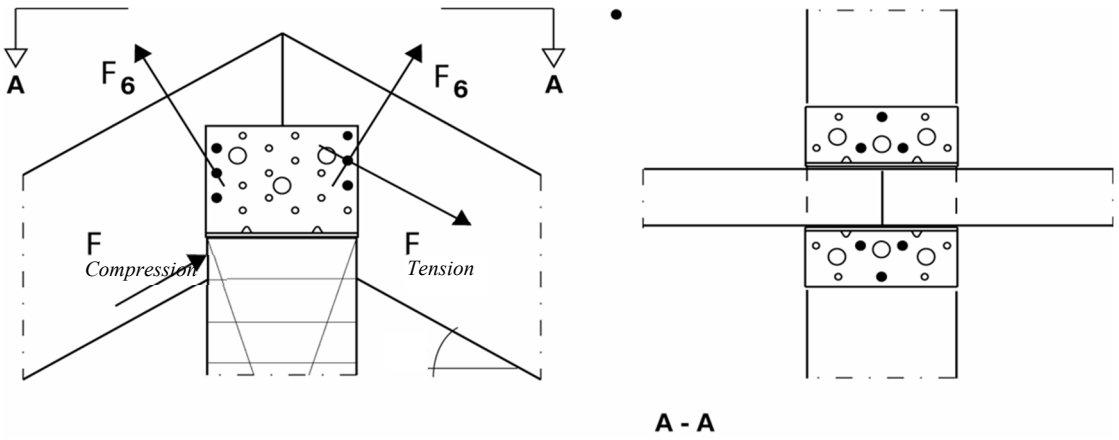
For each bolt (bolt group) it´s needed to check:

$R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Square washer = US40/40/10G or US40/50/10G

Round washer = standard washer of the anchor bolt. For anchor Ø12 the washer diameter is Ø24

Table D17-5 Modified characteristic capacity timber beam to rafter connection - 2 Angle Brackets



Nailing pattern 5)

2 Angle Brackets per connection	**Modified characteristic capacity per connection**								
Load duration: I	$R_{6,singlesided}$ on one rafter				Symmetrical $R_{6,symmetrical}$ on each of two rafters	Height $h_{contact}$ of contact area between rafter and ridge beam			
Roof pitch α [°]	$b_{ridgebeam}$ [mm] 80	90	100	120	>80	80	90	100	120
	$R_{6,singlesided}$ [kN]				**$R_{6,symmetrical}$ [kN]**	**$h_{contact}$ [mm]**			
0	4,5	4,6	4,6	4,6	2,7	0	0	0	0
5	4,6	4,6	4,6	4,7	2,7	3	4	4	5
10	4,6	4,6	4,7	4,7	2,7	7	8	9	11
15	4,7	4,7	4,7	4,7	2,8	11	12	13	16
20	4,7	4,7	4,7	4,7	2,9	15	16	18	22
25	4,7	4,8	4,8	4,8	3,0	19	21	23	28
30	4,8	4,8	4,8	4,8	3,1	23	26	29	35
35	4,8	4,8	4,8	4,8	3,3	28	32	35	42
40	4,9	4,9	4,9	4,9	3,5	34	38	42	50
45	4,9	4,9	4,9	4,9	3,8	40	45	50	60

Same roof pitch at both side of the roof
Connector nail according to ETA-04/0013 4,0x40 in rafter and 4,0x60 in ridge beam

The capacities in the table are for Instant load duration, the capacities for other load durations are found by multiplication by the factor c

Factor c for other load durations	**P**	**L**	**M**	**S**
	0,55	0,64	0,73	0,82

Table D17-6 AE116 – Slip modulus Kser

AE116				K_{ser} [kN/mm]			
	Nail pattern	Fastener		For F1		For F2	
		Flange A	Flange B	CNA4.0x40	CNA4.0x60	CNA4.0x40	CNA4.0x60
2 x AE116 per Connection	7	2 x 12	2 x 2 x M12	10,4	11,5	9,5	10,0
	1	2 x 12	2 x 7	2,1	3,4	3,2	4,5
	3	2 x 8	2 x 7	2,1	3,4	2,7	3,7
1 x AE116 per Connection	7	12	2 x M12	5,2	5,8	4,8	5,0
	1	12	7	1,1	1,7	1,6	2,3
	3	8	7	1,1	1,7	1,4	1,9

Combined symmetrical and single sided forces

For a combination of symmetrical and single sided load, the load carrying capacity is found from the following criteria:

$$\frac{F_{6,symmetrical}}{R_{6,symmetrical,d}} + \frac{F_{6,singlesided}}{R_{6,singlesided,d}} \le 1$$

Combined symmetrical and single sided and tension force

For a combination of symmetrical, single sided force and tension in a rafter, the load carrying capacity is found from the following criteria:

$$\frac{F_{6,symmetrical}}{R_{6,symmetrical,d}} + \frac{F_{6,singlesided}}{R_{6,singlesided,d}} + \frac{F_{tension} \cdot \cos(\alpha)}{R_{tension,d}} \le 1$$

Where: $R_{tension} = 13 \cdot c$ kN, where c is the load duration factor.

Compression

The compressive force in the rafter is decomposed into a vertical force, $F_{compression} \cdot \sin(\alpha)$ and a horizontal force $F_{compression} \cdot \cos(\alpha)$.

The compressive force on the side of the ridge beam consist of contributions from both the rafter loaded in tension, $F_{tension} \cdot \cos(\alpha)$ and from the rafter loaded in compression $F_{compression} \cdot \cos(\alpha)$. The ridge beam must be checked for the compressive force acting perpendicular to the grain.

The maximum force considering the capacity perpendicular to the grain is found from the following expression:

$$R_{c,90,k} = f_{c,90,k} \cdot \left(2{,}38 - \frac{b_{rafter}}{250}\right) \cdot \left(1 + \frac{b_{ridgebeam}}{6 \cdot b_{rafter}}\right) \cdot b_{rafter} \cdot h_{contact}$$

Where:

$f_{c,90,k}$ = characteristic compression strength perpendicular to the grain of ridge beam

b_{rafter} = width of rafter [mm]

$b_{ridgebeam}$ = width of ridge beam [mm]

$h_{contact}$ = height of contact area between rafter and ridge beam, see table above

The capacity of the connection is verified from the following criteria:

$$\left(F_{compression} + F_{tension}\right) \cdot \cos(\alpha) \le R_{c,90,k}$$

Table D17-7 Characteristic capacity CLT timber beam to CLT timber beam – 2 Angle Bracket AE116 – Nailing pattern 10

CLT to CLT connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - CLT	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø12x80	SS-H Ø12x80
AE116	Nailing pattern 10	3	SS-H	3	SS-H	33	29,5

CLT density was considered as C24 - ρ_k = 350 kg/m^3

Table D17-8 AE116 Slip modulus K_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
		SS-H Ø12x80	SS-H Ø12x80
CLT to CLT (with SS-H screws)	10	1,88	2,36

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Annex D18 – AG40312, AG40412, AG40314 & AG40414

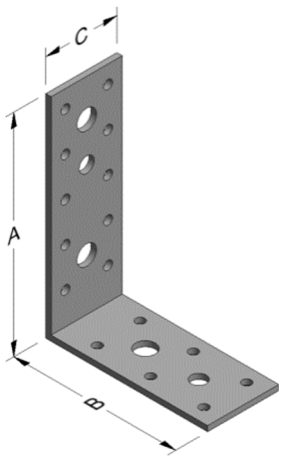
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AG40312	Steel ref. 1	France: EB/7312
AG40412	Steel ref. 1	-
AG40314	Steel ref. 1	-
AG40414	Steel ref. 1	-
AG40312S	Steel ref. 2	-
AG40412S	Steel ref. 2	-
AG40314S	Steel ref. 2	-
AG40414S	Steel ref. 2	-
AG40312S2	Steel ref. 3	-
AG40412S2	Steel ref. 3	-
AG40314S2	Steel ref. 3	-
AG40414S2	Steel ref. 3	-
AG40312Z	Steel ref. 6	-
AG40412Z	Steel ref. 6	-
AG40314Z	Steel ref. 6	-
AG40414Z	Steel ref. 6	-

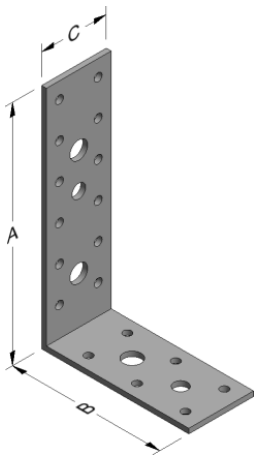
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B		
	A	B	C	Thickness	Ø5	Ø8,5	Ø11	Ø5	Ø8,5	Ø11
AG40312	119	91	40	3,0	10	1	2	6	1	1
AG40412	120	92	40	4,0	10	1	2	6	1	1
AG40314	141	91	40	3,0	12	1	2	6	1	1
AG40414	142	92	40	4,0	12	1	2	6	1	1

Drawings:

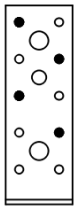
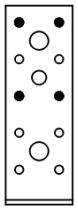
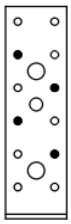
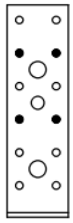
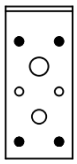
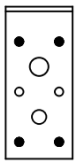
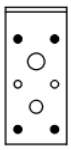
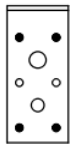


AG40312, AG40412



AG40314, AG40414

Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	Beam to beam, (AG40312, AG40412)	Beam (A) to column (B), (AG40312, AG40412)	Beam to beam, (AG40314, AG40414)	Beam (A) to column (B), (AG40314, AG40414)

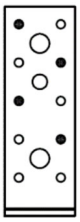
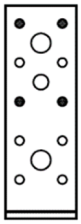
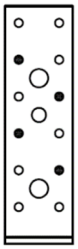
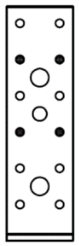
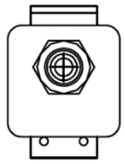
	Nailing pattern 5	Nailing pattern 6	Nailing pattern 7	Nailing pattern 8
Flange A:				
Flange B:				
	Beam (A) to rigid support (B), (AG40312, AG40412)	Column (A) to rigid support (B), (AG40312, AG40412)	Beam (A) to rigid support (B), (AG40314, AG40414)	Column (A) to rigid support (B), (AG40314, AG40414)

Table D18-1 Modified characteristic capacity timber beam to timber beam or timber beam to timber column – 2 Angle Brackets

2 Angle Brackets AG40312 or AG40314 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 1, 2, 3, 4	4	4	S	2,7	3,9	3,0	4,5	e≤0,29b+15 4,6 e>0,29b+15 1,32b+56 e-3,0	e≤0,43b+18 4,6 e>0,43b+18 1,96b+70 e-3,0
			M	2,4	3,6	2,6	4,0	e≤0,27b+15 4,3 e>0,27b+15 1,18b+52 e-3,0	e≤0,42b+18 4,3 e>0,42b+18 1,80b+66 e-3,0

b and e are in mm

Factors for other load durations	$R_{1,k}$		$R_{2/3,k}$		$R_{4/5,k}$	
	CNA Connector nail					
	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,19	1,16	1,22	1,22	1,11	1,11
L multiply M by	0,88	0,91	0,88	0,88	0,88	0,92
P multiply M by	0,75	0,81	0,75	0,75	0,78	0,83

Table D18-2 Modified characteristic capacity timber beam to timber beam or timber beam to timber column – 1 Angle Bracket

1 Angle Bracket AG40312 or AG40314 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ Purlin may rotate		$R_{2/3,k} \times k_{mod}$	
				CNA Connector nail			
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 1, 2, 3, 4	4	4	P	min: $\frac{55}{f + 81}$ $\frac{20}{f + 19}$	$\frac{20}{f + 19}$	1,0	1,4
			L	$\frac{20}{f + 19}$	$\frac{20}{f + 19}$	1,2	1,7
			M	$\frac{20}{f + 19}$	$\frac{20}{f + 19}$	1,3	1,9
			S	$\frac{20}{f + 19}$	$\frac{20}{f + 19}$	1,5	2,1
			I	$\frac{20}{f + 19}$	$\frac{20}{f + 19}$	1,8	2,6

f is in mm

Table D18-3 Modified characteristic capacity timber beam to timber beam or timber beam to timber column – 2 Angle Brackets

2 Angle Brackets AG40412 or AG40414 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 1, 2, 3, 4	4	4	S	2,7	4,4	2,9	4,0	e≤ 0,22b+16 6,1 e> 0,22b+16 1,32b+76 e-4,0	e≤ 0,36b+19 6,1 e> 0,36b+19 2,21b+96 e-4,0
			M	2,4	3,9	2,6	3,5	e≤ 0,20b+16 5,75 e> 0,20b+16 1,18b+73 e-4,0	e≤ 0,34b+19 5,75 e> 0,34b+19 1,96b+90 e-4,0

f are in mm

Factors for other load durations	$R_{1,k}$		$R_{2/3,k}$		$R_{4/5,k}$	
	CNA Connector nail					
	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,22	1,22	1,22	1,22	1,10	1,10
L multiply M by	0,88	0,88	0,88	0,88	0,85	0,89
P multiply M by	0,75	0,75	0,75	0,75	0,65	0,78

Table D18-4 Modified characteristic capacity timber beam to timber beam or timber beam to timber column – 1 Angle Bracket

1 Angle Bracket AG40412 or AG40414 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ Purlin may rotate		$R_{2/3,k} \times k_{mod}$	
				CNA Connector nail			
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 1, 2, 3, 4	4	4	P	min: 55 / f + 82 ; 35 / f + 20	min: 91 / f + 82 ; 35,0 / f + 20	1,0	1,3
			L	min: 64 / f + 82 ; 35 / f + 20	min: 106 / f + 82 ; 35,0 / f + 20	1,1	1,6
			M	min: 73 / f + 82 ; 35 / f + 20	min: 122 / f + 82 ; 35 / f + 20	1,3	1,8
			S	min: 82 / f + 82 ; 35 / f + 20	35 / f + 20	1,5	2,0
			I	min: 100,0 / f + 82 ; 35,0 / f + 20	35 / f + 20	1,8	2,4

f is in mm.

Table D18-5 Modified characteristic capacity timber beam or timber column to rigid support – 2 Angle Brackets

2 Angle Brackets AG40412 or AG40414 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 5, 6, 7, 8	4	1 Bolt	S	8,1	8,1	1,0	1,0	4,1b+61 e-4,0 max: 6,1	4,1b+61 e-4,0 max: 6,1
			M	8,1	8,1	0,8	1,0	4,1b+61 e-4,0 max: 5,7	4,1b+61 e-4,0 max: 5,7

b and e are in mm

Factors for other load durations	$R_{1,k}$		$R_{2/3,k}$		$R_{4/5,k}$	
	CNA Connector nail					
	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,00	1,00	1,00	1,00	1,00	1,00
L multiply M by	0,91	1,00	1,00	1,00	0,86	0,95
P multiply M by	0,78	1,00	0,75	1,00	0,67	0,88

2 Angle Brackets AG per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt\ 1}$	$F_{4/5,bolt\ 2}$
k_{ax}	0,93	1,69	1,85 x e/B	-
k_{lat}	-	0,50	-	1,00

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Table D18-6 Modified characteristic capacity timber beam or timber column to rigid support – 1 Angle Bracket

1 Angle Brackets AG40412 or AG40414 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ Purlin may rotate		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail			
				4,0x40	4,0x60	4,0x40	4,0x60
Nailing patterns 5, 6, 7, 8	4	1 Bolt	S	min: $\frac{47}{f+7}$ $\frac{148}{f+67}$	min: $\frac{47}{f+7}$ $\frac{148}{f+67}$	0,5	0,5
			M	min: $\frac{47}{f+7}$ $\frac{148}{f+67}$	min: $\frac{47}{f+7}$ $\frac{148}{f+67}$	0,4	0,5

f is in mm

Factors for other load durations	$R_{1,k}$ Purlin may rotate		$R_{2/3,k}$	
	CNA Connector nail			
	4,0x40	4,0x60	4,0x40	4,0x60
I multiply S by	1,00	1,00	1,00	1,00
L multiply M by	1,00	1,00	1,00	1,00
P multiply M by	1,00	1,00	0,75	1,00

1 Angle Bracket AG per connection				
factor for:	F_1	$F_{2/3}$	F_4	F_5
k_{ax}	1,85	3,38	-	-
k_{lat}	-	1,00	-	-

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Annex D19 – AH9035 & AH9055

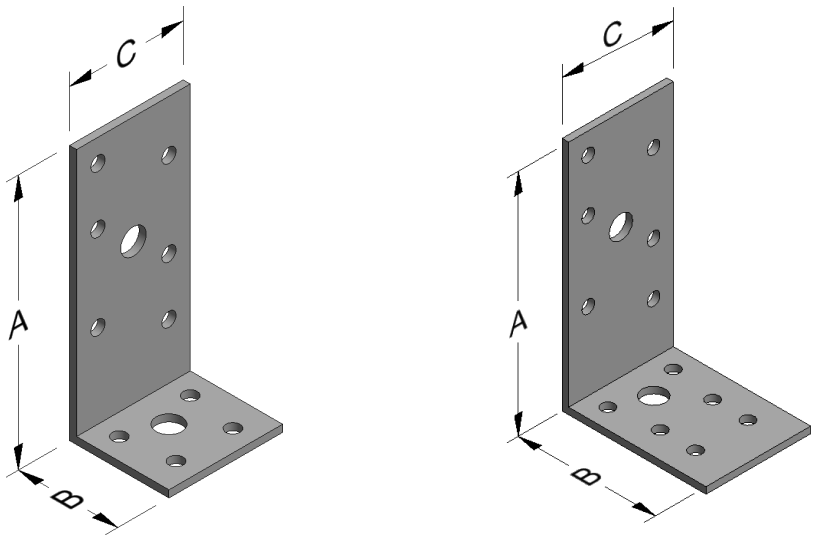
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AH9035	Steel ref. 1	-
AH9055	Steel ref. 1	
AH9035S	Steel ref. 2	-
AH9055S	Steel ref. 2	-
AH9035S2	Steel ref. 3	-
AH9055S2	Steel ref. 3	-
AH9035Z	Steel ref. 6	-
AH9055Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø9	Ø5	Ø9
AH9035	90	35	40	2,5	6	1	4	1
AH9055	90	55	40	2,5	6	1	6	1

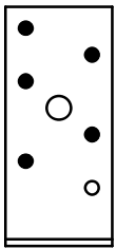
Drawings:



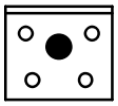
Nailing pattern:

Nailing pattern 1
AH9035

Flange A:



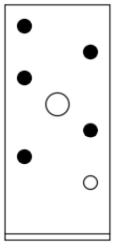
Flange B:



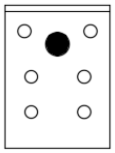
Beam (A) to rigid support (B)

Nailing pattern 1
AH9055

Flange A:



Flange B:



Beam (A) to rigid support (B)

Table D19-1 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket AH9035 or AH9055 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	**$R_{1,k}$ x k_{mod} = min of:**	
	Flange A	Flange B		CNA Connector nail	
				4,0x40	4,0x60
Nailing pattern 1	5	1 Bolt	S	$(1,43+(n-2)\cdot 1,64)\cdot c$ 1,9	$(2,25+(n-2)\cdot 2,13)\cdot c$ 1,9
				$(3,09+(n-2)\cdot 1,64)\cdot c$ 4,0	$(4,10+(n-2)\cdot 2,13)\cdot c$ 4,0
				$0,32\cdot F_{b,k}+0,91$ $0,19\cdot F_{anchor,concrete}+0,54$	

When the purlin has a wane on the side towards the Angle Bracket with an extent from the bottom up to the lower nail the value in the grey square is valid.

The capacities in the table are for short load duration, the capacities for other load durations are found by multiplication by the factor c

Factor c for other load durations	**P**	**L**	**M**	**S**	**I**
	0,67	0,78	0,89	1,00	1,22

The bolt shall have a capacity to sustain an axial force of $F_{1,d}$ x 3,1

Annex D20 – AJ60416

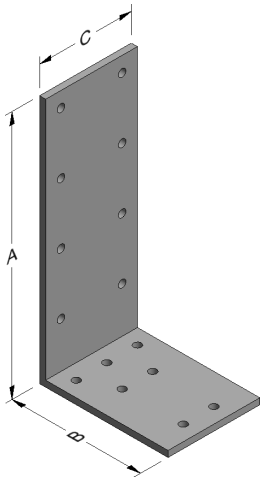
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AJ60416	Steel ref. 1	-
AJ60416S	Steel ref. 2	-
AJ60416S2	Steel ref. 3	-
AJ60416Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AJ60416	164	84	60	4,0	8	7

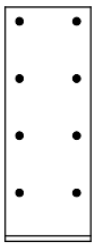
Drawing:



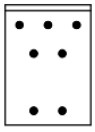
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Beam to Beam
Full nailing

Table D20-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AJ60416 per connection				**Modified characteristic capacity per connection (kN)**		
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4/5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail		
Nailing pattern1	8 x CNA4,0x40	7 x CNA4,0x60	S	10,2	7,0	min: 8,9 5,11b+107 / e-4,0
			M	9,3	6,2	min: 7,1 4,65b+103 / e-4,0

b and e are in mm

Factors for other load durations	$R_{1,k}$	$R_{2,k} = R_{3,k}$	$R_{4,k} = R_{5,k}$
	CNA Connector nail Vertical flange: 8 CNA4,0x40 - Horizontal flange: 7 CNA4,0x60		
I multiply S by	1,18	1,22	1,14
L multiply M by	0,90	0,88	0,85
P multiply M by	0,80	0,75	0,79

Table D20-2 Modified characteristic capacity timber beam to timber beam – 1 angle bracket

1 Angle Bracket AJ60416 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$ Purlin may rotate	$R_{2/3,k} \times k_{mod}$	$R_{4,k} \times k_{mod}$	$R_{5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail			
Nailing pattern1	8 x CNA4,0x40	7 x CNA4,0x60	S	min: 205 / f+74; 55 / f; 53,1 / f+12	3,5	min: 6,0; 53,1 / e-2,0	min: 2,8; 109 / 114-e; 4,6(b+2,0) / e
			M	min: 182,0 / f+74; 50,0 / f; 53,1 / f+12	3,1	min: 5,6; 53,1 / e-2,0	min: 2,6; 96 / 114-e; 4,2(b+2,0) / e

f, e and b are in mm

Factors for other load durations	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	$R_{5,k}$
	CNA Connector nail Vertical flange: 8 CNA4,0x40 - Horizontal flange: 7 CNA4,0x60			
I multiply S by	1,00	1,22	1,00	1,14
L multiply M by	0,88	0,88	0,95	0,88
P multiply M by	0,75	0,75	0,88	0,75

Annex D21 – AJ80416

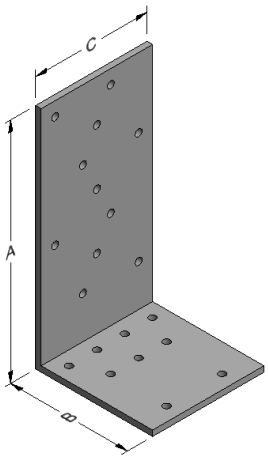
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AJ80416	Steel ref. 1	-
AJ80416S	Steel ref. 2	-
AJ80416S2	Steel ref. 3	-
AJ80416Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AJ80416	164	84	80	4,0	11	9

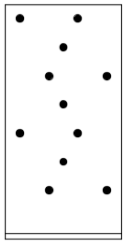
Drawing:



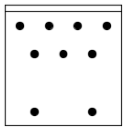
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Beam to Beam
Full nailing

Table D21-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AJ80416 per connection				**Modified characteristic capacity per connection (kN)**		
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4/5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail		
Nailing pattern1	11 x CNA4,0x40	9 x CNA4,0x60	S	14,0	9,0	min: 12,4 $\frac{7,02b+144}{e-4,0}$
			M	12,8	8,0	min: 11,7 $\frac{6,39b+139}{e-4,0}$

b and e are in mm

Factors for other load durations	$R_{1,k}$	$R_{2/3,k}$	$R_{4/5,k}$
	CNA Connector nail		
I multiply S by	1,18	1,22	1,11
L multiply M by	0,90	0,88	0,86
P multiply M by	0,80	0,75	0,65

Table D21-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AJ80416 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4,k} \times k_{mod}$	$R_{5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail			
Nailing pattern1	11 x CNA4,0x40	9 x CNA4,0x60	S	min: $\frac{274}{f+74}$ $\frac{83}{f}$ $\frac{70,8}{f+12}$	4,5	min: 8,0 $\frac{70,8}{e-2,0}$	min: 3,7 $\frac{163}{121-e}$ $\frac{6,3(b+2,0)}{e}$
			M	min: $\frac{243}{f+74}$ $\frac{74}{f}$ $\frac{70,8}{f+12}$	4,0	min: 7,5 $\frac{70,8}{e-2,0}$	min: 3,5 $\frac{145}{121-e}$ $\frac{5,7(b+2,0)}{e}$

f, e and b are in mm

Factors for other load durations	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	$R_{5,k}$
	CNA Connector nail			
I multiply S by	1,00	1,22	1,00	1,14
L multiply M by	0,88	0,88	0,93	0,88
P multiply M by	0,75	0,75	0,87	0,75

Annex D22 – AJ99416

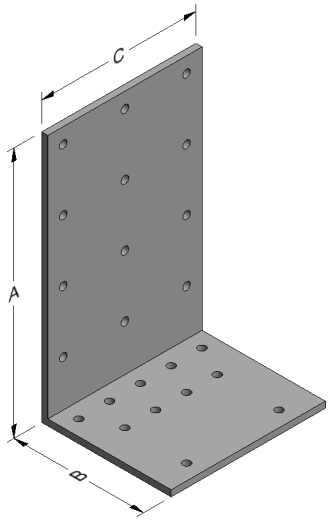
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AJ99416	Steel ref. 1	-
AJ99416S	Steel ref. 2	-
AJ99416S2	Steel ref. 3	-
AJ99416Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AJ99416	164	84	100	4,0	12	11

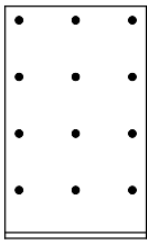
Drawing:



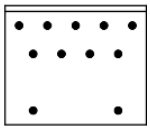
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Beam to Beam
Full nailing

Table D22-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AJ99416 per connection				**Characteristic capacity per connection (kN)**		
Nailing	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4/5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail		
Nailing pattern1	12 x CNA4,0x40	11 x CNA4,0x60	S	17,9	11,7	min: 13,1 $\frac{8,93b+181}{e-4,0}$
			M	15,9	10,4	min: 10,9 $\frac{7,93b+174}{e-4,0}$

b and e are in mm

Factors for other load durations	$R_{1,k}$	$R_{2,k} = R_{3,k}$	$R_{4,k} = R_{5,k}$
	CNA Connector nail		
I multiply S by	1,18	1,22	1,14
L multiply M by	0,88	0,88	0,88
P multiply M by	0,75	0,75	0,77

Table D22-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket AJ99416 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern1	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	$R_{4,k} \times k_{mod}$	$R_{5,k} \times k_{mod}$
	Flange A	Flange B		CNA Connector nail			
Nailing pattern1	12 x CNA4,0x40	11 x CNA4,0x60	S	min: $\frac{342}{f+74}$; $\frac{89}{f+12}$; $\frac{83}{f}$	5,9	min: 10,0; $\frac{89}{e-2,0}$	min: 4,7; $\frac{163}{114-e}$; $\frac{8,0(b+2,0)}{e}$
			M	min: $\frac{304}{f+74}$; $\frac{89}{f+12}$; $\frac{74}{f}$	5,2	min: 9,4; $\frac{89}{e-2,0}$	min: 4,3; $\frac{145}{114-e}$; $\frac{7,1(b+2,0)}{e}$

f, e and b are in mm

Factors for other load durations	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	$R_{5,k}$
	CNA Connector nail			
I multiply S by	1,00	1,22	1,00	1,13
L multiply M by	0,88	0,88	0,94	0,88
P multiply M by	0,75	0,75	0,87	0,75

Annex D23 – KNAG90, 130, 170 & 210

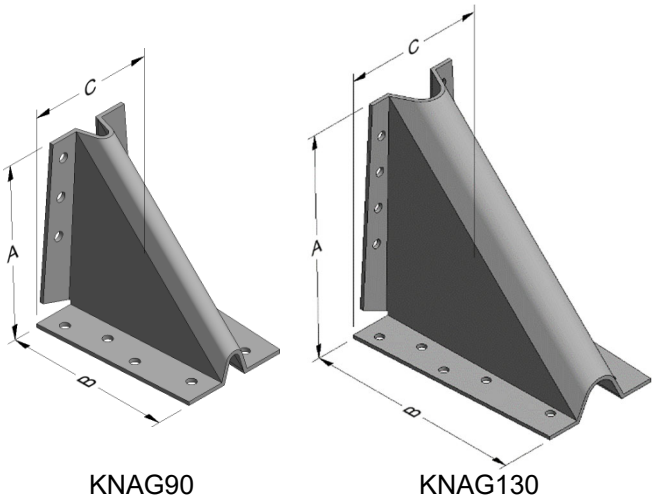
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
KNAG90	Steel ref. 1	France: ECH90/19090
KNAG130	Steel ref. 1	France: ECH125/19130
KNAG170	Steel ref. 1	France: ECH160/19170
KNAG210	Steel ref. 1	France: ECH200/19210
KNAG90S	Steel ref. 2	-
KNAG130S	Steel ref. 2	-
KNAG170S	Steel ref. 2	-
KNAG210S	Steel ref. 2	-
KNAG90S2	Steel ref. 3	-
KNAG130S2	Steel ref. 3	-
KNAG170S2	Steel ref. 3	-
KNAG210S2	Steel ref. 3	-
KNAG90Z	Steel ref. 6	-
KNAG130Z	Steel ref. 6	-
KNAG170Z	Steel ref. 6	-
KNAG210Z	Steel ref. 6	-

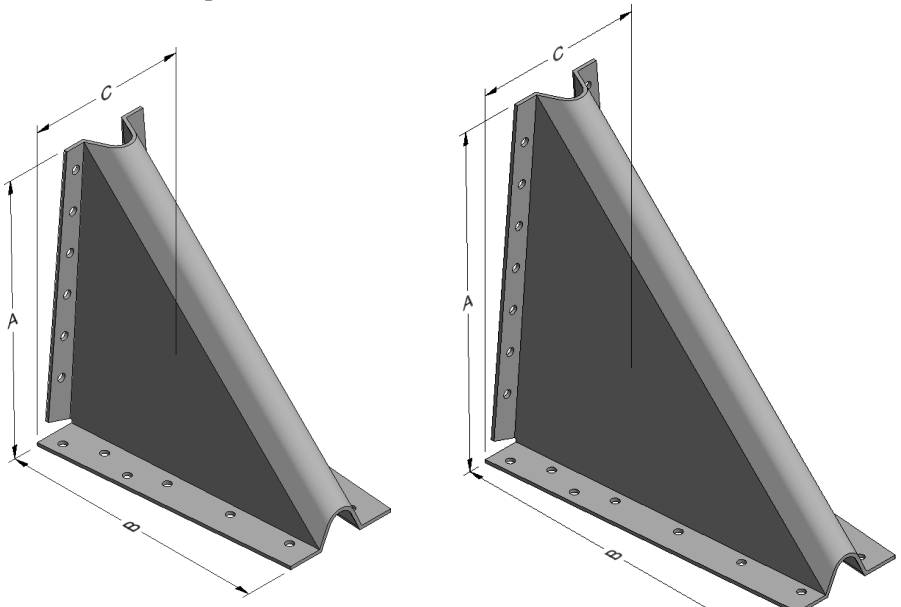
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C (A/B)	Thickness	Ø5	Ø5
KNAG90	90	90	55/65	2,0	6	8
KNAG130	125	125	64/80	2,0	9	10
KNAG170	160	160	80/95	2,0	11	12
KNAG210	200	200	84/100	2,0	14	14

Drawings:

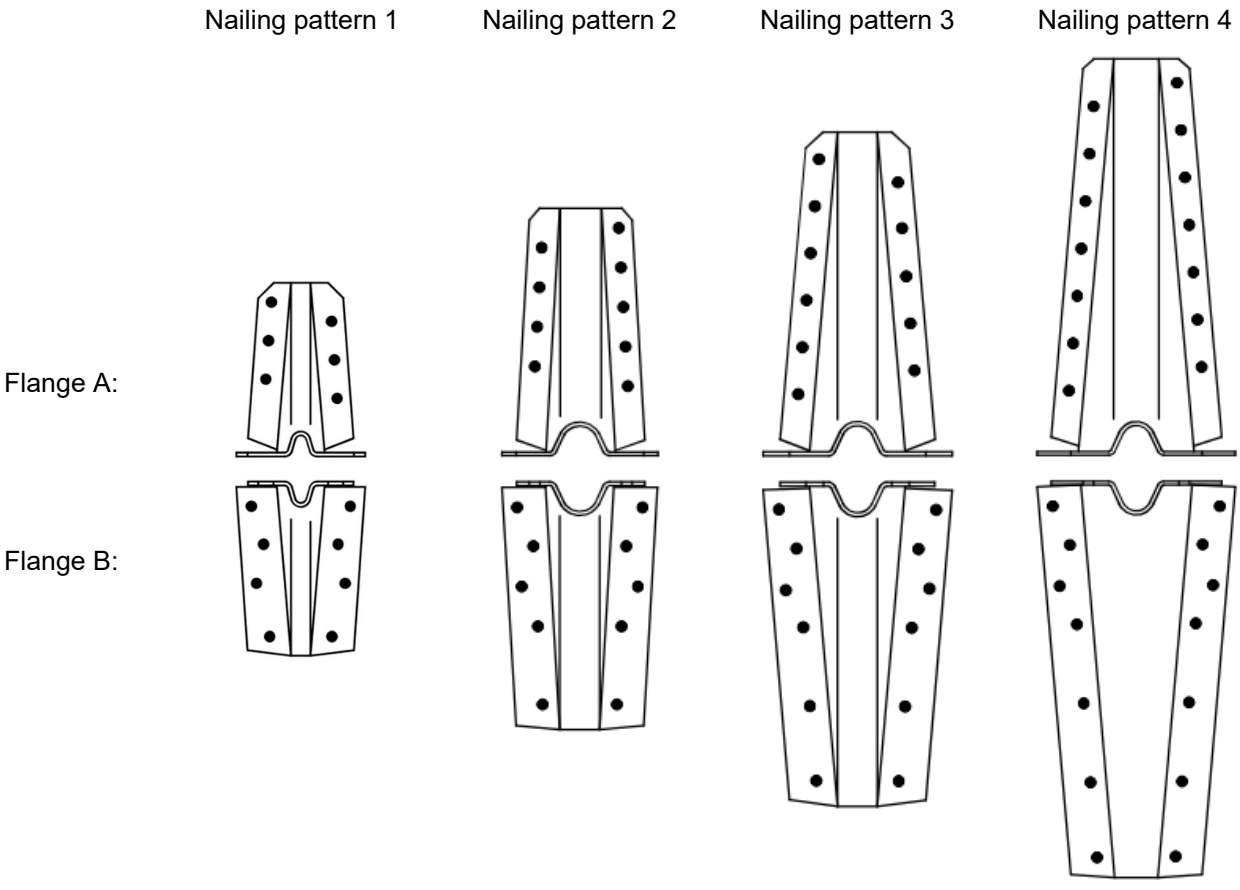


KNAG90 KNAG130



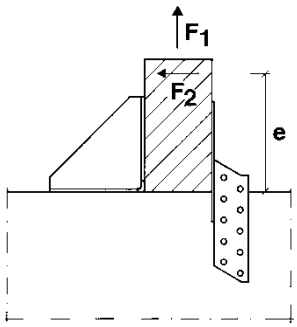
KNAG170 KNAG210

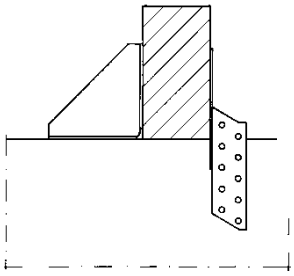
Nailing pattern:



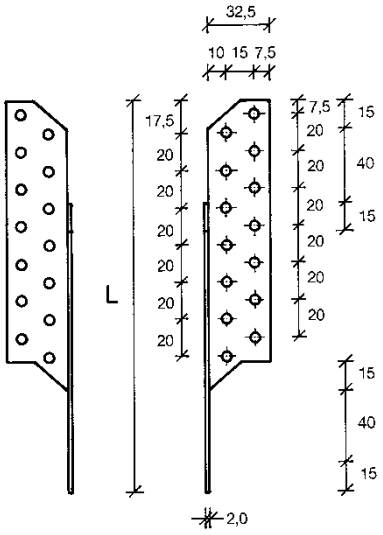
KNAG90	KNAG130	KNAG170	KNAG210
Beam to Beam	Beam to Beam	Beam to Beam	Beam to Beam
Full nailing	Full nailing	Full nailing	Full nailing

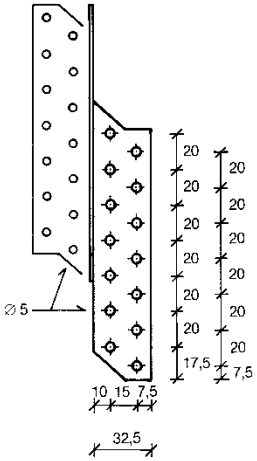
It is possible to make connections with a knight bracket and one or two joist anchors.

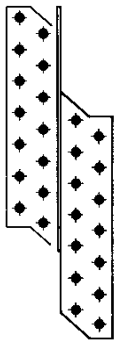


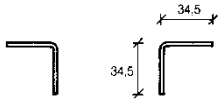


Typical connection with a knight bracket and a joist anchor

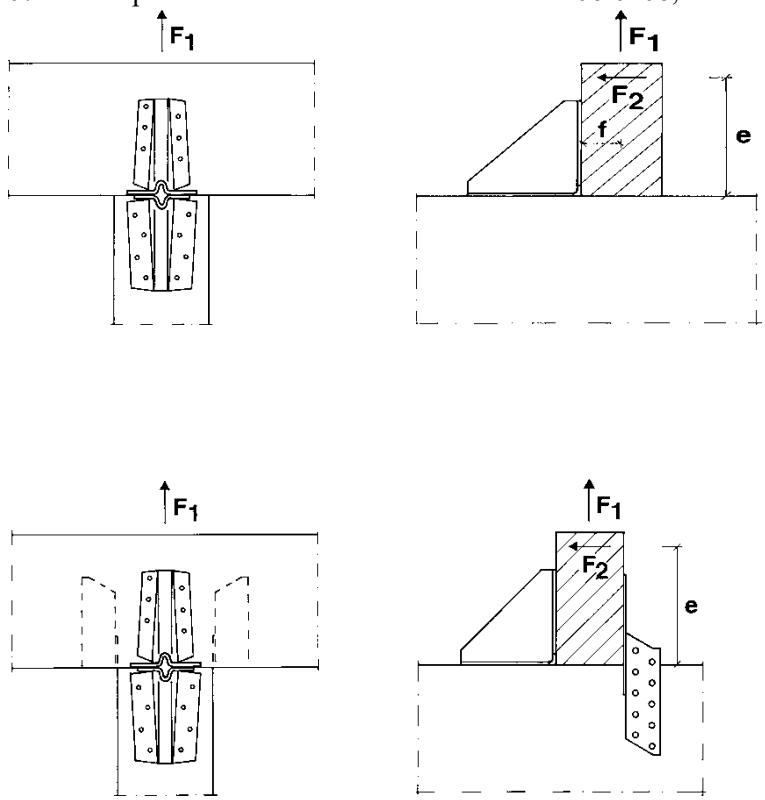








Dimensioned drawings of the joist anchors and nail patterns (full nailing)



One knight bracket per connection
Acting forces

F_1 Lifting force acting in the central axis of the angle bracket but in a distance f from the vertical flange of the knight bracket

F_2 Lateral force acting in the beam direction perpendicular to the vertical flange elevated e above the beam directed towards the knight brackets vertical flange

One knight bracket and one or two joist anchors per connection
Acting forces

F_1 Lifting force acting in the central axis of the knight bracket

F_2 Lateral force acting in the beam direction perpendicular to the vertical flange elevated e above the beam directed towards the knight brackets vertical flange

Wane
Wane is not allowed under the knight bracket.

Table D23-1 Modified characteristic capacity timber beam to timber beam – 1 Knight Bracket Load duration S

1 Knight Bracket KNAG and 1 Joist Anchor per connection					**Modified characteristic capacity per connection (kN)**	
Bracket type	Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	$R_{2,k} \times k_{mod}$
		Flange A	Flange B		CNA Connector nail Beam: 4,0x60 - Joist: 4,0x40	
90	Nailing pattern 1	8 x CNA4,0x40	6 x CNA4,0x60	S	f ≤ 36: $\frac{201}{36+f}$ f>36: $\frac{74}{f}$	e≤17: 14,9-0,314e 17<e≤ 133: $\frac{164}{e}$ 133<e: $\frac{77}{e-70}$
130	Nailing pattern 2	10 x CNA4,0x40	9 x CNA4,0x60		f ≤ 52: $\frac{475}{94+f}$ f>52: $\frac{168}{f}$	e≤ 41: 19,1-0,232e 41<e≤ 176: $\frac{392}{e}$ 176<e: $\frac{181}{e-94}$
170	Nailing pattern 3	12 x CNA4,0x40	11 x CNA4,0x60		f ≤ 75: $\frac{777}{128+f}$ f>75: $\frac{277}{f}$	e≤ 70: 23,4-0,198e 70<e≤ 222: $\frac{672}{e}$ 222<e: $\frac{297}{e-124}$
210	Nailing pattern 4	14 x CNA4,0x40	14 x CNA4,0x60		f ≤ 99: $\frac{1183}{169+f}$ f>99: $\frac{438}{f}$	e≤ 89: 27,7-0,182e 89<e≤ 289: $\frac{1026}{e}$ 289<e: $\frac{486}{e-152}$

e and f are in mm

The capacities in the table are for short load duration, the capacities for other load durations are found by multiplication by the factor c

Factor c for other load durations	**P**	**L**	**M**	**S**	**I**
	0,67	0,78	0,89	1,00	1,19

Table D23-2 Modified characteristic capacity timber beam to timber beam – 1 Knight Bracket and 1 or 2 SPF joist anchors Load duration S

1 Knight Bracket KNAG and 1 or 2 SPF joist anchors per connection			**Modified characteristic capacity per connection (kN)**				
Bracket type	Nailing	Load duration	Joist width mm	Min. Anchor force kN	No. of nails in anchor and example of anchortype	$R_{1,k} \times k_{mod}$	$R_{2,k} \times k_{mod}$
					CNA Connector nail		
					4,0x40	4,0x60	
90	**Full** Nailing 6+8 Nailing pattern 1	S	50	7,5	8+8 nails 1xSPF250	10,8	e ≤ 81: 11,9 e>81: 430/(e-45)
			80	6,0	7+7 nails 1xSPF250	9,3	e ≤ 96: 11,9 e>96: 612/(e-45)
			100	5,5	7+7 nails 1xSPF250	8,8	e ≤ 109: 11,9 e>109: 761/(e-45)
130	**Full** Nailing 9+10 Nailing pattern 2		60	11,4	10+10 nails 1xSPF290	16,4	e ≤ 106: 16,6 e>106: 703/(e-64)
			100	9,0	9+9 nails 1xSPF290	14,0	e ≤ 128: 16,6 e>128: 1056/(e-64)
			140	7,9	9+9 nails 1xSPF290	12,9	e ≤ 152: 16,6 e>152: 1469/(e-64)
170	**Full** Nailing 11+12 Nailing pattern 3		60	19,9	2+10 nails 2xSPF290	28,7	e ≤ 146: 21,4 e>146: 1406/(e-80)
			100	15,6	2+8 nails 2xSPF250	24,4	e ≤ 159: 21,4 e>159: 1683/(e-80)
			140	13,7	2+7 nails 2xSPF250	22,5	e ≤ 180: 21,4 e>180: 2129/(e-80)
210	**Full** Nailing 14+14 Nailing pattern 4		80	25,2	2+11 nails 2xSPF330	36,2	e ≤ 175: 26,3 e>175: 1930/(e-102)
			120	20,6	2+9 nails 2xSPF290	31,7	e ≤ 198: 26,3 e>198: 2536/(e-102)
			160	18,3	2+9 nails 2xSPF290	29,3	e ≤ 230: 26,3 e>230: 3365/(e-102)

e are in mm

The capacities in the table are for short load duration, the capacities for other load durations are found by multiplication by the factor c

Factor c for other load durations	**P**	**L**	**M**	**S**	**I**
	0,67	0,78	0,89	1,00	1,19

Annex D24 – ES10 & ES11

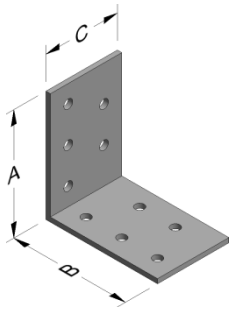
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ES10	Steel ref. 1	-
ES11	Steel ref. 1	-
ES10S	Steel ref. 2	France: ES10IX
ES11S	Steel ref. 2	-
ES10S2	Steel ref. 3	-
ES11S2	Steel ref. 3	-
ES10Z	Steel ref. 6	-
ES11Z	Steel ref. 6	-

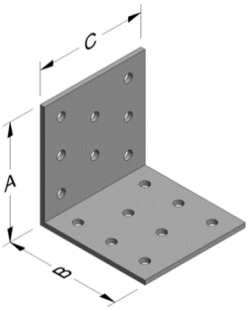
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
ES10/40	62,5	62,5	40	2,5	5	5
ES10/60	62,5	62,5	60	2,5	8	8
ES10/80	62,5	62,5	80	2,5	10	10
ES10/100	62,5	62,5	100	2,5	10	10
ES10/120	62,5	62,5	120	2,5	12	12
ES10/140	62,5	62,5	140	2,5	14	14
ES10/160	62,5	62,5	160	2,5	16	16
ES11/40	82,5	82,5	40	2,5	7	7
ES11/60	82,5	82,5	60	2,5	11	11
ES11/80	82,5	82,5	80	2,5	14	14
ES11/100	82,5	82,5	100	2,5	15	15
ES11/120	82,5	82,5	120	2,5	18	18
ES11/140	82,5	82,5	140	2,5	21	21
ES11/160	82,5	82,5	160	2,5	24	24
ES11/180	82,5	82,5	180	2,5	27	27
ES11/200	82,5	82,5	200	2,5	30	30

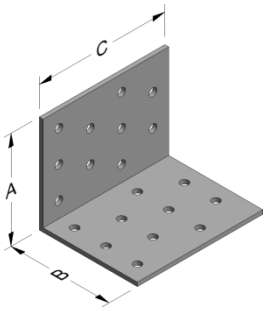
Drawings ES10:



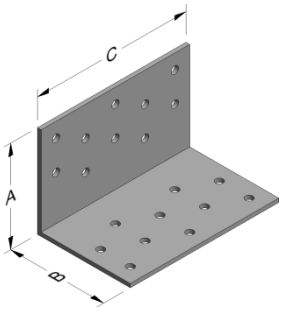
ES10/40



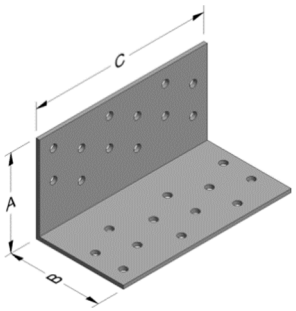
ES10/60



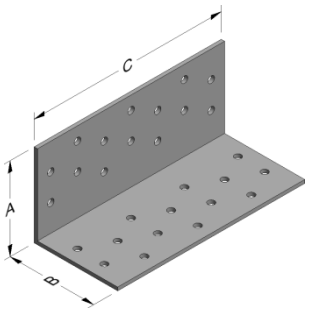
ES10/80



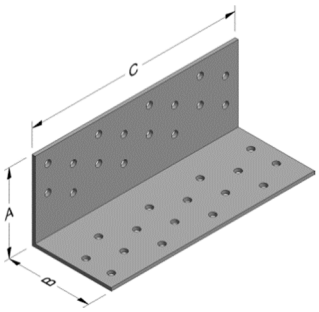
ES10/100



ES10/120

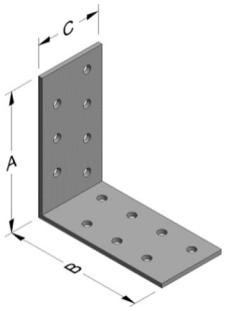


ES10/140

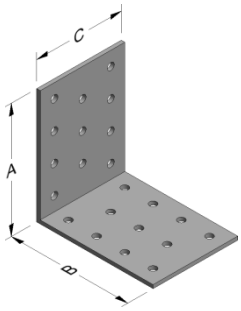


ES10/160

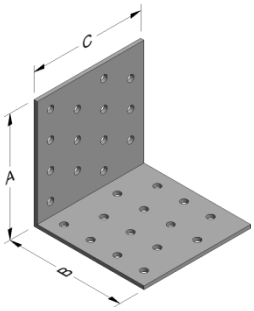
Drawings ES11:



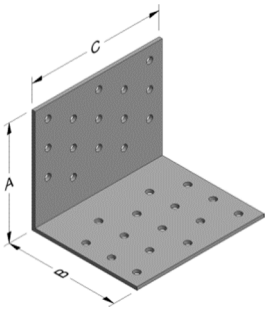
ES11/40



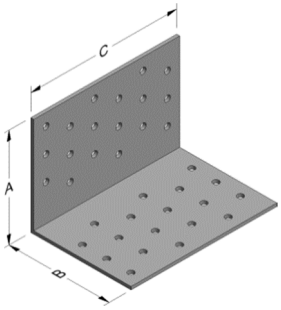
ES11/60



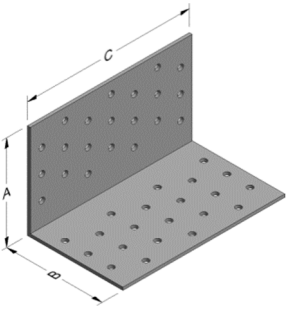
ES11/80



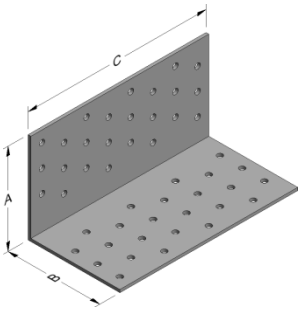
ES11/100



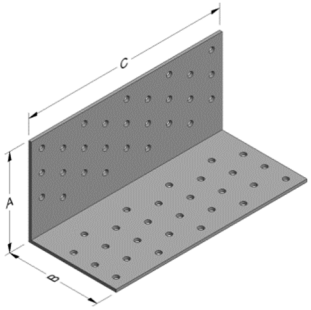
ES11/120



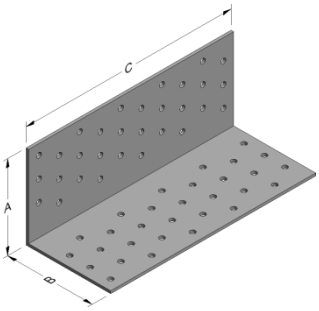
ES11/140



ES11/160



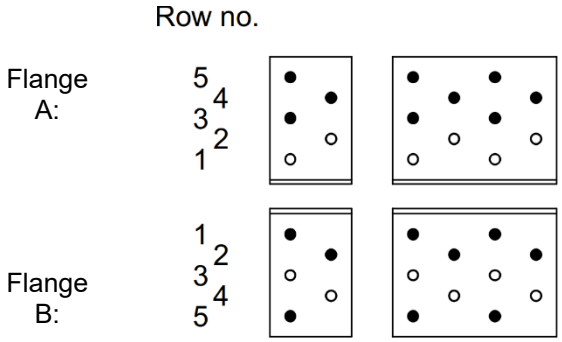
ES11/180



ES11/200

Nailing pattern:

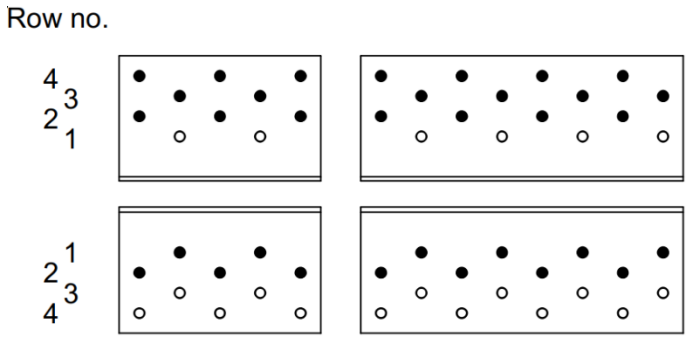
Nailing pattern 1



ES/10/40 to ES10/80

Beam to Beam
Flange A: Nailing in row no. 3, 4, 5
Flange B: Nailing in row no. 1, 2, 5

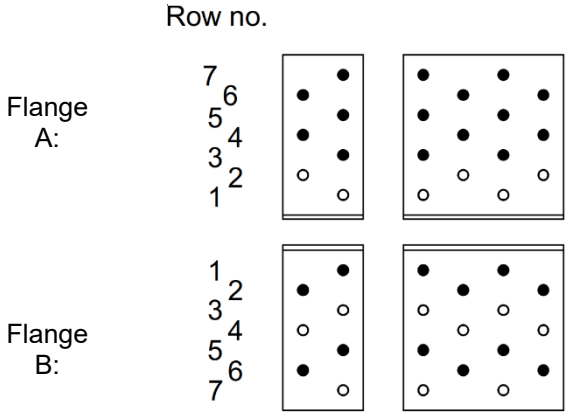
Nailing pattern 2



ES10/100 to ES10/160

Beam to Beam
Flange A: Nailing in row no. 2, 3, 4
Flange B: Nailing in row no. 1, 2

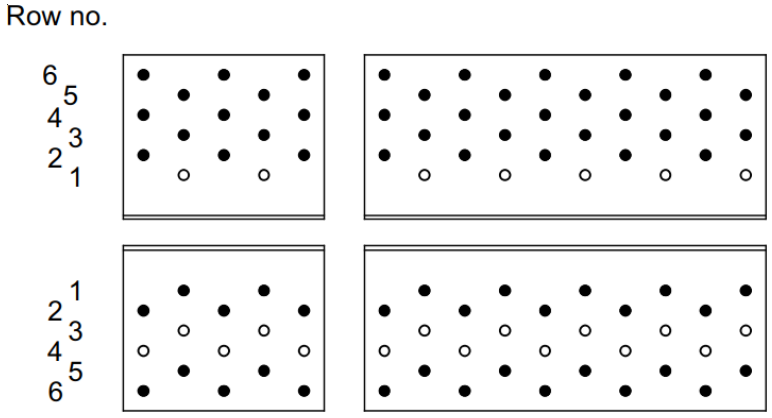
Nailing pattern 3



ES11/40 to ES11/80

Beam to Beam
Flange A: Nailing in row no. 3, 4, 5, 6, 7
Flange B: Nailing in row no. 1, 2, 5, 6

Nailing pattern 4



ES11/100 to ES11/200

Beam to Beam
Flange A: Nailing in row no. 2, 3, 4, 5, 6
Flange B: Nailing in row no. 1, 2, 5, 6

Table D24-1 ES10 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ES10/40 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 1	3	3	P	1,5	2,4	2,6	1,4	1,9	2,1
			L	1,7	2,6	2,7	1,7	2,2	2,4
			M	2,0	2,6	3,2	1,9	2,6	2,7
			S	2,2	2,8	3,7	2,2	2,9	3,1
			I	2,6	3,6	4,5	2,6	3,5	3,8

2 Angle Brackets ES10/60 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 1	5	5	P	2,2	3,5	4,4	3,4	4,5	4,8
			L	2,6	4,1	4,4	3,9	5,2	5,6
			M	2,9	4,4	4,8	4,5	6,0	6,4
			S	3,3	4,4	5,6	5,1	6,7	7,2
			I	4,0	5,4	7,0	6,2	8,2	8,8

2 Angle Brackets ES10/80 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 1	6	6	P	2,9	4,7	5,2	4,4	5,8	6,2
			L	3,4	5,2	5,4	5,1	6,8	7,3
			M	3,9	5,2	6,4	5,8	7,8	8,3
			S	4,4	5,6	7,4	6,6	8,7	9,3
			I	5,2	7,2	9,1	8,0	10,7	11,4

2 Angle Brackets ES10/100 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 2	8	5	P	3,7	3,7	4,7	6,1	8,2	8,7
			L	3,7	4,3	6,0	7,2	9,5	10,2
			M	3,7	5,2	6,4	8,2	10,9	11,6
			S	3,7	6,2	6,4	9,2	12,2	13,1
			I	4,1	6,4	6,4	11,2	15,0	16,0

2 Angle Brackets ES10/120 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 2	9	6	P	4,4	4,6	5,8	7,5	10,0	10,6
			L	4,6	5,2	7,3	8,7	11,6	12,4
			M	4,6	6,4	8,0	10,0	13,3	14,1
			S	4,6	7,6	8,0	11,2	14,9	15,9
			I	5,1	8,0	8,0	13,7	18,2	19,4

2 Angle Brackets ES10/140 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 2	10	7	P	5,2	5,2	6,7	10,0	13,4	14,2
			L	5,2	6,0	8,4	11,7	15,6	16,6
			M	5,2	7,4	9,1	13,4	17,8	19,0
			S	5,2	8,7	9,1	15,1	20,0	21,4
			I	5,8	9,1	9,1	18,4	24,5	26,1

2 Angle Brackets ES10/160 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 2	12	8	P	5,9	6,1	7,7	11,4	15,2	16,2
			L	6,1	7,0	9,7	13,3	17,8	18,9
			M	6,1	8,5	10,6	15,2	20,3	21,6
			S	6,1	10,1	10,6	17,2	22,8	24,3
			I	6,8	10,6	10,6	21,0	27,9	29,8

Table D24-2 ES11 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ES11/40 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 3	5	4	P	1,5	2,4	2,6	2,1	2,8	3,0
			L	1,7	2,6	2,7	2,5	3,3	3,5
			M	2,0	2,6	3,2	2,8	3,7	4,0
			S	2,2	2,8	3,7	3,1	4,2	4,5
			I	2,6	3,6	4,5	3,8	5,1	5,5

2 Angle Brackets ES11/60 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
				CNA Connector nail					
	Flange A	Flange B		4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 3	8	6	P	2,2	3,5	4,4	4,4	5,9	6,3
			L	2,6	4,1	4,4	5,2	6,9	7,3
			M	2,9	4,4	4,8	5,9	7,9	8,4
			S	3,3	4,4	5,6	6,7	8,9	9,4
			I	4,0	5,4	7,1	8,1	10,8	11,5

2 Angle Brackets ES11/80 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
				CNA Connector nail					
	Flange A	Flange B		4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 3	10	8	P	2,9	4,7	5,2	6,1	8,1	8,7
			L	3,4	5,2	5,5	7,1	9,5	10,1
			M	3,9	5,2	6,5	8,1	10,8	11,5
			S	4,4	5,7	7,4	9,1	12,2	13,0
			I	5,2	7,2	9,1	11,2	14,9	15,9

2 Angle Brackets ES11/100 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
				CNA Connector nail					
	Flange A	Flange B		4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	13	10	P	3,7	4,2	5,6	8,8	11,7	12,5
			L	3,7	5,1	6,4	10,2	13,6	14,5
			M	3,7	6,1	6,4	11,7	15,6	16,6
			S	3,8	6,4	6,4	13,2	17,5	18,7
			I	5,0	6,4	6,4	16,1	21,4	22,8

2 Angle Brackets ES11/120 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
				CNA Connector nail					
	Flange A	Flange B		4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	15	12	P	4,4	5,0	6,8	10,4	13,9	14,8
			L	4,6	6,2	8,0	12,2	16,2	17,3
			M	4,6	7,3	8,0	13,9	18,5	19,8
			S	4,6	8,0	8,0	15,7	20,9	22,2
			I	6,0	8,0	8,0	19,1	25,5	27,2

2 Angle Brackets ES11/140 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	17	14	P	5,2	5,8	7,8	14,1	18,8	20,0
			L	5,2	7,2	9,1	16,5	21,9	23,4
			M	5,2	8,6	9,1	18,8	25,0	26,7
			S	5,3	9,1	9,1	21,2	28,2	30,0
			I	7,0	9,1	9,1	25,9	34,4	36,7

2 Angle Brackets ES11/160 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	20	16	P	5,9	6,6	9,0	16,2	21,6	23,0
			L	6,1	8,2	10,6	18,9	25,2	26,8
			M	6,1	9,8	10,6	21,6	28,7	30,7
			S	6,1	10,6	10,6	24,3	32,3	34,5
			I	8,0	10,6	10,6	29,7	39,5	42,2

2 Angle Brackets ES11/180 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	23	18	P	6,6	7,5	10,1	20,4	27,2	29,1
			L	6,7	9,2	11,7	23,9	31,8	33,9
			M	6,7	11,0	11,7	27,3	36,3	38,7
			S	6,8	11,7	11,7	30,7	40,9	43,6
			I	9,0	11,7	11,7	37,5	49,9	53,3

2 Angle Brackets ES11/200 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0 x 35	4,0 x 50	4,0 x 60	4,0 x 35	4,0 x 50	4,0 x 60
Nailing pattern 4	25	20	P	7,4	8,3	11,2	22,8	30,4	32,4
			L	7,6	10,3	13,3	26,7	35,5	37,8
			M	7,6	12,2	13,3	30,5	40,6	43,3
			S	7,6	13,3	13,3	34,3	45,7	48,7
			I	10,0	13,3	13,3	41,9	55,8	59,5

Annex D25 – LS30, LS50, LS70 & LS90

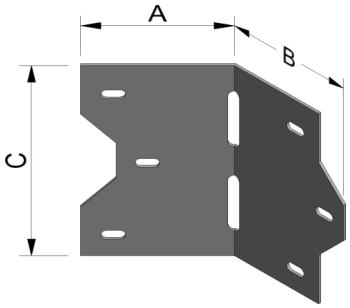
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
LS30	Steel ref. 4, G90	-
LS50	Steel ref. 4, G90	-
LS70	Steel ref. 4, G90	-
LS90	Steel ref. 4, G90	-

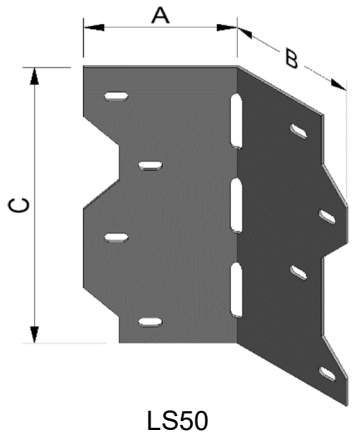
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø7,14x3,96	Ø7,14x3,96
LS30	57,2	41,6	85,7	1,2	3	3
LS50	57,2	41,6	123,8	1,2	4	4
LS70	57,2	41,6	161,9	1,2	5	5
LS90	57,2	41,6	200,0	1,2	6	6

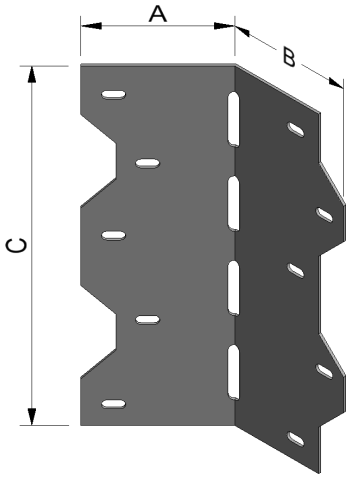
Drawings:



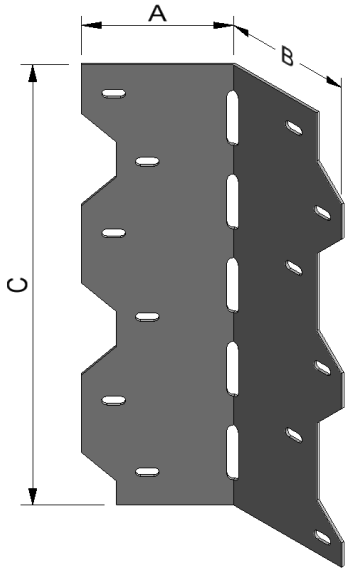
LS30



LS50



LS70



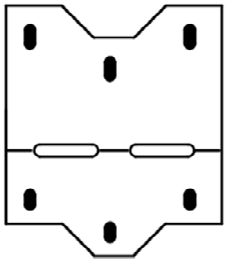
LS90

Nailing pattern:

Nailing pattern 1

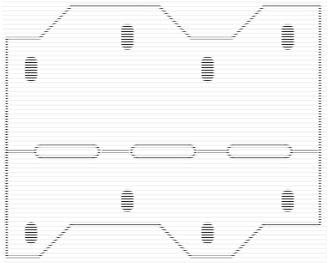
Flange A:

Flange B:



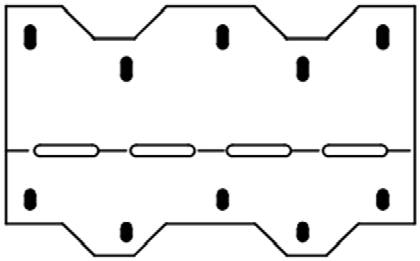
LS30
Beam to Beam
Full nailing

Nailing pattern 2



LS50
Beam to Beam
Full nailing

Nailing pattern 3

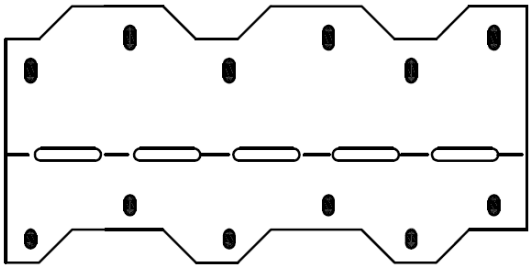


LS70
Beam to Beam
Full nailing

Nailing pattern 4

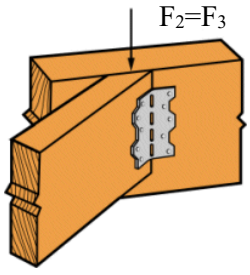
Flange A:

Flange B:



LS90
Beam to Beam
Full nailing

Design Basis:



One angle bracket per connection
Acting forces
$F_2=F_3$ The force is acting in the bending line of the angle bracket and parallel to it.

Table D25-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket LS30 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		Round smooth nail 3,75 x 75	CNA Connector nail 3,7 x 50
Nailing pattern 1	3	3	P	1,0	1,7
			L	1,2	2,0
			M	1,4	2,3
			S	1,6	2,6
			I	1,9	3,1

1 Angle Bracket LS50 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		Round smooth nail 3,75 x 75	CNA Connector nail 3,7 x 50
Nailing pattern 2	4	4	P	1,6	2,6
			L	1,8	3,0
			M	2,1	3,4
			S	2,4	3,9
			I	2,9	4,7

1 Angle Bracket LS70 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		Round smooth nail 3,75 x 75	CNA Connector nail 3,7 x 50
Nailing pattern 3	5	5	P	1,6	2,6
			L	1,9	3,1
			M	2,2	3,5
			S	2,4	4,0
			I	3,0	4,9

1 Angle Bracket LS90 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		Round smooth nail 3,75 x 75	CNA Connector nail 3,7 x 50
Nailing pattern 4	6	6	P	1,9	3,1
			L	2,2	3,7
			M	2,6	4,2
			S	2,9	4,7
			I	3,5	5,8

Annex D26 – TA9Z & TA10Z

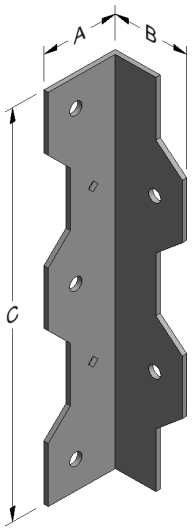
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
TA9Z	Steel ref. 4, G185	-
TA10Z	Steel ref. 4, G185	-

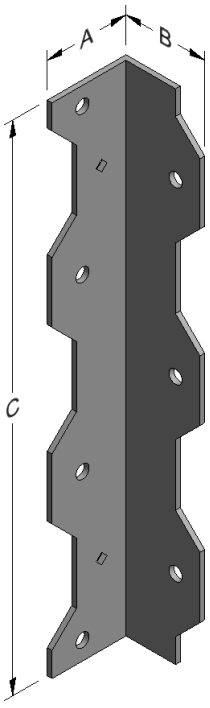
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø7	Ø7
TA9Z	41	41	210	2,5	3	2
TA10Z	41	41	260	2,5	4	3

Drawings:

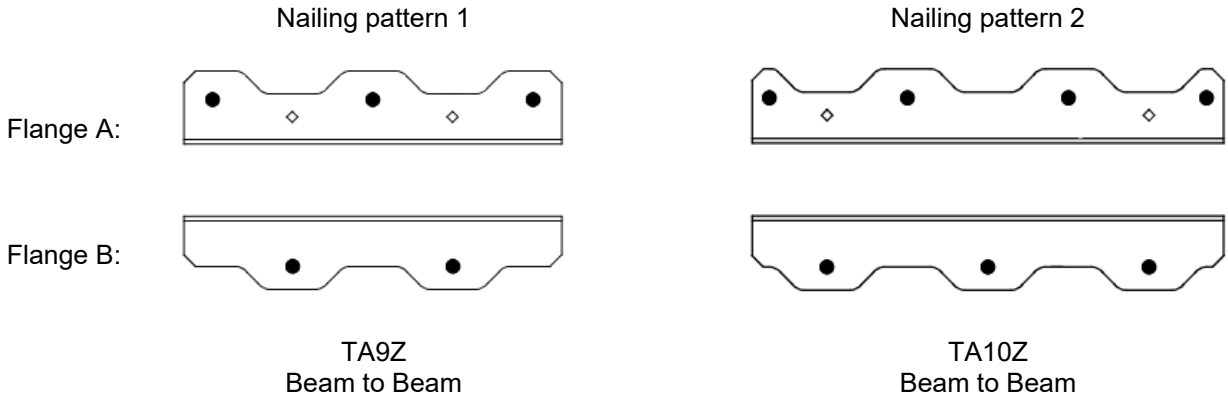


TA9Z

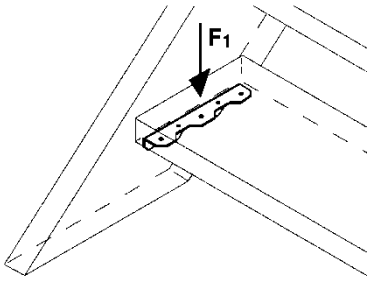


TA10Z

Nailing pattern:



Design basis:



One angle bracket per connection
Acting forces
F_1 Downward force from the step acting close to the string

Typical installation – Design basis

Table D26-1 Modified characteristic capacity timber beam to timber beam – 1 angle bracket

1 Angle Bracket per connection					**Modified characteristic capacity per connection (kN)**
Type	Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$
		Flange A	Flange B		Smooth shank screws 6,0 x 45 in pre-drilled holes
TA9Z	Nailing pattern 1	3	2	P	3,8
				L	4,5
				M	5,2
				S	5,9
				I	7,3
TA10Z	Nailing pattern 2	4	3	P	5,1
				L	6,0
				M	6,9
				S	7,9
				I	9,7

Annex D27 – ABR170 & ABR 220

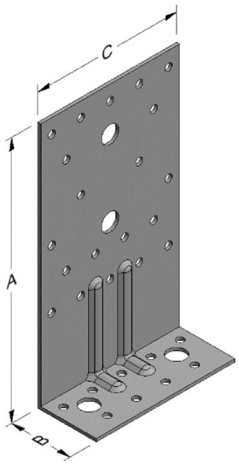
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR170	Steel ref. 1	-
ABR220	Steel ref. 1	-
ABR170S	Steel ref. 2	-
ABR220S	Steel ref. 2	-
ABR170S2	Steel ref. 3	-
ABR220S2	Steel ref. 3	-
ABR170Z	Steel ref. 6	-
ABR220Z	Steel ref. 6	-

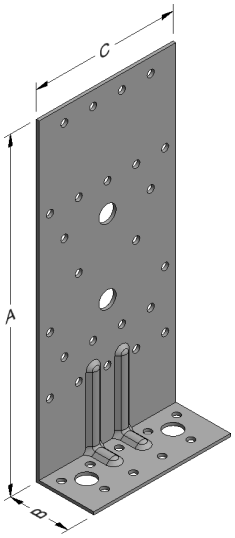
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø12	Ø5	Ø12
ABR170	170	40	95	2,0	20	2	9	2
ABR220	220	40	95	2,0	24	2	9	2

Drawings:



ABR170



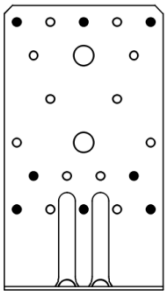
ABR220

Nailing pattern:

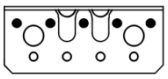
For a combination of different force directions, it's to use the nail pattern with the most nails.

Nailing pattern 1

Flange A:

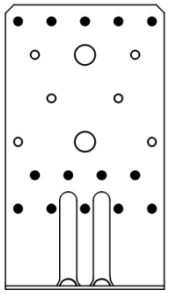


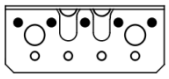
Flange B:



ABR170 and ABR220
Beam/column to beam
For force F_1

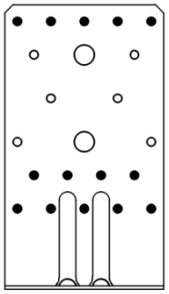
Nailing pattern 2

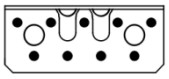




ABR170 and ABR220
Beam/column to beam
For force $F_{2/3}$

Nailing pattern 3

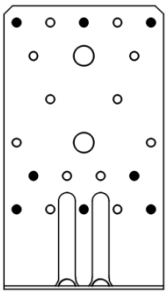




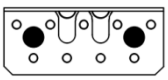
ABR170 and ABR220
Beam/column to beam
For force $F_{4/5}$

Nailing pattern 4

Flange A:

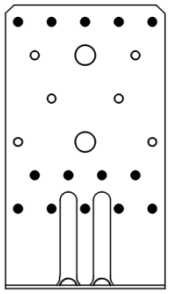


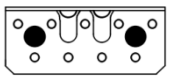
Flange B:



ABR170 and ABR220
Beam/column to rigid
For force F_1

Nailing pattern 5





ABR170 and ABR220
Beam/column to rigid
For force $F_{2/3}$ and $F_{4/5}$

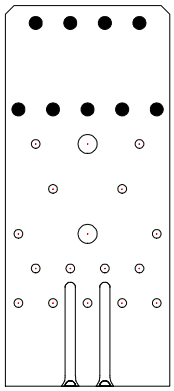
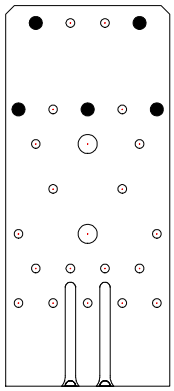
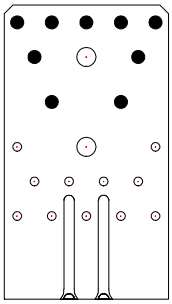
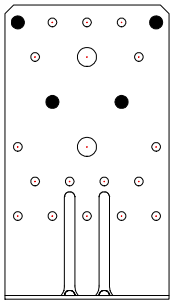
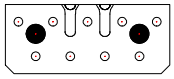
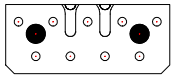
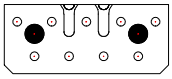
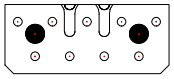
	Nailing pattern 6	Nailing pattern 7	Nailing pattern 8	Nailing pattern 9
Flange A:				
Flange B:				
	ABR220 Beam/column with distance to rigid For force F_1 , $F_{2/3}$, F_6	ABR220 Beam/column with distance to rigid For force F_1 , $F_{2/3}$, F_6	ABR170 Beam/column with distance to rigid For force F_1 , $F_{2/3}$, F_6	ABR170 Beam/column with distance to rigid For force F_1 , $F_{2/3}$, F_6

Table D27-1 Modified characteristic capacity timber beam/column to timber beam – 2 Angle Brackets Load duration M

2 Angle Brackets ABR170 or ABR220 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration		CNA Connector nail		
	Flange A	Flange B			4,0x40	4,0x50	4,0x60
Nailing pattern 1	8	5	M	$R_{1,k} \times k_{mod}$	5,9	7,8	9,8
Nailing pattern 2	14	5		$R_{2/3,k} \times k_{mod}$	13,1	15,8	16,9
Nailing pattern 3	14	9		$R_{4/5,k} \times k_{mod}$	8,0 with e ≤ 50 mm b ≥ 36 mm or e ≤ 90 mm b ≥ 60 mm	8,0 with e ≤ 65 mm b ≥ 36 mm or e ≤ 120 mm b ≥ 60 mm	8,0 with e ≤ 80 mm b ≥ 36 mm or e ≤ 150 mm b ≥ 60 mm

Table D27-2 Modified characteristic capacity timber beam/column to timber beam – 1 Angle Bracket Load duration M

1 Angle Bracket ABR170 or ABR220 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration		CNA Connector nail		
	Flange A	Flange B			4,0x40	4,0x50	4,0x60
Nailing pattern 1	8	5	M	$R_{1,k} \times k_{mod}$	2,9	3,9	4,9
Nailing pattern 2	14	5		$R_{2/3,k} \times k_{mod}$	6,6	7,9	8,5
Nailing pattern 3	14	9		$R_{4,k} \times k_{mod}$	0,7 with e ≤ 50 mm	0,7 with e ≤ 50 mm	0,7 with e ≤ 50 mm
Nailing pattern 3	14	9		$R_{4,k} \times k_{mod}$	Capacity for a connection, witout rotation of purlin: 6,6		
Nailing pattern 3	14	9		$R_{5,k} \times k_{mod}$	1,4 with e ≤ 50 mm b ≥ 36 mm or e ≤ 90 mm b ≥ 60 mm	1,4 with e ≤ 65 mm b ≥ 36 mm or e ≤ 120 mm b ≥ 60 mm	1,4 with e ≤ 80 mm b ≥ 36 mm or e ≤ 150 mm b ≥ 60 mm

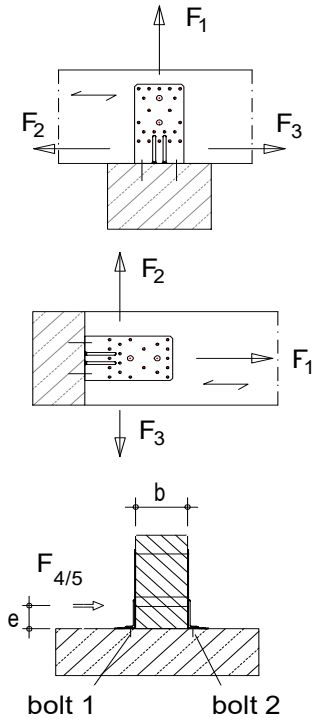
Factors for other Load durations:

Factors for other load durations	**$R_{1,k}$**			**$R_{2/3,k}$**	**$R_{4,k}$**	**$R_{4,k}$ [1)]**	**$R_{5,k}$**	**$R_{4/5,k}$**
	CNA Connector nail			All sizes				
	4,0x40	4,0x50	4,0x60					
I multiply M by	1,38	1,33	1,23	1,38	1	1,38	1	1,31
S multiply M by	1,13	1,13	1,08	1,13	1	1,13	1	1,1
L multiply M by	0,88	0,88	0,88	0,88	1	0,88	1	0,9
P multiply M by	0,75	0,75	0,75	0,75	1	0,75	1	0,79

[1)] capacity for a connection, witout rotation of purlin

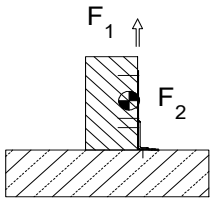
Table D27-3 Characteristic capacity timber beam/column to rigid – 2 Angle Brackets

2 Angle Brackets ABR170 or ABR220 per connection			**Characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners			CNA Connector nail		
	Flange A	Flange B		4,0x40	4,0x50	4,0x60
Nailing pattern 4	8	2 Bolts	**$R_{1,k}$**	$\min\left\{\begin{matrix}33,0\\ \frac{25,2}{k_{mod}}\end{matrix}\right.$	$\min\left\{\begin{matrix}39,8\\ \frac{25,2}{k_{mod}}\end{matrix}\right.$	$\frac{25,2}{k_{mod}}$
Nailing pattern 5	14	2 Bolts	**$R_{2/3,k}$**	19,71	$\min\left\{\begin{matrix}23,8\\ \frac{24,6}{k_{mod}}\end{matrix}\right.$	$\min\left\{\begin{matrix}25,4\\ \frac{24,6}{k_{mod}}\end{matrix}\right.$
Nailing pattern 5	14	2 Bolts	**$R_{4/5,k}$**	the minimum of e is 50 mm	$\min\left\{\begin{matrix}9,15+\frac{80}{e\times k_{mod}}\\ \frac{6,3\times b}{e\times k_{mod}}\end{matrix}\right.$	



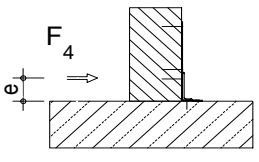
For connection with 2 Angle Brackets it must be checked:

for R_1: $R_{bolt,ax,d} \geq F_{1,d} / n_{bolt}$
for $R_{2/3}$: $R_{bolt,lat,d} \geq F_{2/3,d} / n_{bolt}$
for $R_{4/5}$: Bolt 1: $R_{bolt,ax,d} \geq F_{4/5,d}$ x e / (2xb)
Bolt 2: $R_{bolt,lat,d} \geq F_{4/5,d} / 2$
$R_{4/5,d} \leq R_{1,d}$ x b / (2 x e)



In case of combined force the relevant of the following inequalities shall be fulfilled:

$$\left(\frac{F_{1,d}}{R_{1,d}}+\frac{F_{4/5,d}}{R_{4/5,d}}\right)^2+\left(\frac{F_{2/3,d}}{R_{2,3,d}}\right)\leq 1$$



For $F_{4/5}$ can be use also F_4 or F_5 too, also for $F_{2/3}$ can be use F_2 or F_3 too.

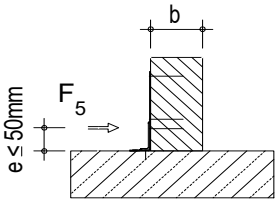


Table D27-4 Characteristic capacity timber beam/column to rigid – 1 Angle Bracket

1 Angle Bracket ABR170 or ABR220 per connection			**Characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners			CNA Connector nail		
	Flange A	Flange B		4,0x40	4,0x50	4,0x60
Nailing pattern 4	8	2 Bolts	$R_{1,k}$	$\min \begin{cases} 16,5 \\ \frac{12,6}{k_{mod}} \end{cases}$	$\min \begin{cases} 19,9 \\ \frac{12,6}{k_{mod}} \end{cases}$	$\frac{12,6}{k_{mod}}$
Nailing pattern 5	14	2 Bolts	$R_{2/3,k}$	9,86	$\min \begin{cases} 11,9 \\ \frac{12,3}{k_{mod}} \end{cases}$	$\min \begin{cases} 12,7 \\ \frac{12,3}{k_{mod}} \end{cases}$
Nailing pattern 5	14	2 Bolts	$R_{4,k}$	e < 100mm $\frac{50}{e \times k_{mod}}$ e ≥ 100mm $\frac{36}{e \times k_{mod}}$		
Nailing pattern 5	14	2 Bolts	$R_{5,k}$	max e ≤ 50mm $\frac{1,8}{k_{mod}}$		

For connection with one Angle Bracket it must be checked:

for R_1: $R_{bolt,ax,d} \geq F_{1,d} / n_{bolt}$

for $R_{2/3}$: $R_{bolt,lat,d} \geq F_{2/3,d} / n_{bolt}$

for R_5 : $R_{bolt,ax,d} \geq F_{5,d}$ x e / (2 x b)

for $R_{4 \text{ or } 5}$: $F_{4 \text{ or } 5,d}$ / 2

In case of combined force the relevant of the following inequalities shall be fulfilled:

$$\left(\frac{F_{1,d}}{R_{1,d}} + \frac{F_{4/5,d}}{R_{4/5,d}} \right)^2 + \left(\frac{F_{2/3,d}}{R_{2,3,d}} \right) \leq 1$$

For $F_{4/5}$ can be use also F_4 or F_5 too, also for $F_{2/3}$ can be use F_2 or F_3 too.

Table D27-5 Characteristic capacity timber beam/column to rigid-façade

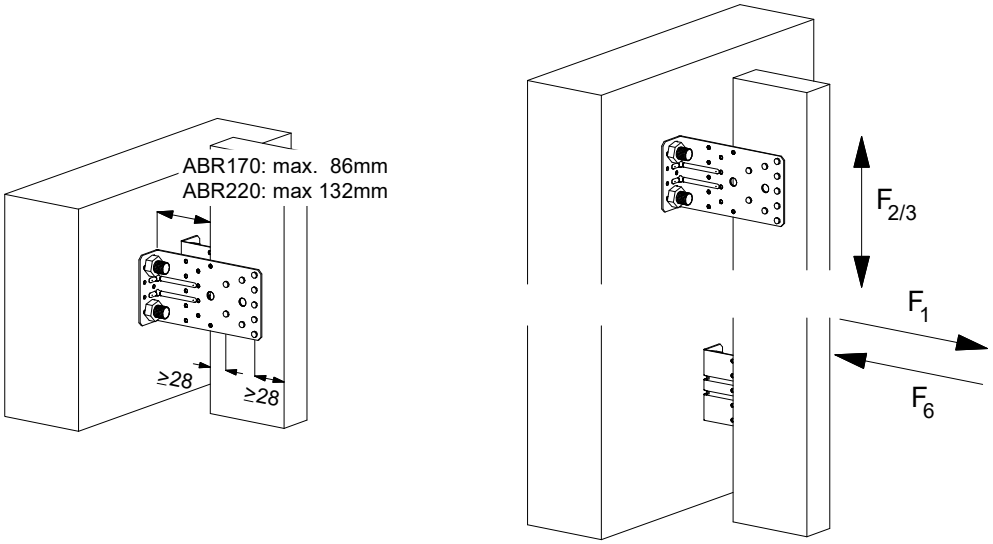
Angle Bracket ABR220			**Characteristic capacity per one ABR (kN)**				
Nailing pattern	Number of fasteners			CNA Connector nail			
	Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 6	9	2 Bolts	$R_{1,k}$	min. 14,3 ; 12,1/kmod	min. 15,9 ; 12,1/kmod	min. 19,4 ; 12,1/kmod	min. 20,6 ; 12,1/kmod
		2 Bolts	$R_{2/3,k}$	2,70	2,90	3,60	3,70
		1 or 2 Bolts	$R_{6,k}$	min. 14,9; 9,0/kmod	min. 16,5; 9,0/kmod	min. 20; 9,0/kmod	min. 21,1; 9,0/kmod
Nailing pattern 7	5	2 Bolts	$R_{1,k}$	8,00	8,90	10,80	min. 11,5 ; 12,1/kmod
		2 Bolts	$R_{2/3,k}$	2,50	2,70	3,30	3,50
		1 or 2 Bolts	$R_{6,k}$	min. 8,3; 9,0/kmod	min. 9,2; 9,0/kmod	min. 11,1; 9,0/kmod	min. 11,7; 9,0/kmod

Table D27-6 Characteristic capacity timber beam/column to rigid-façade

Angle Bracket ABR170			**Characteristic capacity per one ABR (kN)**				
Nailing pattern	Number of fasteners			CNA Connector nail			
	Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 8	9	2 Bolts	$R_{1,k}$	10,20	min. 11,8 ; 12,1/kmod	min. 14,9 ; 12,1/kmod	min. 16,9 ; 12,1/kmod
		2 Bolts	$R_{2/3,k}$	3,50	3,80	4,70	4,90
		1 or 2 Bolts	$R_{6,k}$	min. 14,9; 11,0/kmod	min. 16,5; 11,0/kmod	min. 20; 11,0/kmod	min. 21,1; 11,0/kmod
Nailing pattern 9	4	2 Bolts	$R_{1,k}$	6,00	6,70	8,30	8,90
		2 Bolts	$R_{2/3,k}$	3,30	3,70	4,40	4,70
		1 or 2 Bolts	$R_{6,k}$	min. 6,6; 11,0/kmod	min. 7,3; 11,0/kmod	min. 8,9; 11,0/kmod	min. 9,4; 11,0/kmod

To table 27-5 and 27-6:

- The capacities are given for one ABR, in the case, that in total more ABR are placed alternate opposite on the beam.
- It´s given the option to fix the ABR with only one bolt (the upper one) for only the load in direction F_1 and F_6, the capacity for F_1 is in this case the half.
- The distance of the beam to the support shall be less than 132mm for ABR220, and less than 86mm for ABR170



In case of combined force the relevant of the following inequalities shall be fulfilled:

$$\left(\frac{F_{1/6,d}}{R_{1/6,d}}\right)^2 + \left(\frac{F_{2/3,d}}{R_{2/3,d}}\right)^2 \leq 1{,}0$$

For $F_{1/6}$ can be used F_1 or F_6 , also for $F_{2/3}$ can be used F_2 or F_3 too.

The anchorage for shear load will be check with $R_{anchorbolt,lateral,d} = \frac{R_{2/3,d}}{1{,}74}$

For connection it must be checked:
for R_1: $R_{bolt,ax,d} \geq F_{1,d} / n_{bolt}$
for $R_{2/3}$: $R_{bolt,lat,d} \geq F_{2/3,d} / 1{,}74$
for $R_{2/3}$: $R_{bolt,ax,d} \geq F_{2/3,d}$ x 2/3 for (ABR170)
for $R_{2/3}$: $R_{bolt,ax,d} \geq F_{2/3,d}$ x 4/3 for (ABR220)
for R_6 : constructive fixing

Annex D28 – AB6983

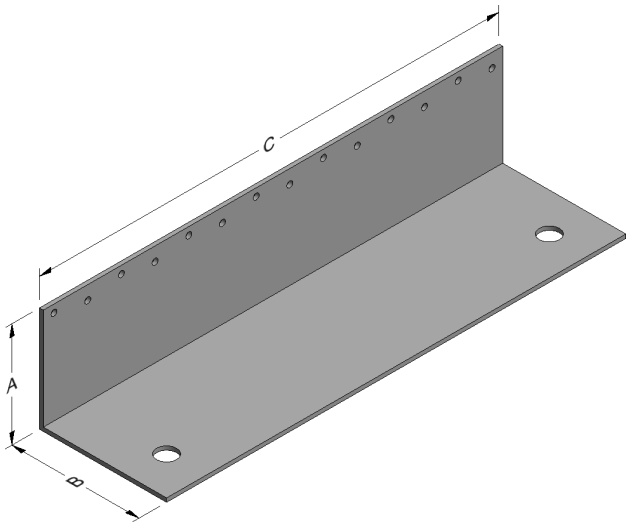
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB6983	Steel ref. 1	-
AB6983S	Steel ref. 2	-
AB6983S2	Steel ref. 3	-
AB6983Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø4	Ø13
AB6983	69	83	300	2,5	14	2

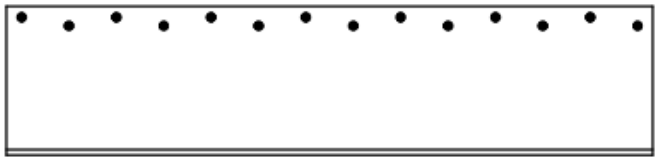
Drawing:



Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:

Timber to rigid

Characteristic capacity per connection (one shear connector per connection):

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail.k}\ x\ 9{,}29 \\ R_{lat.bolt.k}\ x\ 2{,}14/k_{mod} \end{cases}$$

The capacity of the connection between the bolts and concrete has to be checked separately

Fasteners: 14 threaded nails CNA3,1xℓ and 2 bolts Ø12 mm. (Nailing pattern 1)

$R_{lat,nail,k}$ = Characteristic lateral capacity of 1 threaded nail CNA3,1xℓ

$R_{lat,bolt,k}$ = Characteristic lateral capacity of 1 M12 bolt. max. 7,5 kN

Annex D29 – AB36125

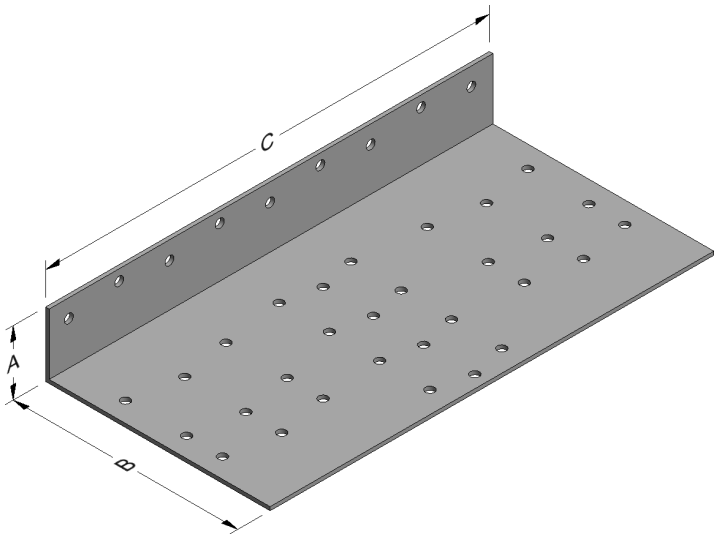
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB36125	Steel ref. 1	-
AB36125S	Steel ref. 2	-
AB36125S2	Steel ref. 3	-
AB36125Z	Steel ref. 6	-

Connector Size Range:

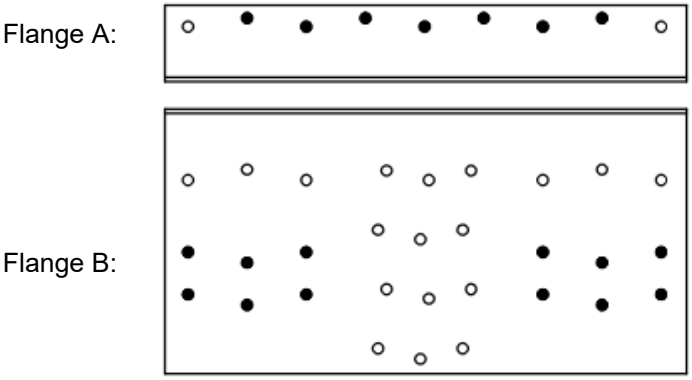
Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
AB36125	36	125	247	2,0	9	34

Drawing:



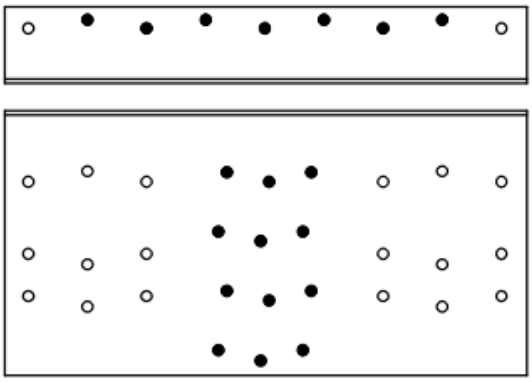
Nailing pattern:

Nailing pattern 1



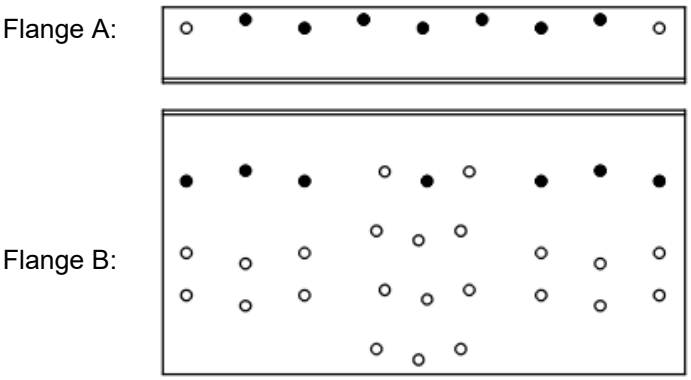
Timber to timber

Nailing pattern 2



Timber to timber

Nailing pattern 3



Timber to timber

Characteristic capacity per connection (one shear connector per connection):

Fasteners: 7 + 12 (Nailing pattern 1):

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail-v,k}\ x\ 5{,}60 \\ R_{lat.nail-h,k}\ x\ 8{,}57 \end{cases}$$

Fasteners: 7 + 12 (Nailing pattern 2):

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail-v,k}\ x\ 5{,}60 \\ R_{lat.nail-h,k}\ x\ 6{,}04 \end{cases}$$

Fasteners: 7 + 7 (Nailing pattern 3):

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail-v,k}\ x\ 5{,}60 \\ R_{lat.nail-h,k}\ x\ 6{,}12 \end{cases}$$

$R_{lat,nail\text{-}v,k}$ = Characteristic lateral capacity of 1 threaded nail CNA4,0xℓ in the vertical flange

$R_{lat,nail\text{-}h,k}$ = Characteristic lateral capacity of 1 threaded nail CNA4,0xℓ in the horizontal flange

Annex D30 – BNV33

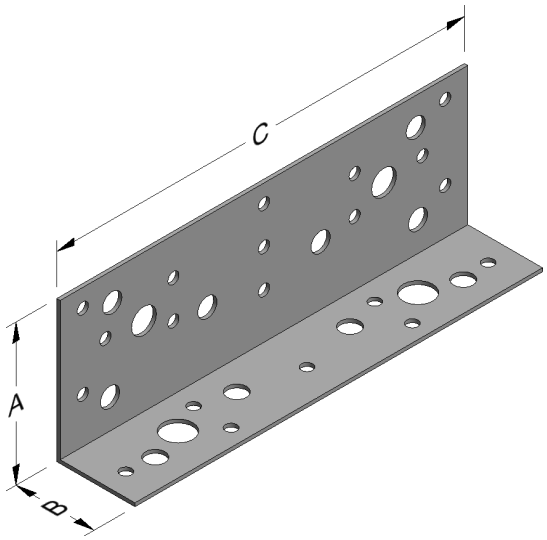
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
BNV33	Steel ref. 1	-
BNV33S	Steel ref. 2	-
BNV33S2	Steel ref. 3	-
BNV33Z	Steel ref. 6	-

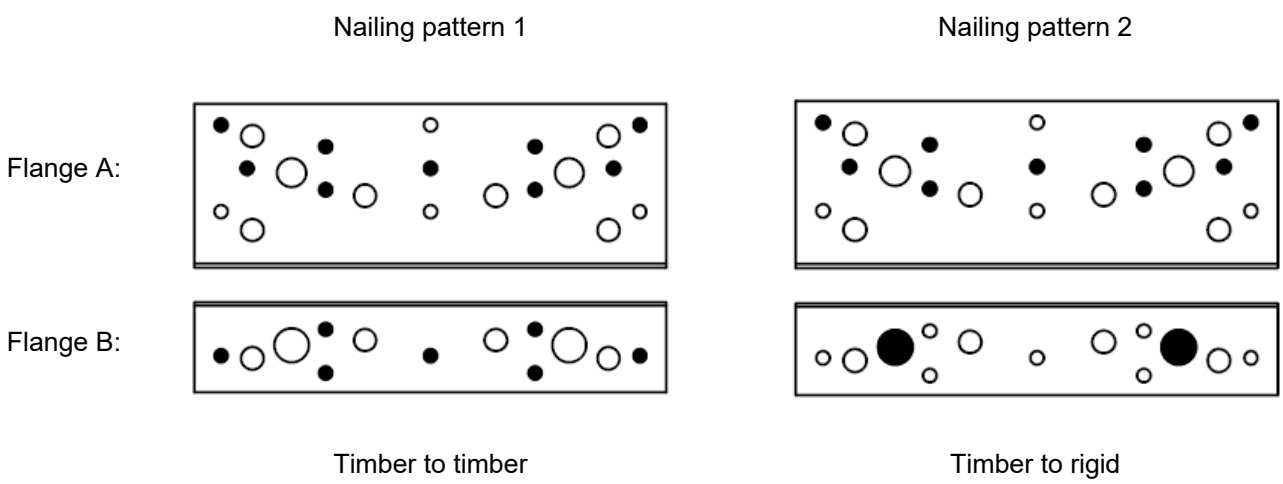
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B		
	A	B	C	Thickness	Ø5	Ø8,5	Ø11	Ø5	Ø8,5	Ø13
BNV33	62,5	34,5	180	1,5	13	6	2	7	4	2

Drawing:



Nailing pattern:



Characteristic capacity per connection (one shear connector per connection):

Fasteners: 9+7 (Nailing pattern 1):

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail-v,k}\ x\ 5{,}82 \\ R_{lat.nail-h,k}\ x\ 6{,}26 \end{cases}$$

Fasteners: 9+2 (Nailing pattern 2)

$$R_{2/3,k} = \min \begin{cases} R_{lat.nail,k}\ x\ 5{,}82 \\ R_{lat.bolt,k}\ x\ 2{,}24/k_{mod} \end{cases}$$

The capacity of the connection between the bolts and concrete has to be checked separately

$R_{lat,nail\text{-}v,k}$ = Characteristic lateral capacity of 1 threaded nail CNA4,0xℓ in the vertical flange

$R_{lat,nail\text{-}h,k}$ = Characteristic lateral capacity of 1 threaded nail CNA4,0xℓ in the horizontal flange

$R_{lat,nail,k}$ = Characteristic lateral capacity of 1 threaded nail CNA4,0xℓ

$R_{lat,bolt,k}$ = Characteristic lateral capacity of 1 M12 bolt, max. 4,5 kN

Annex D31 – E5/1.5

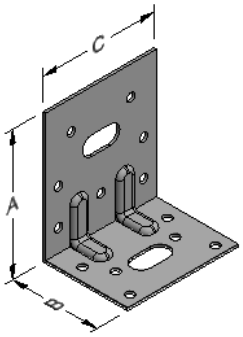
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E5/1.5	Steel ref. 1	-
E5/1.5/11.22/11	Steel ref. 1	-
E5/1.5/13	Steel ref. 1	-
E5/1.5S	Steel ref. 2	-
E5IX/1.5/1122/11	Steel ref. 2	-
E5/1.5/13S	Steel ref. 2	-
E5/1.5S2	Steel ref. 3	-
E5/1.5/11.22/11S2	Steel ref. 3	-
E5/1.5/13S2	Steel ref. 3	-
E5/1.5Z	Steel ref. 6	-
E5/1.5/11.22/11Z	Steel ref. 6	-
E5/1.5/13Z	Steel ref. 6	-

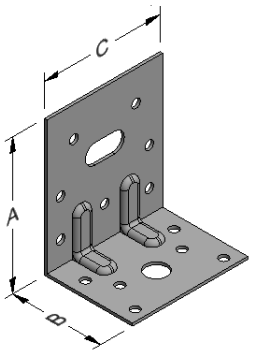
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B		
	A	B	C	Thickness	Ø5	Ø13	11x22	Ø5	Ø13	11x22
E5/1.5	76,5	49,5	65	1,5	7	0	1	6	0	1
E5/1.5/11.22/11 E5IX/1.5/1122/11	76,5	49,5	65	1,5	7	0	1	6	1	0
E5/1.5/13	76,5	49,5	65	1,5	7	1	0	6	1	0

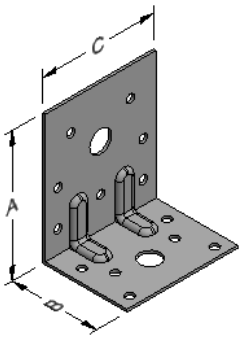
Drawings:



E5/1.5

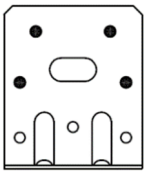
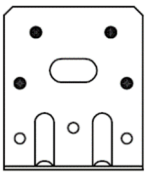
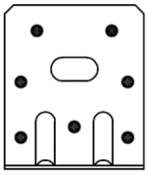
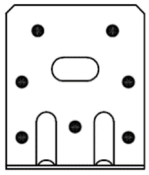
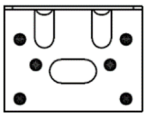
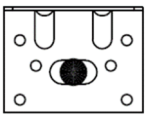
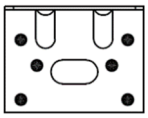
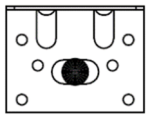


E5/1.5/11.22/11
E5IX/1.5/1122/11



E5/1.5/13

Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	Beam to beam Minimum nailing	Beam (A) to rigid support	Beam to beam Maximum nailing	Beam (A) to rigid support

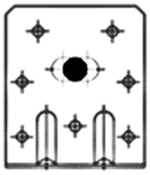
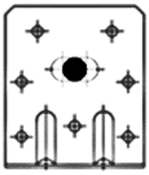
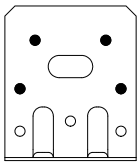
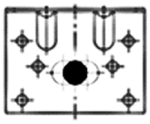
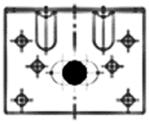
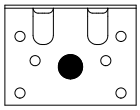
	Nailing pattern 5	Nailing pattern 6	Nailing pattern 7
Flange A:			
Flange B:			
	Beam to beam with large connector screws type SS-H	Beam (A) connected with large connector screws type SS-H to rigid support (B)	Column to rigid support

Table D31-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket E5/1.5 & E5/1.5/11.22/11 & E5IX/1.5/1122/11, Nailing pattern 1

1 Angle Bracket per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern1	4	6	P	f ≤ 6,7 28 / (f + 46)	f ≤ 3,3 57 / (f + 46)	1,5	2,5	Min of 20/(e - 1,5) 23/√(e² + 25)	Min of 20/(e - 1,5)
				f > 6,7 4 / (f + 1)	f > 3,3 4 / (f + 1)			3,6 7,4/(e - 26)	3,6 7,4/(e - 26)
			L	f ≤ 5,5 33 / (f + 46)	f ≤ 2,7 67 / (f + 46)	1,7	2,9	Min of 20/(e - 1,5) 28/√(e² + 25)	Min of 20/(e - 1,5)
				f > 5,5 4 / (f + 1)	f > 2,7 4 / (f + 1)			4 7,4/(e - 26)	4 7,4/(e - 26)
			M	f ≤ 4,6 38 / (f + 46)	f ≤ 2,2 76 / (f + 46)	2	3,3	Min of 20/(e - 1,5) 32/√(e² + 25)	Min of 20/(e - 1,5)
				f > 4,6 4 / (f + 1)	f > 2,2 4 / (f + 1)			4,1 7,4/(e - 26)	4,1 7,4/(e - 26)
			S	f ≤ 3,9 43 / (f + 46)	f ≤ 1,9 86 / (f + 46)	2,2	3,8	Min of 20/(e - 1,5) 36/√(e² + 25)	Min of 20/(e - 1,5)
				f > 3,9 4 / (f + 1)	f > 1,9 4 / (f + 1)			4,4 7,4/(e - 26)	4,4 7,4/(e - 26)
			I	f ≤ 3 52 / (f + 46)	f ≤ 1,4 105 / (f + 46)	2,7	4,6	Min of 20/(e - 1,5) 44/√(e² + 25)	Min of 20/(e - 1,5)
				f > 3 4 / (f + 1)	f > 1,4 4 / (f + 1)			4,9 7,4/(e - 26)	4,9 7,4/(e - 26)

Table D31-2 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11 & E5IX/1.5/1122/11, Nailing pattern 1

2 Angle Brackets per connection				**Modified characteristic capacityper connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	6	P	2,5	5,0	3,0	4,9	e ≤ 0,32 * b + 15 3,9	e ≤ 0,54 * b + 19 3,9
								e > 0,32 * b + 15 0,74*(1,70*b+75)/(e-1,5)	e > 0,54 * b + 19 0,87*(2,89*b+92)/(e-1,5)
			L	3,0	5,6	3,5	5,8	e ≤ 0,34 * b + 15 4,3	e ≤ 0,56 * b + 18 4,3
								e > 0,34 * b + 15 0,74*(1,98*b+79)/(e-1,5)	e > 0,56 * b + 18 0,87*(3,26*b+98)/(e-1,5)
			M	3,3	6,2	3,9	6,6	e ≤ 0,37 * b + 15 4,6	e ≤ 0,57 * b + 18 4,6
								e > 0,37 * b + 15 0,74*(2,26*b+83)/(e-1,5)	e > 0,57 * b + 18 0,87*(3,55*b+102)/(e-1,5)
			S	3,7	6,7	4,4	7,5	e ≤ 0,39 * b + 15 4,8	e ≤ 0,59 * b + 18 4,8
								e > 0,39 * b + 15 0,74*(2,54*b+87)/(e-1,5)	e > 0,59 * b + 18 0,87*(3,84*b+107)/(e-1,5)
			I	4,6	7,7	5,5	9,2	e ≤ 0,43 * b + 15 5,4	e ≤ 0,61 * b + 17 5,4
								e > 0,43 * b + 15 0,74*(3,11*b+96)/(e-1,5)	e > 0,61 * b + 17 0,87*(4,43*b+116)/(e-1,5)

Table D31-3 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket E5/1.5 & E5/1.5/11.22/11 & E5IX/1.5/1122/11, Nailing pattern 2

1 Angle Bracket per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Ø10 Bolt	P	Min of 12,1 / (f + 24) 4,1 / f		0,6	1,1	Min of 36,3 / e 8 / (e - 26) 12,9	
			L			0,8	1,3		
			M			0,9	1,5		
			S			1,1	1,7		
			I			1,2	2,1		

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Bolt factor	for F_1	for $F_{2/3}$	for F_4
k_{ax}	(f+38)/8	0,46	e/8
k_{lat}	-	1,0	1,0

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D31-4 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11 & E5IX/1.5/1122/11, Nailing pattern 2

2 Angle Brackets per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}		$R_{4/5,k}$ x k_{mod}	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Bolt Ø10	P	2,3	4,4	1,3	2,0	e ≤ 0,26 * b + 21 4,4	e ≤ 0,42* b + 25 4,4
								e > 0,26 * b + 21 0,74*(1,54*b+107)/(e-1,5)	e > 0,42* b + 25 0,87*(2,53*b+132)/(e-1,5)
			L	2,7	5,1	1,6	2,6	e ≤ 0,28 * b + 20 4,8	e ≤ 0,46 * b + 25 4,8
								e > 0,28 * b + 20 0,74*(1,80*b+114)/(e-1,5)	e > 0,46 * b + 25 0,87*(2,96*b+143)/(e-1,5)
			M	3,0	5,5	1,8	3,0	e ≤ 0,30 * b + 20 5,1	e ≤ 0,49 * b + 25 5,1
								e > 0,30 * b + 20 0,74*(2,05*b+120)/(e-1,5)	e > 0,49 * b + 25 0,87*(3,38*b+153)/(e-1,5)
			S	3,4	5,5	2,1	3,3	e ≤ 0,31 * b + 20 5,5	e ≤ 0,52 * b + 25 5,5
								e > 0,31 * b + 20 0,74*(2,31*b+126)/(e-1,5)	e > 0,52 * b + 25 0,87*(3,80*b+154)/(e-1,5)
			I	4,1	5,5	2,5	4,1	e ≤ 0,35 * b + 20 6,0	e ≤ 0,57 * b + 26 6,0
								e > 0,35 * b + 20 0,74*(2,82*b+139)/(e-1,5)	e > 0,57 * b + 26 0,87*(4,65*b+185)/(e-1,5)

Note: Value given for a withdrawal characteristic capacity of the bolt of 16 kN. For others bolt withdrawal capacities $R_{k,anchor}$ (kN), value must be limited by 13.6 * $R_{k,anchor}$ / 16

Bolt factor	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
k_{ax}	0,98	0,23	1,96 x e / (b + 25)	-
k_{lat}	-	0,50	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D31-5 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E5/1.5/13 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	**$R_{1,k}$ x k_{mod}**		**$R_{2/3,k}$ x k_{mod}**		**$R_{4,k}$ x k_{mod}**	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Ø10 Bolt	P	Min of 13,6 / (f + 23) 5,2 / f		0,6	1	Min of 36,3 / e 8 / (e - 26) 19,3	
			L			0,8	1,3		
			M			0,9	1,5		
			S			1,1	1,7		
			I			1,2	2,1		

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Bolt factor	for F_1	for $F_{2/3}$	for F_4
k_{ax}	(f + 38) / 8	0,46	e / 8
k_{lat}	-	1,0	1,0

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D31-6 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E5/1.5/13 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Ø10 Bolt	P	2,4	4,7	1,3	2,2	e ≤ 0,27 * b + 21 4,4	e ≤ 0,44* b + 25 4,4
								e > 0,27 * b + 21 0,74*(1,63*b+109)/(e-1,5)	e > 0,44* b + 25 0,87*(2,67*b+136)/(e-1,5)
			L	2,8	5,4	1,6	2,6	e ≤ 0,29 * b + 21 4,8	e ≤ 0,48 * b + 25 4,8
								e > 0,29 * b + 21 0,74*(1,90*b+116)/(e-1,5)	e > 0,48 * b + 25 0,87*(3,12*b+147)/(e-1,5)
			M	3,2	5,9	1,8	3,0	e ≤ 0,31 * b + 21 5,1	e ≤ 0,51 * b + 26 5,1
								e > 0,31 * b + 21 0,74*(2,17*b+123)/(e-1,5)	e > 0,51 * b + 26 0,87*(3,57*b+158)/(e-1,5)
			S	3,6	5,9	2,1	3,3	e ≤ 0,33 * b + 20 5,5	e ≤ 0,54 * b + 25 5,5
								e > 0,33 * b + 20 0,74*(2,45*b+130)/(e-1,5)	e > 0,54 * b + 25 0,87*(4,01*b+169)/(e-1,5)
			I	4,4	5,9	2,5	4,1	e ≤ 0,36 * b + 20 6,0	e ≤ 0,60 * b + 26 6,0
								e > 0,36 * b + 20 0,74*(2,99*b+143)/(e-1,5)	e > 0,60 * b + 26 0,87*(4,90*b+191)/(e-1,5)

Bolt factor	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
k_{ax}	0,98	0,23	1,96 x e / (b + 25)	-
k_{lat}	-	0,50	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D31-7 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 3

2 Angle Brackets per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 3	7	6	P	3,7	4,3	5,2	5,6	5,9	6,5	7,8	8,4
			L	4,3	5,0	6,0	6,5	6,9	7,6	9,1	9,8
			M	4,9	5,7	6,9	7,4	7,8	8,6	10,4	11,2
			S	5,5	6,4	7,7	8,4	8,8	9,7	11,7	12,6
			I	6,7	7,8	9,5	10,2	10,8	11,9	14,3	15,4

Table D31-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 4

2 Angle Brackets per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$ 1)			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 4	7	1 x Ø10 Bolt	P	4,0	4,0	4,0	4,0	3,5	4,0	5,2	5,9
			L	4,6	4,6	4,6	4,6	4,1	4,7	6,0	6,9
			M	5,3	5,3	5,3	5,3	4,6	5,4	6,9	7,9
			S	5,9	5,9	5,9	5,9	5,2	6,0	7,7	8,9
			I	7,3	7,3	7,3	7,3	6,4	7,4	9,5	10,9

Note: 1) only available for a connection in a round hole, not with the version with oblong hole.
When there are two angle brackets, the anchor group must resist to F1 and/or F2
When there is one angle bracket, the anchor must resist to F1 and/or F2

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Table D31-9 E5/1,5 – Slip modulus k_{ser}

2 x E5/1,5			K_{ser} [kN/mm]			
Nail pattern	Fastener		For F_1		For $F_{2/3}$	
	Flange A	Flange B	CNA4,0x35	SS-H Ø10x40	CNA4,0x35	SS-H Ø10x40
3	7	6	3,05	-	2,24	-
4	7	1 x M10 Bolt	1,25	-	4,25	-
5	1	1	-	0,689	-	-
6	1	1 x M10 Bolt	-	0,903	-	-

In case of 1 angle brackets, k_{ser} values can be divided by 2.

Ductility Class

The connection of timber joist to a rigid support with an E5/1.5 with CNA4.0x35 offers a mean ratio for F_1 load direction $D_{u,80\%} / D_y < 4$ ($D_{u,80\%} / D_y$ ratio disclosed in EN12512), therefore this connection has a low capacity to dissipate energy according to EN 1998-1:2004 §8 and is suitable for dissipative zone of DCL class building.

The connection of timber joist to a rigid support with an E5/1.5 with CNA4.0x35 offers a mean ratio for $F_{2/3}$ load direction $D_{u,80\%} / D_y > 6$ ($D_{u,80\%} / D_y$ ratio disclosed in EN12512), therefore this connection has a high capacity to dissipate energy according to EN 1998-1:2004 §8 and is suitable for dissipative zone of DCH class building.

The anchor or fastener in the support shall be designed with sufficient overstrength to ensure the development of cyclic yielding in the dissipation zones as disclosed in 8.6 (4) in EN 1998 -1:2004.

Table D31-10 Characteristic capacity timber beam to timber beam – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 5

Timber to timber connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø10x40	SS-H Ø10x40
E5/1,5 E5/1,5/1,22/11	Nailing pattern 5	1	SS-H	1	SS-H	3,1	-

Table D31-11 Characteristic capacity timber beam to rigid support – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 6

Timber to rigid connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø10x40	SS-H Ø10x40
E5/1,5 E5/1,5/1,22/11	Nailing pattern 6	1	Bolt Ø10	1	SS-H	5	-

Table D31-12 Characteristic capacity timber column to rigid support – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 7

2 angle bracket E5/1.5/11.22/11 per connection			Characteristic capacity (kN) per connection *	
Nailing pattern	Number of fasteners		Load direction : $R_{1,k}$	Load direction : $R_{2/3,k}$
	Flange A	Flange B		
	CNA 4,0x35	Ø10		
Nailing pattern 7	4	1	6,6	3,1

* Tested on a 38x97 column

Table D31-13 Characteristic capacity timber column to rigid support – 2 Angle Brackets E5/1.5 & E5/1.5/11.22/11, Nailing pattern 7

2 angle bracket E5/1.5/11.22/11 per connection			Characteristic capacity (kN) per connection **	
Nailing pattern	Number of fasteners		Load direction : $R_{1,k}$	Load direction : $R_{2/3,k}$
	Flange A	Flange B		
	CNA 4,0x50	Ø10		
Nailing pattern 7	4	1	6,6	4,5

** Tested on a 76x97 column

Annex D32 – E5/2

Product Name:

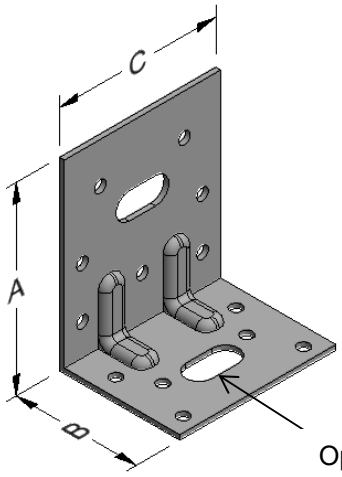
Product Name	Material reference acc. to clause II-1	Alternative product names
E5/2	Steel ref. 1	-
E5/2S	Steel ref. 2	-
E5/2S2	Steel ref. 3	-
E5/2Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	11x22	Ø5	11x22
E5/2	76,5	49,5	65	2,0	7	1	6	1 *)

*) Optional round Hole Ø13

Drawing:



Optional: Round Hole Ø13

Nailing pattern:

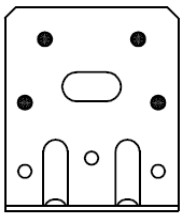
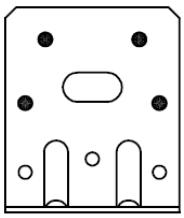
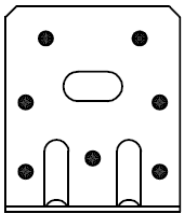
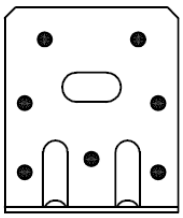
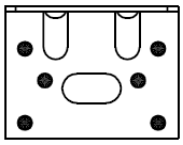
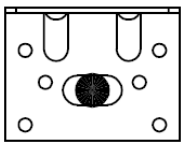
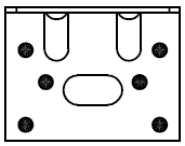
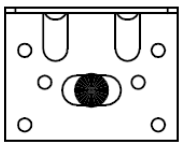
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	Beam to beam Minimum nailing	Beam (A) to rigid support	Beam to beam Maximum nailing	Beam (A) to rigid support

Table D32-1 Modified characteristic capacity timber beam to timber beam - 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E5/2 per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	6	P	f ≤ 14 29 / (f + 46,5)	f ≤ 7 57 / (f + 46,5)	1,4	2,4	Min of 27,7/(e - 2) 23/√(e² + 25)	Min of 27,7/(e - 2) 41/√(e² + 25)	Min of 1,2*(b + 5)/e 1,2	Min of 2,4*(b + 5)/e 2,4
				f > 14 7,1 / (f + 1)	f > 7 7,1 / (f + 1)			4,4 13,1/(e - 27)	4,4 13,1/(e - 27)	For e < 65 19,2 / (65 - e) For e < 41 7 / (41 - e)	For e < 65 38,4 / (65 - e) For e < 41 7 / (41 - e) 65 / e
			L	f ≤ 11 33 / (f + 46,5)	f ≤ 6 67 / (f + 46,5)	1,6	2,9	Min of 27,7/(e - 2) 28/√(e² + 25)	Min of 27,7/(e - 2) 48/√(e² + 25)	Min of 1,4*(b + 5)/e 1,55	Min of 2,8*(b + 5)/e 2,35
				f > 11 7,1 / (f + 1)	f > 6 7,1 / (f + 1)			4,8 13,1/(e - 27)	4,8 13,1/(e - 27)	For e < 65 22,4 / (65 - e) For e < 41 7 / (41 - e)	For e < 65 44,8 / (65 - e) For e < 41 7 / (41 - e) 65 / e
			M	f ≤ 10 38 / (f + 46,5)	f ≤ 5 76 / (f + 46,5)	1,8	3,3	Min of 27,7/(e - 2) 32/√(e² + 25)	Min of 27,7/(e - 2) 55/√(e² + 25)	Min of 1,6*(b + 5)/e 1,6	Min of 3,2*(b + 5)/e 2,5
				f > 10 7,1 / (f + 1)	f > 5 7,1 / (f + 1)			5,2 13,1/(e - 27)	5,2 13,1/(e - 27)	For e < 65 25,6 / (65 - e) For e < 41 7 / (41 - e)	For e < 41 min of: 7 / (41 - e) 65 / e
			S	f ≤ 8 43 / (f + 46,5)	f ≤ 4 86 / (f + 46,5)	2,1	3,7	Min of 27,7/(e - 2) 36/√(e² + 25)	Min of 27,7/(e - 2) 61/√(e² + 25)	Min of 2,42*(b + 5)/e 1,7	Min of 3,6*(b + 5)/e 2,7
				f > 8 7,1 / (f + 1)	f > 4 7,1 / (f + 1)			5,5 13,1/(e - 27)	5,5 13,1/(e - 27)	For e < 65 28,8 / (65 - e) For e < 41 7 / (41 - e)	For e < 41 min of: 7 / (41 - e) 65 / e
			I	f ≤ 6 52 / (f + 46,5)	f ≤ 3 105 / (f + 46,5)	2,6	4,5	Min of 27,7/(e - 2) 44/√(e² + 25)	Min of 27,7/(e - 2) 74/√(e² + 25)	Min of 2,95*(b + 5)/e 1,9	Min of 3,2*(b + 5)/e 2,9
				f > 6 7,1 / (f + 1)	f > 3 7,1 / (f + 1)			6 13,1/(e - 27)	6 13,1/(e - 27)	For e < 65 35,2 / (65 - e) For e < 41 7 / (41 - e)	For e < 41 min of: 7 / (41 - e) 65 / e

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Table D32-2 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E5/2 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	6	P	2,5	5,0	2,8	4,9	e ≤ 0,26 * b + 18 4,8	e ≤ 0,43 * b + 20 4,8
								e > 0,26 * b + 18 0,74*(1,70*b+100)/(e-2)	e > 0,43 * b + 20 0,87*(2,89*b+118)/(e-2)
			L	3,0	5,8	3,2	5,8	e ≤ 0,27 * b + 17 5,4	e ≤ 0,46 * b + 19 5,4
								e > 0,27 * b + 17 0,74*(1,98*b+108)/(e-2)	e > 0,46 * b + 19 0,87*(3,37*b+125)/(e-2)
			M	3,3	6,7	3,7	6,5	e ≤ 0,29 * b + 17 5,7	e ≤ 0,50 * b + 19 5,7
								e > 0,29 * b + 17 0,74*(2,26*b+109)/(e-2)	e > 0,50 * b + 19 0,87*(3,85*b+133)/(e-2)
			S	3,7	7,5	4,2	7,4	e ≤ 0,31 * b + 17 7,1	e ≤ 0,53 * b + 19 7,1
								e > 0,31 * b + 17 0,74*(2,54*b+113)/(e-2)	e > 0,53 * b + 19 0,87*(4,33*b+140)/(e-2)
			I	4,6	8,8	5,2	9,1	e ≤ 0,34 * b + 16 6,7	e ≤ 0,56 * b + 19 6,7
								e > 0,34 * b + 16 0,74*(3,11*b+122)/(e-2)	e > 0,56 * b + 19 0,87*(5,07*b+151)/(e-2)

Table D32-3 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E5/2 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Ø10 Bolt	P	Min of 13,8 / (f+ 24) 7,2 / f		0,6	1,1	Min of 55,4 / e 14,2 / (e -26) 12,9	
			L			0,8	1,3		
			M			0,9	1,5		
			S			1,1	1,7		
			I			1,2	2,1		

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Bolt factor	for F_1	for $F_{2/3}$	for F_4
k_{ax}	(f + 38) / 8	0,09	e / 8
k_{lat}	-	1,00	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D32-4 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E5/2 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	1 x Bolt Ø10	P	2,4	4,5	1,3	2,2	e ≤ 0,22 * b + 23 5,3	e ≤ 0,35* b + 26 5,3
								e > 0,22 * b + 23 0,74*(1,59*b+145)/(e-2)	e > 0,35* b + 26 0,87*(2,61*b+170)/(e-2)
			L	2,7	5,3	1,5	2,7	e ≤ 0,23 * b + 22 6,0	e ≤ 0,38 * b + 25 6,0
								e > 0,23 * b + 22 0,74*(1,85*b+151)/(e-2)	e > 0,38 * b + 25 0,87*(3,05*b+181)/(e-2)
			M	3,1	6,1	1,7	3,1	e ≤ 0,25 * b + 21 6,4	e ≤ 0,40 * b + 25 6,4
								e > 0,25 * b + 21 0,74*(2,12*b+158)/(e-2)	e > 0,40 * b + 25 0,87*(3,48*b+192)/(e-2)
			S	3,5	6,8	2,0	3,4	e ≤ 0,26 * b + 21 6,8	e ≤ 0,43 * b + 25 6,8
								e > 0,26 * b + 21 0,74*(2,38*b+164)/(e-2)	e > 0,43 * b + 25 0,87*(3,92*b+203)/(e-2)
			I	4,3	8,3	2,5	4,1	e ≤ 0,29 * b + 21 7,5	e ≤ 0,47 * b + 25 7,5
								e > 0,29 * b + 21 0,74*(2,91*b+178)/(e-2)	e > 0,47 * b + 25 0,87*(4,79*b+225)/(e-2)

Bolt factor	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
k_{ax}	1,00	0,05	1,99 x e / (b + 25)	-
k_{lat}	-	0,50	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D32-5 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets E5/2 per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 3	7	6	P	3,7	4,3	5,2	5,9	5,9	6,4	7,8	8,3
			L	4,3	5,0	6,0	6,9	6,9	7,5	9,1	9,7
			M	4,9	5,7	6,9	7,8	7,8	8,6	10,4	11,0
			S	5,5	6,4	7,7	8,8	8,8	9,6	11,7	12,4
			I	6,7	7,8	9,5	10,8	10,8	11,8	14,3	15,2

Table D32-6 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E5/2 per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$ 1)			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 4	7	1 x Ø10 Bolt	P	5,0	5,0	5,0	5,0	3,6	4,1	5,3	6,1
			L	5,9	5,9	5,9	5,9	4,2	4,8	6,2	7,1
			M	6,7	6,7	6,7	6,7	4,8	5,5	7,0	8,1
			S	7,6	7,6	7,6	7,6	5,4	6,2	7,9	9,1
			I	9,2	9,2	9,2	9,2	6,6	7,6	9,7	11,1

Note: 1) only available for a connection in a round hole, not with the version with oblong hole.
When there are two angle brackets, the anchor group must resist to F1 and/or F2
When there is one angle bracket, the anchor must resist to F1 and/or F2

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Table D32-7 E5/2 – Slip modulus k_{ser}

2 x E5/2			K_{ser} [kN/mm]	
Nail pattern	Fastener		For F_1	For $F_{2/3}$
	Flange A	Flange B	CNA4,0x35	CNA4,0x35
3	7	6	2,96	1,96
4	7	1 x M10 Bolt	3,90	3,81

In case of 1 angle brackets, k_{ser} values can be divided by 2.

Ductility Class

The connection of timber joist to a rigid support with an E5/2 with CNA4.0x35 offers a mean ratio for F_1 load direction $D_{u,80\%} / D_y < 4$ ($D_{u,80\%} / D_y$ ratio disclosed in EN12512), therefore this connection has a low capacity to dissipate energy according to EN 1998-1:2004 §8 and is suitable for dissipative zone of DCL class building.

The connection of timber joist to a rigid support with an E5/2 with CNA4.0x35 offers a mean ratio for $F_{2/3}$ load direction $D_{u,80\%} / D_y > 6$ ($D_{u,80\%} / D_y$ ratio disclosed in EN12512), therefore this connection has a high capacity to dissipate energy according to EN 1998-1:2004 §8 and is suitable for dissipative zone of DCH class building.

The anchor or fastener in the support shall be designed with sufficient overstrength to ensure the development of cyclic yielding in the dissipation zones as disclosed in 8.6 (4) in EN 1998 -1:2004

Annex D33 – AT1

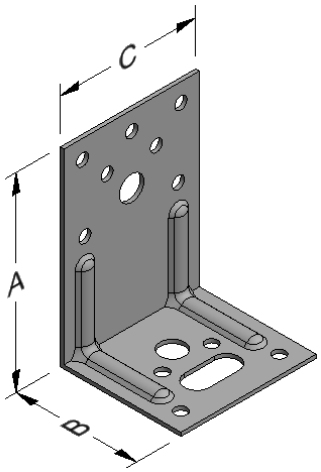
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AT1	Steel ref. 1	-
AT1S	Steel ref. 2	-
AT1S2	Steel ref. 3	-
AT1Z	Steel ref. 6	-

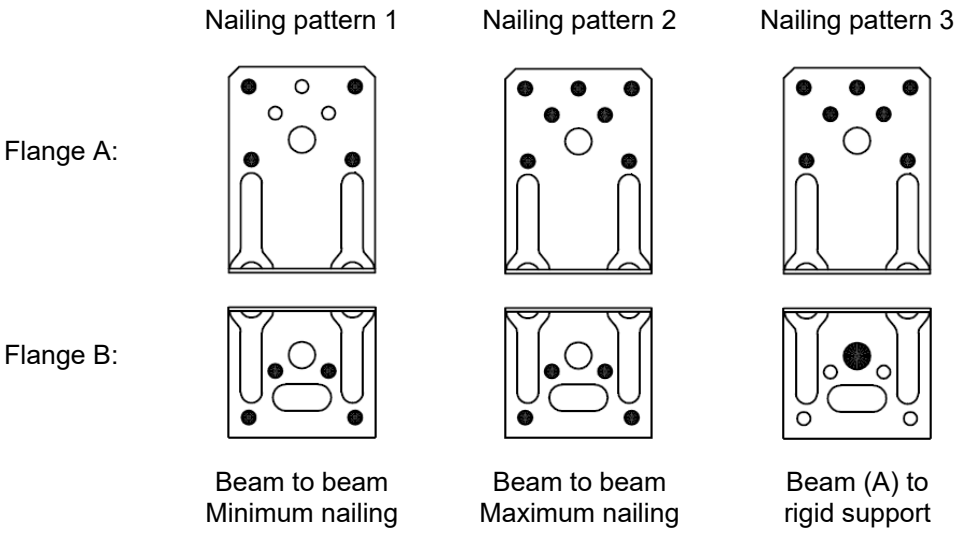
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B		
	A	B	C	Thickness	Ø5	Ø10	Ø5	Ø10	10x22
AT1	77,5	49	55	1,5	7	1	4	1	1

Drawing:



Nailing pattern:



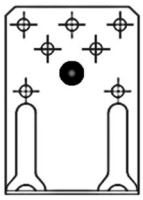
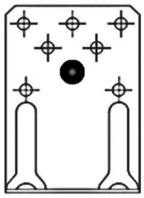
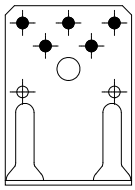
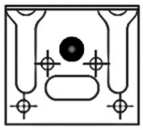
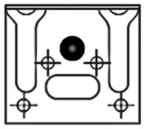
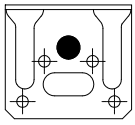
	Nailing pattern 4	Nailing pattern 5	Nailing pattern 5
Flange A:			
Flange B:			
	Beam to beam with large connector screws type SS-H	Beam (A) connected with large connector screws type SS-H to rigid support (B)	Column to rigid support

Table D33-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket AT1 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	4	P	f ≤ 15 15 / (f + 43,5) f > 15 4,3 / (f + 1)	f ≤ 7 32/ (f + 43,5) f > 7 4,3 / (f + 1)	1,2	2,1	Min of 17,7/(e - 1,5) 15/√(e² + 24) 3,5 5,5/(e - 36)	Min of 17,7/(e - 1,5) 27/√(e² + 37,2) 3,5 5,5/(e - 36)	Min of 0,7*(b + 13)/e 1 For e < 42,5 21,7 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,4*(b + 13)/e 1,5 For e < 42,5 43,6 / (70 - e) 40 / e 5,5 / (43 - e)
			L	f ≤ 12 18 / (f + 43,5) f > 12 4,3 / (f + 1)	f ≤ 6 37 / (f + 43,5) f > 6 4,3 / (f + 1)	1,3	2,3	Min of 17,7/(e - 1,5) 18/√(e² + 24) 3,8 5,5/(e - 36)	Min of 17,7/(e - 1,5) 32/√(e² + 37,2) 3,8 5,5/(e - 36)	Min of 0,8*(b + 13)/e 1,1 For e < 42,5 25,4/ (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,63*(b + 13)/e 1,7 For e < 42,5 51 / (70 - e) 40 / e 5,5 / (43 - e)
			M	f ≤ 10 21/ (f + 43,5) f > 10 4,3 / (f + 1)	f ≤ 5 42 / (f + 43,5) f > 5 4,3 / (f + 1)	1,5	2,7	Min of 17,7/(e - 1,5) 21/√(e² + 24) 4,1 5,5/(e - 36)	Min of 17,7/(e - 1,5) 36/√(e² + 37,2) 4,1 5,5/(e - 36)	Min of 0,93*(b + 13)/e 1,2 For e < 42,5 29 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,9*(b + 13)/e 1,7 For e < 42,5 40 / e 5,5 / (43 - e)
			S	f ≤ 9 23 / (f + 43,5) f > 9 4,3 / (f + 1)	f ≤ 4 48 / (f + 43,5) f > 4 4,3 / (f + 1)	1,8	3,1	Min of 17,7/(e - 1,5) 23/√(e² + 24) 4,3 5,5/(e - 36)	Min of 17,7/(e - 1,5) 41/√(e² + 37,2) 4,3 5,5/(e - 36)	Min of 1,05*(b + 13)/e 1,3 For e < 42,5 32,6 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 2,1*(b + 13)/e 1,8 For e < 42,5 40 / e 5,5 / (43 - e)
			I	f ≤ 7 29 / (f + 43,5) f > 7 4,3 / (f + 1)	f ≤ 3 58 / (f + 43,5) f > 3 4,3 / (f + 1)	2,1	3,7	Min of 17,7/(e - 1,5) 29/√(e² + 24) 4,7 5,5/(e - 36)	Min of 17,7/(e - 1,5) 50/√(e² + 37,2) 4,7 5,5/(e - 36)	Min of 1,28*(b + 13)/e 1,4 For e < 42,5 40 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 2,4*(b + 13)/e 1,9 For e < 42,5 40 / e 5,5 / (43 - e)

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Table D33-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket AT1 per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	7	4	P	f ≤ 15 15 / (f + 43,5) f > 15 4,3 / (f + 1)	f ≤ 7 32 / (f + 43,5) f > 7 4,3 / (f + 1)	1,2	2,2	Min of 17,7/(e - 1,5) 15/√(e² + 24) 3,5 5,5/(e - 36)	Min of 17,7/(e - 1,5) 27/√(e² + 37,2) 3,5 5,5/(e - 36)	Min of 0,7*(b + 13)/e 1 For e < 42,5 21,7 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,4*(b + 13)/e 1,5 For e < 42,5 40 / e 5,5 / (43 - e)
			L	f ≤ 12 18 / (f + 43,5) f > 12 4,3 / (f + 1)	f ≤ 6 37 / (f + 43,5) f > 6 4,3 / (f + 1)	1,4	2,5	Min of 17,7/(e - 1,5) 18/√(e² + 24) 3,8 5,5/(e - 36)	Min of 17,7/(e - 1,5) 32/√(e² + 37,2) 3,8 5,5/(e - 36)	Min of 0,8*(b + 13)/e 1,1 For e < 42,5 25,4 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,63*(b + 13)/e 1,7 For e < 42,5 40 / e 5,5 / (43 - e)
			M	f ≤ 10 38 / (f + 46,5) f > 10 4,3 / (f + 1)	f ≤ 5 42 / (f + 43,5) f > 5 4,3 / (f + 1)	1,6	2,8	Min of 17,7/(e - 1,5) 21/√(e² + 24) 4,1 5,5/(e - 36)	Min of 17,7/(e - 1,5) 36/√(e² + 37,2) 4,1 5,5/(e - 36)	Min of 0,93*(b + 13)/e 1,2 For e < 42,5 29 / (70 - e) 40 / e 5,5 / (43 - e)	Min of 1,9*(b + 13)/e 1,7 For e < 42,5 40 / e 5,5 / (43 - e)
			S	f ≤ 9 23 / (f + 43,5) f > 9 4,3 / (f + 1)	f ≤ 4 48 / (f + 43,5) f > 4 4,3 / (f + 1)	1,8	3,1	Min of 17,7/(e - 1,5) 23/√(e² + 24) 4,3 5,5/(e - 36)	Min of 17,7/(e - 1,5) 41/√(e² + 37,2) 4,3 5,5/(e - 36)	Min of 1,05*(b + 13)/e 1,3 For e < 42,5 40 / e 5,5 / (43 - e)	Min of 2,1*(b + 13)/e 1,8 For e < 42,5 40 / e 5,5 / (43 - e)
			I	f ≤ 7 29 / (f + 43,5) f > 7 4,3 / (f + 1)	f ≤ 3 58 / (f + 43,5) f > 3 4,3 / (f + 1)	2,2	3,9	Min of 17,7/(e - 1,5) 29/√(e² + 24) 4,7 5,5/(e - 36)	Min of 17,7/(e - 1,5) 50/√(e² + 37,2) 4,7 5,5/(e - 36)	Min of 1,28*(b + 13)/e 1,4 For e < 42,5 40 / e 5,5 / (43 - e)	Min of 2,4*(b + 13)/e 1,9 For e < 42,5 40 / e 5,5 / (43 - e)

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Table D33-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets AT1 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	4	P	1,5	2,9	2,3	4,0	e ≤ 0,23 * b + 21 3,2	e ≤ 0,34 * b + 21 3,7
								e > 0,23 * b + 21 0,74*(b+77)/(e-1,5)	e > 0,34 * b + 21 0,87*(1,7*b+93)/(e-1,5)
			L	1,7	3,5	2,7	4,8	e ≤ 0,23 * b + 19 3,7	e ≤ 0,36 * b + 21 4
								e > 0,23 * b + 19 0,74*(1,16*b+81)/(e-1,5)	e > 0,36 * b + 21 0,87*(1,98*b+100)/(e-1,5)
			M	2,0	3,9	3,1	5,4	e ≤ 0,23 * b + 18 4,3	e ≤ 0,39 * b + 21 4,3
								e > 0,23 * b + 18 0,74*(1,33*b+85)/(e-1,5)	e > 0,39 * b + 21 0,87*(2,27*b+106)/(e-1,5)
			S	2,2	4,4	3,5	6,1	e ≤ 0,24 * b + 17 4,6	e ≤ 0,41 * b + 21 4,6
								e > 0,24 * b + 17 0,74*(1,5*b+88)/(e-1,5)	e > 0,41 * b + 21 0,87*(2,55*b+113)/(e-1,5)
			I	2,7	5,0	4,3	7,5	e ≤ 0,27 * b + 17 5	e ≤ 0,43 * b + 21 5
								e > 0,27 * b + 17 0,74*(1,83*b+96)/(e-1,5)	e > 0,43 * b + 21 0,87*(2,92*b+121)/(e-1,5)

Table D33-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets AT1 per connection				**Modified characteristic capacity per connection (kN)**									
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$				$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x60
Nailing pattern 2	4	6	P	3,4	4,1	4,8	4,8	5,6	6,1	7,4	7,9	e ≤ 0,23 * b + 21 3,2	e ≤ 0,34 * b + 21 3,7
												e > 0,23 * b + 21 0,74*(b+77)/(e-1,5)	e > 0,34 * b + 21 0,87*(1,7*b+93)/(e-1,5)
			L	3,4	4,1	4,8	4,8	5,6	6,1	7,4	7,9	e ≤ 0,23 * b + 19 3,7	e ≤ 0,36 * b + 21 4,0
												e > 0,23 * b + 19 0,74*(1,16*b+81)/(e-1,5)	e > 0,36 * b + 21 0,87*(1,98*b+100)/(e-1,5)
			M	3,4	4,1	4,8	4,8	5,6	6,1	7,4	7,9	e ≤ 0,23 * b + 18 4,3	e ≤ 0,39 * b + 21 4,3
												e > 0,23 * b + 18 0,74*(1,33*b+85)/(e-1,5)	e > 0,39 * b + 21 0,87*(2,27*b+106)/(e-1,5)
			S	3,4	4,1	4,8	4,8	5,6	6,1	7,4	7,9	e ≤ 0,24 * b + 17 4,6	e ≤ 0,41 * b + 21 4,6
												e > 0,24 * b + 17 0,74*(1,5*b+88)/(e-1,5)	e > 0,41 * b + 21 0,87*(2,55*b+113)/(e-1,5)
			I	3,4	4,1	4,8	4,8	5,6	6,1	7,4	7,9	e ≤ 0,27 * b + 17 5,0	e ≤ 0,43 * b + 21 5,0
												e > 0,27 * b + 17 0,74*(1,83*b+96)/(e-1,5)	e > 0,43 * b + 21 0,87*(2,92*b+121)/(e-1,5)

Table D33-5 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 3

1 Angle Bracket AT1 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 3	7	1 x Ø8 Bolt	P	Min of 28 / (f +13) 4,3 / f		1,0	1,9	Min of 40 / e 5,5 / (e - 35) 6,4	
			L			1,2	2,2		
			M			1,3	2,5		
			S			1,5	2,9		
			I			1,8	3,5		

Note: For $R_{4,k}$ if the purlin is prevented from rotation, consider the value given for two brackets for e=0.

Bolt factor	for F_1	for $F_{2/3}$	for F_4
k_{ax}	(f + 23) / 6	1,31	e / 6
k_{lat}	-	1,00	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D33-6 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets AT1 per connection				Modified characteristic capacity per connection (kN)									
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$				$R_{4/5,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x60
Nailing pattern 3	7	1 x Ø8 Bolt	P	7,5	7,5	7,5	7,5	5,0	5,6	6,9	7,5	e ≤ 0,68 * b + 28 4,3	e ≤ 1,08* b + 34 4,3
												e > 0,68 * b + 28 0,74*(3,93*b+145)/(e-1,5)	e > 1,08* b + 34 0,87*(6,24*b+182)/(e-1,5)
			L	7,5	7,5	7,5	7,5	5,0	5,6	6,9	7,5	e ≤ 0,73 * b + 28 4,6	e ≤ 1,16 * b + 35 4,6
												e > 0,73 * b + 28 0,74*(4,58*b+154)/(e-1,5)	e > 1,16 * b + 35 0,87*(7,28*b+199)/(e-1,5)
			M	7,5	7,5	7,5	7,5	5,0	5,6	6,9	7,5	e ≤ 0,78 * b + 28 4,9	e ≤ 1,24 * b + 35 4,9
												e > 0,78 * b + 28 0,74*(5,23*b+165)/(e-1,5)	e > 1,24 * b + 35 0,87*(8,32*b+217)/(e-1,5)
			S	7,5	7,5	7,5	7,5	5,0	5,6	6,9	7,5	e ≤ 0,83 * b + 28 5,2	e ≤ 1,32 * b + 36 5,2
												e > 0,83 * b + 28 0,74*(5,89*b+176)/(e-1,5)	e > 1,32 * b + 36 0,87*(9,36*b+235)/(e-1,5)
			I	7,5	7,5	7,5	7,5	5,0	5,6	6,9	7,5	e ≤ 0,92 * b + 28 5,8	e ≤ 1,46 * b + 37 5,8
												e > 0,92 * b + 28 0,74*(7,20*b+198)/(e-1,5)	e > 1,46 * b + 37 0,87*(11,44*b+270)/(e-1,5)

Bolt factor	for F_1	for $F_{2/3}$	for $F_{4/5,\ bolt\ 1}$	for $F_{4/5,\ bolt\ 2}$
k_{ax}	1,17	0,65	2,35 x e / (b + 17)	-
k_{lat}	-	0,50	-	1,00

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Table D33-7 Characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 4

Timber to timber connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø8x40	SS-H Ø8x40
AT1	Nailing pattern 4	1	SS-H	1	SS-H	4,5	2,1

Table D33-8 Characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 5

Timber to rigid connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - Timber C24	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø8x40	SS-H Ø8x40
AT1	Nailing pattern 5	1	Bolt Ø8	1	SS-H	5,9	4,1

Table D33-9 AT1 Slip modulus k_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
Timber to timber (with SS-H screws Ø8.0x40)	4	0,305	0,095
Timber to rigid (with SS-H screws Ø8.0x40)	5	0,854	0,585

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Table D33-10: Characteristic capacity column to rigid support – 2 Angle Bracket

The values $R_{i,k}$ for two AT1 per connection, with prevention of rotation (so that only shear force is acting), are stated in the tables below

2 angle bracket AT1 per connection			**Characteristic capacity (kN) per connection ***	
Nailing pattern	Number of fasteners		**Load direction : $R_{1,k}$**	**Load direction : $R_{2/3,k}$**
	Flange A	Flange B		
	CNA 4,0x35	Ø8		
Nailing pattern 6	5	1	7,5	2,5

* Tested on a 38x97 column

2 angle bracket AT1 per connection			**Characteristic capacity (kN) per connection ****	
Nailing pattern	Number of fasteners		**Load direction : $R_{1,k}$**	**Load direction : $R_{2/3,k}$**
	Flange A	Flange B		
	CNA 4,0x50	Ø8		
Nailing pattern 6	5	1	7,5	3,5

** Tested on a 76x97 column

Annex D34 – E4/2.5

Product Name:

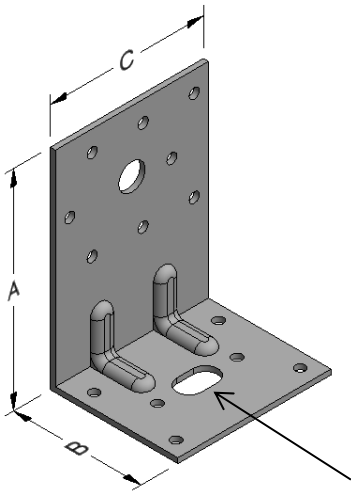
Product Name	Material reference acc. to clause II-1	Alternative product names
E4/2.5	Steel ref. 1	-
E4/2.5S	Steel ref. 2	-
E4/2.5S2	Steel ref. 3	-
E4/2.5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	12x20
E4/2.5	102,5	62,5	75	2,5	8	1	6	1 *)

*) Optional round Hole Ø12

Drawing:



Optional: Round Hole Ø12

Nailing pattern:

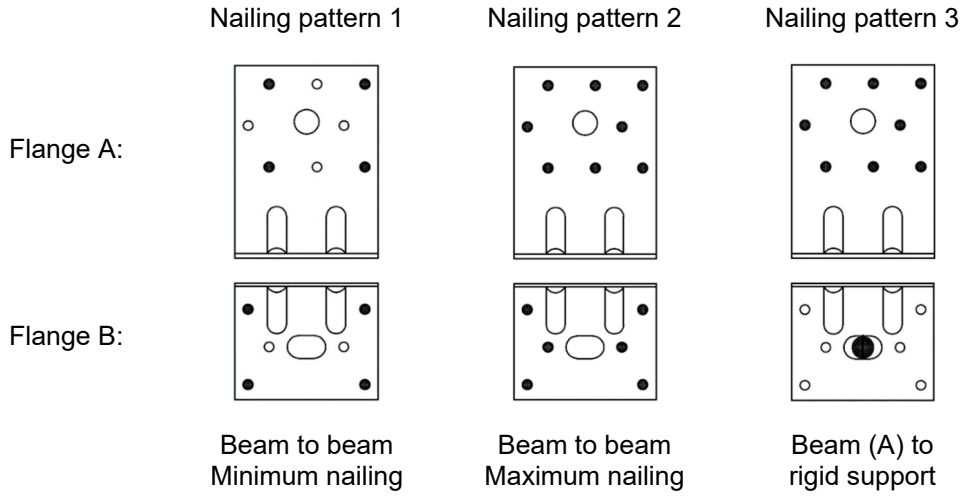


Table D34-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E4/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	4	4	P	f ≤ 92,4 32 / (f + 56,6)	f ≤ 31,1 65/ (f + 56,6)	1,2	2,1
				f > 92,4 20,5 / (f + 1)	f > 31,1 20,5 / (f + 1)		
			L	f ≤ 63,4 37 / (f + 56,6)	f ≤ 24,4 75 / (f + 56,6)	1,5	2,5
				f > 63,4 20,5 / (f + 1)	f > 24,4 20,5 / (f + 1)		
			M	f ≤ 48,1 43/ (f + 56,6)	f ≤ 19,9 87 / (f + 56,6)	1,7	3,0
				f > 48,1 20,5 / (f + 1)	f > 19,9 20,5 / (f + 1)		
			S	f ≤ 38,7 49 / (f + 56,6)	f ≤ 16,8 97 / (f + 56,6)	1,9	3,3
				f > 38,7 20,5 / (f + 1)	f > 16,8 20,5 / (f + 1)		
			I	f ≤ 27,6 60 / (f + 56,6)	f ≤ 12,7 120 / (f + 56,6)	2,3	4,0
				f > 27,6 20,5 / (f + 1)	f > 12,7 20,5 / (f + 1)		

Table D34-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E4/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	8	6	P	$f \leq 65,9$ $37 / (f + 56,6)$	$f \leq 25$ $75/ (f + 56,6)$	1,3	2,6
				$f > 65,9$ $20,5 / (f + 1)$	$f > 25$ $20,5 / (f + 1)$		
			L	$f \leq 47,8$ $43 / (f + 56,6)$	$f \leq 19,8$ $87 / (f + 56,6)$	1,5	3,0
				$f > 47,8$ $20,5 / (f + 1)$	$f > 19,8$ $20,5 / (f + 1)$		
			M	$f \leq 37,4$ $50/ (f + 56,6)$	$f \leq 16,3$ $99 / (f + 56,6)$	1,7	3,5
				$f > 37,4$ $20,5 / (f + 1)$	$f > 16,3$ $20,5 / (f + 1)$		
			S	$f \leq 30,6$ $56 / (f + 56,6)$	$f \leq 13,9$ $112 / (f + 56,6)$	2,1	4,0
				$f > 30,6$ $20,5 / (f + 1)$	$f > 13,9$ $20,5 / (f + 1)$		
			I	$f \leq 22,3$ $68 / (f + 56,6)$	$f \leq 10,5$ $136 / (f + 56,6)$	2,5	4,8
				$f > 22,3$ $20,5 / (f + 1)$	$f > 10,5$ $20,5 / (f + 1)$		

Table D34-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E4/2.5 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of Fasteners		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 2	8	6	P	3,3	3,8	4,3	4,6	4,6	5,0	6,1	6,4
			L	3,9	4,4	5,0	5,3	5,3	5,8	7,1	7,5
			M	4,4	5,0	5,8	6,1	6,1	6,6	8,1	8,6
			S	5,0	5,7	6,5	6,8	6,8	7,5	9,1	9,6
			I	6,1	6,9	7,9	8,4	8,4	9,1	11,1	11,8

Table D34-4 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 3

1 Angle Bracket E4/2.5 per connection				**Modified characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$ 1)	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 3	7	1 x Ø10 Bolt	**P**	Min of 15,4 / (f+13) 20,5 / f		0,6	1,2
			L			0,7	1,4
			M			0,8	1,7
			S			0,9	1,9
			I			1,1	2,2

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D34-5 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets E4/2.5 per connection				**Modified characteristic capacity per connection (kN)**							
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$ 1)			
	Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
Nailing pattern 3	8	1 x Ø10 Bolt	P	7,6	7,6	7,6	7,6	3,4	3,9	4,9	5,4
			L	8,8	8,8	8,8	8,8	4,0	4,6	5,7	6,3
			M	10,1	10,1	10,1	10,1	4,6	5,2	6,5	7,2
			S	11,3	11,3	11,3	11,3	5,1	5,9	7,3	8,1
			I	13,9	13,9	13,9	13,9	6,3	7,2	8,9	9,9

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D35 – E6/2

Product Name:

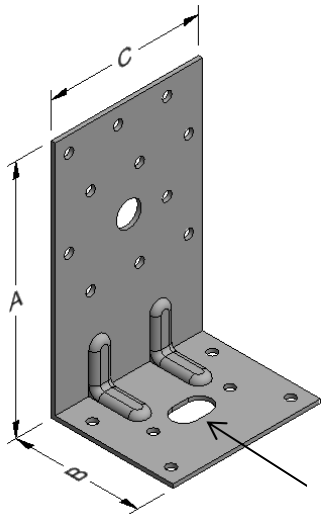
Product Name	Material reference acc. to clause II-1	Alternative product names
E6/2	Steel ref. 1	-
E6/2S	Steel ref. 2	-
E6/2S2	Steel ref. 3	-
E6/2Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	12x20
E6/2	122	62	75	2,0	11	1	6	1 *)

*) Optional round Hole Ø12

Drawing:



Optional: Round Hole Ø12

Nailing pattern:

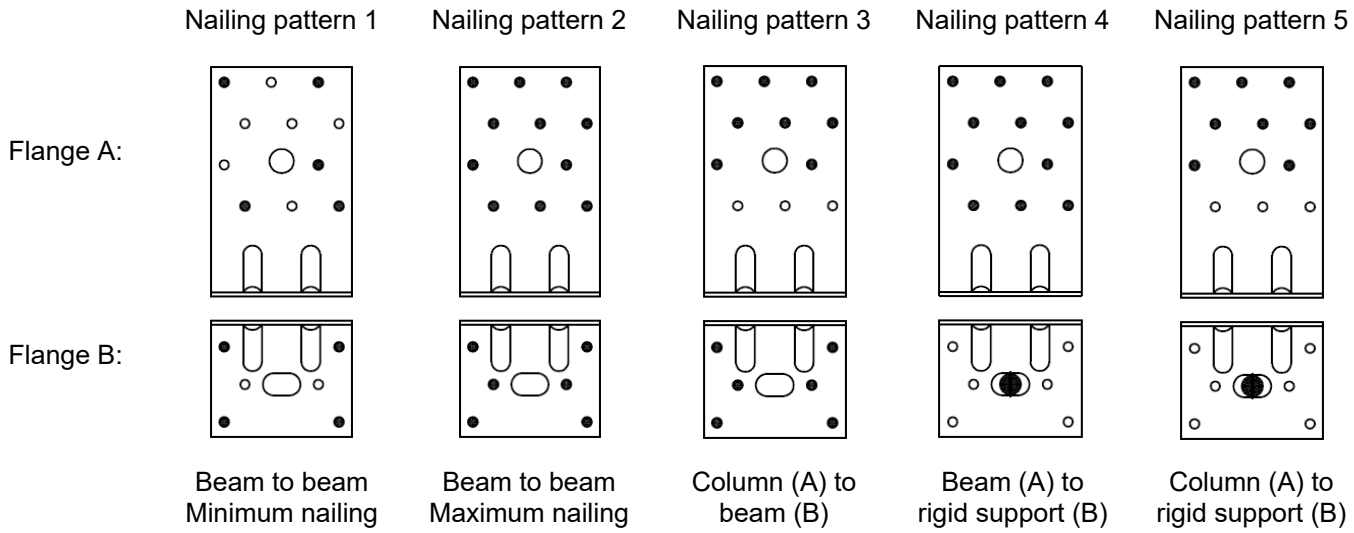


Table D35-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E6/2 per connection				**Modified characteristic capacity (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 1	5	4	P	f ≤ 36,2 32 / (f + 56)	f ≤ 16,1 65/ (f + 56)	1,2	2,2
				f > 36,2 13,1 / (f + 1)	f > 16,1 13,1 / (f + 1)		
			L	f ≤ 28 37 / (f + 56)	f ≤ 13 75 / (f + 56)	1,4	2,6
				f > 28 13,1 / (f + 1)	f > 13 13,1 / (f + 1)		
			M	f ≤ 22,8 43/ (f + 56)	f ≤ 10,9 87 / (f + 56)	1,6	3,0
				f > 22,8 13,1 / (f + 1)	f > 10,9 13,1 / (f + 1)		
			S	f ≤ 19,2 49 / (f + 56)	f ≤ 9,3 97 / (f + 56)	1,7	3,3
				f > 19,2 13,1 / (f + 1)	f > 9,3 13,1 / (f + 1)		
			I	f ≤ 14,5 59 / (f + 56)	f ≤ 7,2 120 / (f + 56)	2,2	4,1
				f > 14,5 13,1 / (f + 1)	f > 7,2 13,1 / (f + 1)		

Table D35-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E6/2 per connection				**Modified characteristic capacity (kN)**			
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
	Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
Nailing pattern 2	11	6	P	$f \leq 28,7$ $37 / (f + 56)$	$f \leq 13,3$ $75/ (f + 56)$	1,5	2,9
				$f > 28,7$ $13,1 / (f + 1)$	$f > 13,3$ $13,1 / (f + 1)$		
			L	$f \leq 22,7$ $44 / (f + 56)$	$f \leq 10,8$ $87 / (f + 56)$	1,8	3,4
				$f > 22,7$ $13,1 / (f + 1)$	$f > 10,8$ $13,1 / (f + 1)$		
			M	$f \leq 18,7$ $50/ (f + 56)$	$f \leq 9,1$ $99 / (f + 56)$	2,1	3,9
				$f > 18,7$ $13,1 / (f + 1)$	$f > 9,1$ $13,1 / (f + 1)$		
			S	$f \leq 15,8$ $56 / (f + 56)$	$f \leq 7,8$ $112 / (f + 56)$	2,4	4,3
				$f > 15,8$ $13,1 / (f + 1)$	$f > 7,8$ $13,1 / (f + 1)$		
			I	$f \leq 12$ $68 / (f + 56)$	$f \leq 6$ $136 / (f + 56)$	2,9	5,3
				$f > 12$ $13,1 / (f + 1)$	$f > 6$ $13,1 / (f + 1)$		

Table D35-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E6/2 per connection				**Modified characteristic capacities (kN)**			
Nailing pattern	Number of Fasteners		Load duration	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
	Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
Nailing pattern 2	5	4	P	1,5	2,9	2,4	4,4
			L	1,7	3,5	2,8	5,1
			M	2,0	3,9	3,2	5,8
			S	2,2	4,4	3,6	6,6
			I	2,7	5,4	4,4	8,0

Table D35-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E6/2 per connection				**Modified characteristic capacities (kN)**			
Nailing pattern	Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
	Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
Nailing pattern 2	11	6	P	2,5	5,0	3,2	5,7
			L	3,0	5,8	3,7	6,7
			M	3,3	6,7	4,2	7,7
			S	3,8	7,5	4,7	8,7
			I	4,6	9,2	5,8	10,6

Table D35-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket Nailing pattern 2 & 3

1 Angle Bracket E6/2 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	**$R_{1,k}$ x k_{mod} Nailing pattern 3**		**$R_{2/3,k}$ x k_{mod} Nailing pattern 2**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 8 For $R_{2/3}$: 11	6	**P**	f ≤ 28,7 37 / (f + 56)	f ≤ 13,3 75/ (f + 56)	1,5	2,9
			f > 28,7 13,1 / (f + 1)	f > 13,3 13,1 / (f + 1)		
		L	f ≤ 22,7 43 / (f + 56)	f ≤ 10,8 87 / (f + 56)	1,8	3,4
			f > 22,7 13,1 / (f + 1)	f > 10,8 13,1 / (f + 1)		
		M	f ≤ 18,7 49/ (f + 56)	f ≤ 9,1 99 / (f + 56)	2,1	3,9
			f > 18,7 13,1 / (f + 1)	f > 9,1 13,1 / (f + 1)		
		S	f ≤ 15,8 56 / (f + 56)	f ≤ 7,8 112 / (f + 56)	2,4	4,3
			f > 15,8 13,1 / (f + 1)	f > 7,8 13,1 / (f + 1)		
		I	f ≤ 12 68 / (f + 56)	f ≤ 6 136 / (f + 56)	2,9	5,3
			f > 12 13,1 / (f + 1)	f > 6 13,1 / (f + 1)		

Table D35-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets Nailing pattern 2 & 3

2 Angle Brackets E6/2 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 3**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 2**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 8 For $R_{2/3}$: 11	6	P	2,5	5,0	3,2	5,8
		L	3,0	5,8	3,7	6,7
		M	3,3	6,7	4,2	7,7
		S	3,8	7,5	4,7	8,7
		I	4,6	9,2	5,8	10,6

Table D35-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E6/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
11	1 x Ø10 Bolt	**P**	Min of 10,9 / (f + 27) 13,1, / f		0,6	1,0
		L			0,7	1,2
		M			0,8	1,3
		S			0,9	1,5
		I			1,1	1,8

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41) / 8	0,53
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D35-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E6/2 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
11	1 x Ø10 Bolt	P	3,9	7,7	1,2	2,0
		L	4,6	9,0	1,4	2,3
		M	5,2	9,7	1,6	2,6
		S	5,8	9,7	1,8	3,0
		I	7,2	9,7	2,2	3,7

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,27
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D35-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket Nailing pattern 4 & 5

1 Angle Bracket E6/2 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 8 For $R_{2/3}$: 11	1 x Ø10 Bolt	**P**	Min of 10,9 / (f+27) 13,1, / f		0,6	1,0
		L			0,7	1,2
		M			0,8	1,3
		S			0,9	1,5
		I			1,1	1,8

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41) / 8	0,53
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D35-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets Nailing pattern 4 & 5

2 Angle Brackets E6/2 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 8 For $R_{2/3}$: 11	1 x Ø10 Bolt	P	2,0	4,0	1,2	2,0
		L	2,2	4,6	1,4	2,3
		M	2,6	5,3	1,6	2,6
		S	3,0	5,9	1,8	3,0
		I	3,7	7,3	2,2	3,7

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,27
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

General note to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D36 – E6/2,5

Product Name:

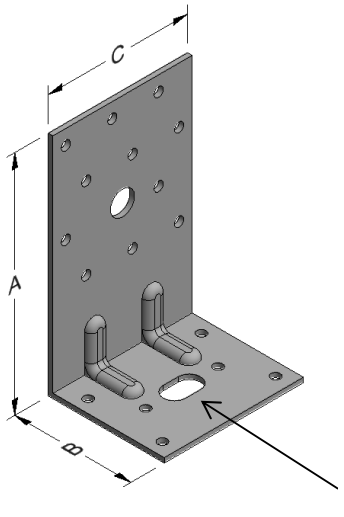
Product Name	Material reference acc. to clause II-1	Alternative product names
E6/2,5	Steel ref. 1	-
E6/2,5S	Steel ref. 2	-
E6/2,5S2	Steel ref. 3	-
E6/2,5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	12x20
E6/2,5	122,5	62,5	75	2,5	11	1	6	1 *)

*) Optional round Hole Ø12

Drawing:



Optional: Round Hole Ø12

Nailing pattern:

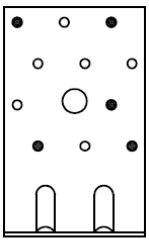
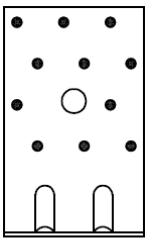
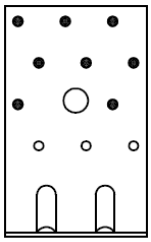
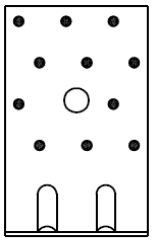
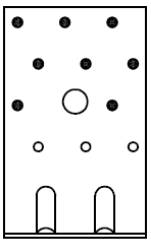
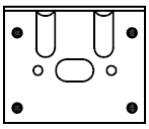
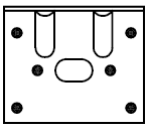
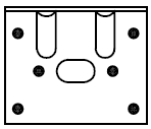
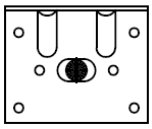
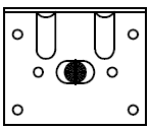
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Minimum nailing	Beam to beam Maximum nailing	Column (A) to beam (B)	Beam (A) to rigid support (B)	Column (A) to rigid support (B)

Table D36-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E6/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
5	4	**P**	f ≤ 92,8 32 / (f + 56)	f ≤ 31,2 65/ (f + 56)	1,2	2,1
			f > 92,8 20,5 / (f + 1)	f > 31,2 20,5 / (f + 1)		
		L	f ≤ 63,6 37 / (f + 56)	f ≤ 24,4 75 / (f + 56)	1,5	2,5
			f > 63,6 20,5 / (f + 1)	f > 24,4 20,5 / (f + 1)		
		M	f ≤ 48,2 43/ (f + 56)	f ≤ 20 87 / (f + 56)	1,7	3,0
			f > 48,2 20,5 / (f + 1)	f > 20 20,5 / (f + 1)		
		S	f ≤ 38,8 49 / (f + 56)	f ≤ 16,8 97 / (f + 56)	1,8	3,3
			f > 38,8 20,5 / (f + 1)	f > 16,8 20,5 / (f + 1)		
		I	f ≤ 27,7 59 / (f + 56)	f ≤ 12,7 120 / (f + 56)	2,2	4,0
			f > 27,7 20,5 / (f + 1)	f > 12,7 20,5 / (f + 1)		

Table D36-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E6/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
11	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 75/ (f + 56)	1,5	2,9
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	1,8	3,3
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 50/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,1	3,9
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	2,4	4,3
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	2,9	5,3
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D36-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E6/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
11	6	P	3,3	3,8	4,3	4,6	5,6	6,2	7,5	8,0
		L	3,9	4,4	5,0	5,3	6,6	7,2	8,8	9,3
		M	4,4	5,0	5,8	6,1	7,5	8,2	10,0	10,6
		S	5,0	5,7	6,5	6,8	8,5	9,3	11,3	12,0
		I	6,1	6,9	7,9	8,4	10,3	11,3	13,8	14,6

Table D36-4 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 2 & 3

1 Angle Bracket E6/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k} \times k_{mod}$ **Nailing pattern 3**		$R_{2/3,k} \times k_{mod}$ **Nailing pattern 2**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 8 For $R_{2/3}$: 11	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 75/ (f + 56)	1,5	2,9
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	1,8	3,4
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 49/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,1	3,9
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	2,4	4,3
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	2,9	5,3
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D36-5 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets Nailing pattern 2 & 3

2 Angle Brackets E6/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	**$R_{1,k}$ x k_{mod} Nailing pattern 3**		**$R_{2/3,k}$ x k_{mod} Nailing pattern 2**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 8 For $R_{2/3}$: 11	6	P	2,5	5,0	3,2	5,8
		L	3,0	5,8	3,7	6,7
		M	3,3	6,7	4,2	7,7
		S	3,8	7,5	4,7	8,7
		I	4,6	9,2	5,8	10,6

Table D36-6 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E6/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 4 Number of fasteners		**Load duration**	**$R_{1,k}$ x k_{mod}**		**$R_{2/3,k}$ x k_{mod}**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
11	1 x Ø10 Bolt	**P**	Min of 14,9 / (f + 27) 20,5 / f		0,6	1,2
		L			0,7	1,4
		M			0,8	1,7
		S			0,9	1,9
		I			1,1	2,2

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D36-7 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E6/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod} 1)			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
11	1 x Ø10 Bolt	P	7,6	7,6	7,6	7,6	3,4	3,9	4,9	5,4
		L	8,8	8,8	8,8	8,8	4,0	4,6	5,7	6,3
		M	10,1	10,1	10,1	10,1	4,6	5,2	6,5	7,2
		S	11,3	11,3	11,3	11,3	5,1	5,9	7,3	8,1
		I	13,9	13,9	13,9	13,9	6,3	7,2	8,9	9,9

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D36-8 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 4 & 5

1 Angle Bracket E6/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 8 For $R_{2/3}$: 11	1 x Ø10 Bolt	**P**	14,9 / (f + 28)		0,6	1,2
		L			0,7	1,4
		M			0,8	1,7
		S			0,9	1,9
		I			1,1	2,2

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D36-9 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets Nailing pattern 4 & 5

2 Angle Brackets E6/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 8 For $R_{2/3}$: 11	1 x Ø10 Bolt	P	2,0	4,0	1,2	2,5
		L	2,2	4,6	1,4	2,8
		M	2,6	5,3	1,6	3,3
		S	3,0	5,9	1,7	3,8
		I	3,7	7,3	2,2	4,6

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General note to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D37 – E7/2,5

Product Name:

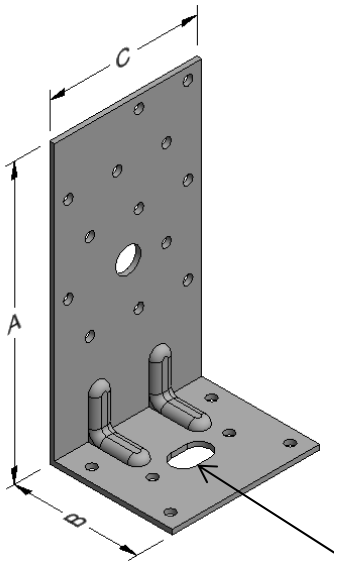
Product Name	Material reference acc. to clause II-1	Alternative product names
E7/2,5	Steel ref. 1	-
E7/2,5S	Steel ref. 2	-
E7/2,5S2	Steel ref. 3	-
E7/2,5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	12x20
E7/2,5	142,5	62,5	75	2,5	13	1	6	1 *)

*) Optional round Hole Ø12

Drawing:



Optional: Round Hole Ø12

Nailing pattern:

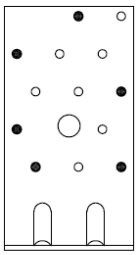
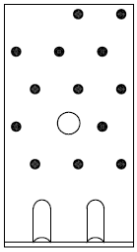
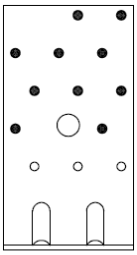
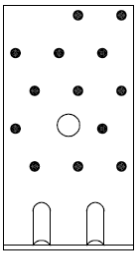
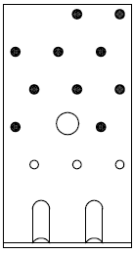
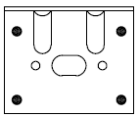
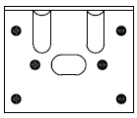
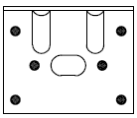
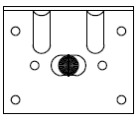
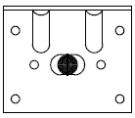
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Minimum nailing	Beam to beam Maximum nailing	Column (A) to beam (B)	Beam (A) to rigid support (B)	Column (A) to rigid support (B)

Table D37-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E7/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
6	4	**P**	f ≤ 92,8 32 / (f + 56)	f ≤ 31,2 65 / (f + 56)	1,3	2,5
			f > 92,8 20,5 / (f + 1)	f > 31,2 20,5 / (f + 1)		
		L	f ≤ 63,6 37 / (f + 56)	f ≤ 24,4 75 / (f + 56)	1,5	2,9
			f > 63,6 20,5 / (f + 1)	f > 24,4 20,5 / (f + 1)		
		M	f ≤ 48,2 43/ (f + 56)	f ≤ 20 87 / (f + 56)	1,7	3,4
			f > 48,2 20,5 / (f + 1)	f > 20 20,5 / (f + 1)		
		S	f ≤ 38,8 49 / (f + 56)	f ≤ 16,8 97 / (f + 56)	1,9	3,8
			f > 38,8 20,5 / (f + 1)	f > 16,8 20,5 / (f + 1)		
		I	f ≤ 27,7 59 / (f + 56)	f ≤ 12,7 119 / (f + 56)	2,3	4,6
			f > 27,7 20,5 / (f + 1)	f > 12,7 20,5 / (f + 1)		

Table D37-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E7/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
13	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 75/ (f + 56)	2,0	3,7
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	2,3	4,4
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 49/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,6	5,0
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	3,0	5,6
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	3,7	6,9
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D37-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E7/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
6	4	P	1,4	1,7	2,8	2,9	2,6	2,8	4,7	5,1
		L	1,7	2,0	3,2	3,4	3,0	3,3	5,5	6,0
		M	1,9	2,2	3,7	3,9	3,4	3,8	6,3	6,8
		S	2,2	2,5	4,1	4,4	3,9	4,2	7,1	7,7
		I	2,6	3,1	5,1	5,4	4,7	5,2	8,7	9,4

Table D37-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E7/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
13	6	P	3,3	3,8	4,3	4,6	6,0	6,5	8,0	8,5
		L	3,9	4,4	5,0	5,3	7,0	7,6	9,3	9,9
		M	4,4	5,0	5,8	6,1	8,0	8,7	10,6	11,4
		S	5,0	5,7	6,5	6,8	9,0	9,8	12,0	12,8
		I	6,1	6,9	7,9	8,4	11,0	12,0	14,6	15,6

Table D37-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 2 & 3

1 Angle Bracket E7/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k} \times k_{mod}$ **Nailing pattern 3**		$R_{2/3,k} \times k_{mod}$ **Nailing pattern 2**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 10 For $R_{2/3}$: 13	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 74/ (f + 56)	1,8	3,7
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	2,1	4,3
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 49/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,5	4,8
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	2,8	5,5
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	3,4	6,7
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D37-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets, Nailing pattern 2 & 3

2 Angle Brackets E7/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 3**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 2**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 10 For $R_{2/3}$: 13	6	P	2,5	5,0	3,7	7,3
		L	2,9	5,8	4,3	8,5
		M	3,3	6,7	4,9	9,8
		S	3,7	7,5	5,6	10,9
		I	4,5	9,2	6,8	13,4

Table D37-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E7/2.5 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4 Number of fasteners		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod} 1)			
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
13	1 x Ø10 Bolt	**P**	19,2 / (f + 28)				0,6	0,7	1,1	1,2
		L					0,7	0,8	1,3	1,4
		M					0,8	0,9	1,4	1,6
		S					0,9	1,0	1,6	1,8
		I					1,1	1,2	2,0	2,2

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D37-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E7/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$ 1)			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
13	1 x Ø10 Bolt	P	7,6	7,6	7,6	7,6	3,4	3,9	4,9	5,4
		L	8,9	8,9	8,9	8,9	4,0	4,6	5,7	6,3
		M	10,2	10,2	10,2	10,2	4,6	5,2	6,5	7,2
		S	11,4	11,4	11,4	11,4	5,1	5,9	7,3	8,1
		I	14,0	14,0	14,0	14,0	6,3	7,2	8,9	9,9

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D37-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 4 & 5

1 Angle Bracket E7/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k} \times k_{mod}$ **Nailing pattern 5**		$R_{2/3,k} \times k_{mod}$ **Nailing pattern 4**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 10 For $R_{2/3}$: 13	1 x Ø10 Bolt	**P**	f ≤ 23,4 8 / f	19,2 / (f + 28)	0,6	1,2
			f > 23,4 19,2 / (f + 28)			
		L	f ≤ 31,9 10 / f		0,7	1,4
			f > 31,9 19,2 / (f + 28)			
		M	f ≤ 43,6 11 / f		0,8	1,7
			f > 43,6 19,2 / (f + 28)			
		S	f ≤ 61,2 13 / f		0,9	1,9
			f > 61,2 19,2 / (f + 28)			
		I	f ≤ 148 16,2 / f		1,1	2,2
			f > 148 19,2 / (f + 28)			

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D37-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets, Nailing pattern 4 & 5

2 Angle Brackets E7/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 10 For $R_{2/3}$: 13	1 x Ø10 Bolt	P	2,0	4,0	1,1	2,5
		L	2,3	4,6	1,4	2,8
		M	2,6	5,3	1,6	3,3
		S	3,0	6,0	1,8	3,7
		I	3,7	7,3	2,2	4,6

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General note to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D38 – E8/2,5

Product Name:

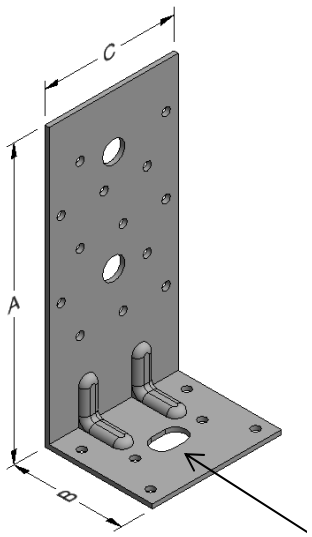
Product Name	Material reference acc. to clause II-1	Alternative product names
E8/2,5	Steel ref. 1	-
E8/2,5S	Steel ref. 2	-
E8/2,5S2	Steel ref. 3	-
E8/2,5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	12x20
E8/2,5	162,5	62,5	75	2,5	13	2	6	1 *)

*) Optional round Hole Ø12

Drawing:



Optional: Round Hole Ø12

Nailing pattern:

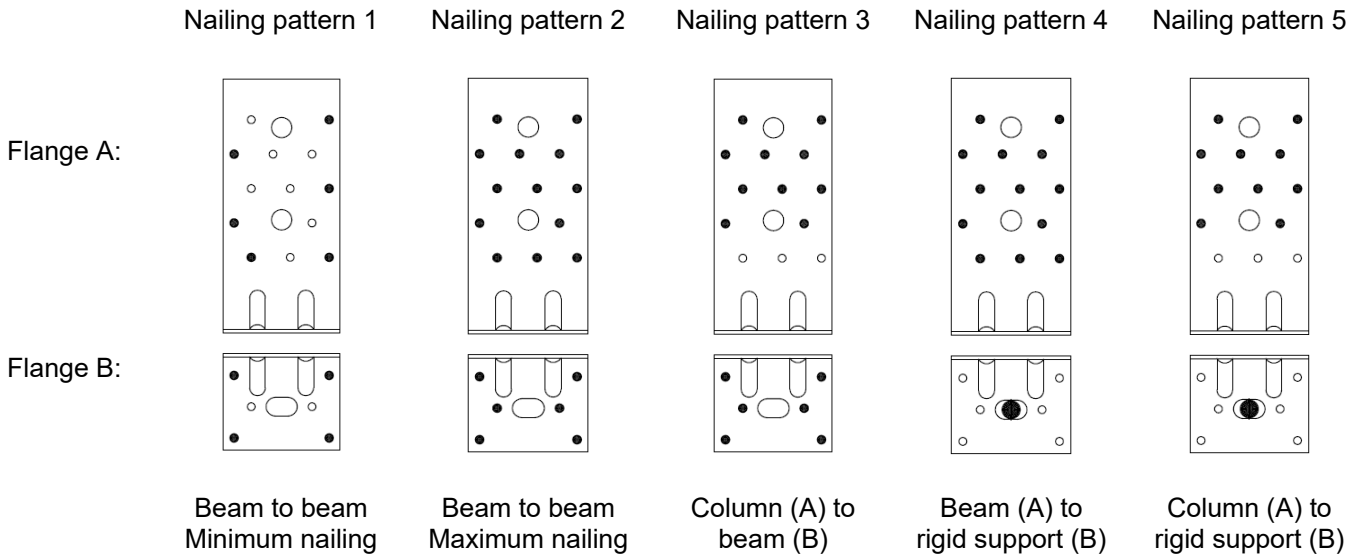


Table D38-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E8/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
6	4	**P**	f ≤ 92,8 32 / (f + 56)	f ≤ 31,2 65 / (f + 56)	1,3	2,5
			f > 92,8 20,5 / (f + 1)	f > 31,2 20,5 / (f + 1)		
		L	f ≤ 63,6 37 / (f + 56)	f ≤ 24,4 75 / (f + 56)	1,5	2,9
			f > 63,6 20,5 / (f + 1)	f > 24,4 20,5 / (f + 1)		
		M	f ≤ 48,2 43/ (f + 56)	f ≤ 20 87 / (f + 56)	1,7	3,4
			f > 48,2 20,5 / (f + 1)	f > 20 20,5 / (f + 1)		
		S	f ≤ 38,8 49 / (f + 56)	f ≤ 16,8 97 / (f + 56)	1,9	3,8
			f > 38,8 20,5 / (f + 1)	f > 16,8 20,5 / (f + 1)		
		I	f ≤ 27,7 59 / (f + 56)	f ≤ 12,7 119 / (f + 56)	2,3	4,6
			f > 27,7 20,5 / (f + 1)	f > 12,7 20,5 / (f + 1)		

Table D38-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E8/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
13	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 75/ (f + 56)	2,0	3,7
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	2,3	4,4
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 49/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,6	5,0
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	3,0	5,6
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	3,7	6,9
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D38-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E8/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
6	4	P	1,4	1,7	2,5	2,6	2,6	2,8	4,8	5,1
		L	1,7	2,0	2,9	3,0	3,0	3,3	5,6	6,0
		M	1,9	2,2	3,3	3,4	3,4	3,8	6,4	6,8
		S	2,2	2,5	3,7	3,9	3,9	4,2	7,2	7,7
		I	2,6	3,1	4,5	4,7	4,7	5,2	8,8	9,4

Table D38-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets E8/2,5 Nailing pattern 2

2 Angle Brackets E8/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
13	6	P	3,3	3,8	4,3	4,6	6,0	6,5	8,0	8,5
		L	3,9	4,4	5,0	5,3	7,0	7,6	9,3	9,9
		M	4,4	5,0	5,8	6,1	8,0	8,7	10,6	11,4
		S	5,0	5,7	6,5	6,8	9,0	9,8	12,0	12,8
		I	6,1	6,9	7,9	8,4	11,0	12,0	14,6	15,6

Table D38-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 2 & 3

1 Angle Bracket E8/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k} \times k_{mod}$ **Nailing pattern 3**		$R_{2/3,k} \times k_{mod}$ **Nailing pattern 2**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 10 For $R_{2/3}$: 13	6	**P**	f ≤ 65,9 37 / (f + 56)	f ≤ 25 74/ (f + 56)	1,8	3,7
			f > 65,9 20,5 / (f + 1)	f > 25 20,5 / (f + 1)		
		L	f ≤ 47,8 43 / (f + 56)	f ≤ 19,8 87 / (f + 56)	2,1	4,3
			f > 47,8 20,5 / (f + 1)	f > 19,8 20,5 / (f + 1)		
		M	f ≤ 37,4 49/ (f + 56)	f ≤ 16,3 99 / (f + 56)	2,5	4,8
			f > 37,4 20,5 / (f + 1)	f > 16,3 20,5 / (f + 1)		
		S	f ≤ 30,6 56 / (f + 56)	f ≤ 13,9 112 / (f + 56)	2,8	5,5
			f > 30,6 20,5 / (f + 1)	f > 13,9 20,5 / (f + 1)		
		I	f ≤ 22,3 68 / (f + 56)	f ≤ 10,5 136 / (f + 56)	3,4	6,7
			f > 22,3 20,5 / (f + 1)	f > 10,5 20,5 / (f + 1)		

Table D38-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets Nailing pattern 2 & 3

2 Angle Brackets E8/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	**$R_{1,k}$ x k_{mod} Nailing pattern 3**		**$R_{2/3,k}$ x k_{mod} Nailing pattern 2**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 10 For $R_{2/3}$: 13	6	P	2,5	5,0	3,7	7,3
		L	2,9	5,8	4,3	8,5
		M	3,3	6,7	4,9	9,8
		S	3,7	7,5	5,6	10,9
		I	4,5	9,2	6,8	13,4

Table D38-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E8/2.5 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	**$R_{1,k}$ x k_{mod}**				**$R_{2/3,k}$ x k_{mod}** 1)			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
13	1 x Ø10 Bolt	**P**	19,2 / (f + 28)				0,6	0,7	1,1	1,2
		L					0,7	0,8	1,3	1,4
		M					0,8	0,9	1,4	1,6
		S					0,9	1,0	1,6	1,8
		I					1,1	1,2	2,0	2,2

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D38-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E8/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$ 1)			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
13	1 x Ø10 Bolt	P	7,6	7,6	7,6	7,6	3,4	3,9	4,9	5,4
		L	8,9	8,9	8,9	8,9	4,0	4,6	5,7	6,3
		M	10,2	10,2	10,2	10,2	4,6	5,2	6,5	7,2
		S	11,4	11,4	11,4	11,4	5,1	5,9	7,3	8,1
		I	14,0	14,0	14,0	14,0	6,3	7,2	8,9	9,9

Note: 1) only available for connection in a round hole, not with the version with oblong hole.

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D38-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 4 & 5

1 Angle Bracket E8/2.5 per connection			**Modified characteristic capacity (kN)**			
Number of fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
For R_1: 10 For $R_{2/3}$: 13	1 x Ø10 Bolt	**P**	f ≤ 23,4 8 / f	19,2 / (f + 28)	0,6	1,2
			f > 23,4 19,2 / (f + 28)			
		L	f ≤ 31,9 10 / f		0,7	1,4
			f > 31,9 19,2 / (f + 28)			
		M	f ≤ 43,6 11 / f		0,8	1,7
			f > 43,6 19,2 / (f + 28)			
		S	f ≤ 61,2 13 / f		0,9	1,9
			f > 61,2 19,2 / (f + 28)			
		I	f ≤ 148 16,2 / f		1,1	2,2
			f > 148 19,2 / (f + 28)			

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 41,5) / 8	1,87
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D38-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets Nailing pattern 4 & 5

2 Angle Brackets E8/2.5 per connection			**Modified characteristic capacities (kN)**			
Number of Fasteners		**Load duration**	$R_{1,k}$ x k_{mod} **Nailing pattern 5**		$R_{2/3,k}$ x k_{mod} **Nailing pattern 4**	
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
For R_1: 10 For $R_{2/3}$: 13	1 x Ø10 Bolt	P	2,0	4,0	1,1	2,5
		L	2,3	4,6	1,4	2,8
		M	2,6	5,3	1,6	3,3
		S	3,0	6,0	1,8	3,7
		I	3,7	7,3	2,2	4,6

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	1,02	0,93
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General note to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D39 – E14/2

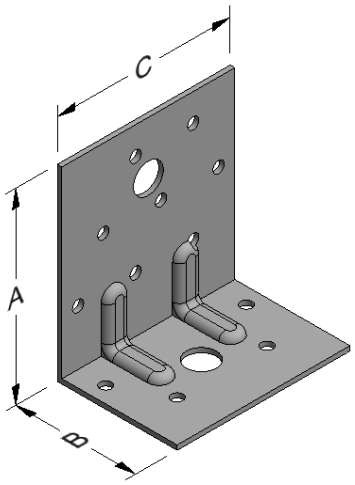
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E14/2	Steel ref. 1	-
E14/2S	Steel ref. 2	-
E14/2S2	Steel ref. 3	-
E14/2Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
E14/2	82	52	75	2,0	8	1	4	1

Drawing:



Nailing pattern:

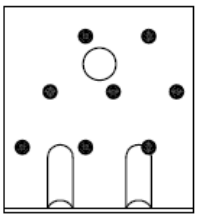
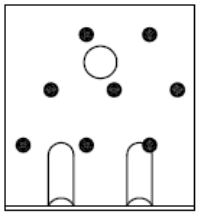
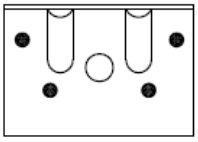
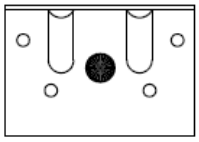
	Nailing pattern 1	Nailing pattern 2
Flange A:		
Flange B:		
	Beam to beam Maximum nailing	Beam (A) to rigid support (B)

Table D39-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E14/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
4	8	**P**	f ≤ 65,3 20 / (f + 39)	f ≤ 21,6 40 / (f + 39)	1,6	2,8
			f > 65,3 13,1 / (f + 1)	f > 21,6 13,1 / (f + 1)		
		L	f ≤ 44,5 23 / (f + 39)	f ≤ 16,9 47 / (f + 39)	1,8	3,4
			f > 44,5 13,1 / (f + 1)	f > 16,9 13,1 / (f + 1)		
		M	f ≤ 33,6 27/ (f + 39)	f ≤ 13,8 54 / (f + 39)	2,1	3,8
			f > 33,6 13,1 / (f + 1)	f > 13,8 13,1 / (f + 1)		
		S	f ≤ 27 31 / (f + 39)	f ≤ 11,6 61 / (f + 39)	2,4	4,4
			f > 27 13,1 / (f + 1)	f > 11,6 13,1 / (f + 1)		
		I	f ≤ 19,2 37 / (f + 39)	f ≤ 8,7 75 / (f + 39)	2,9	5,3
			f > 19,2 13,1 / (f + 1)	f > 8,7 13,1 / (f + 1)		

Table D39-2 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E14/2 per connection			Modified characteristic capacities (kN)			
Nailing pattern 1		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
4	8	P	2,5	5,0	3,2	5,8
		L	2,9	5,8	3,7	6,8
		M	3,3	6,7	4,3	7,7
		S	3,7	7,5	4,8	8,7
		I	4,5	9,2	5,9	10,7

Table D39-3 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket E14/2 Nailing pattern 2

1 Angle Bracket E14/2 per connection			Modified characteristic capacity (kN)		
Nailing pattern 2		Load duration	$R_{1,k} \times k_{mod}$	$R_{2/3,k} \times k_{mod}$	
Number of fasteners					
Flange A	Flange B		4,0x35 4,0x60	4,0x35	4,0x60
8	1 x Ø12 Bolt	**P**	Min of:	1,0	2,0
		L		1,1	2,4
		M	26,5 / (f + 17)	1,4	2,8
		S		1,5	3,1
		I	11,3 / f	1,8	8,0

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 33) / 9	1,04
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D39-4 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E14/2 per connection			Modified characteristic capacities (kN)			
Nailing pattern 2		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
8	1 x Ø12 Bolt	P	2,1	4,2	2,0	4,2
		L	2,5	4,9	2,3	4,8
		M	2,8	5,6	2,7	5,5
		S	3,2	6,4	3,1	6,3
		I	3,9	6,9	3,7	7,6

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,99	0,52
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General note to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D40 – E17/2

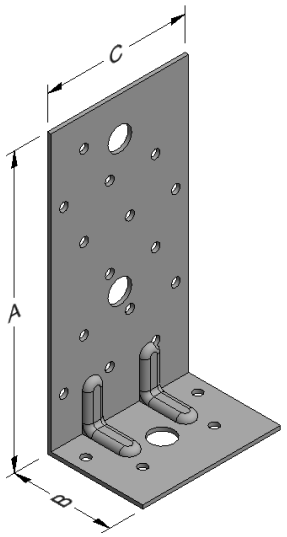
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E17/2	Steel ref. 1	-
E17/2S	Steel ref. 2	-
E17/2S2	Steel ref. 3	-
E17/2Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
E17/2	152	52	75	2,0	15	2	4	1

Drawing:



Nailing pattern:

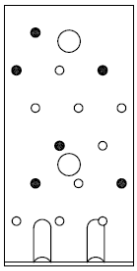
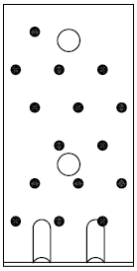
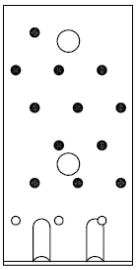
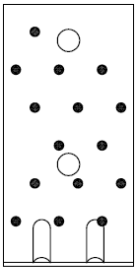
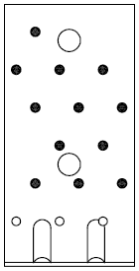
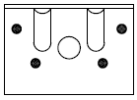
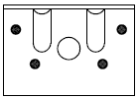
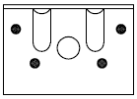
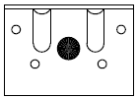
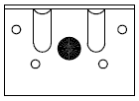
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Minimum nailing	Beam to beam Maximum nailing	Column (A) to beam (B)	Beam (A) to rigid support (B)	Column (A) to rigid support (B)

Table D40-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E17/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
6	4	**P**	f ≤ 65,3 20 / (f + 39)	f ≤ 21,6 40 / (f + 39)	1,2	2,3
			f > 65,3 13,1 / (f + 1)	f > 21,6 13,1 / (f + 1)		
		L	f ≤ 44,5 23 / (f + 39)	f ≤ 16,9 47 / (f + 39)	1,4	2,7
			f > 44,5 13,1 / (f + 1)	f > 16,9 13,1 / (f + 1)		
		M	f ≤ 33,6 27 / (f + 39)	f ≤ 13,8 54 / (f + 39)	1,7	3,1
			f > 33,6 13,1 / (f + 1)	f > 13,8 13,1 / (f + 1)		
		S	f ≤ 27 31 / (f + 39)	f ≤ 11,6 61 / (f + 39)	1,9	3,5
			f > 27 13,1 / (f + 1)	f > 11,6 13,1 / (f + 1)		
		I	f ≤ 19,2 37 / (f + 39)	f ≤ 8,7 75 / (f + 39)	2,3	4,3
			f > 19,2 13,1 / (f + 1)	f > 8,7 13,1 / (f + 1)		

Table D40-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E17/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
15	4	**P**	f ≤ 65,3 20 / (f + 39)	f ≤ 21,6 40 / (f + 39)	2,1	3,6
			f > 65,3 13,1 / (f + 1)	f > 21,6 13,1 / (f + 1)		
		L	f ≤ 44,5 23 / (f + 39)	f ≤ 16,9 47 / (f + 39)	2,4	4,1
			f > 44,5 13,1 / (f + 1)	f > 16,9 13,1 / (f + 1)		
		M	f ≤ 33,6 37 / (f + 39)	f ≤ 13,8 54 / (f + 39)	2,8	4,7
			f > 33,6 13,1 / (f + 1)	f > 13,8 13,1 / (f + 1)		
		S	f ≤ 27 31 / (f + 39)	f ≤ 11,6 61 / (f + 39)	3,1	5,3
			f > 27 13,1 / (f + 1)	f > 11,6 13,1 / (f + 1)		
		I	f ≤ 19,2 37 / (f + 39)	f ≤ 8,7 75 / (f + 39)	3,8	6,5
			f > 19,2 13,1 / (f + 1)	f > 8,7 13,1 / (f + 1)		

Table D40-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E17/2 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
6	4	P	2,5	2,8	4,5	5,0	2,6	2,8	4,4	4,7
		L	2,9	3,3	5,3	5,8	3,0	3,3	5,1	5,5
		M	3,3	3,8	6,0	6,6	3,4	3,8	5,8	6,2
		S	3,7	4,2	6,8	7,5	3,9	4,2	6,6	7,0
		I	4,5	5,2	8,3	9,1	4,7	5,2	8,0	8,6

Table D40-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E17/2 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
15	4	P	2,9	3,4	4,0	4,4	4,9	5,4	6,5	7,0
		L	3,4	3,9	4,7	5,2	5,7	6,3	7,6	8,1
		M	3,9	4,5	5,4	5,9	6,6	7,2	8,7	9,3
		S	4,4	5,0	6,0	6,7	7,4	8,1	9,8	10,4
		I	5,4	6,2	7,4	8,1	9,0	9,9	12,0	12,8

Table D40-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 3

1 Angle Bracket E17/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 3		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	4	**P**	f ≤ 65,3 21 / (f + 39)	f ≤ 21,6 40 / (f + 39)	2,0	3,4
			f > 65,3 13,1 / (f + 1)	f > 21,6 13,1 / (f + 1)		
		L	f ≤ 44,5 23 / (f + 39)	f ≤ 16,9 47 / (f + 39)	2,3	4
			f > 44,5 13,1 / (f + 1)	f > 16,9 13,1 / (f + 1)		
		M	f ≤ 33,6 27 / (f + 39)	f ≤ 13,8 54 / (f + 39)	2,6	4,6
			f > 33,6 13,1 / (f + 1)	f > 13,8 13,1 / (f + 1)		
		S	f ≤ 27 31 / (f + 39)	f ≤ 11,6 61 / (f + 39)	3,0	5,1
			f > 27 13,1 / (f + 1)	f > 11,6 13,1 / (f + 1)		
		I	f ≤ 19,2 37 / (f + 39)	f ≤ 8,7 75 / (f + 39)	3,7	6,3
			f > 19,2 13,1 / (f + 1)	f > 8,7 13,1 / (f + 1)		

Table D40-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets E17/2 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 3		**Load duration**	**$R_{1,k}$ x k_{mod}**		**$R_{2/3,k}$ x k_{mod}**	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	4	P	2,5	5,0	4,0	6,8
		L	2,9	5,8	4,6	8,0
		M	3,3	6,7	5,4	9,1
		S	3,7	7,5	6,0	10,2
		I	4,5	9,2	7,4	12,6

Table D40-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E17/2 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	**$R_{1,k}$ x k_{mod}**				**$R_{2/3,k}$ x k_{mod}**			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	Min of:				1,0	1,2	1,9	2,1
		L					1,2	1,4	2,2	2,5
		M	26,5 / (f +17)				1,4	1,6	2,5	2,8
		S					1,5	1,8	2,8	3,2
		I	11,3 / f				1,9	2,2	3,4	3,9

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 33) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D40-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E17/2 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod}			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	15,2				3,5	4,0	5,0	5,6
		L					4,1	4,6	5,8	6,6
		M					4,6	5,3	6,6	7,5
		S					5,2	5,9	7,5	8,5
		I					6,4	7,3	9,1	10,3

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,99	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D40-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 5

1 Angle Bracket E17/2 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	1 x Ø10 Bolt	**P**	Min of: 26,5 / (f + 17) 11,3 / f		1,0	1,7
		L			1,2	1,9
		M			1,4	2,2
		S			1,5	2,5
		I			1,9	3,1

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 33) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D40-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets, Nailing pattern 5

2 Angle Brackets E17/2 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	1 x Ø10 Bolt	P	6,1	11,7	2,0	3,4
		L	7,1	13,6	2,4	3,9
		M	8,2	14,2	2,8	4,5
		S	9,2	14,2	3,1	5,1
		I	11,2	14,2	3,8	6,2

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,99	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D41 – E18/2,5

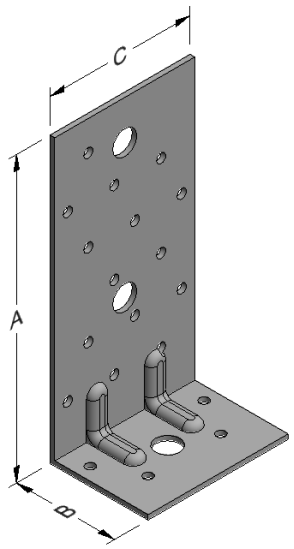
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E18/2,5	Steel ref. 1	-
E18/2,5S	Steel ref. 2	-
E18/2,5S2	Steel ref. 3	-
E18/2,5Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
E18/2,5	152,5	52,5	75	2,5	15	2	4	1

Drawing:



Nailing pattern:

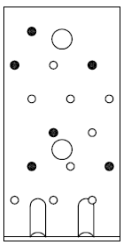
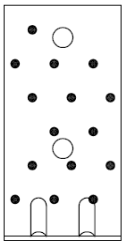
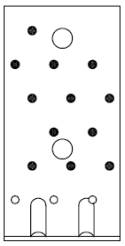
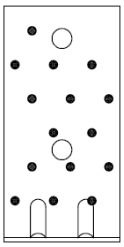
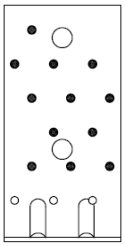
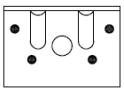
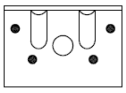
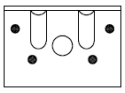
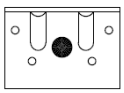
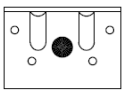
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Minimum nailing	Beam to beam Maximum nailing	Column (A) to beam (B)	Beam (A) to rigid support (B)	Column (A) to rigid support (B)

Table D41-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E18/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
6	4	**P**	f ≤ 5721 20 / (f + 39)	f ≤ 52,3 40 / (f + 39)	1,5	2,7
			f > 5721 20,5 / (f + 1)	f > 52,3 20,5 / (f + 1)		
		L	f ≤ 218 23 / (f + 39)	f ≤ 37 47 / (f + 39)	1,7	3,1
			f > 218 20,5 / (f + 1)	f > 37 20,5 / (f + 1)		
		M	f ≤ 110,5 27 / (f + 39)	f ≤ 28,5 54 / (f + 39)	2	3,5
			f > 110,5 20,5 / (f + 1)	f > 28,5 20,5 / (f + 1)		
		S	f ≤ 73,7 31 / (f + 39)	f ≤ 23,1 61 / (f + 39)	2,3	3,9
			f > 73,7 20,5 / (f + 1)	f > 23,1 20,5 / (f + 1)		
		I	f ≤ 44 37 / (f + 39)	f ≤ 16,6 75 / (f + 39)	2,8	4,8
			f > 44 20,5 / (f + 1)	f > 16,6 20,5 / (f + 1)		

Table D41-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E18/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
15	4	**P**	f ≤ 5721 20 / (f + 39)	f ≤ 52,3 40 / (f + 39)	2,4	4,3
			f > 5721 20,5 / (f + 1)	f > 52,3 20,5 / (f + 1)		
		L	f ≤ 218 23 / (f + 39)	f ≤ 37 47 / (f + 39)	2,8	5
			f > 218 20,5 / (f + 1)	f > 37 20,5 / (f + 1)		
		M	f ≤ 110,5 37 / (f + 39)	f ≤ 28,5 54 / (f + 39)	3,2	5,8
			f > 110,5 20,5 / (f + 1)	f > 28,5 20,5 / (f + 1)		
		S	f ≤ 73,7 31 / (f + 39)	f ≤ 23,1 61 / (f + 39)	3,7	6,5
			f > 73,7 20,5 / (f + 1)	f > 23,1 20,5 / (f + 1)		
		I	f ≤ 44 37 / (f + 39)	f ≤ 16,6 75 / (f + 39)	4,5	8,0
			f > 44 20,5 / (f + 1)	f > 16,6 20,5 / (f + 1)		

Table D41-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E18/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
6	4	P	2,5	2,9	4,5	5,0	3,0	3,2	4,9	5,3
		L	2,9	3,4	5,3	5,8	3,5	3,8	5,7	6,2
		M	3,3	3,8	6,0	6,6	4,0	4,3	6,6	7,1
		S	3,7	4,3	6,8	7,5	4,5	4,9	7,4	8,0
		I	4,5	5,3	8,3	9,1	5,5	5,9	9,0	9,8

Table D41-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E18/2.5 per connection			**Modified characteristic capacities (kN)**							
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
15	4	P	2,9	3,4	4,0	4,4	4,9	5,3	6,5	7,0
		L	3,4	3,9	4,7	5,2	5,7	6,2	7,6	8,1
		M	3,9	4,5	5,4	5,9	6,6	7,1	8,6	9,3
		S	4,4	5,0	6,0	6,7	7,4	8,0	9,7	10,4
		I	5,4	6,2	7,4	8,1	9,0	9,8	11,9	12,8

Table D41-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 3

1 Angle Bracket E18/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 3		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	4	**P**	f ≤ 235,5 20 / (f + 39)	f ≤ 37,9 40 / (f + 39)	2,0	3,6
			f > 235,5 17 / (f + 1)	f > 37,9 17 / (f + 1)		
		L	f ≤ 106,5 23 / (f + 39)	f ≤ 28 47 / (f + 39)	2,4	4,1
			f > 106,5 17 / (f + 1)	f > 28 17 / (f + 1)		
		M	f ≤ 68,5 27 / (f + 39)	f ≤ 22,1 54 / (f + 39)	2,8	4,7
			f > 68,5 17 / (f + 1)	f > 22,1 17 / (f + 1)		
		S	f ≤ 50,3 31 / (f + 39)	f ≤ 18,2 61 / (f + 39)	3,1	5,4
			f > 50,3 17 / (f + 1)	f > 18,2 17 / (f + 1)		
		I	f ≤ 32,6 37 / (f + 39)	f ≤ 13,3 75 / (f + 39)	3,8	6,5
			f > 32,6 17 / (f + 1)	f > 13,3 17 / (f + 1)		

Table D41-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets E18/2.5 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 3		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	4	P	2,5	5,0	4,1	7,1
		L	2,9	5,8	4,8	8,3
		M	3,3	6,7	5,5	9,5
		S	3,7	7,6	6,2	10,7
		I	4,5	9,2	7,7	13,0

Table D41-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E18/2.5 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod}			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	Min of: 56,6 / (f +18) ; 17 / f				1,8	2,1	3,4	3,8
		L					2,1	2,5	3,9	4,4
		M					2,4	2,8	4,5	5,0
		S					2,7	3,2	5,0	5,7
		I					3,3	3,9	6,2	6,9

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 33,5) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D41-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E18/2.5 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	12,3	12,3	12,3	12,3	4,9	5,6	7,0	7,9
		L	14,4	14,4	14,4	14,4	5,7	6,5	8,1	9,2
		M	16,4	16,4	16,4	16,4	6,5	7,4	9,3	10,5
		S	18,5	18,5	18,5	18,5	7,3	8,4	10,4	11,8
		I	22,6	22,6	22,6	22,6	8,9	10,2	12,8	14,4

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,98	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D41-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 5

1 Angle Bracket E18/2.5 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	1 x Ø10 Bolt	**P**	Min of:		1,0	2,0
		L			1,1	2,4
		M	56,5 / (f + 18)		1,3	2,8
		S			1,5	3,1
		I	17,7 / f		1,8	3,8

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 33,5) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D41-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets, Nailing pattern 5

2 Angle Brackets E18/2.5 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	1 x Ø10 Bolt	P	6,0	11,4	2,0	4,2
		L	7,0	13,4	2,3	4,9
		M	8,0	15,4	2,7	5,6
		S	9,0	17,3	3,1	6,3
		I	11,0	19,3	3,7	7,7

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,98	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

Annex D42 – E19/3

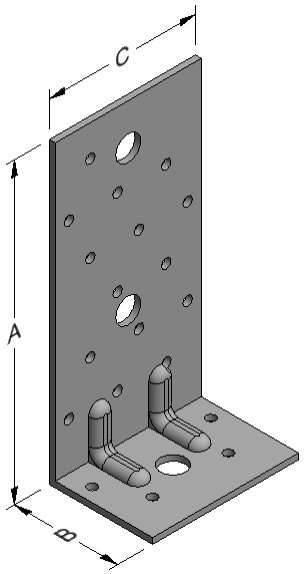
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
E19/3	Steel ref. 1	-
E19/3S	Steel ref. 2	-
E19/3S2	Steel ref. 3	-
E19/3Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
E19/3	153	53	75	3,0	15	2	4	1

Drawing:



Nailing pattern:

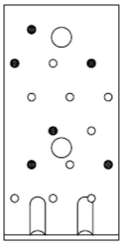
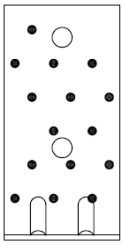
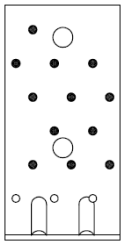
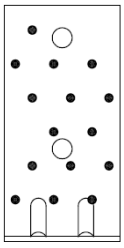
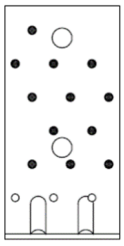
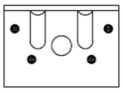
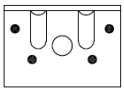
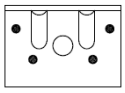
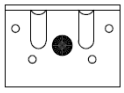
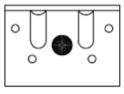
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4	Nailing pattern 5
Flange A:					
Flange B:					
	Beam to beam Minimum nailing	Beam to beam Maximum nailing	Column (A) to beam (B)	Beam (A) to rigid support (B)	Column (A) to rigid support (B)

Table D42-1 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 1

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 1		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
6	4	**P**	20 / (f + 40)	f ≤ 200,6: 40 / (f + 40) f > 200,6: 34,6 / (f + 2)	1,5	2,6
		L	23 / (f + 40)	f ≤ 97,5: 47 / (f + 40) f > 97,5: 34,6 / (f + 2)	1,7	3,0
		M	27 / (f + 40)	f ≤ 64,1: 54 / (f + 40) f > 64,1: 34,6 / (f + 2)	2,0	3,5
		S	31 / (f + 40)	f ≤ 47,5: 61 / (f + 40) f > 47,5: 34,6 / (f + 2)	2,3	3,9
		I	37 / (f + 40)	f ≤ 31,1: 75 / (f + 40) f > 31,1: 34,6 / (f + 2)	2,8	4,8

Table D42-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket, Nailing pattern 2

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 2		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
15	4	**P**	20 / (f + 40)	f ≤ 200,6: 40 / (f + 40) f > 200,6: 34,6 / (f + 2)	2,4	4,3
		L	23 / (f + 40)	f ≤ 97,5: 47 / (f + 40) f > 97,5: 34,6 / (f + 2)	2,8	5,0
		M	27 / (f + 40)	f ≤ 64,1: 54 / (f + 40) f > 64,1: 34,6 / (f + 2)	3,2	5,7
		S	31 / (f + 40)	f ≤ 47,5: 61 / (f + 40) f > 47,5: 34,6 / (f + 2)	3,6	6,4
		I	37 / (f + 40)	f ≤ 31,1: 75 / (f + 40) f > 31,1: 34,6 / (f + 2)	4,4	7,9

Table D42-3 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 1

2 Angle Brackets E19/3 per connection			Modified characteristic capacities (kN)							
Nailing pattern 1		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
6	4	P	2,5	2,9	4,5	5,0	3,0	3,2	4,9	5,3
		L	2,9	3,4	5,3	5,8	3,5	3,8	5,7	6,2
		M	3,3	3,8	6,0	6,6	4,0	4,3	6,6	7,1
		S	3,7	4,3	6,8	7,5	4,5	4,9	7,4	8,0
		I	4,5	5,3	8,3	9,1	5,5	5,9	9,0	9,8

Table D42-4 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets, Nailing pattern 2

2 Angle Brackets E19/3 per connection			Modified characteristic capacities (kN)							
Nailing pattern 2		Load duration	$R_{1,k} \times k_{mod}$				$R_{2/3,k} \times k_{mod}$			
Number of Fasteners										
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60
15	4	P	2,9	3,4	4,0	4,4	4,9	5,3	6,4	6,9
		L	3,4	3,9	4,7	5,2	5,7	6,2	7,5	8,1
		M	3,9	4,5	5,4	5,9	6,5	7,0	8,6	9,2
		S	4,4	5,0	6,0	6,7	7,3	7,9	9,6	10,4
		I	5,4	6,2	7,4	8,1	8,9	9,7	11,8	12,7

Table D42-5 Modified characteristic capacity timber column to timber beam – 1 Angle Bracket, Nailing pattern 3

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 3		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	4	**P**	20 / (f + 40)	f ≤ 101,5 41 / (f + 40) f > 101,5 25,5 / (f + 2)	1,9	3,4
		L	23/ (f + 40)	f ≤ 62,4 47 / (f + 40) f > 62,4 25,5 / (f + 2)	2,2	4,0
		M	23/ (f + 40)	f ≤ 44,8 54 / (f + 40) f > 44,8 25,5 / (f + 2)	2,6	4,6
		S	f ≤ 181,9 31 / (f + 40) f > 181,9 25 / (f + 2)	f ≤ 34,8 61 / (f + 40) f > 34,8 25,5 / (f + 2)	2,9	5,2
		I	f ≤ 78,9 37 / (f + 40) f > 78,9 25 / (f + 2)	f ≤ 23,9 75 / (f + 40) f > 23,9 25,5 / (f + 2)	3,5	6,3

Table D42-6 Modified characteristic capacity timber column to timber beam – 2 Angle Brackets, Nailing pattern 3

2 Angle Brackets E19/3 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 3		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	4	P	2,5	5,0	3,9	6,9
		L	2,9	5,8	4,5	8,1
		M	3,3	6,7	5,1	9,1
		S	3,7	7,5	5,8	10,3
		I	4,5	9,2	7,1	12,7

Table D42-7 Modified characteristic capacity timber beam to rigid support – 1 Angle Bracket, Nailing pattern 4

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod}			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	Min of: 65,6 / (f +18) 25,5 / f				1,8	2,0	3,3	3,7
		L					2,1	2,4	3,9	4,3
		M					2,4	2,7	4,4	5,0
		S					2,7	3,1	5,0	5,6
		I					3,3	3,7	6,1	6,8

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 34) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D42-8 Modified characteristic capacity timber beam to rigid support – 2 Angle Brackets, Nailing pattern 4

2 Angle Brackets E19/3 per connection			**Modified characteristic capacity (kN)**							
Nailing pattern 4		**Load duration**	$R_{1,k}$ x k_{mod}				$R_{2/3,k}$ x k_{mod}			
Number of fasteners										
Flange A	Flange B		4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
15	1 x Ø10 Bolt	**P**	16,9	16,9	16,9	16,9	4,9	5,5	7,0	7,8
		L	19,7	19,7	19,7	19,7	5,7	6,4	8,1	9,1
		M	22,5	22,5	22,5	22,5	6,5	7,4	9,3	10,4
		S	25,3	25,3	25,3	25,3	7,3	8,3	10,4	11,7
		I	30,9	30,9	30,9	30,9	8,9	10,1	12,8	14,3

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,99	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

Table D42-9 Modified characteristic capacity timber column to rigid support – 1 Angle Bracket, Nailing pattern 5

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k}$ x k_{mod}		$R_{2/3,k}$ x k_{mod}	
Number of fasteners						
Flange A	Flange B		4,0x35	4,0x60	4,0x35	4,0x60
12	1 x Ø10 Bolt	**P**	Min of: 17,6 / f 65,6 / (f + 18)	Min of: 25,5 / f 65,6 / (f + 18)	1,7	3,2
		L	Min of: 20,6 / f 65,6 / (f + 18)		2,0	3,7
		M	Min of: 23,6 / f 65,6 / (f + 18)		2,3	4,3
		S	Min of: 25,5 / f 65,6 / (f + 18)		2,6	4,8
		I	Min of: 25,5 / f 65,6 / (f + 18)		3,2	5,9

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	(f + 34) / 9	1,82
k_{lat}	-	1,00

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat}$ x $F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax}$ x $F_{i,d}$; and also the combination

Table D42-10 Modified characteristic capacity timber column to rigid support – 2 Angle Brackets, Nailing pattern 5

2 Angle Brackets E19/3 per connection			**Modified characteristic capacities (kN)**			
Nailing pattern 5		**Load duration**	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$	
Number of Fasteners						
Flange A	Flange B		CNA4,0x35	CNA4,0x60	CNA4,0x35	CNA4,0x60
12	1 x Ø10 Bolt	P	6,0	11,5	3,5	6,4
		L	7,0	13,4	4,1	7,5
		M	8,0	15,4	4,7	8,6
		S	9,0	17,3	5,3	9,7
		I	11,0	19,1	6,5	11,8

Bolt factor	for F_1	for $F_{2/3}$
k_{ax}	0,99	0,91
k_{lat}	-	0,50

For each bolt it´s needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination

General notes to all capacity tables:

- b, e and f are in mm.
- Wane may not occur under the angle bracket.

For the following tables D42-11 to D42-14: The rotation of the supported member shall be blocked

Table D42-11 Modified characteristic capacity timber column to rigid support – 1 Angle Brackets, Nailing pattern 4

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**						
Nailing pattern 4		**Load duration**	$R_{5,k} \times k_{mod}$						
Number of fasteners									
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5.0x35	CSA5.0x40	CSA5.0x50
15	1 x Ø10 Bolt	**P**	4,9	5,5	6,7	7,7	8,8		
		L	5,4	6,2	7,5	7,7			
		M	6,0	6,8	7,7	7,7			
		S	6,5	7,3	7,7	7,7			
		I	7,4	7,7	7,7	7,7			

Bolt factor	for F_5
k_{ax}	2,1
k_{lat}	1

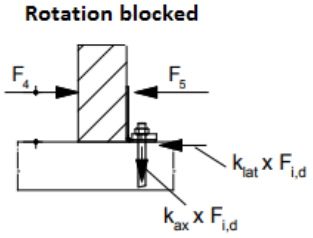


Table D42-12 Modified characteristic capacity timber column to rigid support – 1 Angle Brackets, Nailing pattern 5

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**						
Nailing pattern 5		**Load duration**	$R_{5,k} \times k_{mod}$						
Number of fasteners									
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5.0x35	CSA5.0x40	CSA5.0x50
12	1 x Ø10 Bolt	**P**	3,7	4,2	5,0	5,7	7,0	8,8	
		L	4,1	4,6	5,5	6,4	7,7		
		M	4,5	5,1	6,1	7,0	7,7		
		S	4,9	5,5	6,6	7,6	7,7		
		I	5,7	6,4	7,6	7,7	7,7		

Bolt factor	for F_5
k_{ax}	3,3
k_{lat}	1

Table D42-13 Modified characteristic capacity timber column to rigid support – 1 Angle Brackets, Nailing pattern 4

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**						
Nailing pattern 4		**Load duration**	$R_{4,k} \times k_{mod}$						
Number of fasteners									
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5.0x35	CSA5.0x40	CSA5.0x50
15	1 x Ø10 Bolt	**P**	7,5						
		L	8,0						
		M	8,5						
		S	8,9						
		I	9,8						

Bolt factor	for F_4
k_{ax}	1,8
k_{lat}	1

Table D42-14 Modified characteristic capacity timber column to rigid support – 1 Angle Brackets, Nailing pattern 5

1 Angle Bracket E19/3 per connection			**Modified characteristic capacity (kN)**						
Nailing pattern 5		**Load duration**	$R_{4,k} \times k_{mod}$						
Number of fasteners									
Flange A	Flange B		CNA4,0x35	CNA4,0x40	CNA4,0x50	CNA4,0x60	CSA5.0x35	CSA5.0x40	CSA5.0x50
12	1 x Ø10 Bolt	**P**	7,5						
		L	8,0						
		M	8,5						
		S	8,9						
		I	9,8						

Bolt factor	for F_4
k_{ax}	1,8
k_{lat}	1

Annex D43 – ADR6090

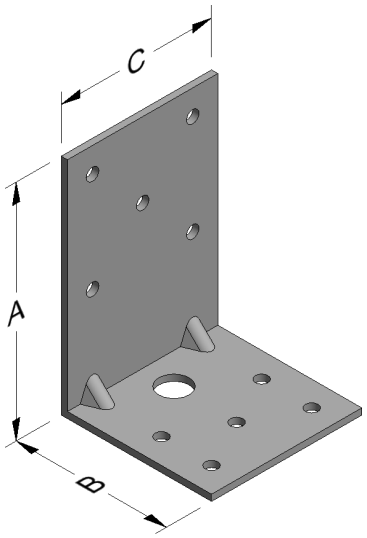
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ADR6090	Steel ref. 1	-
ADR6090S	Steel ref. 2	-
ADR6090S2	Steel ref. 3	-
ADR6090Z	Steel ref. 6	-

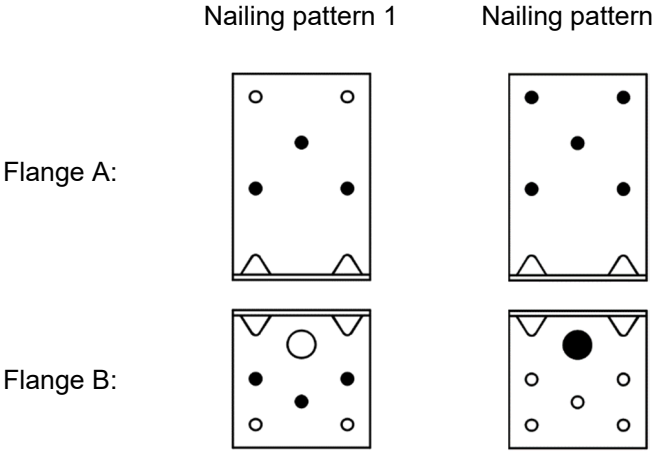
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	Ø5	Ø5	Ø12
ADR6090	90	60	60	2,5	5	5	1

Drawing:



Nailing pattern:



Beam to beam Beam to rigid

Table D43-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ADR6090 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail 4,0x40	4,0x60
Nailing pattern 1	3	3	P	1,8	2,7
			L	2,0	3,0
			M	2,3	3,2
			S	2,6	3,4
			I	2,9	3,8

Table D43-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ADR6090 per connection				**Modified characteristic capacity per connection (kN)**	
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail 4,0x40	4,0x60
Nailing pattern 1	3	3	P	23 / (f + 28) max 20 / (f + 50)	23 / (f + 28) max 32 / (f + 50)
			L	23 / (f + 28) max 22 / (f + 50)	23 / (f + 28) max 37 / (f + 50)
			M	23 / (f + 28) max 26 / (f + 50)	23 / (f + 28)
			S	23 / (f + 28) max 29 / (f + 50)	23 / (f + 28)
			I	23 / (f + 28) max 35 / (f + 50)	23 / (f + 28)

Table D43-3 Characteristic capacity timber beam to rigid support – 1 & 2 Angle Brackets

Connection with 1 or 2 ADR6090 per connection				**Characteristic capacity per connection (kN)**	
				1 Angle Bracket ADR6090 per connection	**2 Angle Brackets ADR6090 per connection**
Nailing pattern	Number of fasteners		Base material	**$R_{1,k}$**	
	Flange A	Flange B		CNA Connector nail 4,0x40 and 4,0x60	CNA Connector nail 4,0x40 and 4,0x60
Nailing pattern 2	5	1 x Bolt	Concrete	min of: $86,5 / ((f+22)xk_{mod})$ $35 / ((f+8)*k_{mod})$ 8,9	min of: 15,7 $9,9 / k_{mod}$
			Ligth weight concrete or masonry	min of: $75 / ((f+22)xk_{mod})$ $35 / ((f+8)*k_{mod})$ 8,3	min of: 14,5 $9,1 / k_{mod}$
for bolt: factor **k_{ax}**				(f+23)/10	0,92

f in mm

For each bolt it is needed to check: $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$

Annex D44 – ADR6035

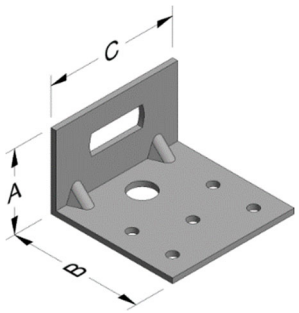
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ADR6035	Steel ref. 1	-
ADR6035S	Steel ref. 2	-
ADR6035S2	Steel ref. 3	-
ADR6035Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	27 x 10	Ø5	Ø12
ADR6035	37	60	60	2,5	1	5	1

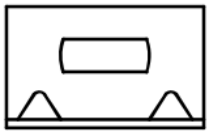
Drawing:



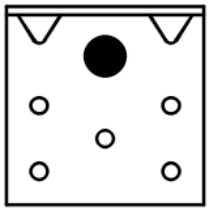
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Steel strap to rigid

Table D44-1 Characteristic capacity steel strap to rigid – 1 Angle Bracket

1 Angle Bracket ADR6035 per connection				**Characteristic capacity per connection (kN)**
Nailing pattern	Number of fasteners		Base material	$R_{1,k}$
	Flange A	Flange B		1 x M10 bolt
Nailing pattern 1	-	1 x M10 Bolt	Concrete	5,2 / k_{mod}
			Ligth weight concrete or masonry	4,0 / k_{mod}
for bolt: factor k_{ax}				2,2

For each bolt it is needed to check: $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$

Annex D45 – ABAI105

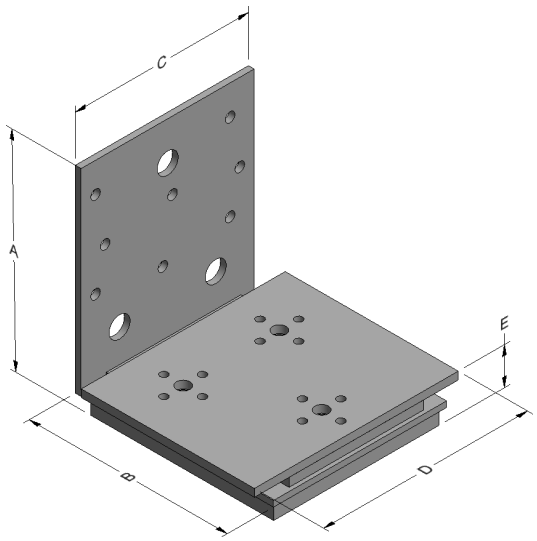
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABAI105	Steel ref. 1	-
ABAI105Z	Steel ref. 6	-

Connector Size Range:

Model no.			Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	D	E	Thickness	Ø5	Ø11	Ø3	Ø7
ABAI105	113	103	90	106	18	3,0	8	3	12	3

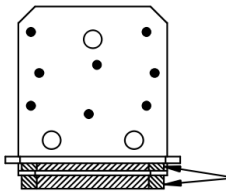
Drawing:



Nailing pattern:

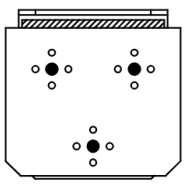
Nailing pattern 1

Flange A:



Sylodyn®

Flange B:



Timber (CLT wall) to Timber (floor)

Table D45-1 Characteristic capacity CLT wall to floor – 1 Angle Bracket

1 Angle Bracket ABAI105 per connection				**Characteristic capacity per connection (kN)**			
Nailing pattern	Number of fasteners			$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	$R_{5,k}$
	Flange A (Wall)	Flange B (Floor)					
Nailing pattern 1	8 x CNA4,0x60 or CSA5,0x50	3 x SDS25600 or 3 x SDS25412 or 3 x SDS25500	Characteristic value R_k (kN)	2,0 / k_{mod}	2,0 / k_{mod}	3,3 / k_{mod}	2,3 / k_{mod}
			Slip modulus k_{ser} (kN/mm)	0,80	0,68	1,16	0,80

Table D45-2 Ultimate limit state capacity (high Deformation) CLT wall to floor – 1 Angle Bracket

1 Angle Bracket ABAI105 per connection			**Ultimate limit state capacity per connection (kN)**			
Nailing pattern	Number of fasteners		$R_{1,u}$	$R_{2/3,u}$	$R_{4,u}$	$R_{5,u}$
	Flange A (Wall)	Flange B (Floor)				
Nailing pattern 1	8 x CNA4,0x60 or CSA5,0x50	3 x SDS25600 or 3 x SDS25412 or 3 x SDS25500	7,9 / k_{mod}	5,9 / k_{mod}	7,3 / k_{mod}	5,4 / k_{mod}

Ultimate limit state values shall only be used under rare disaster situations, e.g. disproportionate callapes, vehicle impact, etc… to evaluate the connected displacements, the slip modulus from table D45-1 can be used.

Annex D46 – AG922

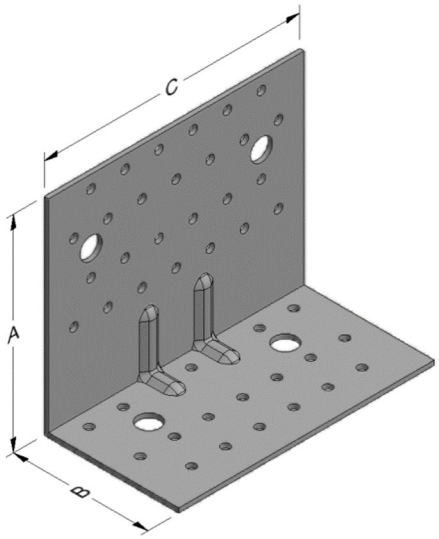
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AG922	Steel ref. 1	-
AG922S	Steel ref. 2	-
AG922S2	Steel ref. 3	-
AG922Z	Steel ref. 6	-

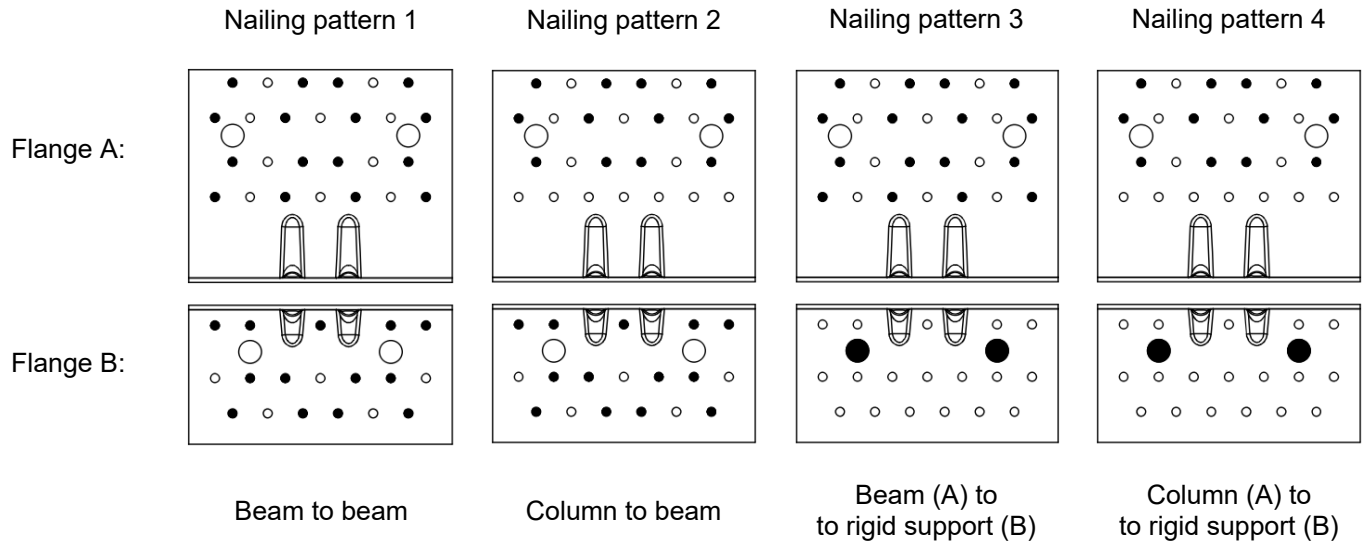
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
AG922	121	79	150	2,5	26	26	18	13

Drawing:



Nailing pattern:



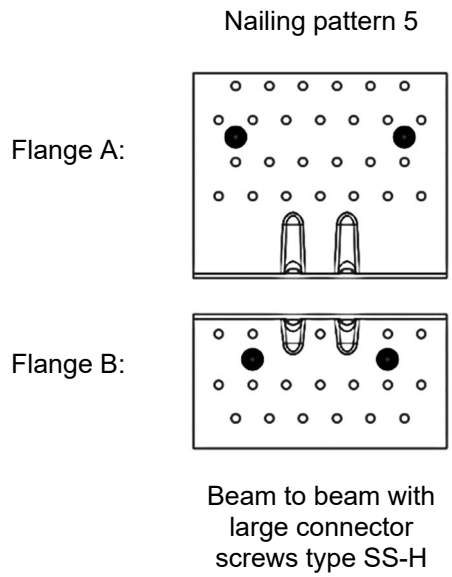


Table D46-1 Characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AG922 per connection			**Characteristic capacities per connection (kN)**		**Slip modulus K_{ser} (kN/mm)**	
Nailing pattern	Number of fasteners		$R_{1,k}$	$R_{2/3,k}$	For force F_1	For force F_2
	Flange A	Flange B	CNA Connector nail 4,0x50		CNA Connector nail 4,0x50	
Nailing pattern 1	16	13	18,5	29,5	5,5	4,15

Table D46-2 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets AG922 per connection			**Characteristic capacities per connection (kN)**			**Slip modulus K_{ser} (kN/mm)**		
Nailing pattern	Number of fasteners		**$R_{1,k}$**	**$R_{2/3,k}$**		**For force F_1**	**For force $F_{2/3}$**	
	Flange A	Flange B	CNA Connector nail			CNA Connector nail		
			4,0x50	4,0x35	4,0x50	4,0x50	4,0x35	4,0x50
Nailing pattern 3	16	2 x Ø12 Bolts	30,6	41,9	48,2	5,6	7,2	6,55

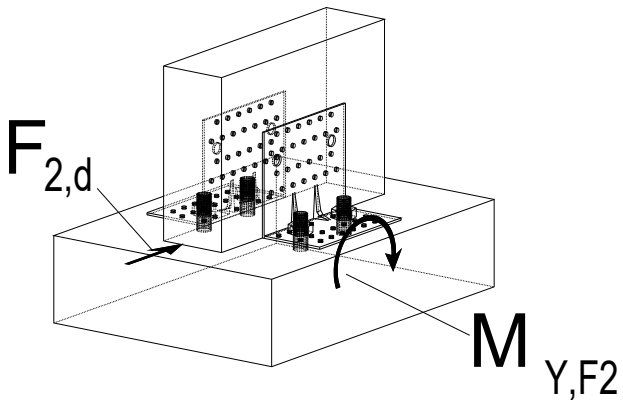
To table D46-2:

The bolt group must be able to resist to:

$F_{2,d}$ [kN]

$M_{x,F2,d} = F_{2,d}$ x 27mm [kNmm]

$M_{y,F2,d} = F_{2,d}$ x 70mm [kNmm]



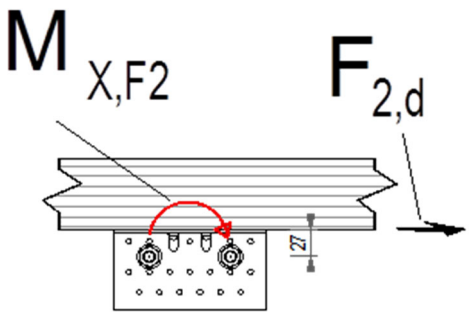


Table D46-3 Characteristic capacity timber column to timber beam – 2 Angle Brackets

2 Angle Brackets AG922 per connection			**Characteristic capacities per connection (kN)**	**Slip modulus K_{ser} (kN/mm)**
Nailing pattern	Number of fasteners		$R_{1,k}$	For force F_1
	Flange A	Flange B	CNA Connector nail 4,0x50	CNA Connector nail 4,0x50
Nailing pattern 2	12	13	19,5	3,18

Table D46-4 Characteristic capacity timber column to rigid support – 2 Angle Brackets

2 Angle Brackets AG922 per connection			**Characteristic capacities per connection (kN)**	**Slip modulus K_{ser} (kN/mm)**
Nailing pattern	Number of fasteners		$R_{1,k}$	For force F_1
	Flange A	Flange B	CNA Connector nail 4,0x50	CNA Connector nail 4,0x50
Nailing pattern 4	12	2 x Ø12 Bolts	37,5	10,59

Table D46-5 Characteristic capacity timber beam to timber column – 1 Angle Bracket

1 Angle Bracket AG922 per connection			**Characteristic capacities per connection (kN)**	**Slip modulus K_{ser} (kN/mm)**
Nailing pattern	Number of fasteners		$R_{1,k}$	For force F_1
	Flange A	Flange B	CNA Connector nail 4,0x50	CNA Connector nail 4,0x50
Nailing pattern 2	12	13	22,6	3,67

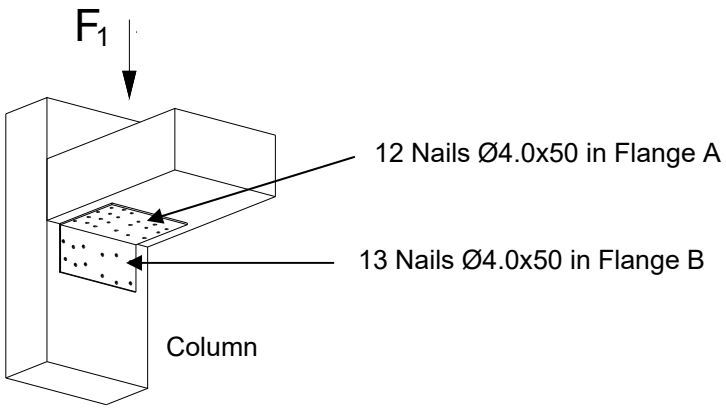


Table D46-6 Characteristic capacity timber beam to rigid support – 1 Angle Bracket

1 Angle Bracket AG922 per connection			Characteristic capacities per connection (kN)	Slip modulus K_{ser} (kN/mm)
Nailing pattern	Number of fasteners		$R_{1,k}$	For force F_1
	Flange A	Flange B	CNA Connector nail 4,0x50	CNA Connector nail 4,0x50
Nailing pattern 4	12	2 x Ø12 Bolts	24,8	3,71

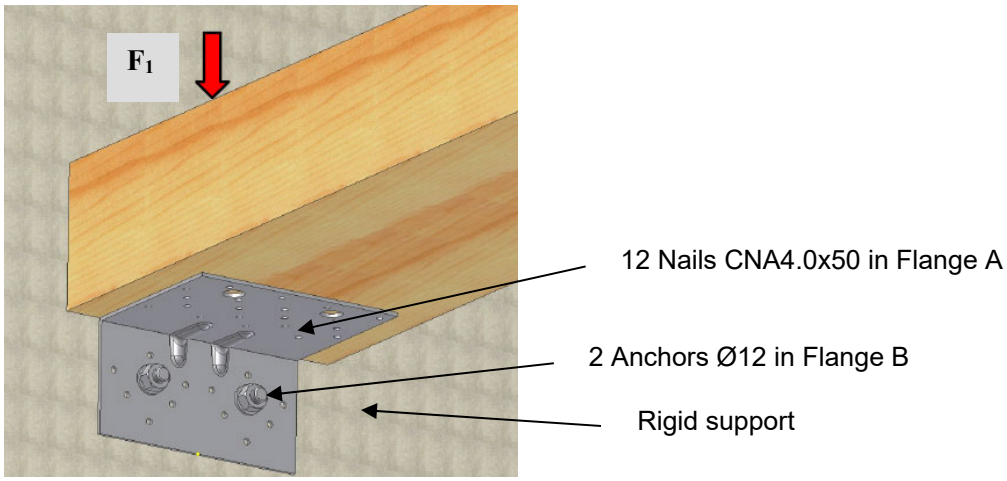


Table D46-7 Bolt factors for D46-2, D46-4 & D46-6

AG922	Connection with 2 Angle Brackets (to table D46-2 & D46-4)		Connection with 1 Angle Bracket (to table D46-6)
factor for:	F_1	$F_{2/3}$	F_1
k_{ax}	0,75	-	1,00
k_{lat}	-	see description	1,00

For each bolt-pair it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Table D46-8 Characteristic capacity CLT timber beam to CLT timber beam – 2 Angle Bracket AG922 – Nailing pattern 5

CLT to CLT connection				2 angle brackets per connection			
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - CLT	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø12x80	SS-H Ø12x80
AG922	Nailing pattern 5	2	SS-H	2	SS-H	23	23

CLT density was considered as C24 - $\rho_k = 350$ kg/m^3

Table D46-9 AG922 Slip modulus K_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
		SS-H Ø12x80	SS-H Ø12x80
CLT to CLT (with SS-H screws)	5	1,42	1,57

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Annex D47 – ABR10525

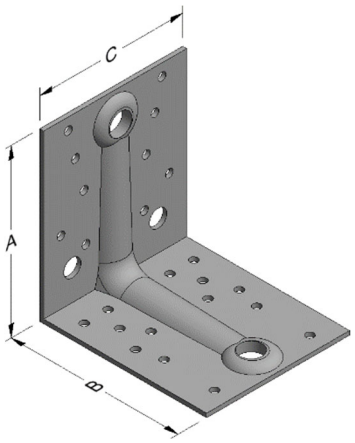
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR10525	Steel ref. 5	-
ABR10525S	Steel ref. 2	-
ABR10525S2	Steel ref. 3	-
ABR10525Z	Steel ref. 7	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B	
	A	B	C	Thickness	Ø5	Ø11	Ø14	Ø5	Ø14
ABR10525	105	105	90	2,5	10	2	1	14	1

Drawing:



Nailing pattern:

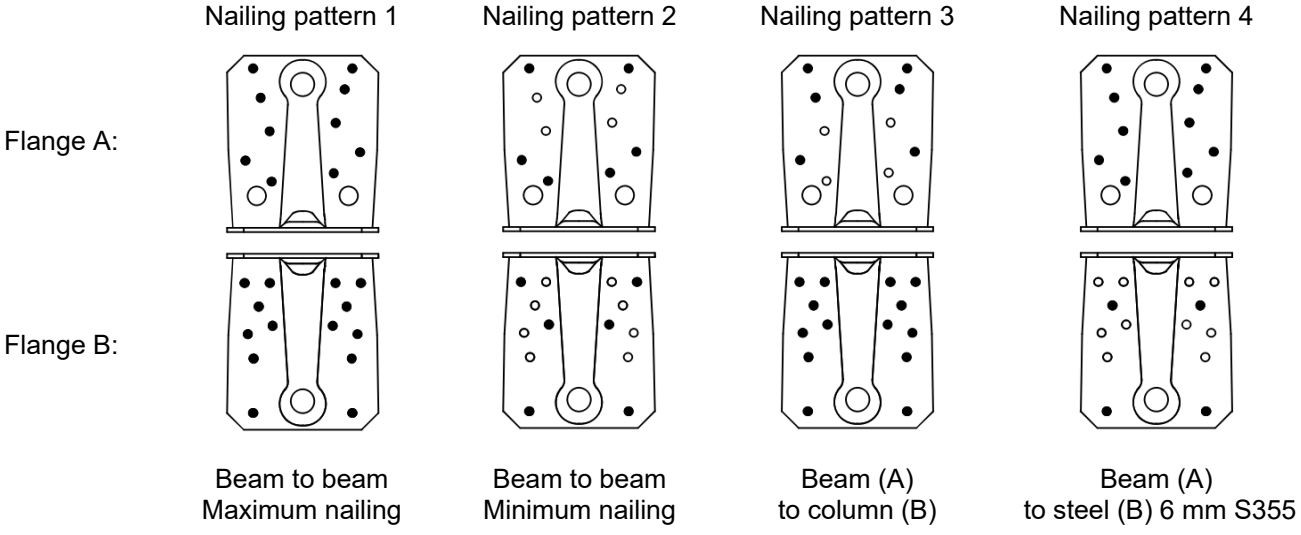


Table D47-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR10525 per connection				**Modified characteristic capacity per connection (kN)**								
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$			$R_{4/5,k} \times k_{mod}$		
				CNA Connector nail								
	Flange A	Flange B		4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	10	14	P	7,6	10,3	17,7	6,4	7,3	11,8	$\frac{6,8 \cdot b+903}{e}$ max 7,1	$\frac{7,2 \cdot b+901}{e}$ max 8,2	$\frac{8,6 \cdot b+894}{e}$ max 12,2
			L	8,9	12,0	20,6	7,5	8,5	13,8	$\frac{7,1 \cdot b+901}{e}$ max 8,0	$\frac{7,5 \cdot b+899}{e}$ max 9,2	$\frac{9,1 \cdot b+891}{e}$ max 13,9
			M	10,2	13,8	23,6	8,6	9,7	15,8	$\frac{7,4 \cdot b+900}{e}$ max 8,8	$\frac{7,9 \cdot b+898}{e}$ max 10,2	$\frac{9,7 \cdot b+888}{e}$ max 15,6
			S	11,4	15,5	26,5	9,7	10,9	17,7	$\frac{7,7 \cdot b+898}{e}$ max 9,7	$\frac{8,2 \cdot b+896}{e}$ max 11,2	$\frac{10,3 \cdot b+885}{e}$ max 17,4
			I	14,0	18,9	32,4	11,8	13,4	21,7	$\frac{8,3 \cdot b+895}{e}$ max 11,4	$\frac{8,9 \cdot b+892}{e}$ max 13,3	$\frac{11,5 \cdot b+879}{e}$ max 20,8

b and e are in mm.

Table D47-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

Table D47-2.1

1 Angle Bracket ABR10525 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$			$R_{2/3,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	8	10	P	f≤ 25: $\frac{221}{f+75}$ f>25: $\frac{55}{f}$	f≤ 27: $\frac{249}{f+75}$ f>27: $\frac{66}{f}$	f≤ 33: $\frac{358}{f+75}$ f>33: $\frac{110}{f}$	3,2	3,6	5,9
			L	f≤ 27: $\frac{244}{f+75}$ f>27: $\frac{64}{f}$	f≤ 29: $\frac{276}{f+75}$ f>29: $\frac{77}{f}$	f≤ 35: $\frac{404}{f+75}$ f>35: $\frac{129}{f}$	3,8	4,3	6,9
			M	f≤ 29: $\frac{267}{f+75}$ f>29: $\frac{74}{f}$	f≤ 31: $\frac{303}{f+75}$ f>31: $\frac{88}{f}$	f≤ 36: $\frac{450}{f+75}$ f>36: $\frac{147}{f}$	4,3	4,9	7,9
			S	f≤ 30: $\frac{290}{f+75}$ f>30: $\frac{83}{f}$	f≤ 32: $\frac{331}{f+75}$ f>32: $\frac{99}{f}$	f≤ 35: $\frac{496}{f+75}$ f>35: $\frac{159}{f}$	4,8	5,5	8,9
			I	f≤ 32: $\frac{336}{f+75}$ f>32: $\frac{101}{f}$	f≤ 34: $\frac{386}{f+75}$ f>34: $\frac{121}{f}$	f≤ 28: $\frac{587}{f+75}$ f>28: $\frac{159}{f}$	5,9	6,7	10,8

f, e and b are in mm.

Table D47-2.2

1 Angle Bracket ABR10525 per connection				Modified characteristic capacity per connection (kN)					
Nailing pattern	Number of fasteners		Load duration	$R_{4,k} \times k_{mod}$			$R_{5,k} \times k_{mod}$		
	Flange A	Flange B		CNA Connector nail					
				4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 1	8	10	P	e≤ 26: 8,0	e≤ 25: 8,8	e≤ 22: 11,3	e≤ 60: 64 83-e	e≤ 58: 77 83-e	e≤ 55: 129 83-e
				26<e≤ 115: 211 e	25<e≤ 123: 220 e	22<e≤ 156: 254 e	60<e≤ 2,40·b-32: 2,8	58<e≤ 2,24·b-27: 3,2	55<e≤ 1,84·b-15: 4,7
				e>115: 60 e-82,5	e>123: 72 e-82,5	e>156: 120 e-82,5	e>2,40·b-32: 6,8·b-323 e-83	e>2,24·b-27: 7,2·b-349 e-83	e>1,84·b-15: 8,6·b-454 e-83
			L	e≤ 23: 9,4	e≤ 22: 10,3	e≤ 20: 13,2	e≤ 59: 75 83-e	e≤ 57: 90 83-e	e≤ 54: 150 83-e
				23<e≤ 121: 218 e	22<e≤ 130: 228 e	20<e≤ 172: 268 e	59<e≤ 2,26·b-30: 3,1	57<e≤ 2,11·b-26: 3,6	54<e≤ 1,74·b-14: 5,3
				e>121: 70 e-82,5	e>130: 84 e-82,5	e>172: 140 e-82,5	e>2,26·b-30: 7,1·b-345 e-83	e>2,11·b-26: 7,5·b-375 e-83	e>1,74·b-14: 9,1·b-497 e-83
			M	e≤ 21: 10,7	e≤ 20: 11,7	e≤ 19: 15,1	e≤ 58: 86 83-e	e≤ 56: 103 83-e	e≤ 53: 172 83-e
				21<e≤ 128: 226 e	20<e≤ 139: 237 e	19<e≤ 146: 282 e	58<e≤ 2,15·b-29: 3,4	56<e≤ 2,00·b-24: 3,9	53<e≤ 1,66·b-12: 5,9
				e>128: 80 e-82,5	e>139: 96 e-82,5	146<e≤ 213: 219,8 e-32,5	e>2,15·b-29: 7,4·b-367 e-83	e>2,00·b-24: 7,9·b-401 e-83	e>1,66·b-12: 9,7·b-541 e-83
						e>213: 159 e-82,5			
			S	e≤ 19: 12,1	e≤ 19: 13,2	e≤ 17: 17	e≤ 57: 97 83-e	e≤ 55: 116 83-e	e≤ 53: 193 83-e
				19<e≤ 135: 233 e	19<e≤ 147: 245 e	17<e≤ 125: 297 e	57<e≤ 2,05·b-28: 3,7	55<e≤ 1,91·b-23: 4,3	53<e≤ 1,59·b-11: 6,5
				e>135: 90 e-82,5	e>147: 108 e-82,5	125<e≤ 300: 219,8 e-32,5	e>2,05·b-28: 7,7·b-388 e-83	e>1,91·b-23: 8,2·b-428 e-83	e>1,59·b-11: 10,3·b-585 e-83
						e>300: 179 e-82,5			
			I	e≤ 17: 14,7	e≤ 16: 16,1	e≤ 16: 20,8	e≤ 55: 118 83-e	e≤ 54: 141 83-e	e≤ 52: 236 83-e
				17<e≤ 149: 247 e	16<e≤ 165: 263 e	16<e≤ 254: 325 e	55<e≤ 1,90·b-26: 4,4	54<e≤ 1,78·b-21: 5,0	52<e≤ 1,49·b-8: 7,7
				e>149: 110 e-82,5	e>165: 132 e-82,5	e>254: 219 e-82,5	e>1,90·b-26: 8,3·b-432 e-83	e>1,78·b-21: 8,9·b-480 e-83	e>1,49·b-8: 11,5·b-672 e-83

f, e and b are in mm.

Table D47-3 Characteristic capacity timber beam to timber beam – 2 Angle Bracket

2 Angle Brackets ABR10525 per connection			**Characteristic capacities per connection (kN)**								
			$R_{1,k}$			**$R_{2/3,k}$**			**$R_{4/5,k}$**		
Nailing pattern	Number of fasteners		CNA Connector nail								
	Flange A	Flange B	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 2	6	6	4,80	5,70	9,50	9,7	10,6	14,3	a=6,8 y=10,1 $\min\left\{\left(\frac{a}{k_{mod}^{0,75}}\times b+902/k_{mod}\right)/e;\ \frac{y}{k_{mod}^{0,2}}\right\}$	a=7,1 y=11,7	a=8,3 y=17,8

e and f in (mm); b = the width of the timber in (mm)

Table D47-4 Characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR10525 per connection			**Characteristic capacities per connection (kN)**											
			$R_{1,k}$			**$R_{2/3,k}$**			**$R_{4,k}$**			**$R_{5,k}$**		
Nailing pattern	Number of fasteners		CNA Connector nail											
	Flange A	Flange B	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60	4,0x35	4,0x40	4,0x60
Nailing pattern 2	6	6	a=224 y=107 $\min\left\{\frac{a}{(f+75)\times k_{mod}^{0,4}};\ \frac{y}{f};\ \frac{159}{f\times k_{mod}}\right\}$	a=249 y=129	a=350 y=214	4,9	5,3	7,2	a=3,4 y=228 z=100 $\min\left\{a;\ \frac{y}{k_{mod}^{0,75}\times e};\ \frac{z}{e-82,5}\right\}$ only for CNA4,0x60 max: 22/(e-32,5)	a=3,7 y=238 z=120	a=4,7 y=278 z=200	a=6,9 y=354 z=3,9 $\min\left\{\frac{a\times b-y}{k_{mod}^{0,7}\times(e-83)};\ \frac{z}{k_{mod}^{0,2}}\right\}$	a=7,2 y=384 z=4,4	a=8,3 y=503 z=6,6

e and f in (mm); b = the width of the timber in (mm)

Table D47-5 Characteristic capacity timber beam to 6mm steel beam – 2 Angle Brackets

2 Angle Brackets ABR10525 per connection			**Characteristic capacity (kN) – timber to 6 mm steel**
Nailing pattern	Flange A	Flange B	**$R_{1,k}$**
Nailing pattern 4	10 x CNA4,0x60	4 x PDPA-75	15,3

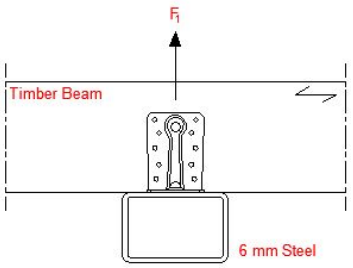
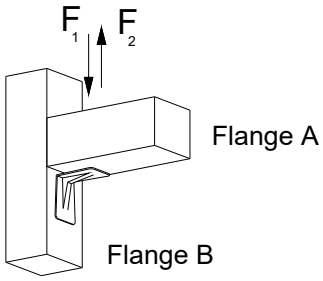


Table D47-6 Characteristic capacity timber beam to timber column – 1 Angle Bracket

2 Angle Brackets ABR10525 per connection			**Characteristic capacity per connection (kN)**			
			$R_{1,k}$		$R_{2,k}$	
Nailing pattern	Number of fasteners		CNA4,0x40	CNA4,0x60	CNA4,0x40	CNA4,0x60
	Flange A (Beam)	Flange B (Colunm)				
Nailing pattern 3	6	14	13,7	18,3	1,5	2,5



Annex D48 – ABR7015/ ABR7020

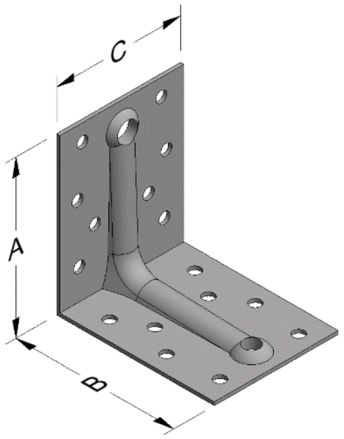
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR7015	Steel ref. 5	-
ABR7015S	Steel ref. 2	-
ABR7015S2	Steel ref. 3	-
ABR7015Z	Steel ref. 7	-
ABR7020	Steel ref. 5	-
ABR7020S	Steel ref. 2	-
ABR7020S2	Steel ref. 3	-
ABR7020Z	Steel ref. 7	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø9	Ø5	Ø7
ABR7015	70	70	55	1,5	8	1	8	1
ABR7020	70	70	55	2,0	8	1	8	1

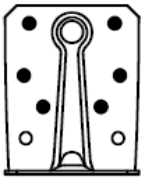
Drawing:



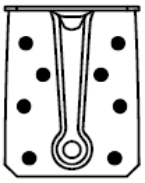
Nailing pattern:

Nailing pattern 1

Flange A:



Flange B:



Beam to beam
Maximum nailing

Table D48-1 Modified characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ABR7015/ ABR7020 per connection				**Modified characteristic capacity per connection (kN)**					
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4/5,k} \times k_{mod}$	
				CNA Connector nail					
	Flange A	Flange B		4,0x35	4,0x40	4,0x35	4,0x40	4,0x35	4,0x40
Nailing pattern 1	6	8	P	3,1	3,7	4,0	4,4	1,5·b+277 e max 5,0	1,8·b+302 e max 6,0
			L	3,6	4,3	4,7	5,1	1,7·b+298 e max 5,8	2,1·b+327 e max 7,0
			M	4,2	4,9	5,3	5,9	2,0·b+319 e max 6,7	2,4·b+352 e max 8,0
			S	4,7	5,5	6,0	6,6	2,2·b+340 e max 7,5	2,6·b+378 e max 9,0
			I	5,7	6,7	7,3	8,1	2,7·b+382 e max 9,2	3,2·b+428 e max 11,0

b and e are in mm.

Table D48-2 Modified characteristic capacity timber beam to timber beam – 1 Angle Bracket

1 Angle Bracket ABR7015/ ABR7020 per connection				Modified characteristic capacity per connection (kN)							
Nailing pattern	Number of fasteners		Load duration	$R_{1,k} \times k_{mod}$		$R_{2/3,k} \times k_{mod}$		$R_{4,k} \times k_{mod}$		$R_{5,k} \times k_{mod}$	
	Flange A	Flange B		CNA Connector nail							
				4,0x35	4,0x40	4,0x35	4,0x40	4,0x35	4,0x40	4,0x35	4,0x40
Nailing pattern 1	6	8	P	f≤ 27: 75 f+60 f>27: 24 f	f≤ 29: 87 f+60 f>29: 28 f	2,0	2,2	e≤6: 6,0 6<e≤ 220: 38 e e>220: 35 e-25	e≤7: 6,6 7<e≤ 102: 46 e e>102: 35 e-25	e≤ 42: 38 60-e 42<e≤ 0,71·b+21: 2,1 e>0,71·b+21: 1,47·b-80 e-60	e≤ 42: 45 60-e 42<e≤ 0,71·b+21: 2,5 e>0,71·b+21: 1,76·b-96 e-60
			L	f≤ 29: 85 f+60 f>29: 27 f	f≤ 24: 98 f+60 f>24: 28 f	2,3	2,6	e≤6: 7,0 6<e≤ 115: 44 e e>115: 35 e-25	e≤7: 7,7 7<e≤ 71: 53 e e>71: 35 e-25	e≤ 42: 44 60-e 42<e≤ 0,71·b+21: 2,4 e>0,71·b+21: 1,72·b-94 e-60	e≤ 42: 52 60-e 42<e≤ 0,71·b+21: 2,9 e>0,71·b+21: 2,06·b-112 e-60
			M	f≤ 25: 94 f+60 f>25: 28 f	f≤ 21: 110 f+60 f>21: 28 f	2,7	2,9	e≤6: 8,0 6<e≤ 80: 51 e e>80: 35 e-25	e≤7: 8,8 7<e≤ 58: 61 e e>58: 35 e-25	e≤ 42: 50 60-e 42<e≤ 0,71·b+21: 2,7 e>0,71·b+21: 1,96·b-107 e-60	e≤ 42: 60 60-e 42<e≤ 0,71·b+21: 3,3 e>0,71·b+21: 2,35·b-128 e-60
			S	f≤ 22: 104 f+60 f>22: 28 f	f≤ 18: 121 f+60 f>18: 28 f	3,0	3,3	e≤6: 9,1 6<e≤ 64: 57 e e>64: 35 e-25	e≤7: 9,9 7<e≤ 51: 68 e e>51: 35 e-25	e≤ 42: 56 60-e 42<e≤ 0,71·b+21: 3,1 e>0,71·b+21: 2,21·b-120 e-60	e≤ 42: 67 60-e 42<e≤ 0,71·b+21: 3,7 e>0,71·b+21: 2,65·b-144 e-60
			I	f≤ 18: 123 f+60 f>18: 28 f	f≤ 15: 144 f+60 f>15: 28 f	3,7	4,0	e≤6: 11,1 6<e≤ 50: 70 e e>50: 35 e-25	e≤6: 12,1 6<e≤ 48: 73 e e>48: 35 e-25	e≤ 42: 69 60-e 42<e≤ 0,71·b+21: 3,8 e>0,71·b+21: 2,70·b-147 e-60	e≤ 42: 82 60-e 42<e≤ 0,71·b+21: 4,5 e>0,71·b+21: 3,23·b-176 e-60

f, e and b are in mm.

Annex D49 – ACR / ACRL

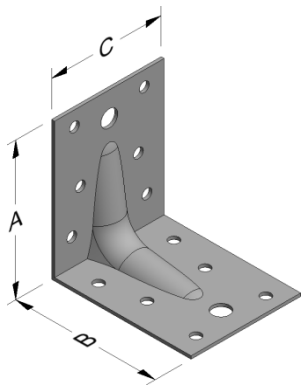
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ACR7010	Steel ref. 1	-
ACR7012	Steel ref. 1	-
ACR7015	Steel ref. 1	-
ACR9012	Steel ref. 1	-
ACR9015	Steel ref. 1	-
ACR9020	Steel ref. 1	-
ACR10512	Steel ref. 1	-
ACR10515	Steel ref. 1	-
ACR10520	Steel ref. 1	-
ACRL10520	Steel ref. 1	-
ACR7010S	Steel ref. 2	-
ACR7012S	Steel ref. 2	-
ACR7015S	Steel ref. 2	-
ACR9012S	Steel ref. 2	-
ACR9015S	Steel ref. 2	-
ACR9020S	Steel ref. 2	-
ACR10512S	Steel ref. 2	-
ACR10515S	Steel ref. 2	-
ACR10520S	Steel ref. 2	-
ACRL10520S	Steel ref. 2	-
ACR7010S2	Steel ref. 3	-
ACR7012S2	Steel ref. 3	-
ACR7015S2	Steel ref. 3	-
ACR9012S2	Steel ref. 3	-
ACR9015S2	Steel ref. 3	-
ACR9020S2	Steel ref. 3	-
ACR10512S2	Steel ref. 3	-
ACR10515S2	Steel ref. 3	-
ACR10520S2	Steel ref. 3	-
ACRL10520S2	Steel ref. 3	-
ACR7010Z	Steel ref. 6	-
ACR7012Z	Steel ref. 6	-
ACR7015Z	Steel ref. 6	-
ACR9012Z	Steel ref. 6	-
ACR9015Z	Steel ref. 6	-
ACR9020Z	Steel ref. 6	-
ACR10512Z	Steel ref. 6	-
ACR10515Z	Steel ref. 6	-
ACR10520Z	Steel ref. 6	-
ACRL10520Z	Steel ref. 6	-

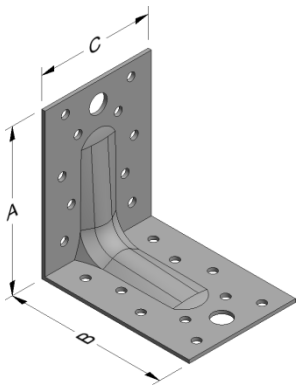
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A				Holes flange B			
	A	B	C	Thickness	Ø5	Ø8,5	Ø11	Ø11x31	Ø5	Ø8,5	Ø11	Ø11x31
ACR7010	70	70	55	1,0	6	1	-	-	6	1	-	-
ACR7012	70	70	55	1,25	6	1	-	-	6	1	-	-
ACR7015	70	70	55	1,5	6	1	-	-	6	1	-	-
ACR9012	88	88	65	1,25	10	-	1	-	5	-	1	-
ACR9015	88	88	65	1,5	10	-	1	-	5	-	1	-
ACR9020	88	88	65	2,0	10	-	1	-	5	-	1	-
ACR10512	105	105	90	1,25	10	-	3	-	14	-	1	-
ACR10515	105	105	90	1,5	10	-	3	-	14	-	1	-
ACR10520	105	105	90	2,0	10	-	3	-	14	-	1	-
ACRL10520	105	105	90	2,0	10	-	2	1	14	-	-	1

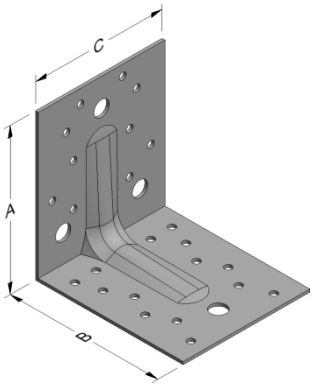
Drawings:



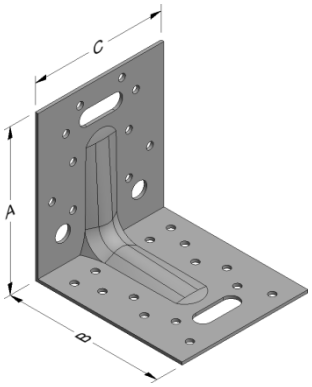
ACR70



ACR90

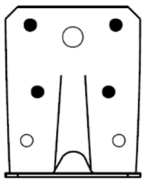
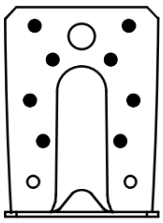
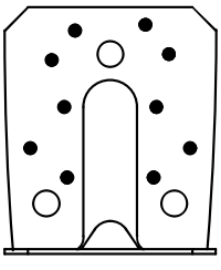
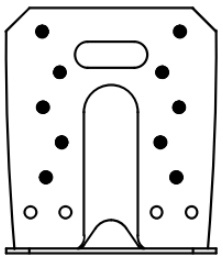
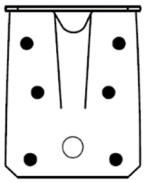
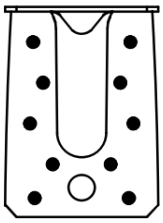
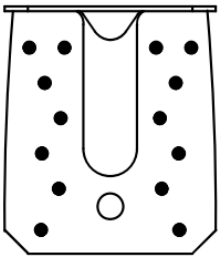
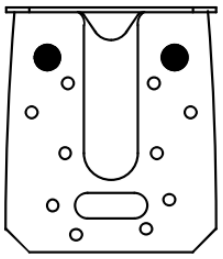


ACR105



ACRL105

Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	ACR7010, ACR7012, ACR7015 Timber to Timber Maximum nailing	ACR9012, ACR9015, ACR9020 Timber to Timber Maximum nailing	ACR10512, ACR10515, ACRL10520 Timber to Timber Maximum nailing	ACR10520, ACRL10520 Timber to rigid

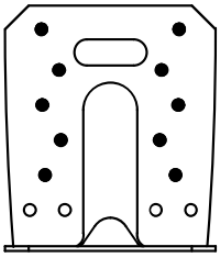
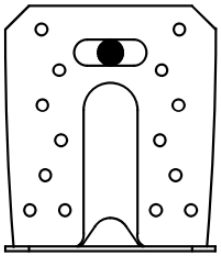
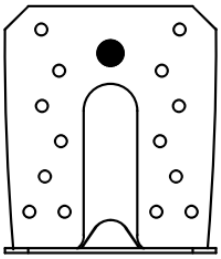
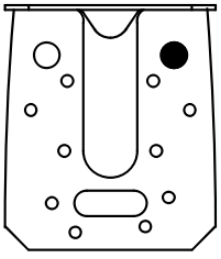
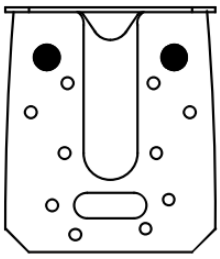
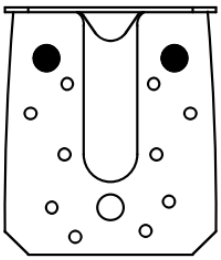
	Nailing pattern 5	Nailing pattern 6	Nailing pattern 7
Flange A:			
Flange B:			
	ACR10520, ACRL10520 Timber to rigid	ACR10520, ACRL10520 Timber to rigid	ACR10520, ACRL10520 Timber to rigid

Table D49-1 Characteristic capacity timber to timber – 2 Angle Brackets

2 Angle Brackets per connection			Characteristic capacity per connection (kN)		
Angle Bracket	Nailing pattern	CNA Connector nail	$R_{1,k}$	$R_{2/3,k}$	$R_{4/5,k}$
ACR7010	Nailing pattern 1 Flange A: 4 Flange B: 6	4,0x35	2,2		
ACR7012		4,0x35	3,2		
ACR7015		4,0x35	3,9		
		4,0x40	5,3	5,0	$\frac{2,13b+165/k_{mod}^{0,7}}{e}$ max 8,0
		4,0x60	8,9	7,3	$\frac{3,54b+200/k_{mod}^{0,6}}{e}$ max 13,2
ACR9012	Nailing pattern 2 Flange A: 8 Flange B: 10	4,0x35	7,9		
ACR9015		4,0x35	8,9		
ACR9020		4,0x35	9,2		
		4,0x40	8,0	9,3	$\frac{6,7b+369/k_{mod}^{0,7}}{e - 10,7}$ max 9,7
		4,0x60	13,3	11,9	$\frac{8b+343/k_{mod}}{e - 10,7}$ max $14,5/k_{mod}^{0,15}$
ACR10512	Nailing pattern 3 Flange A: 10 Flange B: 14	4,0x35	10,9		
ACR10515		4,0x35	13,0		
ACR10520 ACRL10520		4,0x35	13,4		
		4,0x40	10,8	14,5	$\frac{12,7b/k_{mod}^{0,7}+565/k_{mod}}{e - 10,7}$ max $14,1/k_{mod}^{0,25}$
		4,0x60	17,9	20,3	$\frac{15,6b/k_{mod}^{0,6}+556/k_{mod}}{e - 10,7}$ max $21,2/k_{mod}^{0,15}$

b and e are in mm.

Table D49-2 Characteristic capacity timber to timber – 1 Angle Bracket

1 Angle Bracket per connection		**Characteristic capacity per connection (kN)**							
Angle Bracket	Nailing pattern	$R_{1,k}$		$R_{2/3,k}$		$R_{4,k}$		$R_{5,k}$	
		CNA Connector nail							
		4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60	4,0x40	4,0x60
ACR7015	Nailing pattern 1 Flange A: 4 Flange B: 6	2,7	4,5	2,5	3,7	min of: 2,4 $\frac{51}{e \cdot k_{mod}}$ $\frac{14}{(e-35) \cdot k_{mod}}$	min of: 3,1 $\frac{51}{e \cdot k_{mod}}$ $\frac{14}{(e-35) \cdot k_{mod}}$	min of: 2,5 $\frac{30}{55-e}$ $\frac{2,7b+53}{e}$	min of: 4,2 $\frac{49}{55-e}$ $\frac{4,4b+89}{e}$
ACR9020	Nailing pattern 2 Flange A: 8 Flange B: 10	4	6,7	4,7	6	e= /	e= / min of:	min of:	min of:
		1		1	$6,1$			$\frac{5,8}{k_{mod}^{0,4}}$	$\frac{8,5}{k_{mod}^{0,25}}$
		20	$4,3/k_{mod}^{0,2}$	20	$6,1$				
		50	$1,8/k_{mod}^{0,2}$	50	$2,6/k_{mod}^{0,2}$; $2,2/k_{mod}$				
		75	$1,2/k_{mod}^{0,2}$	75	$1,8/k_{mod}^{0,2}$; $1,5/k_{mod}$			$\frac{77}{68-e}$	$\frac{129}{68-e}$
		100	0,8	100	$1,1/k_{mod}^{0,2}$; $1,0/k_{mod}$				
		125	0,5	125	0,8 ; $0,7/k_{mod}$			$\frac{7,2/(k_{mod}^{0,75} \cdot b-308/k_{mod}^{0,55})}{e-68}$	$\frac{8,8/(k_{mod}^{0,6} \cdot b-408/k_{mod}^{0,45})}{e-68}$
		150	0,4	150	0,8 ; $0,6/k_{mod}$				
ACR10520 ACRL10520	Nailing pattern 3 Flange A: 10 Flange B: 14	5,4	9	7,3	10,2	e= /	e= / min of:	min of:	min of:
		1		1	$9,2$			$\frac{8,1}{k_{mod}^{0,45}}$	$\frac{11,2}{k_{mod}^{0,35}}$
		20	$7,2$	20	$9,2$				
		50	$3,4/k_{mod}^{0,35}$	50	$4,9/k_{mod}^{0,35}$				
		75	$2,3/k_{mod}^{0,35}$	75	$3,3/k_{mod}^{0,3}$			$\frac{137}{85-e}$	$\frac{228}{85-e}$
		100	$1,7/k_{mod}^{0,35}$	100	$2,3/k_{mod}^{0,3}$; $2,3/k_{mod}$				
		125	$1,4/k_{mod}^{0,35}$	125	$1,9/k_{mod}^{0,3}$; $1,7/k_{mod}$			$\frac{12,8/(k_{mod}^{0,7} \cdot b-639/k_{mod}^{0,55})}{e-85}$	$\frac{15,7/(k_{mod}^{0,6} \cdot b-840/k_{mod}^{0,45})}{e-85}$
		150	$1,1/k_{mod}^{0,35}$	150	$1,4/k_{mod}^{0,3}$; $1,4/k_{mod}$				

b and e are in mm.

The capacities have been found based on the assumption that the purlin is prevented from rotation.

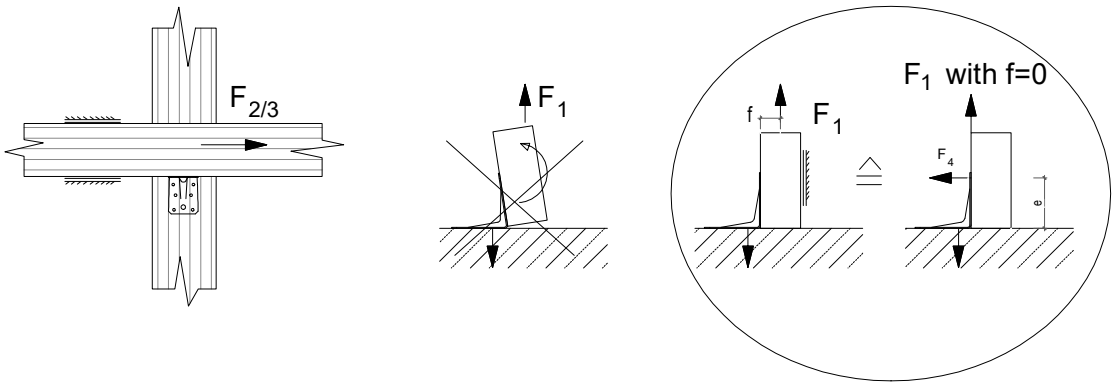


Table D49-3 Characteristic capacity timber beam to rigid support – 2 Angle Brackets

1 Angle Bracket ACR10520 or ACRL10520 per connection			**Characteristic capacity per connection (kN)**									
Nailing pattern	Number of fasteners		$R_{1,k}$					$R_{2,k}$				
	Flange A	Flange B	CNA Connector nail									
			4.0x35	4.0x40	4.0x50	4.0x60	4.0x75	4.0x35	4.0x40	4.0x50	4.0x60	4.0x75
Nailing pattern 4	10	2 x Ø10 Bolts	24,1	27,6	28,5	28,5	28,5	10,8	11,7	14,2	15,1	16,0
Nailing pattern 5	10	1 x Ø10 Bolt	10,1	11,7	15,0	15,0	15,0	6,0	7,0	9,0	10,5	11,7
Nailing pattern 6 & 7	1 x Ø10 Bolt	2 x Ø10 Bolts	7,5*					-	-	-	-	-

*In this case the test had shown that the limiting factor is the bolt resistance of connection ACRL to timber. The bolt resistance must be calculated using the Eurocode 5 §8.2.3 and consider only failure mode (j) and (k).

Annex D50 – MAXIMUS

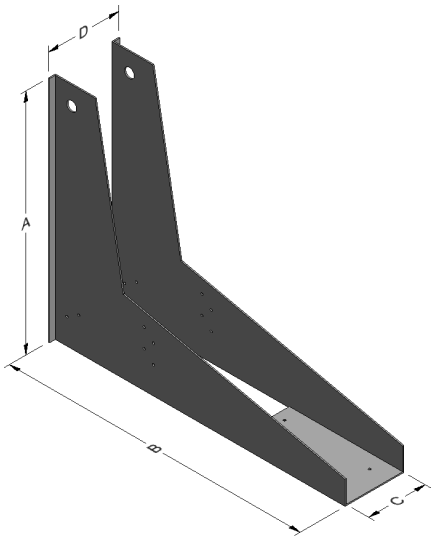
Product Name:

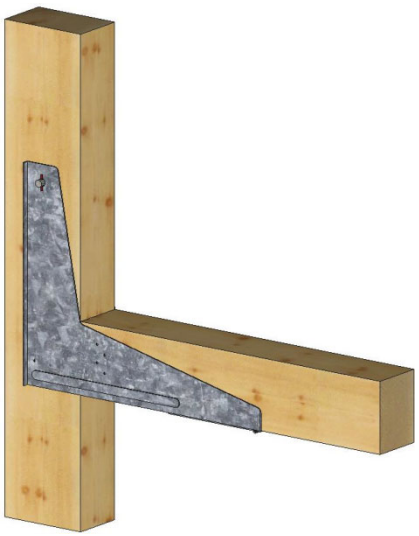
Product Name	Material reference acc. to clause II-1	Alternative product names
MAXIMUS	Steel ref. 1	-
MAXIMUSS	Steel ref. 2	-
MAXIMUSS2	Steel ref. 3	-
MAXIMUSZ	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]					Small holes	Large holes
	A	B	C	D	Thickness	Ø5	Ø21
MAXIMUS	494	623	$100 \leq C \leq 240$	15 + C + 15	2,5	10	2

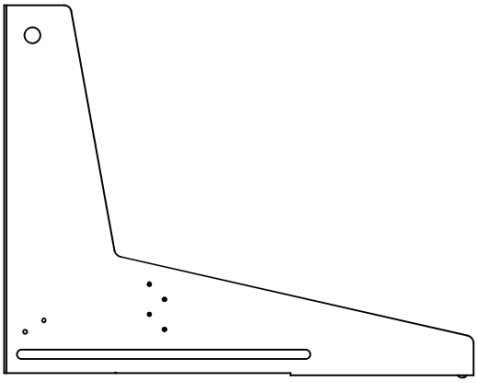
Drawing:





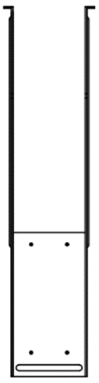
Nailing pattern:

Nailing pattern 1



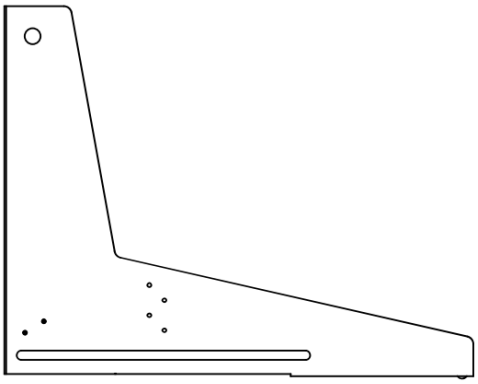
4 x CSA5,0x50 on each side

Nailing pattern 2



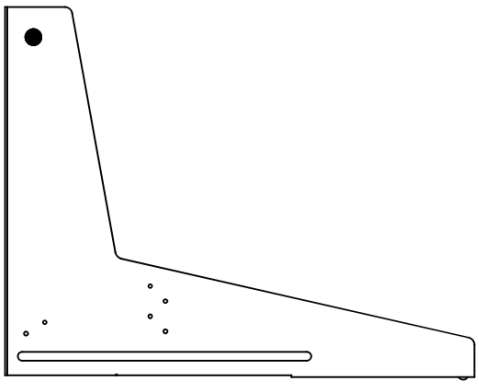
CSA5,0x50 on the bottom

Nailing pattern 3



CSA5,0x50 on each side

Nailing pattern 4



1x bolt M20 or a 20 mm dowel with additional securing pins

For a downward force, at least the fasteners shown in Nailing pattern 1, 2 and 3 shall be inserted. For an uplift force, the fasteners shown in Nailing pattern 1, 2, 3, and 4 are required.

Design Basis:

The loads have been assumed to act on a cantilevering horizontal timber member fastened to a vertical timber by the MAXIMUS connector using the fastener pattern shown in figure Nailing pattern 1 up to 4. Other spans or loads can be verified by engineering judgement. The relevant moment to evaluate deflection is stated as: $M=q*L^2/2$

Possible load distributions which have been considered:

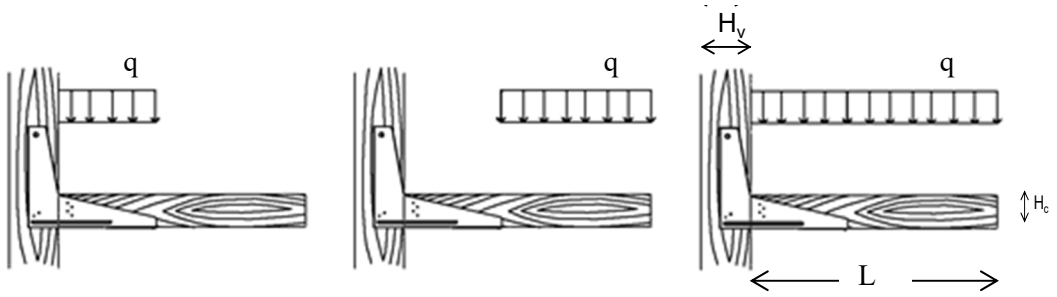


Figure: MAXIMUS possible load distributions

Modified characteristic capacity:

The strength and stiffness values determined are directly applicable to timber of the strength class C24 and better with the following dimensions:

The horizontal cantilevered timber member: Depth H_c =160 mm ; Width B as vertical member (column)

The vertical member: Depth H_v = 220 mm1) for B < 139 mm

220 mm[1)] ≤ H_v ≤ 340 mm for 139 ≤ B < 159 mm

220 mm[1)] ≤ H_v < 700 mm for B ≥ 159 mm

1): These values may be reduced to 180 mm if only downward forces can occur.

Higher depths H_v can be tolerated if a splitting reinforcement designed for at least F_k = 8,8 kN is applied near the dowel. If the width B is smaller than 120 mm the characteristic load-carrying capacity can be determined by applying a factor B/120 mm to the capacities listed in table D50-1.

The characteristic load-carrying capacity $q_{R,k}$ for a cantilever with a length L = 1200 mm is listed in the table D50-1 below. The common types of distributed loads have been evaluated also considering the possible positions of distributed loads shown in the figure D50-3.

Table D50-1 Characteristic capacity timber beam to column – 1 MAXIMUS

Load duration	Spring stiffness* C_φ of the connection for a downward force (kNm)	Characteristic distributed load capacity $q_{R,k}$ per connector (kN/m) and a lever arm L=1200mm	
		downward	uplift
P	43	7,02	-2,60
L	43		
M	48		
S	67		
I	85		

*) C_φ shall be reduced to 60% of these values if the timber moisture exceeds 18% for longer term

Annex D51 – AT2

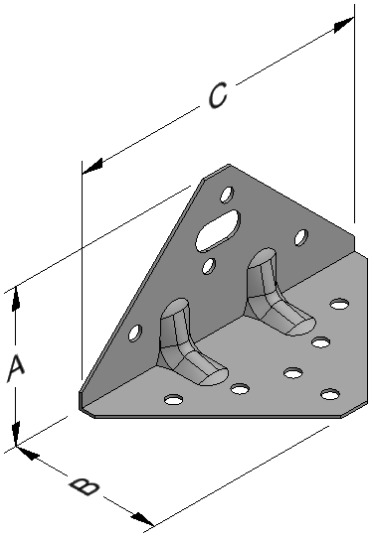
Product Name:

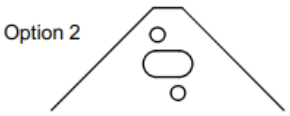
Product Name	Material reference acc. to clause II-1	Alternative product names
AT2	Steel ref. 1	-
AT2S	Steel ref. 2	-
AT2S2	Steel ref. 3	-
AT2Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø9 x 17	Ø5	Ø10
AT2	53	53	103	1,0	4	1	6	1

Drawing:





Nailing pattern:

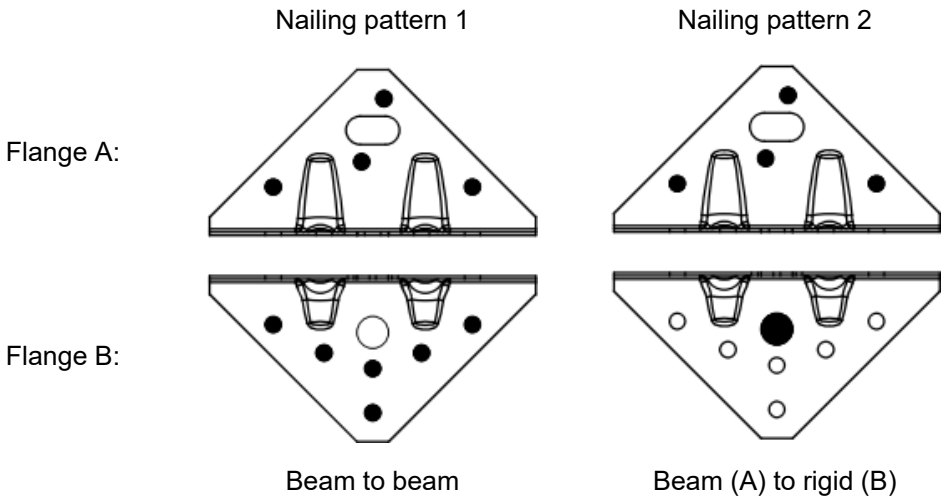


Table D51-1 Characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets AT2 per connection			**Characteristic capacity per connection (kN)**	
Nailing pattern	Number of nails		$R_{1,k}$	$R_{2/3,k}$
	Flange A	Flange B	CNA Connector nail	
			4,0x35	4,0x35
Nailing pattern 1	4	6	5,3	11,1

Table D51-2 Characteristic capacity timber beam to rigid – 2 Angle Brackets

2 Angle Brackets AT2 per connection			**Characteristic capacity per connection (kN)**	
Nailing pattern	Number of nails		$R_{1,k}$	$R_{2/3,k}$
	Flange A	Flange B	CNA Connector nail	
			4,0x35	4,0x35
Nailing pattern 2	4	1 x Ø8 Bolt	4,5	8,0

2 Angle Brackets AT2 per connection				
factor for:	F_1	$F_{2/3}$	$F_{4/5,bolt\ 1}$	$F_{4/5,bolt\ 2}$
k_{ax}	0,62	0,35	-	-
k_{lat}	-	0,50	-	-

For each bolt it's needed to check: $R_{bolt,d,lateral} \geq k_{lat} \times F_{i,d}$; $R_{bolt,d,axial} \geq k_{ax} \times F_{i,d}$; and also the combination.

Annex D52 – ABR865

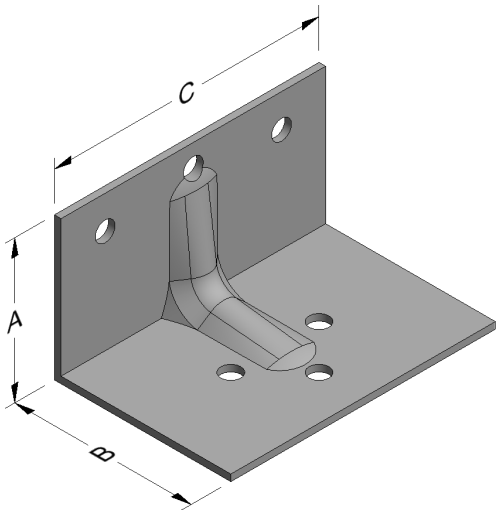
Product Name:

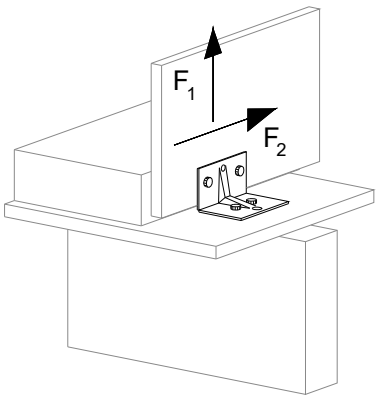
Product Name	Material reference acc. to clause II-1	Alternative product names
ABR865	Steel ref. 1	-
ABR865S	Steel ref. 2	-
ABR865S2	Steel ref. 3	-
ABR865Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø9	Ø9
ABR865	65	80	120	3,0	3	3

Drawing:



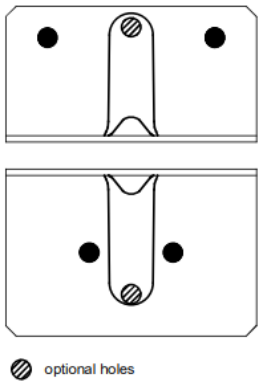


Nailing pattern:

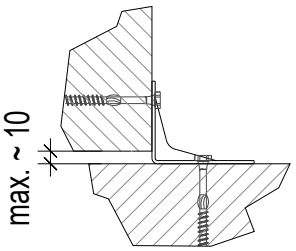
Nailing pattern 1

Flange A:

Flange B:



Timber to Timber
(The optional holes are only for constructive using.)



The connected elements shall be free of twisting, so that no rotation occurs.

The flanges of the ABR865 have to be bear full-faced, for the vertical flange is a gap up to 10 mm allowed.

Table D52-1 Characteristic capacity timber to timber, Load direction F1 – 1 Angle Bracket

1 Angle Bracket ABR865 per connection		**Characteristic capacity per connection (kN)**										
		$R_{1,k}$ = min[table value; 8,48/k_{mod}]										
Nailing pattern	Screw characteristics	Screw: $R_{lat,k}$ (kN)										
	Screw: $R_{ax,k}$ (kN)	4	4,5	5	5	6	6,5	7	7,5	8	8,5	9
Nailing pattern 1 Flange A: 2 Flange B: 2	4	5,9	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1
	4,5	6,2	6,7	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8	6,8
	5	6,5	7,0	7,4	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6
	5,5	6,7	7,2	7,7	8,1	8,4	8,4	8,4	8,4	8,4	8,4	8,4
	6	6,8	7,4	8,0	8,5	8,9	9,1	9,1	9,1	9,1	9,1	9,1
	6,5	7,0	7,6	8,2	8,7	9,2	9,6	9,9	9,9	9,9	9,9	9,9
	7	7,1	7,8	8,4	9,0	9,5	9,9	10,4	10,6	10,6	10,6	10,6
	7,5	7,2	7,9	8,6	9,2	9,7	10,2	10,7	11,1	11,4	11,4	11,4
	8	7,3	8,0	8,7	9,3	9,9	10,5	11,0	11,4	11,8	12,2	12,2
	8,5	7,4	8,1	8,8	9,5	10,1	10,7	11,2	11,7	12,2	12,6	12,9
	9	7,4	8,2	8,9	9,6	10,3	10,9	11,4	12,0	12,4	12,9	13,3
	9,5	7,5	8,3	9,0	9,7	10,4	11,0	11,6	12,2	12,7	13,2	13,6
	10	7,5	8,3	9,1	9,8	10,5	11,2	11,8	12,4	12,9	13,5	13,9
	10,5	7,6	8,4	9,2	9,9	10,6	11,3	12,0	12,6	13,2	13,7	14,1

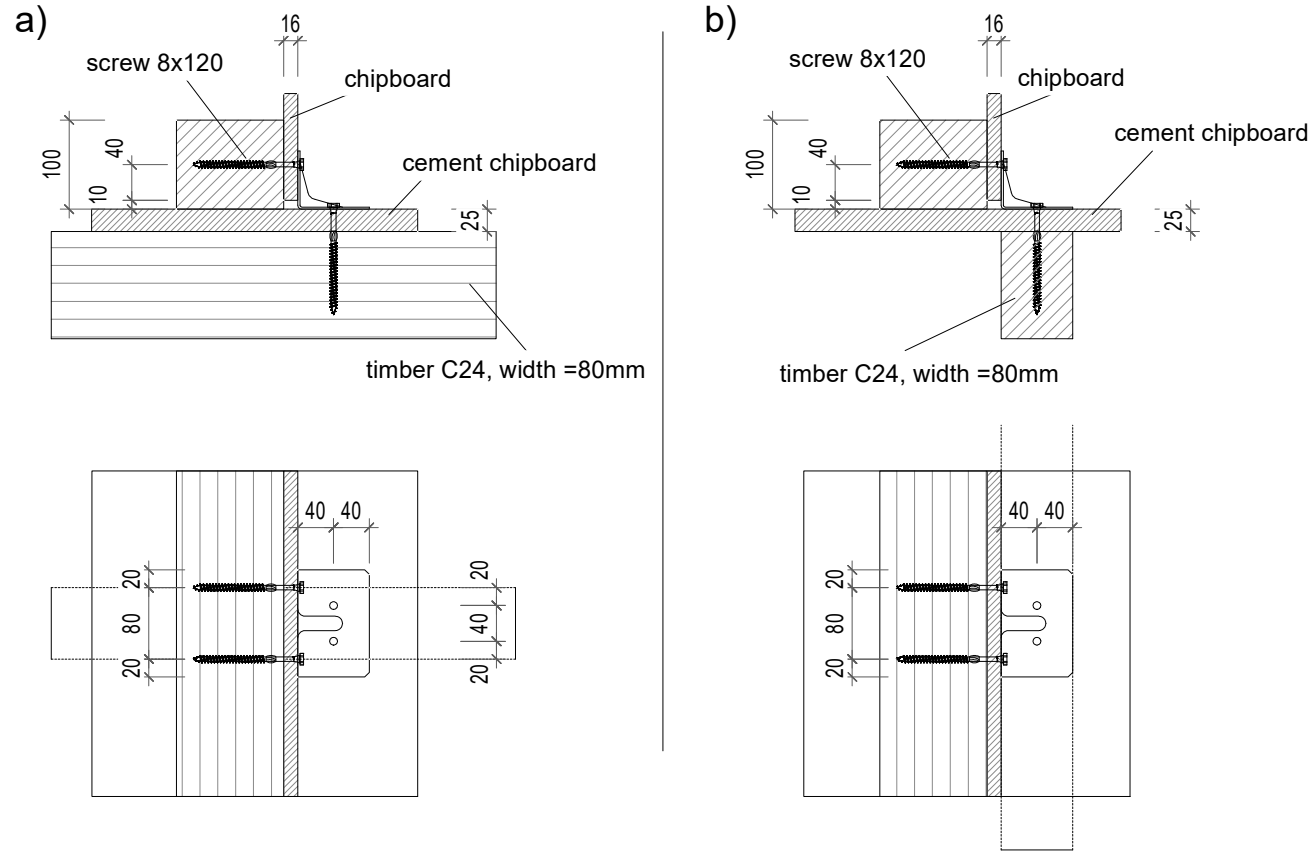
Table D52-2 Characteristic capacity timber to timber, Load direction F2 – 1 Angle Bracket

1 Angle Bracket ABR865 per connection		**Characteristic capacity per connection (kN)**										
		$R_{2,k}$										
Nailing pattern	Screw characteristics	Screw: $R_{lat,k}$ (kN)										
	Screw: $R_{ax,k}$ (kN)	4	4,5	5	5	6	6,5	7	7,5	8	8,5	9
Nailing pattern 1 Flange A: 2 Flange B: 2	4	5,96	6,51	7,01	7,47	7,88	8,25	8,25	8,25	8,25	8,3	8,3
	4,5	6,11	6,71	7,26	7,77	8,23	8,25					
	5	6,23	6,86	7,45	8,01	8,25						
	5,5	6,32	6,98	7,61	8,20							
	6	6,39	7,07	7,73	8,25							
	6,5	6,44	7,15	7,83								
	7	6,49	7,21	7,91								
	7,5	6,53	7,27	7,98								
	8	6,56	7,31	8,04								
	8,5	6,58	7,35	8,09								
	9	6,61	7,38	8,13								
	9,5	6,63	7,40	8,17								
	10	6,64	7,43	8,20								
	10,5	6,66	7,45	8,22								

The tables are based on the characteristic capacities of the used screws with $R_{lat,k}$ for the lateral (shear) capacity and $R_{ax,k}$ for the axial (tension) capacity.

For blank cells are no higher values given as the last filled cell before in the same column.

The values for characteristic capacities of the fastener with $R_{lat,k}$=4,75 kN and $R_{ax,k}$=7,04 kN are for connection as described following with using screws 8,0x120 ASSY Kombi 3.0 according to ETA 11/0190:



Chipboard class P4 according to EN 13986.

Cement-bonded particleboard (in drawings named cement chipboard) according to EN 13986.

Both layers are connected shear fixed with the timber.

Annex D53 – ACFET200 & ACFET200PP

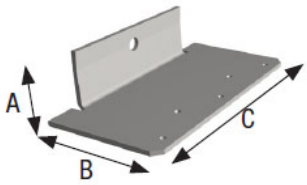
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ACFET200	Steel ref. 1	-
ACFET200PP	Steel ref. 1	-
ACFET200S	Steel ref. 2	-
ACFET200PPS	Steel ref. 2	-
ACFET200S2	Steel ref. 3	-
ACFET200PPS2	Steel ref. 3	-
ACFET200Z	Steel ref. 6	-
ACFET200PPZ	Steel ref. 6	-

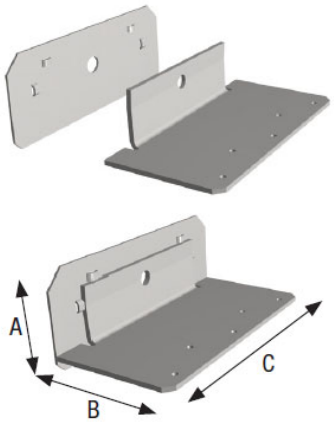
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø12	Ø5
ACFET200	49	100	200	4,0	1	5
ACFET200PP	78	102	200	4,0	1	5

Drawings:



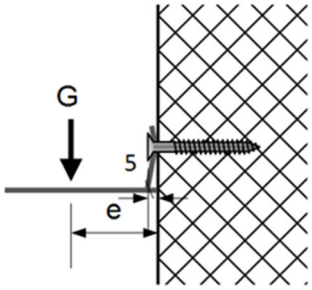
ACFET200



ACFET200PP

Table D53-1 Characteristic capacity timber to rigid – 1 Angle Bracket

1 Angle Bracket ACFET200 or ACFET200PP	**Characteristic capacity per connection (kN)**	**Vertical displacement (mm)**
Nailing		
1 M10 Concrete Screw/Bolt	G_k = 185 KNmm / (e-5 mm)	u_{init} = G x (e-5 mm)^2 / 2400



The concrete screw/bolt is subjected to a shear force of $F_{v,k} = G_k$ and a tension force of $F_{ax,k} = G_k * e / 30$

Annex D54 – ANP

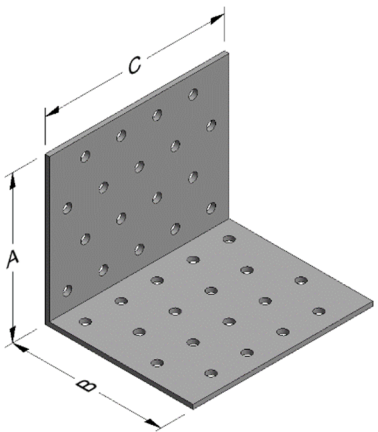
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ANP----	Steel ref. 1	-
ANP----S	Steel ref. 2	-
ANP----S2	Steel ref. 3	-
ANP---Z	Steel ref. 6	-

Connector Size Range:

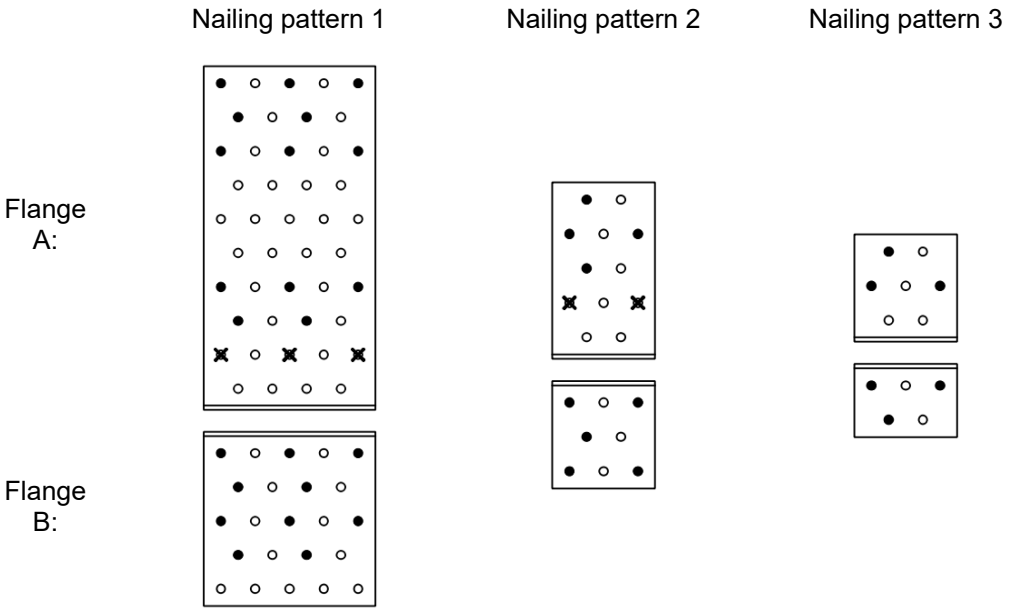
Model no.	Dimensions [mm]				Holes flange A	Holes flange B
	A	B	C	Thickness	Ø5	Ø5
ANP 25 10 10 100 ANP 20 10 10 100	100	100	100	2,5 2,0	23	23
ANP 25 10 10 80 ANP 20 10 10 80	100	100	80	2,5 2,0	18	18
ANP 25 10 10 60 ANP 20 10 10 60	100	100	60	2,5 2,0	13	13
ANP 25 8 8 100 ANP 20 8 8 100	80	80	100	2,5 2,0	18	18
ANP 25 8 8 80 ANP 20 8 8 80	80	80	80	2,5 2,0	14	14
ANP 25 8 8 60 ANP 20 8 8 60	80	80	60	2,5 2,0	10	10
ANP 25 6 6 100 ANP 20 6 6 100	60	60	100	2,5 2,0	14	14
ANP 25 6 6 80 ANP 20 6 6 80	60	60	80	2,5 2,0	11	11
ANP 25 6 6 60 ANP 20 6 6 60	60	60	60	2,5 2,0	8	8
ANP 25 6 6 50 ANP 20 6 6 50	60	60	50	2,5 2,0	6	6
ANP 25 10 20 100 ANP 20 10 20 100	100	200	100	2,5 2,0	45	23
ANP 25 6 10 60 ANP 20 6 10 60	60	100	60	2,5 2,0	12	8
ANP 25 4 6 60 ANP 20 4 6 60	40	60	60	2,5 2,0	7	5

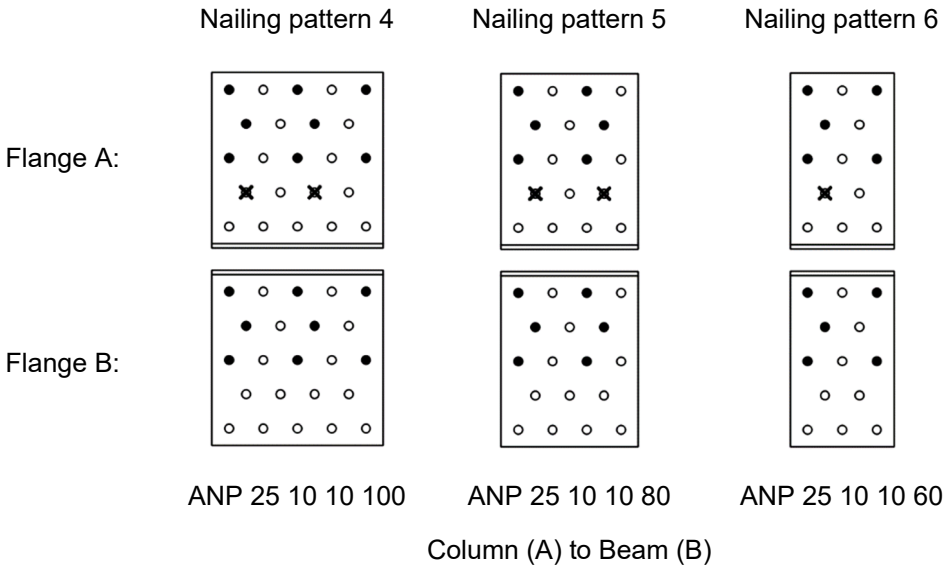
Drawing:

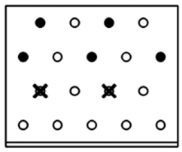
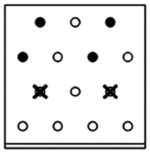
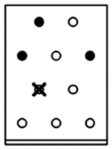
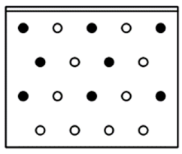
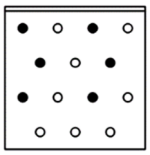
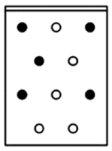


Nailing pattern:

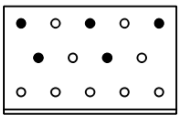
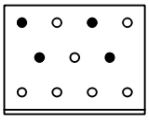
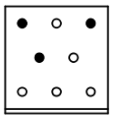
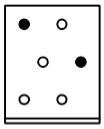
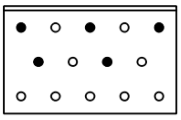
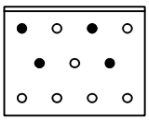
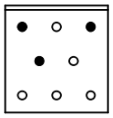
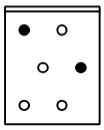
The nail pattern for the product range “ANP20---“ is equal to “ANP25---“ see below:





	Nailing pattern 7	Nailing pattern 8	Nailing pattern 9
Flange A:			
Flange B:			
	ANP 25 8 8 100	ANP 25 8 8 80	ANP 25 8 8 60

Column (A) to Beam (B)
+
Beam (A) to beam (B)
(With additional nails marked with cross
in the 2nd line next to the bending line)

	Nailing pattern 10	Nailing pattern 11	Nailing pattern 12	Nailing pattern 13
Flange A:				
Flange B:				
	ANP 25 6 6 100	ANP 25 6 6 80	ANP 25 6 6 60	ANP 25 6 6 50

Beam (A) to Beam (B)
Info: ANP 25 6 6 40 no values have been determined for this reference because of the minor nail distances.

Table D54-1 Characteristic capacity timber column to timber beam – 2 Angle Brackets

2 Angle Brackets ANP per connection				Characteristic capacity per connection (kN)					
Model No.	Nailing pattern	Number of Fasteners		$R_{1,k}$			$R_{2/3,k}$		
		column	beam	CNA 4.0x40	CNA 4.0x50	CNA 4.0x60	CNA 4.0x40	CNA 4.0x50	CNA 4.0x60
ANP 25 10 10 100	Nailing pattern 4	8	8	6,48	8,30	9,64	9,56	11,80	12,96
ANP 25 10 10 80	Nailing pattern 5	6	6	5,46	6,50	7,16	5,96	7,38	8,16
ANP 25 10 10 60	Nailing pattern 6	5	5	3,88	4,96	6,04	4,90	6,06	6,68
ANP 25 8 8 100	Nailing pattern 7	5	8	6,44	8,14	9,74	7,26	8,90	9,66
ANP 25 8 8 80	Nailing pattern 8	4	6	5,34	6,60	7,26	5,14	6,42	7,02
ANP 25 8 8 60	Nailing pattern 9	3	5	3,88	4,90	5,92	3,16	3,88	4,22
ANP 25 10 20 100	Nailing pattern 1	13	10	7,18	9,56	11,96	11,20	13,74	14,92
ANP 25 6 10 60	Nailing pattern 2	4	5	3,94	5,26	6,58	3,08	3,78	4,10
ANP 20 10 10 100	Nailing pattern 4	8	8	5,84	6,70	7,60	8,06	9,62	10,40
ANP 20 10 10 80	Nailing pattern 5	6	6	4,26	4,80	5,40	5,00	6,00	6,52
ANP 20 10 10 60	Nailing pattern 6	5	5	3,66	4,38	5,00	4,12	4,94	5,34
ANP 20 8 8 100	Nailing pattern 7	5	8	5,84	6,70	7,60	6,16	7,48	8,28
ANP 20 8 8 80	Nailing pattern 8	4	6	4,26	4,80	5,40	4,30	5,22	5,74
ANP 20 8 8 60	Nailing pattern 9	3	5	3,54	4,38	5,00	2,62	3,20	3,58
ANP 20 10 20 100	Nailing pattern 1	13	10	5,52	6,20	6,96	9,20	11,16	11,88
ANP 20 6 10 60	Nailing pattern 2	4	5	3,60	4,40	5,10	1,90	2,32	2,46

Table D54-2 Characteristic capacity timber beam to timber beam – 2 Angle Brackets

2 Angle Brackets ANP per connection				Characteristic capacity per connection (kN)					
Model No.	Nailing pattern	Number of Fasteners		$R_{1,k}$			$R_{2/3,k}$		
		column	beam	CNA 4.0x40	CNA 4.0x50	CNA 4.0x60	CNA 4.0x40	CNA 4.0x50	CNA 4.0x60
ANP 25 10 10 100	Nailing pattern 4	10	8	6,48	8,30	9,64	11,02	13,64	15,00
ANP 25 10 10 80	Nailing pattern 5	8	8	5,46	6,50	7,16	7,76	9,64	10,60
ANP 25 10 10 60	Nailing pattern 6	6	5	3,88	4,96	6,04	5,86	7,22	7,88
ANP 25 8 8 100	Nailing pattern 7	7	8	6,44	8,14	9,74	9,20	11,46	12,70
ANP 25 8 8 80	Nailing pattern 8	6	6	5,34	6,60	7,26	7,28	8,98	9,90
ANP 25 8 8 60	Nailing pattern 9	4	5	3,88	4,90	5,92	3,96	4,94	5,54
ANP 25 6 6 100	Nailing pattern 10	5	5	5,90	7,84	9,26	7,96	9,94	11,06
ANP 25 6 6 80	Nailing pattern 11	4	4	5,12	6,28	7,42	6,02	7,50	8,42
ANP 25 6 6 60	Nailing pattern 12	3	3	3,60	4,80	5,70	3,38	4,20	4,68
ANP 25 6 6 50	Nailing pattern 13	2	2	2,82	3,40	3,96	2,88	3,58	3,96
ANP 25 10 20 100	Nailing pattern 1	16	10	7,18	9,56	11,96	13,14	16,14	17,52
ANP 25 6 10 60	Nailing pattern 2	6	5	3,94	5,26	6,58	5,74	7,10	7,70
ANP 25 6 10 60	Nailing pattern 2	3	3	3,48	4,64	5,80	3,74	4,68	5,32
ANP 20 10 10 100	Nailing pattern 4	10	8	5,84	6,70	7,60	8,06	9,62	10,40
ANP 20 10 10 80	Nailing pattern 5	8	8	4,26	4,80	5,40	5,00	6,00	6,52
ANP 20 10 10 60	Nailing pattern 6	6	5	3,66	4,38	5,00	4,94	5,88	6,30
ANP 20 8 8 100	Nailing pattern 7	7	8	5,84	6,70	7,60	7,72	7,28	10,08
ANP 20 8 8 80	Nailing pattern 8	6	6	4,26	4,80	5,40	6,00	7,10	7,58
ANP 20 8 8 60	Nailing pattern 9	4	5	3,56	4,38	5,00	3,32	4,02	4,42
ANP 20 6 6 100	Nailing pattern 10	5	5	5,44	6,90	8,40	6,26	7,42	7,92
ANP 20 6 6 80	Nailing pattern 11	4	4	4,40	5,54	6,40	4,74	5,64	6,02
ANP 20 6 6 60	Nailing pattern 12	3	3	3,34	4,22	5,16	2,76	3,28	3,50
ANP 20 6 6 50	Nailing pattern 13	2	2	2,32	2,90	3,50	2,42	2,90	3,18
ANP 20 10 20 100	Nailing pattern 1	16	10	5,52	6,20	6,96	9,24	11,22	11,92
ANP 20 6 10 60	Nailing pattern 2	6	5	3,60	4,40	5,10	4,44	5,38	5,72
ANP 20 6 10 60	Nailing pattern 2	3	3	3,50	4,38	5,22	2,58	3,14	3,34

Annex D55 – A-brackets

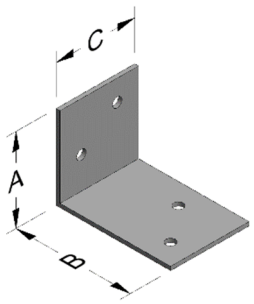
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
A21	Steel ref. 4, G90	-
A23	Steel ref. 4, G90	-
A33	Steel ref. 4, G90	-
A88	Steel ref. 4, G90	-
A21S	Steel ref. 2	-
A23S	Steel ref. 2	-
A33S	Steel ref. 2	-
A88S	Steel ref. 2	-
A21S2	Steel ref. 3	-
A23S2	Steel ref. 3	-
A33S2	Steel ref. 3	-
A88S2	Steel ref. 3	-

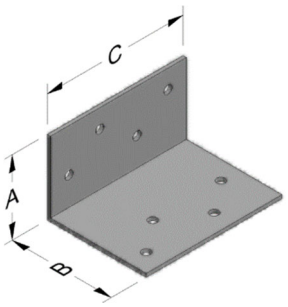
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B		
	A	B	C	Thickness	Ø4	Ø4,34	Ø11,1	Ø4	Ø4,34	Ø11,1
A21	38	50,8	35	1,2	-	2	-	-	2	-
A23	38	50,8	70	1,2	-	4	-	-	4	-
A33	74,6	77,8	38	2,5	4	-	-	4	-	-
A88	203,2	203,2	51	2,5	4	-	3	4	-	3

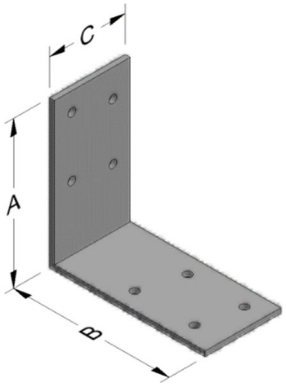
Drawings:



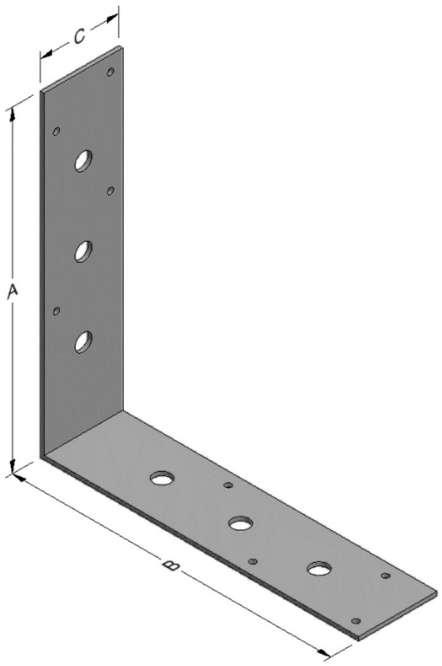
A21



A23

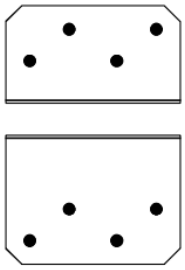
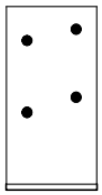
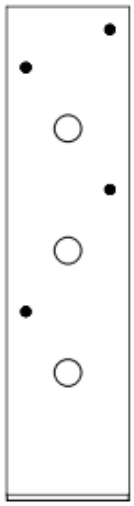
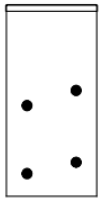
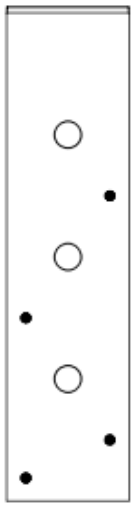


A33



A88

Nailing pattern:

	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3	Nailing pattern 4
Flange A:				
Flange B:				
	A21	A23	A33	A88
	Beam to beam or Column to beam Full nailing	Beam to beam or Column to beam Full nailing	Beam to beam or Column to beam Full nailing	Beam to beam or Column to beam Full nailing

Characteristic Capacities under vertically upward load (F_1)

For the types **A21** and **A23** the following formula needs to be used:
Therefore the values $R_{1,k}$ are stated in the table below.

$$R_{1,d} = R_{1,k} \times \frac{k_{\text{mod}}}{1{,}3}$$

For the types **A33** and **A88** the following formula needs to be used:
The values $R_{1,k}$ + power + $R_{k,steel}$ are stated in Table D55-1 below.

$$R_{1,d} = \min\left(\frac{R_{1,k}}{(k_{\text{mod}})^{power}} \times \frac{k_{\text{mod}}}{1{,}3} ; \frac{R_{k,steel}}{1{,}3} \right)$$

Characteristic Capacities under horizontal load (F2/3)

For $F_{2/3}$-horizontal force the following formula needs to be used:
The values $R_{2/3,k}$ are stated in Table D55-1 below.

$$R_{2/3,d} = R_{2/3,k} \times \frac{k_{\text{mod}}}{1{,}3}$$

Characteristic Capacities under horizontal load (F4/5)

For $F_{4/5}$-horizontal force the following formula needs to be used:
The values for $R_{4/5,k}$ connected with 2 angle brackets and
for $R_{4,k}$ / $R_{5,k}$ connected with 1 angle bracket are stated in Table D55-1 below.
Supported Memer with a minimum width b_t=60mm.
The load capacities $R_{4,k}$ are split in two; with and without rotation of purlin.

$$R_{4/5,d} = R_{4/5,k} \times \frac{k_{\text{mod}}}{1{,}3}$$

Table D55-1 Characteristic capacity timber beam to timber beam or timber column to timber beam – 1 Angle Bracket

1 Angle Bracket A with min b_t = 60 mm per connection				**Characteristic capacity per connection (kN)**					
Model No.	Nailing pattern	Number of Fasteners		**$R_{1,k}$ 1)**			**$R_{k.steel}$**	**$R_{2/3,k}$ 1)**	
		Flange A	Flange B	N3.75x30	N3.75x75 2)	Power		N3.75x30	N3.75x75
A21	Nailing pattern 1	2	2	0,24	-	-	-	0,35	-
A23	Nailing pattern 2	4	4	0,48	-	-	-	1,09	-
A33	Nailing pattern 3	4	4	-	1,15	0,25	1,04	-	2,30
A88	Nailing pattern 4	4	4	-	0,57	1	0,57	-	2,16

1) Characteristic Capacities have been determined in accordance with EN14358 and are based on C24 timber

2) The Characteristic Capacities R1,k and R4/5,k connected with smooth shank nails N3.75x75 shall only be used for short load durations!

Table D55-2 Characteristic capacity timber beam to timber beam or timber column to timber beam – 1 Angle Bracket

1 Angle Bracket A with min b_t = 60 mm per connection				**Characteristic capacity per connection (kN)**									
Model No.	Nailing pattern	Number of Fasteners		**$R_{4,k}$ [1)]**						**$R_{5,k}$ [1)]**			
				N3.75x30			N3.75x75 [2)]			N3.75x30		N3.75x75 [2)]	
		Flange A	Flange B	e (mm)	with rotation	without rotation	e (mm)	with rotation	without rotation	e (mm)	(kN)	e (mm)	(kN)
A21	Nailing pattern 1	2	2	50	0.066 / k_{mod}	0,92	-	-	-	50	0,23	-	-
				100	0.033 / k_{mod}					100	0,13		
				150	0.022 / k_{mod}					150	0,08		
A23	Nailing pattern 2	4	4	50	0.131 / k_{mod}	1,70	-	-	-	50	0,46	-	-
				100	0.066 / k_{mod}					100	0,25		
				150	0.044 / k_{mod}					150	0,17		
A33	Nailing pattern 3	4	4	-	-	-	50	0.28 / k_{mod}	2,00	-	-	50	1.0 / $k_{mod}^{0.5}$
							100	0.14 / k_{mod}				100	0,70
							150	0.10 / k_{mod}				150	0,47
A88	Nailing pattern 4	4	4	-	-	-	50	0,34	2,60	-	-	50	0.57 / k_{mod}
							100	0.20 / k_{mod}				100	0.55 / $k_{mod}^{0.5}$
							150	0.13 / k_{mod}				150	0,47

[1)] Characteristic Capacities have been determined in accordance with EN14358 and are based on C24 timber

[2)] The Characteristic Capacities $R_{1,k}$ and $R_{4/5,k}$ connected with smooth shank nails N3.75x75 shall only be used for short load durations!

Table D55-3 Characteristic capacity timber beam to timber beam or timber column to timber beam – 2 Angle Brackets

2 Angle Brackets A per connection				**Characteristic capacity per connection (kN)**			
Model No.	Nailing pattern	Number of Fasteners		**$R_{4/5,k}$ [1)]**			
				N3.75x30		N3.75x75 [2)]	
		Flange A	Flange B	e (mm)	(kN)	e (mm)	(kN)
A21	Nailing pattern 1	2	2	50	1,15	-	-
				100	1,05		
				150	1,00		
A23	Nailing pattern 2	4	4	50	2,15	-	-
				100	1,95		
				150	1,85		
A33	Nailing pattern 3	4	4	-	-	50	2,95
						100	2,70
						150	2,47
A88	Nailing pattern 4	4	4	-	-	50	3,20
						100	3,15
						150	3,10

[1)] Characteristic Capacities have been determined in accordance with EN14358 and are based on C24 timber

[2)] The Characteristic Capacities $R_{1,k}$ and $R_{4/5,k}$ connected with smooth shank nails N3.75x75 shall only be used for short load durations!

Annex D56 – ABR98 & ABRL98

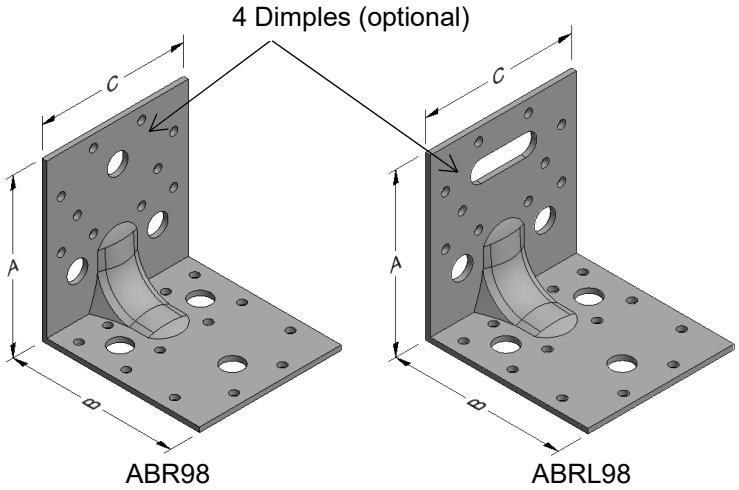
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR98	Steel ref. 1	-
ABRL98	Steel ref. 1	-
ABR98S	Steel ref. 2	-
ABRL98S	Steel ref. 2	-
ABR98S2	Steel ref. 3	-
ABRL98S2	Steel ref. 3	-
ABR98Z	Steel ref. 6	-
ABRL98Z	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Oblong 40x13	Ø5	Ø13
ABR98	98	98	88	3,0	10	3	0	12	3
ABRL98	98	98	88	3,0	10	2	1	12	3

Drawings:



ABR98 ABRL98

Nailing pattern:

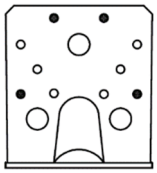
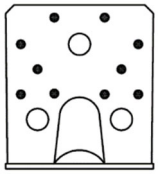
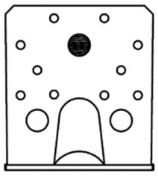
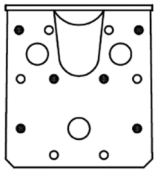
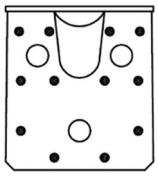
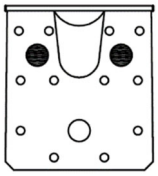
	Nailing pattern 1	Nailing pattern 2	Nailing pattern 3
Flange A:			
Flange B:			
	Beam to beam Minimum nailing ABR98 & ABRL98	Beam to beam Maximum nailing ABR98 & ABRL98	Rigid to rigid ABR98 & ABRL98

Table D56-1 Characteristic capacity beam to beam – 2 Angle Brackets

2 Angle Brackets ABR98 or ABRL98 per connection			**Characteristic capacity (kN) per connection**												
			$F_{1,k}$				**$F_{2/3,k}$**				**$F_{4/5,k}$ 1)**				
Nailing pattern	Number of fasteners		CNA Connector Nail 4,0 x ℓ												
	Flange A	Flange B	35	40	50	60	35	40	50	60	e (mm)	35	40	50	60
Nailing pattern 1	4	6	5,9	7	9	10,8	6	6,9	8,8	9,7	50	11,2	12,5	14,2	14,7
											100	10,6	11,8	13,3	13,6
											150	10,4	11,5	12,9	13,1
Nailing pattern 2	10	12	9,8	11,8	15,7	19,7	12,1	13,7	17,5	19,8	50	14,9	15,5	16,5	17,1
											100	13,6	13,9	14,4	14,9
											150	13,1	13,3	13,7	14

1) Minimum width of timber member b_t = 60 mm

Regarding $F_{2/3}$ – other fasteners may be used using the following formula and factors. Alternatively, the values from above table can be reduced accordingly:

$$R_{2/3,k} = \min\left\{\begin{array}{l}\sqrt{\dfrac{1}{\left(\dfrac{1}{k_{lat.v}\times R_{lat.k}}\right)^2+\left(\dfrac{1}{k_{ax.v}\times R_{ax.k}}\right)^2}} \\ \sqrt{\dfrac{1}{\left(\dfrac{1}{k_{lat.h}\times R_{lat.k}}\right)^2+\left(\dfrac{1}{k_{ax.h}\times R_{ax.k}}\right)^2}}\end{array}\right.$$

Factor	Nailing pattern 1	Nailing pattern 2
$k_{lat.v}$	2,1	4,3
$k_{ax.v}$	41,3	30,7
$k_{lat.h}$	2,9	5,4
$k_{ax.h}$	6,2	13,3

Table D56-2: Characteristic capacity timber beam to rigid support – 2 Angle Brackets

2 Angle Brackets ABR98 or ABRL98 per connection			**Characteristic capacity (kN) per connection**
Nailing pattern	Number of fasteners		**$R_{1,k}$**
	Flange A	Flange B	
Nailing pattern 3	1 M12 Bolt	2 M12 Bolts2)	17,3[1)]

1) k_{mod} =1,0 for all load durations.
2) For each bolt it must be checked that: $R_{bolt,ax,d} \geq 0,5 \times F_{1,d}$

Annex D57 – AB105/513

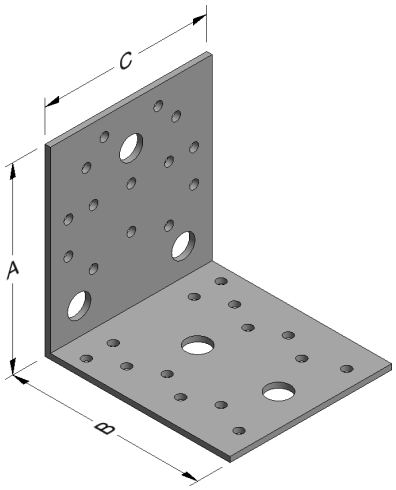
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB105/513	Steel ref. 1	-
AB105/513S	Steel ref. 2	-
AB105/513S2	Steel ref. 3	-
AB105/513Z	Steel ref. 6	-

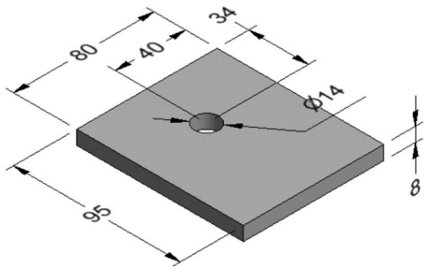
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø13	Ø5	Ø13
AB105/513	105	105	90	3,0	14	3	14	2

Drawings:



AB105/513



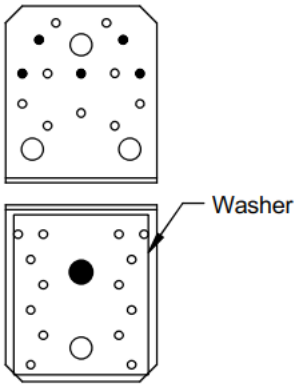
Washer

Nailing pattern:

Nailing pattern 1

Flange A:

Flange B:



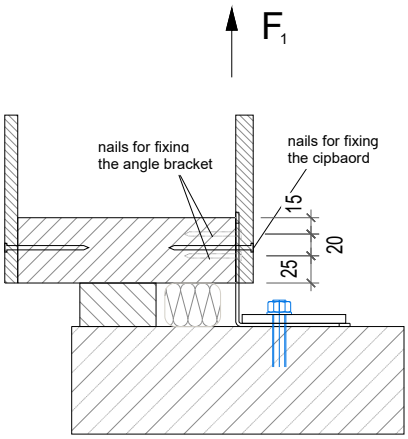
Beam (A) to rigid (B)

Table D57-1 Characteristic capacity timber beam to rigid – 1 Angle Bracket

1 Angle Bracket ABR105/513 per connection				Characteristic capacity per connection (kN)	
Nailing pattern	Number of Fasteners		Installation	$R_{1,k}$	
	Flange A	Flange B		CNA4,0xl or CSA5,0xl	
				min. of	
Nailing pattern 1	5 nails Ø 4,0 or 5 CSA5,0 x l	1 bolt Ø12mm	Normal [1]	n x $R_{lat,k}$	10,1/k_{mod}
			Special [2]	n x $R_{lat,k}$ x 0,8	10,1/k_{mod}

1) Normal = spacing of nails accoding to EN 1995-1-1
2) Special = spacing of nails according to figure below

The washer with t ≥ 8 mm has to fulfil the minimum requirement: steel with $f_{y,k}$ ≥ 235 N/mm²



With:

n = number of nails
$R_{lat,k}$ = characteristic lateral Load-carrying capacity of one connector nail / screw

It is to check additionally for the anchorage: $R_{bolt,ax,d}$ ≥ $F_{1,d}$ x 1,47

With:

$R_{bolt,ax,d}$ = the axial design capacity of the anchor / bolt

Annex D58 – ABR255

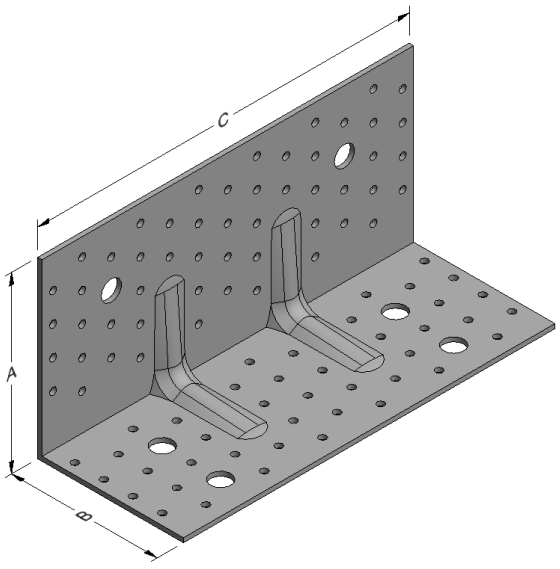
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR255	Steel ref. 1	-
ABR255S	Steel ref. 2	-
ABR255S2	Steel ref. 3	-
ABR255Z	Steel ref. 6	-

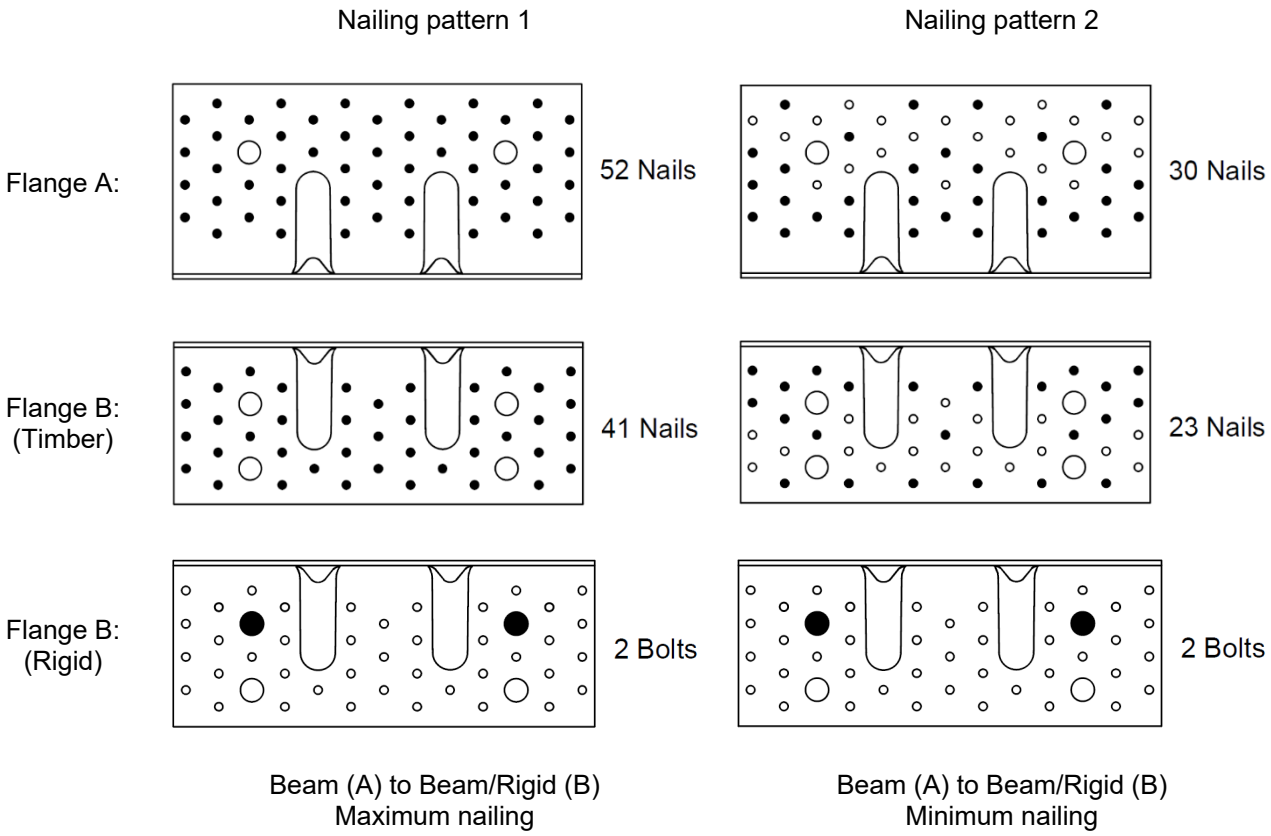
Connector Size Range:

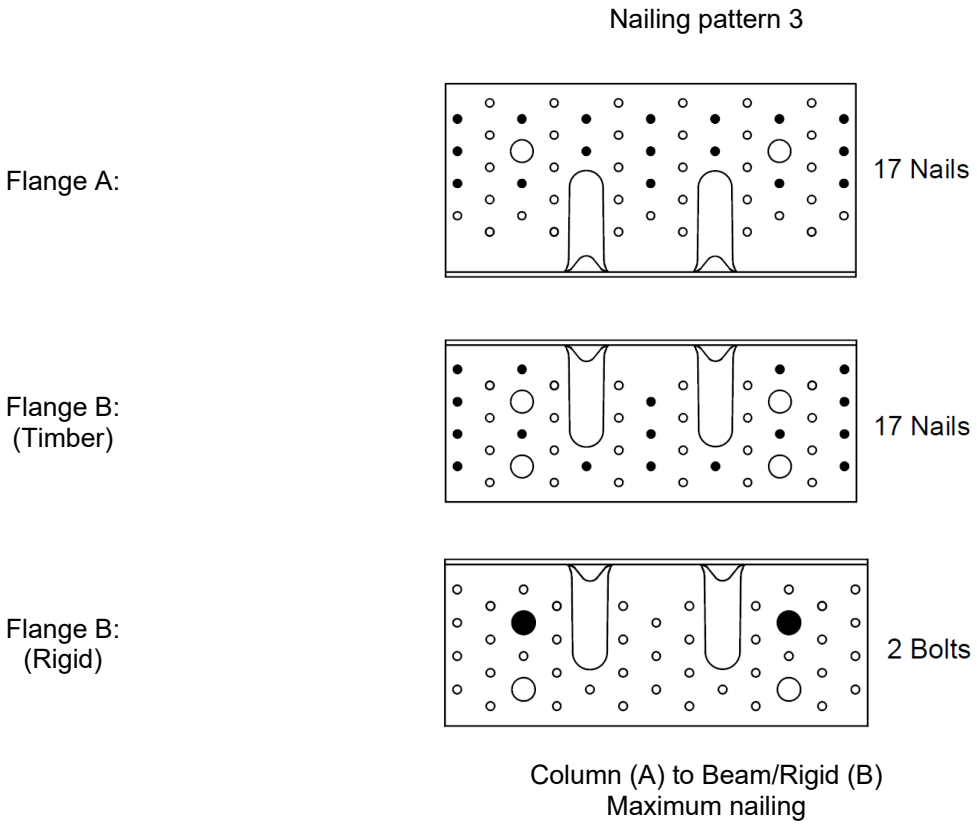
Model no.	Dimensions [mm]				Holes flange A		Holes flange B	
	A	B	C	Thickness	Ø5	Ø14	Ø5	Ø14
ABR255	120	100	255	3,0	52	2	41	4

Drawing:

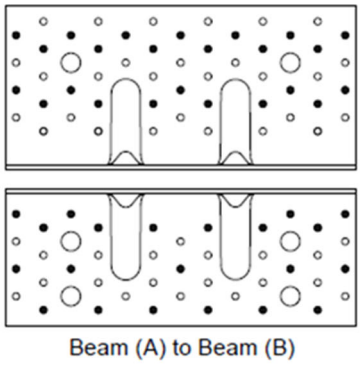


Nailing pattern:

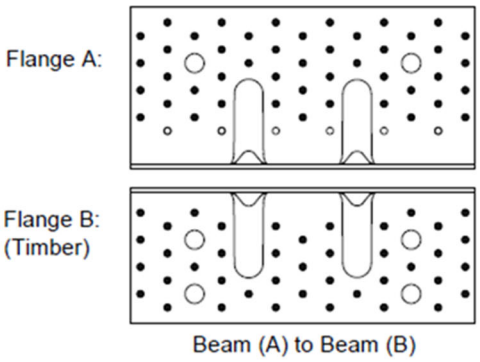




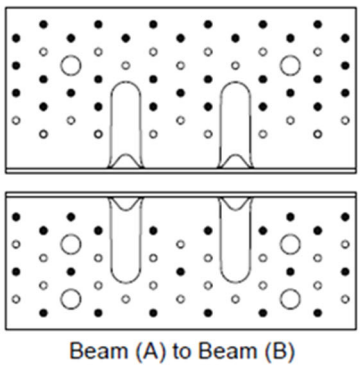
Nailing pattern 4



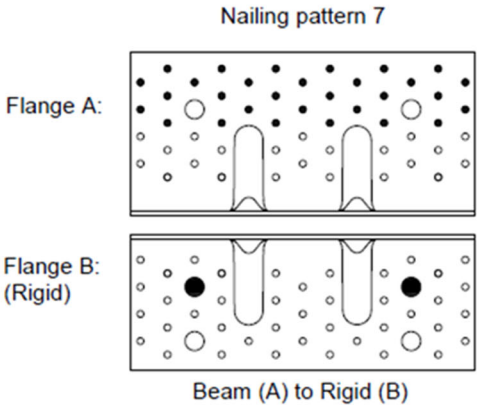
Nailing pattern 5



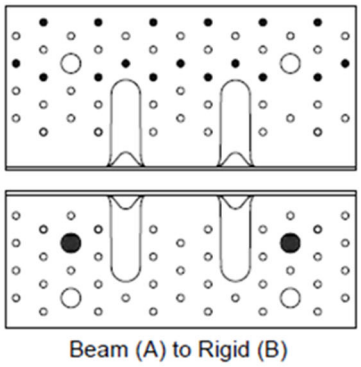
Nailing pattern 6



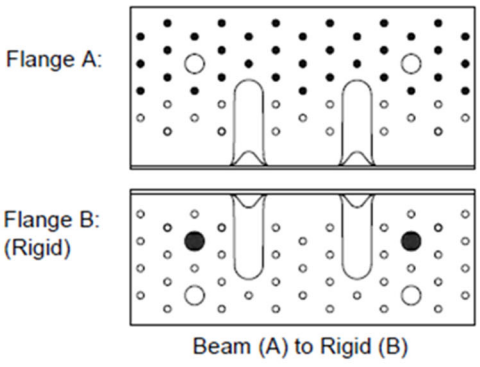
Nailing pattern 7



Nailing pattern 8

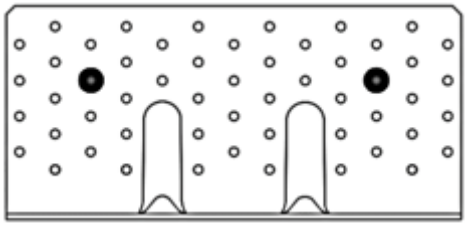


Nailing pattern 9

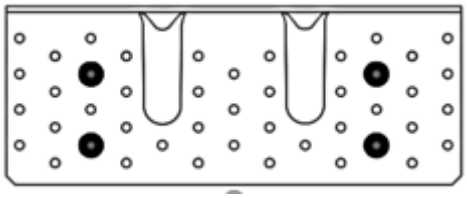


Nailing pattern 10

Flange A:



Flange B:
(Timber)



Timber beam (A) to timber beam (B)
with large connector screws type SS-H

Characteristic Capacities:

The values $R_{i,k}$ for one ABR255 per connection, with prevention of rotation (so that only shear force is acting), are stated in the tables below.
For a connection with 2 x ABR255 the values can be doubled.

Table D58-1: Characteristic capacity beam to beam – 1 Angle Bracket F_1

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection $R_{1,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	41	min of: $14,1/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $16/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $19,5/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $22,5/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $28/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $34,5/k_{mod}$^0,4 $23,6/k_{mod}$	$23,6/k_{mod}$
Nailing pattern 2	30	23	min of: $12,2/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $13,7/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $16,5/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $19,5/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $23,8/k_{mod}$^0,4 $23,6/k_{mod}$	min of: $28/k_{mod}$^0,4 $23,6/k_{mod}$	$23,6/k_{mod}$
Nailing pattern 3	17	17	min of: $10,2/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $11,2/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $13,1/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $15/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $18,3/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $22,3/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $27,2/k_{mod}$^0,4 $26,2/k_{mod}$
Nailing pattern 4	24	21	-	-	min of: $15,6/k_{mod}$^0,4 $26,2/k_{mod}$	min of: $18,1/k_{mod}$^0,4 $26,2/k_{mod}$	-	-	-
Nailing pattern 5	46	41	-	-	-	-	-	-	$23,6/k_{mod}$

In case of nailing pattern 4 and fastener CNA4,0x60 , the same capacities are also valid for an installation with an underlay below the ABR255 flange B. The material is Vibradyn S750 to S1500 (SIT750-100-6 to SIT1500-100-6) with a thickness of 6 mm.
Below the CLT element, which is fixed with flange A, it´s also an underlay up to a thickness of 12,5mm possible.

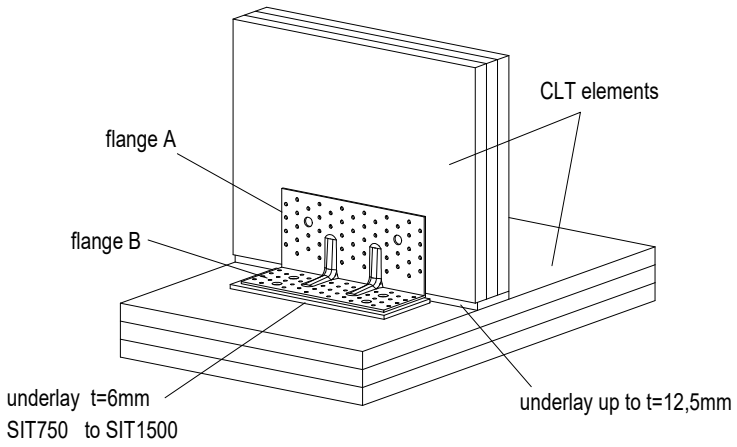


Table D58-2: Characteristic capacity beam to beam – 1 Angle Bracket $F_{2/3}$

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection						
			$R_{2/3,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	41	33.5	37.0	45.9	50.5	41.6	52.6	58.6
Nailing pattern 2	30	23	27.4	30.5	38.0	42.1	34.8	43.8	48.1
Nailing pattern 3	17	17	15.5	17.0	20.9	22.9	18.2	23.0	26.1
Nailing pattern 4	24	21	-	-	28,6	31,4	-	-	-
Nailing pattern 5	46	41	-	-	-	-	-	-	51.7
Nailing pattern 6	32	21	-	-	36,1	39.2	-	-	-

In case of nailing pattern 4 and fastener CNA4,0x60 , the same capacities are also valid for an installation with an underlay below the ABR255 flange B. The material is Vibradyn S750 to S1500 (SIT750-100-6 to SIT1500-100-6) with a thickness of 6 mm.
Below the CLT element, which is fixed with flange A, it´s also an underlay up to a thickness of 12,5mm possible.

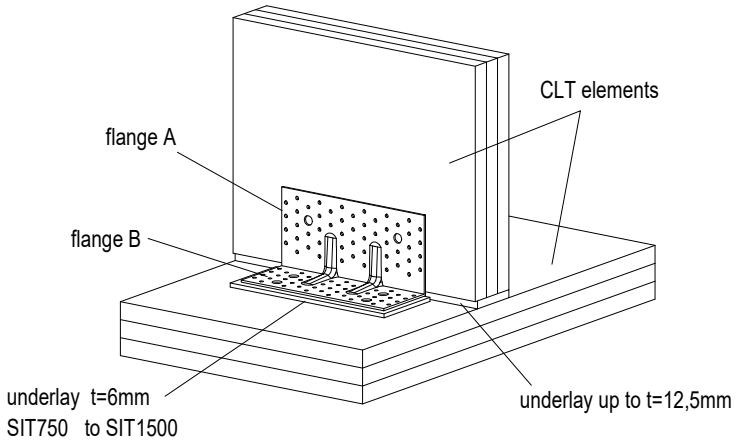


Table D58-3: Characteristic capacity beam to beam – 1 Angle Bracket F_4

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection						
			$R_{4,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	41	12.5	14.9	18.2	21.1	min of: 29.4/k_{mod}^0.5 25.1	min of: 29.4/k_{mod}^0.5 29.9	min of: 29.4/k_{mod}^0.5 36.4
Nailing pattern 2	30	23	12.2	13.8	16.9	19.5	min of: 29.4/k_{mod}^0.5 22.4	min of: 29.4/k_{mod}^0.5 26.9	min of: 29.4/k_{mod}^0.5 32.4
Nailing pattern 3	17	17	8.3	9.5	11.7	13.6	15.9	19.2	23.4
Nailing pattern 4	24	21	-	-	15.9	18.3	-	-	-
Nailing pattern 5	46	41	-	-	-	-	-	-	min of: 29.4/k_{mod}^0.5 37.5

Table D58-4: Characteristic capacity beam to beam – 1 Angle Bracket F_5

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection						
			$R_{5,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	41	min of: 14.3/k_{mod}^0.4 13.4/k_{mod}	min of: 15.7/k_{mod}^0.4 13.4/k_{mod}	min of: 18.8/k_{mod}^0.4 13.4/k_{mod}	13.4/k_{mod}	13.4/k_{mod}	13.4/k_{mod}	13.4/k_{mod}
Nailing pattern 2	30	23	min of: 11.5 13.9/k_{mod}	min of: 13.6 13.9/k_{mod}	min of: 18.0 13.9/k_{mod}	min of: 22.0 13.9/k_{mod}	min of: 25.8 13.9/k_{mod}	13.9/k_{mod}	13.9/k_{mod}
Nailing pattern 3	17	17	min of: 4.2 11.2/k_{mod}	min of: 4.7 11.2/k_{mod}	min of: 5.5 11.2/k_{mod}	min of: 5.7 11.2/k_{mod}	min of: 6.0 11.2/k_{mod}	min of: 6.4 11.2/k_{mod}	min of: 6.9 11.2/k_{mod}
Nailing pattern 4	24	21	-	-	10.8/k_{mod}^0.3	min of: 12.7/k_{mod}^0.3 12.8/k_{mod}	-	-	-
Nailing pattern 5	46	41	-	-	-	-	-	-	12.4/k_{mod}

Table D58-5: Characteristic capacity beam to rigid support – 1 Angle Bracket F_1

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection						
			$R_{1,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	2 x M12 Bolts	min of: 36,8 $22/k_{mod}$	min of: 43,3 $22/k_{mod}$	min of: 56,7 $22/k_{mod}$	min of: 67,9 $22/k_{mod}$	min of: 72,3 $22/k_{mod}$	min of: 92,5 $22/k_{mod}$	min of: 109,8 $22/k_{mod}$
Nailing pattern 2	30	2 x M12 Bolts	min of: 15,94 $22/k_{mod}$	min of: 18,8 $22/k_{mod}$	min of: 24,8 $22/k_{mod}$	min of: 30,3 $22/k_{mod}$	min of: 35,1 $22/k_{mod}$	min of: 45,2 $22/k_{mod}$	min of: 56 $22/k_{mod}$
Nailing pattern 3	17	2 x M12 Bolts	min of: 15,3 $22/k_{mod}$	min of: 17,9 $22/k_{mod}$	min of: 23,1 $22/k_{mod}$	min of: 27 $22/k_{mod}$	min of: 26,4 $22/k_{mod}$	min of: 33,6 $22/k_{mod}$	min of: 38,7 $22/k_{mod}$
Nailing pattern 8	17	2 x M12 Bolts	-	-	min of: 23,4 $22/k_{mod}$	min of: 27,3 $22/k_{mod}$	-	-	-
Nailing pattern 9	35	2 x M12 Bolts	-	-	-	-	-	-	min of: 79,5 $22/k_{mod}$

The bolt group shall be checked using the following expression:

$$F_{ax.d.bolt} = R_{1.d} \text{ x } 1.1$$

Table D58-6: Characteristic capacity beam to rigid support – 1 Angle Bracket $F_{2/3}$ horizontal force

Table D58-6-1: optimized for bolts

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection $R_{2/3,k}$ Optimized for Bolts *)						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	2 x M12 Bolts	min of: 33,0 $42,9/k_{mod}$	min of: 36,0 $42,9/k_{mod}$	min of: 45,3 $42,9/k_{mod}$	min of: 49,2 $42,9/k_{mod}$	min of: 39,6 $42,9/k_{mod}$	min of: 49,7 $42,9/k_{mod}$	min of: 54,4 $42,9/k_{mod}$
Nailing pattern 2	30	2 x M12 Bolts	min of: 21,6 $42,9/k_{mod}$	min of: 23,7 $42,9/k_{mod}$	min of: 29,3 $42,9/k_{mod}$	min of: 32,0 $42,9/k_{mod}$	min of: 25,3 $42,9/k_{mod}$	min of: 31,8 $42,9/k_{mod}$	min of: 34,7 $42,9/k_{mod}$
Nailing pattern 3	17	2 x M12 Bolts	min of: 12,9 $42,9/k_{mod}$	min of: 14,2 $42,9/k_{mod}$	min of: 17,3 $42,9/k_{mod}$	min of: 18,5 $42,9/k_{mod}$	min of: 14,4 $42,9/k_{mod}$	min of: 18,1 $42,9/k_{mod}$	min of: 19,6 $42,9/k_{mod}$
) b=0 & e=0									

The bolt group have to be checked for:

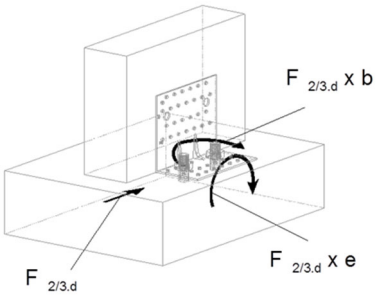


Table D58-6-2: optimized for nails

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection $R_{2/3,k}$ Optimized for Nails **)						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	2 x M12 Bolts	min of: 47,1 61,3/k_{mod}	min of: 52,3 61,3/k_{mod}	min of: 64,8 61,3/k_{mod}	min of: 70,3 61,3/k_{mod}	min of: 56,5 61,3/k_{mod}	min of: 71,1 61,3/k_{mod}	min of: 77,7 61,3/k_{mod}
Nailing pattern 2	30	2 x M12 Bolts	min of: 30,9 61,3/k_{mod}	min of: 33,9 61,3/k_{mod}	min of: 41,8 61,3/k_{mod}	min of: 45,7 61,3/k_{mod}	min of: 36,2 61,3/k_{mod}	min of: 45,5 61,3/k_{mod}	min of: 49,6 61,3/k_{mod}
Nailing pattern 3	17	2 x M12 Bolts	min of: 18,5 57,6/k_{mod}	min of: 20,2 57,6/k_{mod}	min of: 24,8 57,6/k_{mod}	min of: 26,4 57,6/k_{mod}	min of: 20,6 57,6/k_{mod}	min of: 25,8 57,6/k_{mod}	min of: 8 57,6/k_{mod}
Nailing pattern 7	30	2 x M12 Bolts	-	-	min of: 39,8 57,6/k_{mod}	min of: 42,5 57,6/k_{mod}	-	-	-
Nailing pattern 8	17	2 x M12 Bolts	-	-	min of: 24,9 57,6/k_{mod}	min of: 26,5 57,6/k_{mod}	-	-	-
Nailing pattern 9	35	2 x M12 Bolts	-	-	-	-	-	-	min of: 58,0 57,6/k_{mod}

**) Different lever arms for:
Nailing pattern 1: b = 28 mm ; e = 15 mm - Intermediate values of b and e can be found by linear interpolation
Nailing pattern 2: b = 28 mm ; e = 15 mm - Intermediate values of b and e can be found by linear interpolation
Nailing pattern 3: b = 38 mm ; e = 20 mm - Lever arms are fixed
Nailing pattern 7: b = 38 mm ; e = 20 mm - Lever arms are fixed
Nailing pattern 8: b = 38 mm ; e = 20 mm - Lever arms are fixed
Nailing pattern 9: b = 38 mm ; e = 20 mm - Lever arms are fixed

The bolt group shall be checked using the following expressions:

$$V_{y.d} = R_{2/3.d} \qquad M_{x.d} = R_{2/3.d} \times e \qquad M_{y.d} = R_{2/3.d} \times b$$

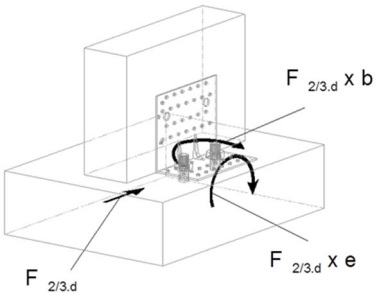


Table D58-7: Characteristic capacity beam to rigid support – 1 Angle Bracket F_4

1 Angle Bracket ABR255 per connection			Characteristic capacity (kN) per connection						
			$R_{4,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	2 x M12 Bolts	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7
Nailing pattern 2	30	2 x M12 Bolts	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7
Nailing pattern 3	17	2 x M12 Bolts	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7
Nailing pattern 8	17	2 x M12 Bolts	-	-	$18.3/k_{mod}$^0,7	$18.3/k_{mod}$^0,7	-	-	-
Nailing pattern 9	35	2 x M12 Bolts	-	-	-	-	-	-	$18.3/k_{mod}$^0,7

The combination of lateral and axial load on the bolt group shall be checked, with

Axial load applied: $F_{ax.bolt.d} = 0.4 \times F_{4.d}$

Lateral load applied: $F_{lat.bolt.d} = F_{4.d}$

Table D58-8: Characteristic capacity beam to rigid support – 1 Angle Bracket F_5

1 Angle Bracket ABR255 per connection			Axial bolt factor	Characteristic capacity (kN) per connection						
				$R_{5,k}$						
Nailing pattern	Number of fasteners			CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	$k_{ax.b}$	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	52	2 x M12 Bolts	1.1	min of: $17.1/k_{mod}$^0.25 $17.7/k_{mod}$	min of: $19.5/k_{mod}$^0.25 $17.7/k_{mod}$	min of: $23.5/k_{mod}$^0.25 $17.7/k_{mod}$	min of: $27.3/k_{mod}$^0.25 $17.7/k_{mod}$	$17.7/k_{mod}$	$17.7/k_{mod}$	$17.7/k_{mod}$
Nailing pattern 2	30	2 x M12 Bolts	1.1	$15.3/k_{mod}$^0.6	$16.5/k_{mod}$^0.6	min of: $19.9/k_{mod}$^0.4 $17.7/k_{mod}$	min of: $23.3/k_{mod}$^0.4 $17.7/k_{mod}$	$17.7/k_{mod}$	$17.7/k_{mod}$	$17.7/k_{mod}$
Nailing pattern 3	17	2 x M12 Bolts	2	$5.2/k_{mod}$^0.7	$5.7/k_{mod}$^0.6	$6.5/k_{mod}$^0.6	$7.4/k_{mod}$^0.5	$8.2/k_{mod}$^0.5	$8.5/k_{mod}$^0.5	$9.2/k_{mod}$^0.5
Nailing pattern 8	17	2 x M12 Bolts	2.2	-	-	$5.9/k_{mod}$^0.6	$6.7/k_{mod}$^0.5	-	-	-
Nailing pattern 9	35	2 x M12 Bolts	2	-	-	-	-	-	-	$9.43/k_{mod}$^0.5

The combination of lateral and axial load on each bolt shall be checked, with

Axial load applied on each bolt: $F_{ax.bolt.d} = k_{ax.b} \times F_{5.d} / 2$

Lateral load applied on each bolt: $F_{lat.bolt.d} = F_{5.d} / 2$

$k_{ax.b}$ is given in the table D58-8 above

Nailing pattern NP4, NP5, NP6, NP7, NP8 and NP9 have been specifically developed for cross laminated timber application. They can be used for applications with other timber based materials provided that the materials comply with the spacing and distances of fasteners in CLT.

Table D58-9: ABR255 Slip modulus K_{ser} – timber to rigid

1 Angle Bracket ABR255 per connection			Slip modulus k_{ser} (kN/mm)														
			For force F_1							For force F_2							
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws			CNA Connector Nails				CSA Connector Screws			
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50	
Nailing pattern 1	52	2 x M12 Bolts	6.1	7.2	9.4	11.3	12.0	15.4	18.3	8.5	9.5	11.7	12.7	10.2	12.9	14.1	
Nailing pattern 2	30	2 x M12 Bolts	2.6	3.1	4.1	5.0	5.8	7.5	9.3	5.6	6.1	7.6	8.3	6.6	8.2	9.0	
Nailing pattern 3	17	2 x M12 Bolts	2.5	3.0	3.8	4.5	4.4	5.6	6.4	3.3	3.7	4.5	4.8	3.7	4.7	5.1	
Nailing pattern 7	30	2 x M12 Bolts	-	-	-	-	-	-	-	-	-	7.2	7.7	-	-	-	
Nailing pattern 8	17	2 x M12 Bolts	-	-	3.8	4.5	-	-	-	-	-	4.5	4.8	-	-	-	
Nailing pattern 9	35	2 x M12 Bolts	-	-	-	-	-	-	13.2	-	-	-	-	-	-	10.5	

Table D58-10: ABR255 Slip modulus Kser – timber to timber

1 Angle Bracket ABR255 per connection			Slip modulus k_{ser} (kN/mm)														
			For force F_1							For force F_2							
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws			CNA Connector Nails				CSA Connector Screws			
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50	
Nailing pattern 1	52	41	6.9	7.9	9.6	11.1	13.8	17.0	-	4.6	5.1	6.3	6.9	5.7	7.2	8.0	
Nailing pattern 2	30	23	6.0	6.7	8.1	9.6	11.7	13.8	-	3.8	4.2	5.2	5.8	4.8	6.0	6.6	
Nailing pattern 3	17	17	5.0	5.5	6.4	7.4	9.0	11.0	13.4	2.1	2.3	2.9	3.1	2.5	3.1	3.6	
Nailing pattern 4	24	21	-	-	7.7	8.9	-	-	-	-	-	3.9	4.3	-	-	-	
Nailing pattern 5	46	41	-	-	-	-	-	-	-	-	-	-	-	-	-	7.1	
Nailing pattern 6	32	21	-	-	-	-	-	-	-	-	-	4.9	5.4	-	-	-	

Table D58-11 Characteristic capacity CLT timber beam to CLT timber beam – 1 Angle Bracket ABR255 – Nailing pattern 10

CLT to CLT connection		1 angle bracket per connection					
Item	Nailing Pattern	Fasteners				Characteristic capacities [kN] - CLT	
		Header		Joist		$R_{1,k}$	$R_{2,k}$
		Qty	Type	Qty	Type	SS-H Ø12x80	SS-H Ø12x80
ABR255	Nailing pattern 10	4	SS-H	2	SS-H	13,4	18,4

CLT density was considered as C24 - $\rho_k = 350$ kg/m³

Table D58-12 ABR255 Slip modulus K_{ser}

Configuration	Nailling pattern	R_1 load direction	R_2 load direction
		k_{ser} [kN/mm]	k_{ser} [kN/mm]
		SS-H Ø12x80	SS-H Ø12x80
CLT to CLT (with SS-H screws)	10	1,84	2,69

These slip modulus are given for 1 angle bracket. In case of 2 brackets, values can be obtained by multiplying the above by 2.

Table D58-13 Ductility class for CLT timber beam to CLT timber beam – 1 Angle Bracket ABR255 – Nailing pattern 3

CLT to CLT connection				1 angle bracket per connection		
Item	Nailing Pattern	Fasteners				Ductility class for lateral load F2/F3
		Header		Joist		
		Qty	Type	Qty	Type	
ABR255	Nailing pattern 3	17	CNA4,0x50	17	CNA4,0x50	DCL

DCL = Low ductility class

Table D58-14 Ductility class for CLT timber beam to rigid support – 1 Angle Bracket ABR255 – Nailing pattern 3

CLT to rigid support connection				1 angle bracket per connection		
Item	Nailing Pattern	Fasteners				Ductility class for lateral load F2/F3
		Header		Joist		
		Qty	Type	Qty	Type	
ABR255	Nailing pattern 3	2	Bolt Ø12 + washer	17	CNA4,0x50	DCL

DCL = Low ductility class

Annex D59 – ABD45100 & ABDW45100

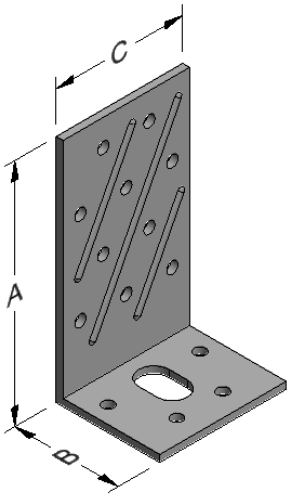
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABD45100	Steel ref. 1	-
ABDW45100	Steel ref. 1	-
ABD45100S	Steel ref. 2	-
ABDW45100S	Steel ref. 2	-
ABD45100S2	Steel ref. 3	-
ABDW45100S2	Steel ref. 3	-
ABD45100Z	Steel ref. 6	-
ABDW45100Z	Steel ref. 6	-

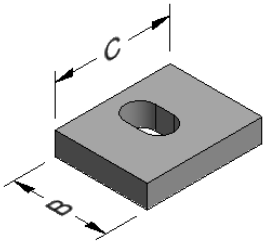
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	Ø5	Ø5	Ø13x21
ABD45100 ABDW45100	100	45	55	3,0	10	4	1
Washer	-	40	50	10	0	0	1

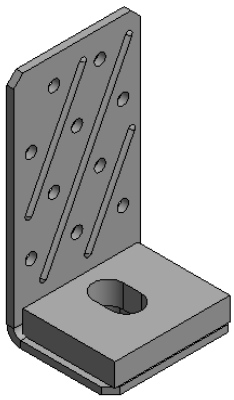
Drawings:



ABD45100



Washer



ABDW45100

Nailing pattern:

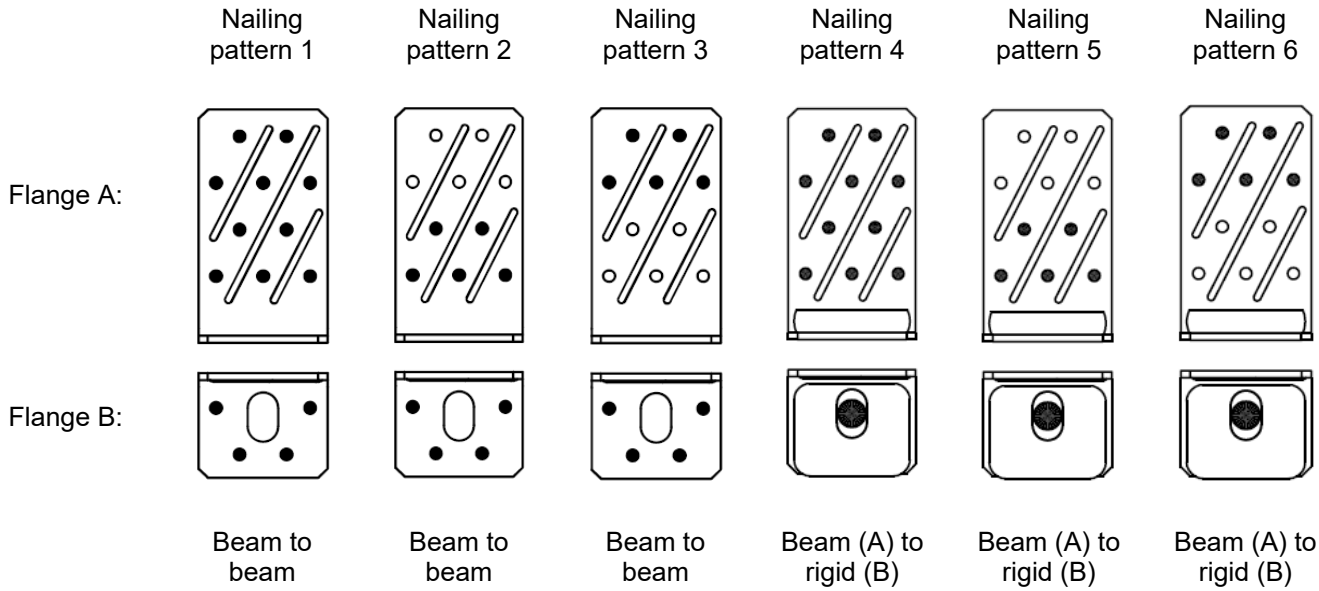


Table D59-1: Characteristic capacity 1 Angle Bracket

1 Angle Bracket ABD45100/ABDW45100 per connection			**Characteristic capacities $R_{1,k}$ [kN] per connection**			
Nailing pattern	Number of fasteners		CNA connector nails			
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	10	4	Min of:	Min of:		
Nailing pattern 2	5	4	1,47	1,96	21,2 / ((f+15) x k_{mod})	21,2 / ((f+15) x k_{mod})
Nailing pattern 3	5	4	21,2 / ((f+15) x k_{mod})	21,2 / ((f+15) x k_{mod})		
Nailing pattern 4	10	1 Bolt	36,5 / ((f + 6) x k_{mod})			
Nailing pattern 5	5	1 Bolt				
Nailing pattern 6	5	1 Bolt				

The necessary capacity of bolt has to be as minimum:

$R_{bolt.axial} = F_{1.d}$ x (40 mm + f) / 23 mm

f in [mm]

Table D59-2: Characteristic capacity 2 Angle Brackets

2 Angle Brackets ABD45100/ABDW45100 per connection			**Characteristic capacities [kN] per connection**				**Characteristic capacities [kN] per connection**			
			$R_{1,k}$				**$R_{2/3,k}$**			
Nailing pattern	Number of fasteners		CNA connector nails				CNA connector nails			
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	4,0x35	4,0x40	4,0x50	4,0x60
Nailing pattern 1	10	4	2,94	3,92	4,9	5,81	6,07	7,01	8,86	10,18
Nailing pattern 2	5	4	2,94	3,92	4,9	5,81	5,65	6,22	7,47	8,12
Nailing pattern 3	5	4	2,94	3,92	4,9	5,81	3,49	3,82	4,57	4,94
Nailing pattern 4	10	1 Bolt	$16,2/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	4,82	6,26	7,51	8,58
Nailing pattern 5	5	1 Bolt	$15,4/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	4,1	5,2	6,05	6,73
Nailing pattern 6	5	1 Bolt	$16,2/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	$16,2/k_{mod}$	1,3	1,7	2,05	2,36

The necessary capacity of bolt has to be as minimum:

$R_{bolt.axial} = F_{1.d} \times 1.65$

$R_{bolt.axial} = F_{2.d} \times 0.4$ $R_{bolt.lat} = F_2$

With:

$R_{bolt.axial}$ = axial capacity of the bolt / both bolts (connection with 1 / 2 ABD)

$R_{bolt.lat}$ = lateral capacity of the bolt / both bolts (connection with 1 / 2 ABD)

For connection with one ABD, the half of capacities as for connection with 2 ABD can be used, if the timber elements are prevented against rotation.

Annex D60 – ADR6090L

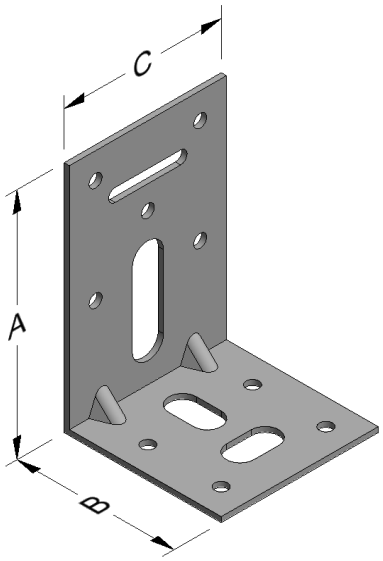
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ADR6090L	Steel ref. 1	-
ADR6090LS	Steel ref. 2	-
ADR6090LS2	Steel ref. 3	-
ADR6090LZ	Steel ref. 6	-

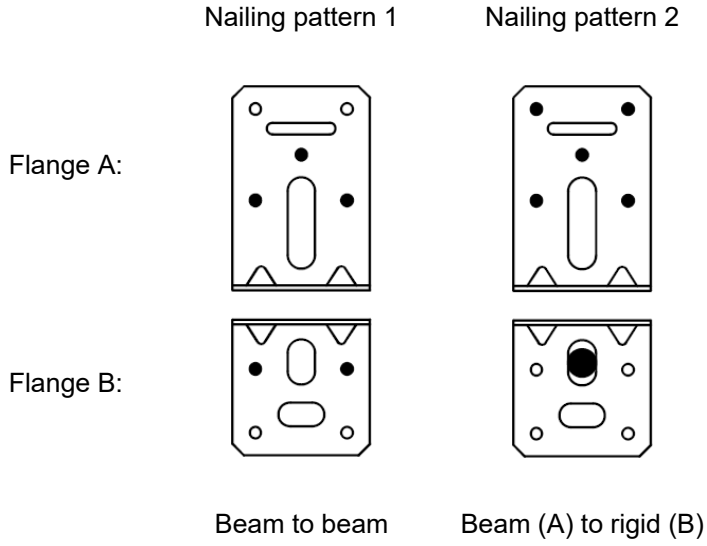
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B		
	A	B	C	Thickness	Ø5	Oblong 12x40	Oblong 5x30	Ø5	Oblong 12x20	Oblong 10,5x20
ADR6090L	89,5	59,5	60	2,0	5	1	1	4	1	1

Drawing:



Nailing pattern:



Characteristic Capacities:

The values $R_{i,k}$ for one ADR6090L per connection are stated in the tables below.
For a connection with 2 x ADR6090L the values ("rotation is prevented") can be doubled.

Table D60-1 Timber to timber - F1 - 1 Angle Bracket

1 x ADR6090L per Connection	**Characteristic capacity $R_{1,k}$ per connection [kN]**	
Nailing pattern 1 Flange A: 3 Flange B: 2	Purlin is free to rotate	Purlin is prevented to rotate
Fastener		
CNA4,0x35	min. [(11/k_{mod})/(f+20) ; 37/(f+50)]	1,1 / $k_{mod}^{0,3}$
CNA4,0x40	(11/k_{mod}) / (f+20)	1,3 / $k_{mod}^{0,3}$
CNA4,0x50	(11/k_{mod}) / (f+20)	min. [1,55/$k_{mod}^{0,3}$; 1,5/k_{mod}]
CNA4,0x60	(11/k_{mod}) / (f+20)	min. [1,8/$k_{mod}^{0,3}$; 1,5/k_{mod}]
CSA5,0x35	(11/k_{mod}) / (f+20)	1,5 / k_{mod}
CSA5,0x40	(11/k_{mod}) / (f+20)	1,5 / k_{mod}
CSA5,0x50	(11/k_{mod}) / (f+20)	1,5 / k_{mod}

Table D60-2 Timber to timber – F2/3-horizontal force - 2 Angle Brackets

2 x ADR6090L per Connection	**Characteristic capacity $R_{2/3,k}$ per connection [kN]**
Nailing pattern 1 Flange A: 3 Flange B: 2	
Fastener	
CNA4,0x35	2,7
CNA4,0x40	3,0
CNA4,0x50	3,8
CNA4,0x60	4,2
CSA5,0x35	4,7
CSA5,0x40	5,5
CSA5,0x50	6,6

Table D60-3 Timber to rigid support - F1

Nailing pattern 2 Flange A: 5 Flange B: 1 Bolt	**Characteristic capacity $R_{1,k}$ per connection [kN]**	
Fastener	**2 x ADR6090L**	**1 x ADR6090L**
CNA4,0x35	min. [13,6 ; 9,9/k_{mod}]	(28/k_{mod}) / (f+30)
CNA4,0x40	min. [9,3 ; 9,9/k_{mod}]	(35/k_{mod}) / (f+30)
CNA4,0x50	9,9 / k_{mod}	
CAN 4,0x60		
CSA5,0x35		
CSA5,0x40		
CSA5,0x50		

Check of Bolts has to be done separately.

Table D60-4 Timber to rigid support – F2/3 - 2 Angle Brackets

2 x ADR6090L per Connection Nailing pattern 2 Flange A: 5 Flange B: 1 Bolt Fastener	**Characteristic capacity $R_{2/3,k}$ per connection [kN]**
CNA4,0x35	3,6
CNA4,0x40	4,1
CNA4,0x50	5,2
CAN 4,0x60	5,9
CSA5,0x35	5,8
CSA5,0x40	6,6
CSA5,0x50	7,8

Check of Bolts has to be done separately.

Bolt factors:

Bolt factor	**1 x ADR6090L per connection**		**2 x ADR6090L per connection**	
	$R_{1,k}$	**$R_{2/3,k}$**	**$R_{1,k}$**	**$R_{2/3,k}$**
k_{ax}	(f+29,5)/10	-	1,13	-
k_{lat}	-	1	-	0,5

For each Bolt it's needed to check: $R_{bolt,ax,d} \geq k_{ax} \times F_{i,d}$ & $k_{lat} \times F_{i,d}$

Annex D61 – ABTR120/180/240

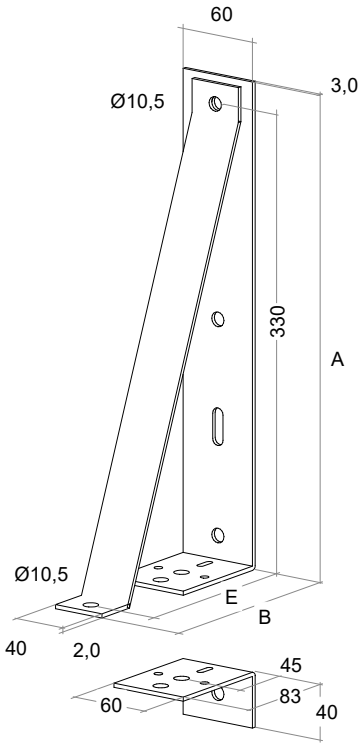
Product Name:

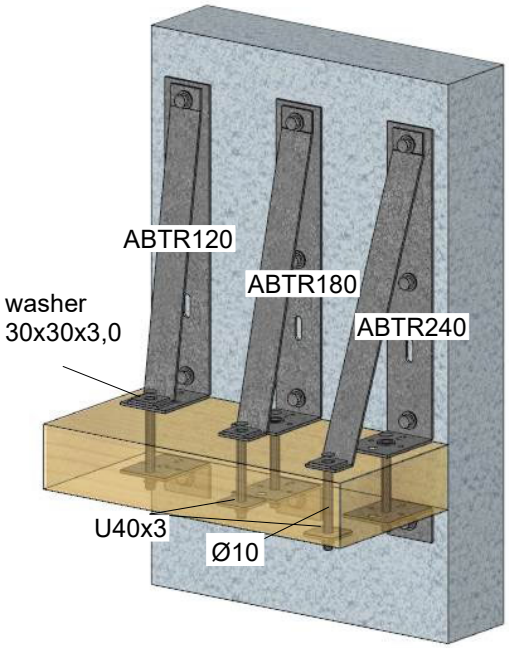
Product Name	Material reference acc. to clause II-1	Alternative product names
ABTR120	Steel ref. 1	GUTEX Durio® Winkel Typ 120
ABTR180	Steel ref. 1	GUTEX Durio® Winkel Typ 180
ABTR240	Steel ref. 1	GUTEX Durio® Winkel Typ 240
ABTR120S	Steel ref. 2	GUTEX Durio® Winkel Typ 120
ABTR180S	Steel ref. 2	GUTEX Durio® Winkel Typ 180
ABTR240S	Steel ref. 2	GUTEX Durio® Winkel Typ 240
ABTR120S2	Steel ref. 3	GUTEX Durio® Winkel Typ 120
ABTR180S2	Steel ref. 3	GUTEX Durio® Winkel Typ 180
ABTR240S2	Steel ref. 3	GUTEX Durio® Winkel Typ 240
ABTR120Z	Steel ref. 6	GUTEX Durio® Winkel Typ 120
ABTR180Z	Steel ref. 6	GUTEX Durio® Winkel Typ 180
ABTR240Z	Steel ref. 6	GUTEX Durio® Winkel Typ 240

Connector Size Range:

Model no.	Dimensions [mm]			
	A	B	E	Thickness
ABTR120	350	83	69	2,0 & 3,0
ABTR180	350	116	102	2,0 & 3,0
ABTR240	350	164	150	2,0 & 3,0

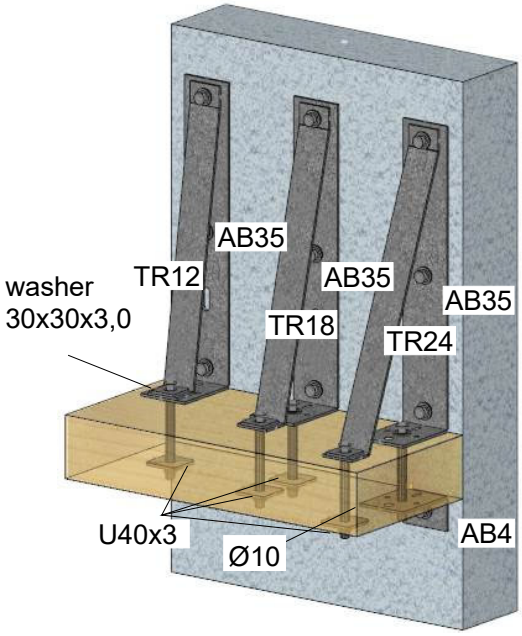
Drawings:


60
3,0
Ø10,5
330
A
Ø10,5
E
B
40
2,0
45
83
60
40

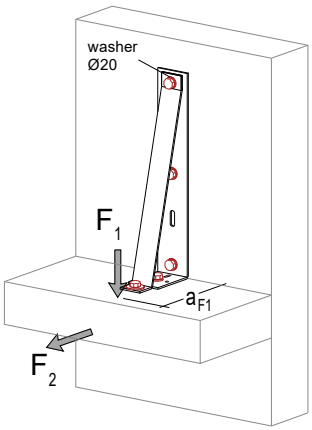

ABTR120
ABTR180
ABTR240
washer
30x30x3,0
U40x3
Ø10

Assignment:

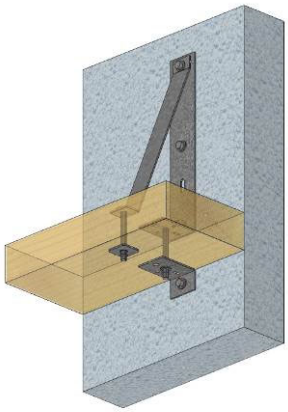
Type	Single Components
ABTR120	AB35, TR12, AB4
ABTR180	AB35, TR18, AB4
ABTR240	AB35, TR24, AB4
U40x3	
Washer 30x30x3,0 (DIN436)	



Characteristic capacity:



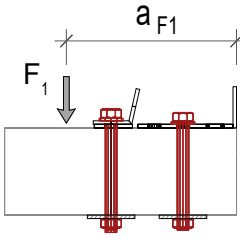
Load directions



Additional Angle Bracket at the lower side

*Table 61-1 Characteristic capacities force direction **F1***

Washer on the lower side	Type 120 a_{dia} = 54mm $R_{1a.k}$ [kN]	Type 180 a_{dia} = 90mm $R_{1a.k}$ [kN]	Type 240 a_{dia} = 135mm $R_{1a.k}$ [kN]
U40x3	min(14,6 ; 10,17/k_{mod})	min(14,6 ; 10,64/k_{mod})	min(14,6 ; 10,71/k_{mod})
30x30x3	min(9,8 ; 10,17/ k_{mod})	min(9,8 ; 10,64/k_{mod})	min(9,8 ; 10,71/k_{mod})



$$R_{1.k} = R_{1a.k} \times a_{dia} / a_{F1}$$

If a_{F1} is smaller than a_{dia} +8mm , the calcualtion has to be done with $a_{F1} = a_{dia}$ + 8mm.

The required capacities of the anchoring connected to the wall shall be at least:

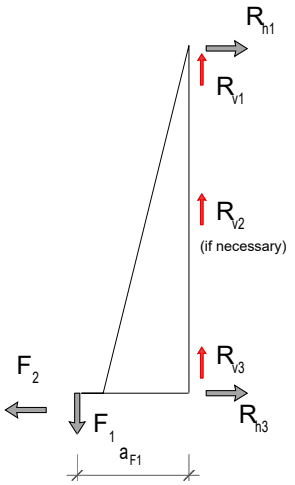
$R_{h1.d}$ = a_{F1} / 330mm x $F_{1.d}$

$R_{v1.d}$ = 1/n x $F_{1.d}$

$R_{v2.d}$ = 1/n x $F_{1.d}$

$R_{v3.d}$ = 1/n x $F_{1.d}$

$R_{h3.d}$ = -a_{F1} / 330mm x $F_{1.d}$



n = number of anchorings (3 for using of all three bolts or 2 for bolts at bottom and top)

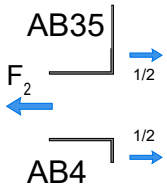
*Table 61-2 Characteristic capacities force direction **F2** (without the AB4)*

$R_{2.k}$ [kN]			
type 120	**type 180**	**type 240**	**AB4**
2,34/k_{mod}	2,34/k_{mod}	2,34/k_{mod}	2,34/k_{mod}

The AB4 shall be use only additionally with the types 120 to 240.

The required capacity of the lower bolt shall be at least: $R_{h3.d} = F_{2.d}$

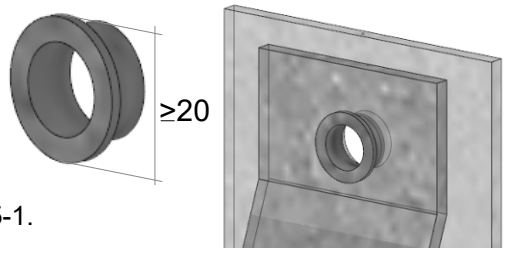
For a connection with the angle bracket AB4 on the lower side of the beam, the force $F_{2,d}$ shall be equally distributed to both brackets.



The design capacities have to be calculated as:

$$R_{i.d} = R_{i.k} \times k_{mod} / \gamma_M$$

The brackets are intendend to be connected with bolts or screws with a Ø of 10mm. In case timberscrews are used for fixing, also screws with a smaller diameter than Ø10 can be applied with a reducer like the one shown aside. The reducer has to embed into both steel plates.



For the distances of the bolts in the beam has to be observe the EN1995-1.
The drilling in the beam should be done on site.

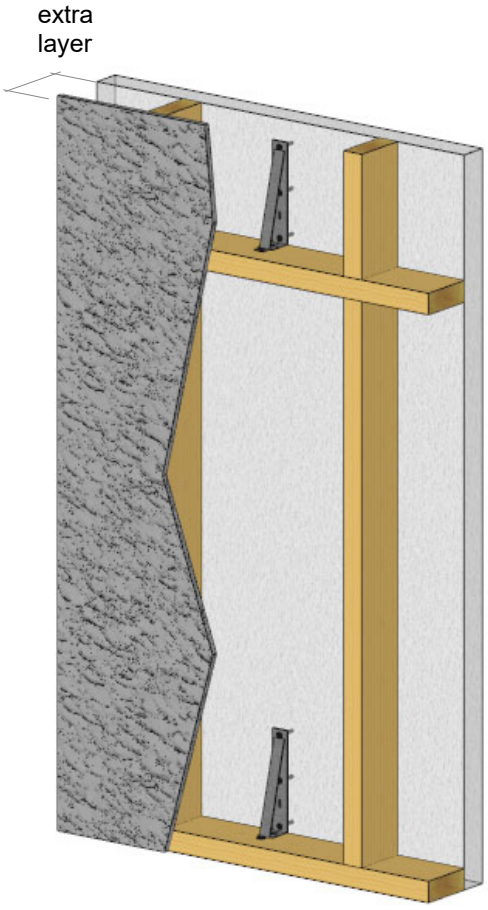
Load combination:

$F_{1.d} / R_{1.d} \leq 1$ and $F_{2.d} / R_{2.d} \leq 1$ check of connector

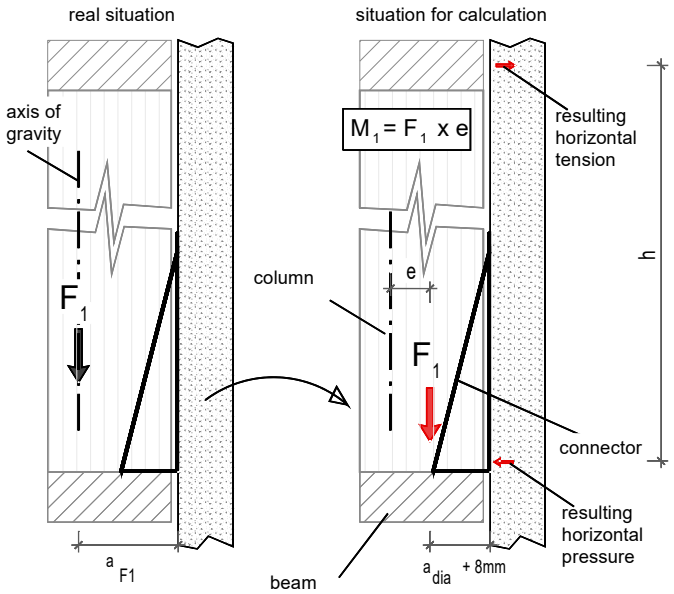
The loads for the anchoring have to be added up , and have to be checked separately according to the individual anchoring type.

Application:

The typical installation of the connector may be as follows:
An extra layer is added to an existing wall. Columns are placed between the horizontal beams, and on these columns are fixed the outer layer. Insulation is placed between the new outer layer and the existing wall.
Due to the columns, the rotation of the beams is prevented. The vertical load can be calculated with a distance (a_{dia} + 8mm) from the wall .



Type	a_{dia} [mm]
ABTR120	54
ABTR180	90
ABTR240	135



Generally the brackets shall be calculated with a lever arm of F_1 of a_{F1} = (a_{dia} + 8mm)
For beam distances h ≥ 2000mm the resulting centering forces can usally be disregarded.
Else all details shall be designed in accordance with EC5.

Annex D62 – ACW155

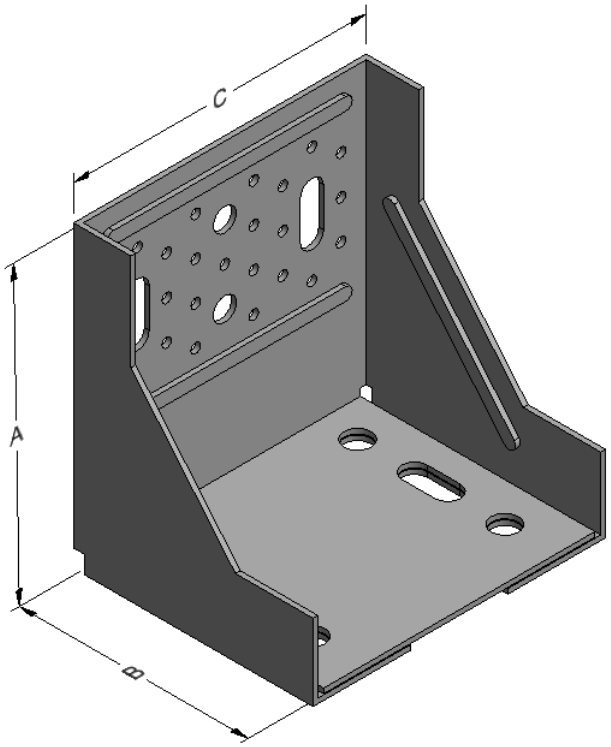
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ACW155	Steel ref. 1	-
ACW155S	Steel ref. 2	-
ACW155S2	Steel ref. 3	-
ACW155Z	Steel ref. 6	-

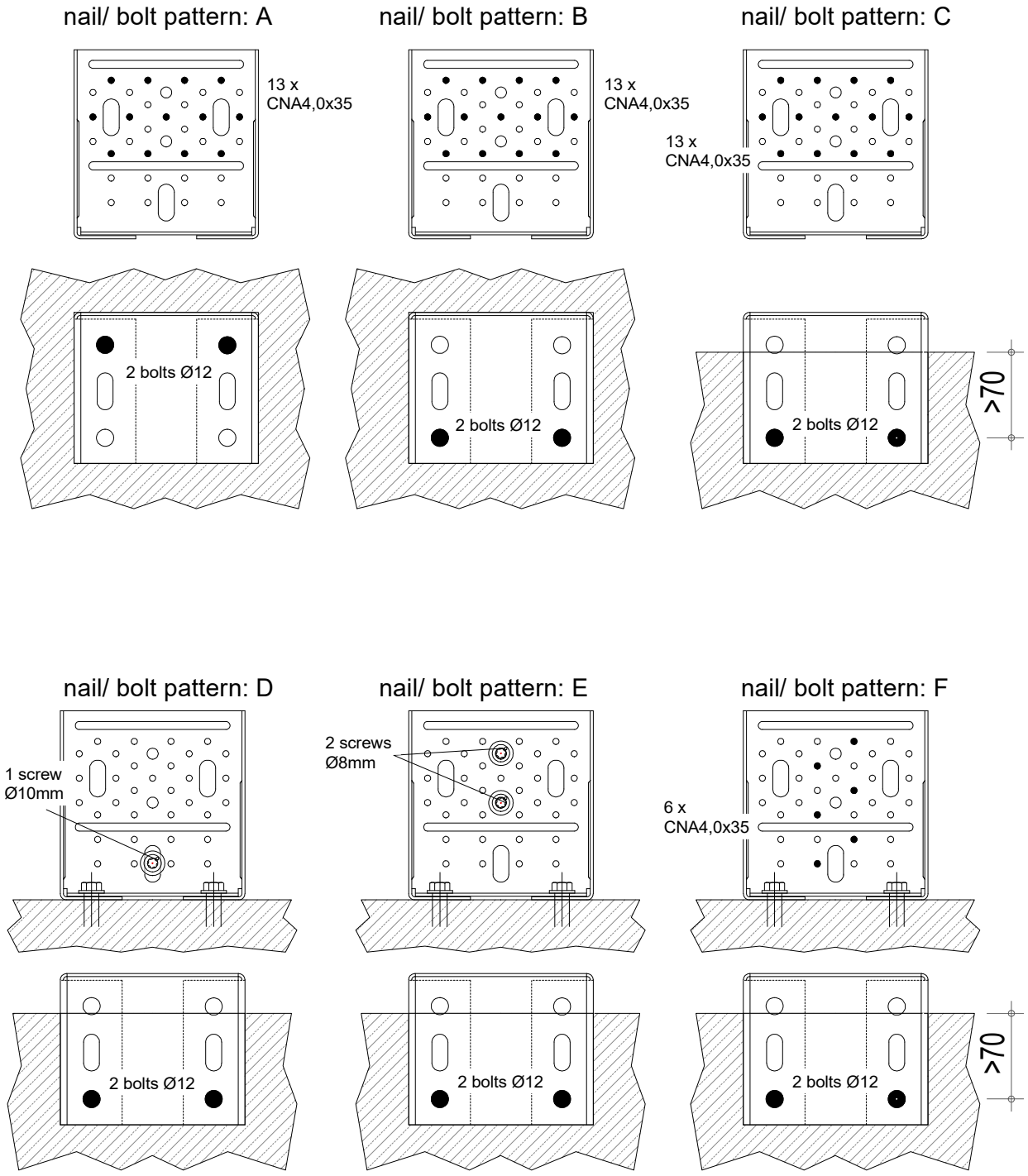
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A			Holes flange B	
	A	B	C	Thickness	Ø5	Ø9	Oblong 13x30	Ø14	Oblong 13x30
ACW155	154	123	150	2,5	33	2	3	4	2

Drawing:

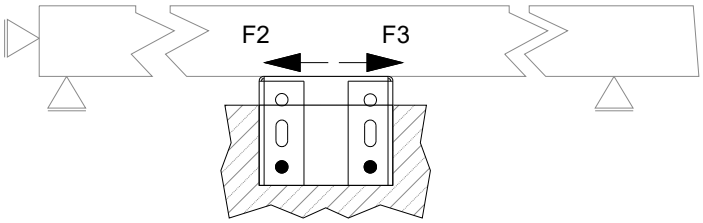


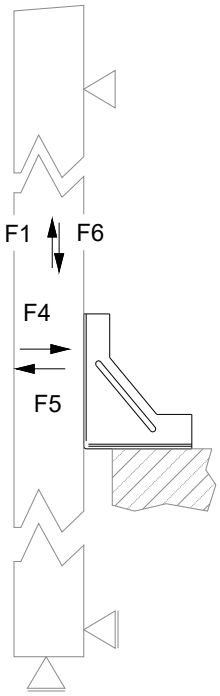
Nailing pattern:



For the nail/bolt pattern A and B, the bolts are positioned with a sufficient distance to any border. The other nail/bolt patterns are for anchorage which has a minimum of 70 mm distance to the border of the concrete.

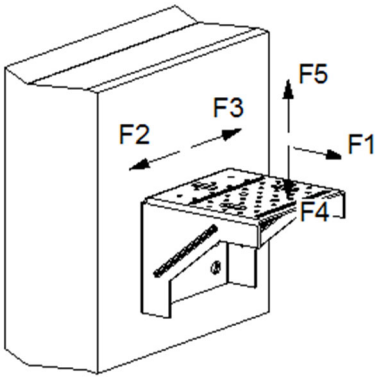
For nailing patterns B to F, the connected timber elements are free to rotate as the connected elements are fixed at minimum to one other point.





For the nailing patterns D to F, it is determined that a vertical load (F6) is always present.

Load directions:



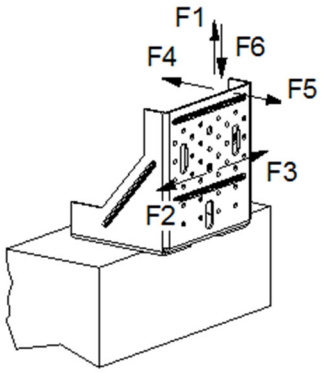


Table 62-1 Characteristic values

Nailing pattern	Number of fasteners		Characteristic capacities [kN]				
	Flange A	Flange B	$R_{1,k}$	$R_{2/3,k}$	$R_{4,k}$	$R_{5,k}$	$R_{6,k}$
A	13 CNA4,0x35	2 x M12 Bolts	16,3	15,3	21,1	5	-
B	13 CNA4,0x35	2 x M12 Bolts	8,8	11,9	6	11,4	21,2
C	13 CNA4,0x35	2 x M12 Bolts	8,8	8,9	6	11,4	21,2
D	1 ESCR Ø10x140	2 x M12 Bolts	-	-	7,5	5,7	-
E	2 ESCR Ø8x100	2 x M12 Bolts	-	-	7,5	3,92	7,73
F	6 CNA4,0x35	2 x M12 Bolts	-	-	7,5	2,64	10,1

The fasteners in the joist/beam can be replaced with different fasteners but must as a minimum have the same capacities of the specified fasteners. For the nail pattern A to C to connect the ACW155, other screws can be used but are also required to have a minimum capacity as the same as the specified fasteners.

The connections with the nail pattern D to F can be used also for the connection of a column.

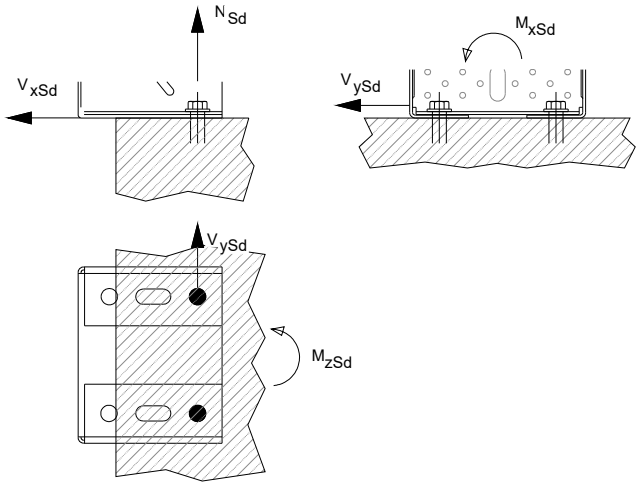
Load combination: $\sum (F_{i,d} / R_{i,d}) \leq 1,0$

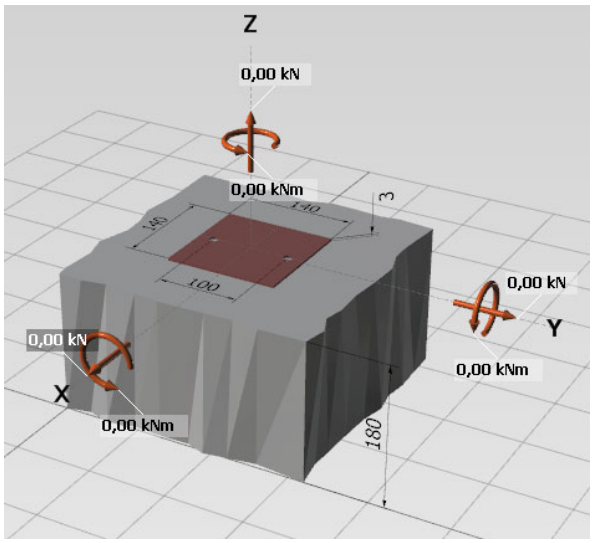
The anchorage must be checked with the following loads:

Table 62-2 Bolt factors

Nailing pattern		The anchoring has to be check for following:							
	for F_1	**for F_2**			**for F_4**		**for F_5**		**for F_6**
	N_{Sd}	**V_{ySd}**	**M_{xSd}**	**M_{zSd}**	**V_{xSd}**	**N_{Sd}**	**V_{xSd}**	**N_{Sd}**	**N_{Sd}**
A	$F_{1.d}$ x 1.1	$F_{2.d}$	$F_{2.d}$ x 27mm	$F_{2.d}$ x 69mm	$F_{4.d}$	$F_{4.d}$ x1,5	$F_{5.d}$	$F_{5.d}$ x 3	-
B	$F_{1.d}$ x 3,7	$F_{2.d}$	$F_{2.d}$ x 92mm	$F_{2.d}$ x 59mm	$F_{4.d}$		$F_{5.d}$	$F_{5.d}$ x 1,3	$F_{6.d}$ x 0.7
C	$F_{1.d}$ x 3,7	$F_{2.d}$	$F_{2.d}$ x 82mm	$F_{2.d}$ x 59mm	$F_{4.d}$		$F_{5.d}$	$F_{5.d}$ x 1,3	$F_{6.d}$ x 0.7
D	-	-	-	-	$F_{4.d}$		$F_{5.d}$	$F_{5.d}$ x 0.7	-
E	-	-	-	-	$F_{4.d}$		$F_{5.d}$	$F_{5.d}$ x 0.9	$F_{6.d}$ x 0.7
F	-	-	-	-	$F_{4.d}$		$F_{5.d}$	$F_{5.d}$ x 1.3	$F_{6.d}$ x 0.7

For load combination, the combination for the anchorage must also be checked.





Annex D63 – AE90-RW

Product Name:

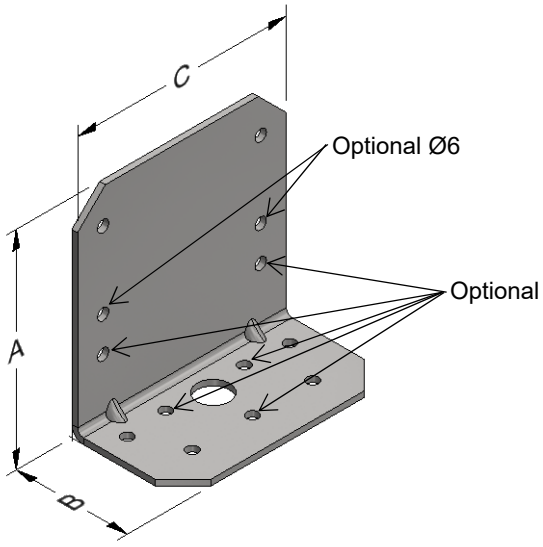
Product Name	Material reference acc. to clause II-1	Alternative product names
AE90-RW	Steel ref. 1	-
AE90-RWS	Steel ref. 2	-
AE90-RWS2	Steel ref. 3	-
AE90-RWZ	Steel ref. 6	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	Ø5	Ø5	Ø14
AE90-RW	90	48	90	2,5	6[1)]	7[1)]	1[2)]

1) Optional 4 holes
2) Optional Ø12 hole

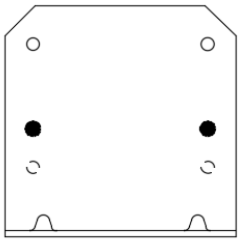
Drawing:



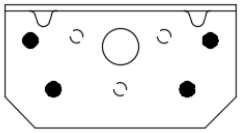
Nailing pattern:

Nailing pattern 1

Flange A:



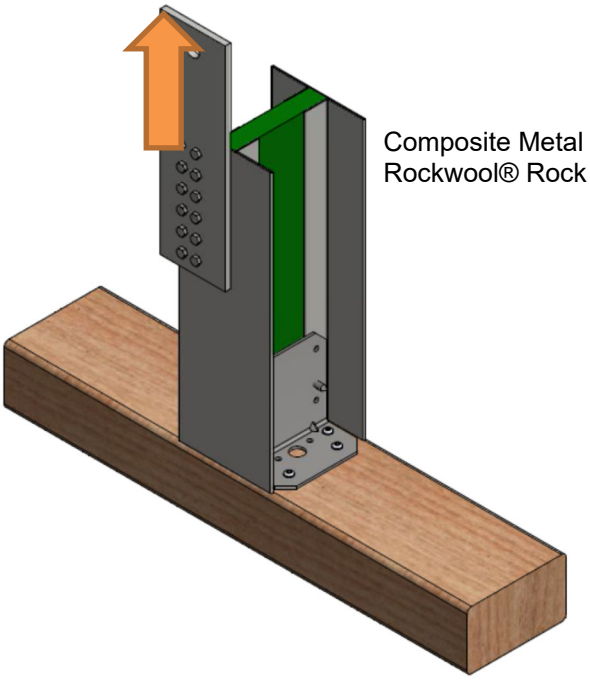
Flange B:



Rockwool Post (A) to beam (B)

Table D63-1 Characteristic capacity - Composite Metal beam to timber beam – 2 Angle Brackets

2 Angle brackets AE90-RW per connection			**Characteristic capacity per connection (kN)**
Nailing pattern	Number of fasteners		**$R_{1,k}$**
	Flange A	Flange B	
Nailing pattern 1	2 Self drilling screws Ø5.5x50	8 CSA5.0x40	9.8 / k_{mod}



Composite Metal Joist Rockwool® Rock Zero

Glulam GL24 – Minimum section 61x105

Annex D64 – CCWR & CCWL

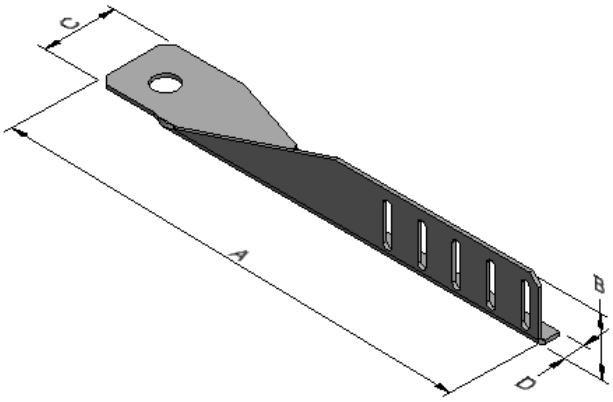
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
CCWR	Steel ref. 1	-
CCWL	Steel ref. 1	-
CCWRZ	Steel ref. 6	-
CCWLZ	Steel ref. 6	-

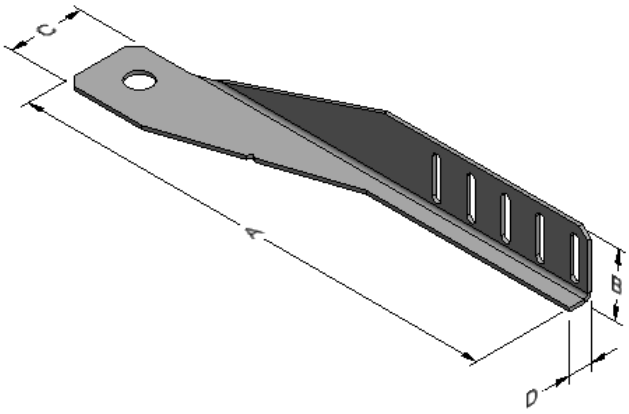
Connector Size Range:

Model no.	Dimensions [mm]					Holes flange B	Holes flange C
	A	B	C	D	Thickness	Ø5x25	Ø14
CCWR CCWL	260	35,5	40	12,5	2,0	5	1

Drawings:

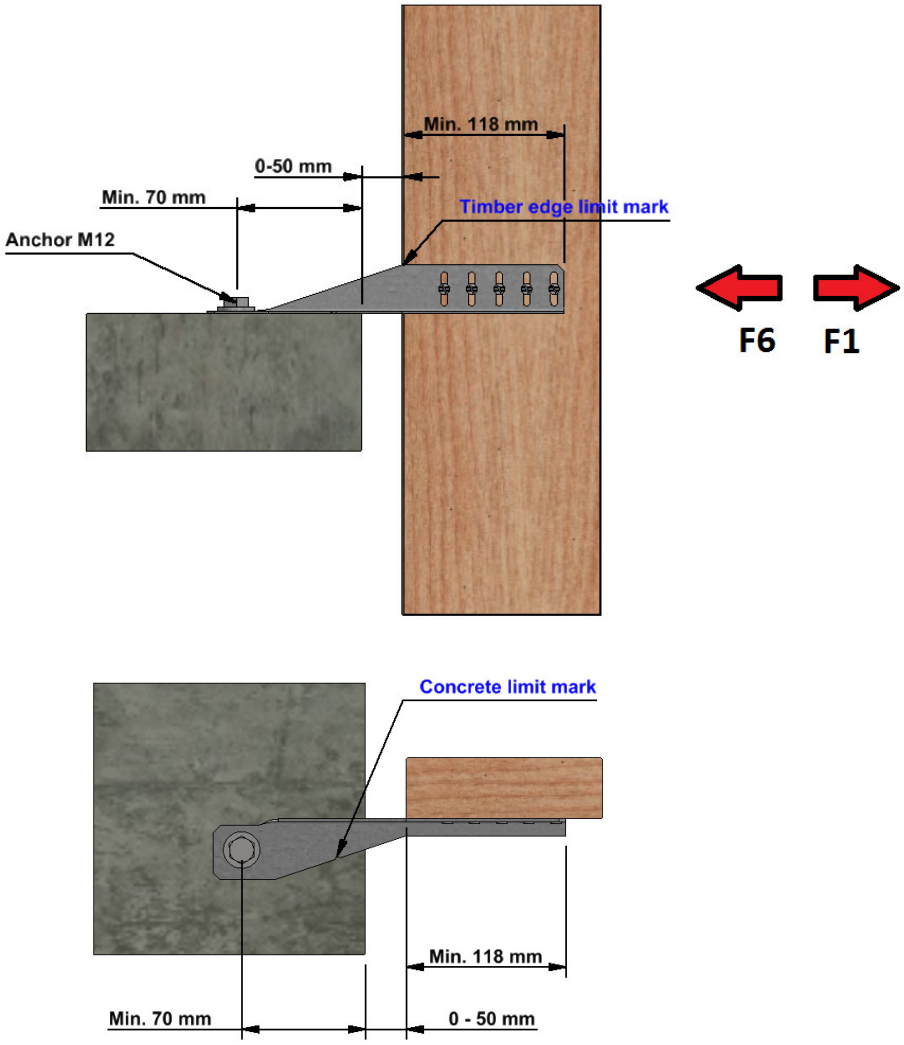


CCWL



CCWR

Typical installation and force directions:



Maximum gap width between edge concrete and timber stud:	50 mm
Minimum distance between anchor and concrete edge:	70 mm
Minimum distance between timber stud edge and end of CCWR/L:	118 mm
Minimum timber stud thickness:	45 mm

Because of the eccentricity of the anchor to the nails alignment, the arrangement of CCW connectors shall fulfil the two following conditions:

- For each unite timber frame wall, no matter how long it is, there shall be at least one of each CCWR and CCWL as illustrated below:

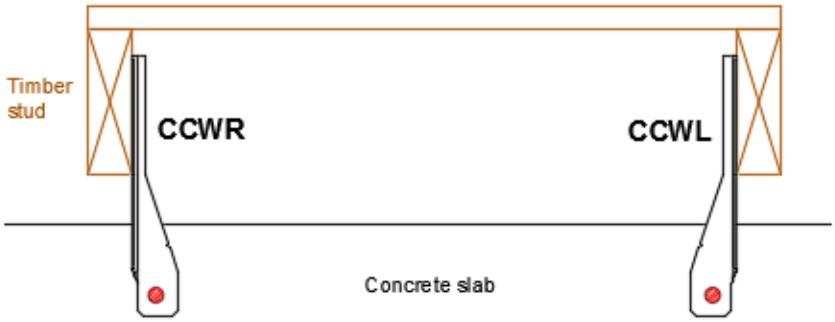


Figure 5: CCW arrangement

- There shall be at least one CCW in the opposite way every four connector as illustrated below:

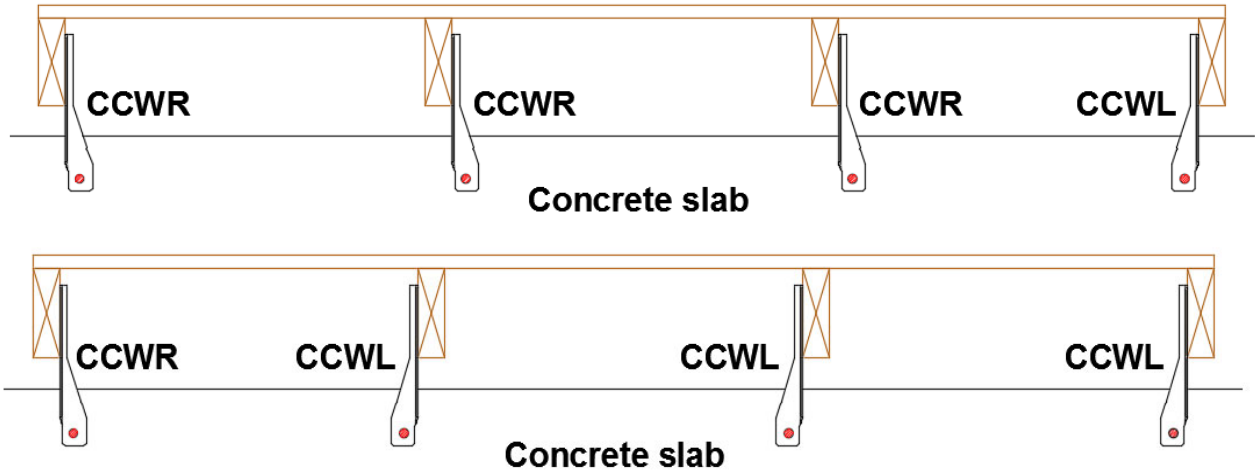
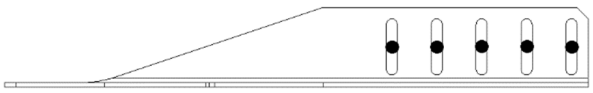


Figure 6: CCW arrangement

Nailing and screwing pattern:

Nailing pattern: 5 CNA4.0x35 or 5 CSA5.0x35 set in centered position



Screwing pattern 1: 3 CSA5.0x40 set in centered position

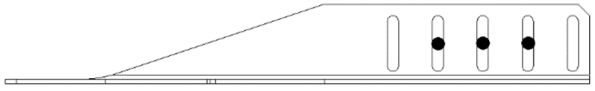


Table 64-1 Characteristic capacities for timber C24

Model	Fasteners		Characteristic capacities [kN] - Timber C24**	
	Header	Timber stud	$R_{1,k}$	$R_{6,k}$
CCWR CCWL	1 Anchor M12*	5 CNA4,0x35	6,87	9,10
	1 Anchor M12*	3 CSA5,0x40	6,40	6,69

Table 64-1 Characteristic capacities for timber C18

Model	Fasteners		Characteristic capacities [kN] - Timber C18**	
	Header	Timber stud	$R_{1,k}$	$R_{6,k}$
CCWR CCWL	1 Anchor M12*	5 CNA4,0x35	6,87	8.33
	1 Anchor M12*	3 CSA5,0x40	6.14	6.39

* The suitable anchor must be used and shall complied with minimum distances given in the corresponding ETA. The capacity of the anchor shall be checked separately by the user.
** The timber stud capacity to tension perpendicular to the grain shall be checked by the user

Annex D65 – ABGU360

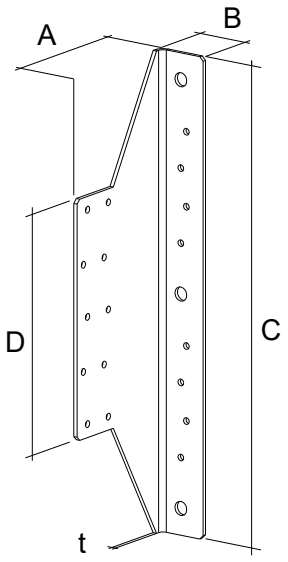
Product Name:

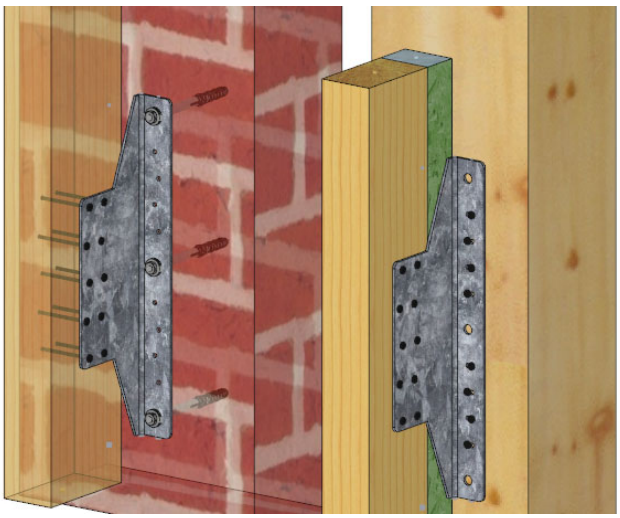
Product Name	Material reference acc. to clause II-1	Alternative product names
ABGU360	Steel ref. 1	GUTEX Durio® Längswinkel
ABGU360S	Steel ref. 2	GUTEX Durio® Längswinkel S
ABGU360Z	Steel ref. 6	GUTEX Durio® Längswinkel Z

Connector Size Range:

Model no.	Dimensions [mm]					Holes flange A	Holes flange B	
	A	B	C	D	t	Ø5	Ø5	Ø10.5
ABGU360	105	40	360	180	3.0	10	8	3

Drawings:





Installation: to rigid support to timber

Characteristic capacity:

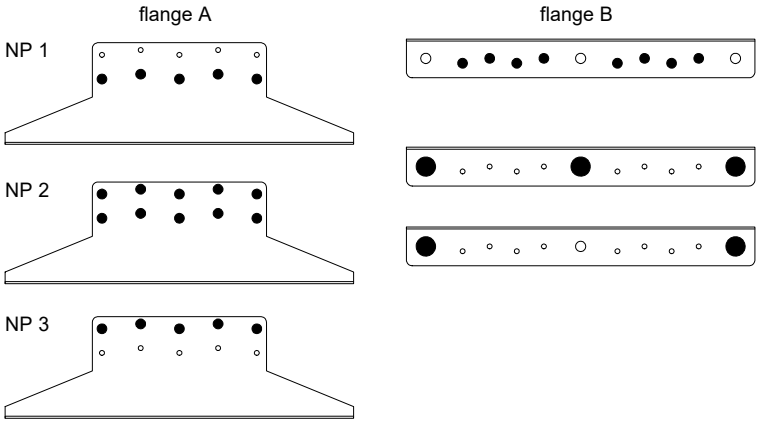
The capacities are given for one angle bracket, based on the assuption, that a connection is made with minimum 2 angle brackets staggered. On this way it´s guranted, that no rotation of the connected beam may happen.

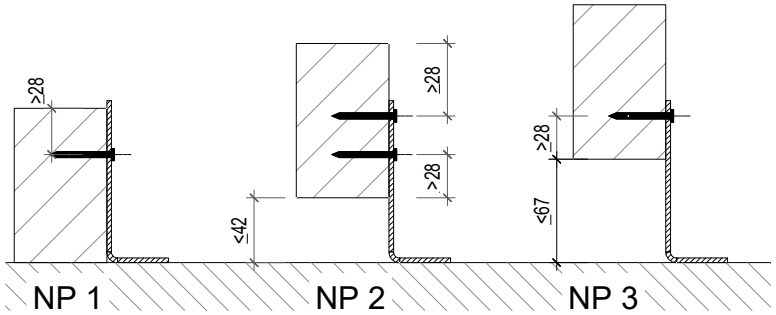
Table 65-1 Characteristic capacities timber to timber

Nailing pattern	number of fastener		characteristic capacities per connection [kN]					
			R1.k			$R2_{/3.k}$		
	Flange A	Flange B	CSA5,0x35	CSA5,0x40	CSA5,0x50	CSA5,0x35	CSA5,0x40	CSA5,0x50
NP1	5	8	8,4	9,4	11,1	4,9	5,4	6,5
NP2	10	8	8,4	9,4	11,1	8,3	9,3	11
NP3	5	8	8,4	9,4	11,1	3,8	4,3	5,1

Table 65-2 Characteristic capacities timber to rigid support

Nailing pattern	number of fastener		characteristic capacities per connection [kN]					
			$R_{1.k}$			$R_{2/3.k}$		
	Flange A	Flange B	CSA5,0x35	CSA5,0x40	CSA5,0x50	CSA5,0x35	CSA5,0x40	CSA5,0x50
NP1	5	2 or 3 bolts	10	11.1	min(11.1 12.6/k_{mod})	4,9	5,4	6,5
NP2	10	2 or 3 bolts	min(19.9 12.6/k_{mod})	min(22.2 12.6/k_{mod})	min(26.3 12.6/k_{mod})	8,3	9,3	11
NP3	5	2 or 3 bolts	10	11.1	min(11.1 12.6/k_{mod})	3,8	4,3	5,1





Minimum distances for the screws in the timberelement for flange A

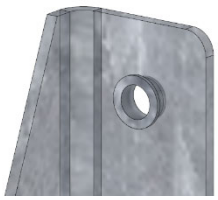
For connection to rigid support has to be check the anchoring as following:

It has to check, that the bolts are able to absorb:
$F_{ax.bolt} = F_{1.d} \times 1.36$
and
$F_{lat.bolt} = R_{2.d}$

The combination has to be check also.

The brackets are intendend to be connected with bolts or screws with a Ø of 10mm. In case timberscrews are used for fixing, also screws with a smaller diameter than Ø10 can be applied with a reducer like the one shown aside. The reducer has to embed into the steel plate.

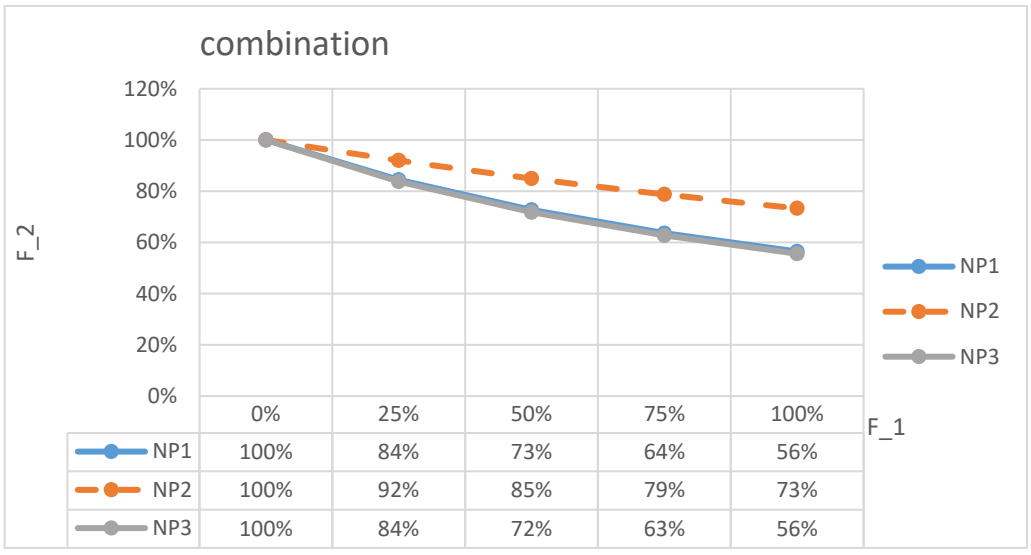
For the distances of the bolts in the beam has to be observe the EN1995-1.
The drilling in the beam should be done on site.



For load combination can be made a simplified check as following:

$(F_{1.d} / R_{1.d})^2 + (F_{2/3.d} / R_{2/3.d}) \leq 1$

Or according the following:



	0%	25%	50%	75%	100%
NP1	100%	84%	73%	64%	56%
NP2	100%	92%	85%	79%	73%
NP3	100%	84%	72%	63%	56%

It gives the percentage of the capacities in the different combinations.
e.g for NP3 and 75% of the R_1 capacity is given a capacity of ~ 63% for the force direction $F_{2/3}$.

The anchoring has to be checked in every case.

Annex D66 – SC2P-H180 & SC2P-V100

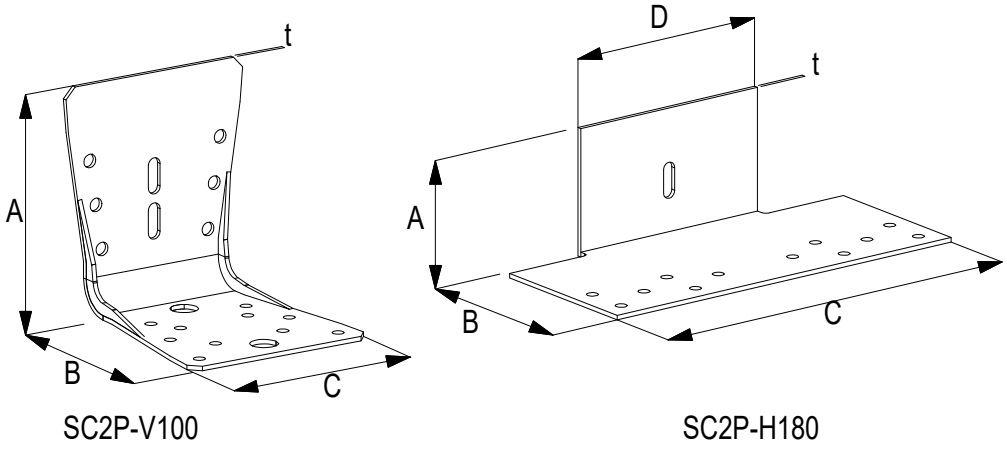
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
SC2P-V100	Steel ref. 1	-
SC2P-H180	Steel ref. 1	-
SC2P-V100S	Steel ref. 2	-
SC2P-H180S	Steel ref. 2	-
SC2P-V100Z	Steel ref. 6	-
SC2P-H180Z	Steel ref. 6	-

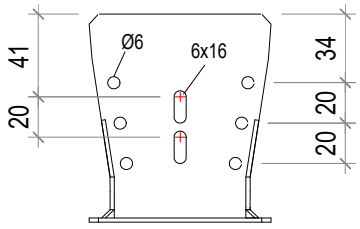
Connector Size Range:

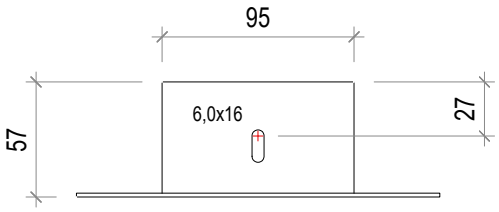
Model no.	Dimensions [mm]					Holes flange A		Holes flange B	
	A	B	C	D	Thickness	Ø6	6x16	Ø5	Ø12
SC2P-V100	103	103	90		2	6	2	10	2
SC2P-H180	57	82	180	95	2	-	1	12	-

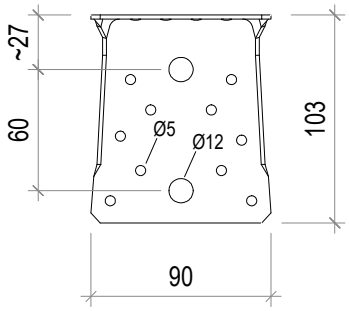
Drawings:

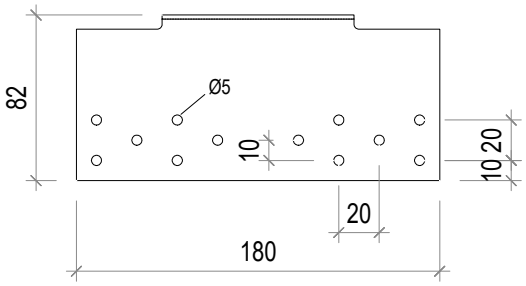


SC2P-V100 SC2P-H180









Nailing pattern:

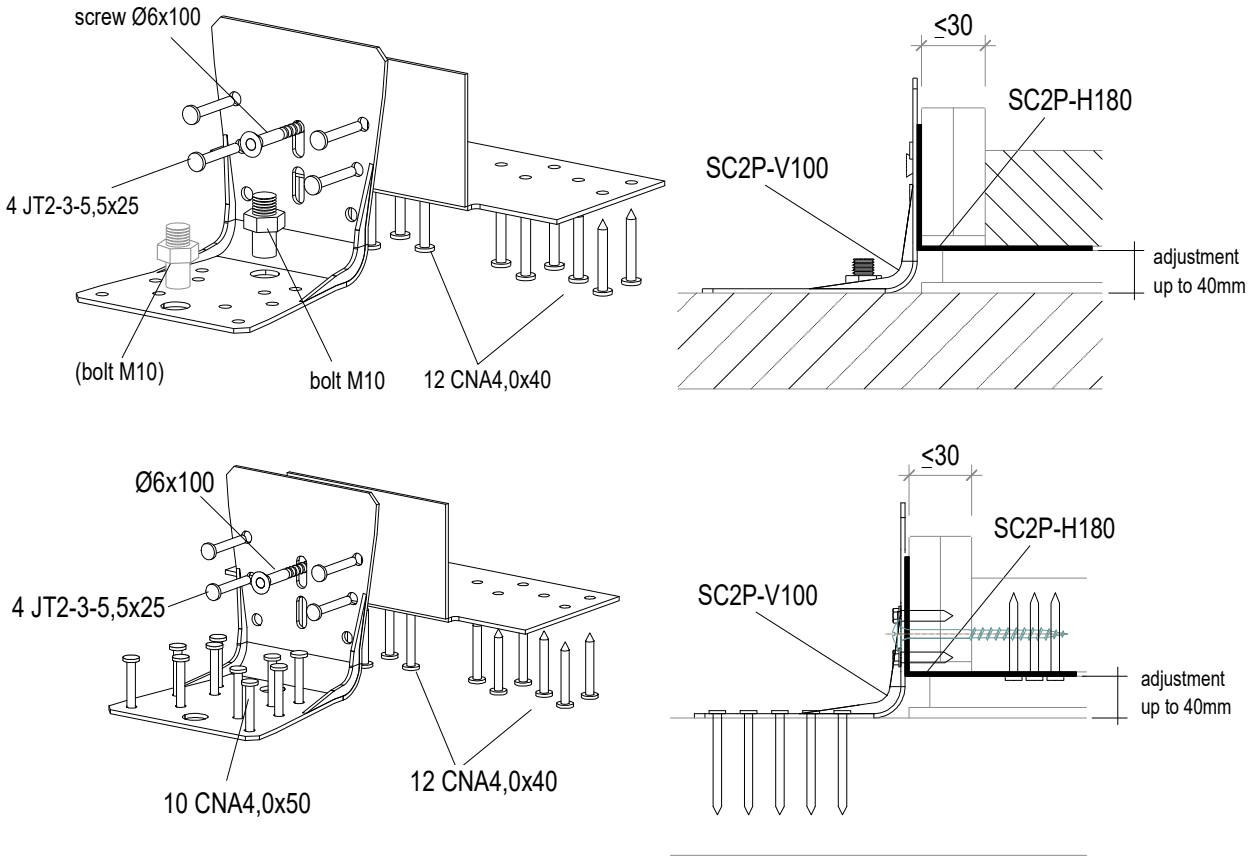


Table D66-1 Characteristic capacity one SC2P-set

Bolts to supported member	fastener to wall and among themself	characteristic capacities [kN]		
		$R_{2/3.k}$	$R_{4.k}$	$R_{5.k}$
1 M10	12 CNA4.0x40 1 Screw Øx100 4 EJOT JT2-3-5,5x25	6,84/k_{mod}	6,4/k_{mod}	5,4/k_{mod}
2 M10		10,6/k_{mod}		
10 CNA4,0x50		6,8/k_{mod}	6,4/k_{mod}	min. 5.6 ; 5,4/k_{mod}

Connection with bolts:

factor for	$F_{2/3}$	F_4	F_5
k_{ax}	-	-	-
k_{lat}	1,12	1	1

It´s assumed, that the weight of the connected wall prevented an uplift force in any bolt

Annex D67 - ABR255SO

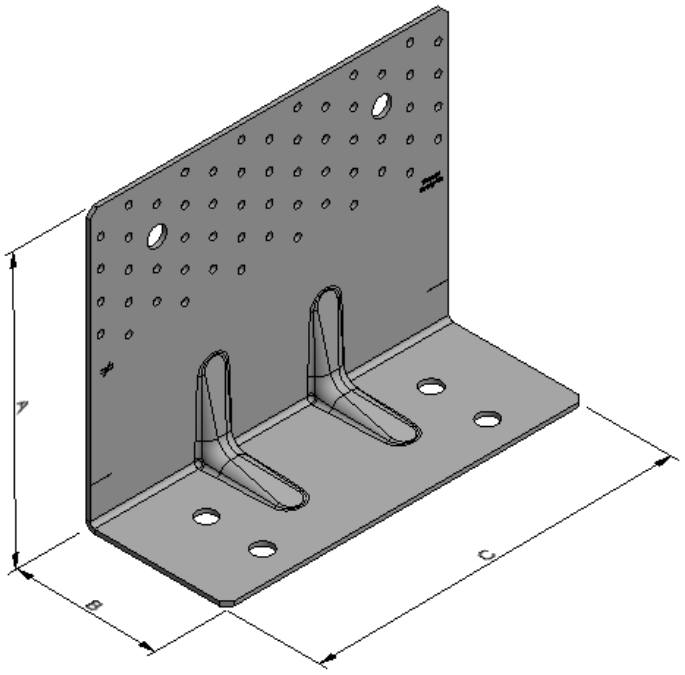
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
ABR255SO	Steel ref. 1	-
ABR255SOS	Steel ref. 2	-
ABR255SOS2	Steel ref. 3	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B
	A	B	C	Thickness	Ø5	Ø14	Ø14
ABR255SO	200	100	255	3,0	56	2	4

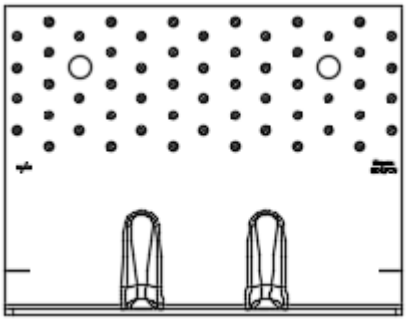
Drawing:



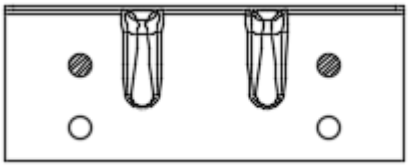
Nailing pattern:

Nailing pattern 1

Flange A:

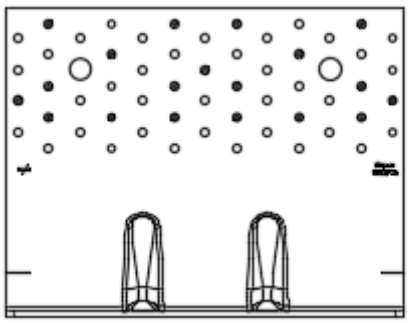


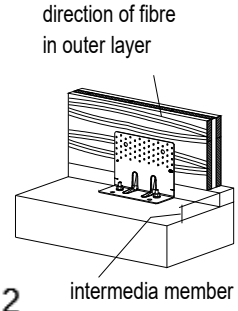
Flange B:
(Rigid)

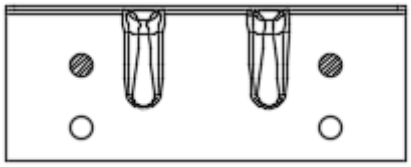


Beam to Rigid
Maximum nailing with intermediate member up to 80mm (CLT or timber beam with horizontal fibre on flange A))

Nailing pattern 2



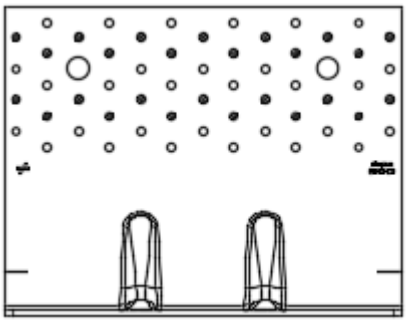




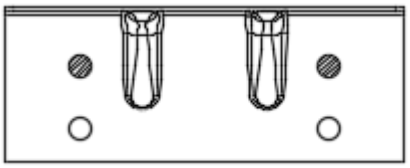
Beam to Rigid
Minimum nailing with intermediate member up to 100mm (CLT or timber beam with horizontal fibre on flange A)

Nailing pattern 4

Flange A:

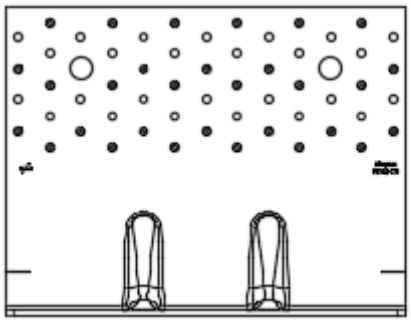


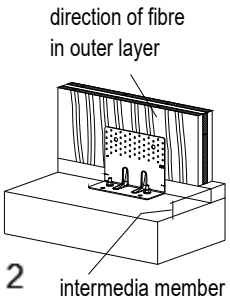
Flange B:
(Rigid)

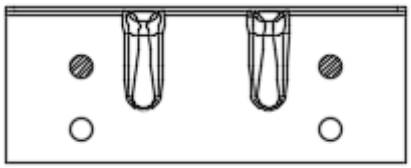


Beam to Rigid
for CLT, with intermediate member up to 88 mm (CLT with vertical fibre on flange A), or up to 68mm for timber column

Nailing pattern 8







Beam to Rigid
for CLT, with intermediate member up to 72 mm (CLT with vertical fibre on flange A), or up to 52mm for timber column

Characteristic Capacities:

The values $R_{i,k}$ for one ABR255SO per connection, with prevention of rotation (so that only shear force is acting), are stated in the tables below.
For a connection with 2 x ABR255SO the values can be doubled.

Table D67-1: Characteristic capacities beam to rigid support – 1 Angle bracket F_1

1 Angle Bracket ABR255SO per connection			Characteristic capacity (kN) per connection $R_{1,k}$						
Nailing pattern	Number of fasteners		CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	56	2 x M12 Bolts	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}
Nailing pattern 2	19	2 x M12 Bolts	min of: 24.3 22.9/k_{mod}	min of: 27.5 22.9/k_{mod}	min of: 34.7 22.9/k_{mod}	22.9/k_{mod}	min of: 33.1 22,9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}
Nailing pattern 4	26	2 x M12 Bolts	min of: 34.2 22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}
Nailing pattern 8	30	2 x M12 Bolts	min of: 36.6 22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}	22.9/k_{mod}

The bolts have to be checked for: $F_{1,bolt,d} = R_{1,d} \times 1{,}1$

1 Angle Bracket ABR255SO per connection			Slip modulus kser (kN/mm) For force F1	
Nailing pattern	Number of fasteners		CNA Connector Nails	CSA Connector Screws
	Flange A	Flange B		
Nailing pattern 1	56	2 x M12 Bolts	3,9	4,1
Nailing pattern 2	19	2 x M12 Bolts	3,5	3,8
Nailing pattern 4	26	2 x M12 Bolts	3,7	3,9
Nailing pattern 8	30	2 x M12 Bolts	3,8	3,9

Table D67-2: Characteristic capacities beam to rigid support – 1 Angle bracket $F_{2/3}$

1 Angle Bracket ABR255SO per connection			Characteristic capacity (kN) per connection					
			$R_{2/3,k}$ Optmized for nails *)					
Nailing pattern	Number of fasteners		CNA Connector Nails			CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	5,0x35	5,0x40	5,0x50
Nailing pattern 1	56	2 x M12 Bolts	29,2	32,5	38,6	39,6	45,3	48,2
Nailing pattern 2	19	2 x M12 Bolts	13,3	15,7	20,7	24,1	27,0	28,8
Nailing pattern 4	26	2 x M12 Bolts	14,2	16,8	21,7	25,3	28,8	31,0
Nailing pattern 8	30	2 x M12 Bolts	18,0	21,3	26,1	29,2	33,0	35,3

* b = 28 mm, eccentricity e detailed in the following table

Table D67-3: eccentricities for table before

1 Angle Bracket ABR255SO per connection			Eccentricity (mm)					
			e					
Nailing pattern	Number of fasteners		CNA Connector Nails			CSA Connector Screws		
	Flange A	Flange B	4,0x35	4,0x40	4,0x50	5,0x35	5,0x40	5,0x50
Nailing pattern 1	56	2 x M12 Bolts	95,0	81,4	61,4	58,3	42,8	35,3
Nailing pattern 2	19	2 x M12 Bolts	146,2	146,2	145,5	121,0	105,0	96,6
Nailing pattern 4	26	2 x M12 Bolts	155,5	155,5	137,6	114,1	96,5	87,2
Nailing pattern 8	30	2 x M12 Bolts	141,8	140,3	109,9	94,9	79,6	71,6

The bolts have to be checked for: $V_{y,d} = F_{2/3,d}$ $M_{x,d} = F_{2/3,d} \times e$ $M_{y,d} = F_{2/3,d} \times b$

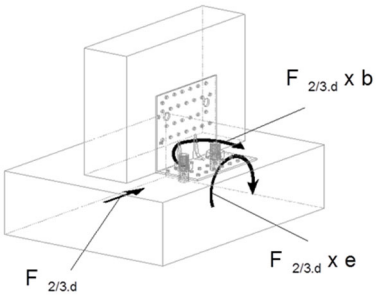


Table D67-4: Characteristic capacities beam to rigid support – 1 Angle bracket F_4

1 Angle Bracket ABR255SO per connection			Characteristic capacity (kN) per connection		
			$R_{4,k}$	Bolt factor	
Nailing pattern	Number of fasteners			$k_{ax.b}$	$k_{lat.b}$
	Flange A	Flange B			
Nailing pattern 1	56	2 x M12 Bolts	18.2 / k_{mod}^0.66	0,4	1
Nailing pattern 2	19	2 x M12 Bolts		0,4	1
Nailing pattern 4	26	2 x M12 Bolts		0,4	1
Nailing pattern 8	30	2 x M12 Bolts		0,4	1

Table D67-5: Characteristic capacities beam to rigid support – 1 Angle bracket F_5

1 Angle Bracket ABR255SO per connection			Characteristic capacity (kN) per connection		
			$R_{5,k}$	Bolt factor	
Nailing pattern	Number of fasteners			$k_{ax.b}$	$k_{lat.b}$
	Flange A	Flange B			
Nailing pattern 1	56	2 x M12 Bolts	5.05 / k_{mod}	3,5	1
Nailing pattern 2	19	2 x M12 Bolts		3,7	1
Nailing pattern 4	26	2 x M12 Bolts		4	1
Nailing pattern 8	30	2 x M12 Bolts		3,4	1

Annex D68 - AB255HD

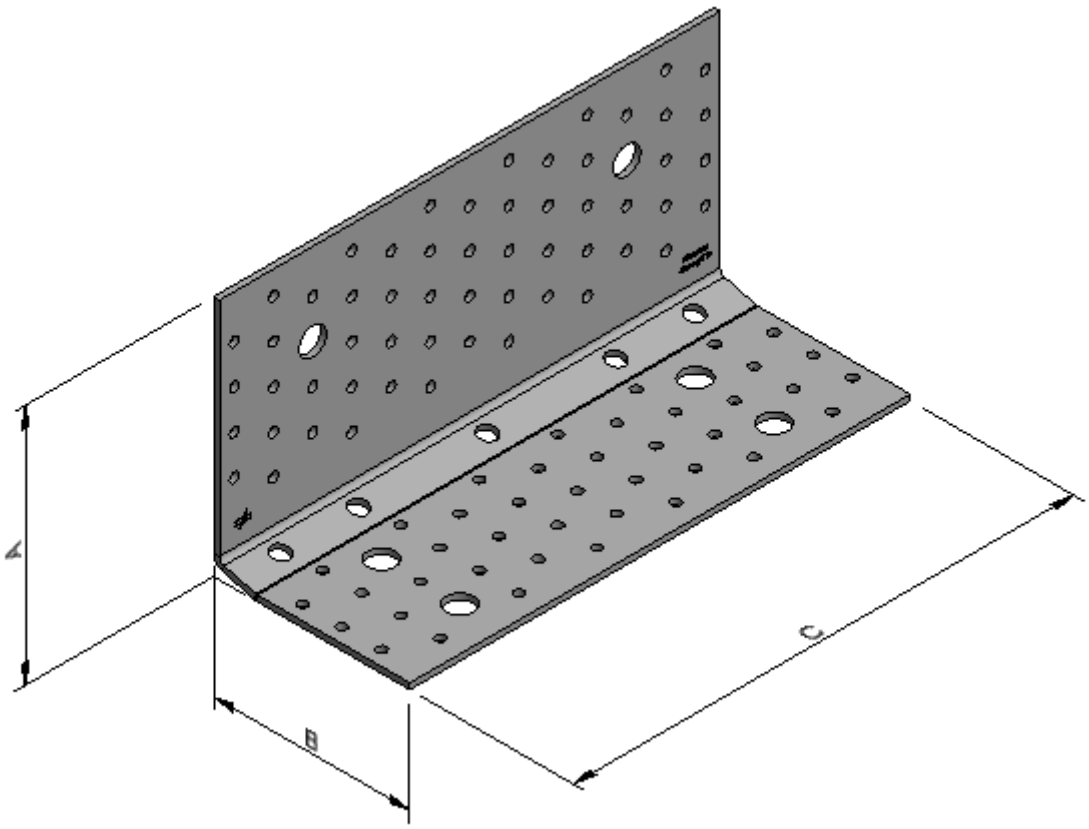
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB255HD	Steel ref. 1	-
AB255HDS	Steel ref. 2	-
AB255HDS2	Steel ref. 3	-

Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A		Holes flange B		
	A	B	C	Thickness	Ø5	Ø14	Ø5	Ø9	Ø14
AB255HD	123	100	255	3,0	56	2	41	5	4

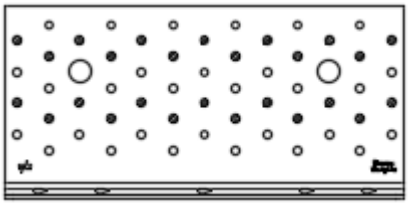
Drawing:



Nailing pattern:

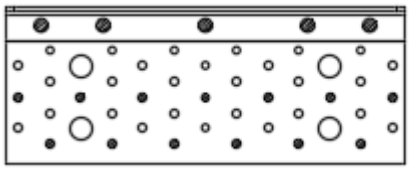
Nailing pattern 1

Flange A:



26

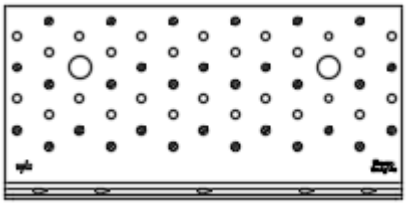
Flange B:



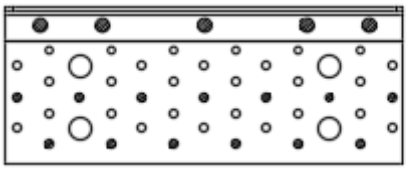
5 + 13

Beam (CLT) to beam (CLT)

Nailing pattern 2



30

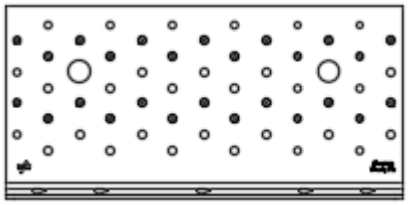


5 + 13

Beam (CLT) to beam (CLT)

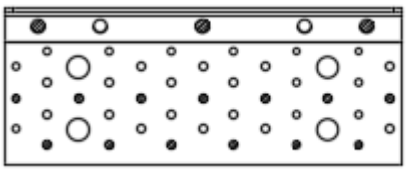
Nailing pattern 4

Flange A:



26

Flange B:
(Rigid)



3 + 13

Beam (CLT) to beam (CLT)

Ø8 screws are set in Ø9mm holes at 15° from vertical plane with a +/-5° tolerance. It can be screws with countersunk head such as ESCRFTC or with hexagonal head such as SSH. The following values are valid with screws with capacities equivalent to ESCRFTC8.0x120 or higher otherwise stated.

Characteristic Capacities:

The values $R_{i,k}$ for one AB255HD per connection, with prevention of rotation (so that only shear force is acting), are stated in the tables below.
For a connection with 2 x AB255HD the values can be doubled.

Table D68-1: Characteristic capacities beam to beam – 1 Angle bracket F_1

1 Angle Bracket AB255HD per connection					Characteristic capacity (kN) per connection						
					$R_{1,k}$						
Nailing pattern	Fasteners				CNA or CSA type:				CNA or CSA type:		
	Flange A	Flange B									
	CNA or CSA	CNA or CSA	Full threaded Ø8 **								
	Qty	Qty	Qty	Type	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	26	13*	5	8x140	min of: 42.9 56/k_{mod}	min of: 47.04 56/k_{mod}	min of: 51.05 56/k_{mod}		min of: 48.4 56/k_{mod}	min of: 51.05 56/k_{mod}	
				8x160			min of: 57.6 56/k_{mod}	min of: 59.4 56/k_{mod}		min of: 54.7 56/k_{mod}	min of: 59.44 56/k_{mod}
				8x180				min of: 61.4 56/k_{mod}			min of: 63.9 56/k_{mod}
				8x200							
Nailing pattern 2	30	13*	5	8x140	min of: 49.55 56/k_{mod}	min of: 51.05 56/k_{mod}			min of: 51.05 56/k_{mod}		
				8x160		min of: 54.27 56/k_{mod}	min of: 59.44 56/k_{mod}		min of: 54.81 56/k_{mod}	min of: 59.44 56/k_{mod}	
				8x180			min of: 66.47 56/k_{mod}	min of: 67.82 56/k_{mod}		min of: 61.97 56/k_{mod}	min of: 67.82 56/k_{mod}
				8x200				min of: 70.88 56/k_{mod}			min of: 72.44 56/k_{mod}
Nailing pattern 3	26	13*	3	8x140	min of: 30.97 56/k_{mod}						
				8x160	min of: 36.26 56/k_{mod}						
				8x180	min of: 41.5 56/k_{mod}						
				8x200	min of: 42.9 56/k_{mod}	min of: 46.85 56/k_{mod}					

* Optional, can be dismissed for F1

** Full threaded screws with d_h = 15mm

Table D68-2: Characteristic capacities beam to beam – 1 Angle bracket $F_{2/3}$

1 Angle Bracket AB255HD per connection				Characteristic capacity (kN) per connection						
				$R_{2/3,k}$						
Nailing pattern	Number of fasteners			CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B								
		CNA or CSA	Ø8	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	26	13	5	31.4	35.0	42.9	45.7	34.9	39.4	46.0
Nailing pattern 2	30	13	5	32.8	37.7	46.5	49.7	38.4	44.3	53.5
Nailing pattern 3	26	13	3	25.9	28.3	32.4	32.4	32.8	37.1	43.4

Table D68-3: Characteristic capacities beam to beam – 1 Angle bracket F_4

1 Angle Bracket AB255HD per connection				Characteristic capacity (kN) per connection						
				$R_{4,k}$						
Nailing pattern	Number of fasteners			CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B								
		CNA or CSA	Ø8	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	26	13	5	13.92 /k_{mod}^0,76						
Nailing pattern 2	30	13	5							
Nailing pattern 3	26	13	3							

Table D68-4: Characteristic capacities beam to beam – 1 Angle bracket F_5

1 Angle Bracket AB255HD per connection				Characteristic capacity (kN) per connection						
				$R_{5,k}$						
Nailing pattern	Number of fasteners			CNA Connector Nails				CSA Connector Screws		
	Flange A	Flange B								
		CNA or CSA	Ø8	4,0x35	4,0x40	4,0x50	4,0x60	5,0x35	5,0x40	5,0x50
Nailing pattern 1	26	13	5	min of: 5.4 9.25/k_{mod}	min of: 6.6 9.25/k_{mod}	min of: 8.7 9.25/k_{mod}	min of: 10.9 9.25/k_{mod}	min of: 17.3 9.25/k_{mod}	9.25/k_{mod}	9.25/k_{mod}
Nailing pattern 2	30	13	5	min of: 8.5 9.25/k_{mod}	min of: 10.2 9.25/k_{mod}	min of: 13.5 9.25/k_{mod}	min of: 16.8 9.25/k_{mod}	9.25/k_{mod}	9.25/k_{mod}	9.25/k_{mod}
Nailing pattern 3	26	13	3	min of: 5.4 9.25/k_{mod}	min of: 6.5 9.25/k_{mod}	min of: 8.7 9.25/k_{mod}	min of: 10.8 9.25/k_{mod}	min of: 16.7 9.25/k_{mod}	9.25/k_{mod}	9.25/k_{mod}

Table D68-5: AB255HD Slip modulus Kser - Timber to Timber

1 Angle Bracket AB255HD per connection				K_{ser} (kN/mm)	
Nailing pattern	Number of fasteners				
	Flange A	Flange B			
		CNA or CSA	Ø8	**Load direction : $R_{1,k}$**	**Load direction : $R_{2/3,k}$**
Nailing pattern 1	26	13	5	12,2	16,0

Annex D69 - AB255SSH

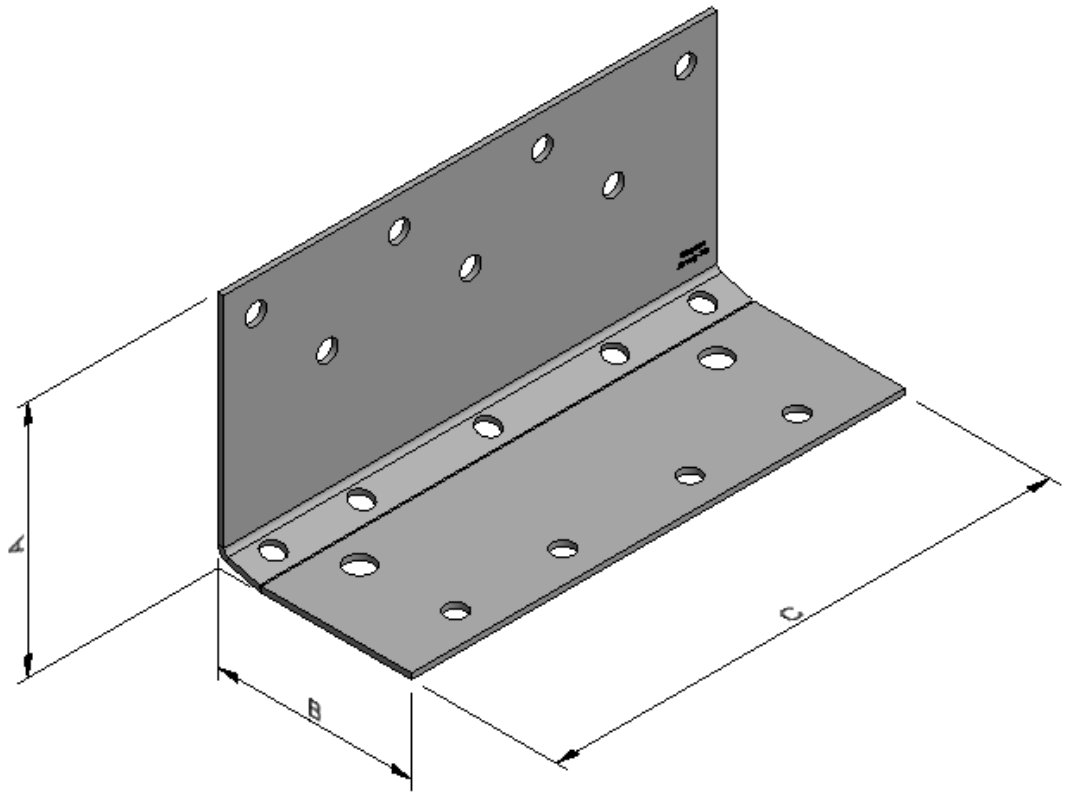
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB255SSH	Steel ref. 1	-
AB255SSHS	Steel ref. 2	-
AB255SSHS2	Steel ref. 3	-

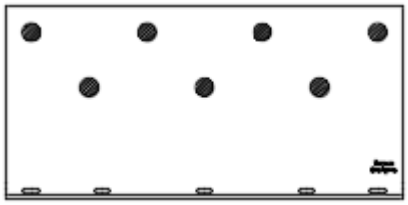
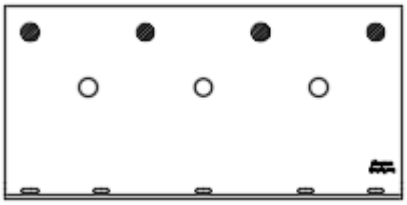
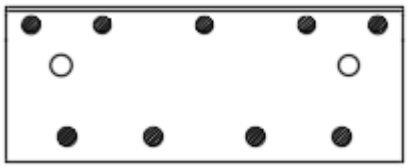
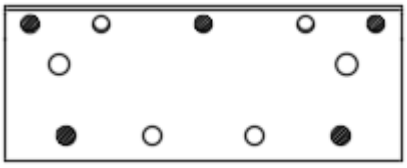
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	Ø11	Ø11	Ø14
AB255SSH	123	100	255	3,0	7	9	2

Drawing:



Nailing pattern:

	Nailing pattern 1	Nailing pattern 2
Flange A:	 7	 4
Flange B:	 9	 5
	Beam (CLT) to beam (CLT)	Beam (CLT) to beam (CLT)

Skewed screws close to the bend are set at 15° from vertical plane. It shall be screws with hexagonal head such as SSH. The following values are valid with screws with capacities equivalent to SSH10.0x40 or higher otherwise stated.

Characteristic Capacities:

The values $R_{i,k}$ for one AB255SSH per connection, with prevention of rotation (so that only shear force is acting), are stated in the tables below.
For a connection with 2 x AB255SSH the values can be doubled.

Table D69-1: Characteristic capacities beam to beam – 1 Angle bracket F_1

1 Angle Bracket AB255SSH per connection			Characteristic capacity (kN) per connection				
Nailing pattern	Fasteners Qty		$R_{1,k}$				
	Flange A	Flange B	SSH				
			10.0x40	10.0x50	10.0x100	10.0x120	10.0x160
Nailing pattern 1	7	9	8.56 * k_{mod}^0.25	19.3 * k_{mod}^0.12	26.36 * k_{mod}^0.09	42,6	56,2
Nailing pattern 2	4	7	4.12 * k_{mod}^0.5	10.9 * k_{mod}^0.2	15.36 * k_{mod}^0.15	25.64 * k_{mod}^0.1	34.21 * k_{mod}^0.07

Table D69-2: Characteristic capacities beam to beam – 1 Angle bracket $F_{2/3}$

1 Angle Bracket AB255SSH per connection			Characteristic capacity (kN) per connection				
Nailing pattern	Fasteners Qty		$R_{2,k} = R_{3.k}$				
	Flange A	Flange B	SSH				
			10.0x40	10.0x50	10.0x100	10.0x120	10.0x160
Nailing pattern 1	7	9	17,4	24,7	35,0	42,6	48,5
Nailing pattern 2	4	7	10,8	15,4	21,8	26,5	30,1

Table D69-3: Characteristic capacities beam to beam – 1 Angle bracket F_4

1 Angle Bracket AB255SSH per connection			Characteristic capacity (kN) per connection				
Nailing pattern	Fasteners Qty		$R_{4,k}$				
	Flange A	Flange B	SSH				
			10.0x40	10.0x50	10.0x100	10.0x120	10.0x160
Nailing pattern 1	7	9	min 13.7 13.92/k_{mod}^0.76	13.9/k_{mod}^0.76	13.9/k_{mod}^0.76	13.9/k_{mod}^0.76	13.9/k_{mod}^0.76
Nailing pattern 2	4	7	min 8.7 13.92/k_{mod}^0.76	min 13.9 13.9/k_{mod}^0.76	min 14.6 13.9/k_{mod}^0.76	min 18.8 13.9/k_{mod}^0.76	13.9/k_{mod}^0.76

Table D69-4: Characteristic capacities beam to beam – 1 Angle bracket F_5

1 Angle Bracket AB255SSH per connection			**Characteristic capacity (kN) per connection**				
Nailing pattern	Fasteners Qty		**$R_{5,k}$**				
	Flange A	Flange B	SSH				
			10.0x40	10.0x50	10.0x100	10.0x120	10.0x160
Nailing pattern 1	7	9	$4.21/k_{mod}$^0.24	$5.02/k_{mod}$^0.24	$5.22/k_{mod}$^0.24	$5.28/k_{mod}$^0.24	$5.32/k_{mod}$^0.24
Nailing pattern 2	4	7	$1.68/k_{mod}$	$1.97/k_{mod}$^0.8	$2.11/k_{mod}$^0.8		

Annex D70 – AB3560

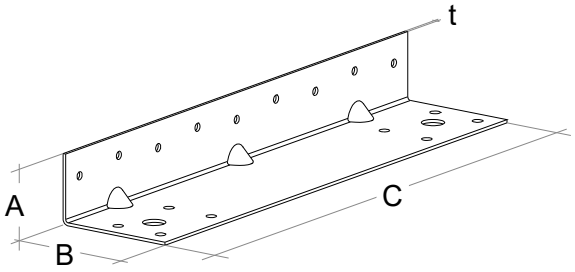
Product Name:

Product Name	Material reference acc. to clause II-1	Alternative product names
AB3560	Steel ref. 1	-
AB3560S	Steel ref. 2	-
AB3560S2	Steel ref. 3	-

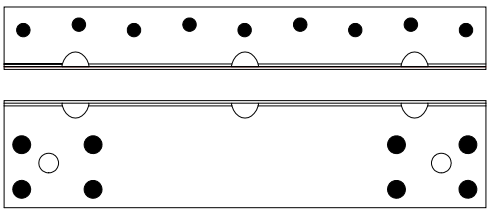
Connector Size Range:

Model no.	Dimensions [mm]				Holes flange A	Holes flange B	
	A	B	C	Thickness	Ø4	Ø5	Ø11
AB3560	35	60	270	1,5	9	8	2

Drawing:



Nailing pattern:



Characteristic Capacities:

The values $R_{i,k}$ for one AB3560 per connection, with prevention of rotation (so that the connected timber elements are prevented against rotation), are stated in the tables below.

Table D70-1: Characteristic capacities beam to beam – 1 Angle bracket

Fastener				*characteristic capacities per connection [kN]*			
Flange A		Flange B					
number	type	number	type	$R_{1.k}$	$R_{2/3.k}$	$R_{4.k}$	$R_{5.k}$
9	CNA3,1x60	8	CSA5,0x25	$\min(3,6/k_{mod}$ $2,6xR_{ax.k-B})$	$\min(7,42xR_{lat.k-A}$ $7,1xR_{lat.k-B})$	$\min(6,5/k_{mod}$ $9,4\ 8xR_{lat.k-B})$	$\min(4,2/k_{mod}$ $2,34x\ R_{lat.k-A})$

$R_{lat.k-A}$ lateral capacity of the nail/screws in flange A

$R_{lat.k-B}$ lateral capacity of the nail/screws in flange B

$R_{ax.k-A}$ axial withdrawal capacity of the nail/screws in flange A

$R_{ax.k-B}$ axial withdrawal capacity of the nail/screws in flange B