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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-09/0316 of 19/05/2016

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:	Joma Various Angle Brackets*) *) See bracket types in section II.1
Product family to which the above construction product belongs:	Three-dimensional nailing plate (timber-to-timber angle bracket)
Manufacturer:	Joma AB Målskog SE-335 91 Gnosjö Tel. +46 370 32 52 50 Fax +46 370 32 51 25 Internet www.joma.se
Manufacturing plant:	Joma AB Målskog SE-335 91 Gnosjö
This European Technical Assessment contains:	113 pages including 2 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 previous ETA with the same number issued on 2014-05-23

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

Joma Angle Brackets type 5566060, 5566080, 5566100, 5588040, 5588060, 5588080, 5588100, 5588120, 5511060, 5511080, 5511100, 5546060, 5568060, 5512100, 406, 407, 408, 409, 412, 420, 423, 425, 433/4433, 434/4434, 435/4435, 436, 444, 445, 470U, 470M, 5526660, 5526680, 55266100, 5528840, 5528860, 5528880, Knagge, are one piece, non-welded, timber-to-timber angle brackets. They are intended for timber-to-timber connections fastened by a range of nails.

Bracket types M it with a rib and bracket types U are without rib.

The angle brackets are made from pre-galvanized steel Grade S 250 GD + min. Z275 according to EN 10346:2009 with a minimum characteristic yield stress of 250 MPa or of steel grade 1.4301 according to EN 10088-2:2005 with a minimum characteristic yield strength of $R_{p0,2}$ = 290 N/mm². The bracket type 436 is made from pre-galvanized steel Grade S 350 GD + min. Z275 according to EN 10346:2009 with a minimum characteristic yield stress of 350 MPa Dimensions, hole positions and typical installations are shown in Annex A.

Bracket type 444 is made from steel Grade S 250 GD with 25 µm Magnelis ZM310 or 50 µm zinc coating corrosion protection or of steel grade 1.4301 according to EN 10088-2:2005 with a minimum characteristic yield stress of 250 MPa

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 column or between a timber member and a concrete or 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 B.The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a characteristic density 0f 350 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

Annex B 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:

$$k_{dens} = \left(\frac{\rho_k}{350} \right)^2$$

Where ρ_k is the characteristic density of the timber in kg/m^3.

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 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. Brackets made from stainless steel are for use in service classes 1, 2 and 3 of EN 1995-1-1:2004, (Eurocode 5).

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

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

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

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance determined
Ductility in cyclic testing	No performance determined
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The brackets are made from steel classified as Euroclass A1 in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	No dangerous materials**)
3.7 Sustainable use of natural resources (BWR7)	No Performance Determined
3.8 General aspects related to the performance of the product	The 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 conditions defined by service class 1 and 2
Identification	See Annex A

*) See additional information in section 3.9 – 3.12.

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

3.9 Methods of verification

The characteristic load-carrying capacities are based on the characteristic values of the nail connections and the steel plates. To obtain design values the capacities have to be multiplied with different partial factors for the material properties, in addition the nail connection with the coefficient k_{mod}.

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

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

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

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

3.10 Mechanical resistance and stability

See annex B for characteristic load-carrying 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.

Joma connector nails

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

The load bearing capacities of the brackets has been determined based on the use of connector nails 4,0 x 40 mm.

The characteristic withdrawal capacity of the nails has been determined by testing in accordance with EN 1382: Timber structures - Test methods - Withdrawal capacity of timber fasteners:

For electroplated zinc covered nails

$F_k = f_u dl = 7{,}6dl$

Further, the angle brackets may be fastened to a concrete structure by bolts with a diameter of 10 mm in holes with a diameter up to 2 mm larger than the bolt.

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

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

3.11 Aspects related to the performance of the product

3.11.1 Corrosion protection in service class 1 and 2.
The joist hanger have a zinc coating weight of min Z275. The steel employed is S250 GD or S 350GD with min Z275 according to EN 10346:2009 or with 25 µm Magnelis ZM310.

2.7.2 Corrosion protection in service class 3
In accordance with Eurocode 5 the brackets are made from steel grade 1.4301 according to EN 10088-2:2005 with a minimum characteristic yield strength of $R_{p0,2}$ = 290 N/mm² or steel S250 GD or S 350 GD with zinc coating thickness 50 µm.

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

JOMA angle brackets are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

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

The following provisions concerning installation apply:

The structural members – the components 1 and 2 shown in the figure on page 25 - to which the brackets are fixed shall be:

- Restrained against rotation. At a load F_4/F_5, the component 2 is allowed to be restrained against rotation by the Angle brackets.
- Strength class C14 or better, see section 1 of this ETA
- Free from wane under the bracket.
- The actual end bearing capacity of the timber member to be used in conjunction with the bracket is checked by the designer of the structure to ensure it is not less than the bracket capacity and, if necessary, the bracket capacity reduced accordingly.
- The gap between the timber members does not exceed 3 mm.
- There are no specific requirements relating to preparation of the timber members.

The execution of the connection shall be in accordance with the approval holder’s technical literature.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

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

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

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

Issued in Charlottenlund on 2016-05-19 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details and definitions

Table A.1 Materials specification

Bracket type	Thickness (mm)	Steel specifications*	Coating specification
5526660 and 5566060	2,0 and 2,5	S 250 GD + Z 275	Z 275
5526680 and 5566080	2,0 and 2,5	S 250 GD + Z 275	Z 275
55266100 and 5566100	2,0 and 2,5	S 250 GD + Z 275	Z 275
5528840 and 5588040	2,0 and 2,5	S 250 GD + Z 275	Z 275
5528860 and 5588060	2,0 and 2,5	S 250 GD + Z 275	Z 275
5528880 and 5588080	2,0 and 2,5	S 250 GD + Z 275	Z 275
5588100	2,5	S 250 GD + Z 275	Z 275
5588120	2,5	S 250 GD + Z 275	Z 275
5511060	2,5	S 250 GD + Z 275	Z 275
5511080	2,5	S 250 GD + Z 275	Z 275
5511100	2,5	S 250 GD + Z 275	Z 275
5546060	2,5	S 250 GD + Z 275	Z 275
5568060	2,5	S 250 GD + Z 275	Z 275
5512100	2,5	S 250 GD + Z 275	Z 275
406	3,0	S 250 GD + Z 275	Z 275
407	3,0	S 250 GD + Z 275	Z 275
408	3,0	S 250 GD + Z 275	Z 275
409	3,0	S 250 GD + Z 275	Z 275
412	3,0	S 250 GD + Z 275	Z 275
420	3,0	S 250 GD + Z 275	Z 275
423	1,5 and 2,5	S 250 GD + Z 275	Z275
425	3,0	S 250 GD + Z 275	Z 275
433/4433	3,0/4,0	S 250 GD + Z 275	Z 275
434/4434	3,0/4,0	S 250 GD + Z 275	Z 275
435/4435	3,0/4,0	S 250 GD + Z 275	Z 275
436	3,0	S 350 GD + Z 275	Z 275
445	3,0	S 250 GD + Z 275	Z 275
470U	2,0 and 2,5	S 250 GD + Z 275	Z 275
470M	2,0 and 2,5	S 250 GD + Z 275	Z 275
Knagge	2,0	S 250 GD + Z 275	Z 275
444	3,0 ± 0,13 and 4,0 ± 0,13	S 250 GD	See below table

* Or stainless steel 1.4301 for all types

Table A.2 Material specification for bracket type 444

Bracket type	**Thickness (mm)**	**Corrosion protection thickness**	**Service class**
4443001, 4443002, 4443003	3 mm	25 µm Magnelis ZM310	1 and 2
4444001, 4444002, 4444003	4 mm	25 µm Magnelis ZM310	1 and 2
4443001 VFZ, 4443002 VFZ, 4443003 VFZ	3 mm	50 µm	1, 2 and 3
4444001 VFZ, 4444002 VFZ, 4444003 VFZ	4 mm	50 µm	1, 2 and 3
4443001 1.4301, 4443002 1.4301, 4443003 1.4301	3 mm	Stainless steel	1, 2 and 3
4444001 1.4301, 4444002 1.4301, 4444003 1.4301	4 mm	Stainless steel	1, 2 and 3

Table A.3 Fastener specification

Nail type Joma	**Nail size (mm)**		**Finish**
According to prEN 14592	Diameter	Length	
Threaded nail	4,0	40	Electroplated zinc or stainless steel

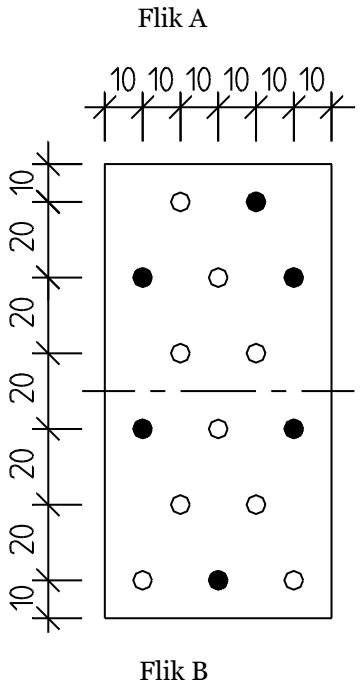


Figure A.1 Dimensions of
Angle Bracket 55266060 and 5566060

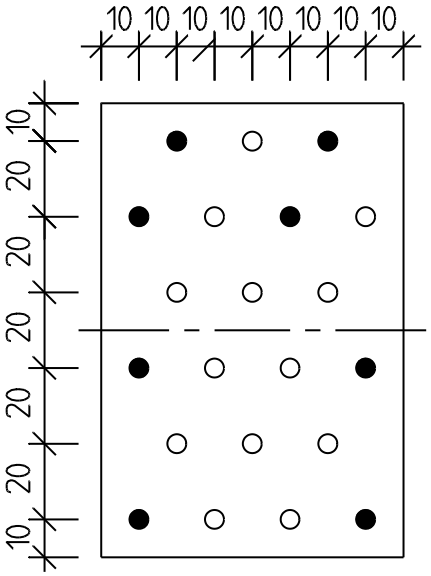


Figure A.2 Dimensions of
Angle Bracket 5526680 and 5566080

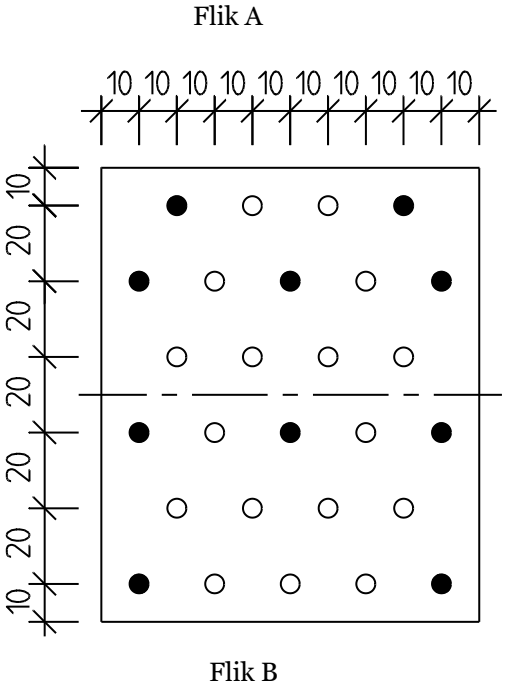


Figure A.3 Dimensions of
Angle Bracket 55266100 and 5566100

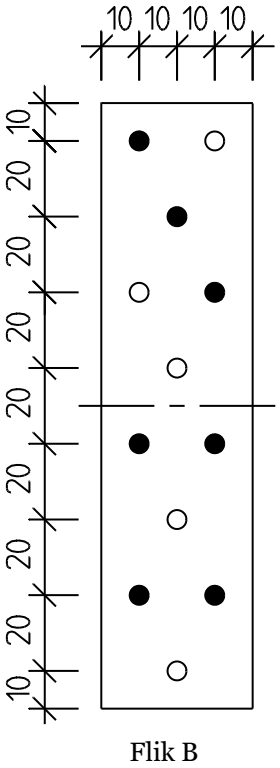


Figure A.4 Dimensions of
Angle Bracket 5528840 and 5588040

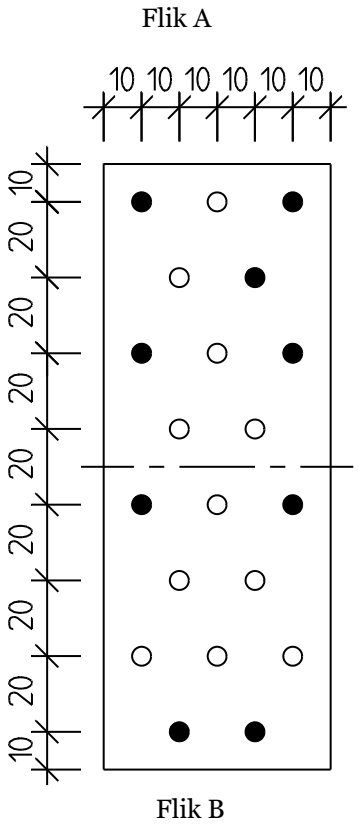


Figure A.5 Dimensions of
Angle Bracket 5528860 and 5588060

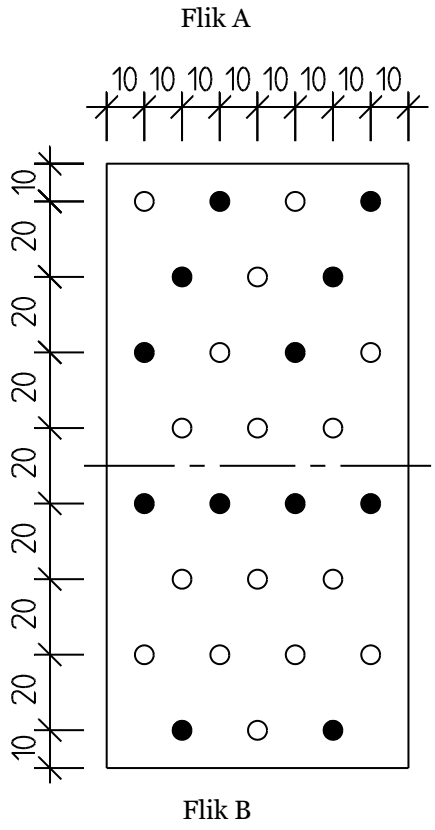


Figure A.6 Dimensions of
Angle Bracket 5528880 and 5588080

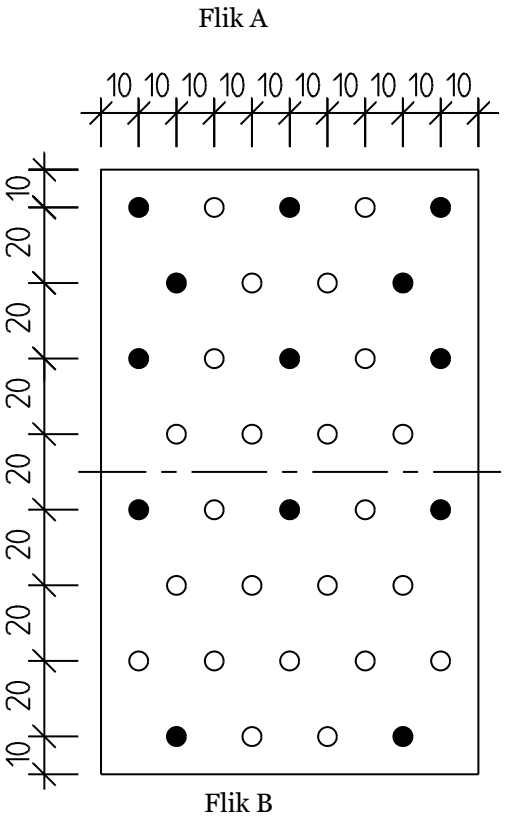


Figure A.7 Dimensions of
Angle Bracket 5588100

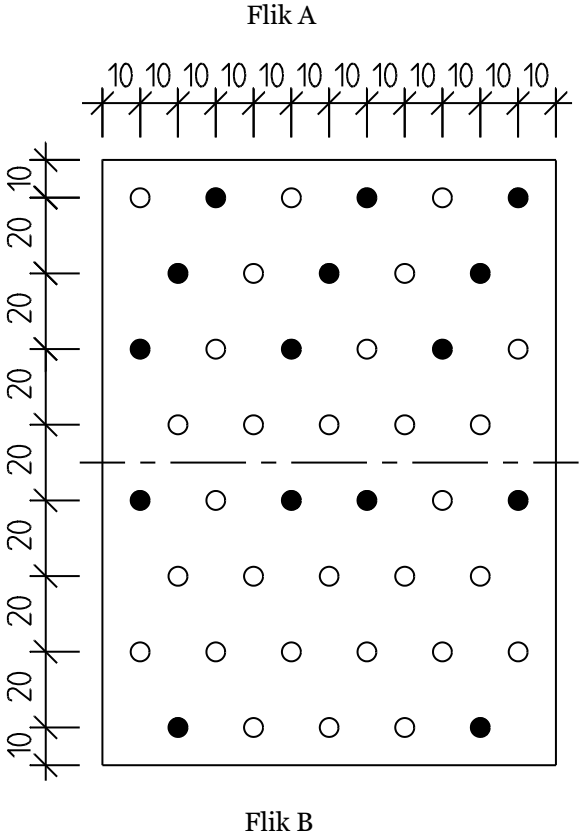


Figure A.8 Dimensions of
Angle Bracket 5588120

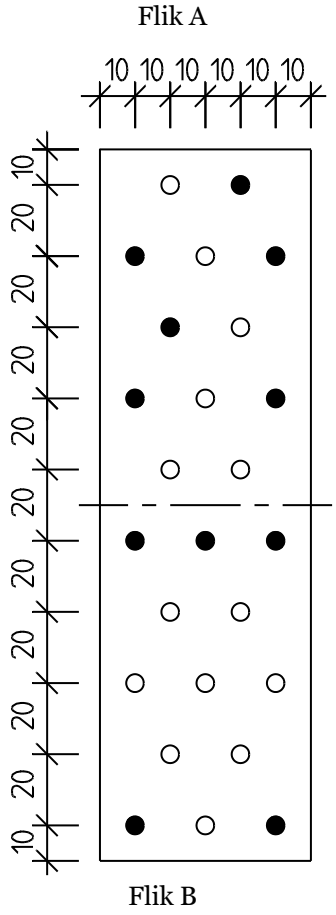


Figure A.9 Dimensions of Angle Bracket 5511060

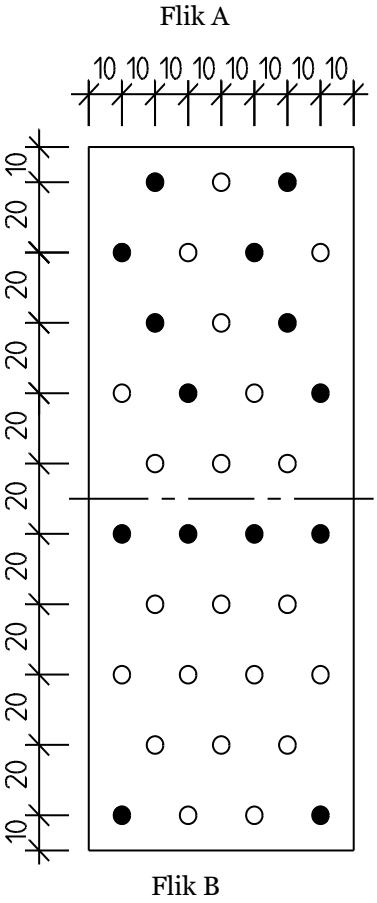
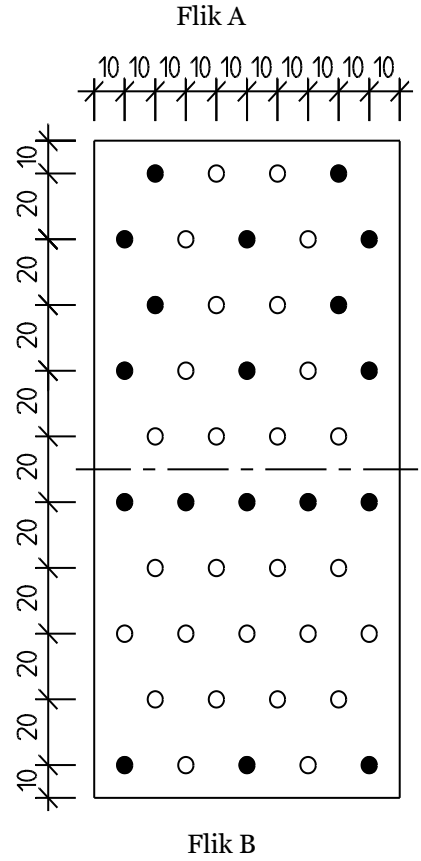


Figure A.10 Dimensions of Angle Bracket 5511080



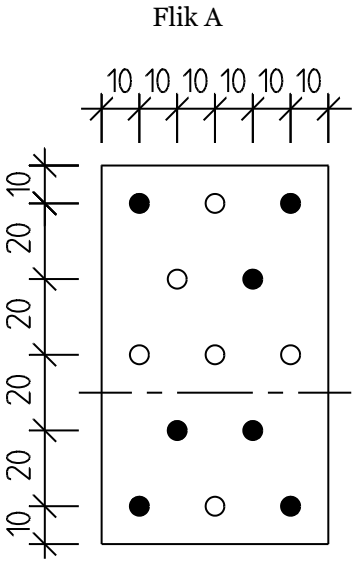


Figure A.11 Dimensions of
Angle Bracket 5511100

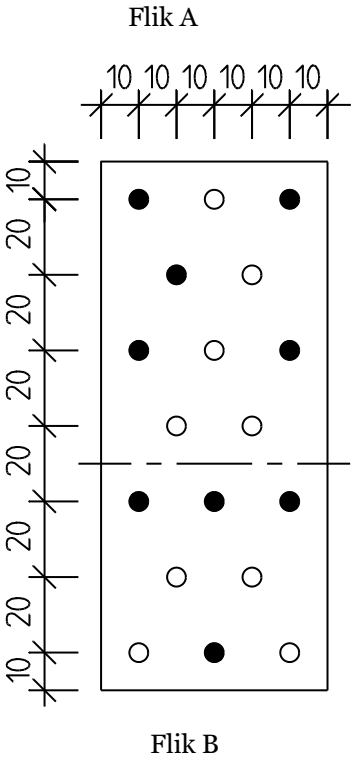


Figure A.12 Dimensions of
Angle Bracket 5546060

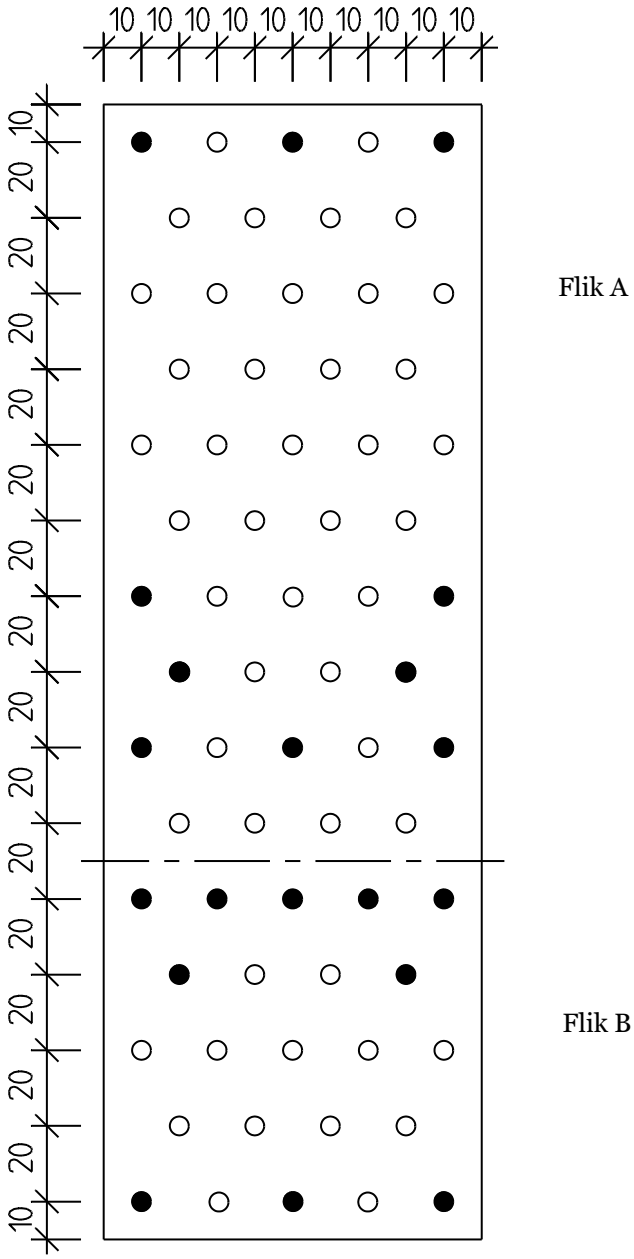


Figure A.13 Dimensions of
Angle Bracket 5568060

Figure A.14 Dimensions of
Angle Bracket 5512100

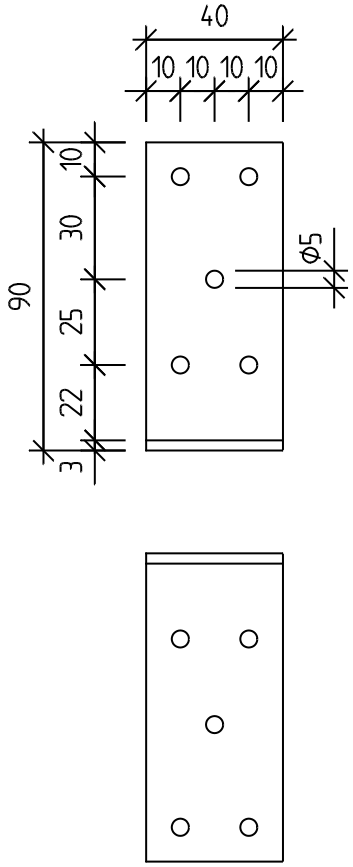


Figure A.15 Dimensions of
Angle Bracket 406

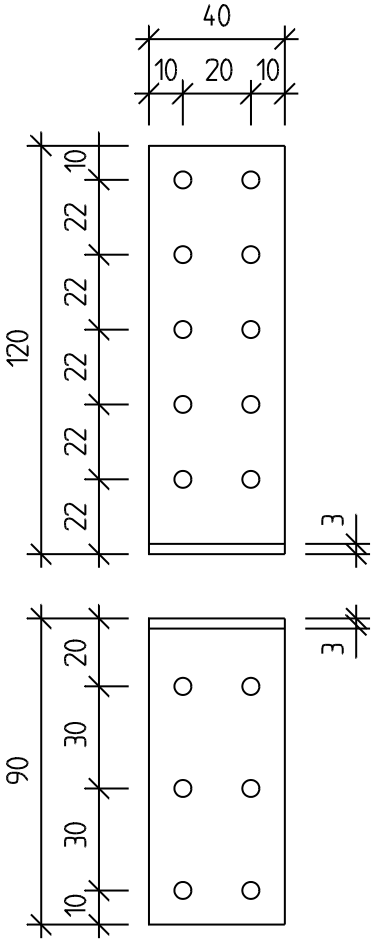


Figure A.16 Dimensions of
Angle Bracket 407

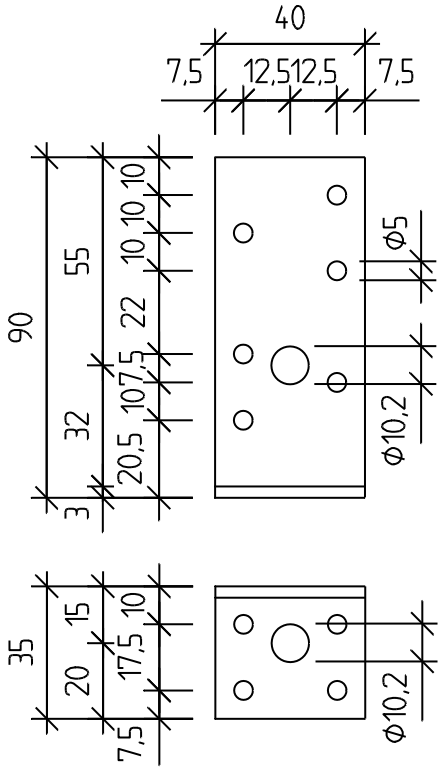


Figure A.17 Dimensions of
Angle Bracket 408

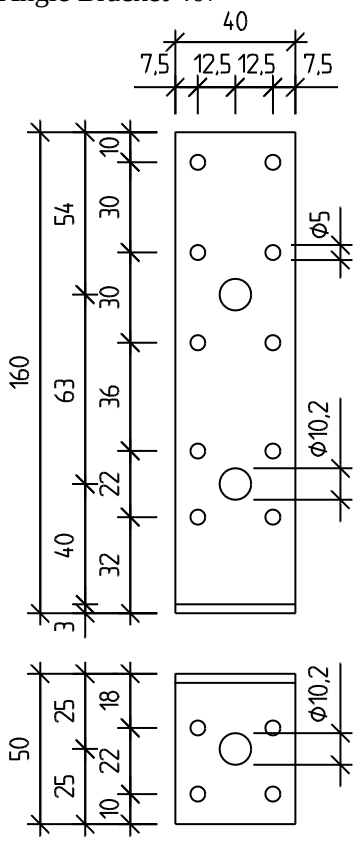


Figure A.18 Dimensions of
Angle Bracket 409

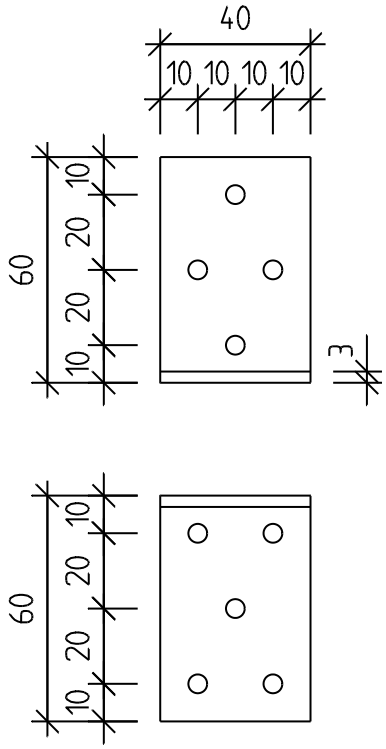


Figure A.19 Dimensions of
Angle Bracket 412

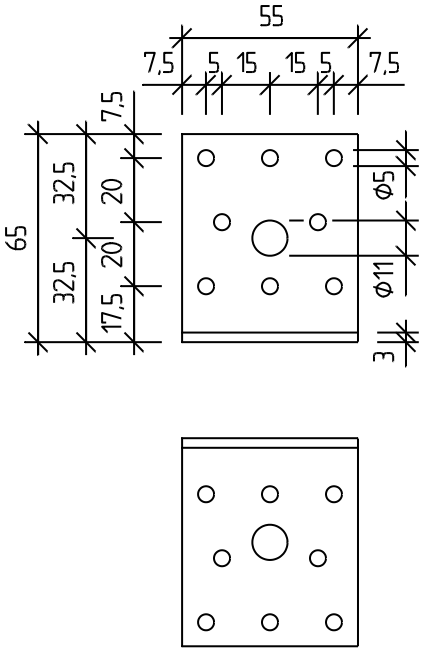


Figure A.20 Dimensions of
Angle Bracket 420

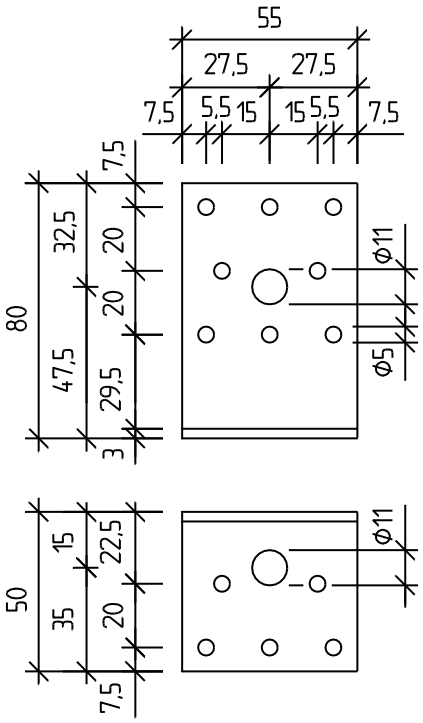


Figure A.21 Dimensions of
Angle Bracket 425

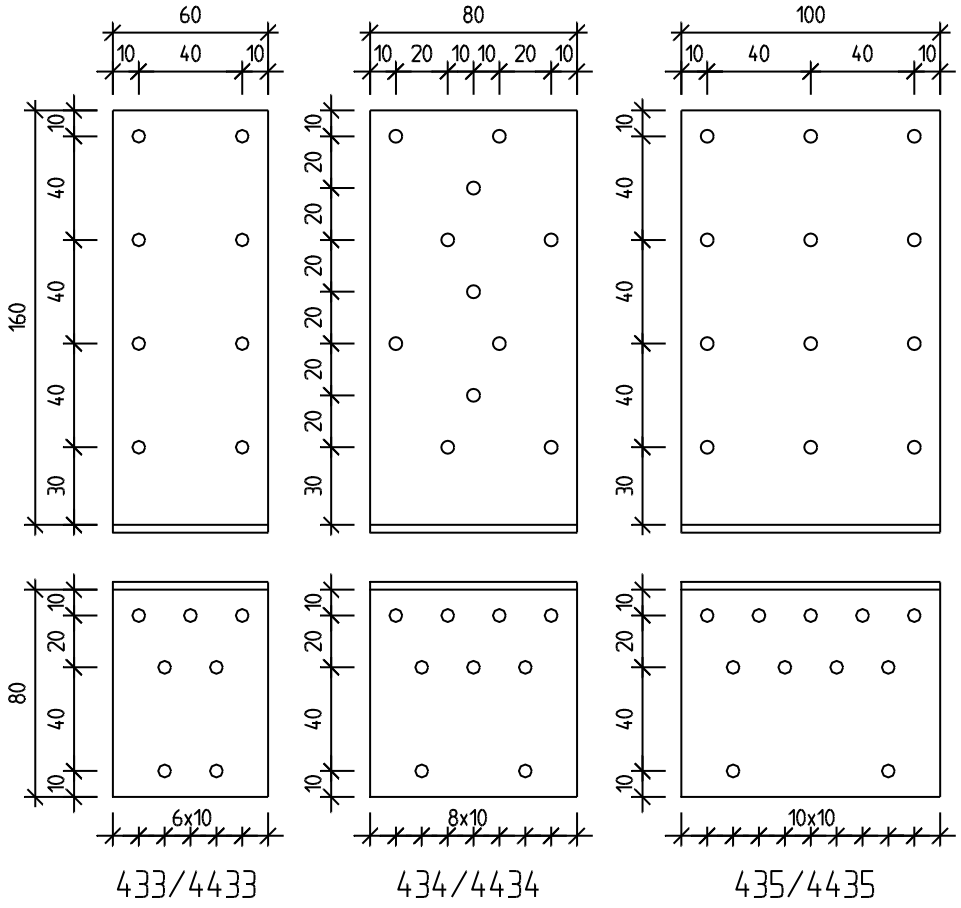


Figure A.22 Dimensions of
Angle Bracket 433/4433, 434/4434, 435/4435

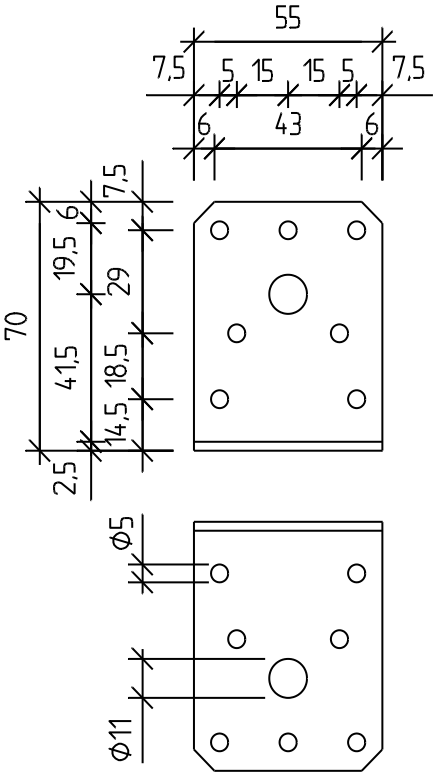


Figure A.23 Dimensions of
Angle Bracket 470U
The bracket is both 2,0 mm and 2,5 mm thick
All other dimensions are identical

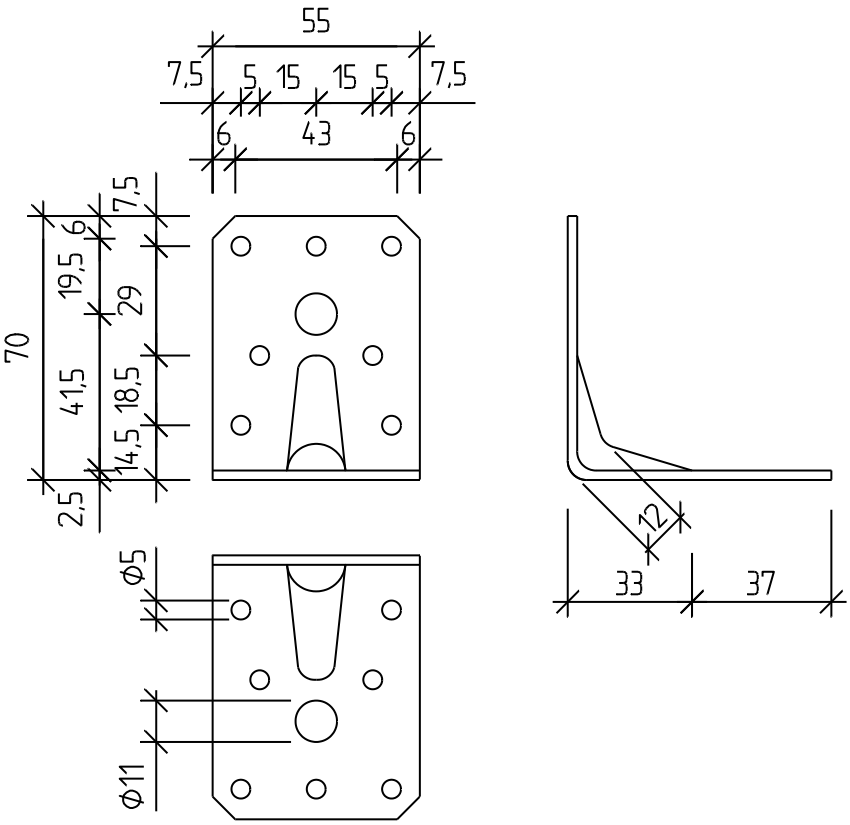


Figure A.24 Dimensions of
Angle Bracket 470M with rib
The bracket is both 2,0 mm and 2,5 mm thick
All other dimensions are identical

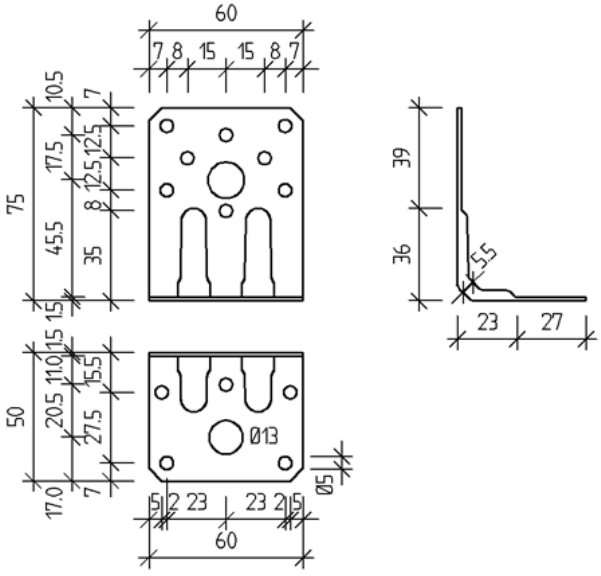


Figure A.25 Dimensions of
Angle Bracket 4230001 with rib
The bracket is 1,5mm thick
All other dimensions are identical.

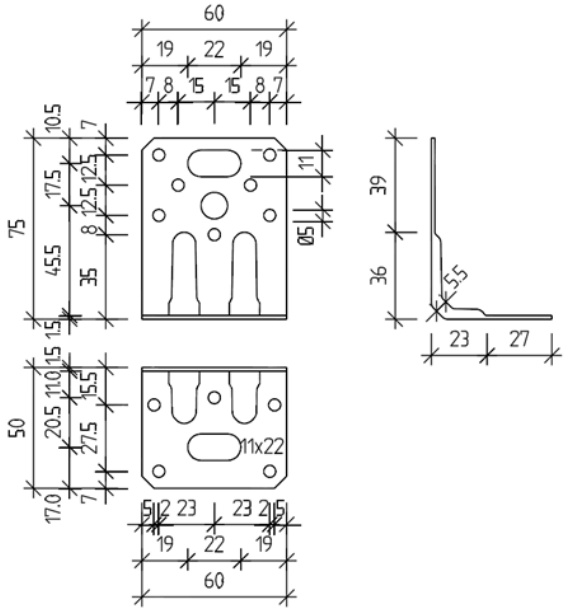


Figure A.26 Dimensions of
Angle Bracket 4230002 with rib
The bracket is 1,5mm thick
All other dimensions are identical.

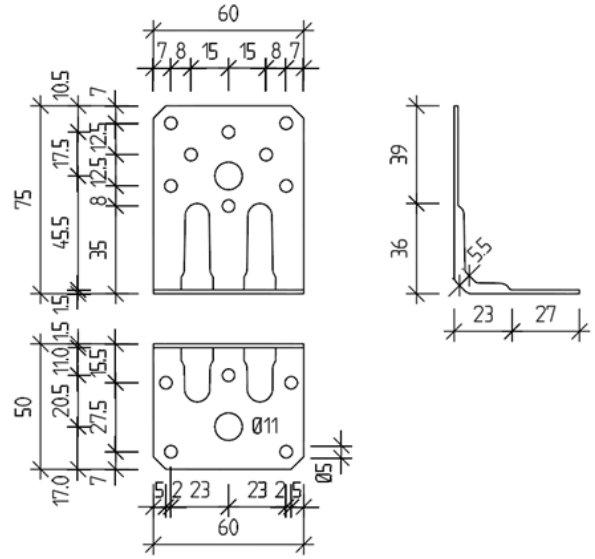


Figure A.27 Dimensions of
Angle Bracket 4230003 with rib
The bracket is 1,5mm thick
All other dimensions are identical.

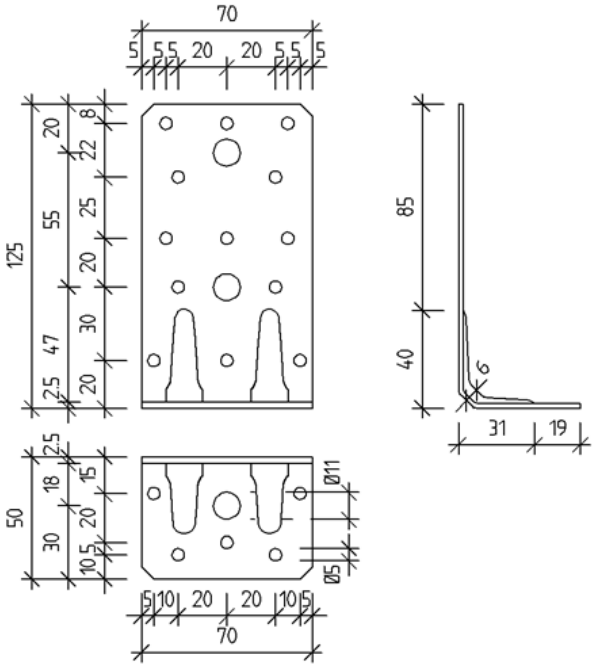


Figure A.28 Dimensions of
Angle Bracket 4230101 with rib
The bracket is 2,5 mm thick
l other dimensions are identical.

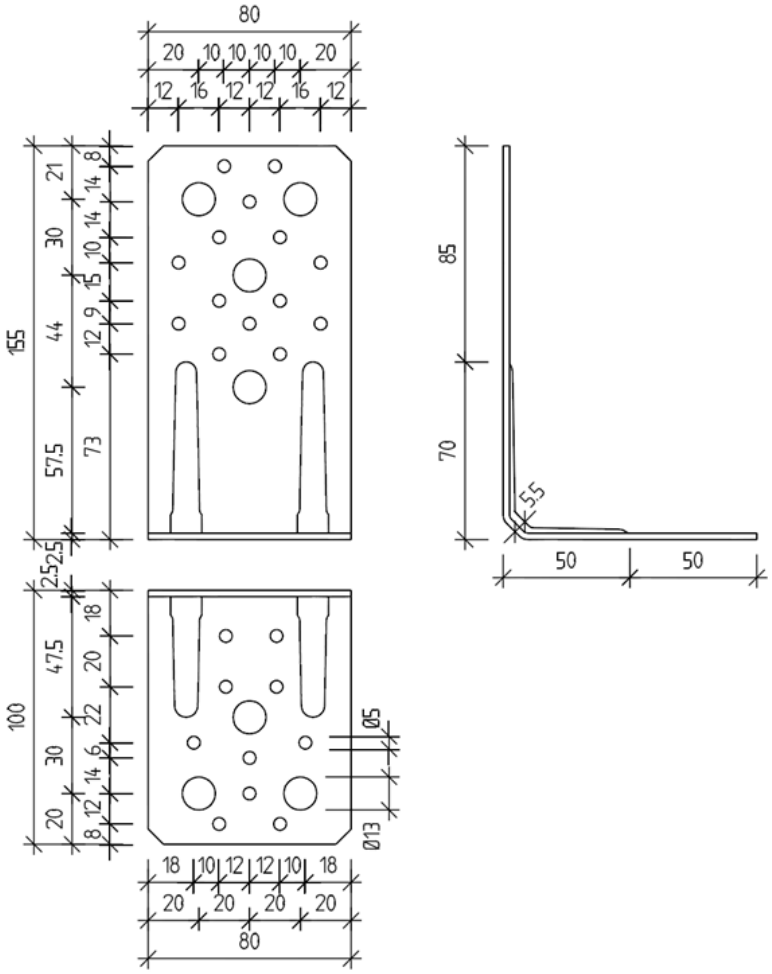


Figure A.29 Dimensions of
Angle Bracket 4230201 with rib
The bracket is 2,5 mm thick
All other dimensions are identical.

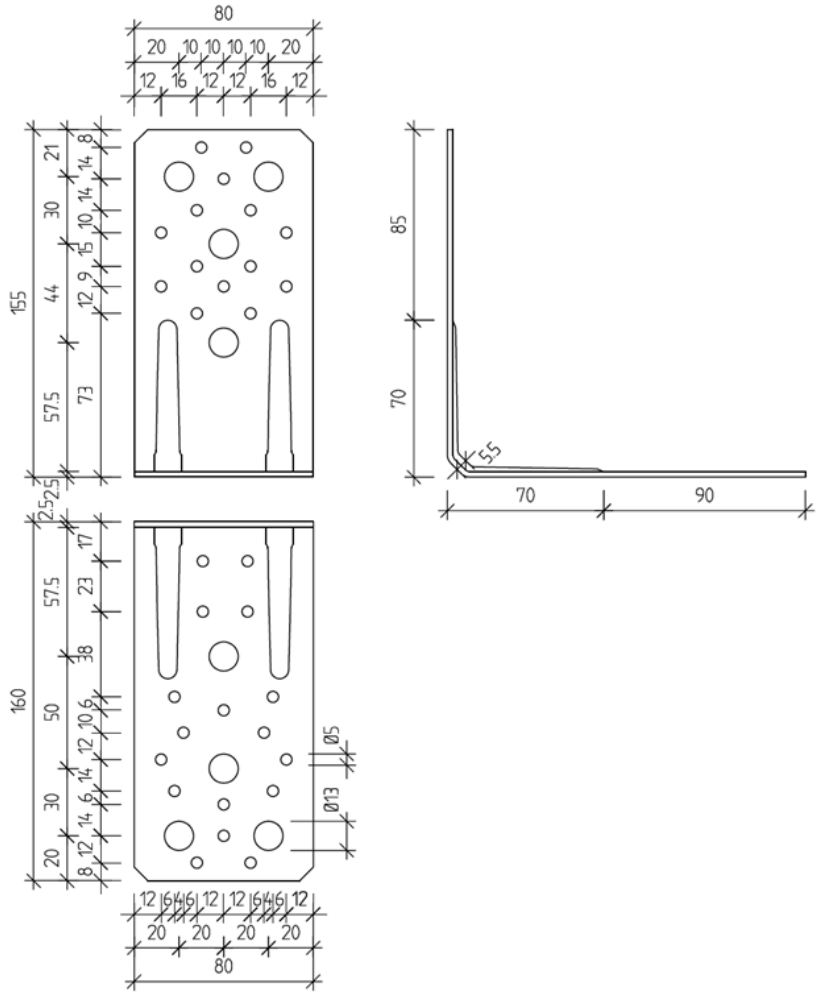


Figure A.30 Dimensions of
Angle Bracket 4230202 with rib
The bracket is 2,5 mm thick
All other dimensions are identical.

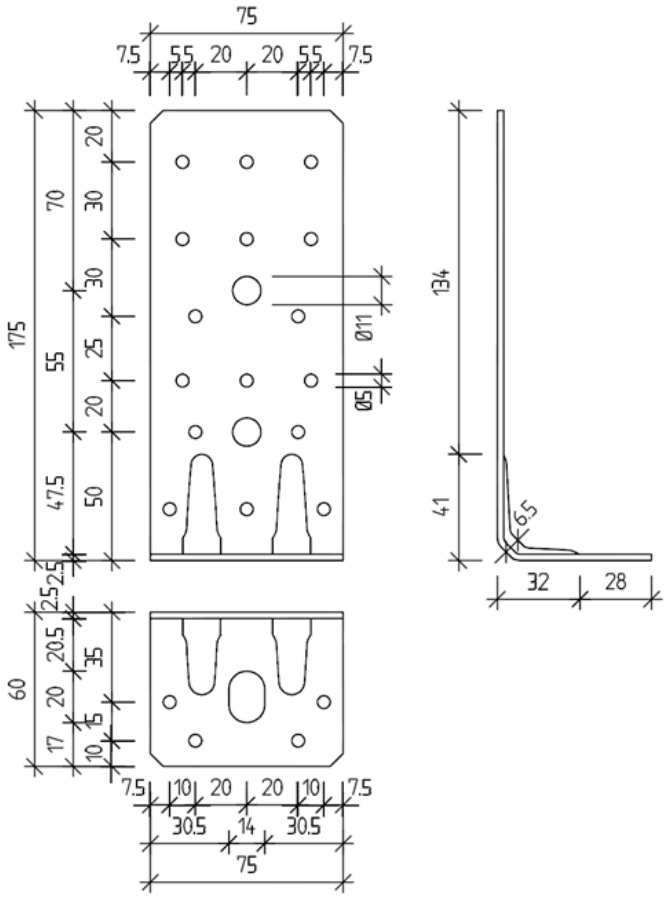


Figure A.31 Dimensions of
Angle Bracket 4230203 with rib
The bracket is 2,5 mm thick
All other dimensions are identical.

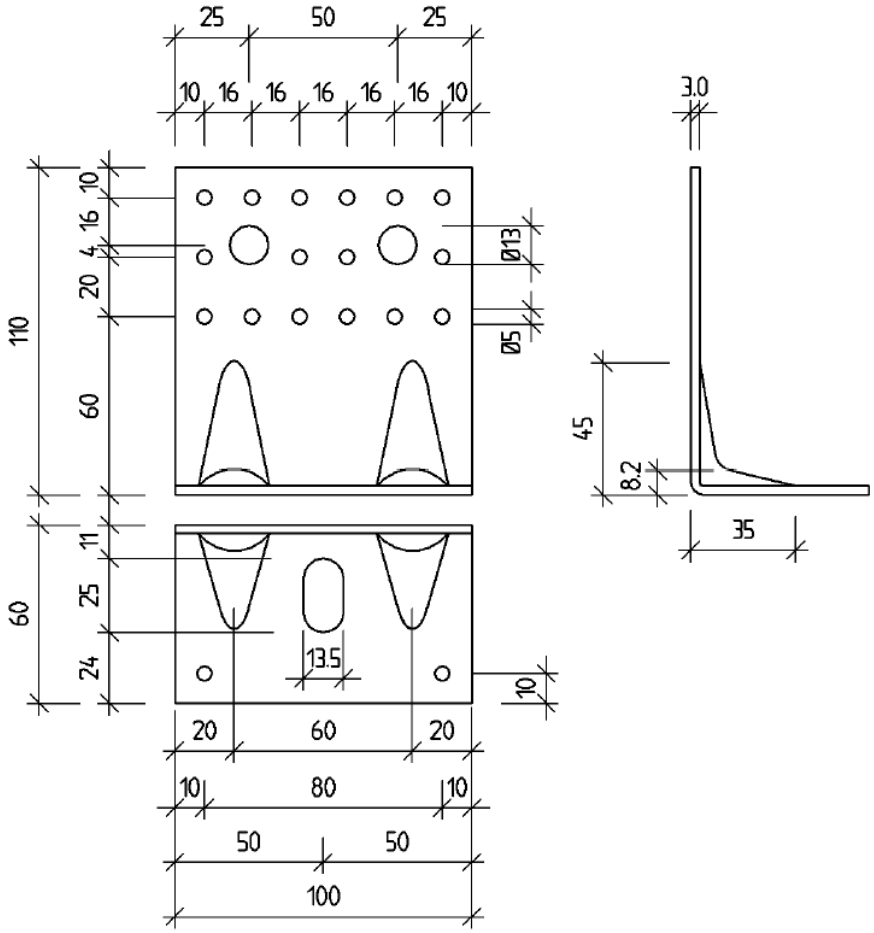


Figure A.32 Dimensions of
Angle Bracket 436 with rib

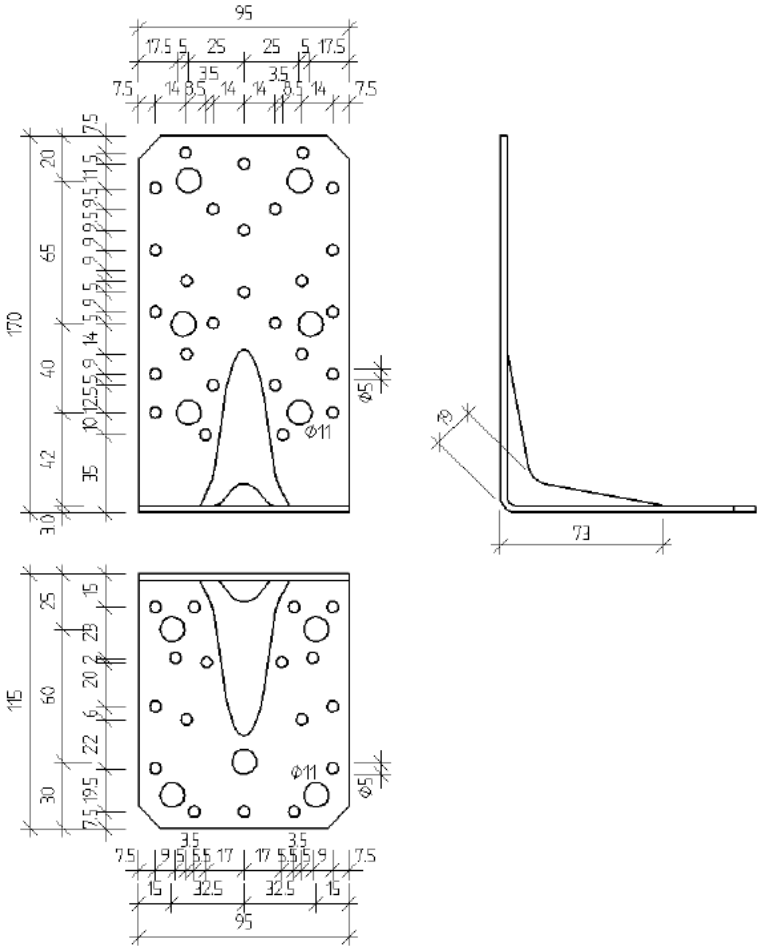
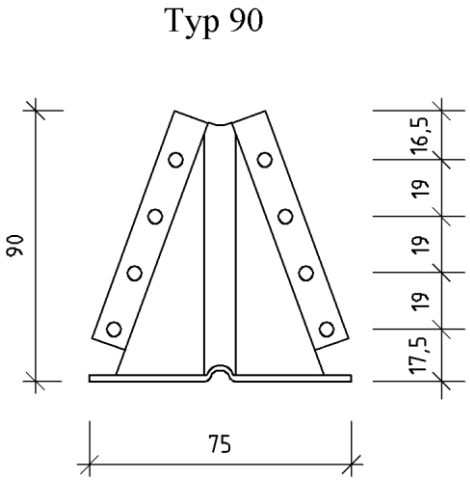


Figure A.33 Dimensions of
Angle Bracket 445 with rib, 3 mm thick



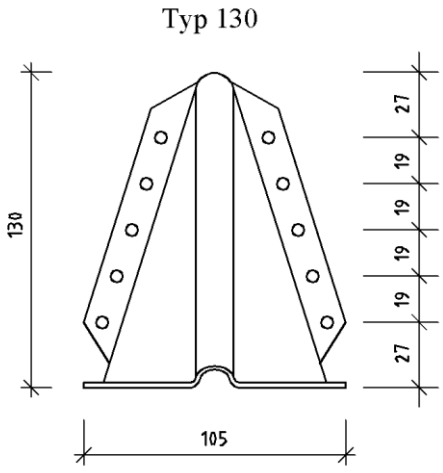


Figure A.34. Dimensions of Knagge 90

Figure A.35. Dimensions of Knagge 130

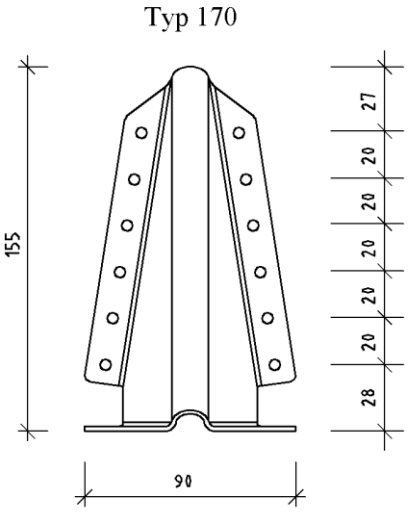


Figure A.36. Dimensions of Knagge 170

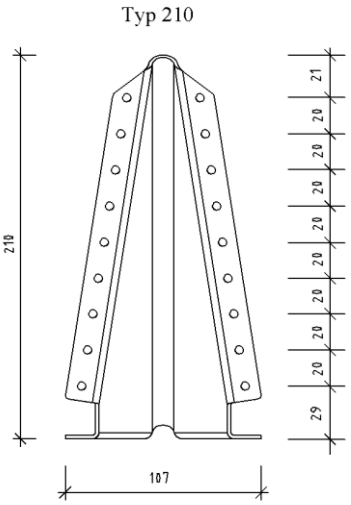


Figure A.37. Dimensions of Knagge 210

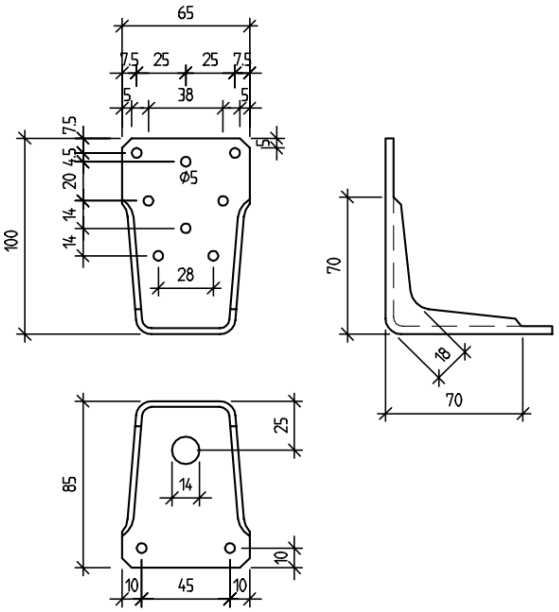


Figure A.38. Dimensions of 4443001 and 4444001

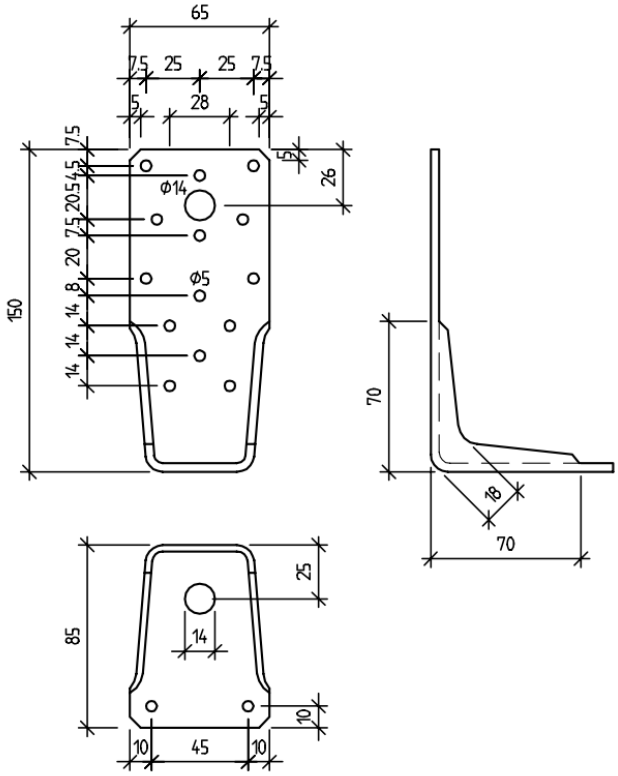


Figure A.37. Dimensions of 4443002 and 4444002

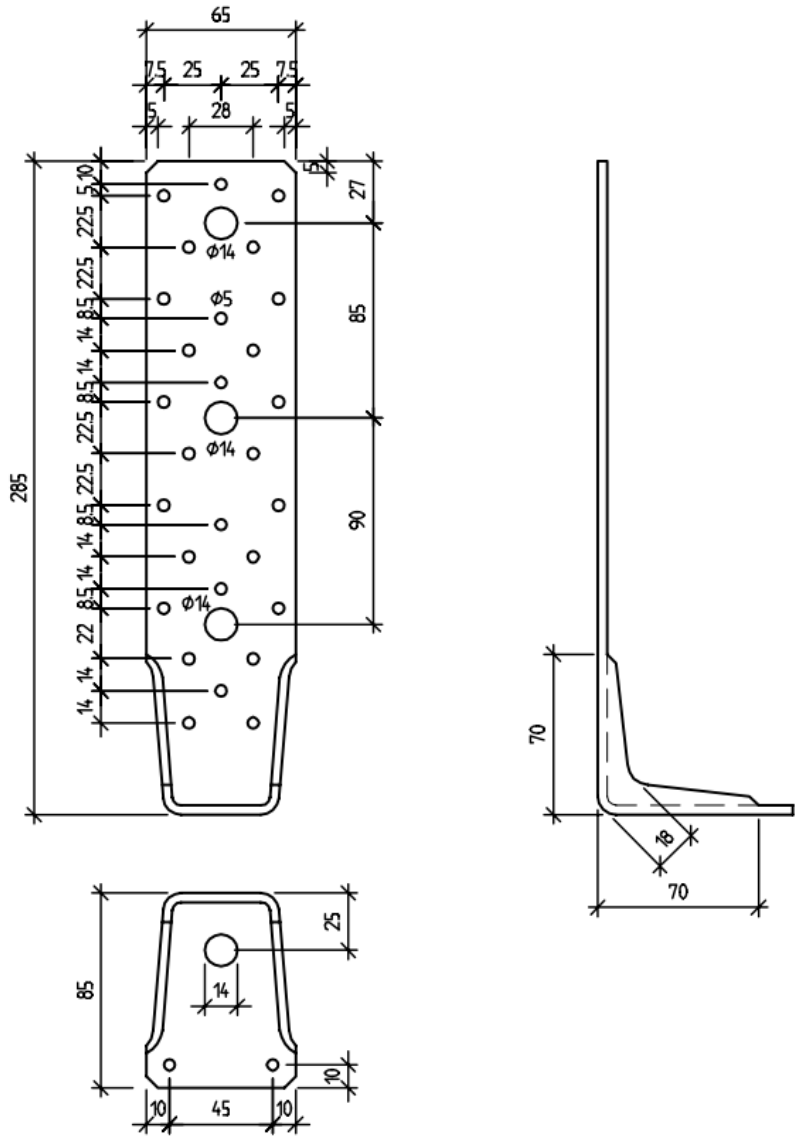
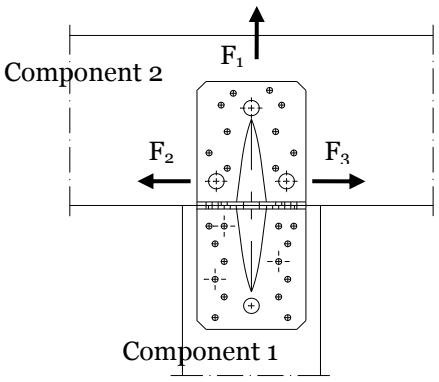


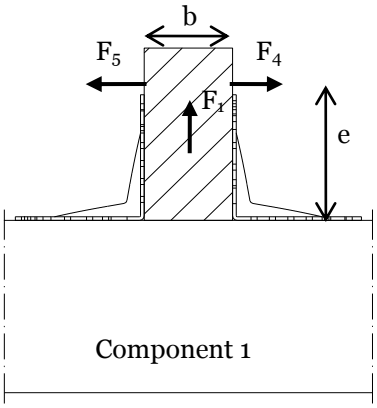
Figure A.38. Dimensions of 4443001 and 4444001

Annex B
Characteristic load-carrying capacity

Design Basis - general

Definitions of forces, their directions and eccentricity
Forces - Beam to beam connection





Fastener specification

The holes which have to be nailed are given in Annex A and the following tables give the characteristic capacities for the nailing patterns for the different forces.

Double angle brackets per connection
The angle brackets must be placed at each side opposite each other, symmetric to the component axis.

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 component 2 and component 1 in the component 2 direction
F_4 and F_5	Lateral force acting in the component 1 direction along the central axis of the joint. If the load is applied with an eccentricity e, a design for combined loading is required.

Single angle bracket per connection
Acting forces

F_1	Lifting force acting in the central axis of the angle bracket. The component 2 shall be prevented from rotation. If the component 2 is prevented from rotation the load-carrying capacity will be half of a connection with double angle brackets.
F_2 and F_3	Lateral force acting in the joint between the component 2 and the component 1 in the component 2 direction. The component 2 shall be prevented from rotation. If the component 2 is prevented from rotation the load-carrying capacity will be half of a connection with double angle brackets.
F_4 and F_5	Lateral force acting in the component 1 direction in the height of the top edge of component 2. F_4 is the lateral force towards the angle bracket; F_5 is the lateral force away from the angle bracket. Only the characteristic load-carrying capacities for angle brackets with ribs are given.

Wane
Wane is not allowed, the timber has to be sharp-edged in the area of the angle brackets.

Timber splitting
For the lifting force F_1 it must be checked in accordance with Eurocode 5 or a similar national Timber Code that splitting will not occur.

Combined forces

For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2 + \left(\frac{F_{2k}}{R_{2k}}\right)^2 + \left(\frac{F_{3k}}{R_{3k}}\right)^2 \leq 1$$

$$\frac{F_{1k}}{R_{1k}} + \frac{F_{4k}}{R_{4k}} + \frac{F_{5k}}{R_{5k}} \leq 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA.

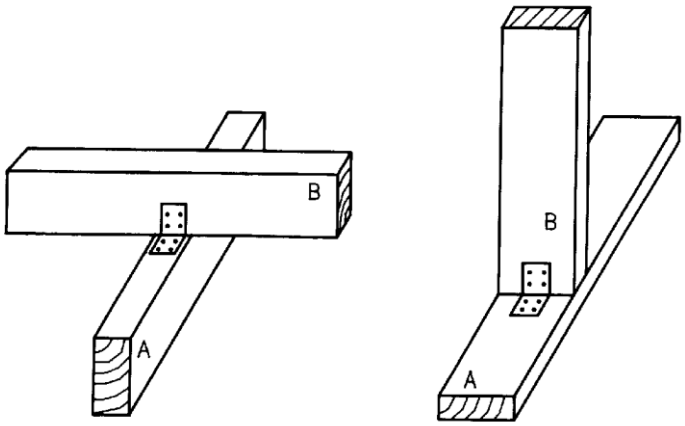
In the upper condition either F_2 or F_3 is zero. In the lower condition either F_4 or F_5 is zero.

Density
The load-carrying capacities of the angle bracket connections are stated 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:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^2$$

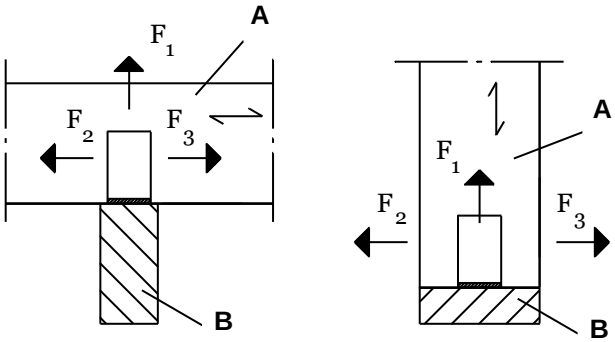
Where ρ_k is the characteristic density of the timber in kg/m^3.

Angle Bracket
2,0 mm thick: 5526660, 5526680, 55266100, 5528840, 5528860, 5528880,
2, 5 mm thick: 5566060, 5566080, 5566100, 5588040, 5588060, 5588080, 5588100, 5588120, 5511060, 5511080, 5511100, 5546060, 5568060, 5512100,
Basis for design



Type 1 Type 2

Figure B.1 Typical installation



Connection type 1 Connection type 2

Figure B.2 Load directions for the two types

The following tables and nailing patterns give the load carrying capacities for connection type 1 and 2 for load duration L, M and S. For load duration P, the value for load duration M shall be multiplied by 0,75 and for load duration I, the value for load duration M shall be multiplied by 1,38.

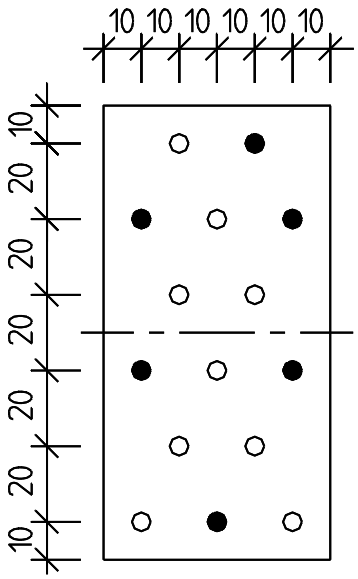
Connection type 1

5526660 and 5566060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,51	0,58	0,66	1,70	1,95	2,19
$R_{2k} = R_{3k}$	1,90	2,18	2,45	3,81	4,35	4,90

Table B.1 Connection type 1

Flik A

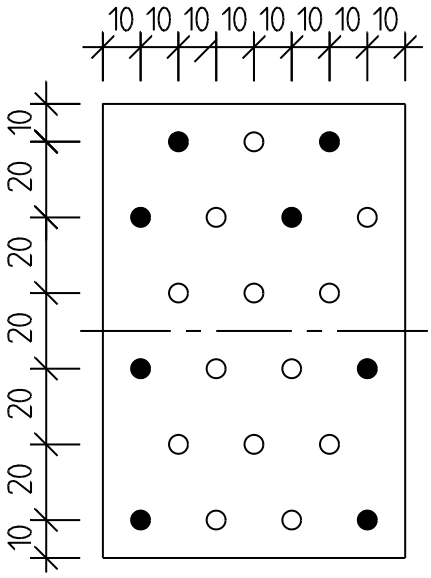


5526680 and 5566080

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,51	0,58	0,66	1,70	1,95	2,19
$R_{2k} = R_{3k}$	2,58	2,95	3,32	5,16	5,90	6,64

Table B.2 Connection type 1

Flik A



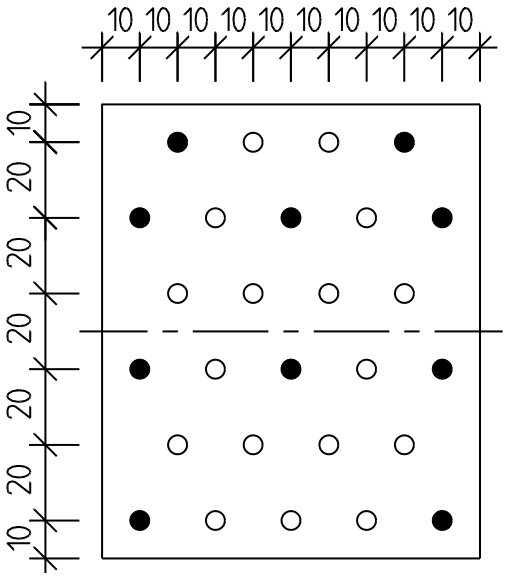
Flik B

55266100 and 5566100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,77	0,88	0,98	2,55	2,92	3,28
$R_{2k} = R_{3k}$	4,04	4,62	5,19	8,08	9,23	10,4

Table B.3 Connection type 1

Flik A



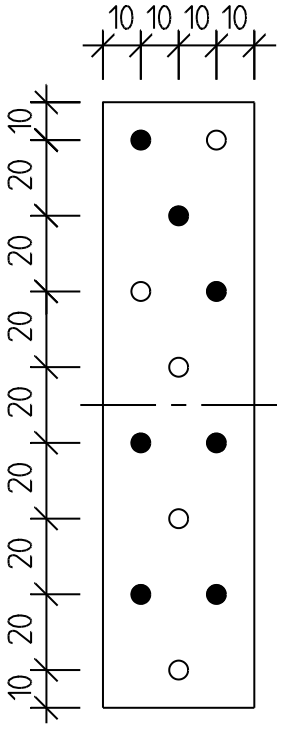
Flik B

5528840 and 5588040

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,54	0,61	0,69	1,79	2,04	2,30
$R_{2k} = R_{3k}$	1,16	1,33	1,49	2,32	2,66	2,99
	5528840					
R_{1k}	0,54	0,60	0,60	1,79	2,00	2,00

Table B.4 Connection type 1

Flik A



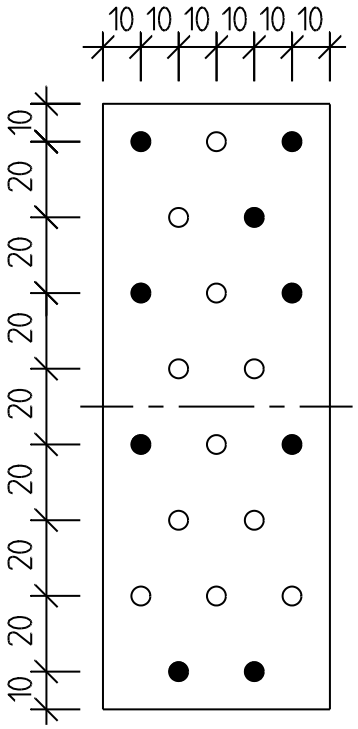
Flik B

5528860 and 5588060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,54	0,61	0,69	1,79	2,04	2,30
$R_{2k} = R_{3k}$	2,30	2,63	2,96	4,60	5,26	5,91

Table B.5 Connection type 1

Flik A



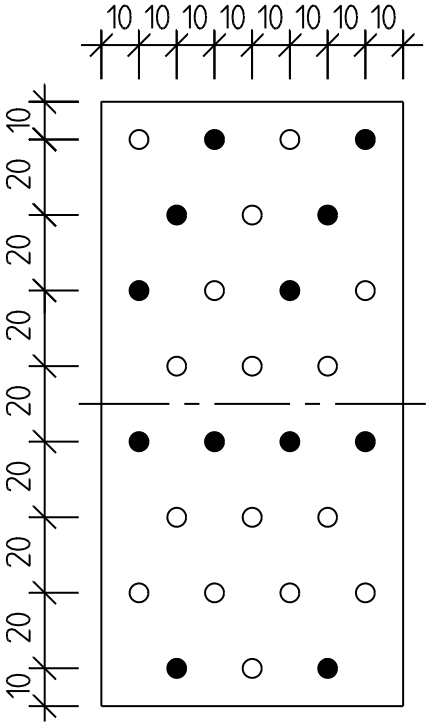
Flik B

5528880 and 5588080

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,07	1,23	1,38	3,58	4,09	4,60
$R_{2k} = R_{3k}$	3,78	4,32	4,86	7,56	8,64	9,72
	5528880					
R_{1k}	1,07	1,20	1,20	3,58	4,00	4,00

Table B.6 Connection type 1

Flik A



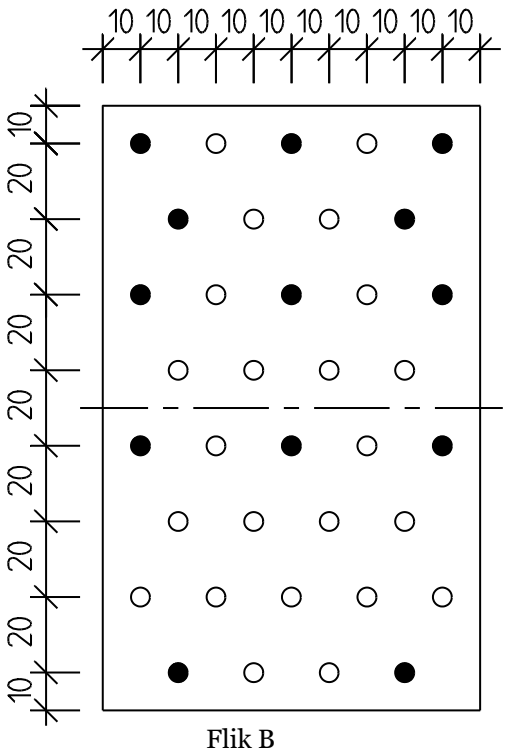
Flik B

5588100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,80	0,92	1,03	2,68	3,06	3,45
$R_{2k} = R_{3k}$	3,93	4,49	5,05	7,86	8,98	10,1

Table B.7 Connection type 1

Flik A



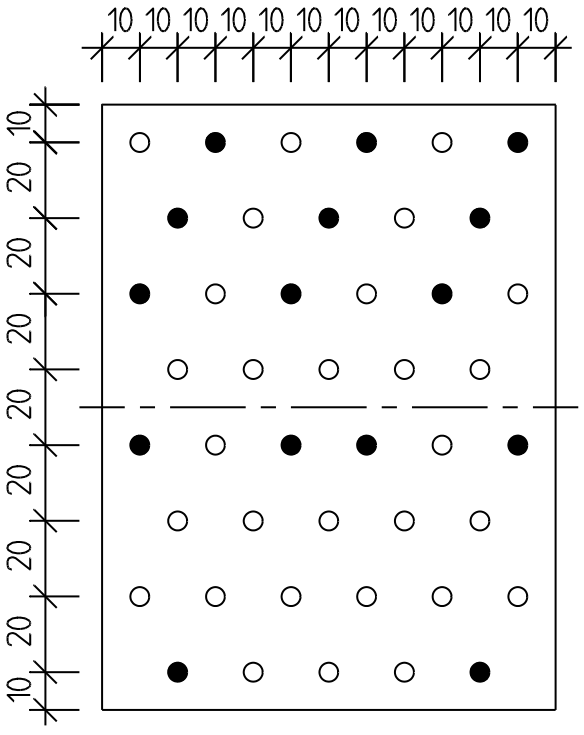
Flik B

5588120

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,07	1,23	1,38	3,58	4,09	4,60
$R_{2k} = R_{3k}$	5,27	6,02	6,77	10,5	12,0	13,5

Table B.8 Connection type 1

Flik A

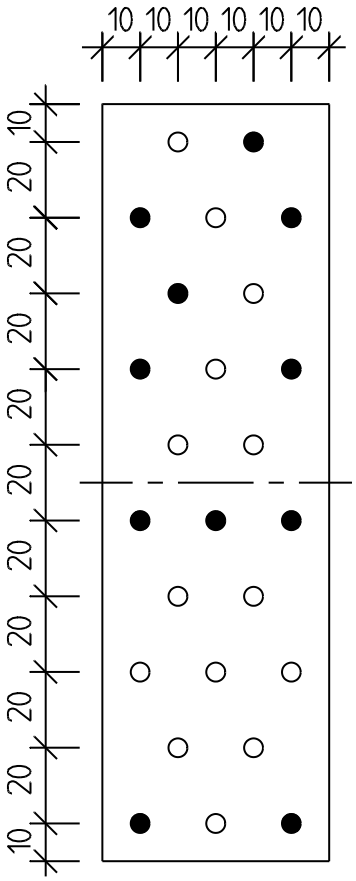


Flik B

5511060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,83	0,95	1,06	2,76	3,15	3,55
$R_{2k} = R_{3k}$	2,72	3,11	3,49	5,43	6,21	6,99

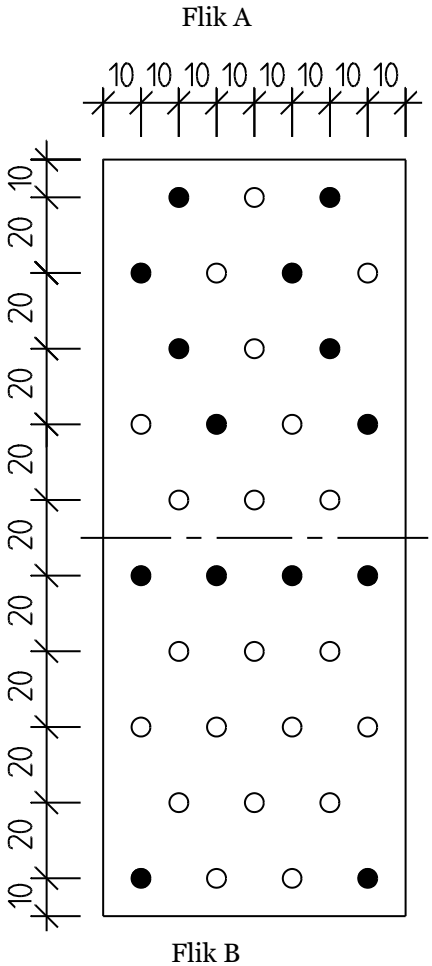
Table B.9 Connection type 1



5511080

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,10	1,26	1,42	3,68	4,20	4,73
$R_{2k} = R_{3k}$	3,59	4,10	4,62	7,18	8,21	9,24

Table B.10 Connection type 1

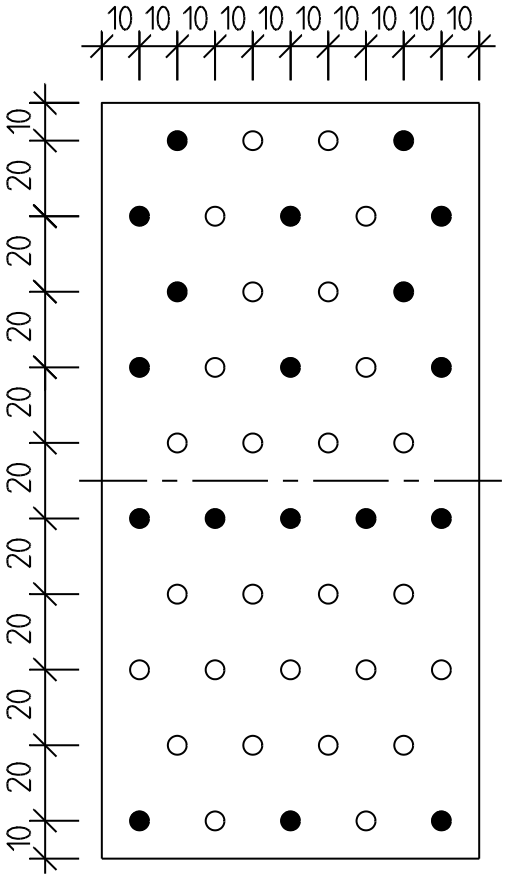


5511100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,38	1,58	1,77	4,60	5,25	5,91
$R_{2k} = R_{3k}$	5,54	6,33	7,13	11,	12,7	14,3

Table B.11 Connection type 1

Flik A



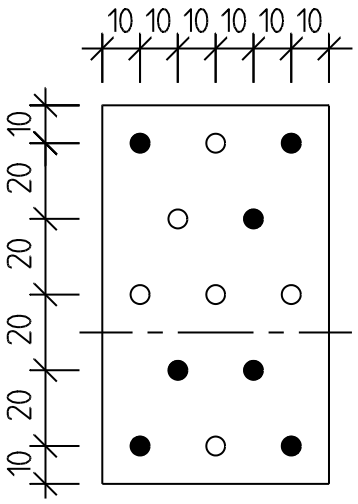
Flik B

5546060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,46	0,53	0,59	1,53	1,75	1,97
$R_{2k} = R_{3k}$	1,45	1,65	1,86	2,89	3,31	3,72

Table B.12 Connection type 1

Flik A



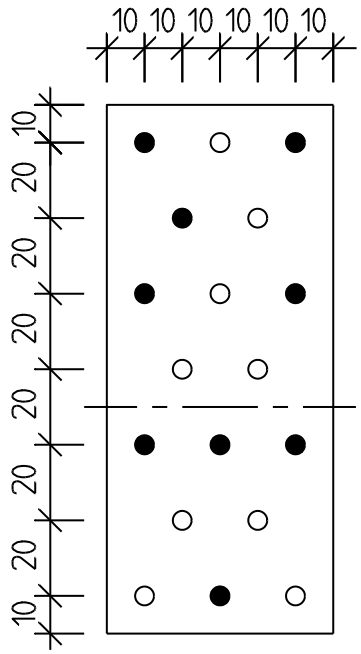
Flik B

5568060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,77	0,88	0,98	2,55	2,92	3,28
$R_{2k} = R_{3k}$	2,38	2,72	3,06	4,76	5,44	6,12
	5526860					
R_{1k}	0,77	0,88	0,90	2,55	2,92	3,00

Table B.13 Connection type 1

Flik A

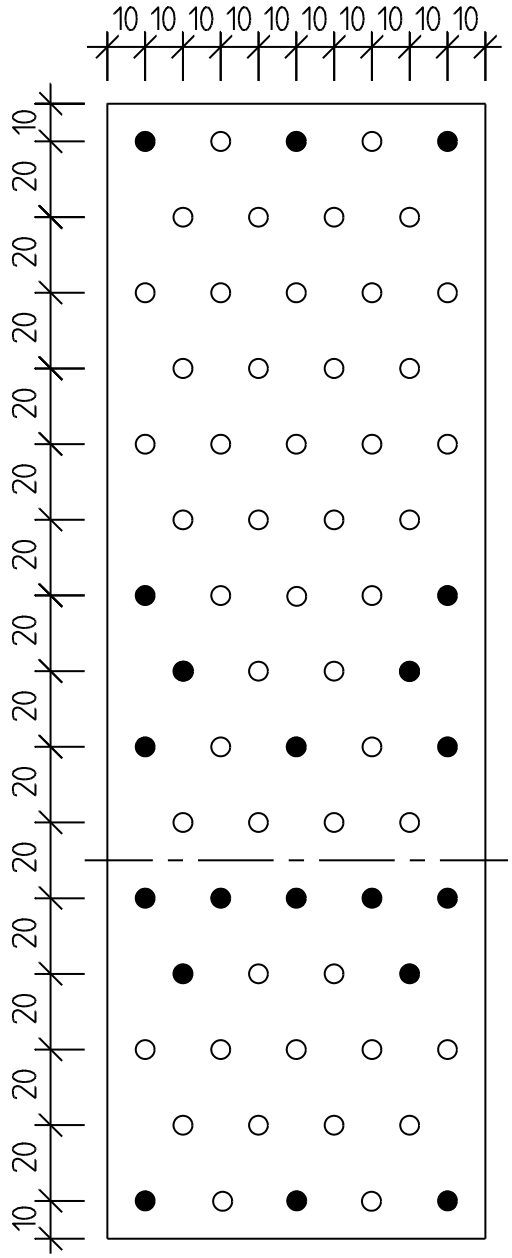


Flik B

5512100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,38	1,58	1,77	4,60	5,25	5,91
$R_{2k} = R_{3k}$	6,62	7,56	8,51	13,2	15,1	17,0

Table B.14 Connection type 1

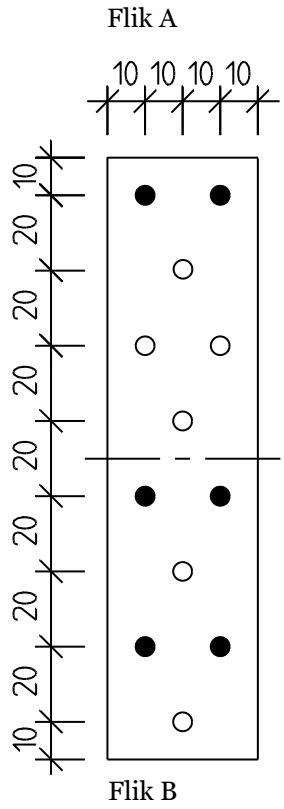


Flik A

Flik B

Connection type 2

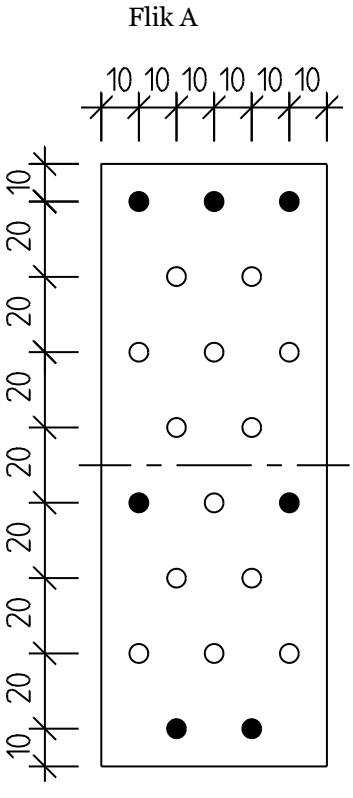
5588040 and 5528840



	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,54	0,61	0,69	1,79	2,04	2,30
$R_{2k} = R_{3k}$	0,36	0,41	0,46	0,72	0,82	0,92
	5528840					
R_{1k}	0,54	0,60	0,60	1,79	2,00	2,00

Table B.15 Connection type 2

5588060 and 5528860



	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,54	0,61	0,69	1,79	2,04	2,30
$R_{2k} = R_{3k}$	1,11	1,27	1,43	2,22	2,54	2,86

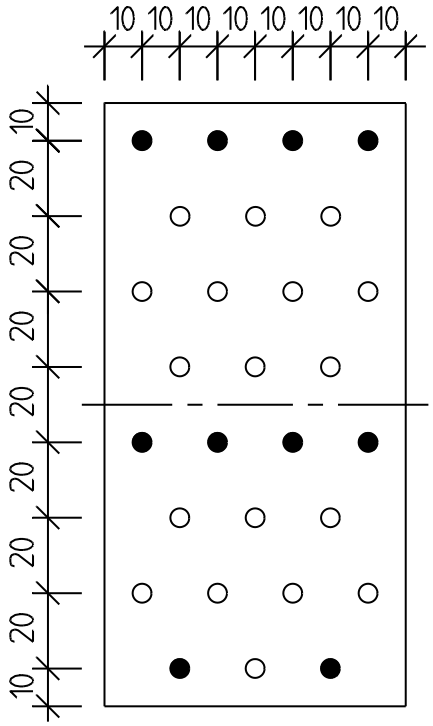
Table B.16 Connection type 2

5588080 and 5528880

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,07	1,23	1,38	3,58	4,09	4,60
$R_{2k} = R_{3k}$	2,01	2,29	2,58	4,01	4,59	5,16
	5528880					
R_{1k}	1,07	1,20	1,20	3,58	4,00	4,00

Table B.17 Connection type 2

Flik A



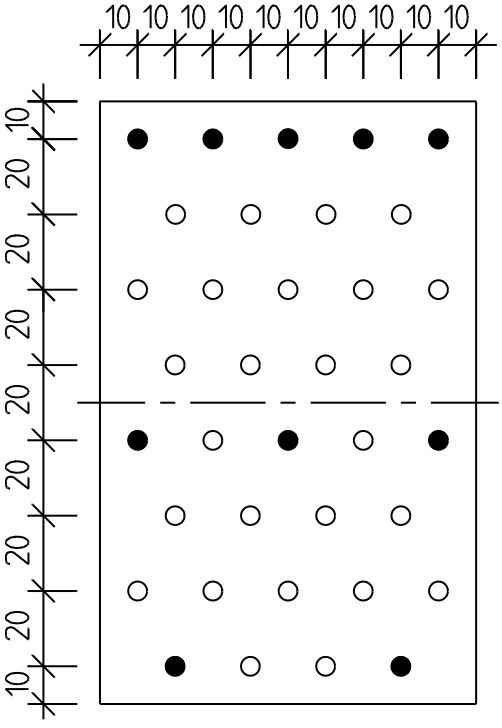
Flik B

5588100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,80	0,92	1,03	2,68	3,06	3,45
$R_{2k} = R_{3k}$	2,56	2,92	3,29	5,11	5,84	6,57

Table B.18 Connection type 2

Flik A



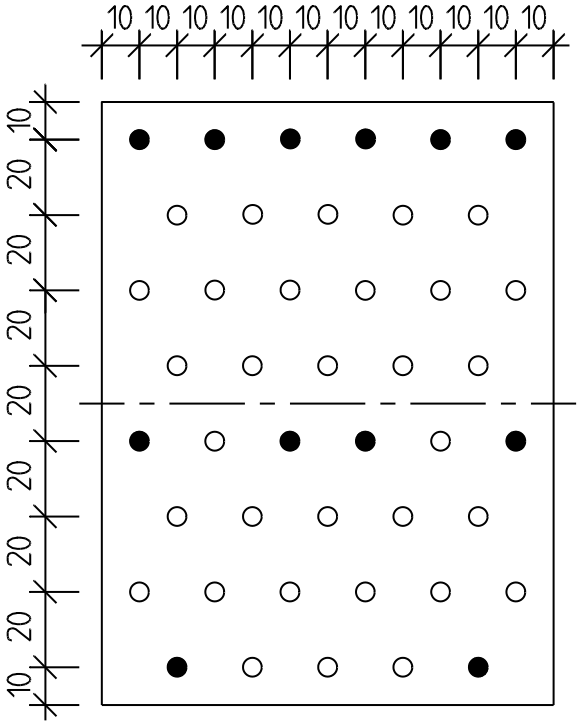
Flik B

5588120

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,07	1,23	1,38	3,58	4,09	4,60
$R_{2k} = R_{3k}$	3,52	4,02	4,52	7,04	8,04	9,05

Table B.19 Connection type 2

Flik A



Flik B

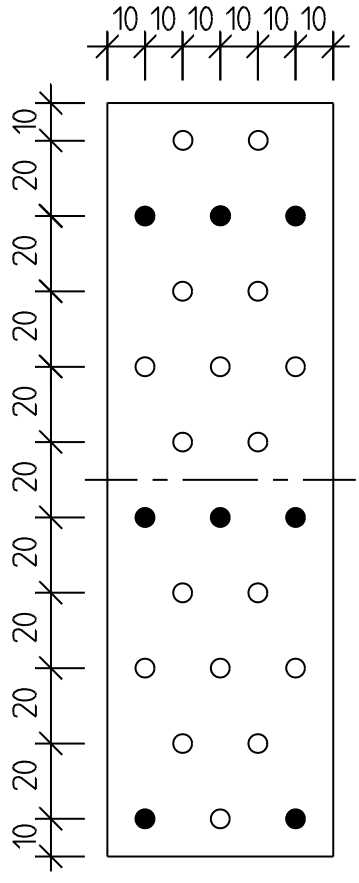
5511060

.

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,83	0,95	1,06	2,76	3,15	3,55
$R_{2k} = R_{3k}$	1,29	1,48	1,66	2,59	2,95	3,32

Table B.20 Connection type 2

Flik A

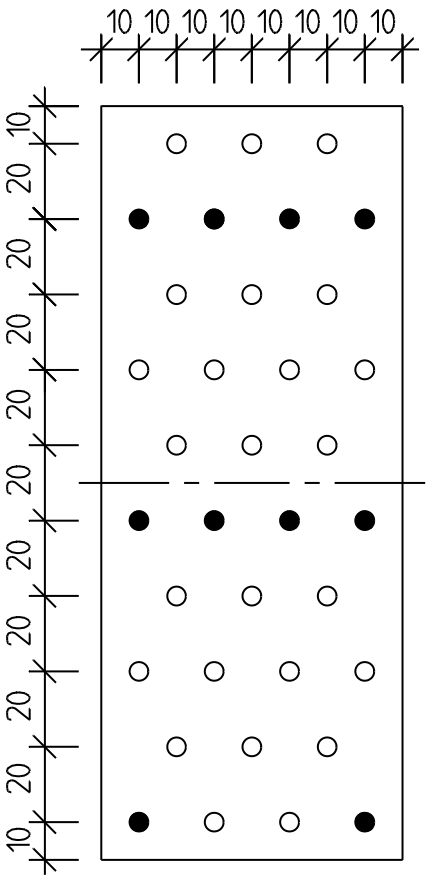


Flik B

5511080

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,10	1,26	1,42	3,68	4,20	4,73
$R_{2k} = R_{3k}$	2,11	2,41	2,71	4,21	4,81	5,41

Table B.21 Connection type 2



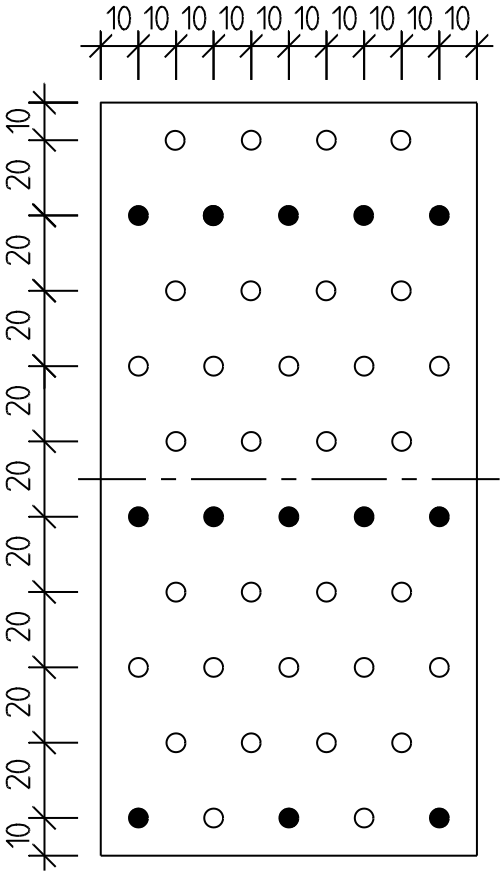
Flik B

Flik A

5511100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,38	1,58	1,77	4,60	5,25	5,91
$R_{2k} = R_{3k}$	3,14	3,59	4,04	6,29	7,18	8,08

Table B.22 Connection type 2



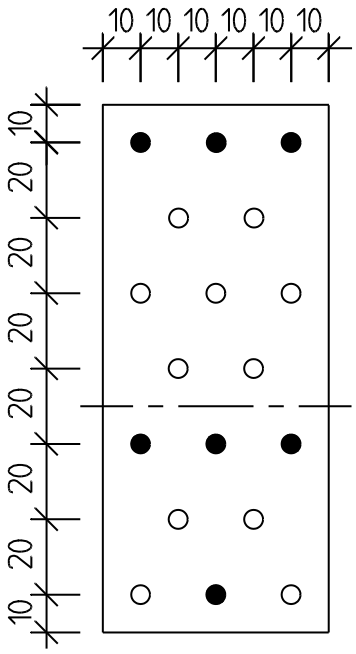
Flik B

5568060

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	0,77	0,88	0,98	2,55	2,92	3,28
$R_{2k} = R_{3k}$	1,10	1,26	1,42	2,21	2,52	2,84
	5526860					
R_{1k}	0,77	0,88	0,90	2,55	2,92	3,00

Table B.23 Connection type 2

Flik A

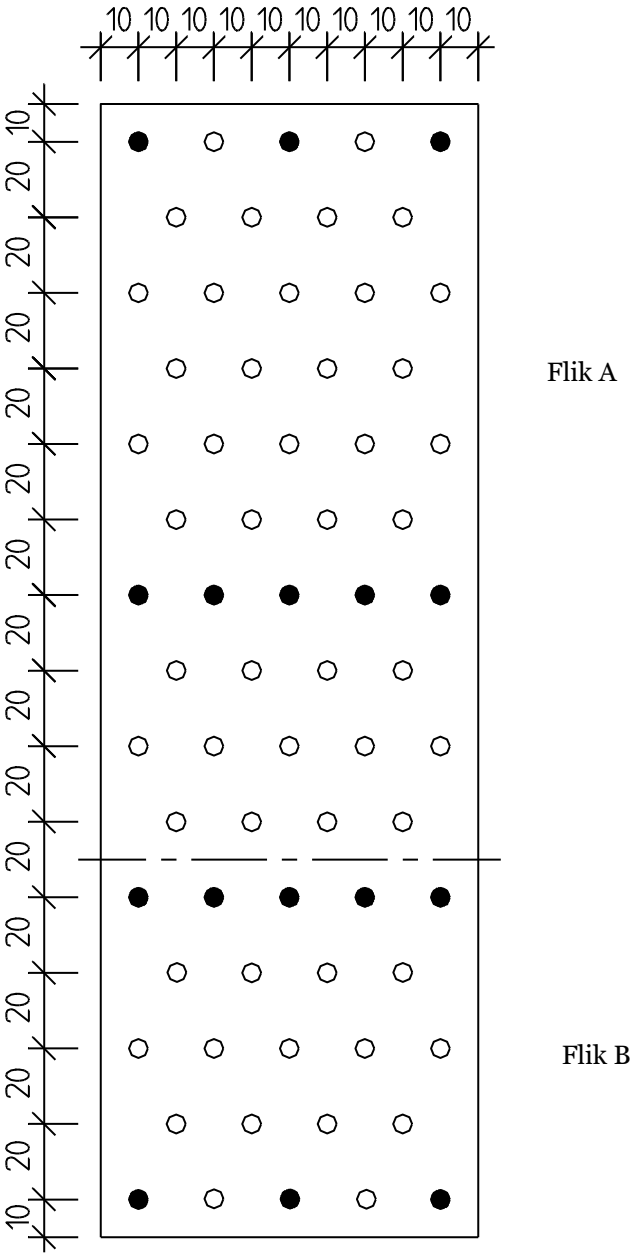


Flik B

5512100

	One bracket			Two brackets		
	Load-duration class			Load-duration class		
	L	M	S	L	M	S
R_{1k}	1,38	1,58	1,77	4,60	5,25	5,91
$R_{2k} = R_{3k}$	4,59	5,25	5,91	9,19	10,5	11,8

Table B.24 Connection type 2



Angle bracket 406 412 and 420
Basis for design

Angle bracket 406 is always installed with two brackets pr. connection.

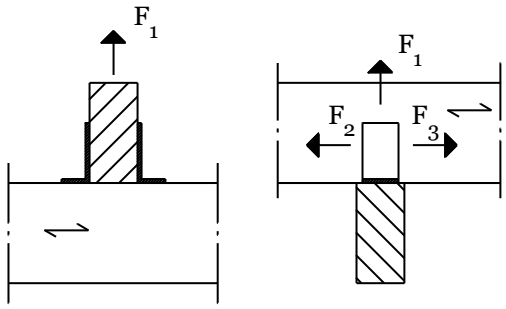


Figure B.3 Load directions

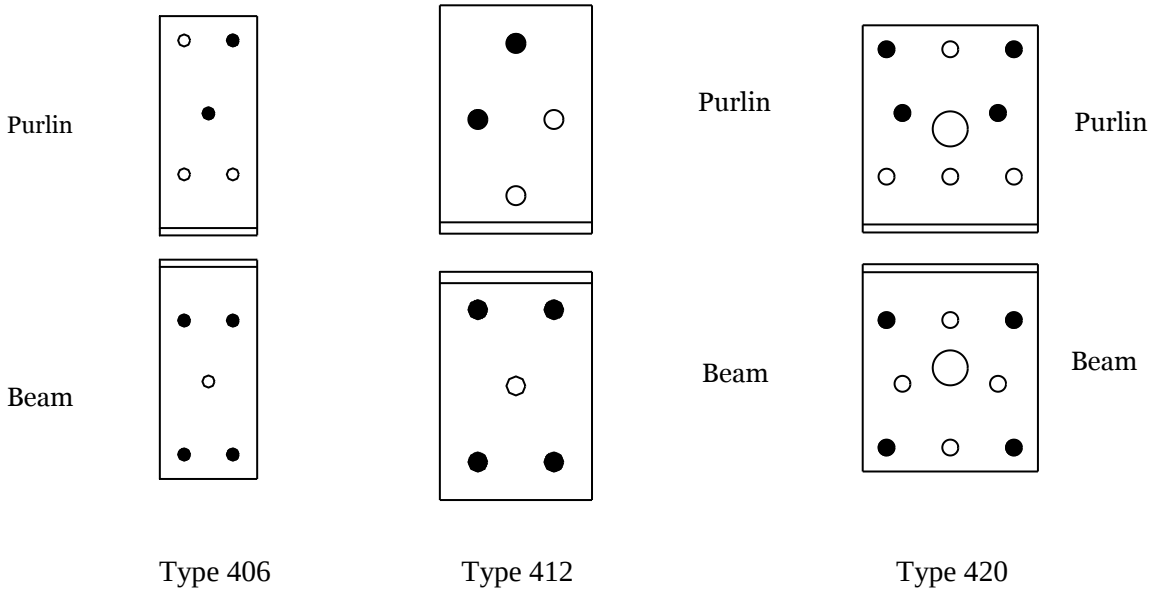


Figure B.4 Nailing pattern

The following tables indicate the load carrying capacities for the various load durations

Table B.25 apply to the connections with two angle brackets pr. Nail 4,0 x 40mm

Type	Load-duration class P (k_{mod} = 0,6)		Load-duration class L (k_{mod} = 0,7)		Load-duration class M (k_{mod} = 0,8)		Load-duration class S (k_{mod} = 0,9)		Load-duration class I (k_{mod} = 1,1)	
	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}
406	1,50	1,23	1,75	1,47	2,00	1,68	2,25	1,89	2,75	2,30
412	1,74	1,59	2,03	1,86	2,32	2,13	2,61	2,39	3,19	2,92
420	1,65	3,62	1,92	4,22	2,19	4,82	2,47	5,42	3,02	6,63

Table B.25

Angle bracket 407, 408, 409 and 425
Basis for design

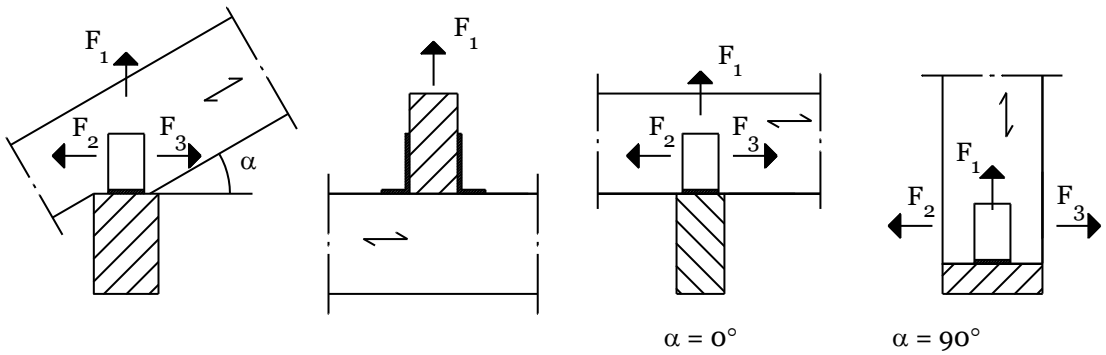
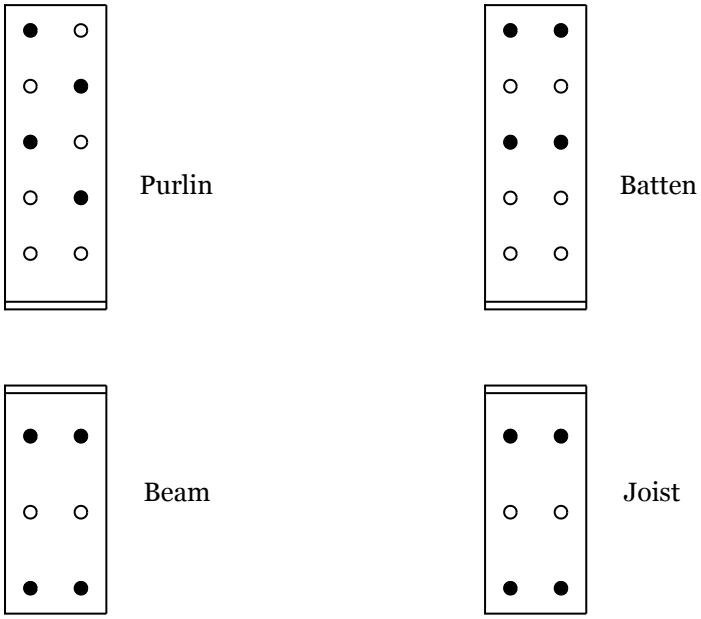


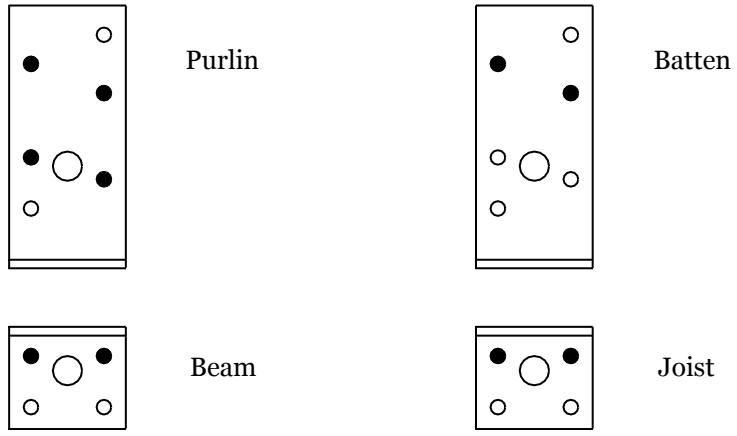
Figure B.5 Load directions



Nail pattern for 407
$0 \leq \alpha < 45°$

Nail pattern for 407
$45° \leq \alpha \leq 90°$

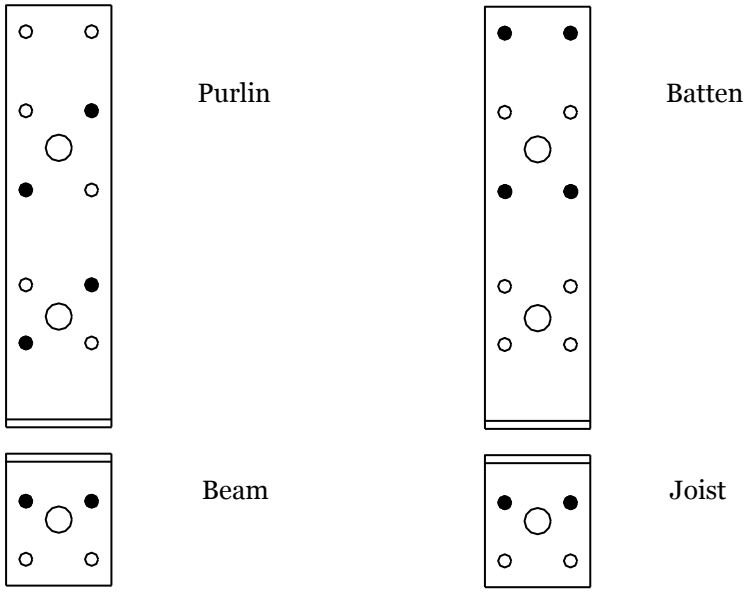
Figure B. 6a Nailing patterns bracket type 407



Nail pattern for 408
$0 \leq \alpha < 45°$

Nail pattern for 408
$45° \leq \alpha \leq 90°$

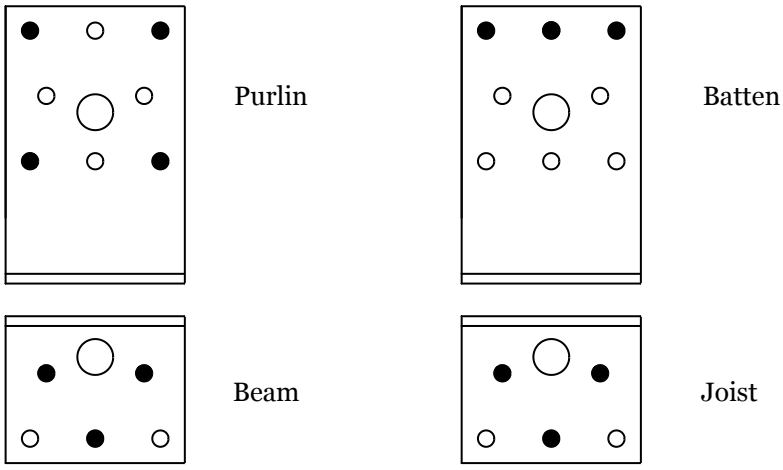
Figure B. 6b Nailing patterns bracket type 408



Nail pattern for 409
$0 \leq \alpha < 45°$

Nail pattern 409
$45° \leq \alpha \leq 90°$

Figure B. 6c Nailing patterns bracket type 409



Nail pattern for 425
$0 \leq \alpha < 45°$

Nail pattern for 425
$45° \leq \alpha \leq 90°$

Figure B. 6d Nailing patterns bracket type 425

The following tables indicate the load carrying capacities for the various load durations

Table B.26 apply to the connections with two angle brackets pr. connection and table B.27 apply to connections with one angle bracket pr. connection. Nail 4,0 x 40mm

Type	Load-duration class P (k_{mod} = 0,6)		Load-duration class L (k_{mod} = 0,7)		Load-duration class M (k_{mod} = 0,8)		Load-duration class S (k_{mod} = 0,9)		Load-duration class I (k_{mod} = 1,1)	
407	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}
$0 \leq \alpha < 45°$	1,58	2,12	1,84	2,47	2,11	2,83	2,37	3,18	2,90	3,89
$45 \leq \alpha \leq 90°$	1,58	2,15	1,84	2,50	2,11	2,86	2,37	3,22	2,90	3,93
408										
$0 \leq \alpha < 45°$	1,75	2,39	2,04	2,79	2,33	3,19	2,63	3,59	3,21	4,39
$45 \leq \alpha \leq 90°$	1,75	0,82	2,04	0,96	2,33	1,10	2,63	1,23	3,21	1,51
409										
$0 \leq \alpha < 45°$	1,62	2,48	1,89	2,89	2,16	3,30	2,43	3,72	2,90	4,54
$45 \leq \alpha \leq 90°$	1,57	1,96	1,83	2,29	2,09	2,62	2,36	2,95	2,88	3,60
425										
$0 \leq \alpha < 45°$	1,67	2,53	1,95	2,95	2,23	3,37	2,50	3,79	2,95	4,64
$45 \leq \alpha \leq 90°$	1,63	1,53	1,90	1,78	2,17	2,03	2,44	2,29	2,99	2,79

Table B.26 Two angle brackets

Type	Load-duration class P (k_{mod} = 0,6)		Load-duration class L (k_{mod} = 0,7)		Load-duration class M (k_{mod} = 0,8)		Load-duration class S (k_{mod} = 0,9)		Load-duration class I (k_{mod} = 1,1)	
407	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}	R_{1k}	R_{2k}=R_{3k}
$0 \leq \alpha < 45°$	0,47	1,05	0,55	1,22	0,63	1,40	0,71	1,57	0,87	1,92
$45 \leq \alpha \leq 90°$	0,47	1,05	0,55	1,22	0,63	1,40	0,71	1,57	0,87	1,92
408										
$0 \leq \alpha < 45°$	0,53	1,20	0,61	1,40	0,70	1,60	0,79	1,79	0,96	2,19
$45 \leq \alpha \leq 90°$	0,53	0,41	0,61	0,48	0,70	0,55	0,79	0,62	0,96	0,75
409										
$0 \leq \alpha < 45°$	0,49	1,24	0,57	1,45	0,65	1,65	0,73	1,86	0,87	2,27
$45 \leq \alpha \leq 90°$	0,47	0,98	0,55	1,14	0,63	1,30	0,71	1,47	0,86	1,79
425										
$0 \leq \alpha < 45°$	0,50	1,26	0,58	1,47	0,67	1,69	0,75	1,90	0,88	2,32
$45 \leq \alpha \leq 90°$	0,49	0,59	0,57	0,69	0,65	0,79	0,73	0,88	0,90	1,08

Table B.27 One angle brackets

Angle Bracket 470M and 470U
Basis for design

Table B.28 apply to the connections with two angle brackets pr. connection and table B. 29 apply to connections with one angle bracket pr. connection. Bracket type 470M can be used in connections with one or two brackets, whereas type 470U can be used in connections with one bracket

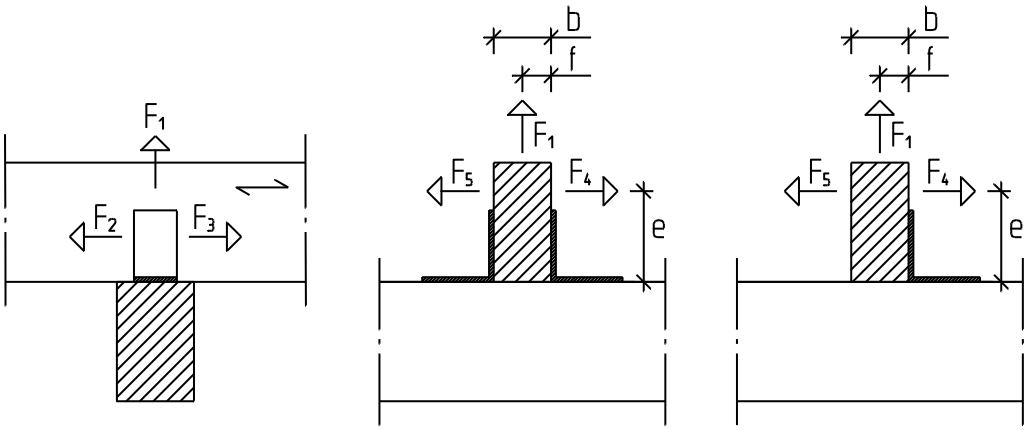


Figure B.7 Load directions

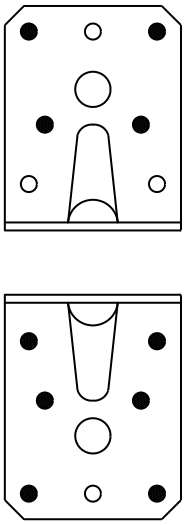


Figure B.8a Nailing pattern type 470M

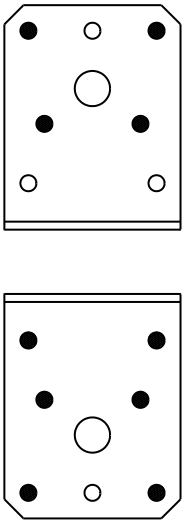


Figure B.8b Nailing pattern type 470U

Table B.28 apply to the connections with two angle brackets. Nails 4,0 x 40mm. Measurements e and b are in mm.

Type	Load-duration class P (k_{mod} = 0,6)			Load-duration class L (k_{mod} = 0,7)			Load-duration class M (k_{mod} = 0,8)		
	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
470M 2,5 mm thick	2,93	4,15	The lesser of $\frac{73+1,46b}{e}$ 6,09	3,42	4,84	The lesser of $\frac{77+1,71b}{e}$ 7,18	3,91	5,53	The lesser of $\frac{81+1,95b}{e}$ 8,27
470M 2,0 mm thick	2,93	4,15	The lesser of $\frac{66+1,46b}{e}$ 6,09	3,42	4,84	The lesser of $\frac{70+1,71b}{e}$ 7,18	3,91	5,53	The lesser of $\frac{73+1,95b}{e}$ 8,27
470U 2,5 mm thick	2,26	4,15	The lesser of $\frac{21+1,13b}{e}$ 4,35	2,42	4,84	The lesser of $\frac{21+1,21b}{e}$ 5,07	2,58	5,53	The lesser of $\frac{21+1,29b}{e}$ 5,79
470U 2,0 mm thick	1,79	4,15	The lesser of $\frac{14+0,89b}{e}$ 4,35	1,83	4,84	The lesser of $\frac{14+0,92b}{e}$ 5,07	1,83	5,53	The lesser of $\frac{14+0,92b}{e}$ 5,79

Table B.28A Bracket 470M and 470U with two brackets in the connection

Type	Load-duration class S (k_{mod} = 0,9)			Load-duration class I (k_{mod} = 1,1)		
	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
470M 2,5 mm thick	4,39	6,22	The lesser of $\frac{84+2{,}20b}{e}$ 9,35	5,37	7,61	The lesser of $\frac{92+2{,}68b}{e}$ 11,51
470M 2,0 mm thick	4,39	6,22	The lesser of $\frac{77+2{,}20b}{e}$ 9,35	5,37	7,61	The lesser of $\frac{84+2{,}68b}{e}$ 11,51
470U 2,5 mm thick	2,73	6,22	The lesser of $\frac{21+1{,}37b}{e}$ 6,52	2,86	7,61	The lesser of $\frac{21+1{,}43b}{e}$ 7,97
470U 2,0 mm thick	1,83	6,22	The lesser of $\frac{14+0{,}92b}{e}$ 6,52	1,83	7,61	The lesser of $\frac{14+0{,}92b}{e}$ 7,97

Table B.28B Bracket 470M and 470U with two brackets in the connection

Table B.29 apply to the connections with one angle bracket. Nails 4,0 x 40mm. Measurements e and b are in mm.

Type	Load-duration class P (k_{mod} = 0,6)			
	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
470M 2,5 mm thick	0,57 for $f \le 25$	1,24	6,09 for $e \le 5$ $\frac{33{,}3}{e}$ for $5<e\le70$	$\frac{25{,}4}{62-e}$ for $e \le 35$ $\frac{33{,}2}{e}$ for $35<e\le70$
470M 2,0 mm thick	0,47 for $f \le 25$	1,24	6,24 for $e \le 4$ $\frac{27{,}0}{e}$ for $4<e\le57$	$\frac{25{,}4}{62-e}$ for $e \le 32$ $\frac{27{,}5}{e}$ for $32<e\le56$

Table B.29a Bracket 470M with one bracket in the connection

Type	Load-duration class L (k_{mod} = 0,7)			
	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
470M 2,5 mm thick	0,62 for $f \le 25$	1,45	7,18 for $e \le 5$ $\frac{36,0}{e}$ for $5<e\le65$	$\frac{29,6}{62-e}$ for $e \le 34$ $\frac{36,2}{e}$ for $34<e\le64$
470M 2,0 mm thick	0,51 for $f \le 25$	1,45	7,32 for $e \le 4$ $\frac{29,6}{e}$ for $5<e\le53$	$\frac{29,6}{62-e}$ for $e \le 31$ $\frac{30,4}{e}$ for $31<e\le52$

Table B.29b Bracket 470M with one bracket in the connection

Type	Load-duration class M (k_{mod} = 0,8)			
	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
470M 2,5 mm thick	0,66 for $f \le 25$	1,66	8,27 for $e \le 5$ $\frac{38,6}{e}$ for $5<e\le61$	$\frac{33,9}{62-e}$ for $e \le 33$ $\frac{39,1}{e}$ for $33<e\le60$
470M 2,0 mm thick	0,56 for $f \le 25$	1,66	8,40 for $e \le 4$ $\frac{32,3}{e}$ for $5<e\le51$	$\frac{33,9}{62-e}$ for $e \le 31$ $\frac{33,3}{e}$ for $31<e\le50$

Table B.29c Bracket 470M with one bracket in the connection

Type	Load-duration class S (k_{mod} = 0,9)			
	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
470M 2,5 mm thick	0,71 for $f \le 25$	1,87	9,35 for $e \le 4$ $\frac{41,2}{e}$ for $4<e\le58$	$\frac{38,1}{62-e}$ for $e \le 32$ $\frac{41,5}{e}$ for $32<e\le57$
470M 2,0 mm thick	0,60 for $f \le 25$	1,87	9,47 for $e \le 4$ $\frac{34,9}{e}$ for $4<e\le49$	$\frac{38,1}{62-e}$ for $e \le 30$ $\frac{36,2}{e}$ for $30<e\le48$

Table B.29d Bracket 470M with one bracket in the connection

Type	Load-duration class I (k_{mod} = 1,1)			
	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
470M 2,5 mm thick	0,80 for $f \leq 25$	2,28	11,51 for $e \leq 4$ $\frac{46,5}{e}$ for $4<e\leq53$	$\frac{46,5}{62-e}$ for $e \leq 30$ $\frac{43,9}{e}$ for $30<e\leq554$
470M 2,0 mm thick	0,69 for $f \leq 25$	2,28	11,62 for $e \leq 3$ $\frac{40,1}{e}$ for $4<e\leq46$	$\frac{46,5}{62-e}$ for $e \leq 29$ $\frac{40,0}{e}$ for $29<e\leq46$

Table B.29e Bracket 470M with one bracket in the connection

Angle Bracket 433/4433, 434/4434 and 435/4435
Basis for design

Table B.28 apply to the connections with two angle brackets pr. connection and table B. 29 apply to connections with one angle bracket pr. connection. Bracket type 470M can be used in connections with one or two brackets, whereas type 470U can be used in connections with one bracket

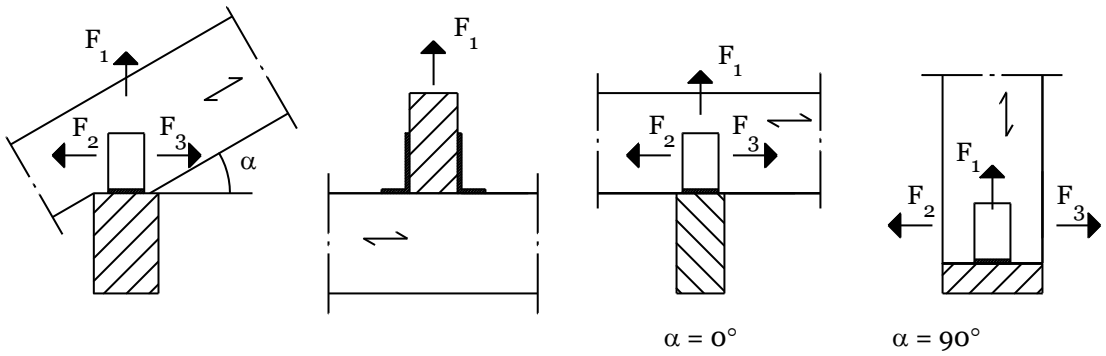


Figure B.9 Load directions

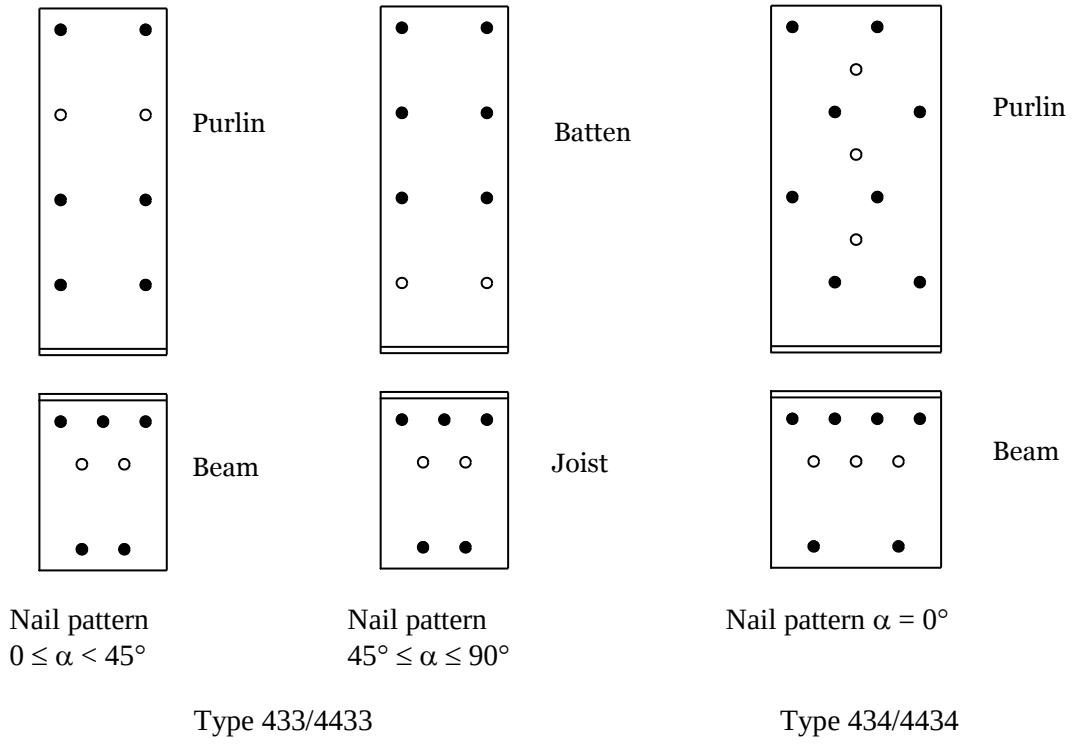


Figure B.10a Nailing pattern type 433/4433 and 434/4434

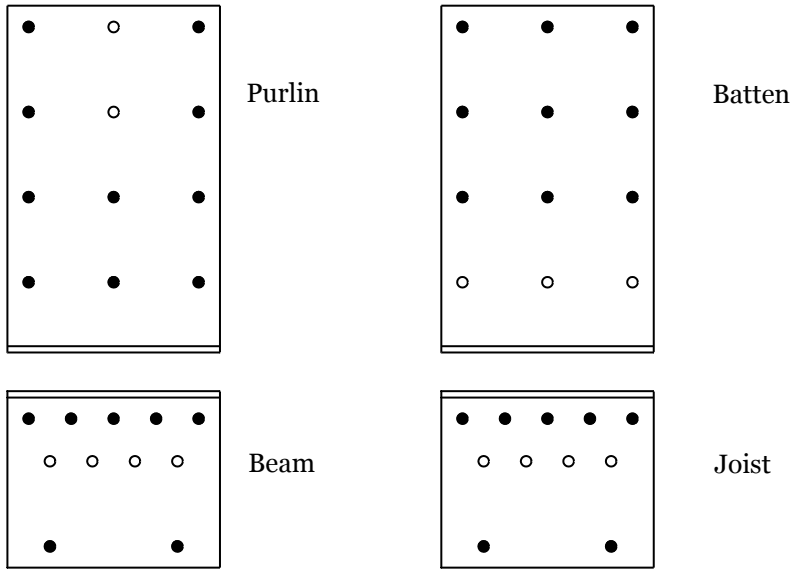


Figure B.10b Nailing pattern type 435/4435

Table B.30 apply to the connections with two angle brackets. Nails 4,0 x 40mm. Measurements e and b are in mm.

Load-duration class P (k_{mod} = 0,6)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	0 ≤ α < 45°	4,0x40	2,30	5,22
	45 ≤ α ≤ 90°	4,0x40	2,30	3,43
4433	0 ≤ α < 45°	4,0x60	4,21	5,78
	45 ≤ α ≤ 90°	4,0x60	4,21	3,97
434	α = 0°	4,0x40	3,06	6,06
4434	α = 0°	4,0x60	5,62	6,92
435	0 ≤ α < 45°	4,0x40	3,83	9,21
	45 ≤ α ≤ 90°	4,0x40	3,83	6,33
4435	0 ≤ α < 45°	4,0x60	7,02	10,31
	45 ≤ α ≤ 90°	4,0x60	7,02	7,51

Table B.30a With two brackets in the connection

Load-duration class L (k_{mod} = 0,7)

		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	2,68	6,09
	$45 \le \alpha \le 90°$	4,0x40	2,68	4,00
4433	$0 \le \alpha < 45°$	4,0x60	4,92	6,74
	$45 \le \alpha \le 90°$	4,0x60	4,92	4,63
434	$\alpha = 0°$	4,0x40	3,58	7,07
4434	$\alpha = 0°$	4,0x60	6,55	8,08
435	$0 \le \alpha < 45°$	4,0x40	4,47	10,75
	$45 \le \alpha \le 90°$	4,0x40	4,47	7,38
4435	$0 \le \alpha < 45°$	4,0x60	8,19	12,03
	$45 \le \alpha \le 90°$	4,0x60	8,19	8,77

Table B.30b With two brackets in the connection

Load-duration class M (k_{mod} = 0,8)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	3,06	6,96
	$45 \le \alpha \le 90°$	4,0x40	3,06	4,57
4433	$0 \le \alpha < 45°$	4,0x60	5,62	7,70
	$45 \le \alpha \le 90°$	4,0x60	5,62	5,29
434	$\alpha = 0°$	4,0x40	4,09	8,08
4434	$\alpha = 0°$	4,0x60	7,49	9,23
435	$0 \le \alpha < 45°$	4,0x40	5,11	12,28
	$45 \le \alpha \le 90°$	4,0x40	5,11	8,44
4435	$0 \le \alpha < 45°$	4,0x60	9,36	13,75
	$45 \le \alpha \le 90°$	4,0x60	9,36	10,02

Table B.30c With two brackets in the connection

Load-duration class S (k_{mod} = 0,9)

		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	3,45	7,83
	$45 \le \alpha \le 90°$	4,0x40	3,45	5,14
4433	$0 \le \alpha < 45°$	4,0x60	6,32	8,67
	$45 \le \alpha \le 90°$	4,0x60	6,32	5,95
434	$\alpha = 0°$	4,0x40	4,60	9,09
4434	$\alpha = 0°$	4,0x60	8,43	10,39
435	$0 \le \alpha < 45°$	4,0x40	5,75	13,82
	$45 \le \alpha \le 90°$	4,0x40	5,75	9,49
4435	$0 \le \alpha < 45°$	4,0x60	10,53	15,46
	$45 \le \alpha \le 90°$	4,0x60	10,53	11,27

Table B.30d With two brackets in the connection

Load-duration class I (k_{mod} = 1,1)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	4,21	9,57
	$45 \le \alpha \le 90°$	4,0x40	4,21	6,28
4433	$0 \le \alpha < 45°$	4,0x60	7,72	10,59
	$45 \le \alpha \le 90°$	4,0x60	7,72	7,28
434	$\alpha = 0°$	4,0x40	5,62	11,11
4434	$\alpha = 0°$	4,0x60	10,30	12,70
435	$0 \le \alpha < 45°$	4,0x40	7,02	16,89
	$45 \le \alpha \le 90°$	4,0x40	7,02	11,60
4435	$0 \le \alpha < 45°$	4,0x60	12,87	18,90
	$45 \le \alpha \le 90°$	4,0x60	12,87	13,77

Table B.30e With two brackets in the connection

Load-duration class P (k_{mod} = 0,6)

		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	0,77	2,60
	$45 \le \alpha \le 90°$	4,0x40	0,77	1,68
4433	$0 \le \alpha < 45°$	4,0x60	1,40	2,87
	$45 \le \alpha \le 90°$	4,0x60	1,40	1,92
434	$\alpha = 0°$	4,0x40	1,02	3,02
4434	$\alpha = 0°$	4,0x60	1,87	3,45
435	$0 \le \alpha < 45°$	4,0x40	1,28	4,52
	$45 \le \alpha \le 90°$	4,0x40	1,28	2,93
4435	$0 \le \alpha < 45°$	4,0x60	2,34	5,01
	$45 \le \alpha \le 90°$	4,0x60	2,34	3,32

Table B.31a With one bracket in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	0,89	3,03
	$45 \le \alpha \le 90°$	4,0x40	0,89	1,96
4433	$0 \le \alpha < 45°$	4,0x60	1,64	3,35
	$45 \le \alpha \le 90°$	4,0x60	1,64	2,24
434	$\alpha = 0°$	4,0x40	1,19	3,53
4434	$\alpha = 0°$	4,0x60	2,18	4,03
435	$0 \le \alpha < 45°$	4,0x40	1,49	5,27
	$45 \le \alpha \le 90°$	4,0x40	1,49	3,42
4435	$0 \le \alpha < 45°$	4,0x60	2,73	5,85
	$45 \le \alpha \le 90°$	4,0x60	2,73	3,88

Table B.31b With one bracket in the connection

Load-duration class M (k_{mod} = 0,8)

		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	1,02	3,47
	$45 \le \alpha \le 90°$	4,0x40	1,02	2,24
4433	$0 \le \alpha < 45°$	4,0x60	1,87	3,83
	$45 \le \alpha \le 90°$	4,0x60	1,87	2,56
434	$\alpha = 0°$	4,0x40	1,36	4,03
4434	$\alpha = 0°$	4,0x60	2,50	4,60
435	$0 \le \alpha < 45°$	4,0x40	1,70	6,02
	$45 \le \alpha \le 90°$	4,0x40	1,70	3,90
4435	$0 \le \alpha < 45°$	4,0x60	3,12	6,68
	$45 \le \alpha \le 90°$	4,0x60	3,12	4,43

Table B.31c With one bracket in the connection

Load-duration class S (k_{mod} = 0,9)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \le \alpha < 45°$	4,0x40	1,15	3,90
	$45 \le \alpha \le 90°$	4,0x40	1,15	2,52
4433	$0 \le \alpha < 45°$	4,0x60	2,11	4,31
	$45 \le \alpha \le 90°$	4,0x60	2,11	2,88
434	$\alpha = 0°$	4,0x40	1,53	4,53
4434	$\alpha = 0°$	4,0x60	2,81	5,18
435	$0 \le \alpha < 45°$	4,0x40	1,92	6,78
	$45 \le \alpha \le 90°$	4,0x40	1,92	4,39
4435	$0 \le \alpha < 45°$	4,0x60	3,51	7,52
	$45 \le \alpha \le 90°$	4,0x60	3,51	4,99

Table B.31d With one bracket in the connection

Load-duration class I (k_{mod} = 1,1)				
		Nails	R_{1k}	$R_{2k}=R_{3k}$
433	$0 \leq \alpha < 45°$	4,0x40	1,40	4,77
	$45 \leq \alpha \leq 90°$	4,0x40	1,40	3,08
4433	$0 \leq \alpha < 45°$	4,0x60	2,57	5,27
	$45 \leq \alpha \leq 90°$	4,0x60	2,57	3,52
434	$\alpha = 0°$	4,0x40	1,87	5,54
4434	$\alpha = 0°$	4,0x60	3,43	6,33
435	$0 \leq \alpha < 45°$	4,0x40	2,34	8,28
	$45 \leq \alpha \leq 90°$	4,0x40	2,34	5,37
4435	$0 \leq \alpha < 45°$	4,0x60	4,29	9,19
	$45 \leq \alpha \leq 90°$	4,0x60	4,29	6,09

Table B.31e With one bracket in the connection
nail

Angle Bracket 423
Basis for design – wood to wood connections

The characteristic capacities in wood to wood connections are given in tables 32a to 32j. The tables 32a to 32e apply to connections with two brackets and tables 32f to 32j apply to connections with one bracket.

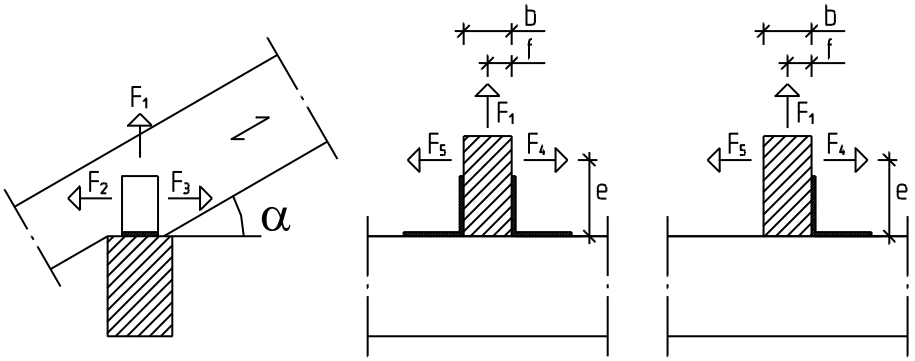


Figure B.11 Load directions

With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.

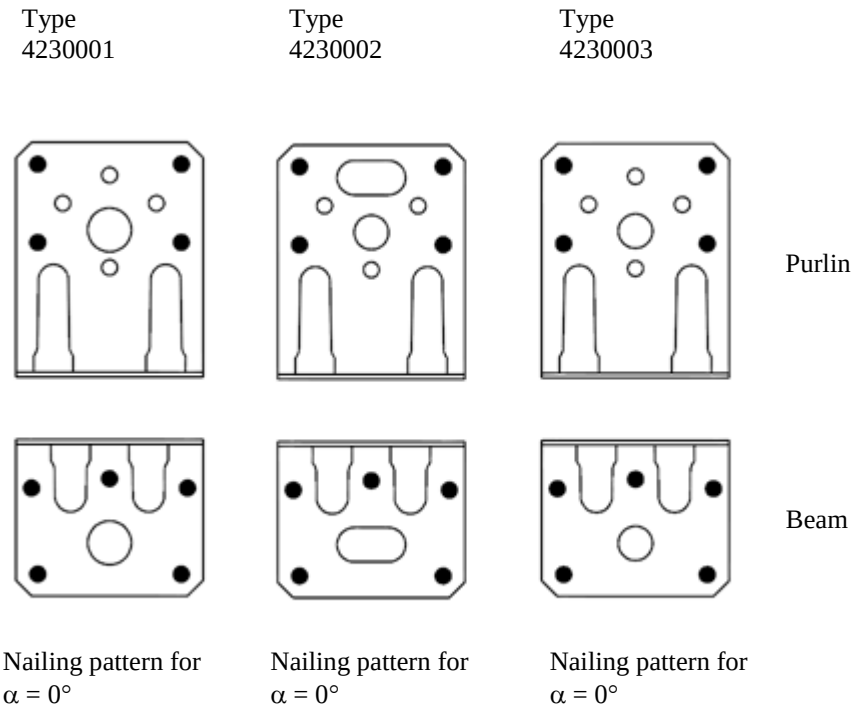
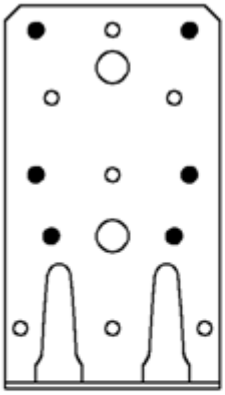
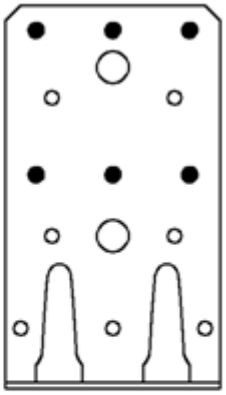


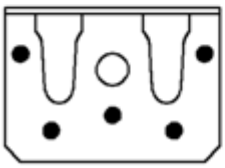
Figure B.11a Nailing pattern type 4230001, 4230002, 4230003



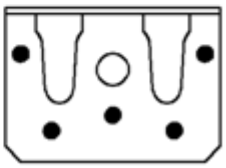
Purlin or truss



Transom



Beam

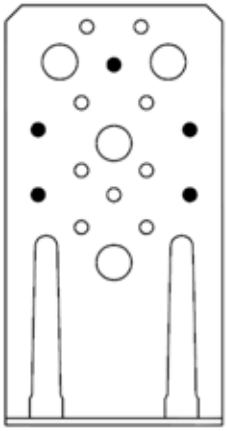


Joist

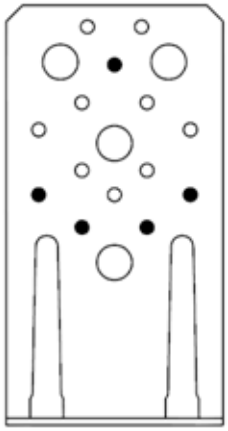
Nailing pattern for $0 \leq \alpha < 45°$

Nailing pattern $45° \leq \alpha \leq 90°$

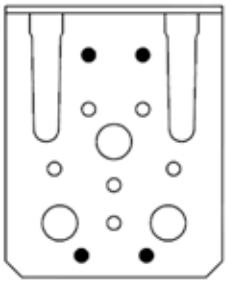
Figure B.11b Nailing pattern type 4230101



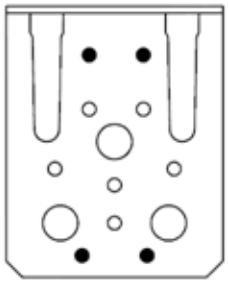
Purlin or truss



Transom



Beam



Joist

Nailing pattern for $0 \leq \alpha < 45°$

Nailing pattern for $45° \leq \alpha \leq 90°$

Figure B.11c Nailing pattern type 4230201

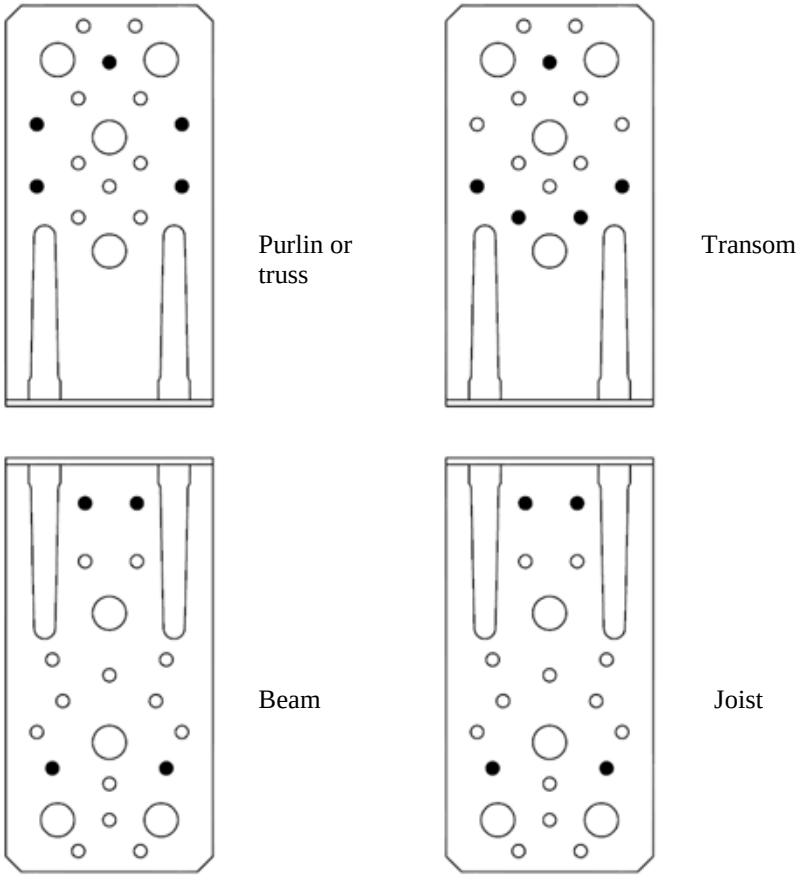


Figure B.11d Nailing pattern type 4230202

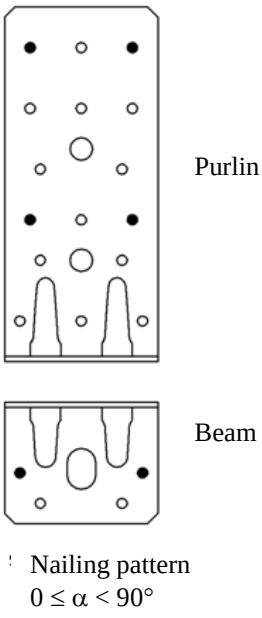


Figure B.11e Nailing pattern type 4230203.

Load-duration class P (k_{mod} = 0,6).				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	2,24	3,00
4230101	$0 \le \alpha < 45°$	4,0x40	1,96	4,76
	$45 \le \alpha \le 90°$	4,0x40	1,96	3,81
4230201	$0 \le \alpha < 45°$	4,0x40	1,60	2,71
	$45 \le \alpha \le 90°$	4,0x40	1,60	3,63
4230202	$0 \le \alpha < 45°$	4,0x40	1,76	2,84
	$45 \le \alpha \le 90°$	4,0x40	1,76	3,76
4230203	$0 \le \alpha \le 90°$	4,0x40	1,16	2,79

Table B.32a with two brackets in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	2,68	3,50
4230101	$0 \le \alpha < 45°$	4,0x40	2,28	5,56
	$45 \le \alpha \le 90°$	4,0x40	2,28	4,44
4230201	$0 \le \alpha < 45°$	4,0x40	1,88	3,16
	$45 \le \alpha \le 90°$	4,0x40	1,88	4,24
4230202	$0 \le \alpha < 45°$	4,0x40	2,06	3,32
	$45 \le \alpha \le 90°$	4,0x40	2,06	4,39
4230203	$0 \le \alpha \le 90°$	4,0x40	1,36	3,25

Table B.32b with two brackets in the connection

Load-duration class M (k_{mod} = 0,8).				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	3,10	4,00
4230101	$0 \leq \alpha < 45°$	4,0x40	2,62	6,35
	$45 \leq \alpha \leq 90°$	4,0x40	2,62	5,08
4230201	$0 \leq \alpha < 45°$	4,0x40	2,14	3,61
	$45 \leq \alpha \leq 90°$	4,0x40	2,14	4,84
4230202	$0 \leq \alpha < 45°$	4,0x40	2,34	3,79
	$45 \leq \alpha \leq 90°$	4,0x40	2,34	5,01
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,56	3,71

Table B.32c with two brackets in the connection

Load-duration class S (k_{mod} = 0,9).				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	3,54	4,50
4230101	$0 \leq \alpha < 45°$	4,0x40	2,90	7,15
	$45 \leq \alpha \leq 90°$	4,0x40	2,90	5,71
4230201	$0 \leq \alpha < 45°$	4,0x40	2,40	4,06
	$45 \leq \alpha \leq 90°$	4,0x40	2,40	5,45
4230202	$0 \leq \alpha < 45°$	4,0x40	2,64	4,26
	$45 \leq \alpha \leq 90°$	4,0x40	2,64	5,64
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,76	4,18

Table B.32d with two brackets in the connection

Load-duration class I (k_{mod} = 1,1).				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	4,42	5,50
4230101	$0 \le \alpha < 45°$	4,0x40	3,60	8,73
	$45 \le \alpha \le 90°$	4,0x40	3,60	6,98
4230201	$0 \le \alpha < 45°$	4,0x40	2,94	4,96
	$45 \le \alpha \le 90°$	4,0x40	2,94	6,66
4230202	$0 \le \alpha < 45°$	4,0x40	3,20	5,21
	$45 \le \alpha \le 90°$	4,0x40	3,20	6,89
4230203	$0 \le \alpha \le 90°$	4,0x40	2,16	5,11

Table B.32e with two brackets in the connection

Load-duration class P (k_{mod} = 0,6)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	$\frac{7,0}{f+14,5}$ for f < 25	1,50
4230101	$0 \le \alpha < 45°$	4,0x40	$\frac{30,6}{f+50}$ for f < 25	2,38
	$45 \le \alpha \le 90°$	4,0x40		1,90
4230201	$0 \le \alpha < 45°$	4,0x40	$\frac{71,8}{f+100}$ for f < 25	1,35
	$45 \le \alpha \le 90°$	4,0x40		1,82
4230202	$0 \le \alpha < 45°$	4,0x40	$\frac{124,8}{f+160}$ for f < 25	1,42
	$45 \le \alpha \le 90°$	4,0x40		1,88
4230203	$0 \le \alpha \le 90°$	4,0x40	$\frac{21,9}{f+60}$ for f < 25	1,39

Table B.32f with one bracket in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	$\frac{7,0}{f+14,5}$ for f < 25	1,75
4230101	0 ≤ α < 45°	4,0x40	$\frac{35,8}{f+50}$ for f < 25	2,78
	45 ≤ α ≤ 90°	4,0x40		2,22
4230201	0 ≤ α < 45°	4,0x40	$\frac{83,8}{f+100}$ for f < 25	1,58
	45 ≤ α ≤ 90°	4,0x40		2,12
4230202	0 ≤ α < 45°	4,0x40	$\frac{145,6}{f+160}$ for f < 25	1,66
	45 ≤ α ≤ 90°	4,0x40		2,19
4230203	0 ≤ α ≤ 90°	4,0x40	$\frac{25,5}{f+60}$ for f < 25	1,62

Table B.32g with one bracket in the connection

Load-duration class M (k_{mod} = 0,8)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	$\frac{7,0}{f+14,5}$ for f < 25	2,00
4230101	0 ≤ α < 45°	4,0x40	$\frac{40,9}{f+50}$ for f < 25	3,18
	45 ≤ α ≤ 90°	4,0x40		2,54
4230201	0 ≤ α < 45°	4,0x40	$\frac{95,7}{f+100}$ for f < 25	1,80
	45 ≤ α ≤ 90°	4,0x40		2,42
4230202	0 ≤ α < 45°	4,0x40	$\frac{166,4}{f+160}$ for f < 25	1,90
	45 ≤ α ≤ 90°	4,0x40		2,51
4230203	0 ≤ α ≤ 90°	4,0x40	$\frac{29,2}{f+60}$ for f < 25	1,86

Table B.32h with one bracket in the connection

Load-duration class S (k_{mod} = 0,9)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	$\frac{7,0}{f+14,5}$ for f < 25	2,25
4230101	0 ≤ α < 45°	4,0x40	$\frac{46}{f+50}$ for f < 25	3,57
	45 ≤ α ≤ 90°	4,0x40		2,86
4230201	0 ≤ α < 45°	4,0x40	$\frac{107,7}{f+100}$ for f < 25	2,03
	45 ≤ α ≤ 90°	4,0x40		2,72
4230202	0 ≤ α < 45°	4,0x40	$\frac{187,1}{f+160}$ for f < 25	2,13
	45 ≤ α ≤ 90°	4,0x40		2,82
4230203	0 ≤ α ≤ 90°	4,0x40	$\frac{32,8}{f+60}$ for f < 25	2,09

Table B.32i with one bracket in the connection

Load-duration class I (k_{mod} = 1,1)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001 4230002 4230003	α =0°	4,0x40	$\frac{7,0}{f+14,5}$ for f < 25	2,75
4230101	0 ≤ α < 45°	4,0x40	$\frac{56,2}{f+50}$ for f < 25	4,37
	45 ≤ α ≤ 90°	4,0x40		3,49
4230201	0 ≤ α < 45°	4,0x40	$\frac{27,3}{f+18}$ for f < 25	2,48
	45 ≤ α ≤ 90°	4,0x40		3,33
4230202	0 ≤ α < 45°	4,0x40	$\frac{27,3}{f+17,5}$ for f < 25	2,61
	45 ≤ α ≤ 90°	4,0x40		3,45
4230203	0 ≤ α ≤ 90°	4,0x40	$\frac{40,1}{f+60}$ for f < 25	2,55

Table B.32i with one bracket in the connection

Combined forces

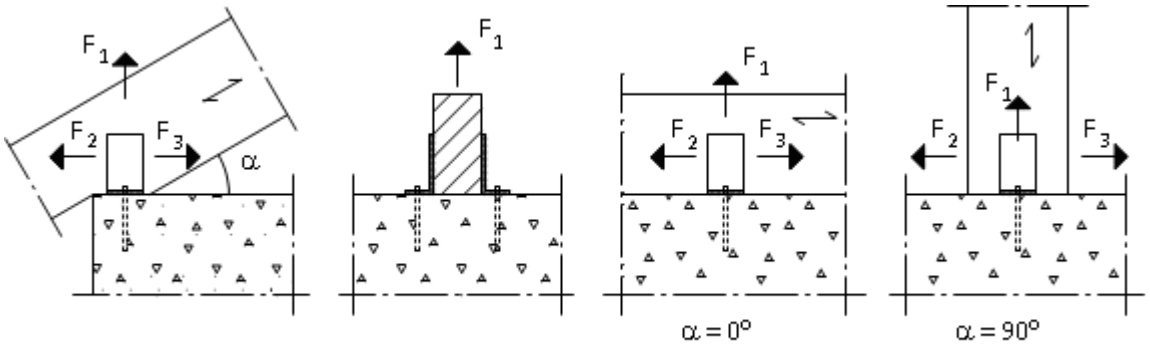
For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2 + \left(\frac{F_{2k}}{R_{2k}}\right)^2 + \left(\frac{F_{3k}}{R_{3k}}\right)^2 \leq 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 32a to 32j.

In the upper condition either F_2 or F_3 is zero

Angle Bracket 423
Basis for design – wood to concrete connections



With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.

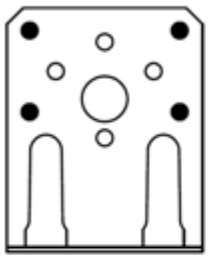
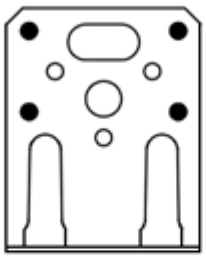
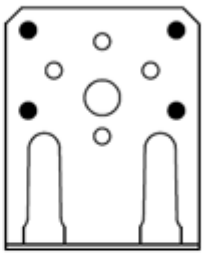
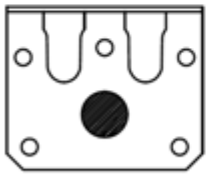
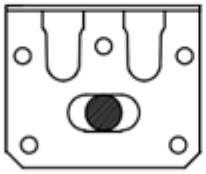
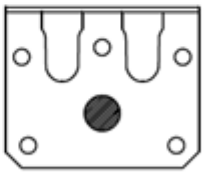
Type 4230001	Type 4230002	Type 4230003	
			Purlin
			Beam
Nailing pattern for α = 0°	Nailing pattern for α = 0°	Nailing pattern for α = 0°	

Figure B.12a Nailing pattern type 4230001, 4230002, 4230003

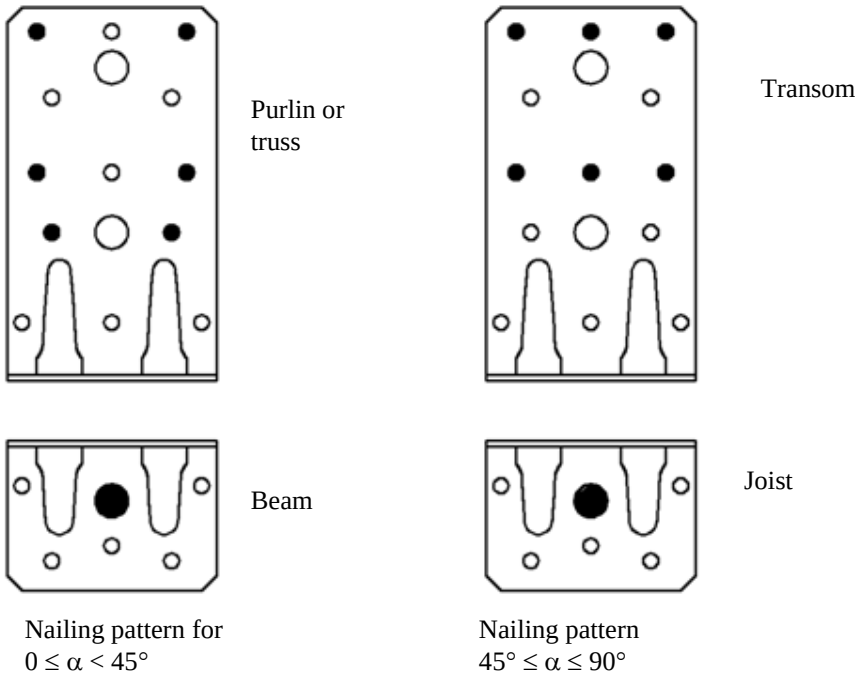


Figure B.12b Nailing pattern type 4230101

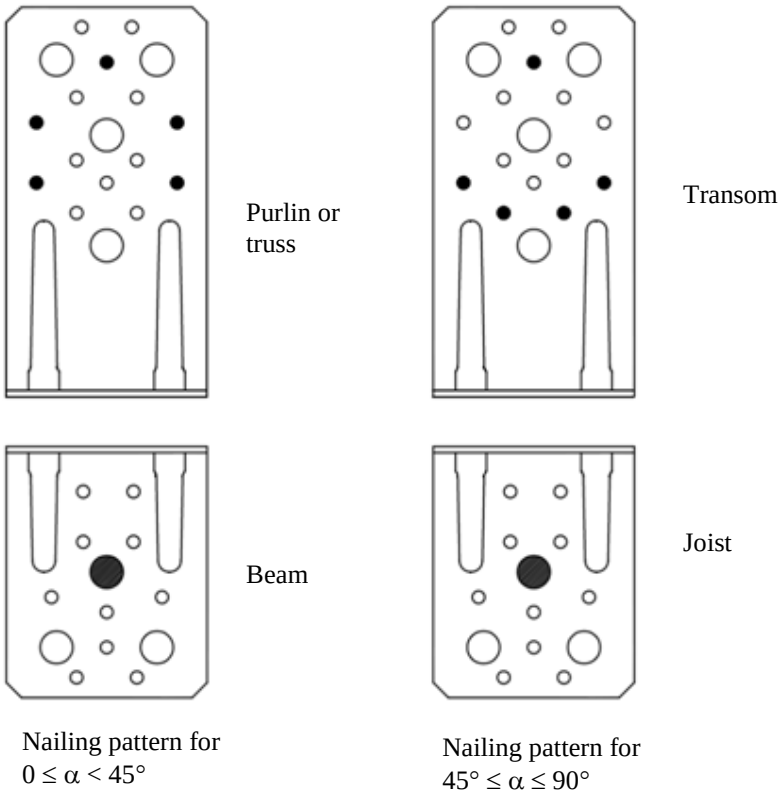
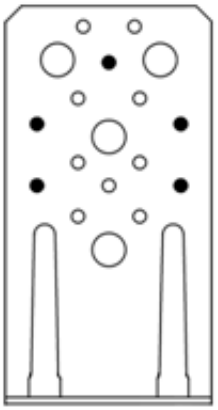
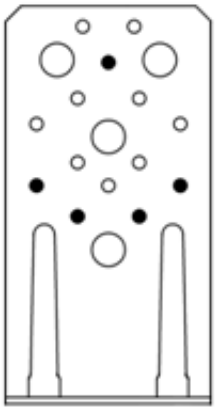


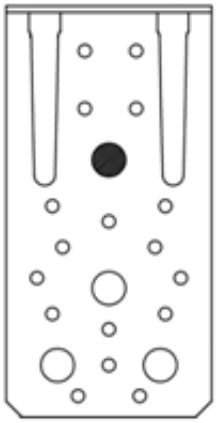
Figure B.12c Nailing pattern type 4230201



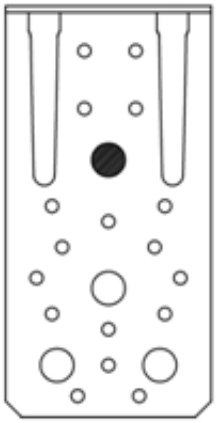
Purlin or truss



Transom



Beam

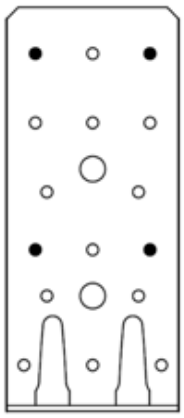


Joist

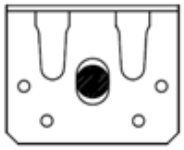
Nailing pattern for
$0 \leq \alpha < 45°$

Nailing pattern for
$45° \leq \alpha \leq 90°$

Figure B.12d Nailing pattern type 4230202



Purlin



Beam

Nailing pattern
$0 \leq \alpha < 90°$

Figure B.12e Nailing pattern type 4230203.

The characteristic capacities in wood to concrete connections are given in tables 33a to 33j. The tables 33a to 33e apply to connections with two brackets and tables 33f to 33j apply to connections with one bracket.

F_{EBt} is the axial load resistance for each bolt at the load effect equivalent to the characteristic capacity F_{Rd}.

Load-duration class P (k_{mod} = 0,6)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	1,80 F_{Bt} = 1,21 F_{Bv} = 0,50	-
4230003	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \le \alpha < 45°$	4,0x40	8,20 F_{Bt} = 5,18 F_{Bv} = 1,00	4,07 F_{Bt} = 1,30 F_{Bv} = 2,04
	$45 \le \alpha \le 90°$	4,0x40	8,60 F_{Bt} = 5,38 F_{Bv} = 0,90	3,30 F_{Bt} = 1,30 F_{Bv} = 1,65
4230201	$0 \le \alpha \le 90°$	4,0x40	3,20 F_{Bt} = 2,12 F_{Bv} = 0,70	1,43 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \le \alpha \le 90°$	4,0x40	2,80 F_{Bt} = 1,66 F_{Bv} = 0,80	1,20 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \le \alpha \le 90°$	4,0x40	3,90 F_{Bt} = 2,95 F_{Bv} = 0,75	1,92 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33a with two brackets in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	1,80 F_{Bt} = 1,21 F_{Bv} = 0,50	-
4230003	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	8,80 F_{Bt} = 5,48 F_{Bv} = 1,10	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	9,60 F_{Bt} = 5,88 F_{Bv} = 1,00	3,77 F_{Bt} = 1,30 F_{Bv} = 1,88
4230201	$0 \leq \alpha \leq 90°$	4,0x40	3,60 F_{Bt} = 2,32 F_{Bv} = 0,90	1,43 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	3,00 F_{Bt} = 1,76 F_{Bv} = 0,90	1,20 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	4,40 F_{Bt} = 3,20 F_{Bv} = 0,80	1,92 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33b with two brackets in the connection

Load-duration class M (k_{mod} = 0,8)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	1,80 F_{Bt} = 1,21 F_{Bv} = 0,50	-
4230003	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	9,50 F_{Bt} = 5,48 F_{Bv} = 1,20	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	10,40 F_{Bt} = 6,28 F_{Bv} = 1,20	4,23 F_{Bt} = 1,30 F_{Bv} = 2,11
4230201	$0 \leq \alpha \leq 90°$	4,0x40	3,60 F_{Bt} = 2,32 F_{Bv} = 0,90	1,43 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	3,00 F_{Bt} = 1,76 F_{Bv} = 0,90	1,20 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	4,80 F_{Bt} = 3,40 F_{Bv} = 0,90	1,92 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33c with two brackets in the connection

Load-duration class S (k_{mod} = 0,9)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	1,80 F_{Bt} = 1,21 F_{Bv} = 0,50	-
4230003	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	10,20 F_{Bt} = 6,18 F_{Bv} = 1,40	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	11,20 F_{Bt} = 6,68 F_{Bv} = 1,30	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
4230201	$0 \leq \alpha \leq 90°$	4,0x40	3,60 F_{Bt} = 2,32 F_{Bv} = 0,90	1,43 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	3,00 F_{Bt} = 1,76 F_{Bv} = 0,90	1,20 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	5,10 F_{Bt} = 3,55 F_{Bv} = 1,00	1,92 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33d with two brackets in the connection

Load-duration class I (k_{mod} = 1,1)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	1,80 F_{Bt} = 1,21 F_{Bv} = 0,50	-
4230003	α =0°	4,0x40	2,40 F_{Bt} = 1,59 F_{Bv} = 0,70	0,59 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	11,80 F_{Bt} = 6,98 F_{Bv} = 1,70	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	11,80 F_{Bt} = 6,98 F_{Bv} = 1,70	4,39 F_{Bt} = 1,30 F_{Bv} = 2,19
4230201	$0 \leq \alpha \leq 90°$	4,0x40	3,60 F_{Bt} = 2,32 F_{Bv} = 0,90	1,43 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	3,00 F_{Bt} = 1,76 F_{Bv} = 0,90	1,20 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	5,10 F_{Bt} = 3,55 F_{Bv} = 1,00	1,92 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33e with two brackets in the connection

Load-duration class P (k_{mod} = 0,6)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	0,54 F_{Bt} = 0,73 F_{Bv} = 0,30	-
4230003	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	2,46 F_{Bt} = 3,11 F_{Bv} = 0,60	2,04 F_{Bt} = 1,30 F_{Bv} = 2,04
	$45 \leq \alpha \leq 90°$	4,0x40	2,58 F_{Bt} = 3,23 F_{Bv} = 0,54	1,65 F_{Bt} = 1,30 F_{Bv} = 1,65
4230201	$0 \leq \alpha \leq 90°$	4,0x40	0,96 F_{Bt} = 1,27 F_{Bv} = 0,42	0,72 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	0,84 F_{Bt} = 1,00 F_{Bv} = 0,48	0,60 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,17 F_{Bt} = 1,77 F_{Bv} = 0,45	0,96 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33f With one bracket in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	0,54 F_{Bt} = 0,73 F_{Bv} = 0,30	-
4230003	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	2,64 F_{Bt} = 3,29 F_{Bv} = 0,66	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	2,88 F_{Bt} = 3,53 F_{Bv} = 0,60	1,88 F_{Bt} = 1,30 F_{Bv} = 1,88
4230201	$0 \leq \alpha \leq 90°$	4,0x40	1,08 F_{Bt} = 1,39 F_{Bv} = 0,54	0,72 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	0,90 F_{Bt} = 1,06 F_{Bv} = 0,54	0,60 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,32 F_{Bt} = 1,92 F_{Bv} = 0,48	0,96 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33g With one bracket in the connection

Load-duration class M (k_{mod} = 0,8)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	0,54 F_{Bt} = 0,73 F_{Bv} = 0,30	-
4230003	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	2,85 F_{Bt} = 3,50 F_{Bv} = 0,72	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	3,12 F_{Bt} = 3,77 F_{Bv} = 0,72	2,11 F_{Bt} = 1,30 F_{Bv} = 2,11
4230201	$0 \leq \alpha \leq 90°$	4,0x40	1,08 F_{Bt} = 1,39 F_{Bv} = 0,54	0,72 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	0,90 F_{Bt} = 1,06 F_{Bv} = 0,54	0,60 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,44 F_{Bt} = 2,04 F_{Bv} = 0,54	0,96 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33h With one bracket in the connection

Load-duration class S (k_{mod} = 0,9)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	0,54 F_{Bt} = 0,73 F_{Bv} = 0,30	-
4230003	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \leq \alpha < 45°$	4,0x40	3,06 F_{Bt} = 3,71 F_{Bv} = 0,84	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \leq \alpha \leq 90°$	4,0x40	3,36 F_{Bt} = 4,01 F_{Bv} = 0,78	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
4230201	$0 \leq \alpha \leq 90°$	4,0x40	1,08 F_{Bt} = 1,39 F_{Bv} = 0,54	0,72 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \leq \alpha \leq 90°$	4,0x40	0,90 F_{Bt} = 1,06 F_{Bv} = 0,54	0,60 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \leq \alpha \leq 90°$	4,0x40	1,53 F_{Bt} = 2,13 F_{Bv} = 0,60	0,96 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33i With one bracket in the connection

Load-duration class I (k_{mod} = 1,1)				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
4230001	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230002	α =0°	4,0x40	0,54 F_{Bt} = 0,73 F_{Bv} = 0,30	-
4230003	α =0°	4,0x40	0,72 F_{Bt} = 0,95 F_{Bv} = 0,42	0,29 F_{Bt} = 0,33 F_{Bv} = 0,29
4230101	$0 \le \alpha < 45°$	4,0x40	3,54 F_{Bt} = 4,19 F_{Bv} = 1,02	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
	$45 \le \alpha \le 90°$	4,0x40	3,54 F_{Bt} = 4,19 F_{Bv} = 1,02	2,19 F_{Bt} = 1,30 F_{Bv} = 2,19
4230201	$0 \le \alpha \le 90°$	4,0x40	1,08 F_{Bt} = 1,39 F_{Bv} = 0,54	0,72 F_{Bt} = 0,91 F_{Bv} = 0,72
4230202	$0 \le \alpha \le 90°$	4,0x40	0,90 F_{Bt} = 1,06 F_{Bv} = 0,54	0,60 F_{Bt} = 0,90 F_{Bv} = 0,60
4230203	$0 \le \alpha \le 90°$	4,0x40	1,53 F_{Bt} = 2,13 F_{Bv} = 0,60	0,96 F_{Bt} = 0,91 F_{Bv} = 0,96

Table B.33j With one bracket in the connection

Combined forces

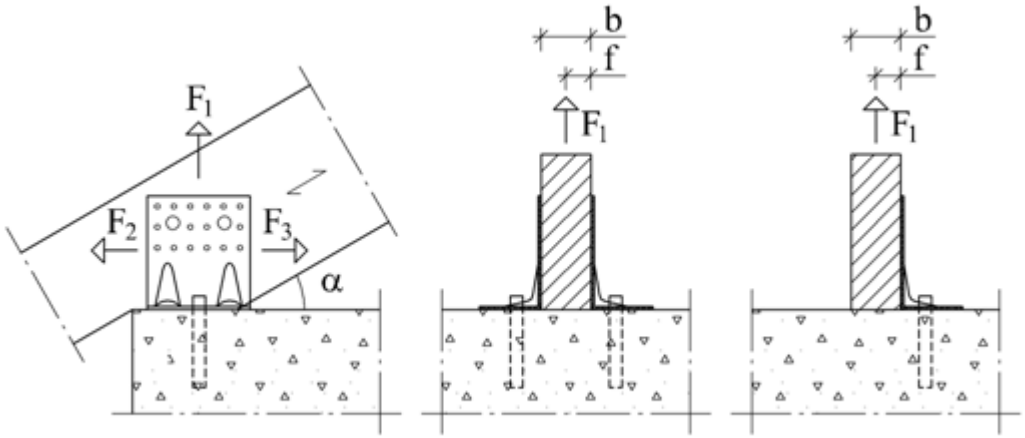
For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2+\left(\frac{F_{2k}}{R_{2k}}\right)^2+\left(\frac{F_{3k}}{R_{3k}}\right)^2 \le 1$$

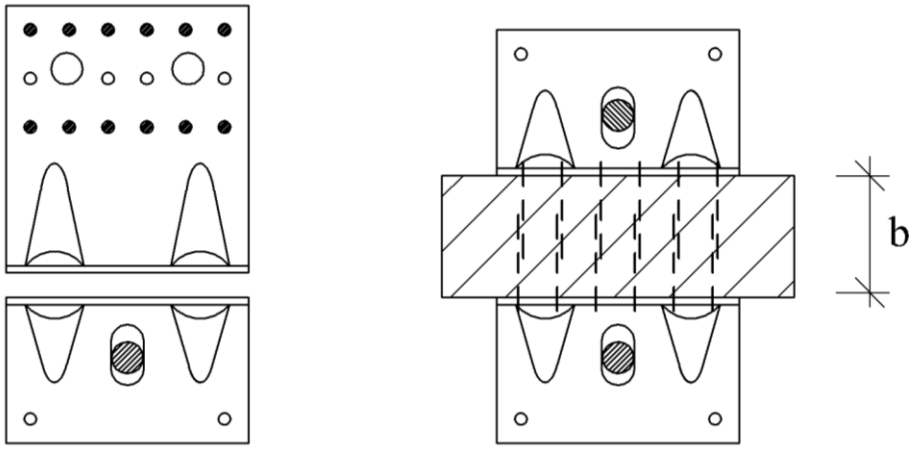
F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 33a to 33j.

In the upper condition either F_2 or F_3 is zero

Angle Bracket 436
Basis for design – wood to concrete connections

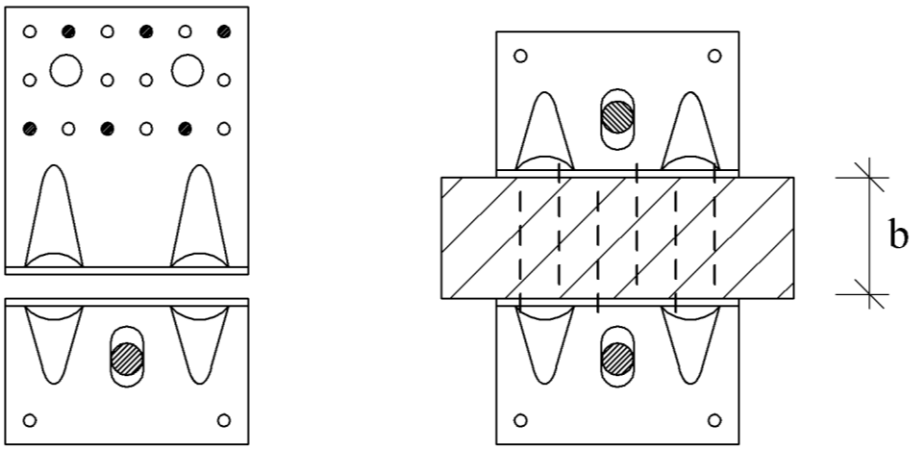


With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.



Nailing pattern for $\alpha = 90°$

Figure B.13a Nailing pattern 1 for type 436. When the nail overlap, the lowest value of b in accordfance with the tables apply.



Nailing pattern for $0 \leq \alpha \leq 90°$

Figure B.13b Nailing pattern 2 for type 436. When two brackets are used the nail shall be staggered to avoid overlap

The characteristic capacities in wood to concrete connections are given in tables 34a to 34i. The tables 34a to 34e apply to connections with two brackets and tables 34f to 34i apply to connections with one bracket.

F_{EBt} is the axial load resistance for each bolt at the load effect equivalent to the characteristic capacity F_{Rd}.

Load duration class P (k_{mod} = 0,6)					
Nail pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12+12 4,0x40	$\alpha = 90°$	53 mm	13,00 F_{Bt} = 8,64	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6+6 4,0x40	$0 \leq \alpha \leq 90°$	45 mm	8,40 F_{Bt} = 6,34	4,54 F_{Bt} = 1,87 F_{Bv} = 2,27

Table B.34a with two brackets in the connection

Load duration class L (k_{mod} = 0,7)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12+12 4,0x40	α = 90°	53 mm	14,60 F_{Bt} = 9,44	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6+6 4,0x40	0 ≤ α ≤ 90°	45 mm	9,60 F_{Bt} = 6,94	5,03 F_{Bt} = 1,87 F_{Bv} = 2,52

Table B.34b with two brackets in the connection

Load duration class M (k_{mod} = 0,8)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12+12 4,0x40	α = 90°	53 mm	16,00 F_{Bt} = 10,14	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6+6 4,0x40	0 ≤ α ≤ 90°	45 mm	10,60 F_{Bt} = 7,44	5,52 F_{Bt} = 1,87 F_{Bv} = 2,76

Table B.34c with two brackets in the connection

Load duration class S (k_{mod} = 0,9)					
Nail-pattern	Nail	Angle α	Minimum width *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12+12 4,0x40	α = 90°	53 mm	17,60 F_{Bt} = 10,94	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6+6 4,0x40	0 ≤ α ≤ 90°	45 mm	12,00 F_{Bt} = 8,14	6,01 F_{Bt} = 1,87 F_{Bv} = 3,01

Table B.34d with two brackets in the connection

Load duration class I (k_{mod} = 1,1)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12+12 4,0x40	α = 90°	53 mm	18,40 F_{Bt} = 11,34	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6+6 4,0x40	0 ≤ α ≤ 90°	45 mm	14,00 F_{Bt} = 9,14	6,46 F_{Bt} = 1,87 F_{Bv} = 3,23

Table B.34e with two brackets in the connection

Load duration class P (k_{mod} = 0,6)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12 4,0x40	α = 90°	45 mm	3,90 F_{Bt} = 5,18	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6 4,0x40	0 ≤ α ≤ 90°	45 mm	2,52 F_{Bt} = 3,80	2,27 F_{Bt} = 1,87 F_{Bv} = 2,27

Table B.34e with one bracket in the connection

Load duration class L (k_{mod} = 0,7)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12 4,0x40	α = 90°	45 mm	4,38 F_{Bt} = 5,66	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6 4,0x40	0 ≤ α ≤ 90°	45 mm	2,88 F_{Bt} = 4,16	2,52 F_{Bt} = 1,87 F_{Bv} = 2,52

Table B.34f with one bracket in the connection

Load duration class M (k_{mod} = 0,8)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12 4,0x40	α = 90°	45 mm	4,80 F_{Bt} = 6,08	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6 4,0x40	0 ≤ α ≤ 90°	45 mm	3,18 F_{Bt} = 4,46	2,76 F_{Bt} = 1,87 F_{Bv} = 2,76

Table B.34g with one bracket in the connection

Load duration class S (k_{mod} = 0,9)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12 4,0x40	α = 90°	45 mm	5,28 F_{Bt} = 6,56	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6 4,0x40	0 ≤ α ≤ 90°	45 mm	3,60 F_{Bt} = 4,88	3,01 F_{Bt} = 1,87 F_{Bv} = 3,01

Table B.34h with one bracket in the connection

Load duration class I (k_{mod} = 1,1)					
Nail-pattern	Nail	Angle α	Minimum width bredd *b*	F_{R1d}	$F_{R2d} = F_{R3d}$
1	12 4,0x40	α = 90°	45 mm	5,52 F_{Bt} = 6,80	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23
2	6 4,0x40	0 ≤ α ≤ 90°	45 mm	4,20 F_{Bt} = 5,48	3,23 F_{Bt} = 1,87 F_{Bv} = 3,23

Table B.34i with one bracket in the connection

Combined forces

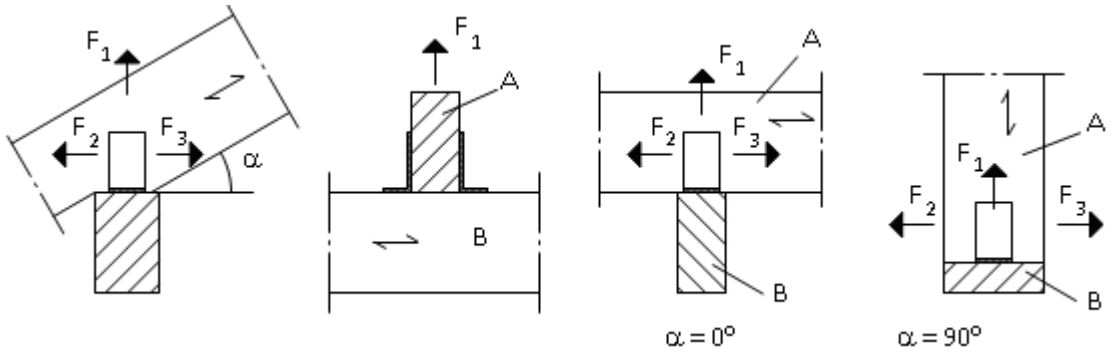
For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2 + \left(\frac{F_{2k}}{R_{2k}}\right)^2 + \left(\frac{F_{3k}}{R_{3k}}\right)^2 \leq 1$$

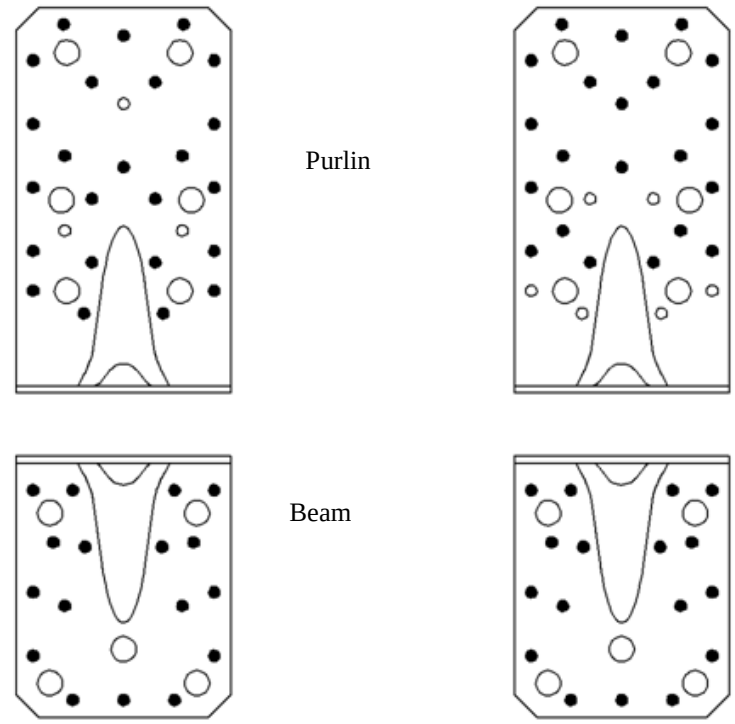
F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 34a to 34i.

In the upper condition either F_2 or F_3 is zero

Angle Bracket 445
Basis for design – wood to wood connections



With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.



Nailing pattern for
$0 \leq \alpha < 45°$

Nailing pattern
$45° \leq \alpha \leq 90°$

Figure B.14a Nailing pattern type 445

The characteristic capacities in wood to wood connections are given in tables 32a to 32j. The tables 32a to 32e apply to connections with two brackets and tables 32f to 32j apply to connections with one bracket.

Load-duration class P (k_{mod} = 0,6).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	6,61	12,88
	45 ≤ α ≤ 90°	4,0x40	6,49	9,65

Table B.35a with two brackets in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	7,71	15,02
	45 ≤ α ≤ 90°	4,0x40	7,57	11,25

Table B.35b with two brackets in the connection

Load-duration class M (k_{mod} = 0,8).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	8,81	17,17
	45 ≤ α ≤ 90°	4,0x40	8,65	12,86

Table B.35c with two brackets in the connection

Load-duration class S (k_{mod} = 0,9).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	9,91	19,31
	45 ≤ α ≤ 90°	4,0x40	9,73	14,47

Table B.35d with two brackets in the connection

Load-duration class I (k_{mod} = 1,1).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	12,11	23,61
	45 ≤ α ≤ 90°	4,0x40	11,89	17,68

Table B.35e with two brackets in the connection

Load-duration class P (k_{mod} = 0,6).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	1,98	6,44
	45 ≤ α ≤ 90°	4,0x40	1,95	4,82

Table B.35f with one bracket in the connection

Load-duration class L (k_{mod} = 0,7)				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	2,31	7,51
	45 ≤ α ≤ 90°	4,0x40	2,27	5,63

Table B.35g with one bracket in the connection

Load-duration class M (k_{mod} = 0,8).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	2,64	8,58
	45 ≤ α ≤ 90°	4,0x40	2,59	6,43

Table B.35h with one bracket in the connection

Load-duration class S (k_{mod} = 0,9).				
		Nail	R_{1k}	R_{2k}=R_{3k}
445	0 ≤ α < 45°	4,0x40	2,97	9,66
	45 ≤ α ≤ 90°	4,0x40	2,92	7,23

Table B.35i with one bracket in the connection

Load-duration class I (k_{mod} = 1,1).				
		Nail	R_{1k}	$R_{2k}=R_{3k}$
445	$0 \le \alpha < 45°$	4,0x40	3,63	11,80
	$45 \le \alpha \le 90°$	4,0x40	3,57	8,84

Table B.35j with one bracket in the connection

Combined forces

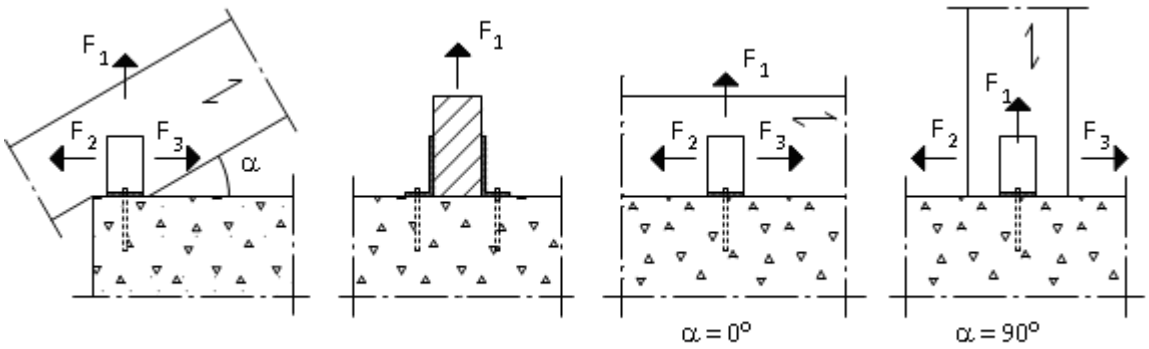
For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2+\left(\frac{F_{2k}}{R_{2k}}\right)^2+\left(\frac{F_{3k}}{R_{3k}}\right)^2 \le 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 35a to 35j.

In the upper condition either F_2 or F_3 is zero

Angle Bracket 445
Basis for design – wood to concrete connections



With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.

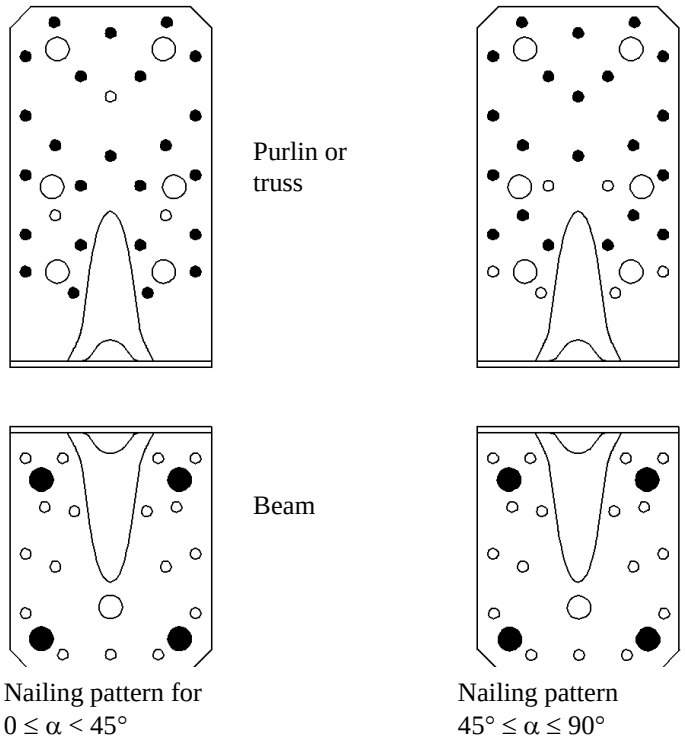


Figure B.15a Nailing pattern type 445

The characteristic capacities in wood to concrete connections are given in tables 36a to 36j. The tables 36a to 36e apply to connections with two brackets and tables 36f to 36j apply to connections with one bracket.

F_{EBt} is the axial load resistance for each bolt at the load effect equivalent to the characteristic capacity F_{Rd}.

Load-duration class P (k_{mod} = 0,6)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	26,00 F_{EBt} = 7,03 F_{EBv} = 1,95	15,85 F_{EBt} = 0,77 F_{EBv} = 4,20
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	23,00 F_{EBt} = 6,28 F_{EBv} = 1,45	12,29 F_{EBt} = 0,77 F_{EBv} = 3,25

Table B.36a with two brackets in the connection

Load-duration class L (k_{mod} = 0,7)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	29,00 F_{EBt} = 7,78 F_{EBv} = 2,30	18,34 F_{EBt} = 0,77 F_{EBv} = 4,86
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	26,00 F_{EBt} = 7,03 F_{EBv} = 1,70	14,19 F_{EBt} = 0,77 F_{EBv} = 3,76

Table B.36b with two brackets in the connection

Load-duration class M (k_{mod} = 0,8)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	30,60 F_{EBt} = 8,18 F_{EBv} = 2,45	20,83 F_{EBt} = 0,77 F_{EBv} = 5,52
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	29,00 F_{EBt} = 7,78 F_{EBv} = 2,00	16,09 F_{EBt} = 0,77 F_{EBv} = 4,26

Table B.36c with two brackets in the connection

Load-duration class S (k_{mod} = 0,9)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	30,60 F_{EBt} = 8,18 F_{EBv} = 2,45	23,32 F_{EBt} = 0,77 F_{EBv} = 6,18
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	30,60 F_{EBt} = 8,18 F_{EBv} = 2,15	17,99 F_{EBt} = 0,77 F_{EBv} = 4,76

Table B.36d with two brackets in the connection

Load-duration class I (k_{mod} = 1,1)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	30,60 F_{EBt} = 8,18 F_{EBv} = 2,45	28,30 F_{EBt} = 0,77 F_{EBv} = 7,50
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	30,60 F_{EBt} = 8,18 F_{EBv} = 2,15	21,79 F_{EBt} = 0,77 F_{EBv} = 5,77

Table B.36e with two brackets in the connection

Load-duration class P (k_{mod} = 0,6)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	7,80 F_{EBt} = 4,22 F_{EBv} = 1,17	7,92 F_{EBt} = 0,77 F_{EBv} = 4,20
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	6,90 F_{EBt} = 3,77 F_{EBv} = 0,87	6,14 F_{EBt} = 0,77 F_{EBv} = 3,25

Table B.36f with one bracket in the connection

Load-duration class L (k_{mod} = 0,7)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	8,70 F_{EBt} = 4,67 F_{EBv} = 1,38	9,17 F_{EBt} = 0,77 F_{EBv} = 4,86
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	7,80 F_{EBt} = 4,22 F_{EBv} = 1,02	7,09 F_{EBt} = 0,77 F_{EBv} = 3,76

Table B.36g with one bracket in the connection

Load-duration class M (k_{mod} = 0,8)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	9,18 F_{EBt} = 4,91 F_{EBv} = 1,47	10,41 F_{EBt} = 0,77 F_{EBv} = 5,52
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	8,70 F_{EBt} = 4,67 F_{EBv} = 1,20	8,04 F_{EBt} = 0,77 F_{EBv} = 4,26

Table B.36h with one bracket in the connection

Load-duration class S (k_{mod} = 0,9)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	9,18 F_{EBt} = 4,91 F_{EBv} = 1,47	11,61 F_{EBt} = 0,77 F_{EBv} = 6,18
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	9,18 F_{EBt} = 4,91 F_{EBv} = 1,29	8,99 F_{EBt} = 0,77 F_{EBv} = 4,76

Table B.36i with one bracket in the connection

Load-duration class I (k_{mod} = 1,1)					
	Angle α	Nail	Bolts	F_{R1k}	$F_{R2k} = F_{R3k}$
445	0 ≤ α < 45°	24 4,0x40	4 ∅10	9,18 F_{EBt} = 4,91 F_{EBv} = 1,47	14,15 F_{EBt} = 0,77 F_{EBv} = 7,50
	45 ≤ α ≤ 90°	21 4,0x40	4 ∅10	9,18 F_{EBt} = 4,91 F_{EBv} = 1,29	10,89 F_{EBt} = 0,77 F_{EBv} = 5,77

Table B.36j with one bracket in the connection

Combined forces

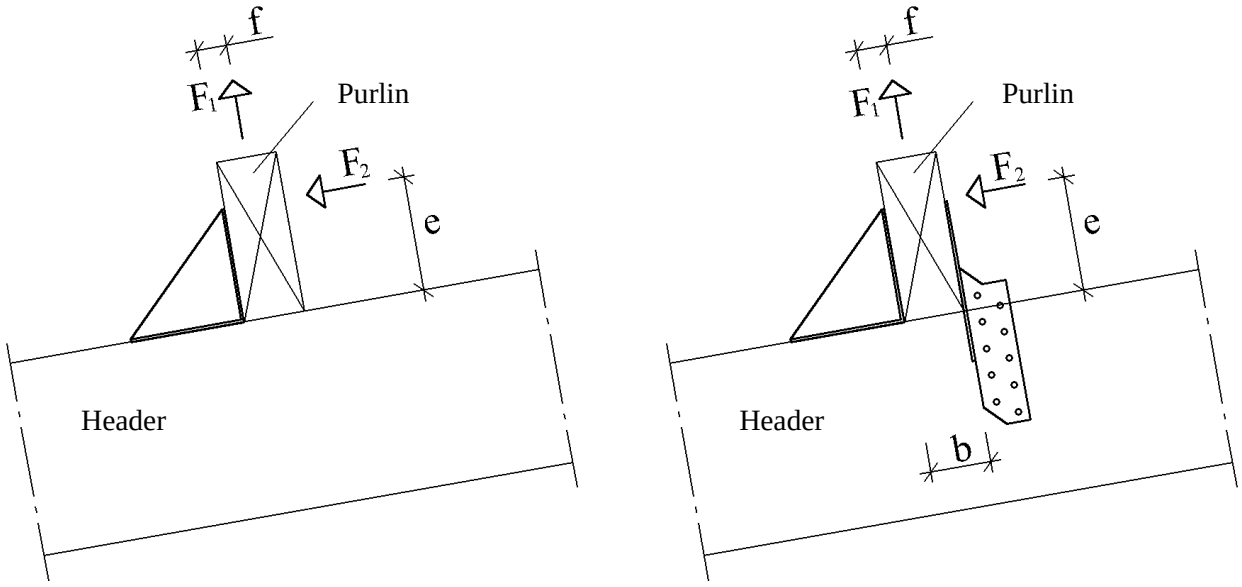
For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2 + \left(\frac{F_{2k}}{R_{2k}}\right)^2 + \left(\frac{F_{3k}}{R_{3k}}\right)^2 \leq 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 36a to 36j.

In the upper condition either F_2 or F_3 is zero

Bracket type Knagge
Basis for design – wood to wood connections



In the header the ”Knagge” shall be nailed with 4,0x60 nails. In the purlin the ”Knagge” shall be nailed with 4,0x40 nails. The purlin ties in both header and purlin shall be nailed with 4,0x40 nails.

The nailing pattern in the purlin tie shall be in accordance with ETA-09/0315 for the purlin ties.

The requirements in EN 1995-1-1:2004 to the edge distance shall be fulfilled. In table 1 is indicated the minimum width of the header and minimum purlin heights for the respective types of ”Knagge”.

Table B37.a Minimum width of the header and minimum purlin heights.

Knagge	minimum purlin heights	Minimum width of the header
90	100	105
130	125	135
170	150	115
210	210	130

Table B37.b Characteristic capacity F_{Rk} in kN with only Knagge type 90. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *f* shall be given in mm.

Knagge typ 90 without purlin tie			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
8 st 4,0x60	8 st 4,0x40	$\frac{166}{f+75}$ for $f \leq 90$	$\frac{166}{e}$ for $e \leq 150$ Max 8,19

Table B37.c Characteristic capacity F_{Rk} in kN Knagge typ 90 with two purlin ties type 170. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *b* shall be given in mm.

Knagge type 90 with two purlin ties type 170			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
8 st 4,0x60	8 st 4,0x40	4,78	$\frac{74+7,8b}{(e-62)}$ for $e \leq 150$ Max 8,34

Table B37.d Characteristic capacity F_{Rk} in kN with only Knagge type 130. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *f* shall be given in mm.

Knagge type 130 with out purlin tie			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
10 st 4,0x60	10 st 4,0x40	$\frac{286}{f+105}$ for $f \leq 125$	$\frac{286}{e}$ for $e \leq 175$ Dock max 10,61

Table B37.e Characteristic capacity F_{Rk} in kN Knagge type 130 with two purline ties type 210. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *b* shall be given in mm.

Knagge type 130 with two purlin ties type 210			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
10 st 4,0x60	10 st 4,0x40	5,68	$\frac{179+10{,}76b}{(e-87)}$ for $e \le 175$ Max 8,72

Table B37.f Characteristic capacity F_{Rk} in kN with only Knagge type 170. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *f* shall be given in mm.

Knagge type 170 without purlin tie			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
12 st 4,0x60	12 st 4,0x40	$\frac{423}{f+125}$ for $f \le 150$	$\frac{423}{e}$ for $e \le 200$ Max 13,15

Table B37.g Characteristic capacity F_{Rk} in kN Knagge type 170 with two purlin ties type 250. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *b* shall be given in mm.

Knagge type 170 with two purlin ties type 250			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
12 st 4,0x60	12 st 4,0x40	6,89	$\frac{13{,}3(b+93{,}5)-18}{e}$ for $e \le 200$ Max 13,62

Table B37.h Characteristic capacity F_{Rk} in kN with only Knagge type 210. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *f* shall be given in mm.

Knagge type 210 without purlin tie			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
18 st 4,0x60	18 st 4,0x40	$\frac{912}{f+175}$ for $f \le 200$	$\frac{912}{e}$ for $e \le 250$ Max 20,68

Table B37.i Characteristic capacity F_{Rk} in kN Knagge type 210 with two purlin ties type 290. Load duration class M (k_{mod} = 0,8). Service class 1 and 2. The dimensions *e* and *b* shall be given in mm.

Knagge type 210 with two purlin ties type 290			
Nails in header	Nails in purlin tie	F_{R1k}	F_{R2k}
18 st 4,0x60	18 st 4,0x40	10,42	$\frac{468 + 20{,}86b}{(e - 135)}$ for $e \leq 250$ Max 16,40

Table B37.j Correction factor at different load duration classes.

Load-duration class k_{mod}				
P	L	M	S	I
0,75	0,88	1,0	1,0	1,0

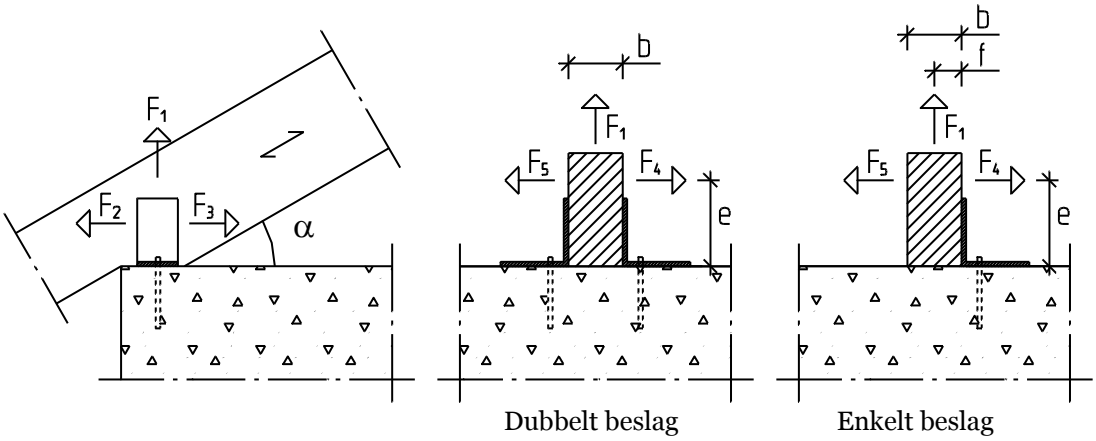
Combined forces

For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

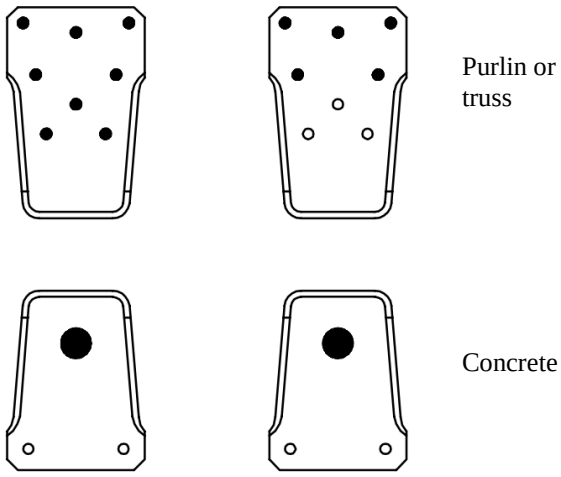
$$\left(\frac{F_{E1k}}{F_{Rik}}\right) + \left(\frac{F_{E2k}}{F_{R2k}}\right) \leq 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 37a to 37j.

Angle Bracket 444
Basis for design – wood to concrete connections



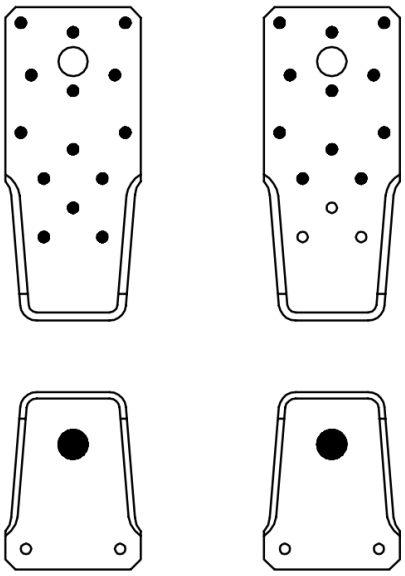
With two brackets in a connection the nails shall not overlap more than what is described in Eurocode 5 section 8.3.1.1. If the purlin is too thin, then brackets shall be staggered.



Nailing pattern for $0 \leq \alpha < 45°$

Nailing pattern $45° \leq \alpha \leq 90°$

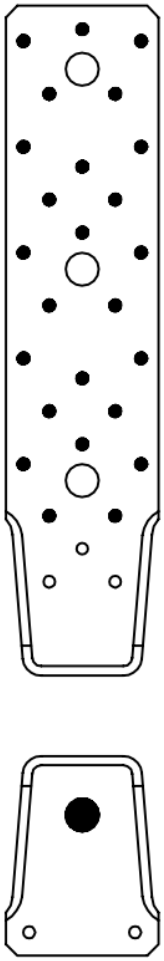
Figure B.16a Nailing pattern type 4443001 and 4444001



Nailing pattern for
$0 \leq \alpha < 45°$

Nailing pattern
$45° \leq \alpha \leq 90°$

Figure B.16b Nailing pattern type 4443002 and 4444002



Nailing pattern for
$0 \leq \alpha < 90°$

Figure B.16c Nailing pattern type 4443003 and 4444003

The characteristic capacities in wood to concrete connections are given in tables 38a to 38m. The tables 38a to 38f apply to connections with two brackets and tables 38g to 38m apply to connections with one bracket.

F_{EBt} is the axial load resistance for each bolt at the load effect equivalent to the characteristic capacity F_{Rd}.

Tabell 38a. with two brackets in the connection (k_{mod} = 0,8)

Angle bracket 4443001 Thickness 3 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
$0 \le \alpha < 45°$	8 4,0x40	21,00 F_{EBt} = 12,62 F_{EBv} = 1,60	3,60 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{10,50b}{e}$ for $e \le 120$ max 11,70 F_{EBt} = 12,62 $F_{EBv} = F$
$45 \le \alpha \le 90°$	5 4,0x40	13,20 F_{EBt} = 8,02 F_{EBv} = 0,80	3,60 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{6,60b}{e}$ for $e \le 120$ max 11,70 F_{EBt} = 8,02 $F_{EBv} = F$

Tabell 38b. with two brackets in the connection (k_{mod} = 0,8).

Angle bracket 4443002 Thickness 3 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
$0 \le \alpha < 45°$	14 4,0x40	25,00 F_{EBt} = 14,52 F_{EBv} = 2,40	3,60 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{12,50b}{e}$ for $e \le 170$ max 11,70 F_{EBt} = 14,52 $F_{EBv} = F$
$45 \le \alpha \le 90°$	11 4,0x40	25,00 F_{EBt} = 14,52 F_{EBv} = 2,40	3,60 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{12,50b}{e}$ for $e \le 170$ max 11,70 F_{EBt} = 14,52 $F_{EBv} = F$

Tabell 38c. with two brackets in the connection (k_{mod} = 0,8).

Angle bracket 4443003 Thickness 3 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
$0 \le \alpha < 90°$	25 4,0x40	25,60 F_{EBt} = 14,82 F_{EBv} = 2,00	3,60 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{12,80b}{e}$ for $e \le 315$ max 11,70 F_{EBt} = 14,82 $F_{EBv} = F$

Tabell 38d. with two brackets in the connection (k_{mod} = 0,8).

Angle bracket 4444001 Thickness 4 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
$0 \le \alpha < 45°$	8 4,0x40	21,00 F_{EBt} = 12,62 F_{EBv} = 1,60	6,37 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{10,50b}{e}$ for $e \le 120$ max 15,60 F_{EBt} = 12,62 $F_{EBv} = F$
$45 \le \alpha \le 90°$	5 4,0x40	13,20 F_{EBt} = 8,02 F_{EBv} = 0,80	4,78 F_{EBt} = 2,51 F_{EBv} = 2,39	$\frac{6,60b}{e}$ for $e \le 120$ max 15,60 F_{EBt} = 8,02 $F_{EBv} = F$

Tabell 38e. with two brackets in the connection (k_{mod} = 0,8).

Angle bracket 4444002 Thickness 4 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
0 ≤ α < 45°	14 4,0x40	33,00 F_{EBt} = 19,61 F_{EBv} = 2,90	6,37 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{16{,}50b}{e}$ for $e \leq 170$ max 15,60 F_{EBt} = 19,61 $F_{EBv} = F$
45 ≤ α ≤ 90°	11 4,0x40	27,00 F_{EBt} = 16,21 F_{EBv} = 1,60	6,37 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{13{,}50b}{e}$ for $e \leq 170$ max 15,60 F_{EBt} = 16,21 $F_{EBv} = F$

Tabell 38f. with two brackets in the connection (k_{mod} = 0,8).

Angle bracket 4444003 Thickness 4 mm				
Angle α	Nail	F_{R1k}	$F_{R2k} = F_{R3k}$	$F_{R4k} = F_{R5k}$
0 ≤ α < 90°	25 4,0x40	34,00 F_{EBt} = 19,71 F_{EBv} = 2,60	6,37 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{17{,}00b}{e}$ for $e \leq 315$ max 15,60 F_{EBt} = 19,71 $F_{EBv} = F$

Tabell 38g. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4443001 Thickness 3 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
0 ≤ α < 45°	8 4,0x40	10,50 F_{EBt} = 12,62 F_{EBv} = 1,60	1,80 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{121}{e}$ for e<100 max 9,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{70,4}{83,0 - e}$ for e ≤ 51 $F = \frac{113}{e}$ for 51<e≤100 $F_{EBt} = \frac{F \cdot e}{17}$ $F_{EBv} = F$
45 ≤ α ≤ 90°	5 4,0x40	6,60 F_{EBt} = 8,02 F_{EBv} = 0,80	1,80 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{121}{e}$ for e<100 max 9,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{27,4}{91,2 - e}$ for e ≤ 73 $F = \frac{113}{e}$ for 73<e≤100 $F_{EBt} = \frac{F \cdot e}{17}$ $F_{EBv} = F$

Tabell 38h. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4443002 Thickness 3 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
0 ≤ α < 45°	14 4,0x40	12,50 F_{EBt} = 14,52 F_{EBv} = 2,40	1,80 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{121}{e}$ for e<100 max 9,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{187,1}{115,8 - e}$ for e ≤ 43 $F = \frac{113}{e}$ for 43<e≤150 $F_{EBt} = \frac{F \cdot e}{17}$ $F_{EBv} = F$
45 ≤ α ≤ 90°	11 4,0x40	12,50 F_{EBt} = 14,52 F_{EBv} = 2,40	1,80 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{121}{e}$ for e<100 max 9,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{122,0}{125,0 - e}$ for e ≤ 60 $F = \frac{113}{e}$ for 60<e≤150 $F_{EBt} = \frac{F \cdot e}{17}$ $F_{EBv} = F$

Tabell 38i. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4443003 Thickness 3 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
0 ≤ α < 90°	25 4,0x40	12,80 F_{EBt} = 14,82 F_{EBv} = 2,00	1,80 F_{EBt} = 1,40 F_{EBv} = 1,80	$\frac{121}{e}$ for e<100 max 9,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{522,0}{219,1 - e}$ for e ≤ 39 $F = \frac{113}{e}$ for 39<e≤180 $F_{EBt} = \frac{F \cdot e}{17}$ $F_{EBv} = F$

Tabell 38j. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4444001 Thickness 4 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
0 ≤ α < 45°	8 4,0x40	10,50 F_{EBt} = 12,62 F_{EBv} = 1,60	3,19 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{163}{e}$ for e<100 max 12,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{70,4}{83,0 - e}$ for e ≤ 54 $F = \frac{130}{e}$ for 54<e≤100 $F_{EBt} = \frac{F \cdot e}{15}$ $F_{EBv} = F$
45 ≤ α ≤ 90°	5 4,0x40	6,60 F_{EBt} = 8,02 F_{EBv} = 0,80	2,39 F_{EBt} = 2,51 F_{EBv} = 2,39	$\frac{163}{e}$ for e<100 max 12,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{27,4}{91,2 - e}$ for e ≤ 75 $F = \frac{130}{e}$ for 75<e≤100 $F_{EBt} = \frac{F \cdot e}{15}$ $F_{EBv} = F$

Tabell 38k. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4444002 Thickness 4 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
0 ≤ α < 45°	14 4,0x40	16,50 F_{EBt} = 19,21 F_{EBv} = 2,90	3,19 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{163}{e}$ for e<140 max 12,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{187,1}{115,8 - e}$ for e ≤ 47 $F = \frac{130}{e}$ for 47<e≤150 $F_{EBt} = \frac{F \cdot e}{15}$ $F_{EBv} = F$
45 ≤ α ≤ 90°	11 4,0x40	13,50 F_{EBt} = 16,21 F_{EBv} = 1,60	3,19 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{163}{e}$ for e<140 max 12,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{122,0}{125,0 - e}$ for e ≤ 65 $F = \frac{130}{e}$ for 65<e≤150 $F_{EBt} = \frac{F \cdot e}{15}$ $F_{EBv} = F$

Tabell 38l. with one bracket in the connection (k_{mod} = 0,8).

Angle bracket 4444003 Thickness 4 mm					
Angle α	Spik	F_{R1k}	$F_{R2k} = F_{R3k}$	F_{R4k}	F_{R5k}
$0 \le \alpha < 90°$	25 4,0x40	17,00 F_{EBt} = 19,71 F_{EBv} = 2,60	3,19 F_{EBt} = 2,51 F_{EBv} = 3,19	$\frac{163}{e}$ for e<140 max 12,00 $F_{EBt} = \frac{F \cdot e}{60}$ $F_{EBv} = F$	$F = \frac{522,0}{219,1 - e}$ for e ≤ 44 $F = \frac{130}{e}$ for 44<e≤180 $F_{EBt} = \frac{F \cdot e}{15}$ $F_{EBv} = F$

Tabell 38m. Correction factor for different load durations.

Force direction	Load duration class k_{mod}					Load duration class k_{mod}				
	P	L	M	S	I	P	L	M	S	I
	Angle bracket 4443001 Thickness 3 mm					**Angle bracket 4444001 Thickness 4 mm**				
F_1	0,75	0,88	1,0	1,13	1,37	0,75	0,88	1,0	1,13	1,37
$F_2 = F_3$	0,75	0,88	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
F_4	1.0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0
F_5	0,75	0,88	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
$F_4 = F_5$	0,75	0,88	1,0	1,13	1,37	0,75	0,88	1,0	1,13	1,37
	Angle bracket 4443002 Thickness 3 mm					**Angle bracket 4444002 Thickness 4 mm**				
F_1	0,8	1,0	1,0	1,0	1,0	0,75	0,88	1,0	1,13	1,25
$F_2 = F_3$	1,0	1,0	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
F_4	1.0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0
F_5	0,75	0,88	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
$F_4 = F_5$	0,8	1,0	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
	Angle bracket 4443003 Thickness 3 mm					**Angle bracket 4444003 Thickness 4 mm**				
F_1	1.0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0
$F_2 = F_3$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
F_4	1.0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0
F_5	0,75	0,88	1,0	1,0	1,0	0,75	0,88	1,0	1,0	1,0
$F_4 = F_5$	1.0	1,0	1,0	1,0	1,0	1.0	1,0	1,0	1,0	1,0

Combined forces

For practical purposes the strength verification is always carried out for design forces and design capacities. If the forces are combined the following inequalities shall be fulfilled:

$$\left(\frac{F_{1k}}{R_{1k}}\right)^2 + \left(\frac{F_{2k}}{R_{2k}}\right)^2 + \left(\frac{F_{3k}}{R_{3k}}\right)^2 \leq 1$$

F_k = Characteristic load (actual load)
R_k = Characteristic capacities from this ETA according to tables 36a to 36j.

In the upper condition either F_2 or F_3 is zero