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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-11/0457 of 2024/02/07

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:	Adveco angle brackets
Product family to which the above construction product belongs:	Three-dimensional nailing plate (Angle brackets for timber-to-timber, timber-to-steel or timber-to-concrete connections)
Manufacturer:	ADVECO SRL Via M. Guglielmo 61 I-25050 Cogozzo V.T. (BS) Tel. +39 030 800 916 Fax +39 030 802 172 Internet www.adveco.com
Manufacturing plant:	ADVECO SRL Via M. Guglielmo 61 I-25050 Cogozzo V.T. (BS)
This European Technical Assessment contains:	31 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:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	The ETA with the same number issued on 2016-12-15

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Adveco angle brackets or hold-downs, respectively, are one-piece non-welded, face-fixed angle brackets to be used in timber to timber or in timber to concrete or to steel connections. They are connected to construction members made of timber or wood-based products with profiled (ringed shank) nails according to EN 14592 and to concrete or steel members with bolts or metal anchors.

The angle brackets are made from pre-galvanized steel DX 51 D / Z 275 according to EN 10346:2009 with $R_e \geq 270$ N/mm², $R_m \leq 500$ N/mm² and $A_{80} \geq 22\%$ and DD 11+Z according to EN 10111:2008 with $R_e \geq 270$ N/mm², $R_m \leq 440$ N/mm² and $A_{80} \geq 24\%$ are available with or without an embossed rib. Dimensions, hole positions and typical installations are shown in Annex B. Adveco angle brackets are made from steel with tolerances according to EN 10143.

2 Specification of the intended use in accordance with the applicable European Assessment document (hereinafter EAD)

The angle brackets are intended for use in making connections in load bearing timber structures, as a connection between a beam and a purlin, 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 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 from 290 kg/m^3 to 420 kg/m^3. This requirement to the material of the wood members can be fulfilled by using the following materials:

- Structural solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glulam classified to GL24-GL36 according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Layered wood plates,
- Plywood according to EN 636

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 ist he 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 or wet conditions defined by service class 3 of Eurocode 5 and for connections subject to static or quasi-static loading.

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

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 angle brackets can be used for connections between a timber member and a member of concrete or steel.

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 (BWR 1)*)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR 2)	
Reaction to fire	The angle brackets are made from steel classified as **Euroclass A1** in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed
3.3 General aspects related to the performance of the product	The connectors 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 classes 1 and 2

*) See additional information in section 3.4 – 3.7.

3.4 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the connectors and the steel plates.

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.

Therefore, to obtain design values according to the Eurocodes or appropriate national codes of practice, the capacities have to be multiplied with different partial factors for the material properties and – for the connectors mounted in wood – also the coefficient k_{mod} that takes into account the load duration class.

Thus, the characteristic values of the load–carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of connectors subjected to shear or the withdrawal capacity of the most loaded connector, 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.

3.5 Mechanical resistance and stability

See annex B for the 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 EAD 130186-00-0603 clause 2.2.1. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in the table on page 11 in Annex A:

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

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

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

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

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

Where:

$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2
d Nail diameter in mm
t_{pen} Penetration depth of the profiles shank in mm $t_{pen} \geq 31$ mm

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

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

Where:

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

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

4,0 mm threaded nails with a truncated cone below the head are used as fasteners, which are particularly suitable for nailed steel-to-timber connections. The specific shape below the head causes a clamping of nails in the steel plate.

Additionally, the angle brackets can be fastened to the concrete structure or steel member by bolts with a diameter of 12 mm or 14 mm in holes with a diameter up to 2 mm larger than the bolt.

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

3.6 Aspects related to the performance of the product

3.6.1 Corrosion protection in service class 1 and 2.
In accordance with EAD 130186-00-0603 the angle bracket has a zinc coating weight of min Z275. The steel used is DX51D + Z according to EN 10346:2009 or DD11 + Z according to EN 10111:2008 with min Z275. As regards the electrolytic galvanizing, the minimum thickness shall be 12 μm and for the hot-dip galvanizing it shall be 20 μm.

3.7 General aspects related to the use of the product

Adveco 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:

There shall be nails or screws in all holes or at least in holes as specified on technical drawings in accordance with this document.

All minimum spacing's and edge/end distances in accordance with Eurocode 5 or an appropriate national code shall be complied with.

The angle bracket connection shall be designed in accordance with Eurocode 5 or an appropriate national code.

The cross section of the connected wooden elements shall have a plane surface against the whole angle bracket.

Nails or screws to be used shall have a diameter which fits the holes of the angle brackets.

The structural members – the components 1 and 2 - 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

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

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 provided for in the applicable EAD

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

Issued in Copenhagen on 2024-02-07 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details definitions

Table A.1 Materials specification

Bracket type		Thickness (mm)	Steel specification	Coating specification
AN3	40 x 40 x 30 x 2,0	2,0	DX 51 D / DD 11	Z 275
AN4	40 x 40 x 40 x 2,0	2,0	DX 51 D / DD 11	Z 275
AN6	50 x 50 x 40 x 2,0	2,0	DX 51 D / DD 11	Z 275
SQ4N	50 x 90 x 50 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ5N	50 x 90 x 80 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ6N	50 x 90 x 110 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ7N	174 x 114 x 95 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ15550	50 x 155 x 40 x 3,0	3,0	DX 51 D / DD 11	Z 275
AN5	60 x 80 x 40 x 2,0	2,0	DX 51 D / DD 11	Z 275
AN1	60 x 90 x 60 x 2,5	2,5	DX 51 D / DD 11	Z 275
AN2	60 x 100 x 100 x 2,5	2,5	DX 51 D / DD 11	Z 275
SQ3	70 x 70 x 55 x 2,0	2,0	DX 51 D / DD 11	Z 275
SQ3N	70 x 70 x 55 x 2,0 with rib	2,0	DX 51 D / DD 11	Z 275
SQ2	90 x 90 x 65 x 2,5	2,5	DX 51 D / DD 11	Z 275
SQ2N	90 x 90 x 65 x 2,5 with rib	2,5	DX 51 D / DD 11	Z 275
AL100	90 x 100 x 260 x 3,0 with rib	3,0	DX 51 D / DD 11	Z 275
SQ1-4	100 x 100 x 90 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ1N-4	100 x 100 x 90 x 3,0 with rib	3,0	DX 51 D / DD 11	Z 275
SQ1N-4 3-fori	100 x 100 x 90 x 3,0 with rib	3,0	DX 51 D / DD 11	Z 275
SQ1-6	100 x 100 x 90 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ1N-6	100 x 100 x 90 x 3,0 with rib	3,0	DX 51 D / DD 11	Z 275
SQA3	70 x 70 x 55 x 2,0	2,0	DX 51 D / DD 11	Z 275
SQA2	90 x 90 x 65 x 2,5	2,5	DX 51 D / DD 11	Z 275
SQA1	100 x 100 x 90 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQNL95	65 x 95 x 85 x 3,5	3,5	DX 51 D / DD 11	Z 275
SQNL135	65 x 135 x 85 x 3,5	3,5	DX 51 D / DD 11	Z 275
SQNL285	65 x 285 x 85 x 3,5	3,5	DX 51 D / DD 11	Z 275
SQ200	60 x 200 x 60 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ300	60 x 300 x 60 x 3,0	3,0	DX 51 D / DD 11	Z 275
SQ400	60 x 400 x 60 x 3,0	3,0	DX 51 D / DD 11	Z 275

Table A.2 Range of sizes

Bracket type		**Height (mm) vertical**		**Height (mm) horizontal**		**Width (mm)**	
AN3	40 x 40 x 30 x 2,0	39	41	39	41	29	31
AN4	40 x 40 x 40 x 2,0	39	41	39	41	39	41
AN6	50 x 50 x 40 x 2,0	49	51	49	51	39	41
SQ4N	50 x 90 x 50 x 3,0	49	51	89	91	49	51
SQ5N	50 x 90 x 80 x 3,0	49	51	89	91	79	81
SQ6N	50 x 90 x 110 x 3,0	49	51	89	91	109	111
SQ7N	174 x 114 x 95 x 3,0	173	175	113	115	94	96
SQ15550	50 x 155 x 40 x 3,0	49	51	154	156	39	41
AN5	60 x 80 x 40 x 2,0	59	61	79	81	39	41
AN1	60 x 90 x 60 x 2,5	59	61	89	91	59	61
AN2	60 x 100 x 100 x 2,5	59	61	99	101	99	101
SQ3	70 x 70 x 55 x 2,0	69	71	69	71	54	56
SQ3N	70 x 70 x 55 x 2,0 with rib	69	71	69	71	53	56
SQ2	90 x 90 x 65 x 2,5	89	91	89	91	64	66
SQ2N	90 x 90 x 65 x 2,5 with rib	89	91	89	91	58	66
AL100	90 x 100 x 260 x 3,0 with rib	89	91	99	101	258	261
SQ1-4	100 x 100 x 90 x 3,0	99	101	99	101	89	91
SQ1N-4	100 x 100 x 90 x 3,0 with rib	99	101	99	101	85	91
SQ1N-4-3-fori	100 x 100 x 90 x 3,0 with rib	99	101	99	101	85	91
SQ1-6	100 x 100 x 90 x 3,0	99	101	99	101	89	91
SQ1N-6	100 x 100 x 90 x 3,0 with rib	99	101	99	101	85	91
SQ3A	70 x 70 x 55 x 2,0	69	71	69	71	54	56
SQ2A	90 x 90 x 65 x 2,5	89	91	89	91	64	66
SQ1A	100 x 100 x 90 x 3,0	99	101	99	101	89	91
SQNL95	65 x 95 x 85 x 3,5	47	66	94	96	84	86
SQNL135	65 x 135 x 85 x 3,5	47	66	134	136	84	86
SQNL285	65 x 285 x 85 x 3,5	47	66	284	286	84	86
RPQ60	60x60x10	59	61	59	61	9	11
SQ200	60 x 200 x 60 x 3,0	59	61	199	201	59	61
SQ300	60 x 300 x 60 x 3,0	59	61	299	301	59	61
SQ400	60 x 400 x 60 x 3,0	59	61	399	401	59	61

Table A.3 Fastener specification

Nail type	**Nail size (mm)**		**Finish**
According to EN 14592	Diameter	Length	
Threaded nail	4,0 6,0	50 60	Electroplated zinc

In the load-carrying-capacities of the nailed connection in Annex B the capacities for threaded nails d=4,0 mm calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral nail load-carrying-capacity.
The load-carrying-capacities of the angle brackets have been determined based on the use of connector nails 4,0 x 50 mm and 6,0 x 60 mm in accordance with the German national approval for the nails. (Tragfähigkeitsklasse 3)
The characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1:2010, paragraph 8.3.2 (head pull-through is not relevant):

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

Where:

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

d Nail diameter in mm

t_{pen} Penetration depth of the profiled shank including the nail point in mm,
(4,0 x 50 mm $t_{pen} \geq 40$ mm; 6,0 x 60 mm $t_{pen} \geq 50$ mm)

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

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

Where:

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

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

BOLTS diameter	**Correspondent Hole diameter**	**Bolt type**
12.0 - 16.0 mm	Max. 2 mm. larger than the bolt diameter	Bolt according to EN 14592

METAL ANCHORS diameter	**Correspondent Hole diameter**	**Anchor type**
12.0 - 16.0 mm	Max. 2 mm. larger than the anchor diameter	See specification of the manufacturer

Annex B
Characteristic load-carrying capacities

Table B.1: Force F_1 Column, 2 angle brackets / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel
SQ4N	50 x 90 x 50 x 3,0	1,2	9,10,12,13	2,53	3,04
SQ5N	50 x 90 x 80 x 3,0	1,2,3	14,15,16,19,20,21	3,79	4,94
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4	17,18,19,20,24,25,26,27	5,05	6,83
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12, 13,14,15,16,17,18,19, 20,22,23,24,25,26, 27,28	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	3,42	7,38
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7	13,14,15,16	2,87	3,04
AN5	60 x 80 x 40 x 2,0	1,2	7,8,9,10,11	3,06	1,35
AN1	60 x 90 x 60 x 2,5	1,2,3	13,14,15,16,17, 18,19,20,21	4,65	3,30
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10	24,25,26,27,28,29,30, 31,32,33,34,35,36	4,28	4,78
SQ3	70 x 70 x 55 x 2,0	1,2,3	11,12,15,16,18,19,20	2,83	1,35
SQ3N	70 x 70 x 55 x 2,0 with rib	1,2,3	11,12,15,16,18,19,20	2,83	1,93
SQ2	90 x 90 x 65 x 2,5	1,3	8,9,10,11,12,14	2,72	1,78
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3	8,9,10,11,12,14	2,72	2,49
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	4,72	27,1
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	3,40	7,78
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	4,65	26,8
SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	4,65	25,8
SQA3	70 x 70 x 55 x 2,0	1,2,3	11,12,15,16,18,19,20	2,83	1,35
SQA2	90 x 90 x 65 x 2,5	1,3	8,9,10,11,12,14	2,72	1,78
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	3,40	7,78

Table B.2: Force F_1 Column, 2 angle brackets with bolt hole / connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			$k_{t,II}$	$F_{1,Rk}$ [kN] (column)		$k_{t,II}$	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel		Timber	Steel
SQNL95	3,4,5	3	0,94	11,2	8,75	0,68	11,2	20,2
SQNL135	1,2,3,4,5,9,10,11	8	0,94	30,0	8,75	0,68	30,0	20,2
SQNL285	1,2,4,5,6,7,8,9,10,11, 12,13,15,16,17,18,19	17	0,94	63,7	8,75	0,68	63,7	20,2

Table B.3: Force F_1 Column, 1 angle bracket / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel
SQ4N	50 x 90 x 50 x 3,0	1,2	9,10,12,13	1,26	1,52
SQ5N	50 x 90 x 80 x 3,0	1,2,3	14,15,16,19,20,21	1,89	2,47
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4	17,18,19,20,24,25,26,27	2,53	3,42
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12, 13,14,15,16,17,18,19, 20,22,23,24,25,26, 27,28	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	1,71	3,69
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7	13,14,15,16	1,44	1,52
AN5	60 x 80 x 40 x 2,0	1,2	7,8,9,10,11	1,53	0,68
AN1	60 x 90 x 60 x 2,5	1,2,3	13,14,15,16,17, 18,19,20,21	2,33	1,65
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10	24,25,26,27,28,29,30,31,32, 33,34,35,36	2,14	2,39
SQ3	70 x 70 x 55 x 2,0	1,2,3	11,12,15,16,18,19,20	1,42	0,68
SQ3N	70 x 70 x 55 x 2,0 with rib	1,2,3	11,12,15,16,18,19,20	1,42	0,96
SQ2	90 x 90 x 65 x 2,5	1,3	8,9,10,11,12,14	1,36	0,89
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3	8,9,10,11,12,14	1,36	1,25
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	2,36	13,5
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	1,70	3,89
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	2,33	13,4
SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	2,33	12,9
SQA3	70 x 70 x 55 x 2,0	1,2,3	11,12,15,16,18,19,20	1,42	0,68
SQA2	90 x 90 x 65 x 2,5	1,3	8,9,10,11,12,14	1,36	0,89
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	1,70	3,89

Table B.4: Force F_1 Column, 1 angle bracket with bolt hole / connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			k_t II	$F_{1,Rk}$ [kN] (column)		k_t II	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel		Timber	Steel
SQNL95	3,4,5	3	2,03	5,62	5,56	1,44	5,62	10,1
SQNL135	1,2,3,4,5,9,10,11	8	2,03	15,0	5,56	1,44	15,0	10,1
SQNL285	1,2,4,5,6,7,8,9,10,11, 12,13,15,16,17,18,19	17	2,03	31,8	5,56	1,44	31,8	10,1

Table B.5: Force F_1 Column, 1 hold-down / connection

Bracket number	$t_{Base\ plate}$ [mm]	capacity per nail ($R_{v,Rk}$) [kN]	concrete	steel			bolt
				Bending ($R_{m,Rk}$) [kN]	Shearing ($R_{c,Rk}$) [kN]	Tension ($R_{t,Rk}$) [kN]	k_t
SQ200	10	1,87	25,7	19,0	28,1	31,3	2,63
SQ300	10	1,87	25,7	19,0	28,1	31,3	2,63
SQ400	10	1,87	25,7	19,0	28,1	31,3	2,63

Table B.6: Force F_1 Purlin, 2 angle brackets / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
AN3	40 x 40 x 30 x 2,0	1,2	4,5,6	1,29	1,13
AN4	40 x 40 x 40 x 2,0	1,2	4,5,6	1,29	1,58
AN6	50 x 50 x 40 x 2,0	1,2	4,5,6	1,00	0,86
SQ4N	50 x 90 x 50 x 3,0	1,2,4,5	9,10,12,13	2,53	3,04
SQ5N	50 x 90 x 80 x 3,0	1,2,3,6,7,8,10	14,15,16,19,20,21	3,79	4,94
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4,7,8,9,10,12	17,18,19,20,24,25,26,27	5,05	6,83
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12,13, 14,15,16,17,18,19,20, 22,23,24,25,26,27,28, 29,32,33,34,35,36	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	3,42	7,38
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7,8,9	13,14,15,16	2,87	3,04
AN5	60 x 80 x 40 x 2,0	1,2,3,4,5	7,8,9,10,11	3,06	1,35
AN1	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	4,65	3,30
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10, 11,12,13,14,15,16, 17,18	24,25,26,27,28,29,30,31,32, 33,34,35,36	4,28	4,78
SQ3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	2,83	1,35
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	2,83	1,93

SQ2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	2,72	1,78
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	2,72	2,49
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	4,72	27,1
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	3,40	7,78
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	4,65	26,81
SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	4,65	25,8
SQ1-6	100 x 100 x 90 x 3,0	1,2,4,5	8,9,10,11,13,14	5,30	3,5
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5	8,9,10,11,13,14	5,30	8,42
SQA3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	2,83	1,35
SQA2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	2,72	1,78
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13, 14,15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	3,40	7,78

Table B.7: Force F_1 Purlin, 2 angle brackets with bolt hole / connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			k_t II	$F_{1,Rk}$ [kN] (purlin)		k_t II	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel		Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	1,02	30,0	11,1	0,72	30,0	20,2
SQNL135	1,2,3,4,5,7,8,9,10, 11,13,14,16	13	1,02	48,7	11,1	0,72	48,7	20,2
SQNL285	1,2,4,5,6,7,8,9,10,11, 12,13,15,16,17,18,19	17	1,02	63,7	11,1	0,72	63,7	20,2

Table B.8: Force F_1 Purlin, 1 angle bracket / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
AN3	40 x 40 x 30 x 2,0	1,2	4,5,6	0,64	0,56
AN4	40 x 40 x 40 x 2,0	1,2	4,5,6	0,64	0,79
AN6	50 x 50 x 40 x 2,0	1,2	4,5,6	0,50	0,43
SQ4N	50 x 90 x 50 x 3,0	1,2,4,5	9,10,12,13	1,26	1,52
SQ5N	50 x 90 x 80 x 3,0	1,2,3,6,7,8,10	14,15,16,19,20,21	1,89	2,47
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4,7,8,9,10,12	17,18,19,20,24,25,26,27	2,53	3,42
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12,13, 14,15,16,17,18,19,20, 22,23,24,25,26,27,28, 29,32,33,34,35,36	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	1,71	3,69
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7,8,9	13,14,15,16	1,44	1,52
AN5	60 x 80 x 40 x 2,0	1,2,3,4,5	7,8,9,10,11	1,53	0,68
AN1	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	2,33	1,65
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9, 10,11,12,13,14, 15,16,17,18	24,25,26,27,28,29,30,31,32, 33,34,35,36	2,14	2,39
SQ3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	1,42	0,68
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	1,42	0,96
SQ2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	1,36	0,89
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	1,36	1,25
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	2,36	13,5
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	1,70	3,89
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	2,33	13,41
SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	2,33	12,9
SQ1-6	100 x 100 x 90 x 3,0	1,2,4,5	8,9,10,11,13,14	2,65	1,7
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5	8,9,10,11,13,14	2,65	4,21
SQA3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	1,42	0,68
SQA2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	1,36	0,89
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	1,70	3,89

Table B.9: Force F_1 Purlin, 1 angle bracket with bolt hole/ connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			k_t II	$F_{1,Rk}$ [kN] (purlin)		k_t II	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel		Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	2,03	15,0	5,56	1,44	15,0	10,1
SQNL135	1,2,3,4,5,7,8,9,10, 11,13,14,16	13	2,03	24,4	5,56	1,44	24,4	10,1
SQNL285	1,2,4,5,6,7,8,9,10,11, 12,13,15,16,17,18,19	17	2,03	31,8	5,56	1,44	31,8	10,1

Table B.10: Forces $F_{2,3}$, 2 angle brackets / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{2,3,Rk}$ [kN]
				Timber
AN3	40 x 40 x 30 x 2,0	1,2	4,5,6	2,72
AN4	40 x 40 x 40 x 2,0	1,2	4,5,6	2,72
AN6	50 x 50 x 40 x 2,0	1,2	4,5,6	2,11
SQ4N	50 x 90 x 50 x 3,0	1,2,4,5	9,10,12,13	4,73
SQ5N	50 x 90 x 80 x 3,0	1,2,3,6,7,8,10	14,15,16,19,20,21	9,66
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4,7,8,9,10,12	17,18,19,20,24,25,26,27	14,2
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12,13, 14,15,16,17,18,19,20, 22,23,24,25,26,27,28, 29,32,33,34,35,36	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	22,0
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7,8,9	13,14,15,16	6,25
AN5	60 x 80 x 40 x 2,0	1,2,3,4,5	7,8,9,10,11	5,56
AN1	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17, 18,19,20,21	10,4
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9, 10,11,12,13,14, 15,16,17,18	24,25,26,27,28,29,30,31,32, 33,34,35,36	22,3
SQ3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	8,17
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	8,17
SQ2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	5,94
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	5,94
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	58,4
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	20,7
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	20,7
SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	18,4
SQ1-6	100 x 100 x 90 x 3,0	1,2,4,5	8,9,10,11,13,14	9,5
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5	8,9,10,11,13,14	9,52
SQA3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	8,1
SQA2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	5,83
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13, 14,15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	20,6

Table B.11: Force F1 Purlin, 2 angle brackets with bolt hole/ connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			k_t II	$F_{1,Rk}$ [kN] (purlin)		k_t II	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel		Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	0,50	37,3	3,69	0,50	21,3	4,71
SQNL135	1,2,3,4,5,7,8,9,10, 11,13,14,16	13	0,50	37,3	6,55	0,50	21,3	8,15

Table B.12: Forces $F_{2,3}$ Column, 1 angle bracket / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{2,3,Rk}$ [kN]
				Timber
AN3	40 x 40 x 30 x 2,0	1,2	4,5,6	1,36
AN4	40 x 40 x 40 x 2,0	1,2	4,5,6	1,36
AN6	50 x 50 x 40 x 2,0	1,2	4,5,6	1,06
SQ4N	50 x 90 x 50 x 3,0	1,2,4,5	9,10,12,13	2,37
SQ5N	50 x 90 x 80 x 3,0	1,2,3,6,7,8,10	14,15,16,19,20,21	4,83
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4,7, 8,9,10,12	17,18,19,20,24,25,26,27	7,11
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12,13, 14,15,16,17,18,19,20, 22,23,24,25,26,27,28, 29,32,33,34,35,36	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	11,0
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7,8,9	13,14,15,16	3,12
AN5	60 x 80 x 40 x 2,0	1,2,3,4,5	7,8,9,10,11	2,78
AN1	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17, 18,19,20,21	5,18
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11,1 2,13,14, 15,16,17,18	24,25,26,27,28,29,30,31,32, 33,34,35,36	11,2
SQ3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	4,09
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	4,09
SQ2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	2,97
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	2,97
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	29,2
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	10,4
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	10,4

SQ1N-4 - 3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 11,12,14, 15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	9,2
SQ1-6	100 x 100 x 90 x 3,0	1,2,4,5	8,9,10,11,13,14	4,8
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5	8,9,10,11,13,14	4,76
SQA3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	4,1
SQA2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	2,91
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13, 14,15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	10,3

Table B.13: Forces $F_{2,3}$, Column 1 angle bracket with bolt hole / connection

Bracket number	Nail number n_V	Number of nails	outwards bolt			inwards bolt		
			$k_{t,\perp}$	e_y [mm]	$F_{2,3Rk}$ [kN] Timber	$k_{t,\perp}$	e_y [mm]	$F_{2,3Rk}$ [kN] Timber
SQNL95	1,2,3,4,5,7,8,10	8	1,00	37,3	1,84	1,00	21,3	2,35
SQNL135	1,2,3,4,5,7,8,9,10, 11,13,14,16	13	1,00	37,3	3,28	1,00	21,3	4,07

Table B.14: Forces $F_{4,5}$, 2 angle brackets / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{4,5,Rk}$ [kN]	
				Timber	Steel
AN3	40 x 40 x 30 x 2,0	1,2	4,5,6	6,86	1,43
AN4	40 x 40 x 40 x 2,0	1,2	4,5,6	6,87	1,96
AN6	50 x 50 x 40 x 2,0	1,2	4,5,6	6,33	2,23
SQ4N	50 x 90 x 50 x 3,0	1,2,4,5	9,10,12,13	7,42	4,53
SQ5N	50 x 90 x 80 x 3,0	1,2,3,6,7,8,10	14,15,16,19,20,21	8,38	8,11
SQ6N	50 x 90 x 110 x 3,0	1,2,3,4,7,8,9,10,12	17,18,19,20,24,25,26,27	10,4	10,9
SQ7N	174 x 114 x 95 x 3,0	1,2,3,4,5,6,7,8,10,12,13, 14,15,16,17,18,19,20, 22,23,24,25,26,27,28, 29,32,33,34,35,36	41,42,45,46,47,48,49,50,51, 52,53,54,55,58,59,60,61,62	12,4	9,17
SQ15550	50 x 155 x 40 x 3,0	1,2,4,5,6,7,8,9	13,14,15,16	8,67	3,76
AN5	60 x 80 x 40 x 2,0	1,2,3,4,5	7,8,9,10,11	6,63	2,16
AN1	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17, 18,19,20,21	10,2	4,32
AN2	60 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11, 12,13,14,15,16,17,18	24,25,26,27,28,29,30,31,32, 33,34,35,36	14,9	6,95
SQ3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	7,87	3,10
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	8,03	2,23
SQ2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	5,75	5,27

SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	6,41	6,39
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13, 14,15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	18,9	13,7
SQ1-4	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	14,8	8,30
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9, 10,11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	17,0	15,1
SQ1N-4-3 fori	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	14,4	11,4
SQ1-6	100 x 100 x 90 x 3,0	1,2,4,5	8,9,10,11,13,14	13,9	7,8
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5	8,9,10,11,13,14	13,5	11,9
SQA3	70 x 70 x 55 x 2,0	2,3,5,6,7,8	11,12,15,16,18,19,20	7,9	3,1
SQA2	90 x 90 x 65 x 2,5	1,3,4,5,6	8,9,10,11,12,14	5,8	5,3
SQA1	100 x 100 x 90 x 3,0	1,2,3,4,6,7,8,9, 10,11,12,13, 14,15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	14,8	8,3

Table B.15: Force $F_{4,5}$, 2 angle bracket with bolt hole / connection

Bracket number	Nail number n_V	Number of nails	$k_{t,\perp}$	$k_{t,II}$	$F_{4,5Rk}$ [kN]	
					Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	0,70	0,38	9,05	9,95
SQNL135	1,2,3,4,5,7,8,9,10,11,13,14,16	13	0,69	0,34	9,49	9,97

Table B.16: Force F_4, 1 angle bracket / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{4,Rk}$ [kN]	
				Timber	Steel
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	8,03	1,70
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	6,41	4,63
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	16,4	9,09
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	15,6	10,35
SQ1N-4 3-fori	100 x 100 x 90 x 3,0 3-fori with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	14,4	8,1
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5,6	8,9,10,11,13,14	13,5	9,55

Table B.17: Force F_4, bolt inwards, 1 angle bracket / connection

Bracket number	Nail number n_V	Number of nails	$k_{t,\perp}$	$k_{t,II}$	$F_{4,Rk}$ [kN]	
					Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	1,00	0,14	9,05	6,95
SQNL135	1,2,3,4,5,7,8,9,10,11,13,14,16	13	1,00	0,10	9,49	6,90

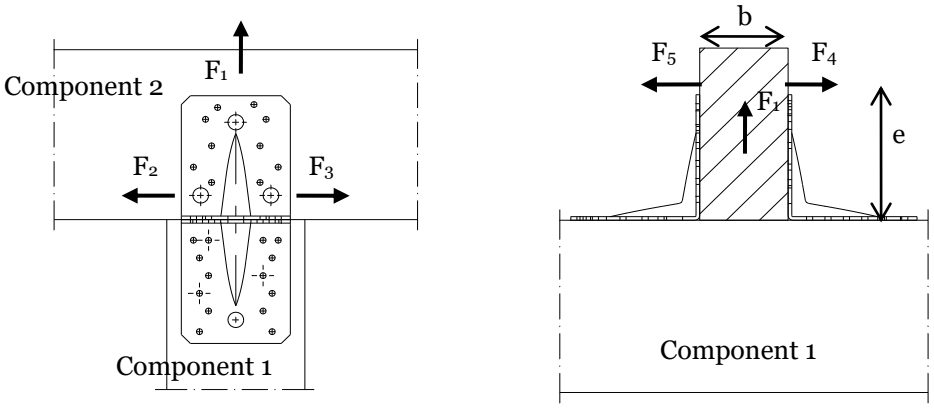
Table B.18: Force F_5, 1 angle bracket / connection

Bracket number	Bracket type	Nail number n_V	Nail number n_h	$F_{5,Rk}$ [kN]	
				Timber	Steel
SQ3N	70 x 70 x 55 x 2,0 with rib	2,3,5,6,7,8	11,12,15,16,18,19,20	1,91	0,59
SQ2N	90 x 90 x 65 x 2,5 with rib	1,3,4,5,6	8,9,10,11,12,14	1,77	1,76
AL100	90 x 100 x 260 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,34,35,36,37, 40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57	6,33	5,01
SQ1N-4	100 x 100 x 90 x 3,0 with rib	1,2,3,4,6,7,8,9,10, 11,12,13,14, 15,16,17	20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,37,38	5,91	5,23
SQ1N-4 3-fori	100 x 100 x 90 x 3,0 3 fori with rib	1,2,3,4,6,7,8,9,11, 12,14,15,16,17	20,21,22,23,24,25,27,28,30, 31,32,33,35,36,37,38	2,32	3,69
SQ1N-6	100 x 100 x 90 x 3,0 with rib	1,2,4,5,6	8,9,10,11,13,14	2,67	2,50

Table B.19: Force F_5, bolt outwards 1 angle bracket / connection

Bracket number	Nail number n_V	Number of nails	$k_{t,\perp}$	$k_{t,II}$	$F_{5,Rk}$ [kN]	
					Timber	Steel
SQNL95	1,2,3,4,5,7,8,10	8	1,00	1,25	2,72	3,96
SQNL135	1,2,3,4,5,7,8,9,10,11,13,14,16	13	1,00	1,12	2,92	4,40

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



Fastener specification
Holes are marked with numbers referring to the nailing pattern in Annex B.

Double angle brackets per connection
The angle brackets must be placed at each side opposite to each other, symmetrically 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.

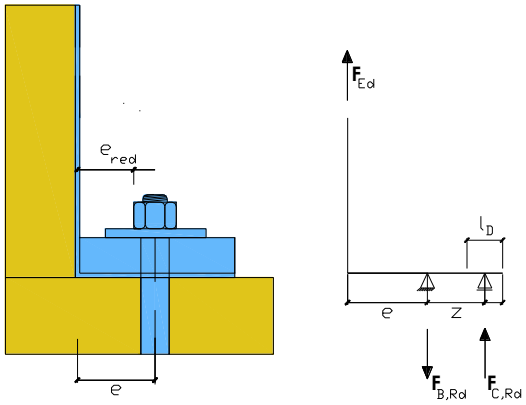
Timber splitting
For the lifting force F_1 it must be checked in accordance with Eurocode 5 or a similar national Timber Code that splitting will not occur.

Connection to timber, concrete or steel with a bolt or metal anchor
The tensile load $F_{B,Ed}$ for the design of a bolt or metal anchor is calculated as:

$F_{B,t,Ed} = k_t \cdot F_{Ed}$ for tensile load
$F_{B,v,Ed} = F_{Ed}$ for shear load

Where:

$F_{B,t,Ed}$	Bolt tensile load in N
$F_{B,v,Ed}$	Bolt shear load in N
k_t	Coefficient taking into account the moment arm (k_t =1+e/z)
F_{Ed}	Load on vertical flap of the angle bracket in N



Combined forces
If the forces F_1 and F_2/F_3 or F_4/F_5 act at the same time, the following inequality shall be fulfilled:

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

The forces F_2 and F_3 or F_4 and F_5 are forces with opposite direction. Therefore only one force F_2 or F_3, and F_4 or F_5, respectively, is able to act simultaneously with F_1, while the other shall be set to zero.

If the load F_4/F_5 is applied with an eccentricity e, a design for combined loading **for connections with double angle brackets** is required. Here, an additional force ΔF_1 has to be added to the existing force F_1.

$$\Delta F_{1,d} = F_{4,d} / F_{5,d} \cdot \frac{e}{B}$$

B is the width of component 2.

Adveco Angle Brackets, angle brackets with bolt hole and hold-downs

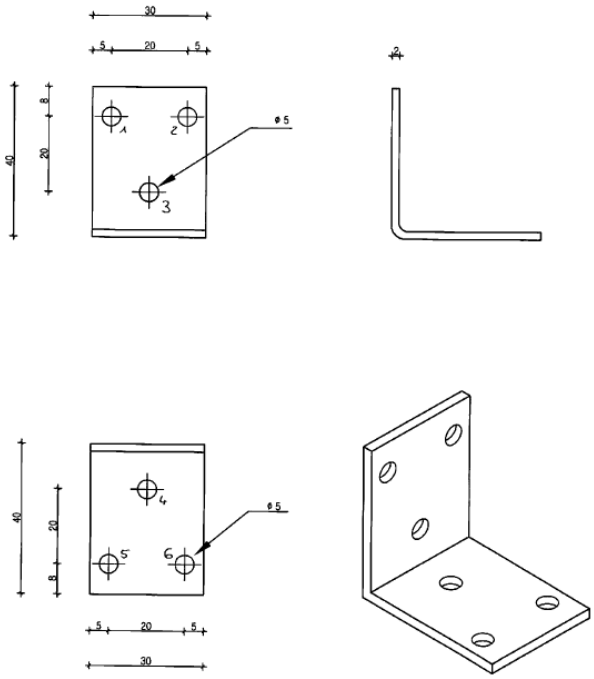


Figure B. 1 Dimensions of angle bracket 40x40x30x2,0

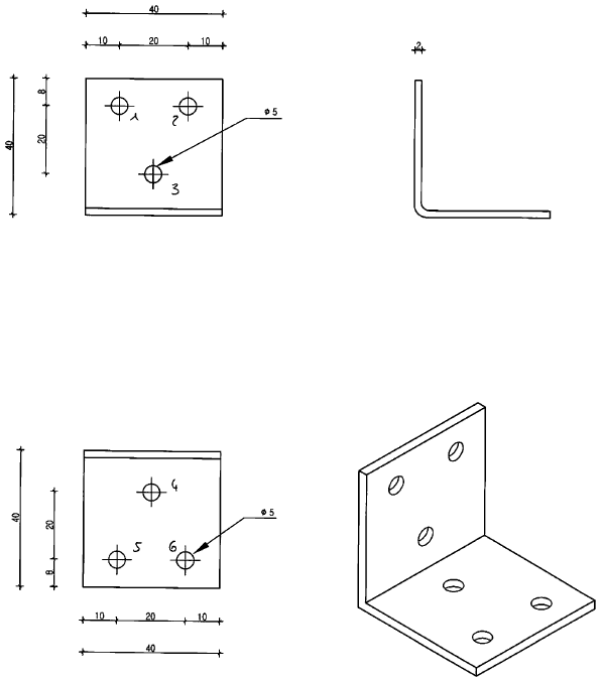


Figure B. 2 Dimensions of angle bracket 40x40x40x2,0

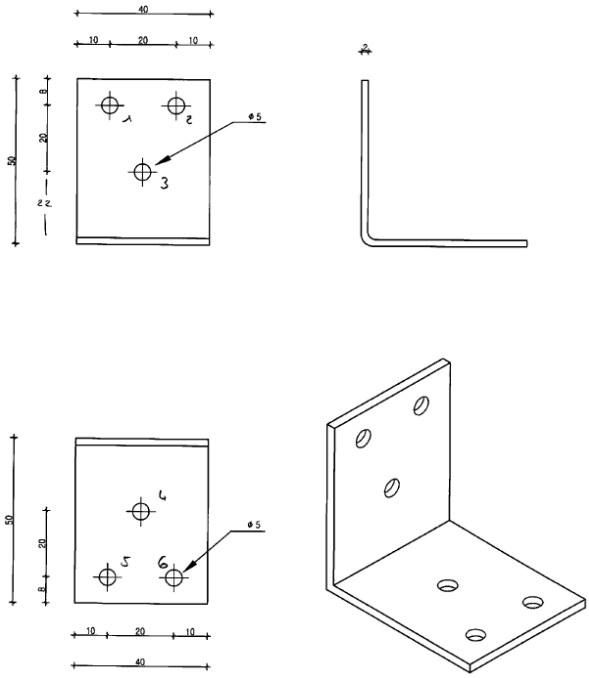


Figure B. 3 Dimensions of angle bracket 50x50x40x2,0

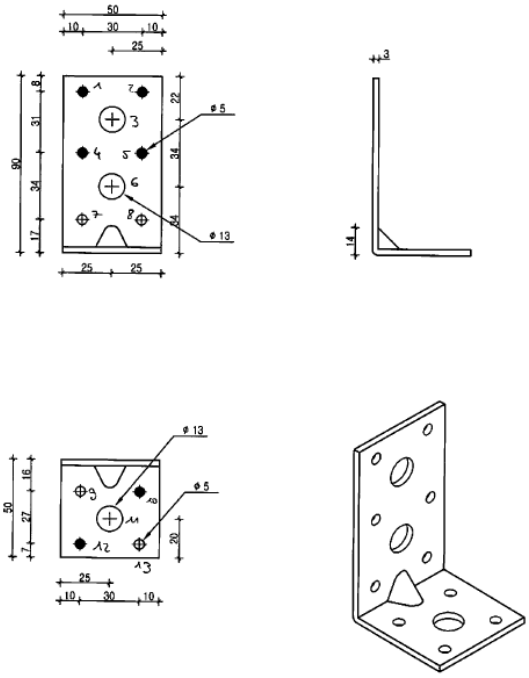


Figure B. 4 Dimensions of angle bracket 50x90x50x3,0

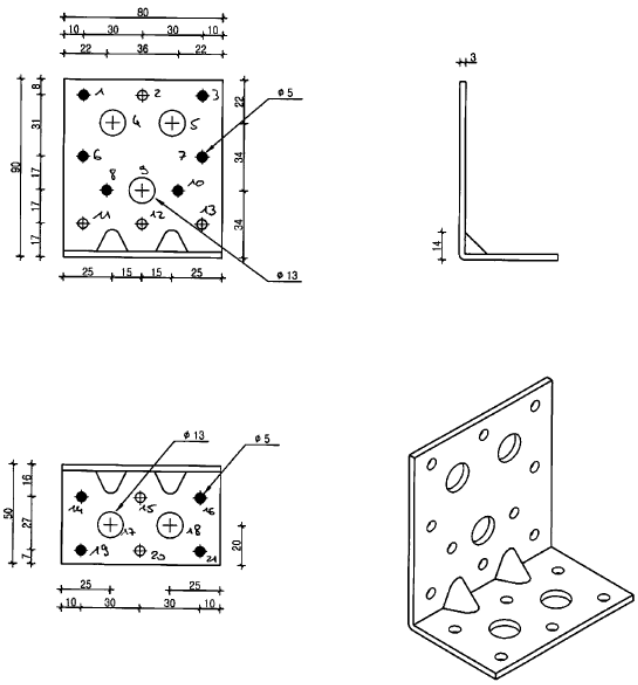


Figure B. 5 Dimensions of angle bracket 50x90x80x3,0

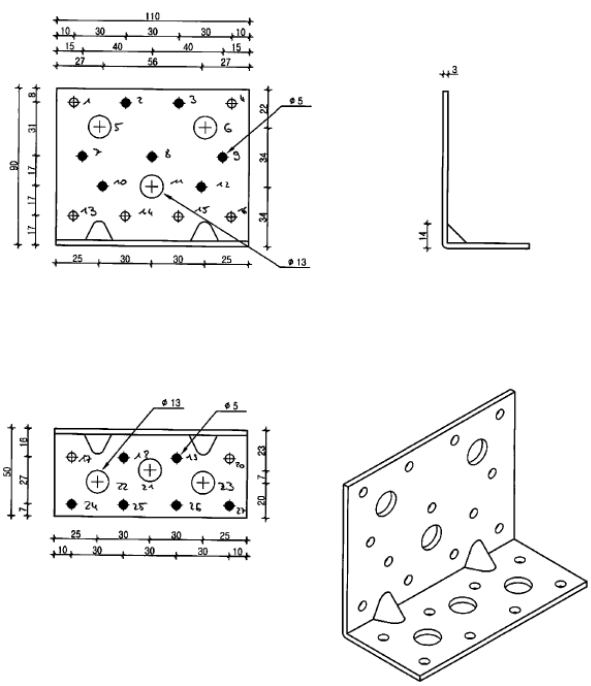


Figure B. 6 Dimensions of angle bracket 50x90x110x3,0

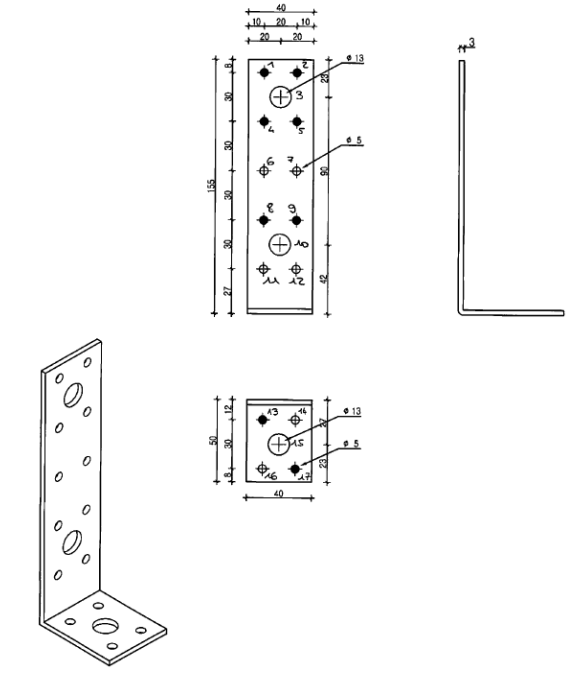


Figure B. 7 Dimensions of angle bracket 50x155x40x3,0

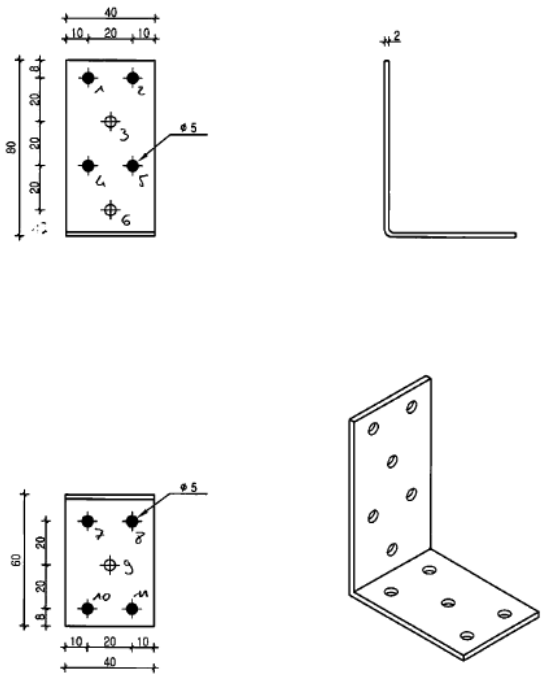


Figure B. 8 Dimensions of angle bracket 60x80x40x2,0

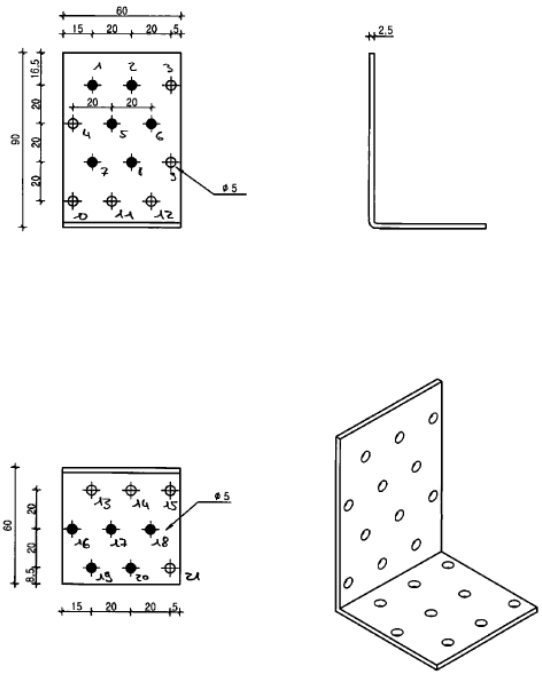


Figure B. 9 Dimensions of angle bracket 60x90x60x2,5

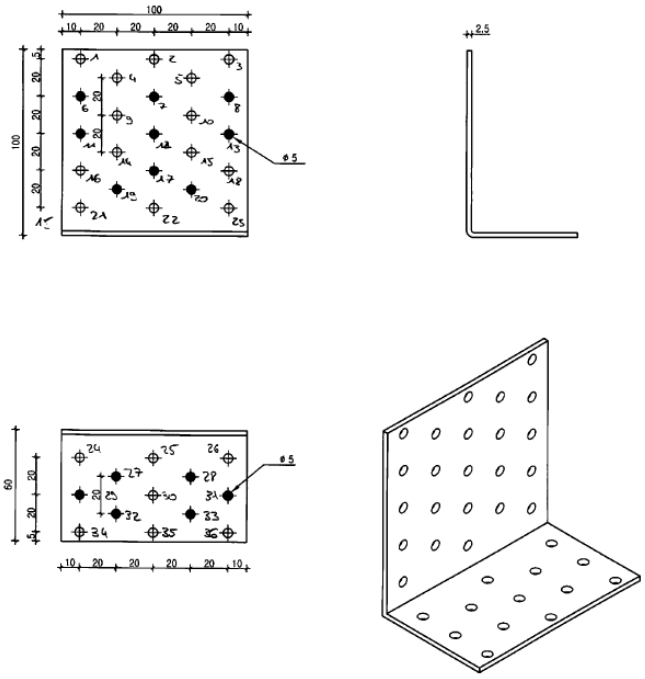


Figure B. 10 Dimensions of angle bracket 60x100x100x2,5

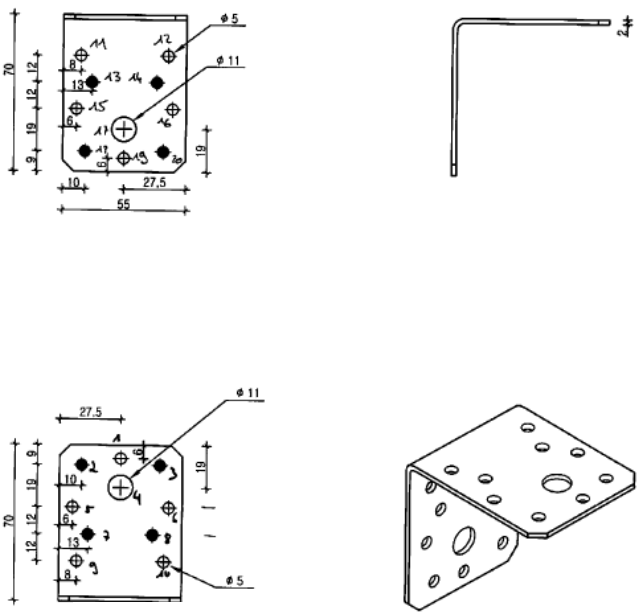


Figure B. 11 Dimensions of angle bracket 70x70x55x2,0

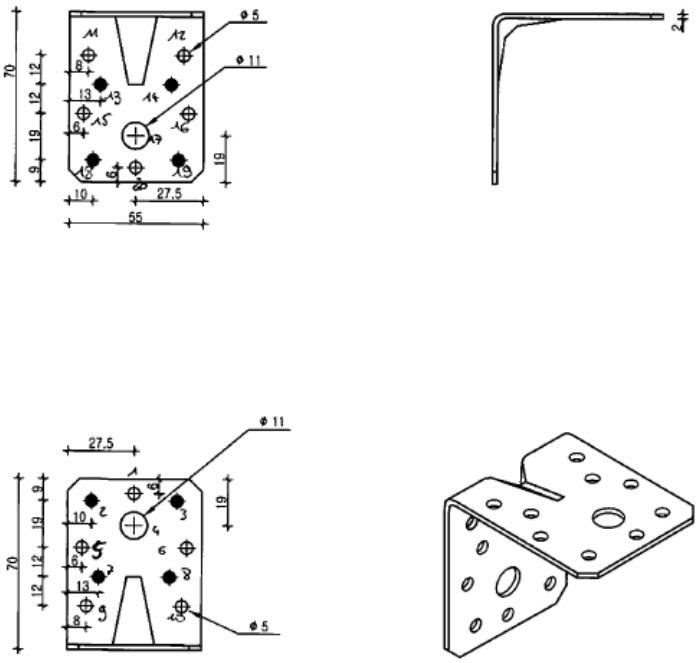


Figure B. 12 Dimensions of angle bracket 70x70x55x2,0 (with rib)

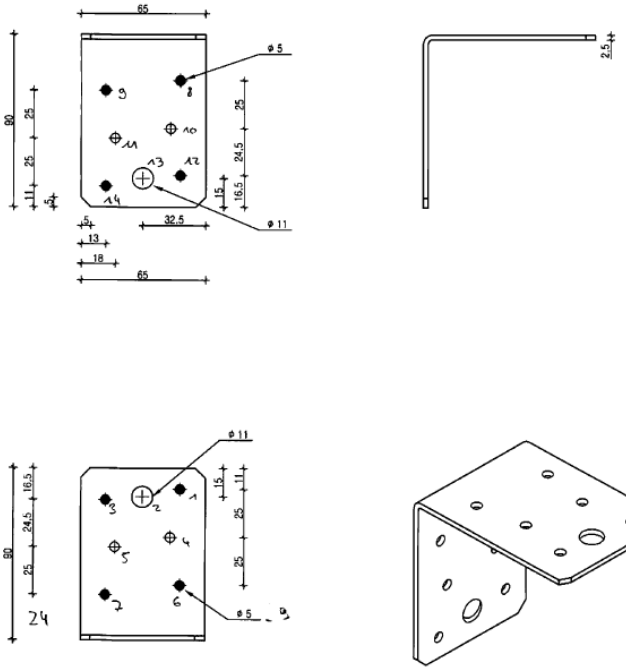


Figure B. 13 Dimensions of angle bracket 90x90x65x2,5

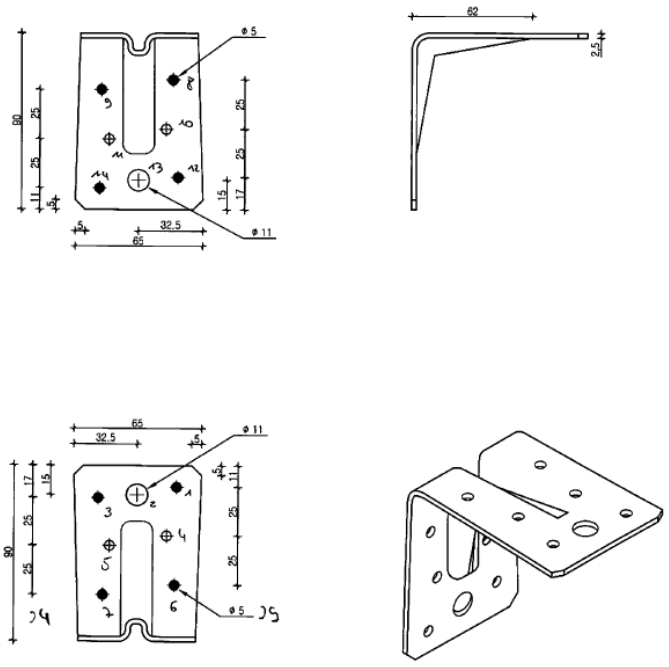


Figure B. 14 Dimensions of angle bracket 90x90x60x2,5 (with rib)

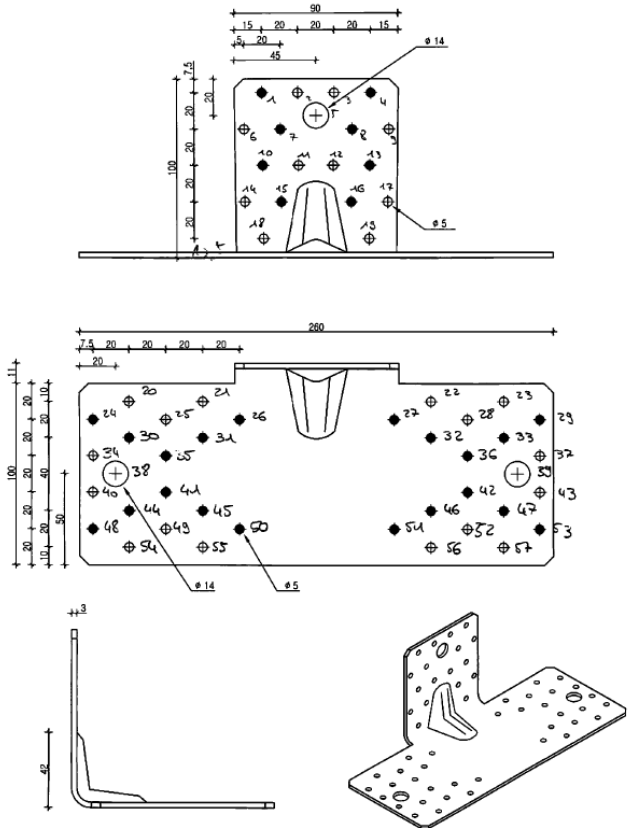


Figure B. 15 Dimensions of angle bracket 90x100x260x3,0 (with rib)

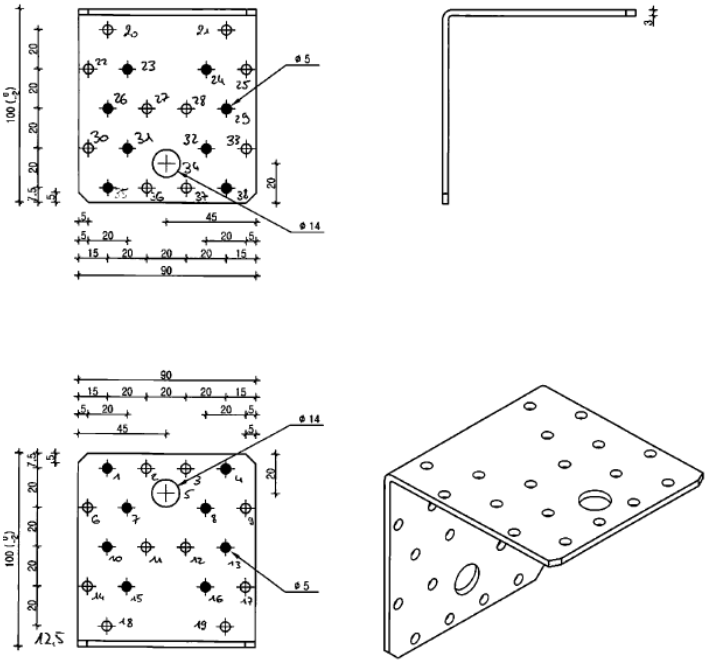


Figure B. 16 Dimensions of angle bracket 100x100x90x3,0

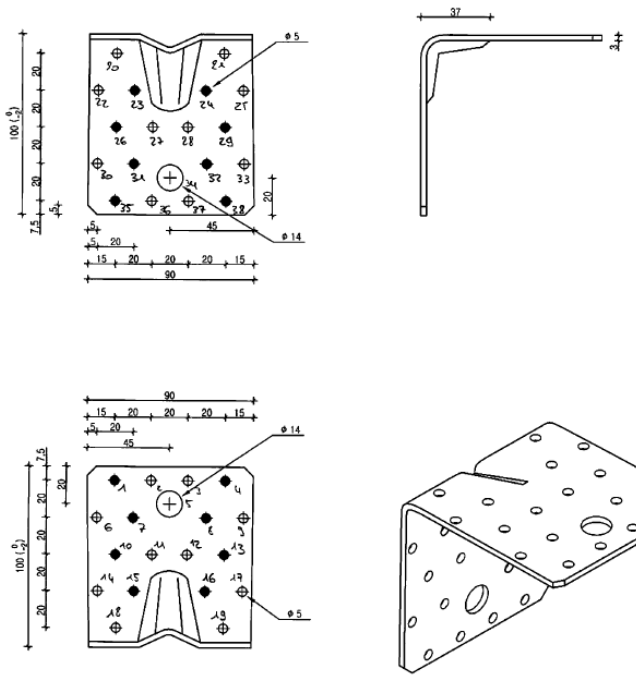


Figure B. 17 Dimensions of angle bracket 100x100x90x3,0 (with rib)

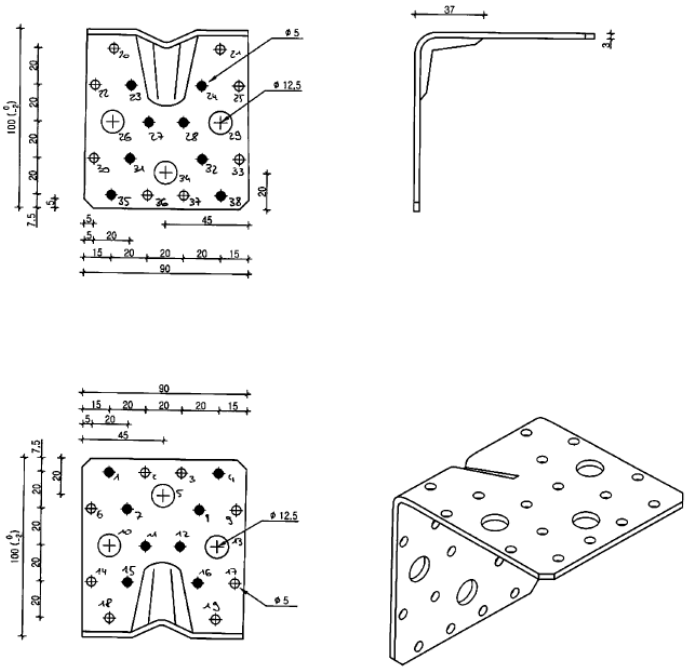


Figure B. 18 Dimensions of angle bracket 100x100x90x3,0 – 3-fori (with rib)

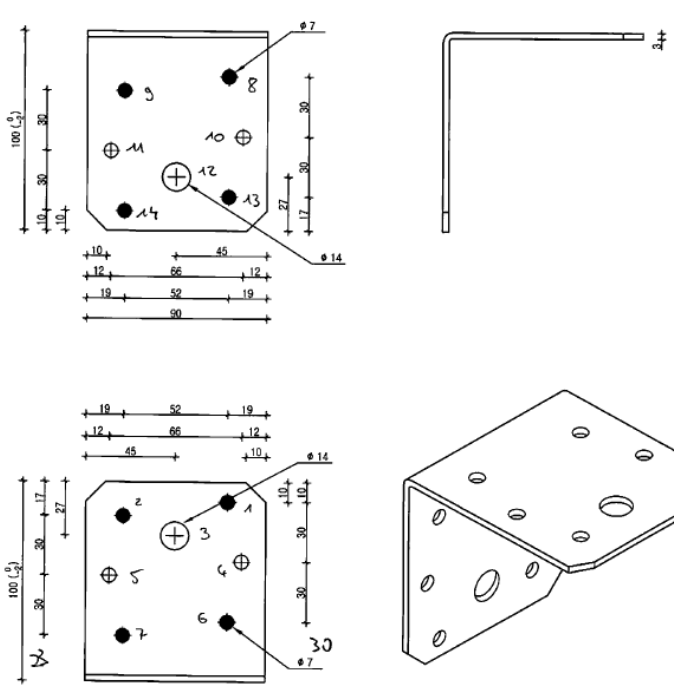


Figure B. 19 Dimensions of angle bracket 100x100x90x3,0

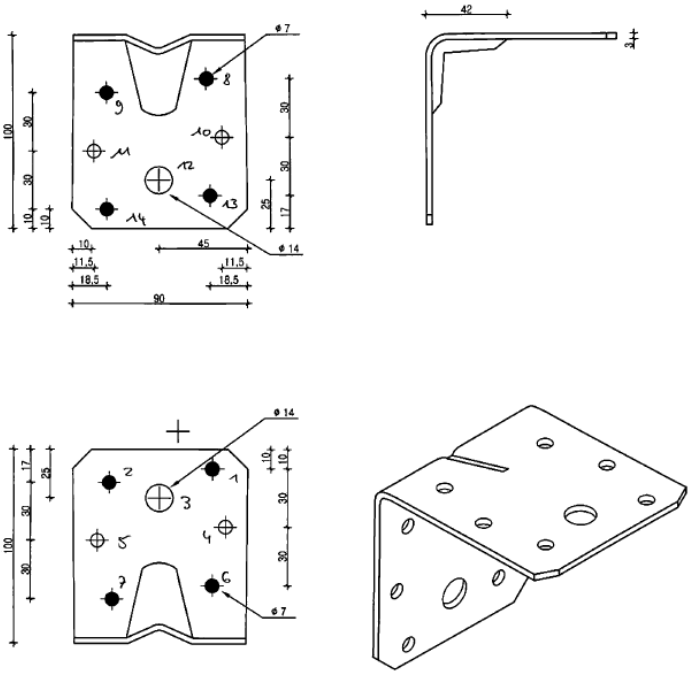


Figure B. 20 Dimensions of angle bracket 100x100x90x3,0 (with rib)

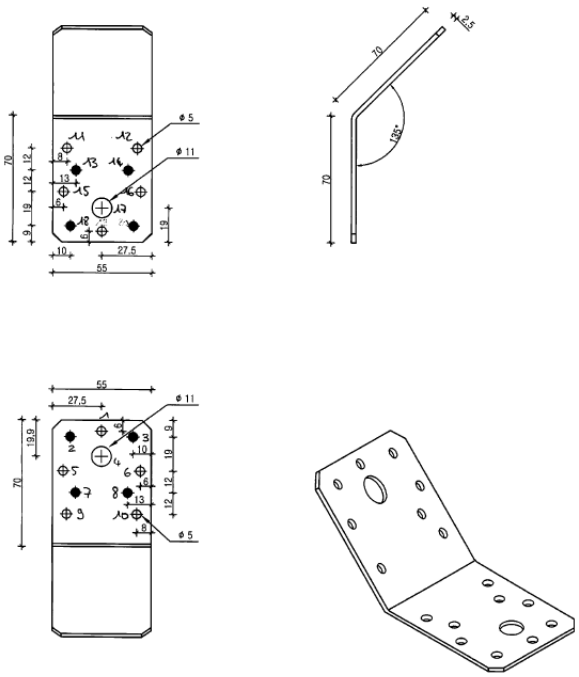


Figure B. 21 Dimensions of a 135° angle bracket 70x70x55x2,0

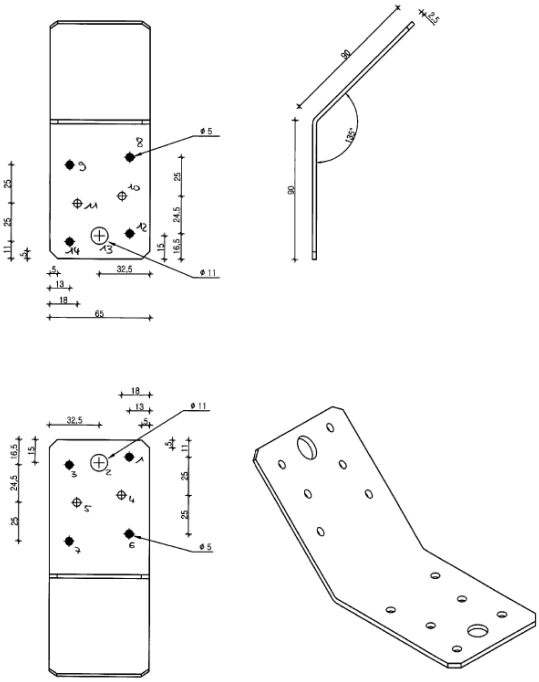


Figure B. 22 Dimensions of a 135° angle bracket 90x90x65x2,5

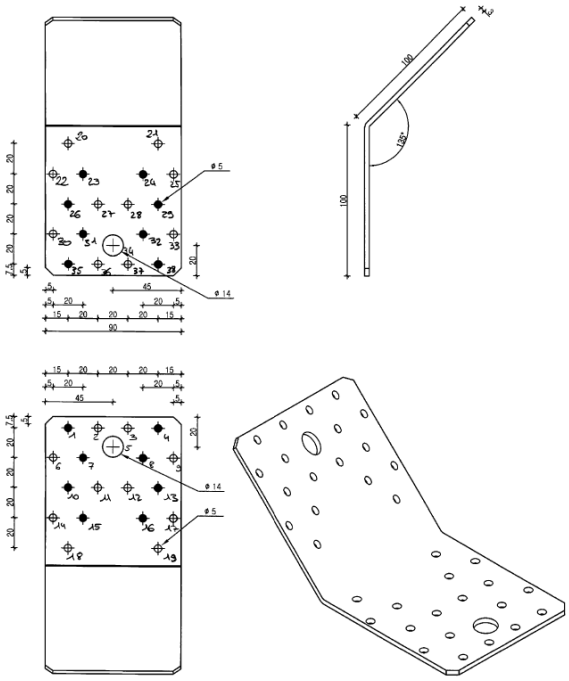


Figure B. 23 Dimensions of a 135° angle bracket 100x100x90x3,0

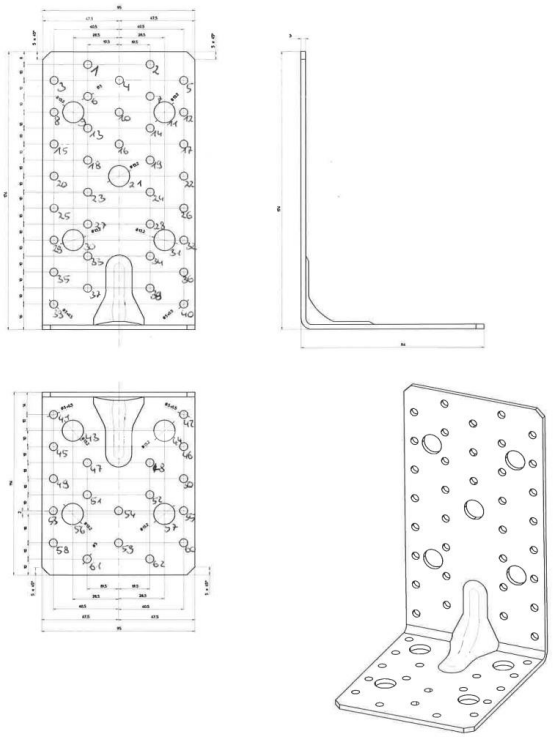


Figure B.24 Dimensions of bracket type SQ7N 174x114x95x3,0

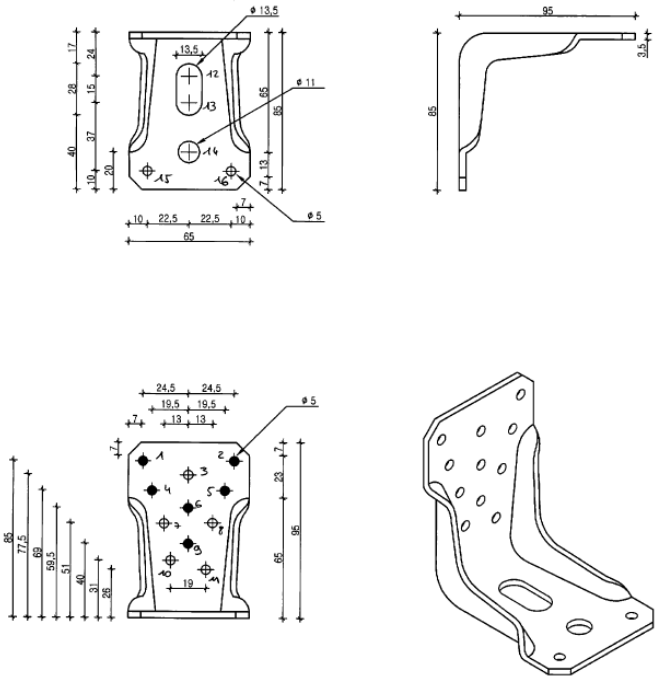


Figure B. 24 Dimensions of an angle bracket with bolt hole 65x95x85x3,5

Figure B. 25 Dimensions of an angle bracket with bolt hole 65x135x85x3,5

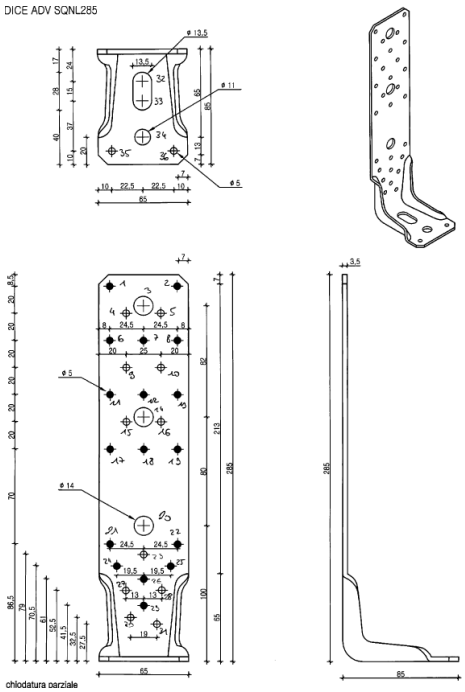


Figure B. 26 Dimensions of an angle bracket with bolt hole 65x285x85x3,5

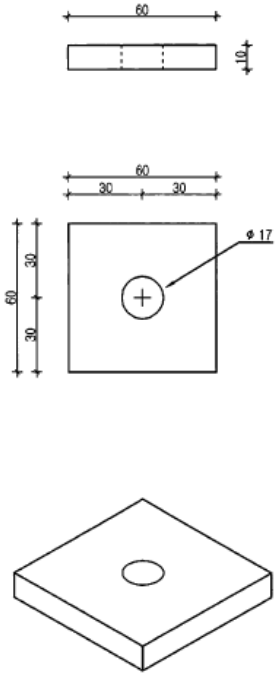


Figure B. 27 Dimensions of the foot plate for hold-downs 60x60x10

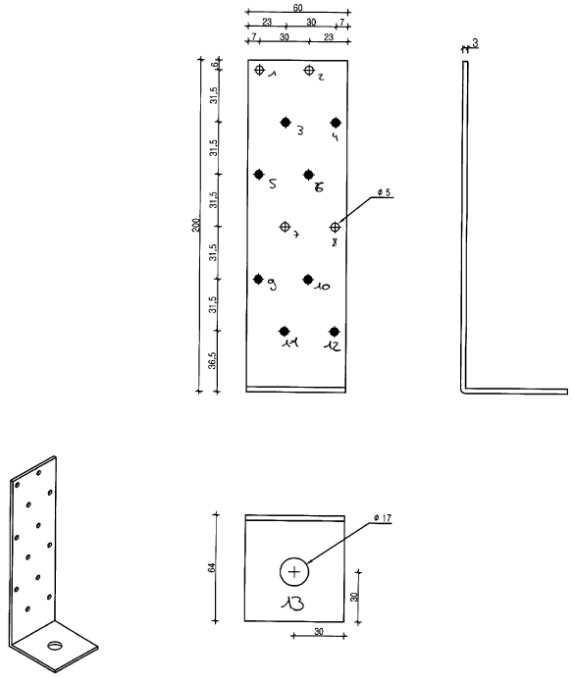


Figure B. 28 Dimensions of a hold-down 60x200x60x3,0

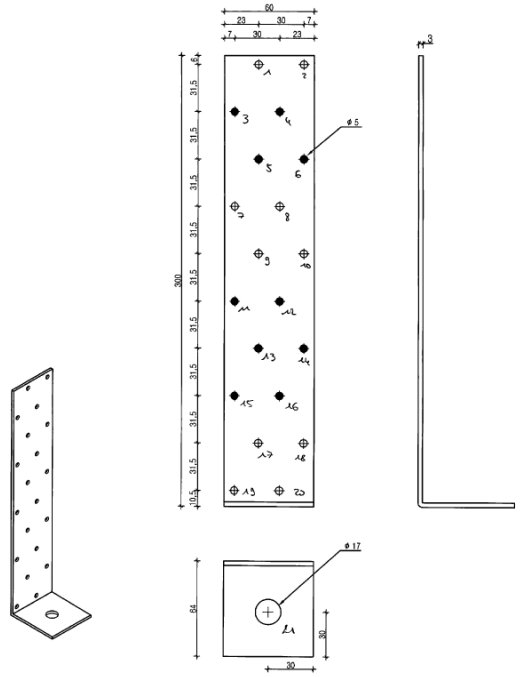


Figure B. 29 Dimensions of a hold-down 60x300x60x3,0

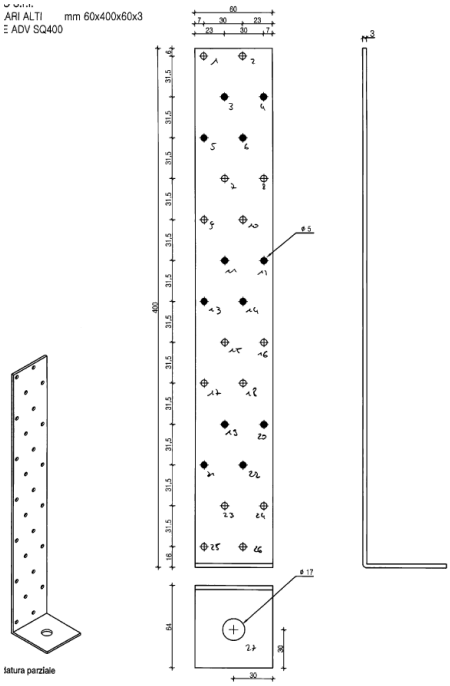


Figure B. 30 Dimensions of a hold-down 60x400x60x3,0

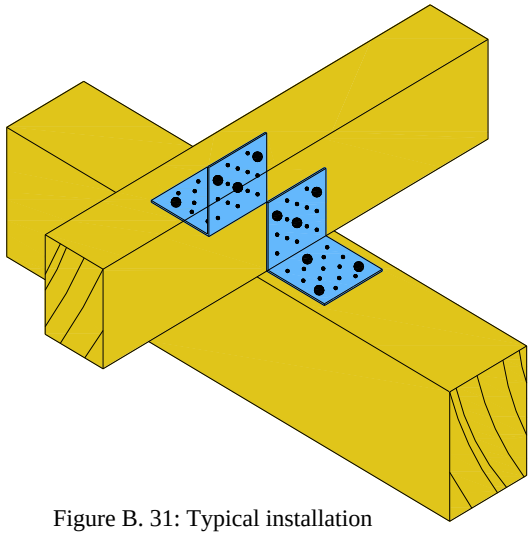


Figure B. 31: Typical installation