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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

MEMBER OF EOTA



European Technical Assessment ETA-09/0355 of 2025/12/19

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:

BB Various Angle Brackets

Product family to which the above construction product belongs:

Three-dimensional nailing plate (Angle brackets for timber-to-timber connections)

Manufacturer:

BB Stanz- und Umformtechnik GmbH
Nordhäuser Str. 42
D-06536 Berga
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Manufacturing plant:

BB Stanz- und Umformtechnik GmbH
Nordhäuser Str. 42
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This European Technical Assessment contains:

57 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, Three Dimensional Nailing Plates

This version replaces:

The previous ETA with the same number issued on 2019/06/11

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of the product

The following types of brackets are covered by this ETA are described in annex A:

BB angle brackets 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 or bolts according to EN 14592 and to concrete or steel members with bolts or metal anchors. They are available in various sizes.

The angle brackets with a steel plate thickness of up to 6 mm are made from pre-galvanized steel S250GD + Z275 according to EN 10346 with $R_e \geq 250 \text{ N/mm}^2$ and $R_m \geq 330 \text{ N/mm}^2$ and tolerances according to EN 10143 or steel grade DD11 + Fe/Zn 12 according to EN 10111 with $R_{eL} \geq 220 \text{ N/mm}^2$ and $R_m \geq 330 \text{ N/mm}^2$ and tolerances according to EN 10051. Dimensions, hole positions and typical installations are shown in Annex B.

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 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 (see Annex B).

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 425 kg/m^3 . This requirement to the material of the wood members can be fulfilled by using

the following materials:

- Structural solid timber according to EN 14081,
- Glulam according to EN 14080,
- Glued solid timber according to EN 14080,
- LVL according to EN 14374,
- Cross laminated timber according to ETA,
- Plywood according to EN 636.

Annex B states the characteristic values of 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:

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

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.

The angle brackets may also be used in outdoor timber structures, service class 3, when a corrosion protection in accordance with Eurocode 5 is applied, or when stainless steel with similar or better characteristic yield and ultimate strength is employed. To avoid contact corrosion, stainless steel angle brackets shall be used with nails made from stainless steel.

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)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	No performance assessed
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.5
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The angle brackets are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed

*) See additional information in section 3.3 – 3.7.

3.3 Methods of verification

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

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity may 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 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 $\gamma_{M,H}$ for timber connections or $\gamma_{M,S} = \gamma_{M0}$ for steel, respectively, have to be taken into account.

3.4 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 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.

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 characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1: 2004, 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 Karlsruhe, 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
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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 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.

3.5 Aspects related to the performance of the product

3.5.1 Corrosion protection in service class 1 and 2.

In accordance with EAD 130186-00-0603 the angle brackets have a zinc coating Fe/Zn 12 according to EN ISO 2081 or a weight of min. Z275 according to EN 10346

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

BB 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.
- Strength class C24 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 assessment holder's technical literature.

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 2025-12-19 by



Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details definitions

Table A.1: Materials specification

Bracket number	Bracket type	Comments	Steel specification	Coating specification
50031362	90 x 50 x 116 x 3,0	-	S250GD	Z275
61812940	120 x 90 x 40 x 4,0	-	S250GD	Z275
61814940	140 x 90 x 40 x 4,0	-	S250GD	Z275
61816540	160 x 50 x 40 x 4,0	-	S250GD	Z275
61816640	160 x 80 x 60 x 4,0	-	S250GD	Z275
61816840	160 x 80 x 80 x 4,0	-	S250GD	Z275
63111020	100 x 100 x 100 x 2,0	-	S250GD	Z275
63111025	100 x 100 x 100 x 2,5	-	S250GD	Z275
63114020	100 x 100 x 40 x 2,0	-	S250GD	Z275
63116020	100 x 100 x 60 x 2,5	-	S250GD	Z275
63116025	100 x 100 x 60 x 2,5	-	S250GD	Z275
63118020	100 x 100 x 80 x 2,0	-	S250GD	Z275
63118025	100 x 100 x 80 x 2,5	-	S250GD	Z275
63144420	40 x 40 x 40 x 2,0	-	S250GD	Z275
63144425	40 x 40 x 40 x 2,5	-	S250GD	Z275
63144820	40 x 40 x 80 x 2,0	-	S250GD	Z275
63146020	40 x 40 x 60 x 2,0	-	S250GD	Z275
63146025	40 x 40 x 60 x 2,5	-	S250GD	Z275
63144825	40 x 40 x 80 x 2,5	-	S250GD	Z275
63155420	50 x 50 x 40 x 2,0	-	S250GD	Z275
63161020	60 x 60 x 100 x 2,0	-	S250GD	Z275
63161025	60 x 60 x 100 x 2,5	-	S250GD	Z275
63164020	60 x 60 x 40 x 2,0	-	S250GD	Z275
63164025	60 x 60 x 40 x 2,5	-	S250GD	Z275
63164220	60 x 40 x 25 x 2,0	-	S250GD	Z275
63164625	60 x 40 x 60 x 2,5	-	S250GD	Z275
63165020	60 x 60 x 50 x 2,0	-	S250GD	Z275
63165025	60 x 60 x 50 x 2,5	-	S250GD	Z275
63166020	60 x 60 x 60 x 2,0	-	S250GD	Z275
63166025	60 x 60 x 60 x 2,5	-	S250GD	Z275
63166920	60 x 60 x 90 x 2,0	-	S250GD	Z275
63166820	60 x 60 x 80 x 2,0	-	S250GD	Z275
63168025	60 x 60 x 80 x 2,5	-	S250GD	Z275
63168625	60 x 80 x 60 x 2,5	-	S250GD	Z275
63181020	80 x 80 x 100 x 2,0	-	S250GD	Z275
63181025	80 x 80 x 100 x 2,5	-	S250GD	Z275
63184020	80 x 80 x 40 x 2,0	-	S250GD	Z275
63184025	80 x 80 x 40 x 2,5	-	S250GD	Z275
63186020	80 x 80 x 60 x 2,0	-	S250GD	Z275
63186025	80 x 80 x 60 x 2,5	-	S250GD	Z275
63188020	80 x 80 x 80 x 2,0	-	S250GD	Z275
63188025	80 x 80 x 80 x 2,5	-	S250GD	Z275
63206020	60 x 60 x 25 x 2,0	-	S250GD	Z275
63355320	50 x 50 x 30 x 2,0	with slotted holes	S250GD	Z275
63371066	100 x 75 x 60 x 6,0	with slotted hole	S250GD	Z275
63375320	70 x 50 x 30 x 2,0	with slotted holes	S250GD	Z275
63385325	80 x 50 x 30 x 2,5	with slotted holes	S250GD	Z275
63410020	40 x 40 x 100 x 2,0	-	S250GD	Z275
63415020	40 x 40 x 150 x 2,0	-	S250GD	Z275

63420020	40 x 40 x 200 x 2,0	-	S250GD	Z275
64155320	50 x 50 x 35 x 2,0	-	S250GD	Z275
64103525	50 x 50 x 35 x 2,5	-	S250GD	Z275
64104030	50 x 50 x 40 x 3,0	-	S250GD	Z275
64107020	70 x 70 x 55 x 2,0	-	S250GD	Z275
64110520	105 x 105 x 90 x 2,0	-	S250GD	Z275
64114034	140 x 35 x 40 x 2,5	-	S250GD	Z275
64141225	40 x 120 x 2,5	-	S250GD	Z275
61816540	160 x 50 x 40 x 3,0	-	S250GD	Z275
64141640	40 x 160 x 40 x 3,0	-	S250GD	Z275
64186025	83 x 42 x 40 x 2,5	-	S250GD	Z275
64186030	83 x 42 x 40 x 3,0	-	S250GD	Z275
64149042	40 x 90 x 40 x 3,0	-	S250GD	Z275
64155320	50 x 50 x 35 x 2,0	-	DD11	Fe/Zn 12
64159025	50 x 90 x 50 x 3,0	-	S250GD	Z275
64159830	90 x 48 x 76 x 3,0	-	S250GD	Z275
64166430	60 x 60 x 45 x 3,0	-	S250GD	Z275
64166530	65 x 65 x 55 x 3,0	-	S250GD	Z275
64169025	60 x 90 x 60 x 2,5	with slotted hole	S250GD	Z275
64169030	60 x 90 x 60 x 2,5	with slotted holes	S250GD	Z275
64169125	60 x 90 x 60 x 2,5	with slotted holes	S250GD	Z275
64169225	60 x 90 x 60 x 2,5	with slotted holes	S250GD	Z275
64186020	83 x 62 x 40 x 2,0	with rib	S250GD	Z275
64190525	105 x 105 x 90 x 2,5	with rib	S250GD	Z275
64191225	120 x 90 x 40 x 3,0	-	S250GD	Z275
64191225	90 x 120 x 40x 3,0	-	S250GD	Z275
64197020	70 x 70 x 55 x 2,0	with rib	S250GD	Z275
64197115	70 x 70 x 55 x 1,5	with rib	S250GD	Z275
64199020	90 x 90 x 65 x 2,0	with rib	S250GD	Z275
64199115	90 x 90 x 65 x 1,5	with rib	S250GD	Z275
64199430	90 x 90 x 40 x 3,0	-	S250GD	Z275
65107025	70 x 70 x 55 x 2,5	135° angled	S250GD	Z275
65109025	90 x 90 x 65 x 2,5	135° angled	S250GD	Z275
65110530	105 x 105 x 90 x 3,0	135° angled	S250GD	Z275
65155425	50 x 50 x 40 x 2,5	135° angled	S250GD	Z275
65109625	90 x 90 x 40 x 2,5	135° angled	S250GD	Z275
65206000	80 x 80 x 60 x 1,5	with curve	S250GD	Z275
65208000	120 x 120 x 75 x 1,5	with curve	S250GD	Z275

Table A.2: Range of sizes

Bracket number	Dimensions in mm	Height vertical in mm		Height horizontal in mm		Width in mm	
50031362	90 x 50 x 116 x 3,0	89	91	49	51	115	117
61812940	120 x 90 x 40 x 4,0	119	121	89	91	39	41
61814940	140 x 90 x 40 x 4,0	139	141	89	91	39	41
61816540	160 x 50 x 40 x 4,0	159	161	49	51	39	41
61816640	164 x 84 x 60 x 4,0	163	165	83	85	59	61
61816840	164 x 84 x 80 x 4,0	163	165	83	85	79	81
63111020	100 x 100 x 100 x 2,0	98	102	98	102	99	101
63111025	100 x 100 x 100 x 2,5	97	103	97	103	99	101
63114020	102 x 102 x 40 x 2,0	97	103	97	103	39	41
63116020	102,5 x 102,5 x 60 x 2,5	101,5	103,5	101,5	103,5	59	61
63116025	102,5 x 102,5 x 60 x 2,5	98	102	98	102	59	61
63118020	100 x 100 x 80 x 2,0	98	102	98	102	79	81
63118025	102,5 x 102,5 x 80 x 2,5	98	102	98	102	79	81
63144420	40 x 40 x 40 x 2,0	39	41	39	41	39	41
63144425	40 x 40 x 40 x 2,5	39	41	39	41	39	41
63144820	40 x 40 x 80 x 2,0	38	42	38	42	79	81
63146020	40 x 40 x 60 x 2,0	39	41	39	41	59	61
63146025	40 x 40 x 60 x 2,5	39	41	39	41	59	61
63144825	40 x 40 x 80 x 2,5	38	42	38	42	79	81
63155420	50 x 50 x 40 x 2,0	49	51	49	51	39	41
63161020	60 x 60 x 100 x 2,0	58	62	58	62	99	101
63161025	62,5 x 62,5 x 100 x 2,5	59,5	65,5	59,5	65,5	99	101
63164020	60 x 60 x 40 x 2,0	59	61	59	61	39	41
63164025	60 x 60 x 40 x 2,5	59	61	59	61	39	41
63164220	60 x 40 x 25 x 2,0	59	61	39	41	24	26
63164625	60 x 40 x 60 x 2,5	59	61	39	41	59	61
63165020	60 x 60 x 50 x 2,0	59	61	59	61	49	51
63165025	60 x 60 x 50 x 2,5	57	63	57	63	49	51
63166020	60 x 60 x 60 x 2,0	59	61	59	61	59	61
63166025	60 x 60 x 60 x 2,5	59	61	59	61	59	61
63166920	60 x 60 x 90 x 2,0	59	61	59	61	89	91
63166820	60 x 60 x 80 x 2,0	58	62	58	62	79	81
63168025	60 x 60 x 80 x 2,5	58	62	58	62	79	81
63168625	80 x 60 x 60 x 2,5	79	81	59	61	59	61
63181020	80 x 80 x 100 x 2,0	78	82	78	82	99	101
63181025	80 x 80 x 100 x 2,5	77	83	77	83	99	101
63184020	80 x 80 x 40 x 2,0	79	81	79	81	39	41
63184025	80 x 80 x 40 x 2,5	79	81	79	81	39	41
63186020	80 x 80 x 60 x 2,0	79	81	79	81	59	61
63186025	80 x 80 x 60 x 2,5	79	81	79	81	59	61
63188020	80 x 80 x 80 x 2,0	78	82	78	82	79	81
63188025	80 x 80 x 80 x 2,5	78	82	78	82	79	81
63206020	60 x 60 x 25 x 2,0	59	61	59	61	24	26
63355320	52 x 52 x 30 x 2,0	51	53	51	53	29	31
63371066	103 x 71 x 60 x 6,0	102	104	70	72	59	61
63375320	72 x 52 x 30 x 2,0	71	73	51	53	29	31
63385325	82 x 52 x 30 x 2,5	81	83	51	53	29	31
63410020	40 x 40 x 100 x 2,0	39	41	39	41	99	101
63415020	42 x 42 x 150 x 2,0	41	43	41	43	149	151
63420020	42 x 42 x 200 x 2,0	41	43	41	43	199	201
64155320	50 x 50 x 35 x 2,5	49	51	49	51	34	36
64103525	50 x 50 x 35 x 2,5	49	51	49	51	34	36

64104030	50 x 50 x 40 x 3,0	49	51	49	51	39	41
64107020	70 x 70 x 55 x 2,0	69	71	69	71	54	56
64110520	105 x 105 x 90 x 2,0	104	106	104	106	89	91
64114034	140 x 40 x 40 x 2,5	139	141	39	41	39	41
64141225	120 x 40 x 40 x 2,5	119	121	39	41	39	41
61816540	166 x 50 x 40 x 3,0	165	167	49	51	39	41
64141640	40 x 160 x 40 x 3,0	159	161	39	41	39	41
64186025	83 x 42 x 40 x 2,5	82	84	41	43	39	41
64186030	83 x 42 x 40 x 3,0	82	84	41	43	39	41
64149042	40 x 90 x 40 x 3,0	89	91	39	41	39	41
64155320	50 x 50 x 35 x 2,0	49	51	49	51	34	36
64159025	53 x 93 x 50 x 3,0	52	54	92	94	50	52
64159830	90 x 48 x 76 x 3,0	89	91	47	49	75	77
64166430	60 x 60 x 45 x 3,0	59	61	59	61	44	46
64166530	65 x 65 x 55 x 3,0	64	66	64	66	54	56
64169025	60 x 90 x 60 x 2,5	59	61	89	91	59	61
64169030	60 x 90 x 60 x 2,5	59	61	89	91	59	61
64169125	60 x 90 x 60 x 2,5	59	61	89	91	59	61
64169225	60 x 90 x 60 x 2,5	59	61	89	91	59	61
64186020	82 x 62 x 40 x 2,0	81	83	61	63	39	41
64190525	104,5 x 104,5 x 90 x 2,5	103,5	105,5	103,5	105,5	89	91
64191225	123 x 93 x 40 x 3,0	122	124	92	94	39	41
64191225	90 x 120 x 40 x 3,0	89	91	119	121	39	41
64197020	69,5 x 69,5 x 55 x 2,0	68,5	70,5	68,5	70,5	54	56
64197115	69 x 69 x 55 x 1,5	68	70	68	70	54	56
64199020	89,5 x 89,5 x 65 x 2,0	88,5	90,5	88,5	90,5	64	66
64199115	89 x 89 x 65 x 1,5	88	90	88	90	64	66
64199430	90 x 90 x 40 x 3,0	89	91	89	91	39	41
65107025	70 x 70 x 55 x 2,5	69	71	69	71	54	56
65109025	90 x 90 x 65 x 2,5	89	91	89	91	64	66
65110530	105 x 105 x 90 x 3,0	104	106	104	106	89	91
65155425	50 x 50 x 40 x 2,5	49	51	49	51	39	41
65109625	90 x 90 x 40 x 2,5	89	91	89	91	39	41
65206000	80 x 80 x 57 x 1,5	79	81	79	81	56	58
65208000	123 x 123 x 74 x 1,5	122	124	122	124	73	75

Table A.3: Fastener specification

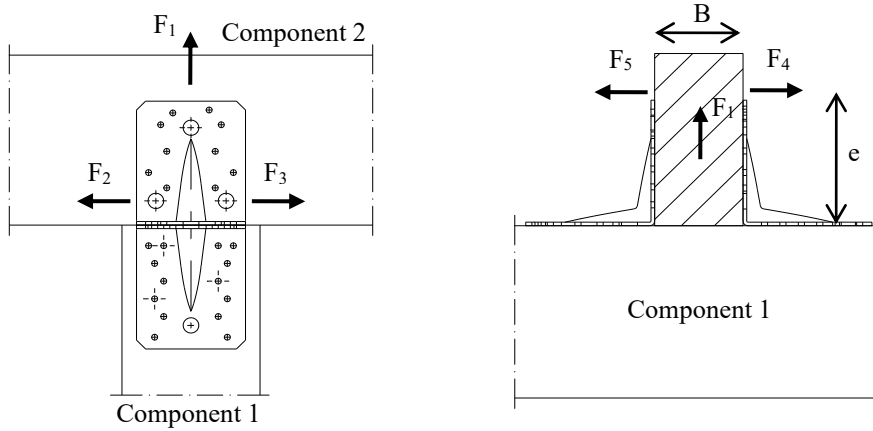
Three-dimensional nailing plate type	Nail diameter	Nail length	Nail type
Angle brackets	4.0 mm	min. 40 mm	Ringed shank nails according to EN 14592
<p>In the load-carrying capacities of the nailed connection, the capacities for threaded nails calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral nail load-carrying capacity.</p> <p>The load-carrying capacities of the angle brackets have been determined based on the use of connector nails 4,0 x 40 mm.</p> <p>The characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1:2004 + AC:2006 + A1:2008 + A2:2014, paragraph 8.3.2 (head pull-through is not relevant):</p> $F_{ax,Rk} = f_{ax,k} \times d \times t_{pen}$ <p>Where:</p> <p>$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm²</p> <p>d Nail diameter in mm</p> <p>t_{pen} Penetration depth of the profiled shank including the nail point in mm, $t_{pen} \geq 30$ mm</p> <p>Based on tests by Versuchsanstalt für Stahl, Holz und Steine, University of Karlsruhe, the characteristic value of the withdrawal resistance for the threaded nails used can be calculated as:</p> $f_{ax,k} = 50 \times 10^{-6} \times \rho_k^2$ <p>Where:</p> <p>ρ_k Characteristic density of the timber in kg/m³</p> <p>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.</p>			

BOLTS diameter	Correspondence Hole diameter	Bolts type
12.0 and 14.0	Max. 2 mm. larger than the bolt diameter	See specification of the manufacturer

METAL ANCHORS diameter	Correspondence Hole diameter	Anchors type
12.0 and 14.0	Max. 2 mm. larger than the anchor diameter	See specification of the manufacturer

Annex B Characteristic load-carrying capacities

Definitions of forces, their directions and eccentricity



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 Central lifting force acting in component 2.
- F_2 and F_3 Central lateral force acting in component 2 in axial direction of component 2.
- F_4 and F_5 Central lateral force acting in component 2 in axial direction of component 1. 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 component 2. The component 2 shall be prevented from rotation.
- F_2 and F_3 Lateral force acting in component 2 in axial direction of component 2. The component 2 shall be prevented from rotation.
- F_4 and F_5 Lateral force acting in component 2 in axial direction of component 1. F_4 is the lateral force towards the angle bracket; F_5 is the lateral force away from the angle bracket. The component 2 shall be prevented from rotation. Only 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

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 loads $F_{B,Ed}$ for the design of the maximal loaded bolt or metal anchor in a bolt or metal anchor group are calculated as:

$$F_{B,t,Ed} = k_t \cdot F_{Ed} \quad \text{for tensile load}$$

Where:

$F_{B,t,Ed}$ Bolt tensile load in N

$F_{B,v,Ed}$ Bolt shear load in N

k_t Coefficient, according to the tables B.1 to B.4

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:

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

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 .

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

B is the width of component 2.

Results angle bracket force F_1 **Table B.1:** Force F_1 Column, 2 angle brackets / connection, timber-timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9	23,24,25,26,31	2,61	2,57
61812940	120 x 90 x 40 x 4,0	1,2,3,4	8,9,10,14,15	1,21	4,67
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6	10,11,12,16,17	1,21	4,67
61816540	160 x 50 x 40 x 3,0	1,2,3,4,5,6,7	13,14	1,40	
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7	11,12	1,37	2,50
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6	9,10,11,12,13,14,15	3,63	6,43
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	4,84	8,57
63111020	100 x 100 x 100 x 2,0	1,2,3,4,5,6,7,8,9	24,25,26,27,28,29,30,31,32, 33,34,35,36,37,38,39,40,41, 42,43,44,45	5,26	4,00
63111025	100 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9	24,25,26,27,28,29,30,31,32, 33,34,35,36,37,38,39,40,41, 42,43,44,45	5,26	7,38
63114020	100 x 100 x 40 x 2,0	1,2,3,4	11,12,13,14,15,16,17,18,19, 20	2,58	
63116020	100 x 100 x 60 x 2,5	1,2,3,4,5	14,15,16,17,18,19,20,21,22, 23,24,25	2,61	3,55
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5	14,15,16,17,18,19,20,21,22, 23,24,25	2,63	3,91
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7	18,19,20,21,22,23,24,25,26, 27,28,29,30,31,32,33,34,35	5,26	3,00
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7	18,19,20,21,22,23,24,25,26, 27,28,29,30,31,32,33,34,35	5,26	4,69
63144420	40 x 40 x 40 x 2,0	-	-	-	-
63144425	40 x 40 x 40 x 2,5	-	-	-	-
63164220	60 x 40 x 25 x 2,0	-	-	-	-
63164625	60 x 40 x 60 x 2,5	-	-	-	-
63166920	60 x 60 x 90 x 2,0	-	-	-	-
63168625	60 x 80 x 60 x 2,5	1,2,3	13,14,15,16,17,18,19,20,21	3,61	3,52
63181020	80 x 80 x 100 x 2,0	1,2,3,4	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	5,10	
63181025	80 x 80 x 100 x 2,5	1,2,3,4	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	5,10	
63186020	80 x 80 x 60 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19, 20	3,82	
63186025	80 x 80 x 60 x 2,5	1,2,3	11,12,13,14,15,16,17,18,19, 20	3,70	2,81
63188020	80 x 80 x 80 x 2,0	1,2,3,4	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	5,10	3,00
63188025	80 x 80 x 80 x 2,5	1,2,3,4	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	4,93	3,75
63206020	60 x 60 x 25 x 2,0	-	-	-	-
63375320	70 x 50 x 30 x 2,0	1,2	7,8	1,66	0,28

63385325	80 x 50 x 30 x 2,5	1,2	9,10	2,11	0,68
64107020	70 x 70 x 55 x 2,0	1,2,3	12,13,14,20,21,22	3,05	1,00
64110520	105 x 105 x 90 x 2,0	1,2,6,7,8,9,10	18,19,20,21,27,28,29,33,34	4,85	2,00
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11	21,22,24,25	2,10	2,34
64141225	40 x 120 x 2,5	1,2,4,5,7,8	18,19,21,22	2,10	2,34
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14	24,25,27,28	2,10	2,34
64149025	90 x 40 x 40 x 2,5	1,2	8,9,11,12	1,83	1,67
64149030	90 x 40 x 40 x 3,0	1,2	8,9,11,12	1,83	2,41
64149042	40 x 90 x 40 x 3,0	2,3	13,14,16,17	2,10	2,34
64155320	50 x 50 x 35 x 2,5	-	-	-	-
64155320	50 x 50 x 35 x 2,0	-	-	-	-
64159025	50 x 90 x 50 x 3,0	1,3,5,6	13,14,16,17,18	1,58	1,49
64159530	90 x 50 x 50 x 3,0	1,3,5,6	13,14,16,17,18	1,60	2,15
64159830	90 x 48 x 76 x 3,0	1,2,3,6	16,17,20,21	1,95	4,11
64166530	65 x 65 x 55 x 3,0	1,2	8,9,13,14	2,21	3,38
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6	10,12,14,15,16	1,98	1,69
64169030	60 x 90 x 60 x 2,5	1,2	6,7,8,9	1,76	1,42
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6	10,11,13,14,15	1,98	1,74
64169225	60 x 90 x 60 x 2,5	1,2,4	8,9,11,12,13	1,98	1,74
64186020	83 x 62 x 40 x 2,0	1,2	6,7,8,9,10	2,32	1,31
64190525	105 x 105 x 90 x 2,5	1,2,6,7	14,15,16,17,20,21,27,28	6,39	
64191225	90 x 120 x 40x 3,0	1,2,3,4,5	10,11,12,13,14,15	2,56	2,93
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8	18,19,21,22,24,25,27,28	2,59	3,38
64197020	70 x 70 x 55 x 2,0	1,2	8,9,10,11,13,14	2,98	
64197115	70 x 70 x 55 x 1,5	1,2	8,9,10,11,13,14	2,98	
64199020	90 x 90 x 65 x 2,0	1,2	12,13,14,15,21,22	3,56	5,95
64199115	90 x 90 x 65 x 1,5	1,2	12,13,14,15,21,22	3,55	
64199430	90 x 90 x 40 x 3,0	1,2	11,12,14,15,19,20	2,30	1,82
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,15,16,20,21,22	3,05	1,56
65107025	70 x 70 x 55 x 2,5	-	-	-	
65109025	90 x 90 x 65 x 2,5	1,2,4,5	10,11,12,13,15,16,17,19,20	4,84	2,34
65109025	90 x 90 x 65 x 2,5	1,2	17,18,21,22,29,30	1,61	3,49
65109625	90 x 90 x 40 x 2,5	1,2	11,12,14,15,19,20	2,28	1,23
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	4,85	
65110530	105 x 105 x 90 x 3,0	4,5	18,19,20,21,27,28,29,33,34	6,36	6,35
65155425	50 x 50 x 40 x 2,5	-	-	-	-
65206000	80 x 80 x 60 x 1,5	1,3	8,9,10,12	1,76	4,15
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7	12,13,15,18,19,21,23,24	2,12	6,95

Table B.2: Force F₁ Column, 1 angle brackets / connection, timber-timber

Bracket number	Bracket type	Nail number n _v	Nail number n _H	F _{1,Rk} [kN] (column)	
				Timber	Steel
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9	23,24,25,26,31	1,31	1,28
61812940	120 x 90 x 40 x 4,0	1,2,3,4	8,9,10,14,15	0,61	2,33
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6	10,11,12,16,17	0,61	2,33
61816540	160 x 50 x 40 x 3,0	1,2,3,4,5,6,7	13,14	0,70	0,72
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7	11,12	0,69	1,25
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6	9,10,11,12,13,14,15	1,81	3,21
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	2,42	4,29
63111020	100 x 100 x 100 x 2,0	1,2,3,4,5,6,7,8,9	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	2,63	2,00
63111025	100 x 100 x 100 x 2,5	1,2,3,4,5,6,7,8,9	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	2,63	3,69
63114020	100 x 100 x 40 x 2,0	1,2,3,4	11,12,13,14,15,16,17,18,19,20	1,29	0,63
63116020	100 x 100 x 60 x 2,5	1,2,3,4,5	14,15,16,17,18,19,20,21,22,23,24,25	1,30	
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5	14,15,16,17,18,19,20,21,22,23,24,25	1,32	1,95
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	2,63	1,50
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	2,63	
63144420	40 x 40 x 40 x 2,0	-	-	-	-
63144425	40 x 40 x 40 x 2,5	-	-	-	-
63164220	60 x 40 x 25 x 2,0	-	-	-	-
63164625	60 x 40 x 60 x 2,5	-	-	-	-
63166920	60 x 60 x 90 x 2,0	-	-	-	-
63168625	60 x 80 x 60 x 2,5	1,2,3	13,14,15,16,17,18,19,20,21	1,80	1,76
63181020	80 x 80 x 100 x 2,0	1,2,3,4	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	2,55	
63181025	80 x 80 x 100 x 2,5	1,2,3,4	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	2,55	3,13
63186020	80 x 80 x 60 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19,20	1,91	
63186025	80 x 80 x 60 x 2,5	1,2,3	11,12,13,14,15,16,17,18,19,20	1,85	1,41
63188020	80 x 80 x 80 x 2,0	1,2,3,4	15,16,17,18,19,20,21,22,23,24,25,26,27,28	2,55	
63188025	80 x 80 x 80 x 2,5	1,2,3,4	15,16,17,18,19,20,21,22,23,24,25,26,27,28	2,47	1,88
63206020	60 x 60 x 25 x 2,0	-	-	-	-
63375320	70 x 50 x 30 x 2,0	1,2	7,8	0,83	0,14
63385325	80 x 50 x 30 x 2,5	1,2	9,10	1,06	0,34
64107020	70 x 70 x 55 x 2,0	1,2,3	12,13,14,20,21,22	1,53	0,50

64110520	105 x 105 x 90 x 2,0	1,2,6,7,8,9,10	18,19,20,21,27,28,29,33,34	2,43	1,00
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11	21,22,24,25	1,05	1,17
64141225	40 x 120 x 2,5	1,2,4,5,7,8	18,19,21,22	1,05	1,17
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14	24,25,27,28	1,05	1,17
64149025	90 x 40 x 40 x 2,5	1,2	8,9,11,12	0,91	0,84
64149030	90 x 40 x 40 x 3,0	1,2	8,9,11,12	0,91	1,21
64149042	40 x 90 x 40 x 3,0	2,3	13,14,16,17	1,05	1,17
64155320	50 x 50 x 35 x 2,5	-	-	-	-
64155320	50 x 50 x 35 x 2,0	-	-	-	-
64159025	50 x 90 x 50 x 3,0	1,3,5,6	13,14,16,17,18	0,79	0,74
64159530	90 x 50 x 50 x 3,0	1,3,5,6	13,14,16,17,18	0,80	1,07
64159830	90 x 48 x 76 x 3,0	1,2,3,6	16,17,20,21	0,97	2,06
64166530	65 x 65 x 55 x 3,0	1,2	8,9,13,14	1,10	1,69
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6	10,12,14,15,16	0,99	0,85
64169030	60 x 90 x 60 x 2,5	1,2	6,7,8,9	0,88	0,71
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6	10,11,13,14,15	0,99	0,87
64169225	60 x 90 x 60 x 2,5	1,2,4	8,9,11,12,13	0,99	0,87
64186020	83 x 62 x 40 x 2,0	1,2	6,7,8,9,10	1,16	0,66
64190525	105 x 105 x 90 x 2,5	1,2,6,7	14,15,16,17,20,21,27,28	3,19	8,68
64191225	90 x 120 x 40x 3,0	1,2,3,4,5	10,11,12,13,14,15	1,28	1,47
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8	18,19,21,22,24,25,27,28	1,30	1,69
64197020	70 x 70 x 55 x 2,0	1,2	8,9,10,11,13,14	1,49	2,72
64197115	70 x 70 x 55 x 1,5	1,2	8,9,10,11,13,14	1,49	2,10
64199020	90 x 90 x 65 x 2,0	1,2	12,13,14,15,21,22	1,78	
64199115	90 x 90 x 65 x 1,5	1,2	12,13,14,15,21,22	1,78	
64199430	90 x 90 x 40 x 3,0	1,2	11,12,14,15,19,20	1,15	0,91
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,15,16,20,21,22	1,53	0,78
65107025	70 x 70 x 55 x 2,5	-	-	-	
65109025	90 x 90 x 65 x 2,5	1,2,4,5	10,11,12,13,15,16,17,19,20	2,42	1,17
65109025	90 x 90 x 65 x 2,5	1,2	17,18,21,22,29,30	0,81	1,74
65109625	90 x 90 x 40 x 2,5	1,2	11,12,14,15,19,20	1,14	0,62
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	2,43	2,25
65110530	105 x 105 x 90 x 3,0	4,5	18,19,20,21,27,28,29,33,34	3,18	
65206000	80 x 80 x 60 x 1,5	1,3	8,9,10,12	0,88	2,07
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7	12,13,15,18,19,21,23,24	1,06	3,48

Table B.3: Force F₁ Column, 2 angle brackets / connection, timber-concrete/steel

Article-No.	Dimension	Bolt number n _v	Bolt number n _H	F _{1,Rk} [kN] (column)		Bolt k _t
				Timber	Steel	
63371066	100 x 75 x 60 x 6,0	1	2	-	7,62	0,78

Table B.4: Force F_1 Column, 1 angle bracket / connection, timber-concrete/steel

Bracket number	Bracket type	Bolt number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (column)		Bolt k_t
				Timber	Steel	
63371066	100 x 75 x 60 x 6,0	1	2	-	3,81	1,55

Table B.5: Force F_1 Purlin, 2 angle brackets / connection, timber-timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9,11,12,13,14,17,18,20	23,24,25,26,31	2,61	2,57
61812940	120 x 90 x 40 x 4,0	1,2,3,4,5,6,7	8,9,10,14,15	1,21	
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6,7,8,9	10,11,12,16,17	1,21	4,67
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7,8,9,10	11,12	1,37	
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6,7,8	9,10,11,12,13,14,15	3,63	6,43
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8,9,10,11	12,13,14,15,16,17,18,19,20	4,84	8,57
63111020	100 x 100 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	5,26	
63111025	100 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	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	5,26	7,38
63114020	100 x 100 x 40 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	2,58	1,25
63116020	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	2,61	3,55
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	2,63	3,91
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	5,26	
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	5,26	4,69
63144420	40 x 40 x 40 x 2,0	1,2	4,5,6	2,10	1,50
63144425	40 x 40 x 40 x 2,5	1,2	4,5,6	2,10	2,34
63144820	40 x 40 x 80 x 2,0	1,2,3	8,9,10,11,12,13,14	2,80	2,55
63144825	40 x 40 x 80 x 2,5	1,2,3	8,9,10,11,12,13,14	2,94	4,06
63146020	40 x 40 x 60 x 2,0	1,2,3	6,7,8,9,10	3,15	2,25
63146025	40 x 40 x 60 x 2,5	1,2,3	6,7,8,9,10	3,15	3,52
63155420	50 x 50 x 40 x 2,0	1,2,3	7,8,9,10,11,12	1,14	
63161020	60 x 60 x 100 x 2,0	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	4,81	4,00
63161025	60 x 60 x 100 x 2,5	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	4,76	5,68
63164020	60 x 60 x 40 x 2,0	1,2,3	6,7,8,9	1,11	1,31
63164025	60 x 60 x 40 x 2,5	1,2,3	6,7,8,9	1,11	2,04
63164220	60 x 40 x 25 x 2,0	1,2	4,5	0,99	0,85
63164625	60 x 40 x 60 x 2,5	1,2,3,4,5	8,9,10,11,12	2,94	2,81

63165020	60 x 60 x 50 x 2,0	1,2,3,4	7,8,9,10,11,12	2,41	2,00
63165025	60 x 60 x 50 x 2,5	1,2,3,4,5	8,9,10,11,12,13,14,15	3,45	2,19
63166020	60 x 60 x 60 x 2,0	1,2,3,4,5,6	10,12,13,14,15,16,18	3,61	2,25
63166025	60 x 60 x 60 x 2,5	1,2,3,4,5,6	10,11,12,13,14,15,16,17,18	3,34	2,63
63166820	60 x 60 x 80 x 2,0	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20, 21	3,34	3,80
63166920	60 x 60 x 90 x 2,0	1,2,3,4,5,6,7,8	13,14,15,16,17,18,19,20,21, 22,23,24	4,81	3,50
63168025	60 x 60 x 80 x 2,5	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20, 21	3,34	3,80
63168625	60 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	3,61	3,52
63181020	80 x 80 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11, 12,13	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	5,10	4,00
63181025	80 x 80 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11, 12,13	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	5,10	6,25
63184020	80 x 80 x 40 x 2,0	1,2,3,4	7,8,9,10,11,12	1,27	1,75
63184025	80 x 80 x 40 x 2,5	1,2,3,4	7,8,9,10,11,12	1,27	2,73
63186020	80 x 80 x 60 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	3,82	2,25
63186025	80 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	3,70	2,81
63188020	80 x 80 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	5,10	3,00
63188025	80 x 80 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	4,93	3,75
63206020	60 x 60 x 25 x 2,0	1,2	4,5,6	1,16	0,85
63355320	50 x 50 x 30 x 2,0	1,2	5,6	1,66	0,28
63375320	70 x 50 x 30 x 2,0	1,2,3,4,5,6	7,8	1,66	0,28
63385325	80 x 50 x 30 x 2,5	1,2,3,4,5,6	9,10	2,11	0,68
63410020	40 x 40 x 100 x 2,0	1,2,3,4,5	10,11,12,13,14,15,16,17,18	4,67	
63415020	40 x 40 x 150 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19, 20	2,86	5,19
63420020	40 x 40 x 200 x 2,0	1,2,3,4,5	16,17,18,19,20,21,22,23,24, 25,26,27,28,29,30	4,77	
64104030	50 x 50 x 40 x 3,0	1,2	6,7,9,10	1,80	1,93
64107020	70 x 70 x 55 x 2,0	1,2,3,7,8	12,13,14,20,21,22	3,05	1,00
64110520	105 x 105 x 90 x 2,0	1,2,6,8,10,11,12,14,15	18,19,20,21,27,28,29,33,34	4,85	2,00
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11,13,14, 16,17	21,22,24,25	2,10	2,34
64141225	40 x 120 x 2,5	1,2,4,5,7,8,10,11,13,14	18,19,21,22	2,10	2,34
64141640	40 x 160 x 40 x 3,0	1,2,3,4,5,6,7,8,9,10	13,14	1,40	1,44
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14, 16,17,19,20	24,25,27,28	2,10	2,34
64149025	90 x 40 x 40 x 2,5	1,2,3,4	8,9,11,12	1,83	1,67
64149030	90 x 40 x 40 x 3,0	1,2,3,4	8,9,11,12	1,83	2,41
64149042	40 x 90 x 40 x 3,0	2,3,5,6,8,9	13,14,16,17	2,10	2,34
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	2,12	
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	1,93	1,26

64155320	50 x 50 x 35 x 2,0	1,2	6,7,9,10	1,93	0,55
64159025	50 x 90 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	1,58	1,49
64159530	90 x 50 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	1,60	2,15
64159830	90 x 48 x 76 x 3,0	1,2,3,6,7,8,9,10,11,12	16,17,20,21	1,95	4,11
64166430	60 x 60 x 45 x 3,0	1,2,3,5	8,9,13,14	2,00	2,25
64166530	65 x 65 x 55 x 3,0	1,2,3,4	8,9,13,14	2,21	3,38
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,9	10,12,14,15,16	1,98	1,69
64169030	60 x 90 x 60 x 2,5	1,2,3	6,7,8,9	1,76	1,42
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6,7,9	10,11,13,14,15	1,98	1,74
64169225	60 x 90 x 60 x 2,5	1,2,4,5,6	8,9,11,12,13	1,98	1,74
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	2,32	1,31
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	6,39	17,4
64191225	90 x 120 x 40x 3,0	1,2,3,4,5,6,7,8	10,11,12,13,14,15	2,56	2,93
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8,10,11,13,14	18,19,21,22,24,25,27,28	2,59	3,38
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	2,98	5,44
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	2,98	4,21
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	3,56	5,95
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	3,55	4,42
64199430	90 x 90 x 40 x 3,0	1,2,4,5,6,7	11,12,14,15,19,20	2,30	1,82
65107025	70 x 70 x 55 x 2,5	1,2,3,4,6,7,8,	12,13,14,15,16,20,21,22	3,05	1,56
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,20,21,22	3,28	1,38
65109025	90 x 90 x 65 x 2,5	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	4,84	2,34
65109025	90 x 90 x 65 x 2,5	1,2,7,9,10	17,18,21,22,29,30	1,61	3,49
65109625	90 x 90 x 40 x 2,5	1,2,4,5,6,7	11,12,14,15,19,20	2,28	1,23
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10,11,12,13, 14,15	18,19,20,21,27,28,29,33,34	4,85	4,50
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	6,76	6,35
65155425	50 x 50 x 40 x 2,5	1,2	6,7,9,10	1,80	1,34
65206000	80 x 80 x 60 x 1,5	1,3,4,5	8,9,10,12	1,76	4,15
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7,10	12,13,15,18,19,21,23,24	2,12	

Table B.6: Force F_1 Purlin, 1 angle bracket / connection, timber-timber

Bracket number	Bracket type	Nail number n_v	Nail number n_H	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9,11,12,13,14, 17,18,20	23,24,25,26,31	1,31	1,28
61812940	120 x 90 x 40 x 4,0	1,2,3,4,5,6,7	8,9,10,14,15	0,61	2,33
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6,7,8,9	10,11,12,16,17	0,61	2,33
61816540	160 x 50 x 40 x 3,0	1,2,3,4,5,6,7,8,9,10	13,14	0,70	
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7,8,9,10	11,12	0,69	1,25
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6,7,8	9,10,11,12,13,14,15	1,81	3,21
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8,9,10,11	12,13,14,15,16,17,18,19,20	2,42	4,29

63111020	100 x 100 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	2,63	2,00
63111025	100 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	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	2,63	3,69
63114020	100 x 100 x 40 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	1,29	0,63
63116020	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	1,30	1,78
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	1,32	1,95
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	2,63	1,50
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	2,63	2,34
63144420	40 x 40 x 40 x 2,0	1,2	4,5,6	1,05	0,75
63144425	40 x 40 x 40 x 2,5	1,2	4,5,6	1,05	1,17
63144820	40 x 40 x 80 x 2,0	1,2,3	8,9,10,11,12,13,14	1,40	
63144825	40 x 40 x 80 x 2,5	1,2,3	8,9,10,11,12,13,14	1,47	
63146020	40 x 40 x 60 x 2,0	1,2,3	6,7,8,9,10	1,58	1,13
63146025	40 x 40 x 60 x 2,5	1,2,3	6,7,8,9,10	1,58	
63155420	50 x 50 x 40 x 2,0	1,2,3	7,8,9,10,11,12	0,57	
63161020	60 x 60 x 100 x 2,0	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	2,41	2,00
63161025	60 x 60 x 100 x 2,5	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	2,38	2,84
63164020	60 x 60 x 40 x 2,0	1,2,3	6,7,8,9	0,56	0,65
63164025	60 x 60 x 40 x 2,5	1,2,3	6,7,8,9	0,56	
63164220	60 x 40 x 25 x 2,0	1,2	4,5	0,50	0,43
63164625	60 x 40 x 60 x 2,5	1,2,3,4,5	8,9,10,11,12	1,47	1,41
63165020	60 x 60 x 50 x 2,0	1,2,3,4	7,8,9,10,11,12	1,20	1,00
63165025	60 x 60 x 50 x 2,5	1,2,3,4,5	8,9,10,11,12,13,14,15	1,73	
63166020	60 x 60 x 60 x 2,0	1,2,3,4,5,6	10,12,13,14,15,16,18	1,80	1,13
63166025	60 x 60 x 60 x 2,5	1,2,3,4,5,6	10,11,12,13,14,15,16,17,18	1,67	1,31
63166820	60 x 60 x 80 x 2,0	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20,21	1,67	1,90
63166920	60 x 60 x 90 x 2,0	1,2,3,4,5,6,7,8	13,14,15,16,17,18,19,20,21,22,23,24	2,41	1,75
63168025	60 x 60 x 80 x 2,5	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20,21	1,67	1,90
63168625	60 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	1,80	1,76
63181020	80 x 80 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	2,55	2,00
63181025	80 x 80 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	2,55	3,13
63184020	80 x 80 x 40 x 2,0	1,2,3,4	7,8,9,10,11,12	0,64	0,88
63184025	80 x 80 x 40 x 2,5	1,2,3,4	7,8,9,10,11,12	0,64	1,37
63186020	80 x 80 x 60 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	1,91	1,13

63186025	80 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	1,85	1,41
63188020	80 x 80 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23,24,25,26,27,28	2,55	1,50
63188025	80 x 80 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23,24,25,26,27,28	2,47	1,88
63206020	60 x 60 x 25 x 2,0	1,2	4,5,6	0,58	0,43
63355320	50 x 50 x 30 x 2,0	1,2	5,6	0,83	
63375320	70 x 50 x 30 x 2,0	1,2,3,4,5,6	7,8	0,83	
63385325	80 x 50 x 30 x 2,5	1,2,3,4,5,6	9,10	1,06	
63410020	40 x 40 x 100 x 2,0	1,2,3,4,5	10,11,12,13,14,15,16,17,18	2,33	1,47
63415020	40 x 40 x 150 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19,20	1,43	2,60
63420020	40 x 40 x 200 x 2,0	1,2,3,4,5	16,17,18,19,20,21,22,23,24,25,26,27,28,29,30	2,38	3,37
64104030	50 x 50 x 40 x 3,0	1,2	6,7,9,10	0,90	0,96
64107020	70 x 70 x 55 x 2,0	1,2,3,7,8	12,13,14,20,21,22	1,53	
64110520	105 x 105 x 90 x 2,0	1,2,6,8,10,11,12,14,15	18,19,20,21,27,28,29,33,34	2,43	
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11,13,14,16,17	21,22,24,25	1,05	
64141225	40 x 120 x 2,5	1,2,4,5,7,8,10,11,13,14	18,19,21,22	1,05	1,17
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14,16,17,19,20	24,25,27,28	1,05	
64149025	90 x 40 x 40 x 2,5	1,2,3,4	8,9,11,12	0,91	0,84
64149030	90 x 40 x 40 x 3,0	1,2,3,4	8,9,11,12	0,91	1,21
64149042	40 x 90 x 40 x 3,0	2,3,5,6,8,9	13,14,16,17	1,05	
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	1,06	0,78
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	0,96	0,63
64155320	50 x 50 x 35 x 2,0	1,2	6,7,9,10	0,96	
64159025	50 x 90 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	0,79	0,74
64159530	90 x 50 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	0,80	1,07
64159830	90 x 48 x 76 x 3,0	1,2,3,6,7,8,9,10,11,12	16,17,20,21	0,97	2,06
64166430	60 x 60 x 45 x 3,0	1,2,3,5	8,9,13,14	1,00	1,13
64166530	65 x 65 x 55 x 3,0	1,2,3,4	8,9,13,14	1,10	
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,9	10,12,14,15,16	0,99	0,85
64169030	60 x 90 x 60 x 2,5	1,2,3	6,7,8,9	0,88	0,71
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6,7,9	10,11,13,14,15	0,99	0,87
64169225	60 x 90 x 60 x 2,5	1,2,4,5,6	8,9,11,12,13	0,99	0,87
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	1,16	0,66
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	3,19	8,68
64191225	90 x 120 x 40x 3,0	1,2,3,4,5,6,7,8	10,11,12,13,14,15	1,28	1,47
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8,10,11,13,14	18,19,21,22,24,25,27,28	1,30	1,69
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	1,49	2,72
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	1,49	2,10
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	1,78	2,97

64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	1,78	2,21
64199430	90 x 90 x 40 x 3,0	1,2,4,5,6,7	11,12,14,15,19,20	1,15	0,91
65107025	70 x 70 x 55 x 2,5	1,2,3,4,6,7,8,	12,13,14,15,16,20,21,22	1,53	
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,20,21,22	1,64	0,69
65109025	90 x 90 x 65 x 2,5	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	2,42	1,17
65109025	90 x 90 x 65 x 2,5	1,2,7,9,10	17,18,21,22,29,30	0,81	1,74
65109625	90 x 90 x 40 x 2,5	1,2,4,5,6,7	11,12,14,15,19,20	1,14	
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10,11,12,13, 14,15	18,19,20,21,27,28,29,33,34	2,43	
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	3,38	3,18
65155425	50 x 50 x 40 x 2,5	1,2	6,7,9,10	0,90	
65206000	80 x 80 x 60 x 1,5	1,3,4,5	8,9,10,12	0,88	2,07
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7,10	12,13,15,18,19,21,23,24	1,06	3,48

Table B.7: Force F_1 Purlin, 2 angle brackets / connection, timber-concrete/steel

Article-No.	Dimension	Bolt number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (purlin)		Bolt k_t
				Timber	Steel	
63371066	100 x 75 x 60 x 6,0	1	2	-	7,62	

Table B.8: Force F_1 Purlin, 1 angle bracket / connection, timber-concrete/steel

Bracket number	Bracket type	Bolt number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (purlin)		Bolt k_t
				Timber	Steel	
63371066	100 x 75 x 60 x 6,0	1	2	-	3,81	1,55

Results angle bracket force F_2 / F_3 **Table B.9:** Force $F_{2/3}$ Purlin, 2 angle brackets / connection, timber-timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{2/3,Rk}$ [kN]
				(purlin) Timber
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9,11,12,13,14,17,18,20	23,24,25,26,31	9,16
61812940	120 x 90 x 40 x 4,0	1,2,3,4,5,6,7	8,9,10,14,15	4,89
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6,7,8,9	10,11,12,16,17	4,94
61816540	160 x 50 x 40 x 3,0	1,2,3,4,5,6,7,8,9,10	13,14	2,89
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7,8,9,10	11,12	2,80
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6,7,8	9,10,11,12,13,14,15	7,42
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8,9,10,11	12,13,14,15,16,17,18,19,20	9,43
63111020	100 x 100 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	20,9
63111025	100 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	24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45	20,2
63114020	100 x 100 x 40 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	7,06
63116020	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	8,61
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	8,85
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	15,6
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	15,5
63144420	40 x 40 x 40 x 2,0	1,2	4,5,6	2,64
63144425	40 x 40 x 40 x 2,5	1,2	4,5,6	2,62
63144820	40 x 40 x 80 x 2,0	1,2,3	8,9,10,11,12,13,14	6,67
63144825	40 x 40 x 80 x 2,5	1,2,3	8,9,10,11,12,13,14	6,35
63146020	40 x 40 x 60 x 2,0	1,2,3	6,7,8,9,10	5,34
63146025	40 x 40 x 60 x 2,5	1,2,3	6,7,8,9,10	5,31
63155420	50 x 50 x 40 x 2,0	1,2,3	7,8,9,10,11,12	3,35
63161020	60 x 60 x 100 x 2,0	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	14,3
63161025	60 x 60 x 100 x 2,5	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	13,8
63164020	60 x 60 x 40 x 2,0	1,2,3	6,7,8,9	2,20
63164025	60 x 60 x 40 x 2,5	1,2,3	6,7,8,9	2,18
63164220	60 x 40 x 25 x 2,0	1,2	4,5	1,82
63164625	60 x 40 x 60 x 2,5	1,2,3,4,5	8,9,10,11,12	5,20
63165020	60 x 60 x 50 x 2,0	1,2,3,4	7,8,9,10,11,12	4,36
63165025	60 x 60 x 50 x 2,5	1,2,3,4,5	8,9,10,11,12,13,14,15	6,27
63166020	60 x 60 x 60 x 2,0	1,2,3,4,5,6	10,12,13,14,15,16,18	6,28

63166025	60 x 60 x 60 x 2,5	1,2,3,4,5,6	10,11,12,13,14,15,16,17,18	7,23
63166820	60 x 60 x 80 x 2,0	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20, 21	9,22
63166920	60 x 60 x 90 x 2,0	1,2,3,4,5,6,7,8	13,14,15,16,17,18,19,20,21, 22,23,24	12,6
63168025	60 x 60 x 80 x 2,5	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20, 21	9,22
63168625	60 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	9,17
63181020	80 x 80 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11, 12,13	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	17,6
63181025	80 x 80 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11, 12,13	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	17,7
63184020	80 x 80 x 40 x 2,0	1,2,3,4	7,8,9,10,11,12	3,17
63184025	80 x 80 x 40 x 2,5	1,2,3,4	7,8,9,10,11,12	3,15
63186020	80 x 80 x 60 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	8,77
63186025	80 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	8,38
63188020	80 x 80 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	13,7
63188025	80 x 80 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	12,9
63206020	60 x 60 x 25 x 2,0	1,2	4,5,6	1,86
63355320	50 x 50 x 30 x 2,0	1,2	5,6	2,38
63375320	70 x 50 x 30 x 2,0	1,2,3,4,5,6	7,8	2,83
63385325	80 x 50 x 30 x 2,5	1,2,3,4,5,6	9,10	2,26
63410020	40 x 40 x 100 x 2,0	1,2,3,4,5	10,11,12,13,14,15,16,17,18	12,1
63415020	40 x 40 x 150 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19, 20	9,69
63420020	40 x 40 x 200 x 2,0	1,2,3,4,5	16,17,18,19,20,21,22,23,24, 25,26,27,28,29,30	16,1
64104030	50 x 50 x 40 x 3,0	1,2	6,7,9,10	2,53
64107020	70 x 70 x 55 x 2,0	1,2,3,7,8	12,13,14,20,21,22	5,38
64110520	105 x 105 x 90 x 2,0	1,2,6,8,10,11,12,14,15	18,19,20,21,27,28,29,33,34	10,5
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11,13,14, 16,17	21,22,24,25	5,73
64141225	40 x 120 x 2,5	1,2,4,5,7,8,10,11,13,14	18,19,21,22	5,73
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14, 16,17,19,20	24,25,27,28	5,73
64149025	90 x 40 x 40 x 2,5	1,2,3,4	8,9,11,12	3,19
64149030	90 x 40 x 40 x 3,0	1,2,3,4	8,9,11,12	3,17
64149042	40 x 90 x 40 x 3,0	2,3,5,6,8,9	13,14,16,17	3,95
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	2,59
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	2,82
64155320	50 x 50 x 35 x 2,0	1,2	6,7,9,10	2,84
64159025	50 x 90 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	5,50
64159530	90 x 50 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	5,46
64159830	90 x 48 x 76 x 3,0	1,2,3,6,7,8,9,10,11,12	16,17,20,21	7,78

64166430	60 x 60 x 45 x 3,0	1,2,3,5	8,9,13,14	4,23
64166530	65 x 65 x 55 x 3,0	1,2,3,4	8,9,13,14	5,30
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,9	10,12,14,15,16	6,03
64169030	60 x 90 x 60 x 2,5	1,2,3	6,7,8,9	2,99
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6,7,9	10,11,13,14,15	5,76
64169225	60 x 90 x 60 x 2,5	1,2,4,5,6	8,9,11,12,13	5,36
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	4,11
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	9,17
64191225	90 x 120 x 40x 3,0	1,2,3,4,5,6,7,8	10,11,12,13,14,15	5,68
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8,10,11,13,14	18,19,21,22,24,25,27,28	7,60
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	5,49
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	5,56
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	6,82
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	6,87
64199430	90 x 90 x 40 x 3,0	1,2,4,5,6,7	11,12,14,15,19,20	4,70
65107025	70 x 70 x 55 x 2,5	1,2,3,4,6,7,8,	12,13,14,15,16,20,21,22	7,18
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,20,21,22	2,59
65109025	90 x 90 x 65 x 2,5	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	7,10
65109025	90 x 90 x 65 x 2,5	1,2,7,9,10	17,18,21,22,29,30	3,68
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10,11,12,13, 14,15	18,19,20,21,27,28,29,33,34	11,5
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	6,53
65206000	80 x 80 x 60 x 1,5	1,3,4,5	8,9,10,12	3,82
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7,10	12,13,15,18,19,21,23,24	5,76

Table B.10: Force $F_{2/3}$ Purlin, 1 angle bracket / connection, timber-timber

Bracket number	Bracket type	Nail number n_v	Nail number n_H	$F_{2/3,Rk}$ [kN] (purlin)
				Timber
50031362	90 x 50 x 116 x 3,0	1,2,3,5,6,9,11,12,13,14, 17,18,20	23,24,25,26,31	4,58
61812940	120 x 90 x 40 x 4,0	1,2,3,4,5,6,7	8,9,10,14,15	2,44
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6,7,8,9	10,11,12,16,17	2,47
61816540	160 x 50 x 40 x 3,0	1,2,3,4,5,6,7,8,9,10	13,14	1,45
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7,8,9,10	11,12	1,40
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6,7,8	9,10,11,12,13,14,15	3,71
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8,9,10,11	12,13,14,15,16,17,18,19,20	4,71
63111020	100 x 100 x 100 x 2,0	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, 33,34,35,36,37,38,39,40,41, 42,43,44,45	10,5
63111025	100 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, 33,34,35,36,37,38,39,40,41, 42,43,44,45	10,1
63114020	100 x 100 x 40 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	3,53

63116020	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	4,30
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22,23,24,25	4,42
63118020	100 x 100 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	7,81
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13,14	18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35	7,76
63144420	40 x 40 x 40 x 2,0	1,2	4,5,6	1,32
63144425	40 x 40 x 40 x 2,5	1,2	4,5,6	1,31
63144820	40 x 40 x 80 x 2,0	1,2,3	8,9,10,11,12,13,14	3,34
63144825	40 x 40 x 80 x 2,5	1,2,3	8,9,10,11,12,13,14	3,17
63146020	40 x 40 x 60 x 2,0	1,2,3	6,7,8,9,10	2,67
63146025	40 x 40 x 60 x 2,5	1,2,3	6,7,8,9,10	2,65
63155420	50 x 50 x 40 x 2,0	1,2,3	7,8,9,10,11,12	1,68
63161020	60 x 60 x 100 x 2,0	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	7,16
63161025	60 x 60 x 100 x 2,5	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23,24,25,26,27	6,89
63164020	60 x 60 x 40 x 2,0	1,2,3	6,7,8,9	1,10
63164025	60 x 60 x 40 x 2,5	1,2,3	6,7,8,9	1,09
63164220	60 x 40 x 25 x 2,0	1,2	4,5	0,91
63164625	60 x 40 x 60 x 2,5	1,2,3,4,5	8,9,10,11,12	2,60
63165020	60 x 60 x 50 x 2,0	1,2,3,4	7,8,9,10,11,12	2,18
63165025	60 x 60 x 50 x 2,5	1,2,3,4,5	8,9,10,11,12,13,14,15	3,13
63166020	60 x 60 x 60 x 2,0	1,2,3,4,5,6	10,12,13,14,15,16,18	3,14
63166025	60 x 60 x 60 x 2,5	1,2,3,4,5,6	10,11,12,13,14,15,16,17,18	3,62
63166820	60 x 60 x 80 x 2,0	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20,21	4,61
63166920	60 x 60 x 90 x 2,0	1,2,3,4,5,6,7,8	13,14,15,16,17,18,19,20,21,22,23,24	6,30
63168025	60 x 60 x 80 x 2,5	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20,21	4,61
63168625	60 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	4,58
63181020	80 x 80 x 100 x 2,0	1,2,3,4,5,6,7,8,9,10,11,12,13	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	8,81
63181025	80 x 80 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11,12,13	19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36	8,84
63184020	80 x 80 x 40 x 2,0	1,2,3,4	7,8,9,10,11,12	1,59
63184025	80 x 80 x 40 x 2,5	1,2,3,4	7,8,9,10,11,12	1,58
63186020	80 x 80 x 60 x 2,0	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	4,38
63186025	80 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19,20	4,19
63188020	80 x 80 x 80 x 2,0	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23,24,25,26,27,28	6,85
63188025	80 x 80 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23,24,25,26,27,28	6,47
63206020	60 x 60 x 25 x 2,0	1,2	4,5,6	0,93

63355320	50 x 50 x 30 x 2,0	1,2	5,6	1,19
63375320	70 x 50 x 30 x 2,0	1,2,3,4,5,6	7,8	1,42
63385325	80 x 50 x 30 x 2,5	1,2,3,4,5,6	9,10	1,13
63410020	40 x 40 x 100 x 2,0	1,2,3,4,5	10,11,12,13,14,15,16,17,18	6,08
63415020	40 x 40 x 150 x 2,0	1,2,3	11,12,13,14,15,16,17,18,19,20	4,85
63420020	40 x 40 x 200 x 2,0	1,2,3,4,5	16,17,18,19,20,21,22,23,24,25,26,27,28,29,30	8,08
64104030	50 x 50 x 40 x 3,0	1,2	6,7,9,10	1,27
64107020	70 x 70 x 55 x 2,0	1,2,3,7,8	12,13,14,20,21,22	2,69
64110520	105 x 105 x 90 x 2,0	1,2,6,8,10,11,12,14,15	18,19,20,21,27,28,29,33,34	5,24
64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11,13,14,16,17	21,22,24,25	2,87
64141225	40 x 120 x 2,5	1,2,4,5,7,8,10,11,13,14	18,19,21,22	2,87
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14,16,17,19,20	24,25,27,28	2,87
64149025	90 x 40 x 40 x 2,5	1,2,3,4	8,9,11,12	1,59
64149030	90 x 40 x 40 x 3,0	1,2,3,4	8,9,11,12	1,58
64149042	40 x 90 x 40 x 3,0	2,3,5,6,8,9	13,14,16,17	1,98
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	1,29
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	1,41
64155320	50 x 50 x 35 x 2,0	1,2	6,7,9,10	1,42
64159025	50 x 90 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	2,75
64159530	90 x 50 x 50 x 3,0	1,3,5,6,7,8,9	13,14,16,17,18	2,73
64159830	90 x 48 x 76 x 3,0	1,2,3,6,7,8,9,10,11,12	16,17,20,21	3,89
64166430	60 x 60 x 45 x 3,0	1,2,3,5	8,9,13,14	2,11
64166530	65 x 65 x 55 x 3,0	1,2,3,4	8,9,13,14	2,65
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,9	10,12,14,15,16	3,01
64169030	60 x 90 x 60 x 2,5	1,2,3	6,7,8,9	1,50
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6,7,9	10,11,13,14,15	2,88
64169225	60 x 90 x 60 x 2,5	1,2,4,5,6	8,9,11,12,13	2,68
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	2,05
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	4,58
64191225	90 x 120 x 40x 3,0	1,2,3,4,5,6,7,8	10,11,12,13,14,15	2,84
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8,10,11,13,14	18,19,21,22,24,25,27,28	3,80
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	2,75
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	2,78
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	3,41
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	3,43
64199430	90 x 90 x 40 x 3,0	1,2,4,5,6,7	11,12,14,15,19,20	2,35
65107025	70 x 70 x 55 x 2,5	1,2,3,4,6,7,8,	12,13,14,15,16,20,21,22	3,59
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,20,21,22	1,30
65109025	90 x 90 x 65 x 2,5	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	3,55
65109025	90 x 90 x 65 x 2,5	1,2,7,9,10	17,18,21,22,29,30	1,84

65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10,11,12,13, 14,15	18,19,20,21,27,28,29,33,34	5,74
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	3,26
65206000	80 x 80 x 60 x 1,5	1,3,4,5	8,9,10,12	1,91
65208000	120 x 120 x 75 x 1,5	1,2,4,6,7,10	12,13,15,18,19,21,23,24	2,88

Results angle bracket force F_4 / F_5 **Table B.11:** Basic Force $F_{4/5}$ Purlin, 2 angle brackets / connection, timber-timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{4/5,Rk}$ [kN] (purlin)	
				Timber	Steel
61812940	120 x 90 x 40 x 4,0	1,2,3,4,5,6,7	8,9,10,14,15	4,86	4,96
61814940	140 x 90 x 40 x 4,0	1,2,3,4,5,6,7,8,9	10,11,12,16,17	5,01	4,95
61816540	160 x 50 x 40 x 4,0	1,2,3,4,5,6,7,8,9,10	11,12	4,21	5,03
61816640	160 x 80 x 60 x 4,0	1,2,3,4,5,6,7,8	9,10,11,12,13,14,15	7,31	
61816840	160 x 80 x 80 x 4,0	1,2,3,4,5,6,7,8,9,10,11	12,13,14,15,16,17,18,19,20	9,27	
63111025	100 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, 33,34,35,36,37,38,39,40,41, 42,43,44,45	13,2	7,64
63116025	100 x 100 x 60 x 2,5	1,2,3,4,5,6,7,8,9,10	14,15,16,17,18,19,20,21,22, 23,24,25	7,36	3,88
63118025	100 x 100 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11, 12,13,14	18,19,20,21,22,23,24,25,26, 27,28,29,30,31,32,33,34,35	6,01	3,96
63144420	40 x 40 x 40 x 2,0	1,2	4,5,6	3,46	1,52
63144425	40 x 40 x 40 x 2,5	1,2	4,5,6	4,08	
63144825	40 x 40 x 80 x 2,5	1,2,3	8,9,10,11,12,13,14	10,6	4,77
63146025	40 x 40 x 60 x 2,5	1,2,3	6,7,8,9,10	7,22	3,20
63161025	60 x 60 x 100 x 2,5	1,2,3,4,5,6,7,8,9	15,16,17,18,19,20,21,22,23, 24,25,26,27	11,4	6,31
63164025	60 x 60 x 40 x 2,5	1,2,3	6,7,8,9	3,56	2,49
63164220	60 x 40 x 25 x 2,0	1,2	4,5	2,51	
63164625	60 x 40 x 60 x 2,5	1,2,3,4,5	8,9,10,11,12	6,85	3,60
63165025	60 x 60 x 50 x 2,5	1,2,3,4,5	8,9,10,11,12,13,14,15	7,18	2,97
63166025	60 x 60 x 60 x 2,5	1,2,3,4,5,6	10,11,12,13,14,15,16,17,18	7,40	3,86
63166920	60 x 60 x 90 x 2,0	1,2,3,4,5,6,7,8	13,14,15,16,17,18,19,20,21, 22,23,24	7,64	
63168025	60 x 60 x 80 x 2,5	1,2,3,4,5,6,7	12,13,14,15,16,17,18,19,20, 21	8,50	
63168625	60 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21	7,90	
63181025	80 x 80 x 100 x 2,5	1,2,3,4,5,6,7,8,9,10,11, 12,13	19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,35,36	12,7	4,75
63184025	80 x 80 x 40 x 2,5	1,2,3,4	7,8,9,10,11,12	4,04	
63186025	80 x 80 x 60 x 2,5	1,2,3,4,5,6,7,8	11,12,13,14,15,16,17,18,19, 20	8,11	3,98
63188025	80 x 80 x 80 x 2,5	1,2,3,4,5,6,7,8,9,10,11	15,16,17,18,19,20,21,22,23, 24,25,26,27,28	11,0	5,27
63206020	60 x 60 x 25 x 2,0	1,2	4,5,6	2,51	1,10
63355320	50 x 50 x 30 x 2,0	1,2	5,6	4,09	1,14
63375320	70 x 50 x 30 x 2,0	1,2,3,4,5,6	7,8	4,28	1,14
63385325	80 x 50 x 30 x 2,5	1,2,3,4,5,6	9,10	4,15	1,52
64107020	70 x 70 x 55 x 2,0	1,2,3,7,8	12,13,14,20,21,22	5,57	2,60
64110520	105 x 105 x 90 x 2,0	1,2,6,8,10,11,12,14,15	18,19,20,21,27,28,29,33,34	7,57	3,90

64114034	140 x 35 x 40 x 2,5	1,2,4,5,7,8,10,11,13,14,16,17	21,22,24,25	5,15	2,53
64141225	40 x 120 x 2,5	1,2,4,5,7,8,10,11,13,14	18,19,21,22	5,13	2,54
64141640	40 x 160 x 40 x 3,0	1,2,4,5,7,8,10,11,13,14,16,17,19,20	24,25,27,28	5,06	2,55
64149042	40 x 90 x 40 x 3,0	2,3,5,6,8,9	13,14,16,17	5,01	2,58
64155320	50 x 50 x 35 x 2,5	1,2	6,7,9,10	3,39	1,77
64155320	50 x 50 x 35 x 2,0	1,2	6,7,9,10	2,93	0,94
64166530	65 x 65 x 55 x 3,0	1,2,3,4	8,9,13,14	6,69	3,70
64169025	60 x 90 x 60 x 2,5	1,2,3,4,5,6,7,9	10,12,14,15,16	7,97	5,26
64169125	60 x 90 x 60 x 2,5	1,2,4,5,6,7,9	10,11,13,14,15	7,65	3,62
64169225	60 x 90 x 60 x 2,5	1,2,4,5,6	8,9,11,12,13	7,05	3,53
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	4,81	2,48
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	10,4	9,95
64191225	90 x 120 x 40x 3,0	1,2,4,5,7,8,10,11,13,14	18,19,21,22,24,25,27,28	5,86	2,94
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	6,74	4,25
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	6,64	3,34
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	8,18	
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	8,28	
65107025	70 x 70 x 55 x 2,5	1,2,3	12,13,14,20,21,22	-	-
65109025	90 x 90 x 65 x 2,5	1,2,7,9,10	17,18,21,22,29,30	-	-
65110530	105 x 105 x 90 x 3,0	1,2,4,5,6,8,10	18,19,20,21,27,28,29,33,34	-	-

Table B.12: Basic Force F_4 Purlin, 1 angle bracket / connection, timber-timber

Bracket number	Bracket type	Nail number n_v	Nail number n_H	$F_{4,Rk}$ [kN] (purlin)	
				Timber	Steel
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	4,22	1,53
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	11,7	7,47
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	7,03	3,26
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	6,68	2,59
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	7,68	3,89
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	7,67	

Table B.13: Basic Force F_5 Purlin, 1 angle bracket / connection, timber-timber

Bracket number	Bracket type	Nail number n_v	Nail number n_H	$F_{5,Rk}$ [kN] (purlin)	
				Timber	Steel
64186020	83 x 62 x 40 x 2,0	1,2,3,4,5	6,7,8,9,10	1,03	
64190525	105 x 105 x 90 x 2,5	1,2,6,7,8,9,10,11	14,15,16,17,20,21,27,28	2,58	
64197020	70 x 70 x 55 x 2,0	1,2,4,5	8,9,10,11,13,14	1,57	
64197115	70 x 70 x 55 x 1,5	1,2,4,5	8,9,10,11,13,14	1,49	0,98
64199020	90 x 90 x 65 x 2,0	1,2,6,7,8,9	12,13,14,15,21,22	1,78	1,70
64199115	90 x 90 x 65 x 1,5	1,2,6,7,8,9	12,13,14,15,21,22	1,72	1,25

BB Angle Brackets

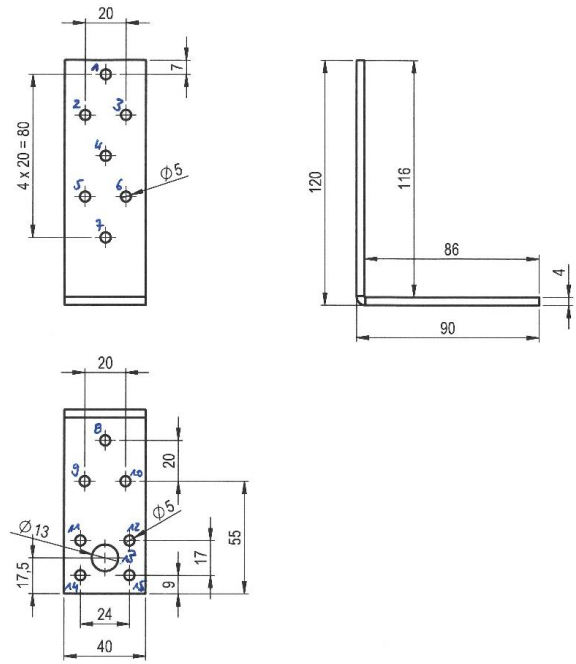
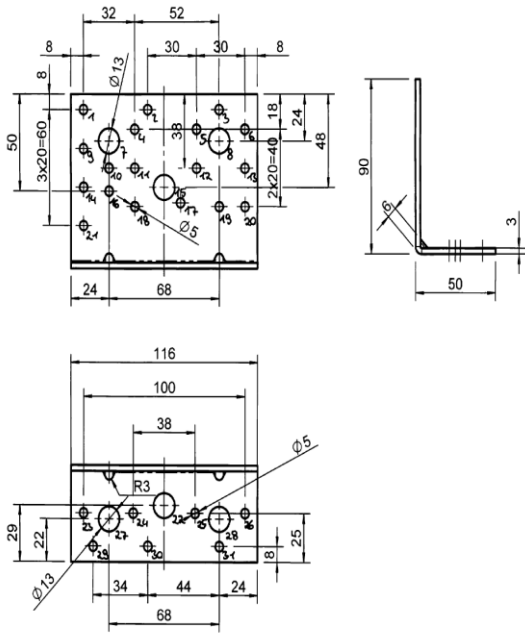


Figure B. 1 Dimensions of Angle Bracket 50031362

Figure B. 2 Dimensions of Angle Bracket 61812940

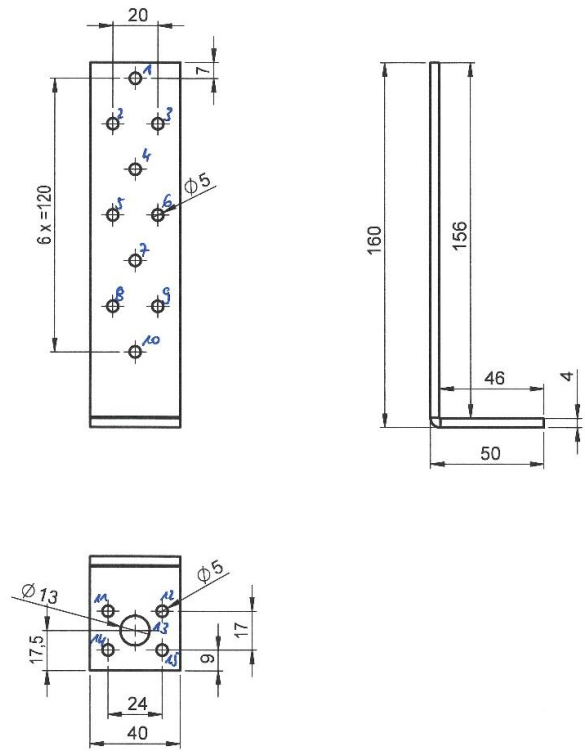
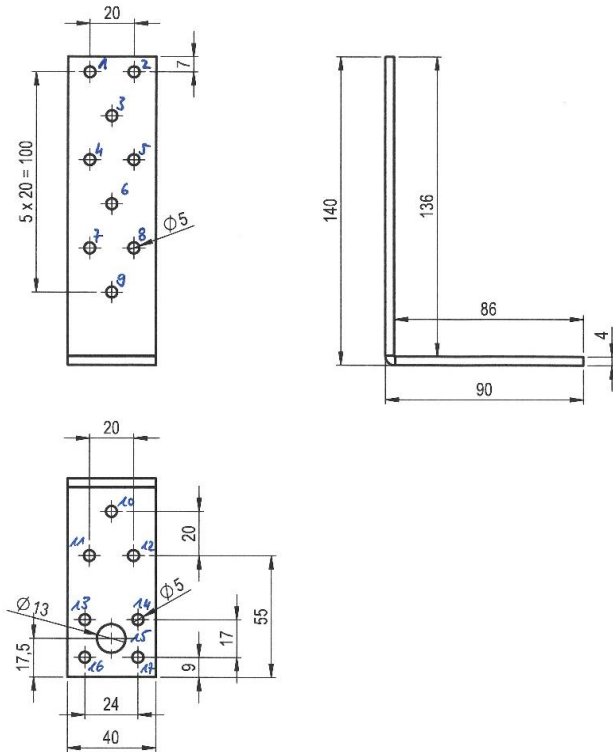


Figure B. 3 Dimensions of Angle Bracket 61814940

Figure B. 4 Dimensions of Angle Bracket 61816540

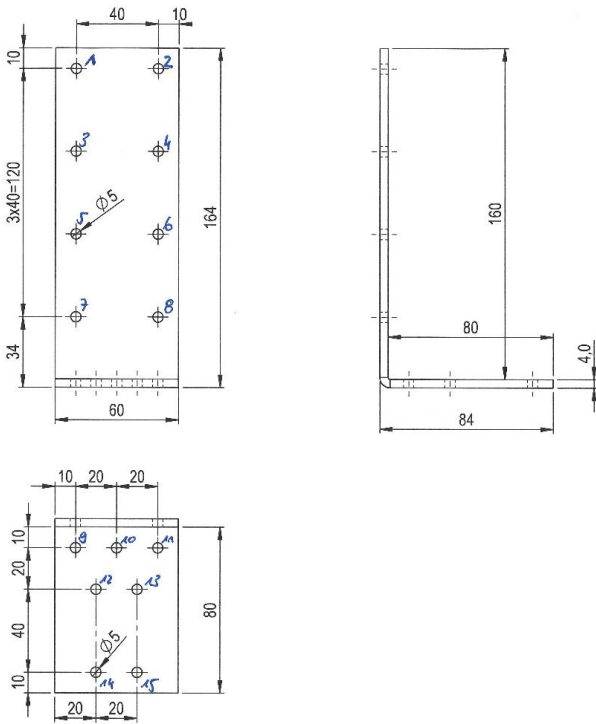


Figure B. 5 Dimensions of Angle Bracket 61816640

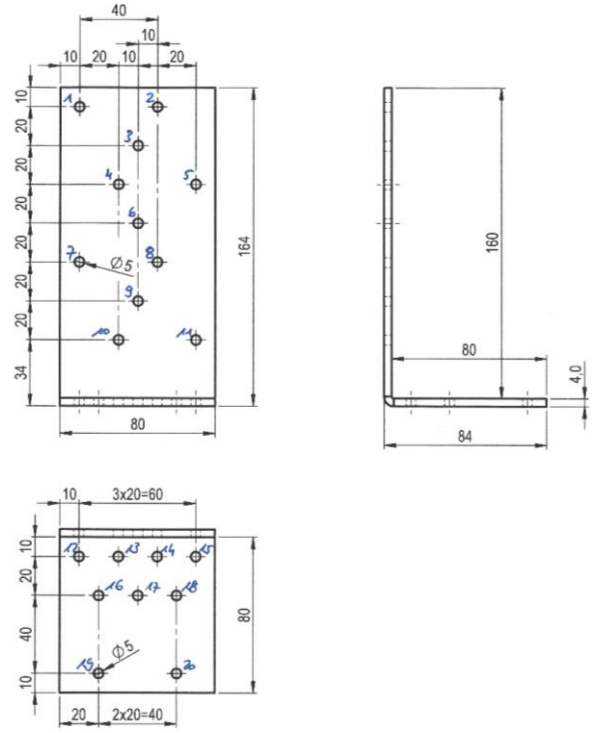


Figure B. 6 Dimensions of Angle Bracket 61816840

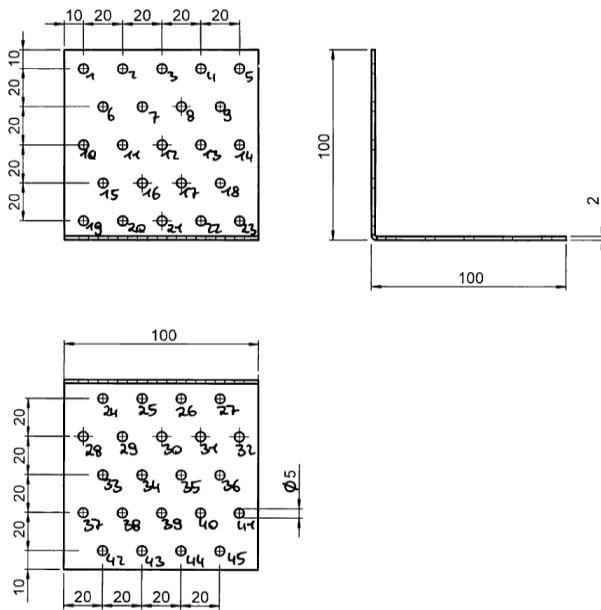


Figure B. 7 Dimensions of Angle Bracket 63111020

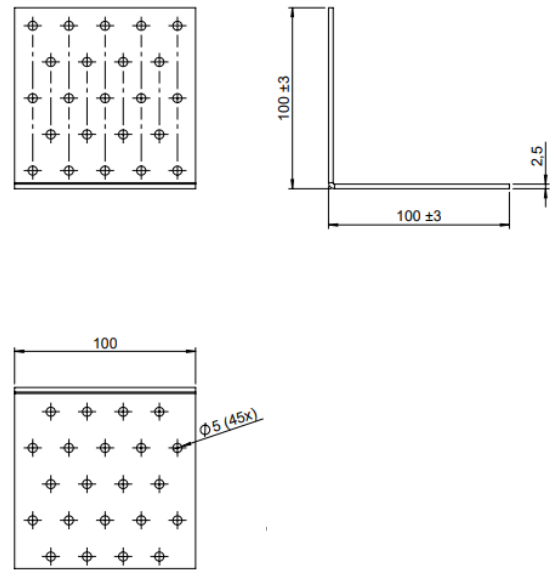


Figure B. 8 Dimensions of Angle Bracket 63111025

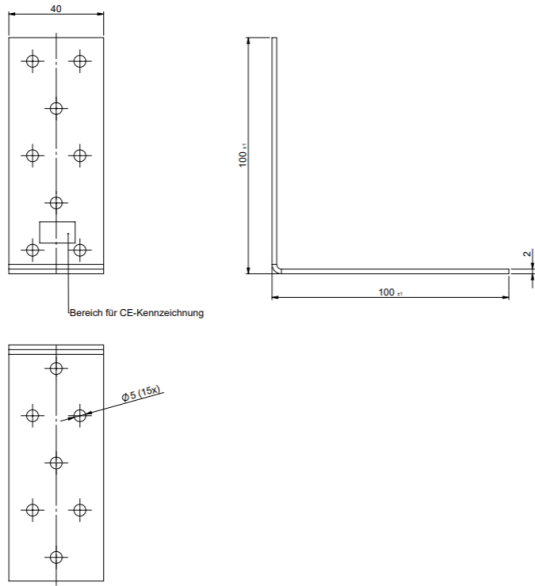


Figure B. 9 Dimensions of Angle Bracket 63114020

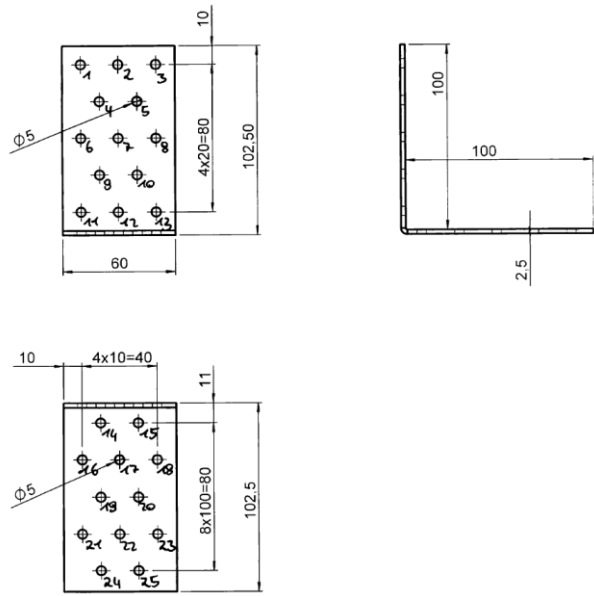


Figure B. 20 Dimensions of Angle Bracket 63116020

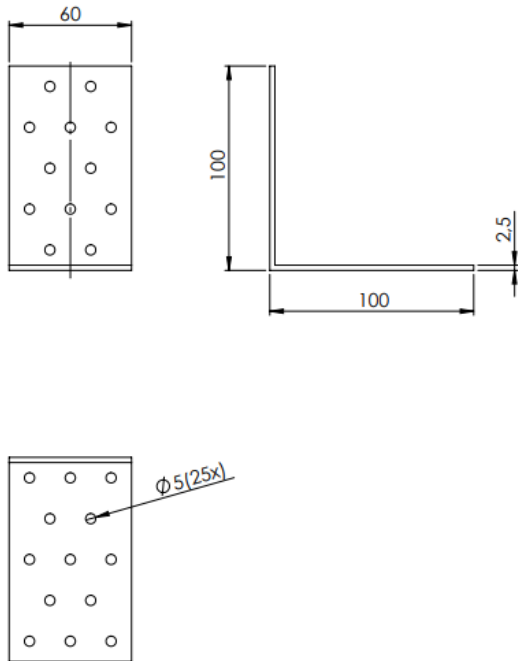


Figure B. 31 Dimensions of Angle Bracket 63116025

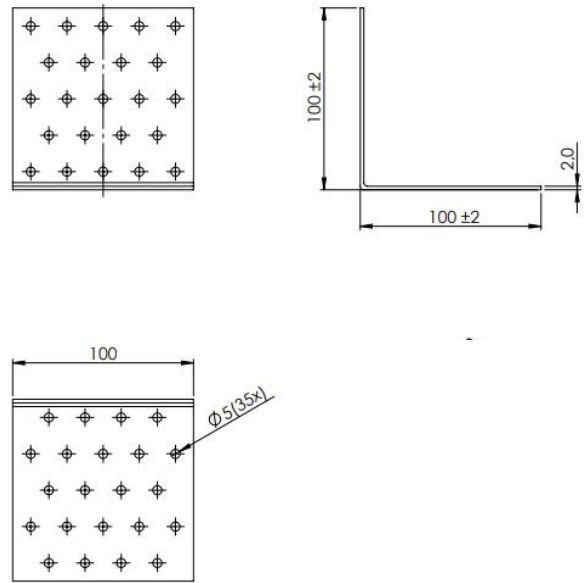


Figure B. 42 Dimensions of Angle Bracket 63118020

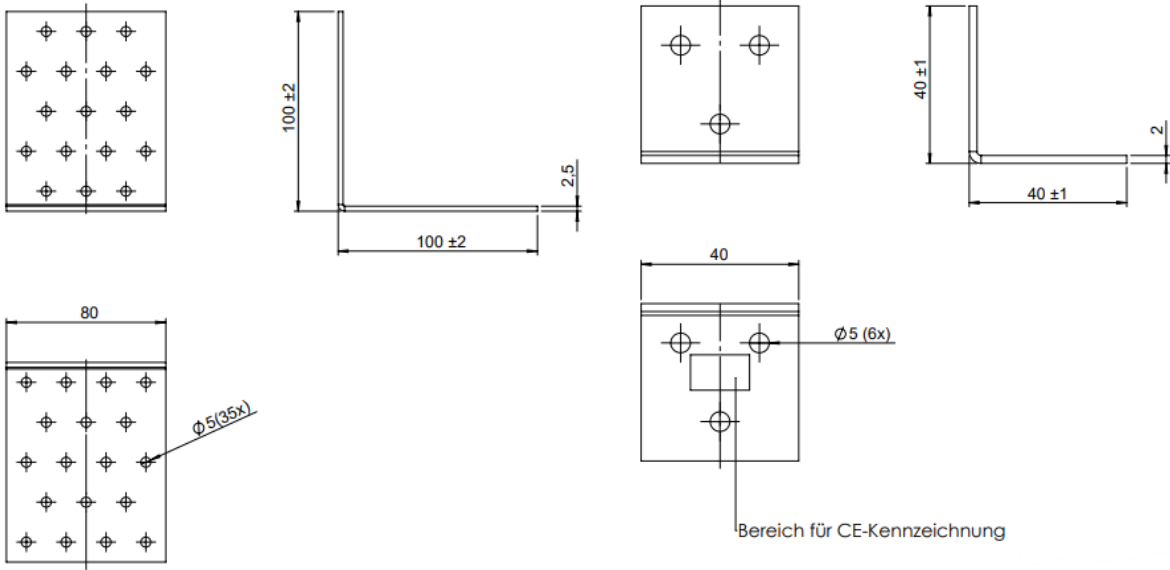


Figure B. 53 Dimensions of Angle Bracket 63118025

Figure B. 64 Dimensions of Angle Bracket 63144420

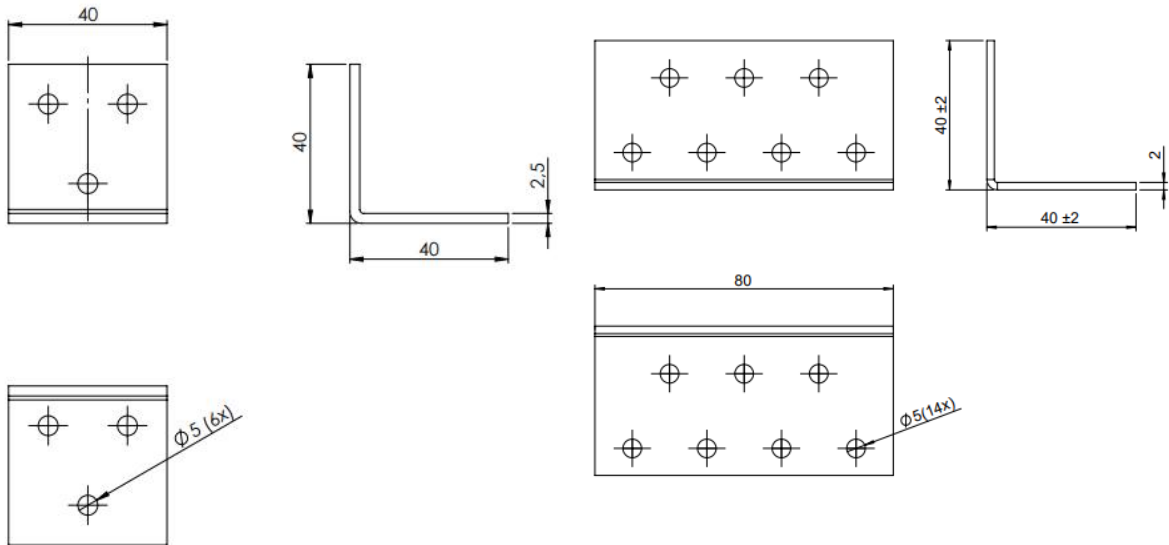


Figure B. 75 Dimensions of Angle Bracket 63144425

Figure B. 86 Dimensions of Angle Bracket 63144820

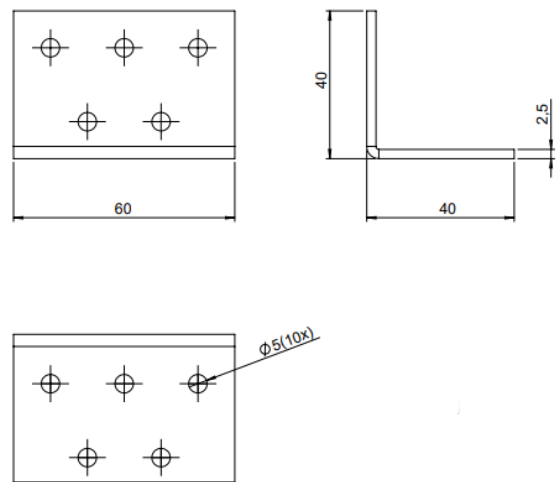
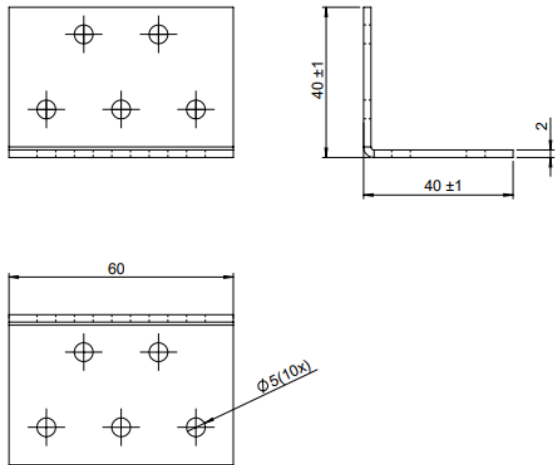


Figure B. 97 Dimensions of Angle Bracket 63146020

Figure B. 108 Dimensions of Angle Bracket 63146025

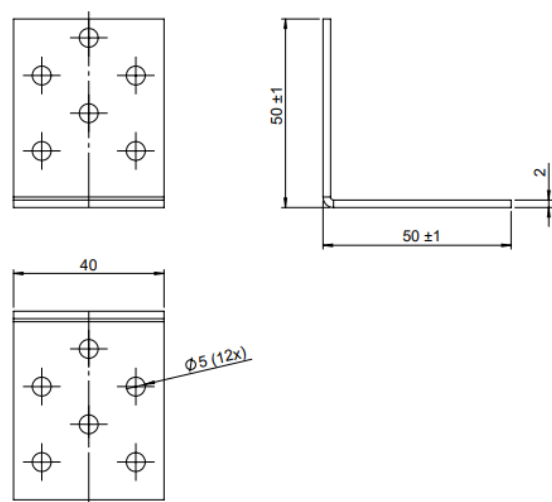
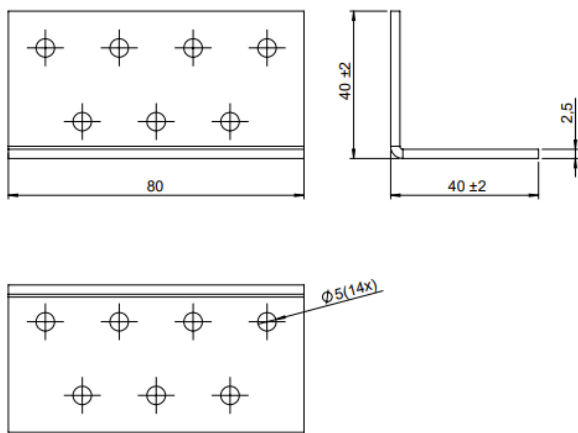


Figure B. 119 Dimensions of Angle Bracket 63144825

Figure B. 20 Dimensions of Angle Bracket 63155420

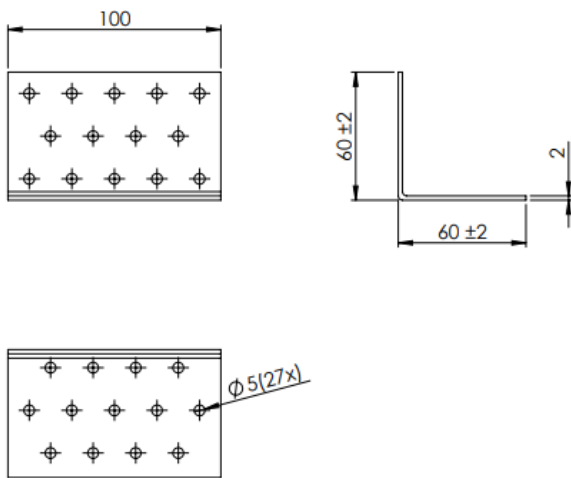


Figure B. 21 Dimensions of Angle Bracket 63161020

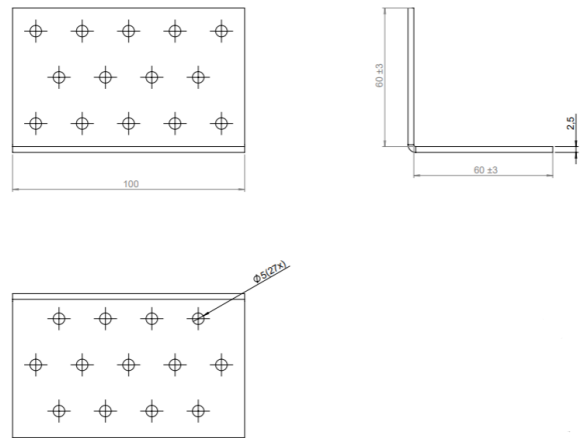


Figure B. 22 Dimensions of Angle Bracket 63161025

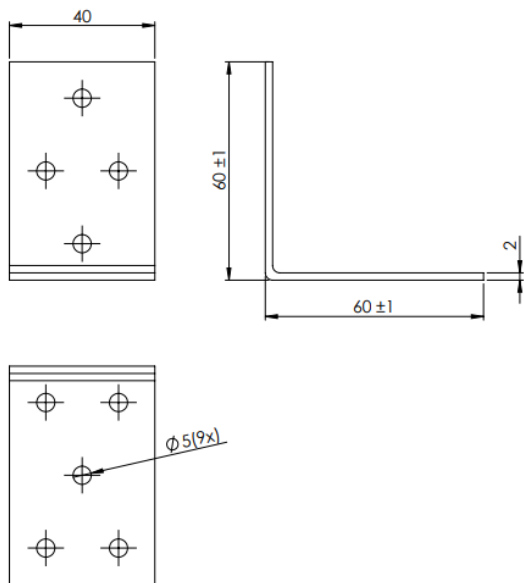


Figure B. 23 Dimensions of Angle Bracket 63164020

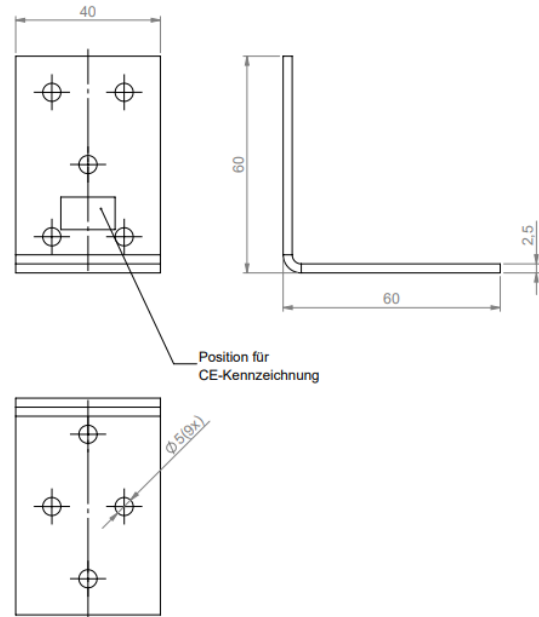


Figure B. 24 Dimensions of Angle Bracket 63164025

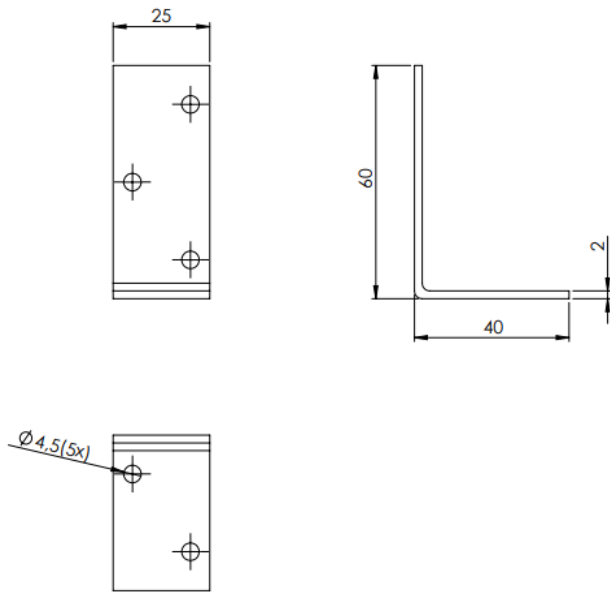


Figure B. 25 Dimensions of Angle Bracket 63164220

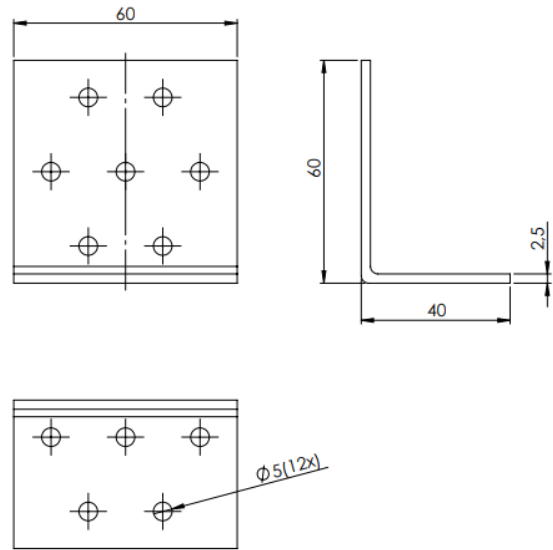


Figure B. 26 Dimensions of Angle Bracket 63164625

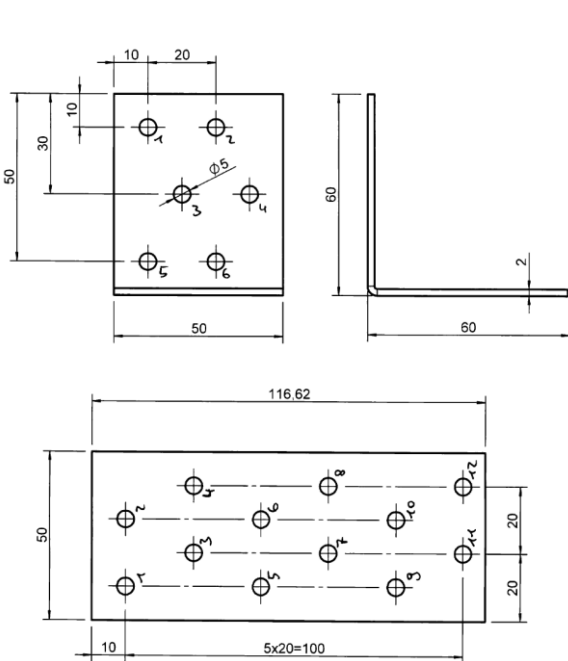


Figure B. 27 Dimensions of Angle Bracket 63165020

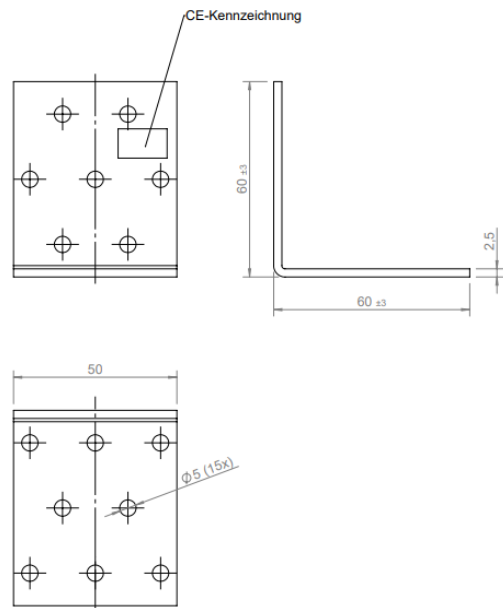


Figure B. 28 Dimensions of Angle Bracket 63165025

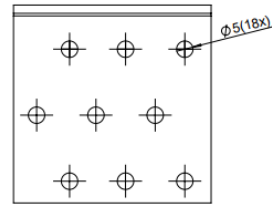
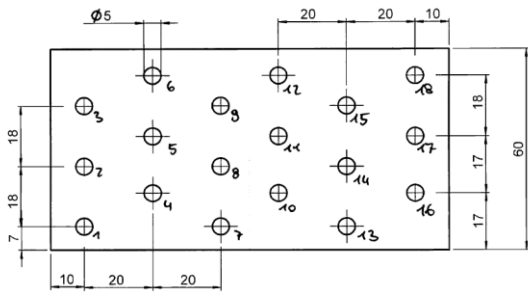
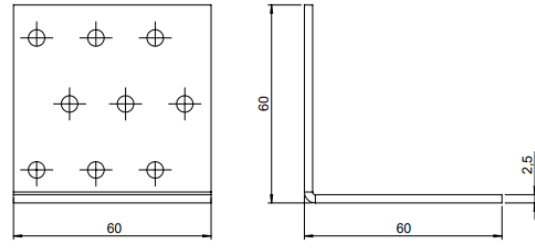
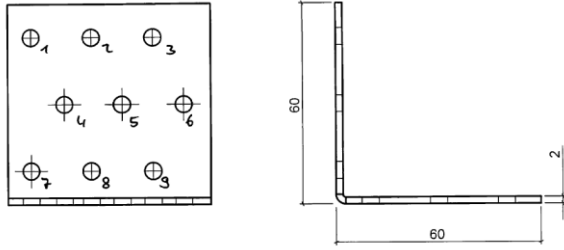


Figure B. 29 Dimensions of Angle Bracket 63166020

Figure B. 30 Dimensions of Angle Bracket 63166025

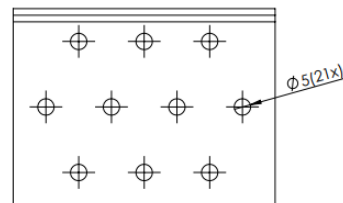
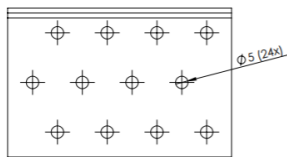
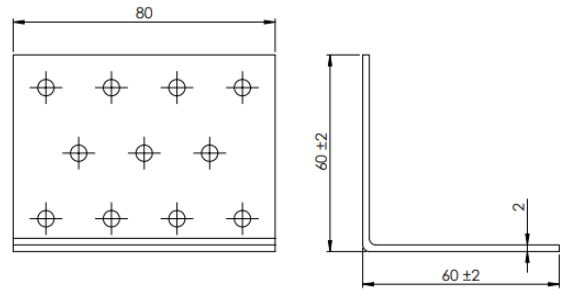
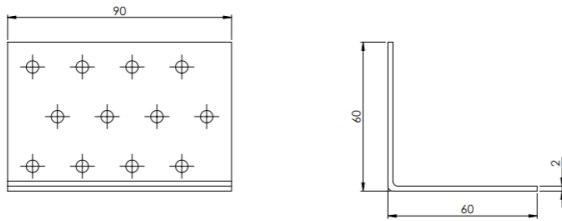


Figure B. 31 Dimensions of Angle Bracket 63166920

Figure B. 32 Dimensions of Angle Bracket 63166820

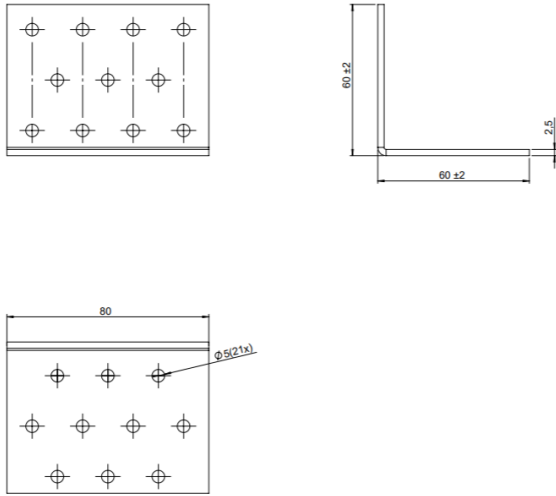


Figure B. 33 Dimensions of Angle Bracket 63168025

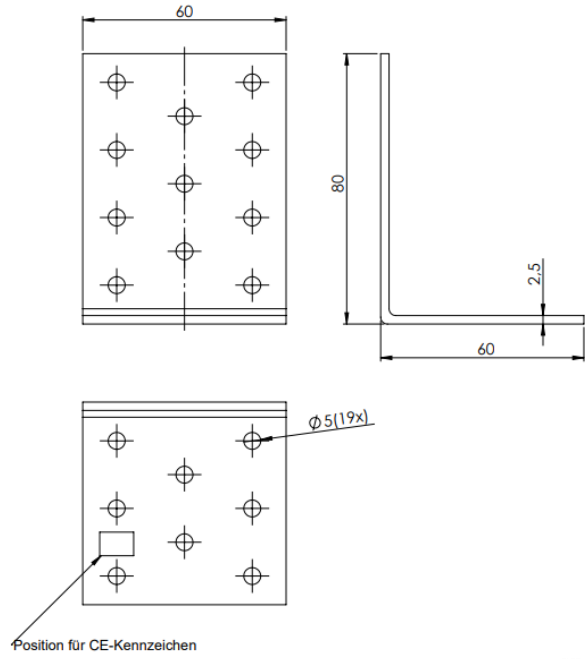


Figure B 34 Dimensions of Angle Bracket 63168625

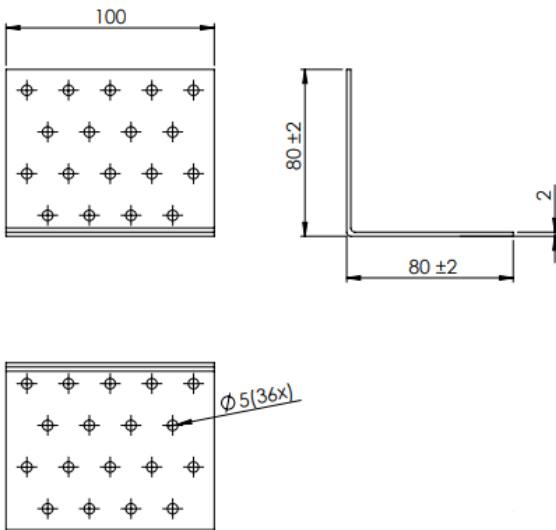


Figure B. 35 Dimensions of Angle Bracket 63181020

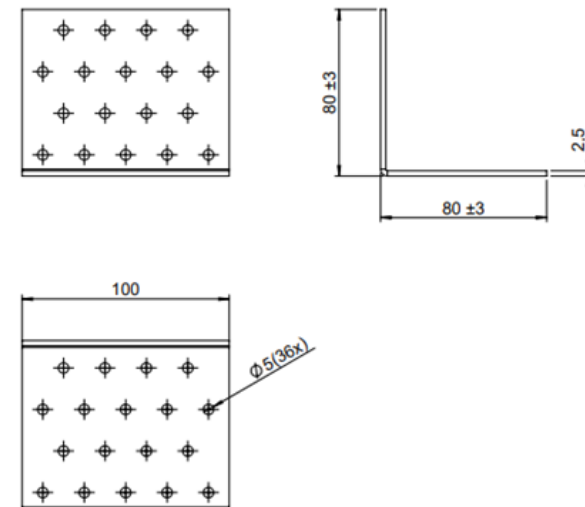


Figure B. 36 Dimensions of Angle Bracket 63181025

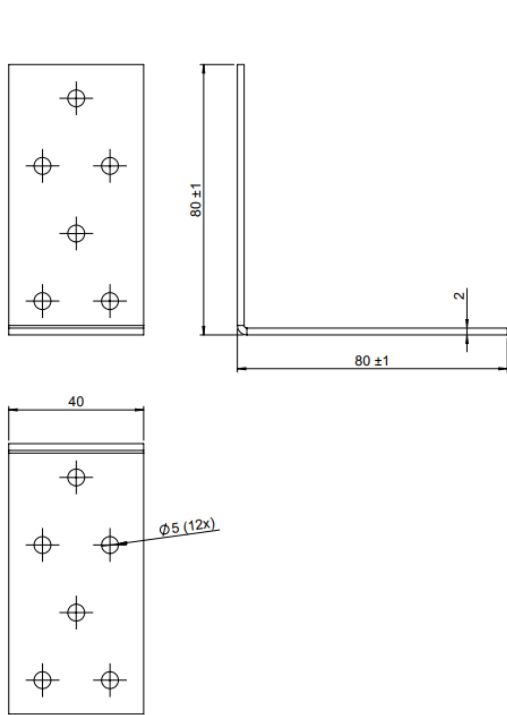


Figure B. 37 Dimensions of Angle Bracket 63184020

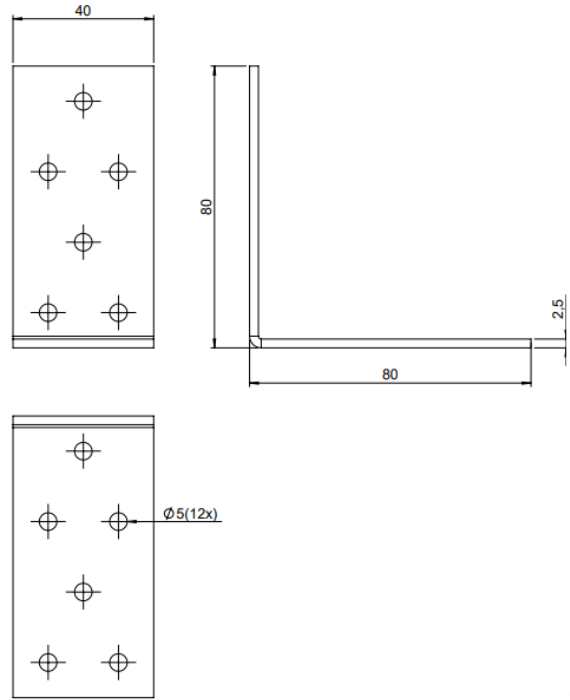


Figure B. 38 Dimensions of Angle Bracket 63184025

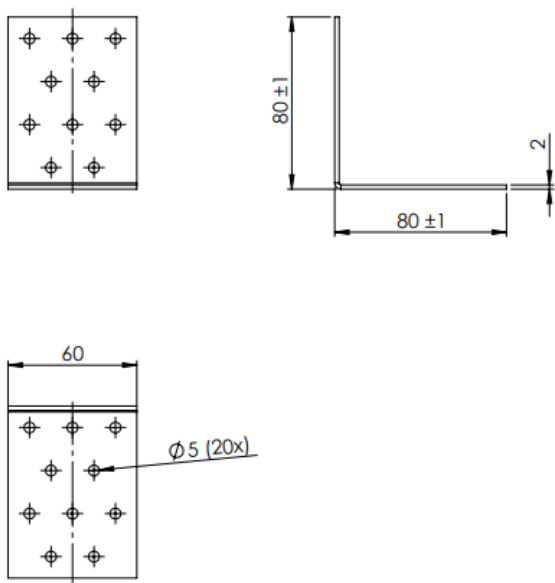


Figure B. 39 Dimensions of Angle Bracket 63186020

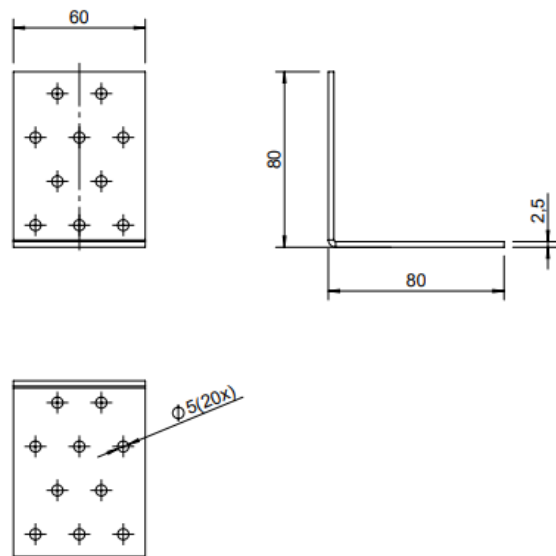


Figure B. 40 Dimensions of Angle Bracket 63186025

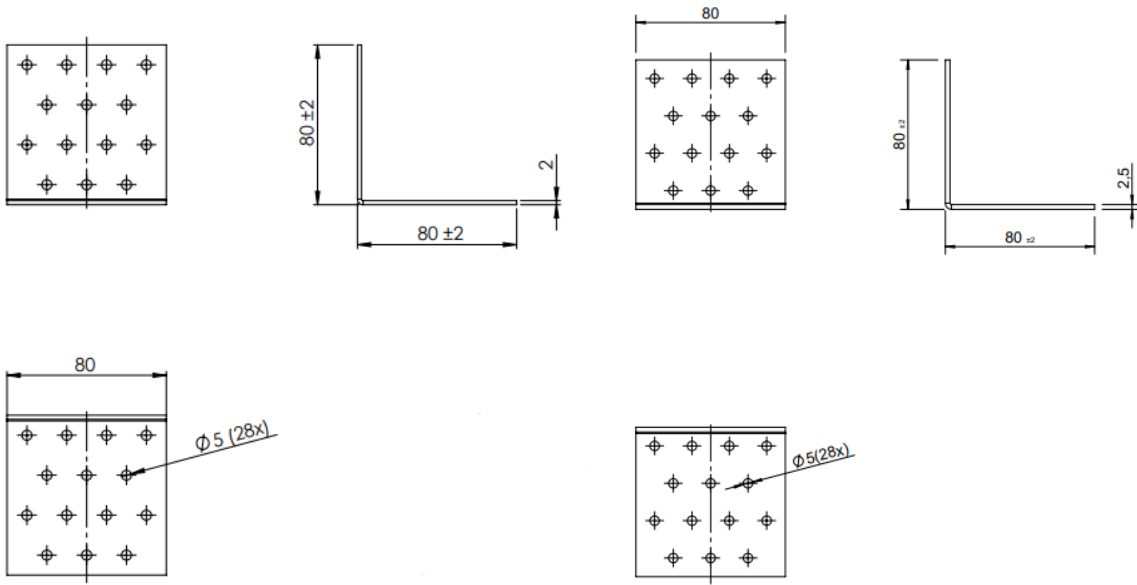


Figure B. 41 Dimensions of Angle Bracket 63188020

Figure B. 42 Dimensions of Angle Bracket 63188025

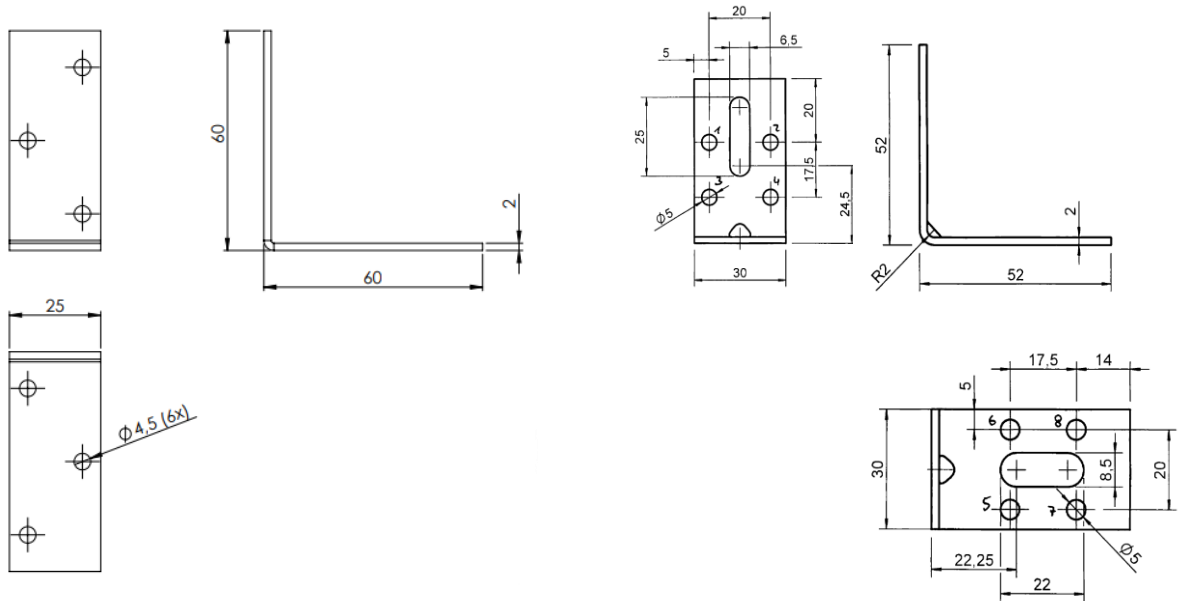


Figure B. 43 Dimensions of Angle Bracket 63206020

Figure B. 44 Dimensions of Angle Bracket 63355320

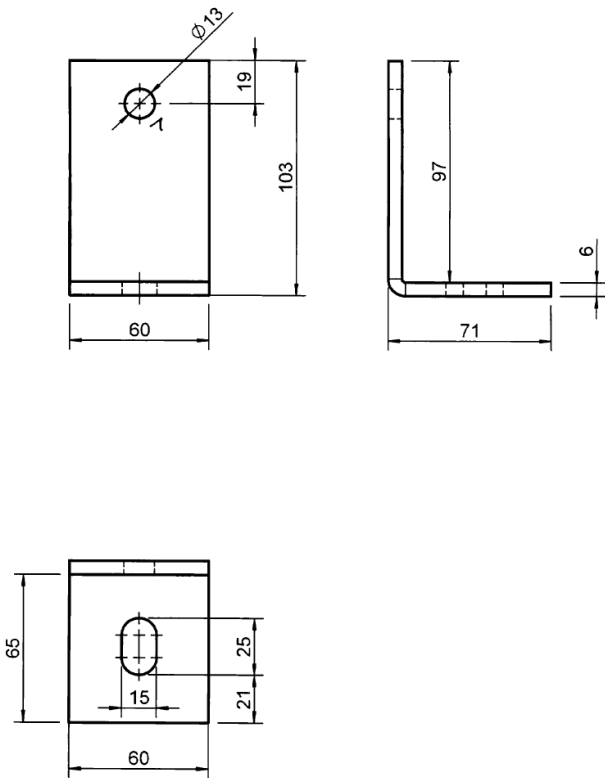


Figure B. 45 Dimensions of Angle Bracket 63371066

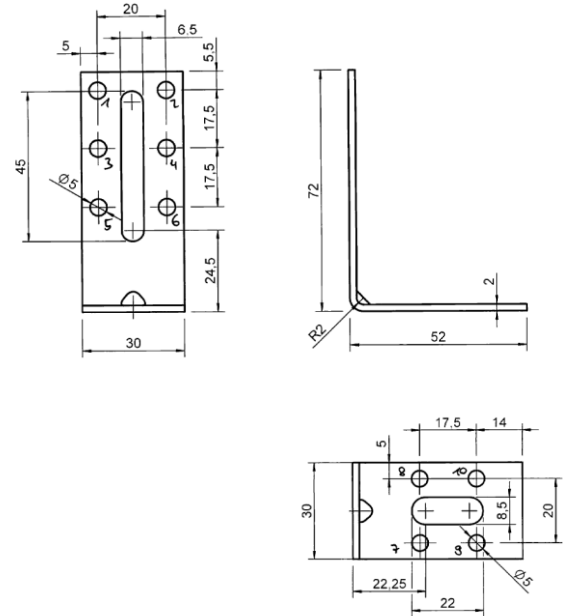


Figure B. 46 Dimensions of Angle Bracket 63375320

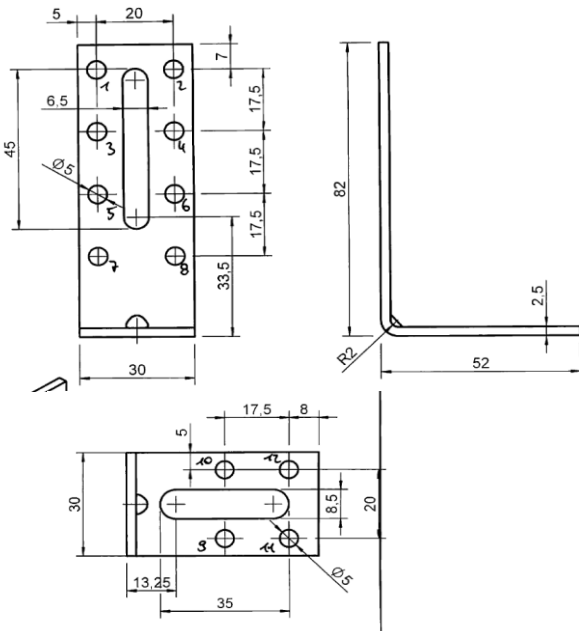


Figure B. 47 Dimensions of Angle Bracket 63385325

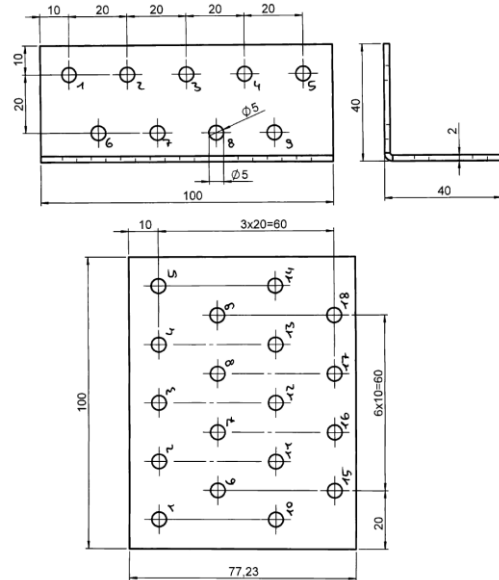


Figure B. 48 Dimensions of Angle Bracket 63410020

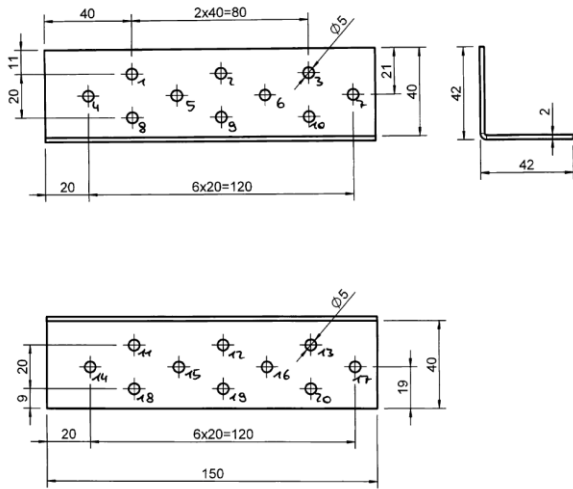


Figure B. 49 Dimensions of Angle Bracket 63415020

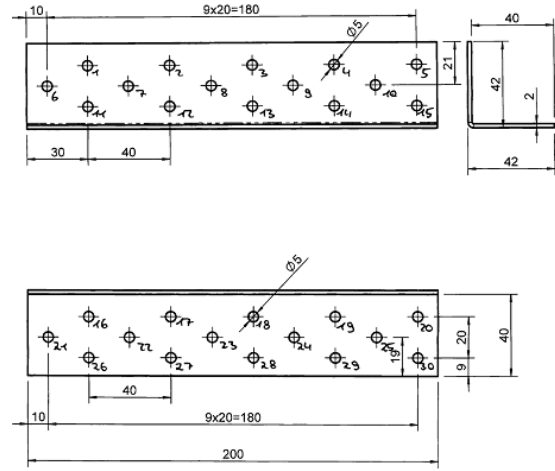


Figure B. 50 Dimensions of Angle Bracket 63420020

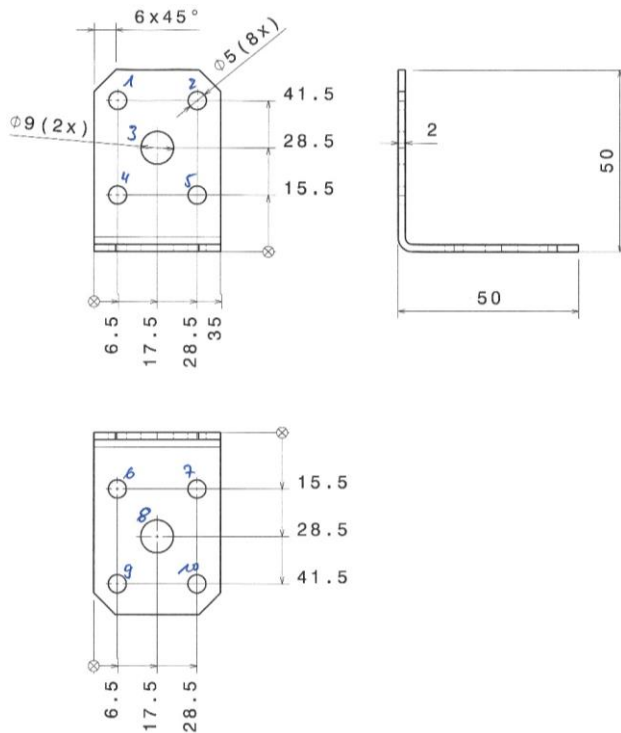


Figure B. 51 Dimensions of Angle Bracket 64155320

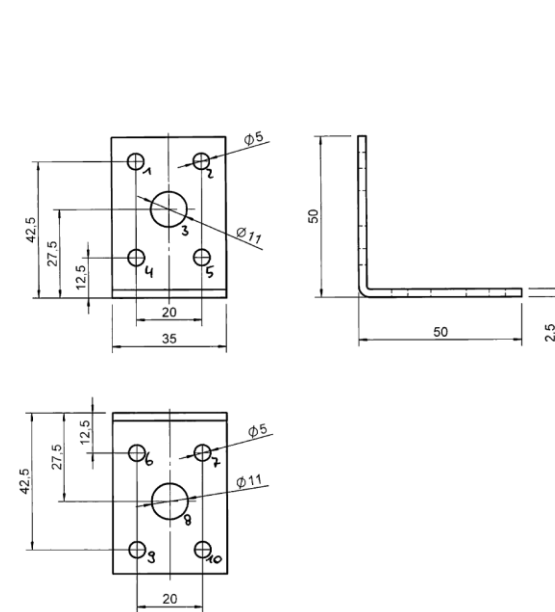


Figure B. 52 Dimensions of Angle Bracket 64103525

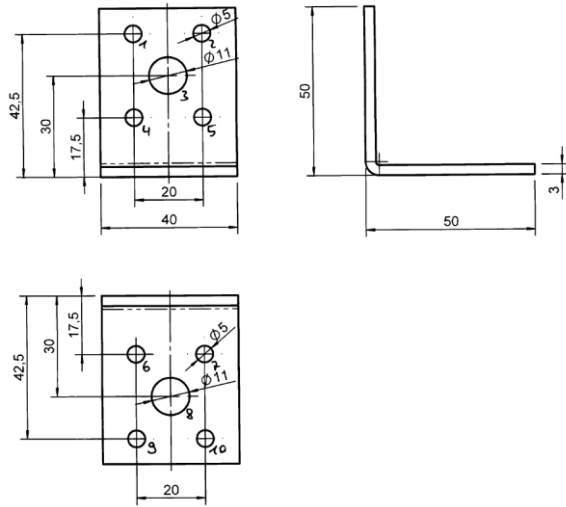


Figure B. 53 Dimensions of Angle Bracket 64104030

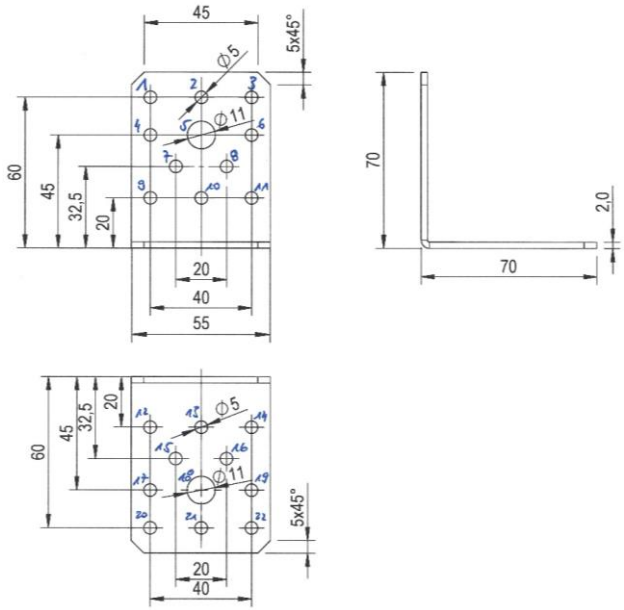


Figure B. 54 Dimensions of Angle Bracket 64107020

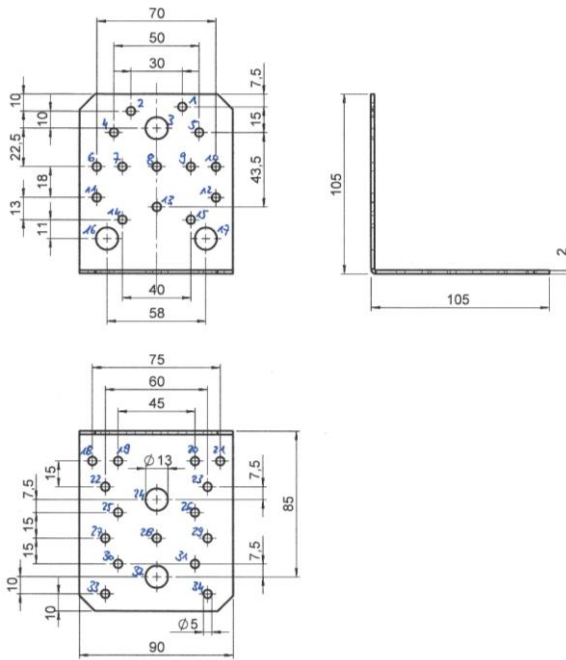


Figure B. 55 Dimensions of Angle Bracket 64110520

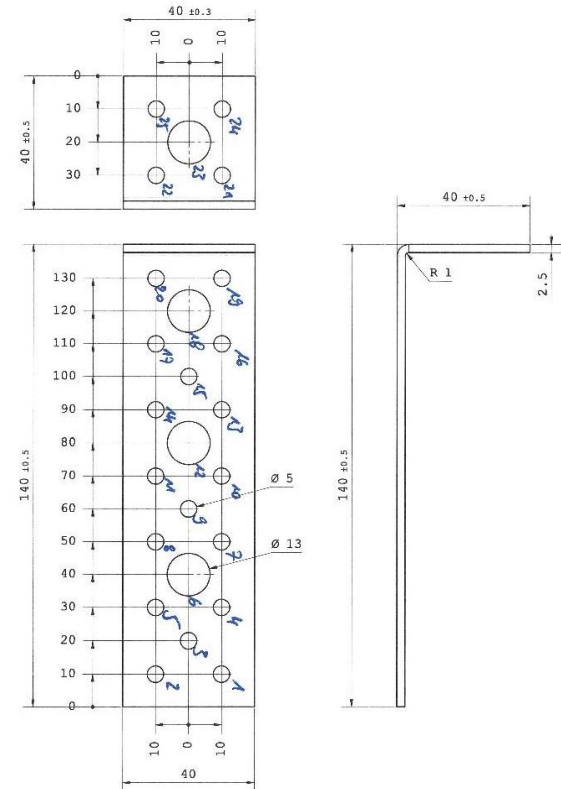


Figure B. 56 Dimensions of Angle Bracket 64114034

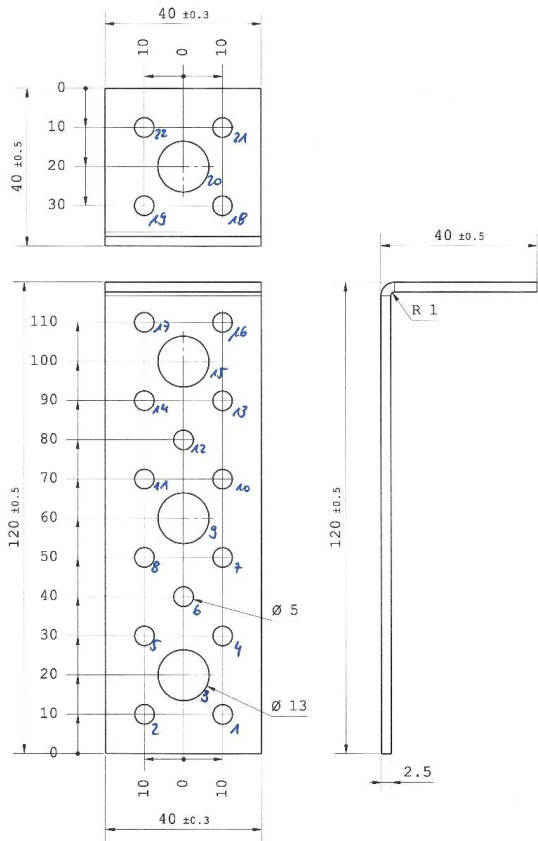


Figure B. 57 Dimensions of Angle Bracket 64141225

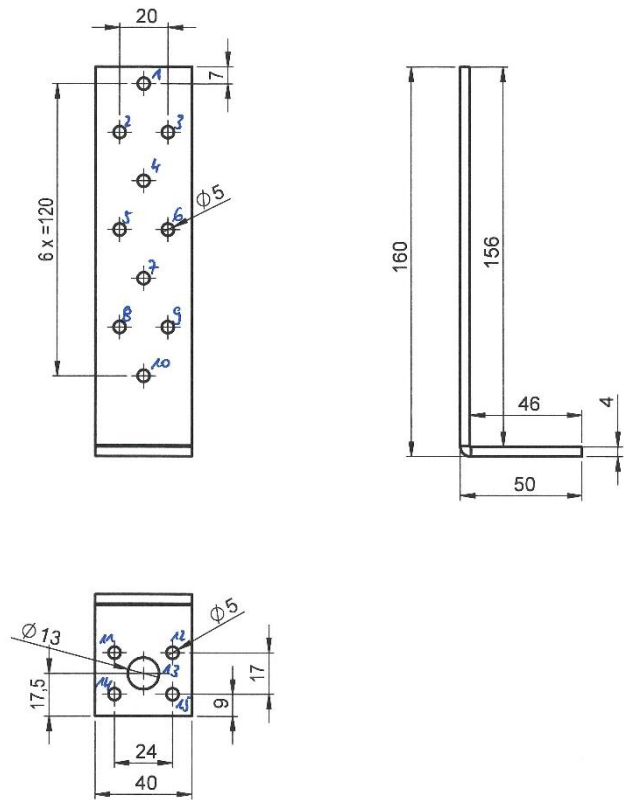


Figure B. 58 Dimensions of Angle Bracket 61816540

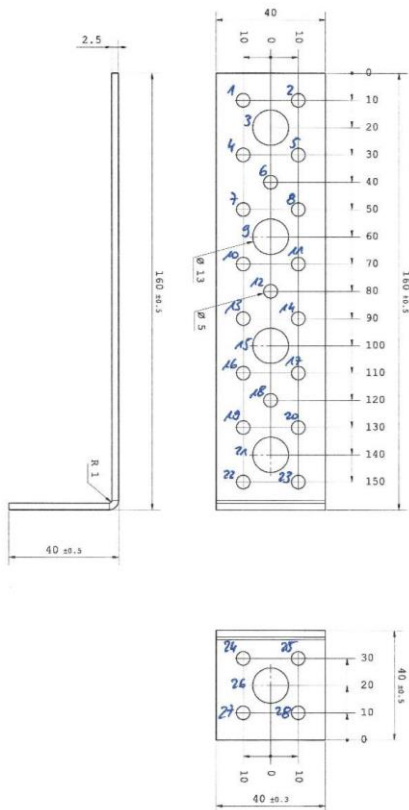


Figure B. 59 Dimensions of Angle Bracket 64141640

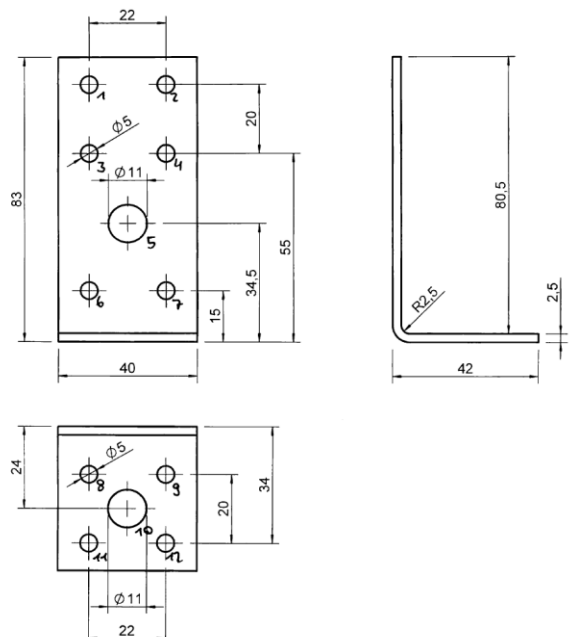


Figure B. 60 Dimensions of Angle Bracket 64186025

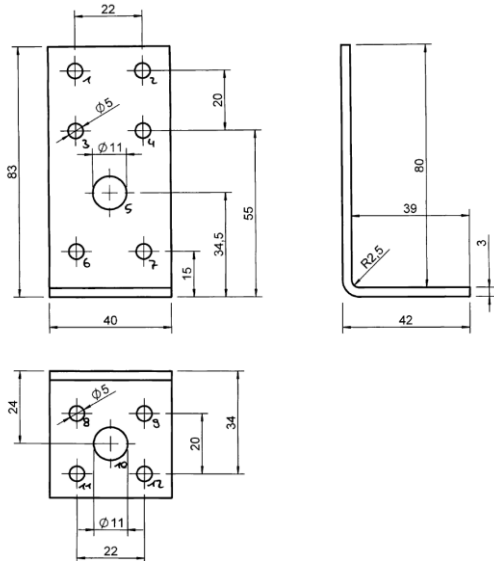


Figure B. 61 Dimensions of Angle Bracket 64186030

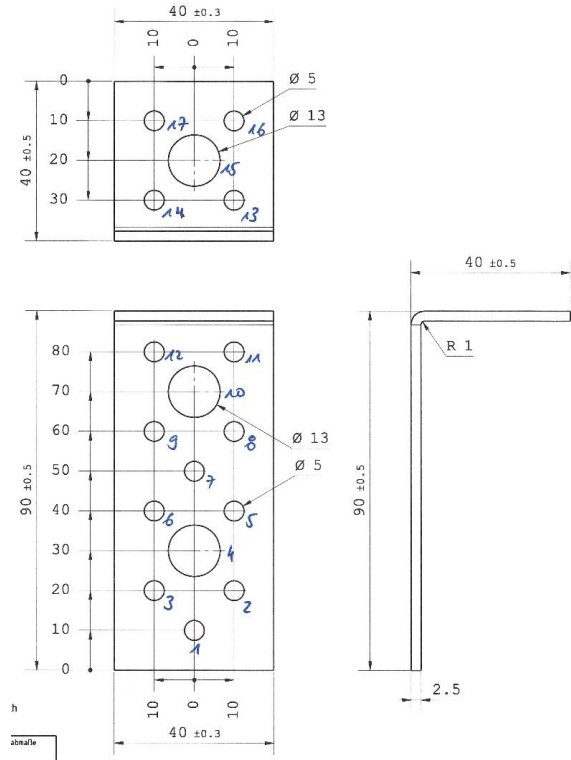


Figure B. 62 Dimensions of Angle Bracket 64149042

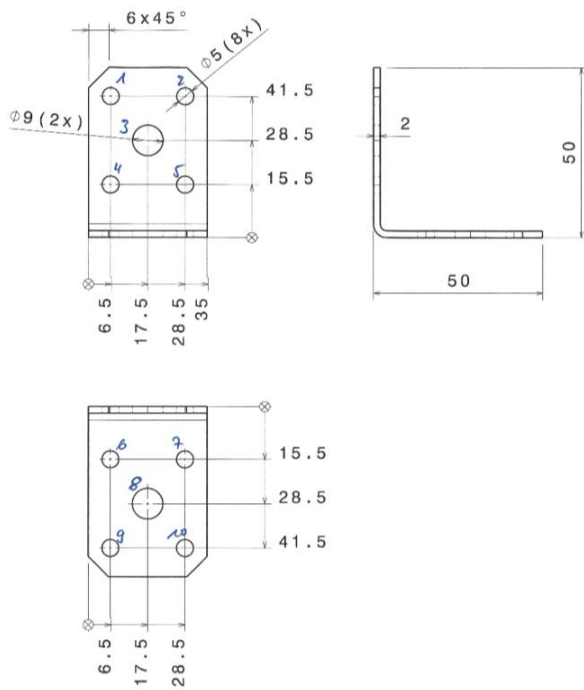


Figure B. 63 Dimensions of Angle Bracket 64155320

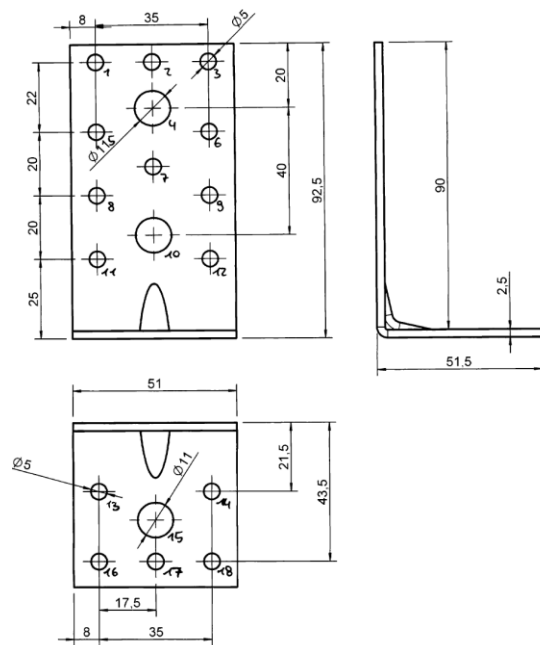


Figure B. 64 Dimensions of Angle Bracket 64159025

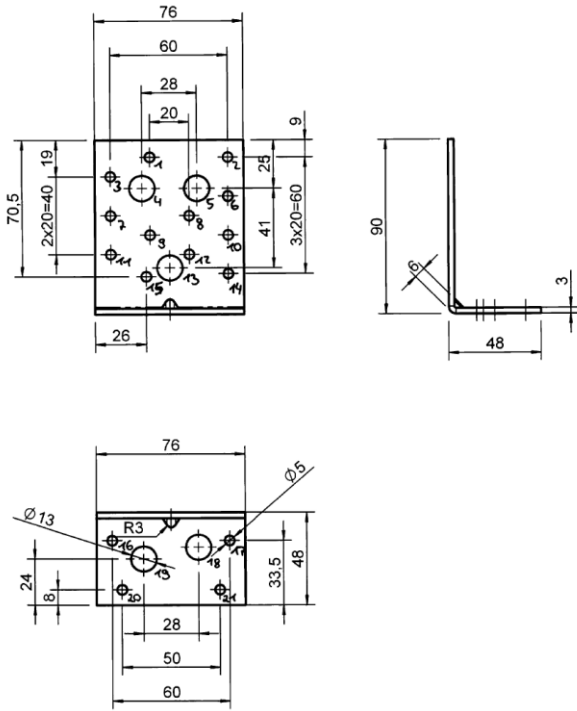


Figure B. 65 Dimensions of Angle Bracket 64159830

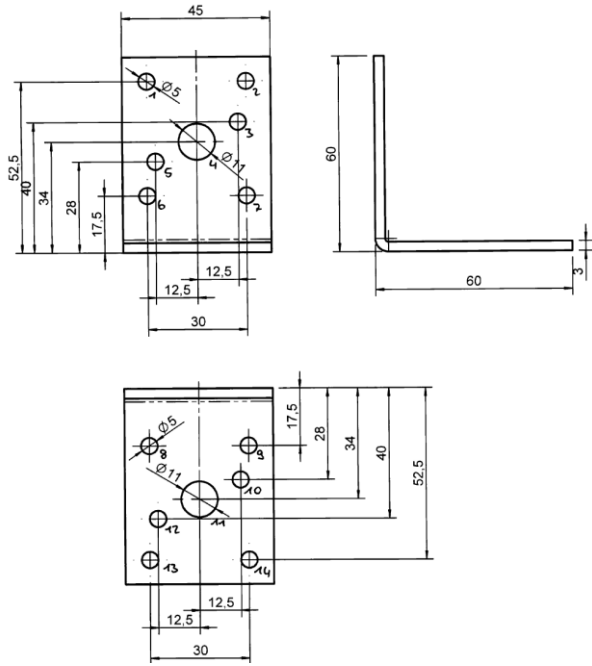


Figure B. 66 Dimensions of Angle Bracket 64166430

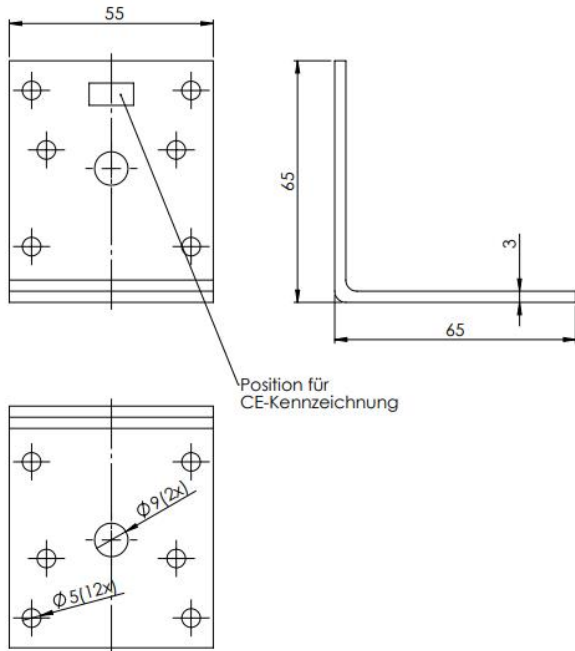


Figure B. 67 Dimensions of Angle Bracket 64166530

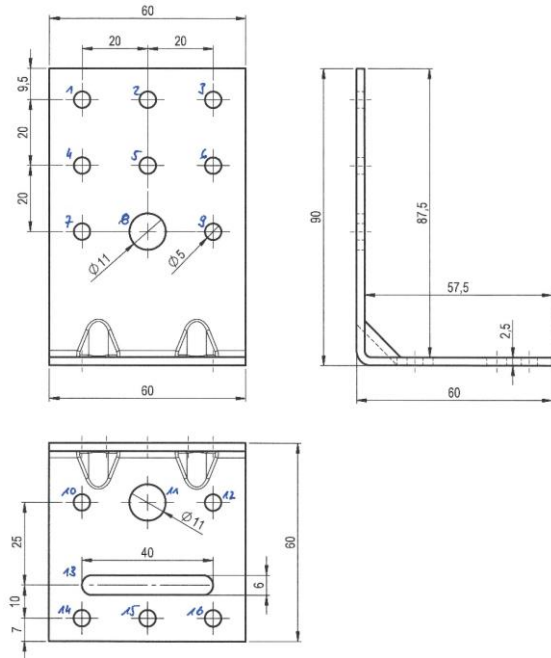


Figure B. 68 Dimensions of Angle Bracket 64169025

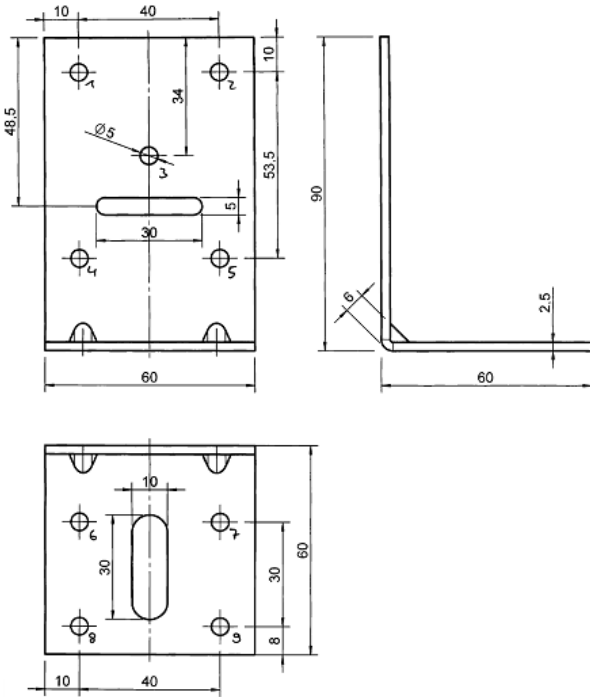


Figure B. 69 Dimensions of Angle Bracket 64169030

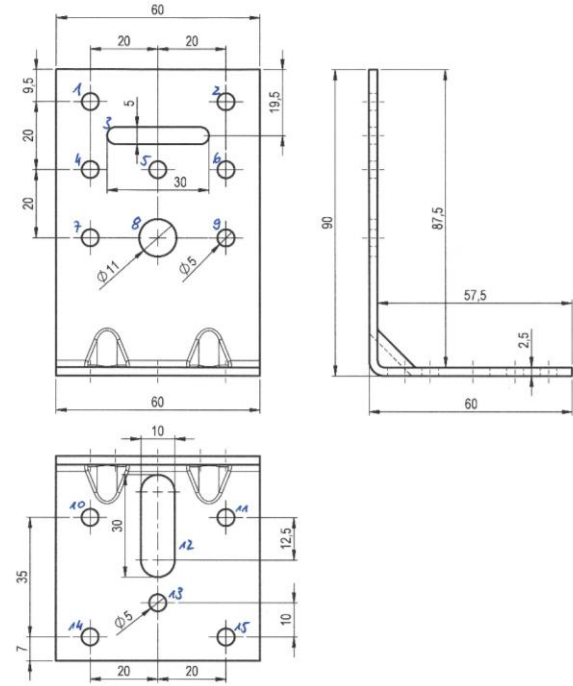


Figure B. 70 Dimensions of Angle Bracket 64169125

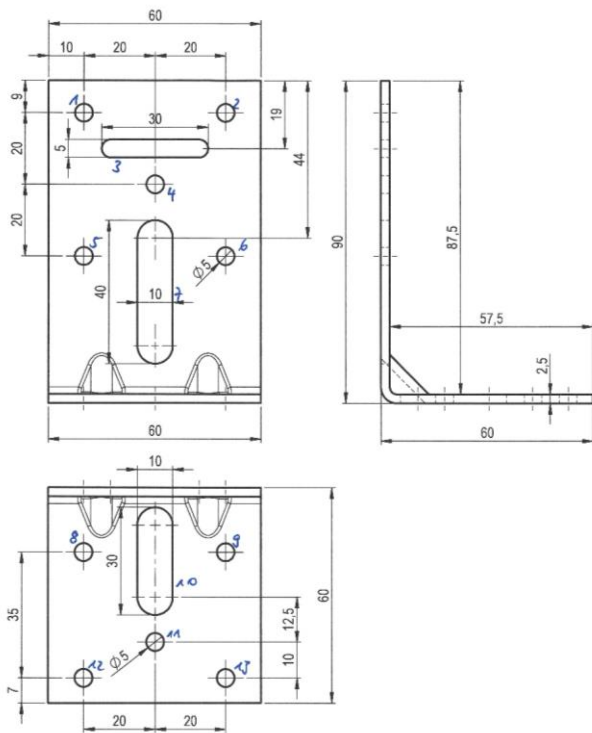


Figure B. 71 Dimensions of Angle Bracket 64169225

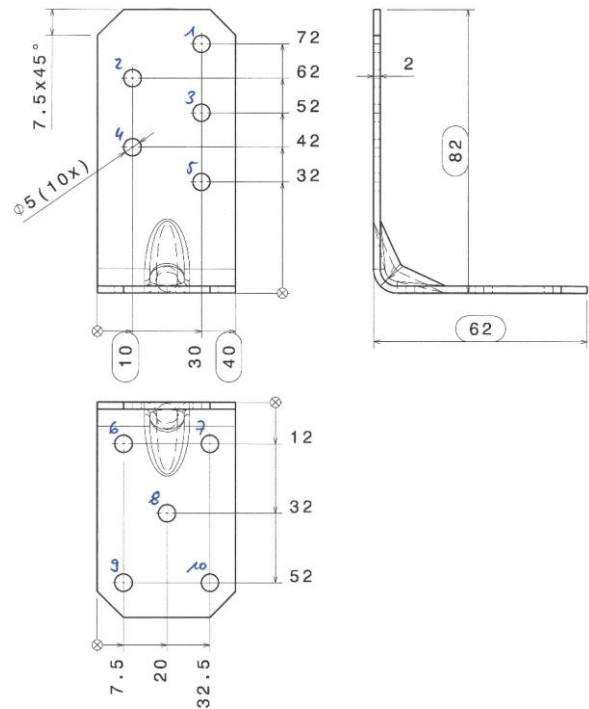


Figure B. 72 Dimensions of Angle Bracket 64186020

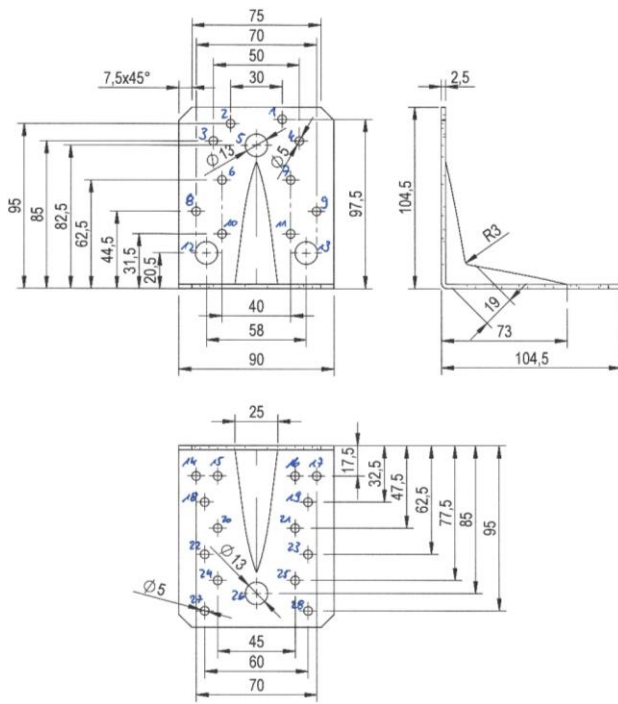


Figure B. 73 Dimensions of Angle Bracket 64190525

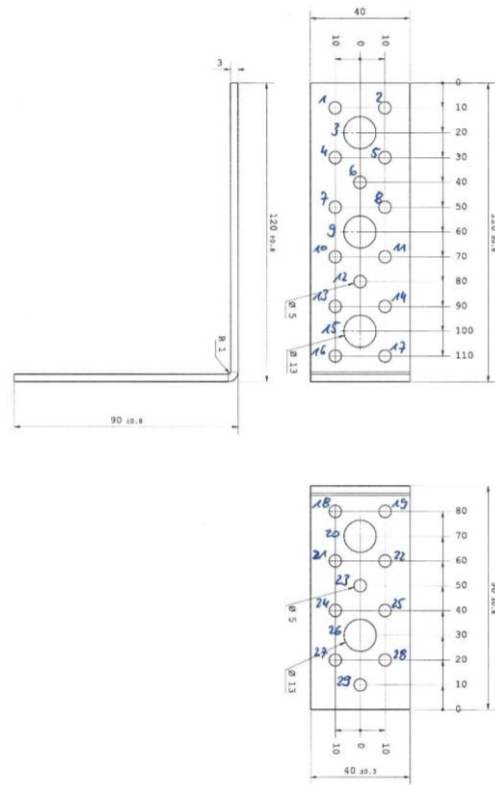


Figure B. 74 Dimensions of Angle Bracket 64191225

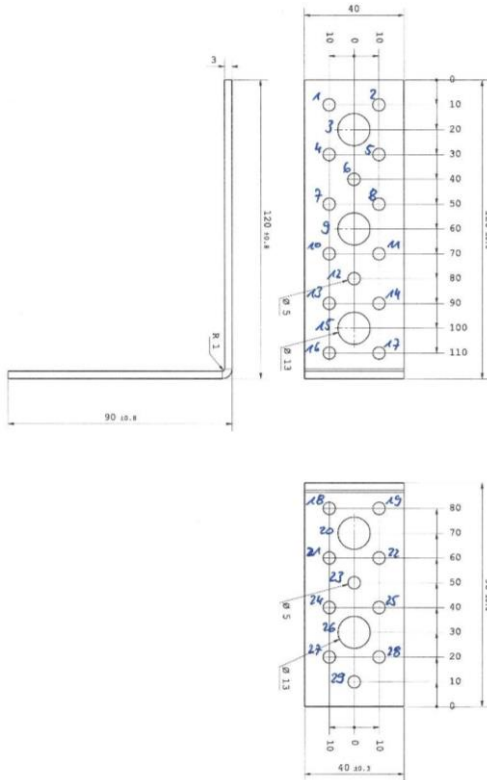


Figure B. 75 Dimensions of Angle Bracket 64191225

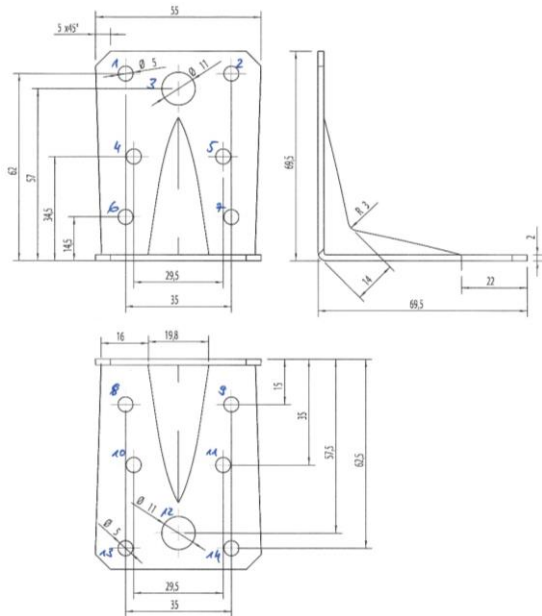


Figure B. 76 Dimensions of Angle Bracket 64197020

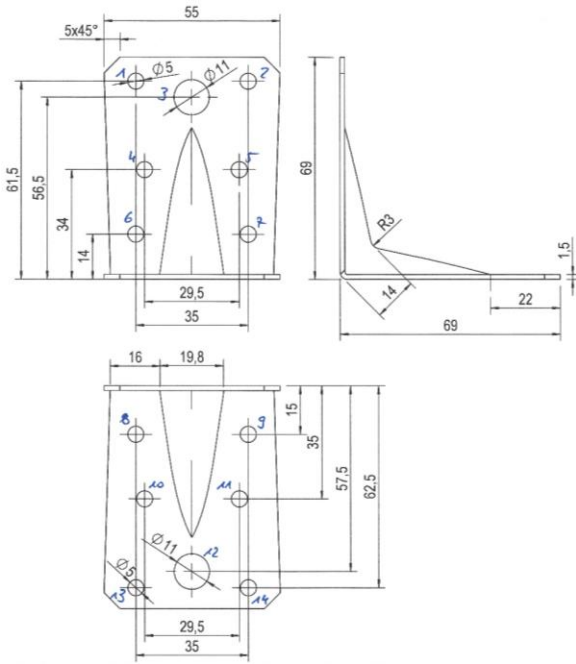


Figure B. 77 Dimensions of Angle Bracket 64197115

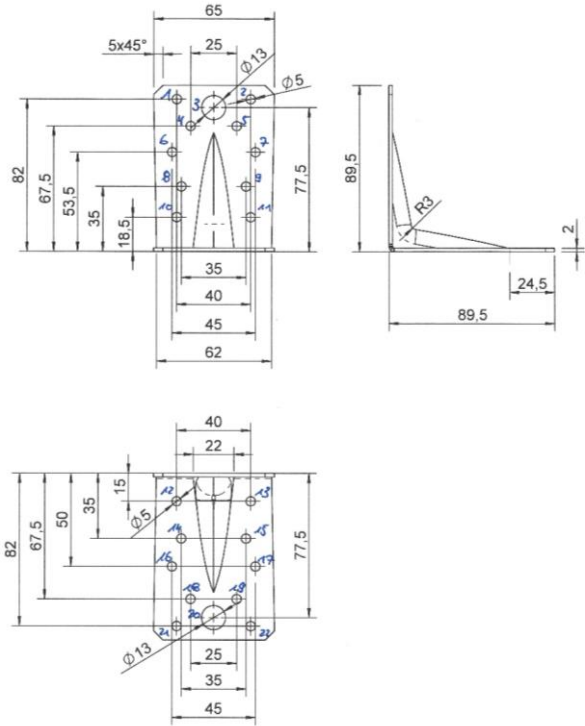


Figure B. 78 Dimensions of Angle Bracket 64199020

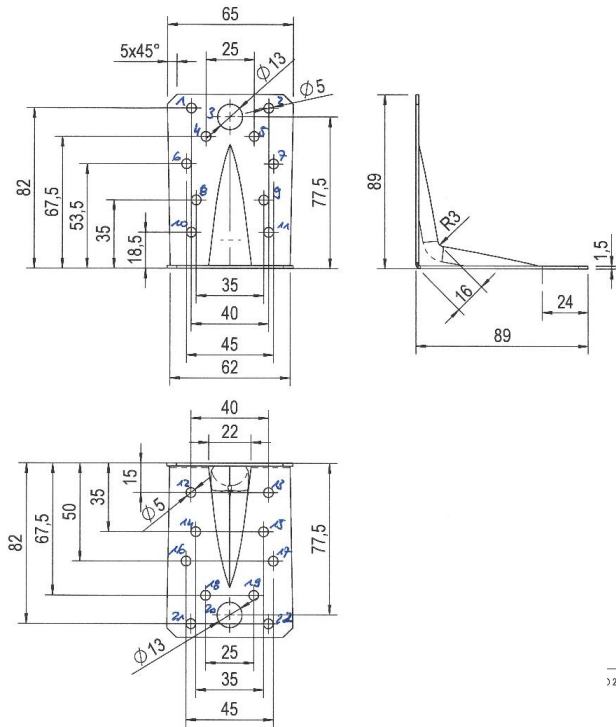
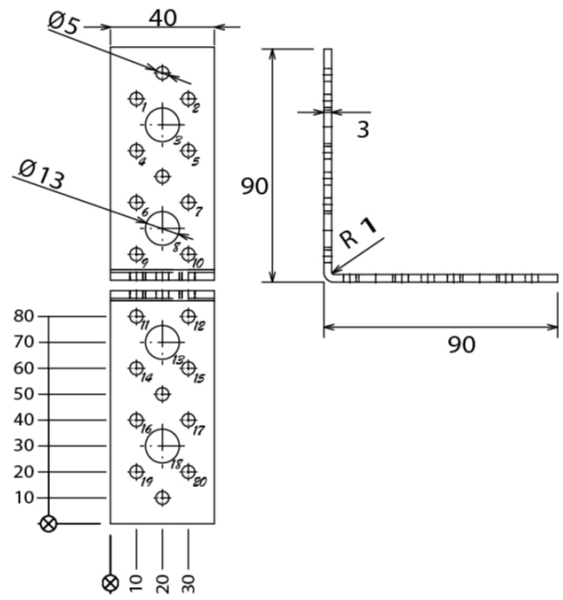


Figure B. 79 Dimensions of Angle Bracket 64199115



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Figure B. 80 Dimensions of Angle Bracket 64199430

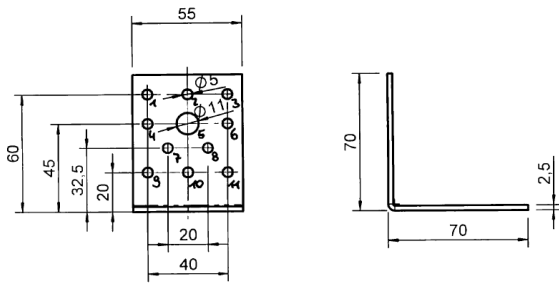


Figure B. 81 Dimensions of Angle Bracket 65107025

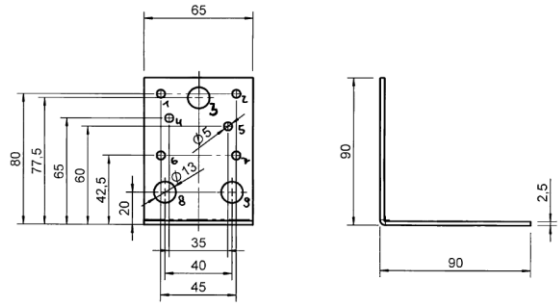


Figure B. 82 Dimensions of Angle Bracket 65109025

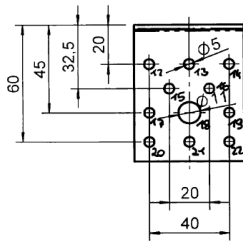


Figure B. 83 Dimensions of Angle Bracket 65110530

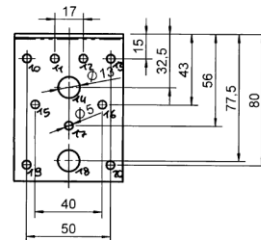


Figure B. 84 Dimensions of Angle Bracket 65155425

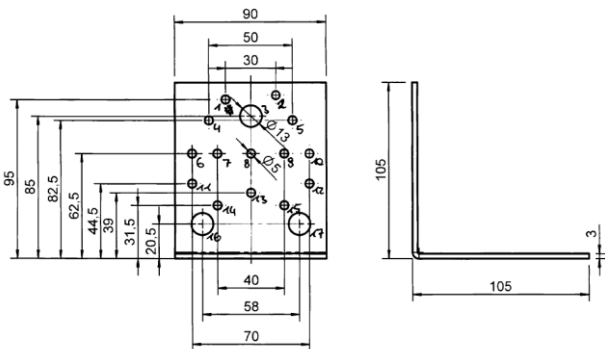


Figure B. 83 Dimensions of Angle Bracket 651110530

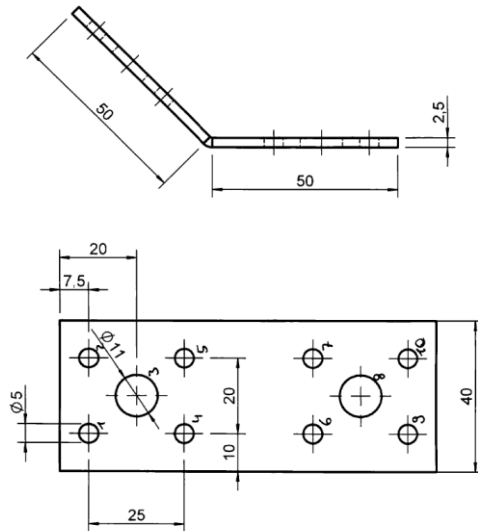


Figure B. 84 Dimensions of Angle Bracket 65155425

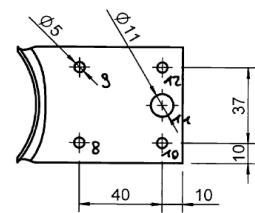
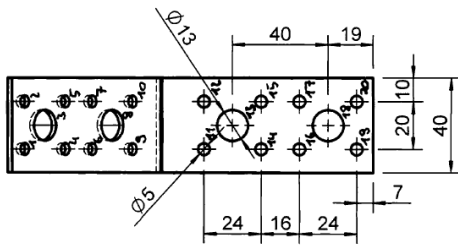
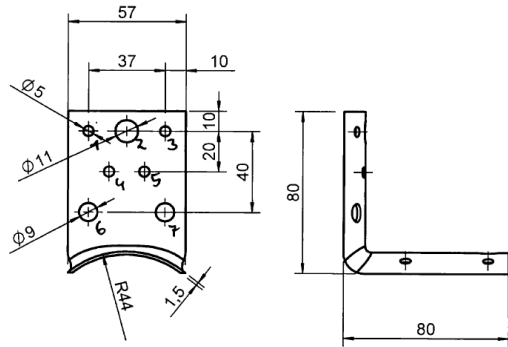
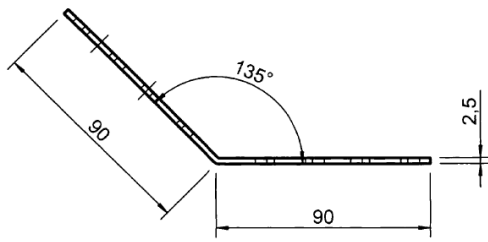


Figure B. 85 Dimensions of Angle Bracket 65109625

Figure B. 86 Dimensions of Angle Bracket 65206000

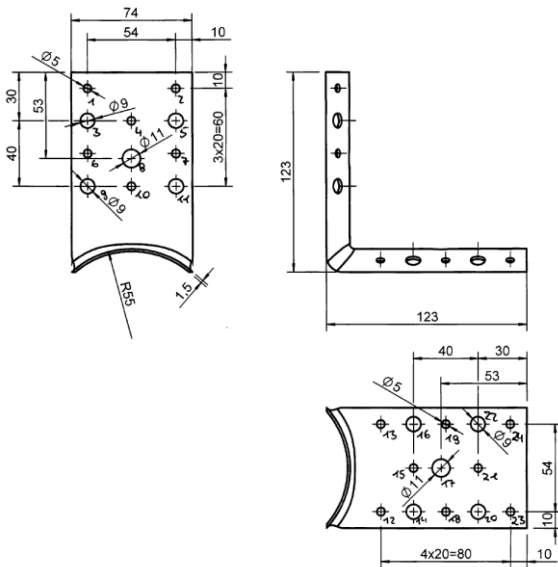


Figure B. 87 Dimensions of Angle Bracket 65208000