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

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-09/0084 of 12/06/2014

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 Angle Brackets type 401M, 401U, 402M and 402U with and without a rib and 401M PES and 402M PES.
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:	30 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 2013-06-07 and expiry on 2018-06-07

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 401M, 401U, 402M, 402U, 401 M PES and 402 M PES 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. Dimensions, hole positions and typical installations are shown in Annex A.

The brackets with designation PES are 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

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 connectors of 50 years.

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

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance determined
Ductility in cyclic testing	No performance determined
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The angle brackets are made from steel classified as Euroclass A1 in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	The product does not contain/release dangerous substances specified in TR 034, dated March 2012 **)
3.7 Sustainable use of natural resources (BWR7)	No Performance Determined
3.8 General aspects related to the performance of the product	The angle brackets have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
Identification	See Annex A

*) See additional information in section 3.8 – 3.9.

**) 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, 4,0 × 60 mm and 4,0 x 75 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

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

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

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

3.11 Aspects related to the performance of the product

3.11.1 Corrosion protection in service class 1 and 2.
In accordance with ETAG 015 shall the angle bracket have a zinc coating weight of Z275. The steel employed is S250 GD or S350 GD with Z275 according to EN 10346:2009.

3.11.2 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

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 12 - 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 II.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 2014-06-12 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
401M with rib	2,5	S 250 GD + Z 275 or stainless steel 1.4301	Z 275
401U without rib	2,5	S 250 GD + Z 275 or stainless steel 1.4301	Z 275
402M with rib	3,0	S 250 GD + Z 275 or stainless steel 1.4301	Z 275
402U without rib	3,0	S 250 GD + Z 275 or stainless steel 1.4301	Z 275
401M PES with rib	1,5	S 350 GD + Z 275	Z 275
402M PES with rib	2,0	S 350 GD + Z 275	Z 275

Table A.2 Range of sizes

Bracket type	Height (mm)		Width (mm)	
	min	**max**	**min**	**max**
401M with rib	90	90	60	65
401U without rib	90	90	65	65
402M with rib	105	105	90	90
402U without rib	105	105	90	90
401M PES with rib	90	90	60	65
402M PES with rib	105	105	90	90

Table A.3 Fastener specification

Nail type Joma	Nail size (mm)		Finish
According to EN 14592	Diameter	Length	
Threaded nail	4,0	40	Electroplated zinc or stainless steel
Threaded nail	4,0	60	Electroplated zinc or stainless steel
Threaded nail	4,0	75	Electroplated zinc or stainless steel

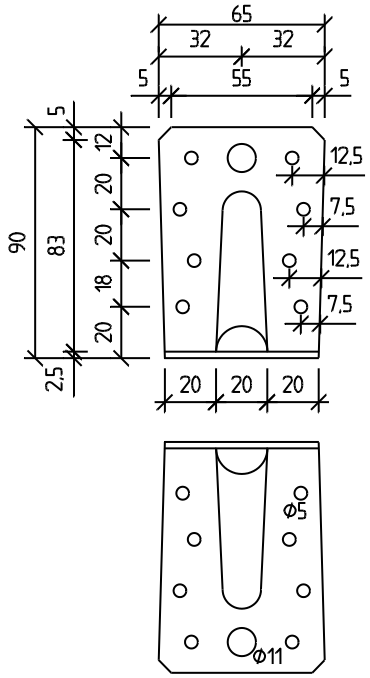


Figure A.1 Dimensions of
Angle Bracket 401M with rib

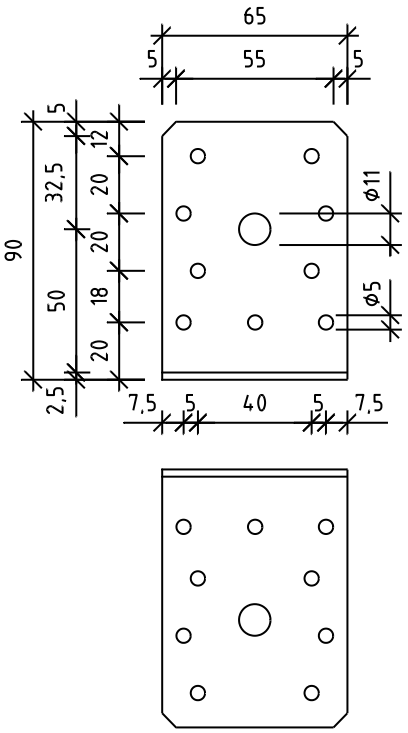


Figure A.2 Dimensions of
Angle Bracket 401U without rib

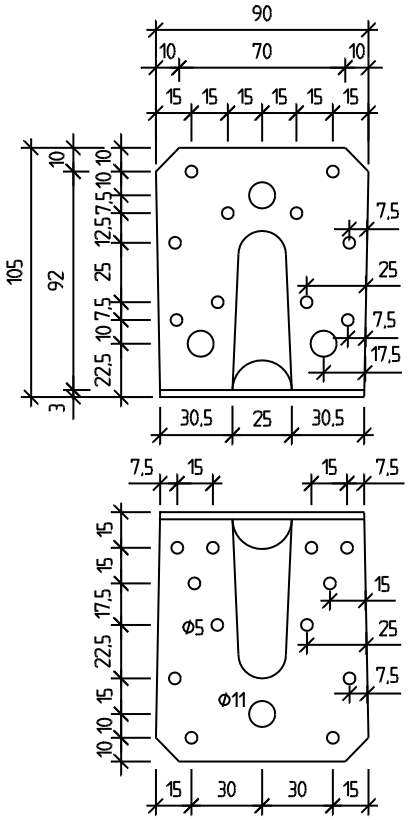


Figure A.3 Dimensions of
Angle Bracket 402M with rib

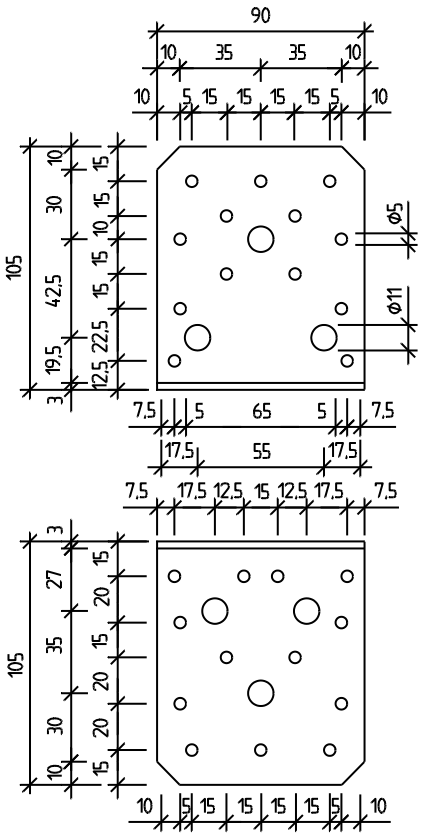


Figure A.4 Dimensions of
Angle Bracket 402U without rib

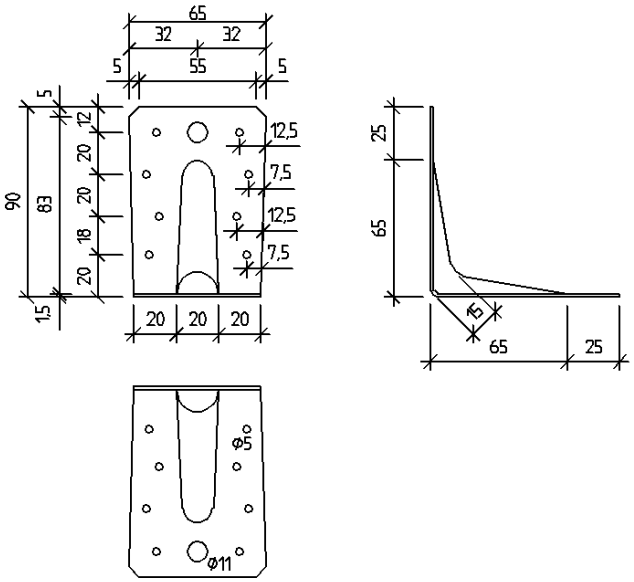


Figure A.5 Dimensions of
Angle Bracket 401M PES with rib

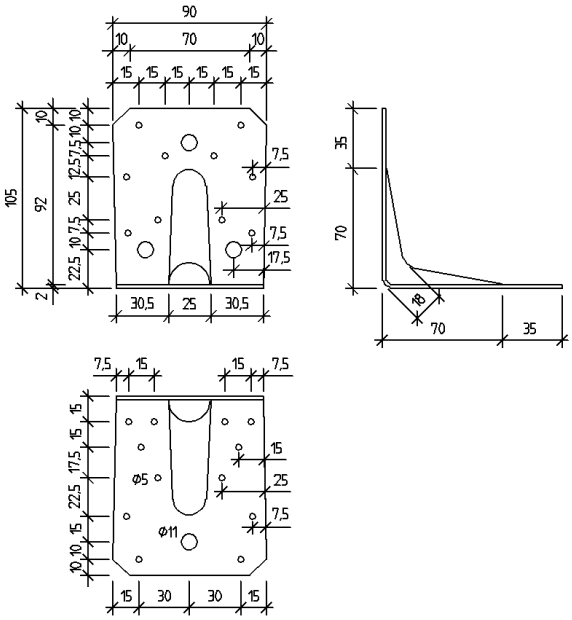


Figure A.6 Dimensions of
Angle Bracket 402 M PES with rib

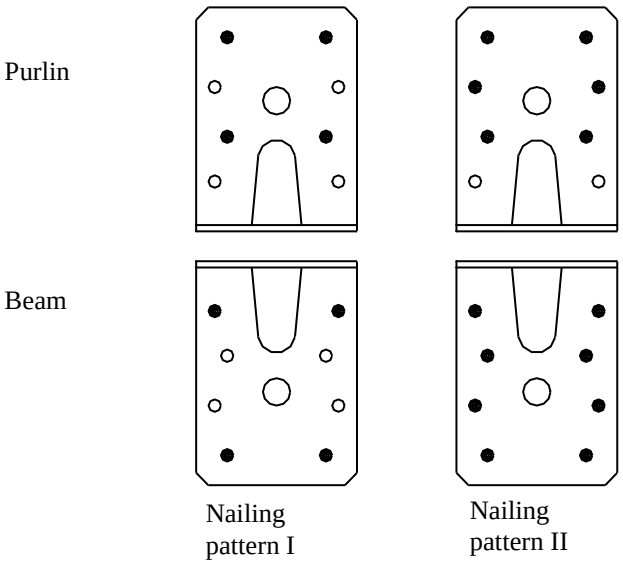


Figure A.5 Nailing patterns type 401M

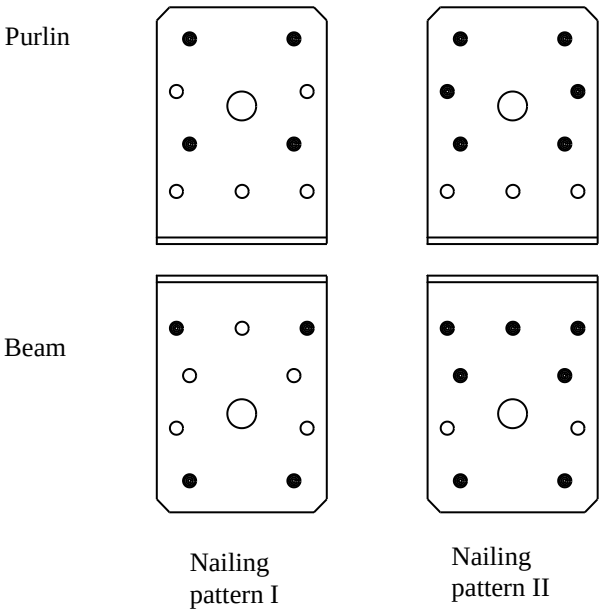


Figure A.6 Nailing patterns type 401U

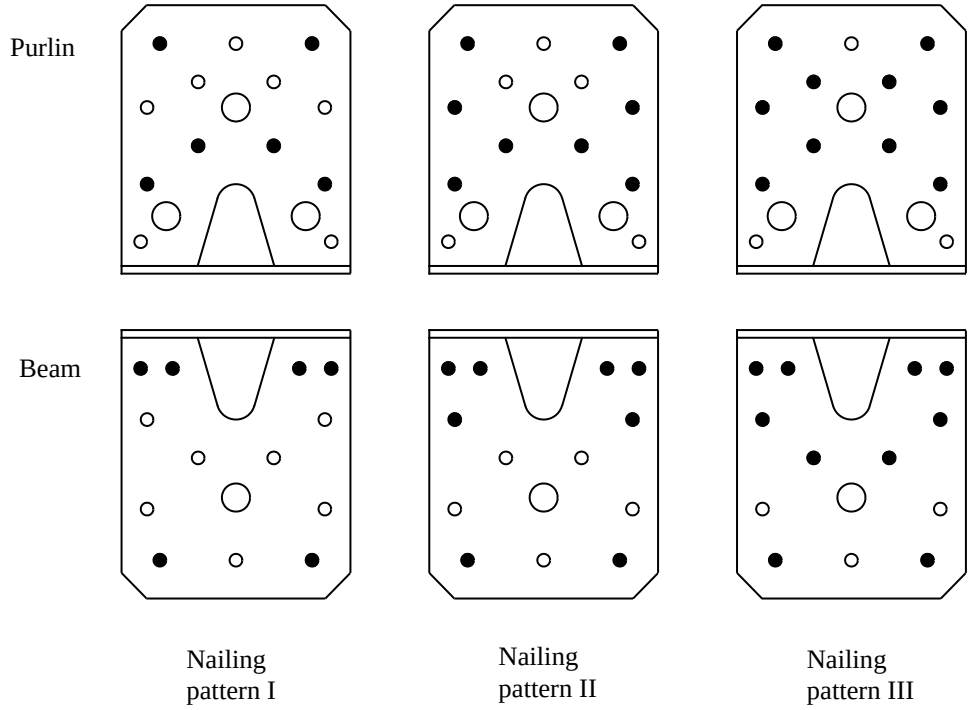


Figure A.7 Nailing patterns type 402M

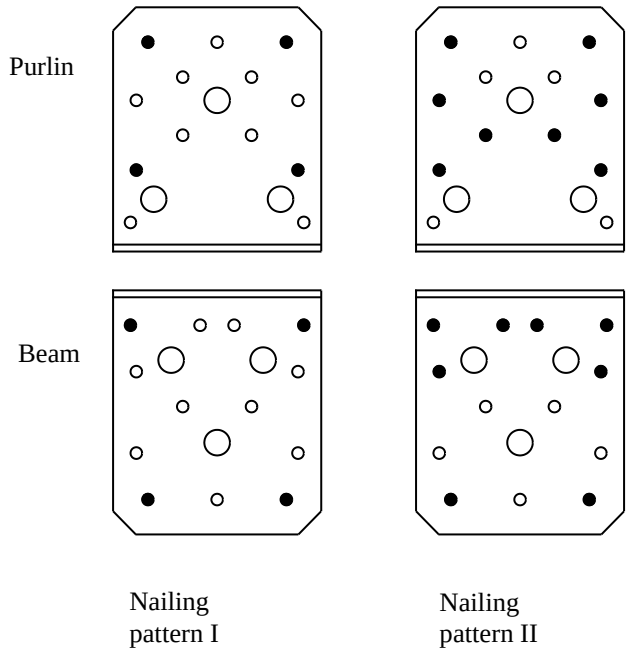


Figure A.8 Nailing patterns type 402U

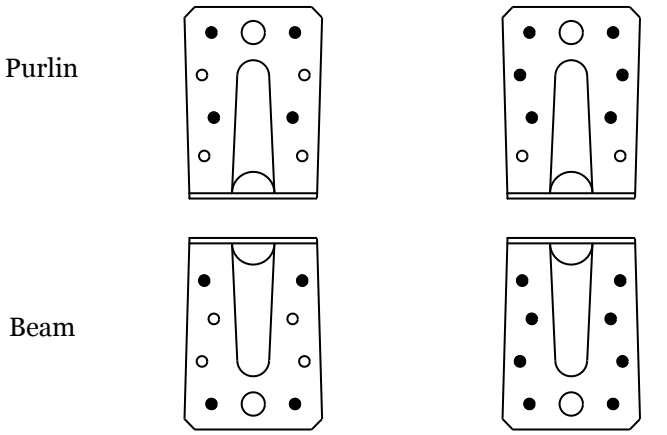


Figure A.9 Nailing patterns type 401M PES

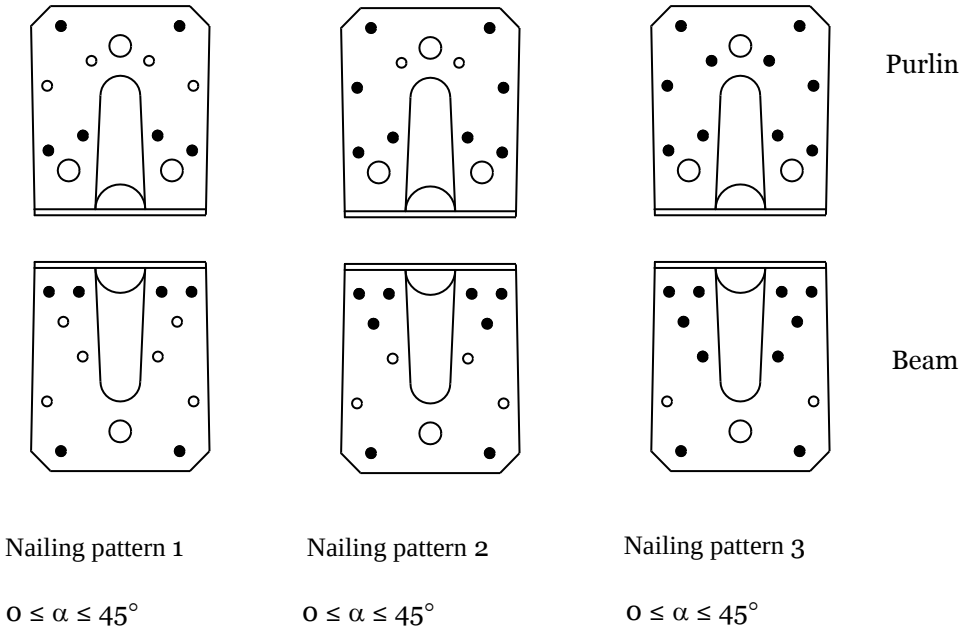
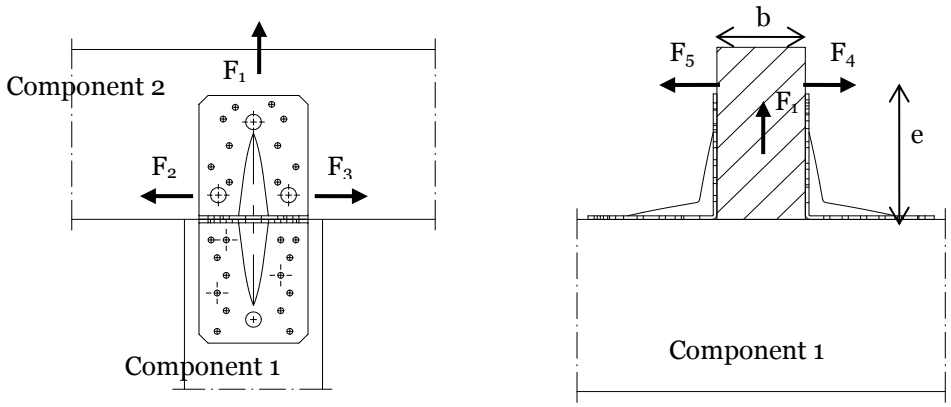


Figure A.10 Nailing patterns type 402M PES

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.

Load durations
Depending on the actual load duration the values in the following tables shall be multiplied with the factor k_{mod} according to

Load-duration class k_{mod}				
Permanent	Long-term	Medium-term	Short-term	Instantaneous
0,6	0,7	0,8	0,9	1,1

Angle Bracket 401M
Basis for design

Tables B.1 and B.2 apply to the connections with two angle brackets pr. connection and tables B.3 and B.4 apply to connections with one angle bracket pr. connection. In table B.1 and B.3 $\alpha = 0$ has been applied and for table B.2 and B.4 $\alpha = 90^{o}$ applies in accordance with the below figure:

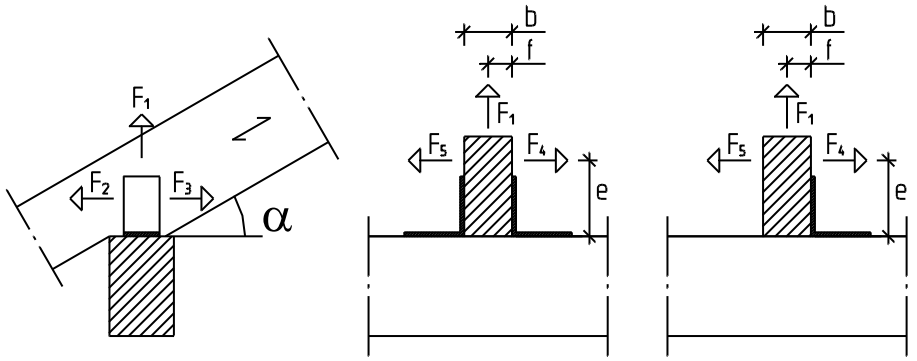


Table B.1 Characteristic capacity R_k in kN with two brackets, $\alpha = 0$. The measurements e and b are in mm.

Nails	Nailing pattern, see annex A	R_{1k}	$R_{2k} = R_{3k}$	$R_{4k} = R_{5k}$
4,0 x 40	I	2,92	6,03	The lesser of $\frac{105 + 1{,}46b}{e}$ 5,98
	II	6,32	9,03	The lesser of $\frac{139 + 3{,}16b}{e}$ 13,85
4,0 x 60	I	5,35	6,71	The lesser of $\frac{129 + 2{,}68b}{e}$ 7,49
	II	8,19	10,44	The lesser of $\frac{158 + 4{,}09b}{e}$ 15,48

Table B.2 Characteristic capacity R_k in kN with two brackets, α = 90°.

Nails	Nailing pattern, see annex A	$R_{2k}=R_{3k}$
4,0 x 40 and 4,0 x 60	I	4,64
	II	6,86

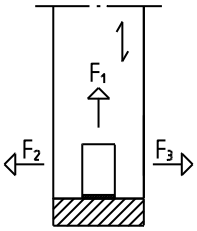


Table B.3 Characteristic capacity R_k in kN with one bracket, α = 0. The measurements e and b are in mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
4,0 x 40	I	$\frac{102}{f+90}$ for $f < 34$ $\frac{76}{f+58}$ for $f \geq 34$	1,81	5,98 for $e < 13$ $\frac{75,8}{e}$ for $13<e<79$ $\frac{20,31}{e-58}$ for $e \geq 79$	$\frac{58}{78-e}$ for $e < 36$ $\frac{50}{e}$ for $36<e<97$ $\frac{20}{e-58}$ for $e \geq 97$
	II	$\frac{105}{f+58}$ for $f < 79$ $\frac{76}{f+20}$ for $f \geq 79$	2,71	13,85 for $e < 5$ $\frac{75,8}{e}$ for $5<e<79$ $\frac{20,31}{e-58}$ for $e \geq 79$	$\frac{58}{71-e}$ for $e < 37$ $\frac{62}{e}$ for $37<e<86$ $\frac{20}{e-58}$ for $e \geq 86$
4,0 x 60	I	$\frac{122}{f+58}$ for $f < 42$ $\frac{76}{f+20}$ for $f \geq 42$	2,01	7,49 for $e < 10$ $\frac{75,8}{e}$ for $10<e<79$ $\frac{20,31}{e-58}$ for $e \geq 79$	$\frac{107}{78-e}$ for $e < 27$ $\frac{57}{e}$ for $27<e<90$ $\frac{20}{e-58}$ for $e \geq 90$
	II	$\frac{175}{f+58}$ for $f < 9$ $\frac{76}{f+20}$ for $f \geq 9$	3,13	15,48 for $e < 5$ $\frac{75,8}{e}$ for $5<e<79$ $\frac{20,31}{e-58}$ for $e \geq 79$	$\frac{107}{78-e}$ for $e < 28$ $\frac{68}{e}$ for $28<e<82$ $\frac{20}{e-58}$ for $e \geq 82$

Table B.4 Characteristic capacity R_k in kN with one bracket, $\alpha = 90^o$ and load direction $F_2 = F_3$. For other load directions the capacities in table B.3 apply independent on α.

Nail	Nailing pattern, see annex A	$R_{2k}=R_{3k}$
4,0 x 40 and 4,0 x 60	I	1,39
	II	2,06

Angle bracket 401U
Basis for design

Angle bracket 401U is always installed with two brackets pr. connection.

In table B.5 $\alpha = 0$ has been applied and for table B.6 $\alpha = 90^{\circ}$ applies in accordance with the above figure:

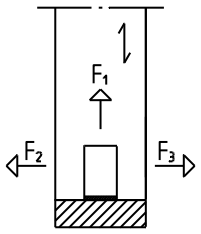
If $0 < \alpha < 90^{\circ}$, interpolation between the values is possible.

Table B.5 Characteristic capacity R_k in kN with two brackets, $\alpha = 0$. The measurements e and b are in mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
4,0 x 40	I	2,54	5,88	The lesser of $\frac{25+1{,}27b}{e}$ 3,62
	II	2,54	9,18	The lesser of $\frac{25+1{,}27b}{e}$ 7,24

Table B.6 Characteristic capacity R_k in kN with two brackets, $\alpha = 90^{\circ}$ and load direction $F_2 = F_3$. For other load directions the capacities in table B.5 apply independent on α.

Nail	Nailing pattern, see annex A	$R_{2k}=R_{3k}$
4,0 x 40	I	4,45
	II	6,92



Angle bracket 402M
Basis for design

Tables B.7 and B.8 apply to the connections with two angle brackets pr. connection and tables B.9, B.10 and B.11 apply to connections with one angle bracket pr. connection. In table B.7, B.9 and B.10 $\alpha = 0$ has been applied and for table B.8 and B.11 $\alpha = 90º$ applies in accordance with the above figure:

If $0 < \alpha < 90º$, interpolation between the values is possible.

Table B.7 Characteristic capacity R_k in kN with two brackets, $\alpha = 0$. The measurements e and b are in mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
4,0 x 40	I	5,84	11,65	The lesser of $\frac{275+2{,}92b}{e}$ 8,14
	II	8,27	14,83	The lesser of $\frac{294+4{,}13b}{e}$ 12,00
	III	10,13	16,00	The lesser of $\frac{308+5{,}07b}{e}$ 18,08
4,0 x 60	I	10,70	13,31	The lesser of $\frac{312+5{,}35b}{e}$ 10,76
	II	15,16	17,13	The lesser of $\frac{345+7{,}58b}{e}$ 14,94
	III	18,58	18,69	The lesser of $\frac{371+9{,}29b}{e}$ 18,97
4,0 x 75	I	14,35	14,38	The lesser of $\frac{339+7{,}17b}{e}$ 11,87
	II	20,33	18,61	The lesser of $\frac{384+10{,}16b}{e}$ 16,16
	III	24,91	20,75	The lesser of $\frac{418+12{,}46b}{e}$ 20,37

Table B.8 Characteristic capacity R_k in kN with two brackets, $\alpha = 90^o$ and load direction $F_2 = F_3$. For other load directions the capacities in table B.7 apply independent on α.

Nail	Nailing pattern, see annex A	$R_{2k}=R_{3k}$
4,0 x 40 4,0 x 60 4,0 x 75	I	7,38
	II	9,40
	III	10,11

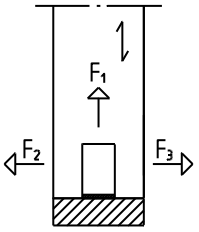


Table B.9 Characteristic capacity R_k in kN with one bracket, α = 0. The measurements e and b are in mm. Nails 4,0 x 40 mm and 4,0 x 60 mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
4,0 x 40	I	$\frac{262}{f+105}$ for $f < 48$ $\frac{203}{f+70}$ for $f \geq 48$	3,50	8,14 for $e < 25$ $\frac{203}{e}$ for $25<e<88$ $\frac{42,2}{e-70}$ for $e \geq 88$	$\frac{145}{89-e}$ for $e < 50$ $\frac{182}{e}$ for $50<e<91$ $\frac{42}{e-70}$ for $e \geq 91$
	II	$\frac{354}{f+105}$ for $f < 28$ $\frac{261}{f+70}$ for $f \geq 28$	4,45	12,00 for $e < 19$ $\frac{232}{e}$ for $19<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{136}{81-e}$ for $e < 49$ $\frac{210}{e}$ for $49<e<88$ $\frac{42}{e-70}$ for $e \geq 88$
	III	$\frac{261}{f+70}$	4,80	16,08 for $e < 145$ $\frac{232}{e}$ for $14<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{133}{80-e}$ for $e < 52$ $\frac{251}{e}$ for $52<e<84$ $\frac{42}{e-70}$ for $e \geq 84$
4,0 x 60	I	$\frac{336}{f+70}$ for $f < 107$ $\frac{232}{f+15}$ for $f \geq 107$	3,99	10,76 for $e < 22$ $\frac{232}{e}$ for $22<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{267}{89-e}$ for $e < 37$ $\frac{190}{e}$ for $37<e<90$ $\frac{42}{e-70}$ for $e \geq 90$
	II	$\frac{443}{f+70}$ for $f < 45$ $\frac{232}{f+15}$ for $f \geq 45$	5,14	14,94 for $e < 16$ $\frac{232}{e}$ for $16<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{250}{81-e}$ for $e < 39$ $\frac{224}{e}$ for $39<e<86$ $\frac{42}{e-70}$ for $e \geq 86$
	III	$\frac{443}{f+70}$ for $f < 45$ $\frac{232}{f+15}$ for $f \geq 45$	5,61	18,97 for $e < 12$ $\frac{232}{e}$ for $12<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{244}{80-e}$ for $e < 42$ $\frac{274}{e}$ for $42<e<83$ $\frac{42}{e-70}$ for $e \geq 83$

Table B.10 Characteristic capacity R_k in kN with one bracket, α = 0. The measurements e and b are in mm. Nails 4,0 x 75 mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
4,0x75	I	$\frac{437}{f+70}$ for $f < 47$ $\frac{232}{f+15}$ for $f \geq 47$	4,31	11,87 for $e < 20$ $\frac{232}{e}$ for $20<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{358}{89-e}$ for $e < 31$ $\frac{187}{e}$ for $31<e<90$ $\frac{42}{e-70}$ for $e \geq 90$
	II	$\frac{580}{f+70}$ for $f < 21$ $\frac{232}{f+15}$ for $f \geq 21$	5,58	16,16 for $e < 14$ $\frac{232}{e}$ for $14<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{335}{81-e}$ for $e < 32$ $\frac{217}{e}$ for $32<e<87$ $\frac{42}{e-70}$ for $e \geq 87$
	III	$\frac{580}{f+70}$ for $f < 21$ $\frac{232}{f+15}$ for $f \geq 21$	6,22	20,37 for $e < 11$ $\frac{232}{e}$ for $11<e<86$ $\frac{42,2}{e-70}$ for $e \geq 86$	$\frac{327}{80-e}$ for $e < 35$ $\frac{258}{e}$ for $35<e<84$ $\frac{42}{e-70}$ for $e \geq 84$

Table B.11 Characteristic capacity R_k in kN with one bracket, α = 90° and load direction $F_2 = F_3$. For other load directions the capacities in table B.9 and B.10 apply independent on α.

Nail	Nailing pattern, see annex A	$R_{2k}=R_{3k}$
4,0 x 40 4,0 x 60 4,0 x 75	I	2,21
	II	2,82
	III	3,03

Angle bracket 402U
Basis for design

Angle bracket 402U is always installed with two brackets pr. connection.

In table B.12 $\alpha = 0$ has been applied and for table B.13 $\alpha = 90^{\circ}$ applies in accordance with the above figure:

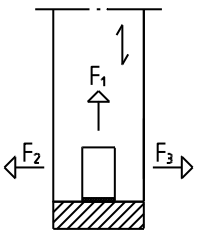
If $0 < \alpha < 90^{\circ}$, interpolation between the values is possible.

Table B.12 Characteristic capacity R_k in kN with two brackets, $\alpha = 0$. The measurements e and b are in mm.

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
4,0 x 40	I	2,92	7,08	The lesser of $\frac{51+1{,}46b}{e}$ 3,62
	II	5,84	13,66	The lesser of $\frac{51+2{,}92b}{e}$ 7,24
4,0 x 60	I	5,35	7,88	The lesser of $\frac{51+2{,}68b}{e}$ 3,93
	II	6,75	16,04	The lesser of $\frac{51+3{,}38b}{e}$ 7,85

Table B.13 Characteristic capacity R_k in kN with two brackets, $\alpha = 90^{\circ}$ and load direction $F_2 = F_3$. For other load directions the capacities in table B.12 apply independent on α.

Nail	Nailing patter, see annex A	$R_{2k}=R_{3k}$
4,0 x 40 4,0 x 60	I	4,91
	II	9,20



Angle Bracket 401M PES

Basis for design

Tables B.14 and B.15 apply to the connections with two angle brackets pr. connection and tables B.3 and B.4 apply to connections with one angle bracket pr. connection:

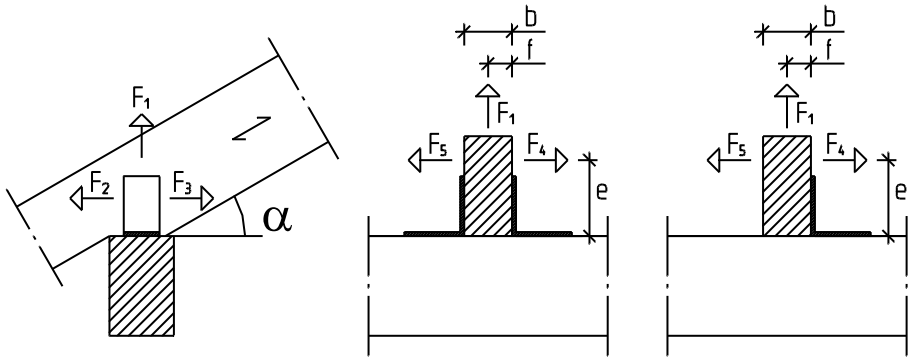


Table B.13 Characteristic capacity R_k in kN with two brackets, $0 \le \alpha \le 45°$. The measurements e and b are in mm. (k_{mod} = 0,8)

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
4,0x40	1	2,33	3,49	The smaller of $\frac{1{,}17\,(b+67)}{e}$ 3,89
	2	5,14	5,16	The smaller of $\frac{2{,}57\,(b+46)}{e}$ 7,68
4,0x60	1	4,28	3,98	The smaller of $\frac{2{,}14\,(b+51)}{e}$ 4,30
	2	7,31	6,14	The smaller of $\frac{3{,}65\,(b+38)}{e}$ 8,95

Table B.14 Characteristic capacity R_k in kN with one bracket, $0 \le \alpha \le 45°$. The measurements e and b are in mm. (k_{mod} = 0,8)

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
4,0x40	1	0,71 for $f \le 25$	1,05	3,51 for $e \le 16$ $\frac{54,6}{e}$ for $16<e\le71$	$\frac{46,7}{78-e}$ for $e \le 36$ $\frac{39,5}{e}$ for $36<e<78$ $\frac{10,2}{e-58}$ for $e \ge 78$
	2	0,94 for $f \le 25$	1,55	7,68 for $e \le 9$ $\frac{66,0}{e}$ for $9<e\le69$	$\frac{46,7}{71,3-e}$ for $e \le 43$ $\frac{69,5}{e}$ for $43<e\le68$ $\frac{10,2}{e-58}$ for $e \ge 68$
4,0x60	1	1,10 for $f \le 25$	1,19	4,30 for $e \le 15$ $\frac{66,0}{e}$ for $15<e\le69$	$\frac{85,6}{78-e}$ for $e \le 25$ $\frac{39,5}{e}$ for $25<e\le78$ $\frac{10,2}{e-58}$ for $e \ge 78$
	2	1,62 for $f \le 25$	1,84	8,95 for $e \le 7$ $\frac{66,0}{e}$ for $7<e\le69$	$\frac{85,6}{71,3-e}$ for $e \le 32$ $\frac{69,5}{e}$ for $32<e\le68$ $\frac{10,2}{e-58}$ for $e \ge 68$

Table B. 15 Correction factor at different load duration classes

Load direction	Load duration class k_{mod}				
	P	L	M	S	I
F_1 two brackets	0,75	0,88	1,0	1,03	1,10
$F_2 = F_3$	0,75	0,88	1,0	1,12	1,38
F_4 F_5 $F_4 = F_5$	0,75	0,88	1,0	1,0	1,0
F_1 one bracket	0,75	0,88	1,0	1,12	1,34

Angle Bracket 402M PES

Basis for design

Tables B.14 and B.15 apply to the connections with two angle brackets pr. connection and tables B.3 and B.4 apply to connections with one angle bracket pr. connection:

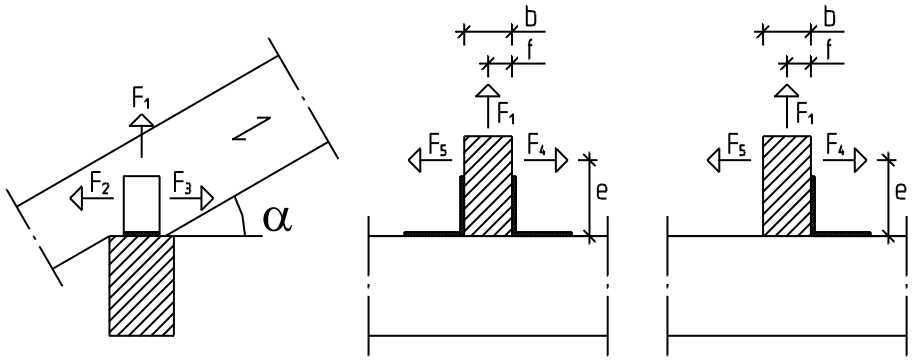


Table B.16 Characteristic capacity R_k in kN with two brackets, $0 \leq \alpha \leq 45°$. The measurements e and b are in mm. (k_{mod} = 0,8)

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	$R_{4k}=R_{5k}$
4,0x40	1	4,68	8,99	The smaller of $\frac{2,33(85+b)}{e}$ 8,35
	2	6,62	11,45	The smaller of $\frac{3,31(80+b)}{e}$ 11,13
	3	8,11	12,36	The smaller of $\frac{4,05(75+b)}{e}$ 13,91
4,0x60	1	8,56	10,29	The smaller of $\frac{4,28(72+b)}{e}$ 9,08
	2	12,13	13,26	The smaller of $\frac{6,06(55+b)}{e}$ 12,10
	3	14,86	14,48	The smaller of $\frac{7,43(47+b)}{e}$ 15,13

Table B.17 Characteristic capacity R_k in kN with one bracket, $0 \le \alpha \le 45°$. The measurements e and b are in mm. (k_{mod} = 0,8)

Nail	Nailing pattern, see annex A	R_{1k}	$R_{2k}=R_{3k}$	R_{4k}	R_{5k}
4,0x40	1	1,62 for $f \le 25$	2,70	$6{,}39$ for $e \le 24$ $\frac{155}{e}$ for $24<e<84$ $\frac{26}{e-70}$ $e \ge 84$	$\frac{116{,}5}{89{,}1-e}$ for $e \le 41$ $\frac{98}{e}$ for $41<e<95$ $\frac{26}{e-70}$ $e \ge 95$
	2	2,12 for $f \le 25$	3,43	$8{,}56$ for $e \le 24$ $\frac{201}{e}$ for $24<e<80$ $\frac{26}{e-70}$ $e \ge 80$	$\frac{109}{81{,}5-e}$ for $e \le 40$ $\frac{107}{e}$ for $40<e<93$ $\frac{26}{e-70}$ $e \ge 93$
	3	2,12 for $f \le 25$	3,71	$11{,}75$ for $e \le 17$ $\frac{201}{e}$ for $17<e<80$ $\frac{26}{e-70}$ $e \ge 80$	$\frac{106{,}6}{80{,}2-e}$ for $e \le 44$ $\frac{130}{e}$ for $44<e<88$ $\frac{26}{e-70}$ $e \ge 88$
4,0x60	1	2,75 for $f \le 25$	3,09	$7{,}50$ for $e \le 32$ $\frac{243}{e}$ for $32<e<78$ $\frac{26}{e-70}$ $e \ge 78$	$\frac{213{,}6}{89{,}1-e}$ for $e \le 28$ $\frac{98}{e}$ for $28 <e< 95$ $\frac{26}{e-70}$ $e \ge 95$
	2	3,65 for $f \le 25$	3,98	$10{,}87$ for $e \le 22$ $\frac{243}{e}$ for $22<e<78$ $\frac{26}{e-70}$ $e \ge 78$	$\frac{200}{81{,}5-e}$ for $e \le 28$ $\frac{107}{e}$ for $28 <e< 93$ $\frac{26}{e-70}$ $e \ge 93$
	3	3,65 for $f \le 25$	4,34	$13{,}99$ for $e \le 17$ $\frac{243}{e}$ for $17<e<78$ $\frac{26}{e-70}$ $e \ge 78$	$\frac{195{,}3}{80{,}2-e}$ for $e \le 33$ $\frac{130}{e}$ for $33<e<88$ $\frac{26}{e-70}$ $e \ge 88$

Table B. 18 Correction factor at different load duration classes

Load direction	Lod duration class k_{mod}				
	P	L	M	S	I
F_1	0,75	0,88	1,0	1,12	1,30
$F_2 = F_3$	0,75	0,88	1,0	1,12	1,37
$F_4 = F_5$	0,75	0,88	1,0	1,0	1,0
F_4 and F_5	0,75	0,88	1,0	1,0	1,0