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to Article 29 of the Regulation (EU)  
No 305/2011 of the European  
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MEMBER OF EOTA



## European Technical Assessment ETA-09/0355 of 2019/06/11

### 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  
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**Manufacturing plant:**

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

**This European Technical Assessment contains:**

55 pages including 2 annexes which form an integral part of the document

**This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:**

Guideline for European Technical Approval (ETAG) No. 015 Three Dimensional Nailing Plates, April 2013, used as European Assessment Document (EAD).

**This version replaces:**

The previous ETA with the same number issued on 2015-01-05

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## II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

### 1 Technical description of product and intended use

#### 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 EAD

The angle brackets are intended for use in making connections in load bearing timber structures, as a connection between a beam and a purlin, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

The 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  $290 \text{ kg/m}^3$  to  $425 \text{ kg/m}^3$ . 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  $350 \text{ kg/m}^3$ . For timber or wood based material with a lower characteristic density than  $350 \text{ kg/m}^3$  the load-carrying capacities shall be reduced by the  $k_{\text{dens}}$  factor:

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

Where  $\rho_k$  is the characteristic density of the timber in  $\text{kg/m}^3$ .

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  |
|--|---|
| <b>3.1 Mechanical resistance and stability*) (BWR1)</b>              |   |
| Characteristic load-carrying capacity                                | See Annex B   |
| Stiffness  | No performance assessed   |
| Ductility in cyclic testing  | No performance assessed   |
| <b>3.2 Safety in case of fire (BWR2)</b>                             |   |
| 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  |
| <b>3.7 Sustainable use of natural resources (BWR7)</b>               |   |
| <b>3.8 General aspects related to the performance of the product</b> | The angle brackets have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2 |
| Identification   | See Annex A   |

\*) See additional information in section 3.8 – 3.9.

### 3.9 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.

### 3.10 Mechanical resistance and stability

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

The characteristic capacities of the angle brackets are determined by calculation assisted by testing as described in the EOTA Guideline 015 clause 5.1.2. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

*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<br>$t_{pen} \geq 31$ 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:

|            |  |
|------------|--|
| $\sigma_k$ | Characteristic density of the timber in $kg/m^3$ |
|------------|--|

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

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

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

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

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

### 3.11 Aspects related to the performance of the product

3.11.1 Corrosion protection in service class 1 and 2.  
In accordance with ETAG 015 015 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

### 3.12 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 Attestation and verification of constancy of performance (AVCP)**

### **4.1 AVCP system**

According to the decision 97/638/EC of the European Commission<sup>1</sup>, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

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

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

Issued in Copenhagen on 2019-06-11 by



Thomas Bruun  
Managing Director, ETA-Danmark

**Annex A**  
**Product details definitions**

**Table A.1:** Materials specification

| <b>Bracket number</b> | <b>Bracket type</b>   | <b>Comments</b>    | <b>Steel specification</b> | <b>Coating specification</b> |
|-----------------------|-----------------------|--------------------|----------------------------|------------------------------|
| 633 553 20            | 50 x 50 x 30 x 2,0    | with slotted holes | S250GD                     | Z275                         |
| 633 753 20            | 70 x 50 x 30 x 2,0    | with slotted holes | S250GD                     | Z275                         |
| 633 853 25            | 80 x 50 x 30 x 2,5    | with slotted holes | S250GD                     | Z275                         |
| 631 460 25            | 40 x 40 x 60 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 480 25            | 40 x 40 x 80 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 640 25            | 60 x 60 x 40 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 650 25            | 60 x 60 x 50 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 660 25            | 60 x 60 x 60 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 680 25            | 60 x 60 x 80 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 610 25            | 60 x 60 x 100 x 2,5   | -                  | S250GD                     | Z275                         |
| 631 480 25            | 80 x 80 x 40 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 860 25            | 80 x 80 x 60 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 880 25            | 80 x 80 x 80 x 2,5    | -                  | S250GD                     | Z275                         |
| 631 810 25            | 80 x 80 x 100 x 2,5   | -                  | S250GD                     | Z275                         |
| 631 160 25            | 100 x 100 x 60 x 2,5  | -                  | S250GD                     | Z275                         |
| 631 180 25            | 100 x 100 x 80 x 2,5  | -                  | S250GD                     | Z275                         |
| 631 110 25            | 100 x 100 x 100 x 2,5 | -                  | S250GD                     | Z275                         |
| 631 554 20            | 50 x 50 x 40 x 2,0    | -                  | S250GD                     | Z275                         |
| 634 100 20            | 40 x 40 x 100 x 2,0   | -                  | S250GD                     | Z275                         |
| 634 150 20            | 40 x 40 x 150 x 2,0   | -                  | S250GD                     | Z275                         |
| 634 200 20            | 40 x 40 x 200 x 2,0   | -                  | S250GD                     | Z275                         |
| 641 035 25            | 50 x 50 x 35 x 2,5    | -                  | S250GD                     | Z275                         |
| 641 040 30            | 50 x 50 x 40 x 3,0    | -                  | S250GD                     | Z275                         |
| 641 664 30            | 60 x 60 x 45 x 3,0    | -                  | S250GD                     | Z275                         |
| 641 994 30            | 90 x 90 x 40 x 3,0    | -                  | S250GD                     | Z275                         |
| 641 595 30            | 90 x 50 x 50 x 3,0    | -                  | S250GD                     | Z275                         |
| 500 313 62            | 90 x 50 x 116 x 3,0   | -                  | S250GD                     | Z275                         |
| 641 598 30            | 90 x 48 x 76 x 3,0    | -                  | S250GD                     | Z275                         |
| 641 912 30            | 120 x 90 x 40 x 3,0   | -                  | S250GD                     | Z275                         |
| 641 690 30            | 90 x 60 x 60 x 2,5    | with slotted holes | S250GD                     | Z275                         |
| 641 590 30            | 90 x 50 x 50 x 2,5    | -                  | S250GD                     | Z275                         |
| 641 490 25            | 90 x 40 x 40 x 2,5    | -                  | S250GD                     | Z275                         |
| 641 490 30            | 90 x 40 x 40 x 3,0    | -                  | S250GD                     | Z275                         |
| 651 554 25            | 50 x 50 x 40 x 2,5    | 135° angled        | S250GD                     | Z275                         |
| 651 070 25            | 70 x 70 x 55 x 2,5    | -                  | S250GD                     | Z275                         |
| 651 994 25            | 90 x 90 x 40 x 2,5    | 135° angled        | S250GD                     | Z275                         |
| 651 090 25            | 90 x 90 x 65 x 2,5    | -                  | S250GD                     | Z275                         |
| 651 105 30            | 105 x 105 x 90 x 3,0  | -                  | S250GD                     | Z275                         |
| 641 416 40            | 160 x 50 x 40 x 3,0   | -                  | S250GD                     | Z275                         |
| 631 460 20            | 40 x 40 x 60 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 480 20            | 40 x 40 x 80 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 610 20            | 60 x 60 x 100 x 2,0   | -                  | S250GD                     | Z275                         |
| 631 640 20            | 60 x 60 x 40 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 650 20            | 60 x 60 x 50 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 660 20            | 60 x 60 x 60 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 680 20            | 60 x 60 x 80 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 810 20            | 80 x 80 x 100 x 2,0   | -                  | S250GD                     | Z275                         |
| 631 480 20            | 80 x 80 x 40 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 860 20            | 80 x 80 x 60 x 2,0    | -                  | S250GD                     | Z275                         |
| 631 880 20            | 80 x 80 x 80 x 2,0    | -                  | S250GD                     | Z275                         |



|            |                       |                    |        |          |
|------------|-----------------------|--------------------|--------|----------|
| 631 140 20 | 100 x 100 x 40 x 2,0  | -                  | S250GD | Z275     |
| 631 160 20 | 100 x 100 x 60 x 2,5  | -                  | S250GD | Z275     |
| 631 180 20 | 100 x 100 x 80 x 2,0  | -                  | S250GD | Z275     |
| 631 110 20 | 100 x 100 x 100 x 2,0 | -                  | S250GD | Z275     |
| RHV 60     | 80 x 80 x 60 x 1,5    | with curve         | S250GD | Z275     |
| RHV 80     | 120 x 120 x 75 x 1,5  | with curve         | S250GD | Z275     |
| 633 710 66 | 100 x 75 x 60 x 6,0   | with slotted hole  | S250GD | Z275     |
| 618 129 40 | 120 x 90 x 40 x 4,0   | -                  | S250GD | Z275     |
| 618 149 40 | 140 x 90 x 40 x 4,0   | -                  | S250GD | Z275     |
| 618 165 40 | 160 x 50 x 40 x 4,0   | -                  | S250GD | Z275     |
| 618 166 40 | 160 x 80 x 60 x 4,0   | -                  | S250GD | Z275     |
| 618 168 40 | 160 x 80 x 80 x 4,0   | -                  | S250GD | Z275     |
| 631 444 20 | 40 x 40 x 40 x 2,0    | -                  | S250GD | Z275     |
| 631 444 25 | 40 x 40 x 40 x 2,5    | -                  | S250GD | Z275     |
| 631 642 20 | 60 x 40 x 25 x 2,0    | -                  | S250GD | Z275     |
| 631 646 25 | 60 x 40 x 60 x 2,5    | -                  | S250GD | Z275     |
| 631 669 20 | 60 x 60 x 90 x 2,0    | -                  | S250GD | Z275     |
| 631 686 25 | 60 x 80 x 60 x 2,5    | -                  | S250GD | Z275     |
| 632 060 20 | 60 x 60 x 25 x 2,0    | -                  | S250GD | Z275     |
| 641 035 25 | 50 x 50 x 35 x 2,5    | -                  | S250GD | Z275     |
| 641 070 20 | 70 x 70 x 55 x 2,0    | -                  | S250GD | Z275     |
| 641 105 20 | 105 x 105 x 90 x 2,0  | -                  | S250GD | Z275     |
| 641 140 34 | 40 x 140 x 2,5        | -                  | S250GD | Z275     |
| 641 412 25 | 40 x 120 x 2,5        | -                  | S250GD | Z275     |
| 641 416 40 | 40 x 160 x 2,5        | -                  | S250GD | Z275     |
| 641 490 42 | 40 x 90 x 2,5         | -                  | S250GD | Z275     |
| 641 553 20 | 50 x 50 x 35 x 2,0    | -                  | DD11   | Fe/Zn 12 |
| 641 665 30 | 65 x 65 x 55 x 3,0    | -                  | S250GD | Z275     |
| 641 690 25 | 60 x 90 x 60 x 2,5    | with slotted hole  | S250GD | Z275     |
| 641 691 25 | 60 x 90 x 60 x 2,5    | with slotted holes | S250GD | Z275     |
| 641 692 25 | 60 x 90 x 60 x 2,5    | with slotted holes | S250GD | Z275     |
| 641 860 20 | 83 x 62 x 40 x 2,0    | with rib           | S250GD | Z275     |
| 641 905 25 | 105 x 105 x 90 x 2,5  | with rib           | S250GD | Z275     |
| 641 912 30 | 90 x 120 x 3,0        | -                  | S250GD | Z275     |
| 641 970 20 | 70 x 70 x 55 x 2,0    | with rib           | S250GD | Z275     |
| 641 971 15 | 70 x 70 x 55 x 1,5    | with rib           | S250GD | Z275     |
| 641 990 20 | 90 x 90 x 65 x 2,0    | with rib           | S250GD | Z275     |
| 641 991 15 | 90 x 90 x 65 x 1,5    | with rib           | S250GD | Z275     |
| 651 070 25 | 70 x 70 x 55 x 2,5    | 135° angled        | S250GD | Z275     |
| 651 090 25 | 90 x 90 x 65 x 2,5    | 135° angled        | S250GD | Z275     |
| 651 105 30 | 105 x 105 x 90 x 3,0  | 135° angled        | S250GD | Z275     |

**Table A.2:** Range of sizes

| Bracket number | Dimensions in mm         | Height vertical in mm |       | Height horizontal in mm |       | Width in mm |     |
|----------------|--------------------------|-----------------------|-------|-------------------------|-------|-------------|-----|
|                |                          |                       |       |                         |       |             |     |
| 633 553 20     | 52 x 52 x 30 x 2,0       | 51                    | 53    | 51                      | 53    | 29          | 31  |
| 633 753 20     | 72 x 52 x 30 x 2,0       | 71                    | 73    | 51                      | 53    | 29          | 31  |
| 633 853 25     | 82 x 52 x 30 x 2,5       | 81                    | 83    | 51                      | 53    | 29          | 31  |
| 631 460 25     | 40 x 40 x 60 x 2,5       | 39                    | 41    | 39                      | 41    | 59          | 61  |
| 631 480 25     | 42,5 x 42,5 x 80 x 2,5   | 41,5                  | 43,5  | 41,5                    | 43,5  | 79          | 81  |
| 631 640 25     | 60 x 60 x 40 x 2,5       | 59                    | 61    | 59                      | 61    | 39          | 41  |
| 631 650 25     | 62,5 x 62,5 x 50 x 2,5   | 61,5                  | 63,5  | 61,5                    | 63,5  | 49          | 51  |
| 631 660 25     | 60 x 60 x 60 x 2,5       | 59                    | 61    | 59                      | 61    | 59          | 61  |
| 631 680 25     | 60 x 60 x 80 x 2,5       | 59                    | 61    | 59                      | 61    | 79          | 81  |
| 631 610 25     | 62,5 x 62,5 x 100 x 2,5  | 61,5                  | 63,5  | 61,5                    | 63,5  | 99          | 101 |
| 631 480 25     | 80 x 80 x 40 x 2,5       | 79                    | 81    | 79                      | 81    | 39          | 41  |
| 631 860 25     | 82,5 x 82,5 x 60 x 2,5   | 81,5                  | 83,5  | 81,5                    | 83,5  | 59          | 61  |
| 631 880 25     | 82,5 x 82,5 x 80 x 2,5   | 81,5                  | 83,5  | 81,5                    | 83,5  | 79          | 81  |
| 631 810 25     | 80 x 80 x 100 x 2,5      | 79                    | 81    | 79                      | 81    | 99          | 101 |
| 631 160 25     | 102,5 x 102,5 x 60 x 2,5 | 101,5                 | 103,5 | 101,5                   | 103,5 | 59          | 61  |
| 631 180 25     | 102,5 x 102,5 x 80 x 2,5 | 101,5                 | 103,5 | 101,5                   | 103,5 | 79          | 81  |
| 631 110 25     | 100 x 100 x 100 x 2,5    | 99                    | 101   | 99                      | 101   | 99          | 101 |
| 631 554 20     | 50 x 50 x 40 x 2,0       | 49                    | 51    | 49                      | 51    | 39          | 41  |
| 634 100 20     | 40 x 40 x 100 x 2,0      | 39                    | 41    | 39                      | 41    | 99          | 101 |
| 634 150 20     | 42 x 42 x 150 x 2,0      | 41                    | 43    | 41                      | 43    | 149         | 151 |
| 634 200 20     | 42 x 42 x 200 x 2,0      | 41                    | 43    | 41                      | 43    | 199         | 201 |
| 641 035 25     | 50 x 50 x 35 x 2,5       | 49                    | 51    | 49                      | 51    | 34          | 36  |
| 641 040 30     | 50 x 50 x 40 x 3,0       | 49                    | 51    | 49                      | 51    | 39          | 41  |
| 641 664 30     | 60 x 60 x 45 x 3,0       | 59                    | 61    | 59                      | 61    | 44          | 46  |
| 641 994 30     | 90 x 90 x 40 x 3,0       | 89                    | 91    | 89                      | 91    | 39          | 41  |
| 641 595 30     | 93 x 52 x 51 x 3,0       | 92                    | 94    | 51                      | 53    | 50          | 52  |
| 500 313 62     | 90 x 50 x 116 x 3,0      | 89                    | 91    | 49                      | 51    | 115         | 117 |
| 641 598 30     | 90 x 48 x 76 x 3,0       | 89                    | 91    | 47                      | 49    | 75          | 77  |
| 641 912 30     | 123 x 93 x 40 x 3,0      | 122                   | 124   | 92                      | 94    | 39          | 41  |
| 641 690 30     | 90 x 60 x 60 x 2,5       | 89                    | 91    | 59                      | 61    | 59          | 61  |
| 641 590 30     | 92,5 x 51,5 x 51 x 2,5   | 91,5                  | 93,5  | 50,5                    | 52,5  | 50          | 52  |
| 641 490 25     | 83 x 42 x 40 x 2,5       | 82                    | 84    | 41                      | 43    | 39          | 41  |
| 641 490 30     | 83 x 42 x 40 x 3,0       | 82                    | 84    | 41                      | 43    | 39          | 41  |
| 651 554 25     | 50 x 50 x 40 x 2,5       | 49                    | 51    | 49                      | 51    | 39          | 41  |
| 651 070 25     | 70 x 70 x 55 x 2,5       | 69                    | 71    | 69                      | 71    | 54          | 56  |
| 651 994 25     | 90 x 90 x 40 x 2,5       | 89                    | 91    | 89                      | 91    | 39          | 41  |
| 651 090 25     | 90 x 90 x 65 x 2,5       | 89                    | 91    | 89                      | 91    | 64          | 66  |
| 651 105 30     | 105 x 105 x 90 x 3,0     | 104                   | 106   | 104                     | 106   | 89          | 91  |
| 641 416 40     | 166 x 50 x 40 x 3,0      | 165                   | 167   | 49                      | 51    | 39          | 41  |
| 631 460 20     | 40 x 40 x 60 x 2,0       | 39                    | 41    | 39                      | 41    | 59          | 61  |
| 631 480 20     | 40 x 40 x 80 x 2,0       | 39                    | 41    | 39                      | 41    | 79          | 81  |
| 631 610 20     | 62,5 x 62,5 x 100 x 2,0  | 61,5                  | 63,5  | 61,5                    | 63,5  | 99          | 101 |
| 631 640 20     | 60 x 60 x 40 x 2,0       | 59                    | 61    | 59                      | 61    | 39          | 41  |
| 631 650 20     | 60 x 60 x 50 x 2,0       | 59                    | 61    | 59                      | 61    | 49          | 51  |
| 631 660 20     | 60 x 60 x 60 x 2,0       | 59                    | 61    | 59                      | 61    | 59          | 61  |
| 631 680 20     | 60 x 60 x 80 x 2,5       | 59                    | 61    | 59                      | 61    | 79          | 81  |
| 631 810 20     | 80 x 80 x 100 x 2,0      | 79                    | 81    | 79                      | 81    | 99          | 101 |
| 631 480 20     | 80 x 80 x 40 x 2,0       | 79                    | 81    | 79                      | 81    | 39          | 41  |
| 631 860 20     | 80 x 80 x 60 x 2,0       | 79                    | 81    | 79                      | 81    | 59          | 61  |
| 631 880 20     | 80 x 80 x 80 x 2,0       | 79                    | 81    | 79                      | 81    | 79          | 81  |
| 631 140 20     | 102 x 102 x 40 x 2,0     | 101                   | 103   | 101                     | 103   | 39          | 41  |

|            |                          |       |       |       |       |    |     |
|------------|--------------------------|-------|-------|-------|-------|----|-----|
| 631 160 20 | 102,5 x 102,5 x 60 x 2,5 | 101,5 | 103,5 | 101,5 | 103,5 | 59 | 61  |
| 631 180 20 | 100 x 100 x 80 x 2,0     | 99    | 101   | 99    | 101   | 79 | 81  |
| 631 110 20 | 100 x 100 x 100 x 2,0    | 99    | 101   | 99    | 101   | 99 | 101 |
| RHV 60     | 80 x 80 x 57 x 1,5       | 79    | 81    | 79    | 81    | 56 | 58  |
| RHV 80     | 123 x 123 x 74 x 1,5     | 122   | 124   | 122   | 124   | 73 | 75  |
| 633 710 66 | 103 x 71 x 60 x 6,0      | 102   | 104   | 70    | 72    | 59 | 61  |
| 618 129 40 | 120 x 90 x 40 x 4,0      | 119   | 121   | 89    | 91    | 39 | 41  |
| 618 149 40 | 140 x 90 x 40 x 4,0      | 139   | 141   | 89    | 91    | 39 | 41  |
| 618 165 40 | 160 x 50 x 40 x 4,0      | 159   | 161   | 49    | 51    | 39 | 41  |
| 618 166 40 | 164 x 84 x 60 x 4,0      | 163   | 165   | 83    | 85    | 59 | 61  |
| 618 168 40 | 164 x 84 x 80 x 4,0      | 163   | 165   | 83    | 85    | 79 | 81  |
| 631 444 20 | 40 x 40 x 40 x 2,0       | 39    | 41    | 39    | 41    | 39 | 41  |
| 631 444 25 | 40 x 40 x 40 x 2,5       | 39    | 41    | 39    | 41    | 39 | 41  |
| 631 642 20 | 62 x 42 x 25 x 2,0       | 61    | 63    | 41    | 43    | 24 | 26  |
| 631 646 25 | 62,5 x 42,5 x 60 x 2,5   | 61,5  | 63,5  | 41,5  | 43,5  | 59 | 61  |
| 631 669 20 | 60 x 60 x 90 x 2,0       | 59    | 61    | 59    | 61    | 89 | 91  |
| 631 686 25 | 80 x 60 x 60 x 2,5       | 79    | 81    | 59    | 61    | 59 | 61  |
| 632 060 20 | 62 x 62 x 25 x 2,0       | 61    | 63    | 61    | 63    | 24 | 26  |
| 641 035 25 | 50 x 50 x 35 x 2,5       | 49    | 51    | 49    | 51    | 34 | 36  |
| 641 070 20 | 70 x 70 x 55 x 2,0       | 69    | 71    | 69    | 71    | 54 | 56  |
| 641 105 20 | 105 x 105 x 90 x 2,0     | 104   | 106   | 104   | 106   | 89 | 91  |
| 641 140 34 | 140 x 40 x 40 x 2,5      | 139   | 141   | 39    | 41    | 39 | 41  |
| 641 412 25 | 120 x 40 x 40 x 2,5      | 119   | 121   | 39    | 41    | 39 | 41  |
| 641 416 40 | 160 x 40 x 40 x 2,5      | 159   | 161   | 39    | 41    | 39 | 41  |
| 641 490 42 | 90 x 40 x 40 x 2,5       | 89    | 91    | 39    | 41    | 39 | 41  |
| 641 553 20 | 50 x 50 x 35 x 2,0       | 49    | 51    | 49    | 51    | 34 | 36  |
| 641 665 30 | 65 x 65 x 55 x 3,0       | 64    | 66    | 64    | 66    | 54 | 56  |
| 641 690 25 | 90 x 60 x 60 x 2,5       | 89    | 91    | 59    | 61    | 59 | 61  |
| 641 691 25 | 90 x 60 x 60 x 2,5       | 89    | 91    | 59    | 61    | 59 | 61  |
| 641 692 25 | 90 x 60 x 60 x 2,5       | 89    | 91    | 59    | 61    | 59 | 61  |
| 641 860 20 | 82 x 62 x 40 x 2,0       | 81    | 83    | 61    | 63    | 39 | 41  |
| 641 905 25 | 104,5 x 104,5 x 90 x 2,5 | 103,5 | 105,5 | 103,5 | 105,5 | 89 | 91  |
| 641 912 30 | 120 x 90 x 40 x 3,0      | 119   | 121   | 89    | 91    | 39 | 41  |
| 641 970 20 | 69,5 x 69,5 x 55 x 2,0   | 68,5  | 70,5  | 68,5  | 70,5  | 54 | 56  |
| 641 971 15 | 69 x 69 x 55 x 1,5       | 68    | 70    | 68    | 70    | 54 | 56  |
| 641 990 20 | 89,5 x 89,5 x 65 x 2,0   | 88,5  | 90,5  | 88,5  | 90,5  | 64 | 66  |
| 641 991 15 | 89 x 89 x 65 x 1,5       | 88    | 90    | 88    | 90    | 64 | 66  |
| 651 070 25 | 70 x 70 x 55 x 2,5       | 69    | 71    | 69    | 71    | 54 | 56  |
| 651 090 25 | 90 x 90 x 65 x 2,5       | 89    | 91    | 89    | 91    | 64 | 66  |
| 651 105 30 | 105 x 105 x 90 x 3,0     | 104   | 106   | 104   | 106   | 89 | 91  |

**Table A.3:** Fastener specification

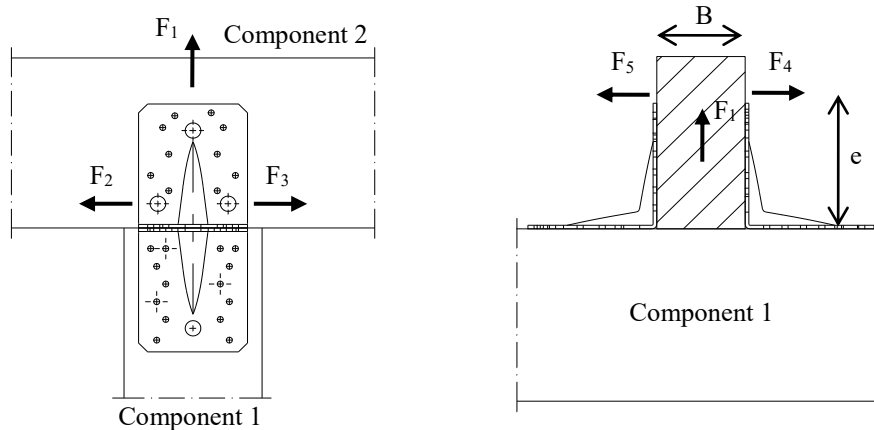
| <b>Three-dimensional nailing plate type</b>   | <b>Nail diameter</b> | <b>Nail length</b> | <b>Nail type</b>                         |
|---|----------------------|--------------------|--|
| Angle brackets  | 4.0 mm               | min. 40 mm         | Ringed shank nails according to EN 14592 |
| <p>In 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><math>f_{ax,k}</math> Characteristic value of the withdrawal parameter in N/mm<sup>2</sup></p> <p><math>d</math> Nail diameter in mm</p> <p><math>t_{pen}</math> Penetration depth of the profiled shank including the nail point in mm, <math>t_{pen} \geq 30</math> 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><math>\rho_k</math> Characteristic density of the timber in kg/m<sup>3</sup></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> |                      |                    |  |

| <b>BOLTS diameter</b> | <b>Correspondence Hole diameter</b>      | <b>Bolts type</b>                     |
|-----------------------|--|---------------------------------------|
| 12.0 and 14.0         | Max. 2 mm. larger than the bolt diameter | See specification of the manufacturer |

| <b>METAL ANCHORS diameter</b> | <b>Correspondence Hole diameter</b>        | <b>Anchors type</b>                   |
|-------------------------------|--|---------------------------------------|
| 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  $\Delta F_1$  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 |
| 633 753 20     | 70 x 50 x 30 x 2,0    | 1,2               | 7,8   | 1,66                     | 0,28  |
| 633 853 25     | 80 x 50 x 30 x 2,5    | 1,2               | 9,10  | 2,11                     | 0,68  |
| 631 860 25     | 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  |
| 631 880 25     | 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  |
| 631 810 25     | 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                     | 6,25  |
| 631 160 25     | 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  |
| 631 180 25     | 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  |
| 631 110 25     | 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  |
| 641 994 30     | 90 x 90 x 40 x 3,0    | 1,2               | 11,12,14,15,19,20   | 2,30                     | 1,82  |
| 641 595 30     | 90 x 50 x 50 x 3,0    | 1,3,5,6           | 13,14,16,17,18  | 1,60                     | 2,15  |
| 500 313 62     | 90 x 50 x 116 x 3,0   | 1,2,3,5,6,9       | 23,24,25,26,31  | 2,61                     | 2,57  |
| 641 598 30     | 90 x 48 x 76 x 3,0    | 1,2,3,6           | 16,17,20,21   | 1,95                     | 4,11  |
| 641 912 30     | 120 x 90 x 40 x 3,0   | 1,2,3,4,5         | 10,11,12,13,14,15   | 2,56                     | 2,93  |
| 641 690 30     | 90 x 60 x 60 x 2,5    | 1,2               | 6,7,8,9   | 1,76                     | 1,42  |
| 641 590 30     | 90 x 50 x 50 x 2,5    | 1,3,5,6           | 13,14,16,17,18  | 1,58                     | 1,49  |
| 641 490 25     | 90 x 40 x 40 x 2,5    | 1,2               | 8,9,11,12   | 1,83                     | 1,67  |
| 641 490 30     | 90 x 40 x 40 x 3,0    | 1,2               | 8,9,11,12   | 1,83                     | 2,41  |
| 651 554 25     | 50 x 50 x 40 x 2,5    | -                 | -   | -                        | -     |
| 651 070 25     | 70 x 70 x 55 x 2,5    | 1,2,3             | 12,13,14,15,16,20,21,22   | 3,05                     | 1,56  |
| 651 994 25     | 90 x 90 x 40 x 2,5    | 1,2               | 11,12,14,15,19,20   | 2,28                     | 1,23  |
| 651 090 25     | 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  |
| 651 105 30     | 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                     | 4,50  |
| 641 416 40     | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7     | 13,14   | 1,40                     | 1,44  |
| 631 810 20     | 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                     | 4,00  |
| 631 860 20     | 80 x 80 x 60 x 2,0    | 1,2,3             | 11,12,13,14,15,16,17,18,19,20                                     | 3,82                     | 2,25  |
| 631 880 20     | 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  |
| 631 140 20     | 100 x 100 x 40 x 2,0  | 1,2,3,4           | 11,12,13,14,15,16,17,18,19,20                                     | 2,58                     | 1,25  |
| 631 160 20     | 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  |
| 631 180 20     | 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  |

|            |                       |                         |   |      |      |
|------------|-----------------------|-------------------------|---|------|------|
| 631 110 20 | 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,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 5,26 | 4,00 |
| RHV 60     | 80 x 80 x 60 x 1,5    | 1,3                     | 8,9,10,12   | 1,76 | 4,15 |
| RHV 80     | 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 |
| 618 129 40 | 120 x 90 x 40 x 4,0   | 1,2,3,4                 | 8,9,10,14,15  | 1,21 | 4,67 |
| 618 149 40 | 140 x 90 x 40 x 4,0   | 1,2,3,4,5,6             | 10,11,12,16,17  | 1,21 | 4,67 |
| 618 165 40 | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7           | 11,12   | 1,37 | 2,50 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0    | -                       | -   | -    | -    |
| 631 444 25 | 40 x 40 x 40 x 2,5    | -                       | -   | -    | -    |
| 631 642 20 | 60 x 40 x 25 x 2,0    | -                       | -   | -    | -    |
| 631 646 25 | 60 x 40 x 60 x 2,5    | -                       | -   | -    | -    |
| 631 669 20 | 60 x 60 x 90 x 2,0    | -                       | -   | -    | -    |
| 631 686 25 | 60 x 80 x 60 x 2,5    | 1,2,3                   | 13,14,15,16,17,18,19,20,21  | 3,61 | 3,52 |
| 632 060 20 | 60 x 60 x 25 x 2,0    | -                       | -   | -    | -    |
| 641 035 25 | 50 x 50 x 35 x 2,5    | -                       | -   | -    | -    |
| 641 070 20 | 70 x 70 x 55 x 2,0    | 1,2,3                   | 12,13,14,20,21,22   | 3,05 | 1,00 |
| 641 105 20 | 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 |
| 641 140 34 | 40 x 140 x 2,5        | 1,2,4,5,7,8,10,11       | 21,22,24,25   | 2,10 | 2,34 |
| 641 412 25 | 40 x 120 x 2,5        | 1,2,4,5,7,8             | 18,19,21,22   | 2,10 | 2,34 |
| 641 416 40 | 40 x 160 x 2,5        | 1,2,4,5,7,8,10,11,13,14 | 24,25,27,28   | 2,10 | 2,34 |
| 641 490 42 | 40 x 90 x 2,5         | 2,3                     | 13,14,16,17   | 2,10 | 2,34 |
| 641 553 20 | 50 x 50 x 35 x 2,0    | -                       | -   | -    | -    |
| 641 665 30 | 65 x 65 x 55 x 3,0    | 1,2                     | 8,9,13,14   | 2,21 | 3,38 |
| 641 690 25 | 60 x 90 x 60 x 2,5    | 1,2,3,4,5,6             | 10,12,14,15,16  | 1,98 | 1,69 |
| 641 691 25 | 60 x 90 x 60 x 2,5    | 1,2,4,5,6               | 10,11,13,14,15  | 1,98 | 1,74 |
| 641 692 25 | 60 x 90 x 60 x 2,5    | 1,2,4                   | 8,9,11,12,13  | 1,98 | 1,74 |
| 641 860 20 | 83 x 62 x 40 x 2,0    | 1,2                     | 6,7,8,9,10  | 2,32 | 1,31 |
| 641 905 25 | 105 x 105 x 90 x 2,5  | 1,2,6,7                 | 14,15,16,17,20,21,27,28   | 6,39 | 17,4 |
| 641 912 30 | 90 x 120 x 3,0        | 1,2,4,5,7,8             | 18,19,21,22,24,25,27,28   | 2,59 | 3,38 |
| 641 970 20 | 70 x 70 x 55 x 2,0    | 1,2                     | 8,9,10,11,13,14   | 2,98 | 5,44 |
| 641 971 15 | 70 x 70 x 55 x 1,5    | 1,2                     | 8,9,10,11,13,14   | 2,98 | 4,21 |
| 641 990 20 | 90 x 90 x 65 x 2,0    | 1,2                     | 12,13,14,15,21,22   | 3,56 | 5,95 |
| 641 991 15 | 90 x 90 x 65 x 1,5    | 1,2                     | 12,13,14,15,21,22   | 3,55 | 4,42 |
| 651 070 25 | 70 x 70 x 55 x 2,5    | -                       | -   | -    | -    |
| 651 090 25 | 90 x 90 x 65 x 2,5    | 1,2                     | 17,18,21,22,29,30   | 1,61 | 3,49 |
| 651 105 30 | 105 x 105 x 90 x 3,0  | 4,5                     | 18,19,20,21,27,28,29,33,34  | 6,36 | 6,35 |



**Table B.2:** Force F<sub>1</sub> Column, 1 angle brackets / connection, timber-timber

| Bracket number | Bracket type          | Nail number n <sub>v</sub> | Nail number n <sub>H</sub>  | F <sub>1,Rk</sub> [kN] (column) |       |
|----------------|-----------------------|----------------------------|---|---------------------------------|-------|
|                |                       |                            |   | Timber                          | Steel |
| 633 753 20     | 70 x 50 x 30 x 2,0    | 1,2                        | 7,8   | 0,83                            | 0,14  |
| 633 853 25     | 80 x 50 x 30 x 2,5    | 1,2                        | 9,10  | 1,06                            | 0,34  |
| 631 860 25     | 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  |
| 631 880 25     | 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  |
| 631 810 25     | 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  |
| 631 160 25     | 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  |
| 631 180 25     | 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                            | 2,34  |
| 631 110 25     | 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  |
| 641 994 30     | 90 x 90 x 40 x 3,0    | 1,2                        | 11,12,14,15,19,20   | 1,15                            | 0,91  |
| 641 595 30     | 90 x 50 x 50 x 3,0    | 1,3,5,6                    | 13,14,16,17,18  | 0,80                            | 1,07  |
| 500 313 62     | 90 x 50 x 116 x 3,0   | 1,2,3,5,6,9                | 23,24,25,26,31  | 1,31                            | 1,28  |
| 641 598 30     | 90 x 48 x 76 x 3,0    | 1,2,3,6                    | 16,17,20,21   | 0,97                            | 2,06  |
| 641 912 30     | 120 x 90 x 40 x 3,0   | 1,2,3,4,5                  | 10,11,12,13,14,15   | 1,28                            | 1,47  |
| 641 690 30     | 90 x 60 x 60 x 2,5    | 1,2                        | 6,7,8,9   | 0,88                            | 0,71  |
| 641 590 30     | 90 x 50 x 50 x 2,5    | 1,3,5,6                    | 13,14,16,17,18  | 0,79                            | 0,74  |
| 641 490 25     | 90 x 40 x 40 x 2,5    | 1,2                        | 8,9,11,12   | 0,91                            | 0,84  |
| 641 490 30     | 90 x 40 x 40 x 3,0    | 1,2                        | 8,9,11,12   | 0,91                            | 1,21  |
| 651 070 25     | 70 x 70 x 55 x 2,5    | 1,2,3                      | 12,13,14,15,16,20,21,22   | 1,53                            | 0,78  |
| 651 994 25     | 90 x 90 x 40 x 2,5    | 1,2                        | 11,12,14,15,19,20   | 1,14                            | 0,62  |
| 651 090 25     | 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  |
| 651 105 30     | 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  |
| 641 416 40     | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7              | 13,14   | 0,70                            | 0,72  |
| 631 810 20     | 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                            | 2,00  |
| 631 860 20     | 80 x 80 x 60 x 2,0    | 1,2,3                      | 11,12,13,14,15,16,17,18,19,20                                     | 1,91                            | 1,13  |
| 631 880 20     | 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                            | 1,50  |
| 631 140 20     | 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  |
| 631 160 20     | 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                            | 1,78  |
| 631 180 20     | 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  |
| 631 110 20     | 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  |
| RHV 60         | 80 x 80 x 60 x 1,5    | 1,3                        | 8,9,10,12   | 0,88                            | 2,07  |
| RHV 80         | 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  |

|            |                      |                         |                            |      |      |
|------------|----------------------|-------------------------|----------------------------|------|------|
| 618 129 40 | 120 x 90 x 40 x 4,0  | 1,2,3,4                 | 8,9,10,14,15               | 0,61 | 2,33 |
| 618 149 40 | 140 x 90 x 40 x 4,0  | 1,2,3,4,5,6             | 10,11,12,16,17             | 0,61 | 2,33 |
| 618 165 40 | 160 x 50 x 40 x 4,0  | 1,2,3,4,5,6,7           | 11,12                      | 0,69 | 1,25 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0   | -                       | -                          | -    | -    |
| 631 444 25 | 40 x 40 x 40 x 2,5   | -                       | -                          | -    | -    |
| 631 642 20 | 60 x 40 x 25 x 2,0   | -                       | -                          | -    | -    |
| 631 646 25 | 60 x 40 x 60 x 2,5   | -                       | -                          | -    | -    |
| 631 669 20 | 60 x 60 x 90 x 2,0   | -                       | -                          | -    | -    |
| 631 686 25 | 60 x 80 x 60 x 2,5   | 1,2,3                   | 13,14,15,16,17,18,19,20,21 | 1,80 | 1,76 |
| 632 060 20 | 60 x 60 x 25 x 2,0   | -                       | -                          | -    | -    |
| 641 035 25 | 50 x 50 x 35 x 2,5   | -                       | -                          | -    | -    |
| 641 070 20 | 70 x 70 x 55 x 2,0   | 1,2,3                   | 12,13,14,20,21,22          | 1,53 | 0,50 |
| 641 105 20 | 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 |
| 641 140 34 | 40 x 140 x 2,5       | 1,2,4,5,7,8,10,11       | 21,22,24,25                | 1,05 | 1,17 |
| 641 412 25 | 40 x 120 x 2,5       | 1,2,4,5,7,8             | 18,19,21,22                | 1,05 | 1,17 |
| 641 416 40 | 40 x 160 x 2,5       | 1,2,4,5,7,8,10,11,13,14 | 24,25,27,28                | 1,05 | 1,17 |
| 641 490 42 | 40 x 90 x 2,5        | 2,3                     | 13,14,16,17                | 1,05 | 1,17 |
| 641 553 20 | 50 x 50 x 35 x 2,0   | -                       | -                          | -    | -    |
| 641 665 30 | 65 x 65 x 55 x 3,0   | 1,2                     | 8,9,13,14                  | 1,10 | 1,69 |
| 641 690 25 | 60 x 90 x 60 x 2,5   | 1,2,3,4,5,6             | 10,12,14,15,16             | 0,99 | 0,85 |
| 641 691 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6               | 10,11,13,14,15             | 0,99 | 0,87 |
| 641 692 25 | 60 x 90 x 60 x 2,5   | 1,2,4                   | 8,9,11,12,13               | 0,99 | 0,87 |
| 641 860 20 | 83 x 62 x 40 x 2,0   | 1,2                     | 6,7,8,9,10                 | 1,16 | 0,66 |
| 641 905 25 | 105 x 105 x 90 x 2,5 | 1,2,6,7                 | 14,15,16,17,20,21,27,28    | 3,19 | 8,68 |
| 641 912 30 | 90 x 120 x 3,0       | 1,2,4,5,7,8             | 18,19,21,22,24,25,27,28    | 1,30 | 1,69 |
| 641 970 20 | 70 x 70 x 55 x 2,0   | 1,2                     | 8,9,10,11,13,14            | 1,49 | 2,72 |
| 641 971 15 | 70 x 70 x 55 x 1,5   | 1,2                     | 8,9,10,11,13,14            | 1,49 | 2,10 |
| 641 990 20 | 90 x 90 x 65 x 2,0   | 1,2                     | 12,13,14,15,21,22          | 1,78 | 2,97 |
| 641 991 15 | 90 x 90 x 65 x 1,5   | 1,2                     | 12,13,14,15,21,22          | 1,78 | 2,21 |
| 651 070 25 | 70 x 70 x 55 x 2,5   | -                       | -                          | -    | -    |
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2                     | 17,18,21,22,29,30          | 0,81 | 1,74 |
| 651 105 30 | 105 x 105 x 90 x 3,0 | 4,5                     | 18,19,20,21,27,28,29,33,34 | 3,18 | 3,18 |

**Table B.3:** Force  $F_1$  Column, 2 angle brackets / connection, timber-concrete/steel

| Article-No. | Dimension           | Bolt number<br>$n_V$ | Bolt number<br>$n_H$ | $F_{1,Rk}$ [kN]<br>(column) |       | Bolt<br>$k_t$ |
|-------------|---------------------|----------------------|----------------------|-----------------------------|-------|---------------|
|             |                     |                      |                      | Timber                      | Steel |               |
| 633 710 66  | 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 |            |
| 633 710 66     | 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 |
| 633 553 20     | 50 x 50 x 30 x 2,0    | 1,2  | 5,6   | 1,66                     | 0,28  |
| 633 753 20     | 70 x 50 x 30 x 2,0    | 1,2,3,4,5,6                                  | 7,8   | 1,66                     | 0,28  |
| 633 853 25     | 80 x 50 x 30 x 2,5    | 1,2,3,4,5,6                                  | 9,10  | 2,11                     | 0,68  |
| 631 460 25     | 40 x 40 x 60 x 2,5    | 1,2,3  | 6,7,8,9,10  | 3,15                     | 3,52  |
| 631 480 25     | 40 x 40 x 80 x 2,5    | 1,2,3  | 8,9,10,11,12,13,14  | 2,94                     | 4,06  |
| 631 640 25     | 60 x 60 x 40 x 2,5    | 1,2,3  | 6,7,8,9   | 1,11                     | 2,04  |
| 631 650 25     | 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  |
| 631 660 25     | 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  |
| 631 680 25     | 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  |
| 631 610 25     | 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  |
| 631 480 25     | 80 x 80 x 40 x 2,5    | 1,2,3,4                                      | 7,8,9,10,11,12  | 1,27                     | 2,73  |
| 631 860 25     | 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  |
| 631 880 25     | 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  |
| 631 810 25     | 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  |
| 631 160 25     | 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  |
| 631 180 25     | 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  |
| 631 110 25     | 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  |
| 631 554 20     | 50 x 50 x 40 x 2,0    | 1,2,3  | 7,8,9,10,11,12  | 1,14                     | 1,75  |
| 634 100 20     | 40 x 40 x 100 x 2,0   | 1,2,3,4,5                                    | 10,11,12,13,14,15,16,17,18  | 4,67                     | 2,94  |
| 634 150 20     | 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  |
| 634 200 20     | 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                     | 6,73  |
| 641 035 25     | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 2,12                     | 1,56  |
| 641 040 30     | 50 x 50 x 40 x 3,0    | 1,2  | 6,7,9,10  | 1,80                     | 1,93  |
| 641 664 30     | 60 x 60 x 45 x 3,0    | 1,2,3,5                                      | 8,9,13,14   | 2,00                     | 2,25  |
| 641 994 30     | 90 x 90 x 40 x 3,0    | 1,2,4,5,6,7                                  | 11,12,14,15,19,20   | 2,30                     | 1,82  |
| 641 595 30     | 90 x 50 x 50 x 3,0    | 1,3,5,6,7,8,9                                | 13,14,16,17,18  | 1,60                     | 2,15  |
| 500 313 62     | 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  |

|            |                       |  |   |      |      |
|------------|-----------------------|--|---|------|------|
| 641 598 30 | 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 |
| 641 912 30 | 120 x 90 x 40 x 3,0   | 1,2,3,4,5,6,7,8                                  | 10,11,12,13,14,15   | 2,56 | 2,93 |
| 641 690 30 | 90 x 60 x 60 x 2,5    | 1,2,3  | 6,7,8,9   | 1,76 | 1,42 |
| 641 590 30 | 90 x 50 x 50 x 2,5    | 1,3,5,6,7,8,9                                    | 13,14,16,17,18  | 1,58 | 1,49 |
| 641 490 25 | 90 x 40 x 40 x 2,5    | 1,2,3,4  | 8,9,11,12   | 1,83 | 1,67 |
| 641 490 30 | 90 x 40 x 40 x 3,0    | 1,2,3,4  | 8,9,11,12   | 1,83 | 2,41 |
| 651 554 25 | 50 x 50 x 40 x 2,5    | 1,2  | 6,7,9,10  | 1,80 | 1,34 |
| 651 070 25 | 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 |
| 651 994 25 | 90 x 90 x 40 x 2,5    | 1,2,4,5,6,7                                      | 11,12,14,15,19,20   | 2,28 | 1,23 |
| 651 090 25 | 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 |
| 651 105 30 | 105 x 105 x 90 x 3,0  | 1,2,4,5,6,8,10,11,12,13,<br>14,15                | 18,19,20,21,27,28,29,33,34  | 4,85 | 4,50 |
| 641 416 40 | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7,8,9,10                             | 13,14   | 1,40 | 1,44 |
| 631 460 20 | 40 x 40 x 60 x 2,0    | 1,2,3  | 6,7,8,9,10  | 3,15 | 2,25 |
| 631 480 20 | 40 x 40 x 80 x 2,0    | 1,2,3  | 8,9,10,11,12,13,14  | 2,80 | 2,55 |
| 631 610 20 | 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,<br>24,25,26,27                                | 4,81 | 4,00 |
| 631 640 20 | 60 x 60 x 40 x 2,0    | 1,2,3  | 6,7,8,9   | 1,11 | 1,31 |
| 631 650 20 | 60 x 60 x 50 x 2,0    | 1,2,3,4  | 7,8,9,10,11,12  | 2,41 | 2,00 |
| 631 660 20 | 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 |
| 631 680 20 | 60 x 60 x 80 x 2,0    | 1,2,3,4,5,6,7                                    | 12,13,14,15,16,17,18,19,20,<br>21   | 3,34 | 3,80 |
| 631 810 20 | 80 x 80 x 100 x 2,0   | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13                | 19,20,21,22,23,24,25,26,27,<br>28,29,30,31,32,33,34,35,36                 | 5,10 | 4,00 |
| 631 480 20 | 80 x 80 x 40 x 2,0    | 1,2,3,4  | 7,8,9,10,11,12  | 1,27 | 1,75 |
| 631 860 20 | 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,<br>20   | 3,82 | 2,25 |
| 631 880 20 | 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,<br>24,25,26,27,28                             | 5,10 | 3,00 |
| 631 140 20 | 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,<br>20   | 2,58 | 1,25 |
| 631 160 20 | 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,<br>23,24,25                                   | 2,61 | 3,55 |
| 631 180 20 | 100 x 100 x 80 x 2,0  | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14             | 18,19,20,21,22,23,24,25,26,<br>27,28,29,30,31,32,33,34,35                 | 5,26 | 3,00 |
| 631 110 20 | 100 x 100 x 100 x 2,0 | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14,15,16,17,18 | 24,25,26,27,28,29,30,31,32,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 5,26 | 4,00 |
| RHV 60     | 80 x 80 x 60 x 1,5    | 1,3,4,5  | 8,9,10,12   | 1,76 | 4,15 |
| RHV 80     | 120 x 120 x 75 x 1,5  | 1,2,4,6,7,10                                     | 12,13,15,18,19,21,23,24   | 2,12 | 6,95 |
| 618 129 40 | 120 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7                                    | 8,9,10,14,15  | 1,21 | 4,67 |
| 618 149 40 | 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 |
| 618 165 40 | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9,10                             | 11,12   | 1,37 | 2,50 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0    | 1,2  | 4,5,6   | 2,10 | 1,50 |
| 631 444 25 | 40 x 40 x 40 x 2,5    | 1,2  | 4,5,6   | 2,10 | 2,34 |
| 631 642 20 | 60 x 40 x 25 x 2,0    | 1,2  | 4,5   | 0,99 | 0,85 |

|            |                      |   |   |      |      |
|------------|----------------------|---|---|------|------|
| 631 646 25 | 60 x 40 x 60 x 2,5   | 1,2,3,4,5                               | 8,9,10,11,12                            | 2,94 | 2,81 |
| 631 669 20 | 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,<br>22,23,24 | 4,81 | 3,50 |
| 631 686 25 | 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 |
| 632 060 20 | 60 x 60 x 25 x 2,0   | 1,2                                     | 4,5,6                                   | 1,16 | 0,85 |
| 641 035 25 | 50 x 50 x 35 x 2,5   | 1,2                                     | 6,7,9,10                                | 1,93 | 1,26 |
| 641 070 20 | 70 x 70 x 55 x 2,0   | 1,2,3,7,8                               | 12,13,14,20,21,22                       | 3,05 | 1,00 |
| 641 105 20 | 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 |
| 641 140 34 | 40 x 140 x 2,5       | 1,2,4,5,7,8,10,11,13,14,<br>16,17       | 21,22,24,25                             | 2,10 | 2,34 |
| 641 412 25 | 40 x 120 x 2,5       | 1,2,4,5,7,8,10,11,13,14                 | 18,19,21,22                             | 2,10 | 2,34 |
| 641 416 40 | 40 x 160 x 2,5       | 1,2,4,5,7,8,10,11,13,14,<br>16,17,19,20 | 24,25,27,28                             | 2,10 | 2,34 |
| 641 490 42 | 40 x 90 x 2,5        | 2,3,5,6,8,9                             | 13,14,16,17                             | 2,10 | 2,34 |
| 641 553 20 | 50 x 50 x 35 x 2,0   | 1,2                                     | 6,7,9,10                                | 1,93 | 0,55 |
| 641 665 30 | 65 x 65 x 55 x 3,0   | 1,2,3,4                                 | 8,9,13,14                               | 2,21 | 3,38 |
| 641 690 25 | 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 |
| 641 691 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6,7,9                           | 10,11,13,14,15                          | 1,98 | 1,74 |
| 641 692 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6                               | 8,9,11,12,13                            | 1,98 | 1,74 |
| 641 860 20 | 83 x 62 x 40 x 2,0   | 1,2,3,4,5                               | 6,7,8,9,10                              | 2,32 | 1,31 |
| 641 905 25 | 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 |
| 641 912 30 | 90 x 120 x 3,0       | 1,2,4,5,7,8,10,11,13,14                 | 18,19,21,22,24,25,27,28                 | 2,59 | 3,38 |
| 641 970 20 | 70 x 70 x 55 x 2,0   | 1,2,4,5                                 | 8,9,10,11,13,14                         | 2,98 | 5,44 |
| 641 971 15 | 70 x 70 x 55 x 1,5   | 1,2,4,5                                 | 8,9,10,11,13,14                         | 2,98 | 4,21 |
| 641 990 20 | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9                             | 12,13,14,15,21,22                       | 3,56 | 5,95 |
| 641 991 15 | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9                             | 12,13,14,15,21,22                       | 3,55 | 4,42 |
| 651 070 25 | 70 x 70 x 55 x 2,5   | 1,2,3                                   | 12,13,14,20,21,22                       | 3,28 | 1,38 |
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2,7,9,10                              | 17,18,21,22,29,30                       | 1,61 | 3,49 |
| 651 105 30 | 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 |

**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 |
| 633 553 20     | 50 x 50 x 30 x 2,0 | 1,2               | 5,6                               | 0,83                     | 0,14  |
| 633 753 20     | 70 x 50 x 30 x 2,0 | 1,2,3,4,5,6       | 7,8                               | 0,83                     | 0,14  |
| 633 853 25     | 80 x 50 x 30 x 2,5 | 1,2,3,4,5,6       | 9,10                              | 1,06                     | 0,34  |
| 631 460 25     | 40 x 40 x 60 x 2,5 | 1,2,3             | 6,7,8,9,10                        | 1,58                     | 1,76  |
| 631 480 25     | 40 x 40 x 80 x 2,5 | 1,2,3             | 8,9,10,11,12,13,14                | 1,47                     | 2,03  |
| 631 640 25     | 60 x 60 x 40 x 2,5 | 1,2,3             | 6,7,8,9                           | 0,56                     | 1,02  |
| 631 650 25     | 60 x 60 x 50 x 2,5 | 1,2,3,4,5         | 8,9,10,11,12,13,14,15             | 1,73                     | 1,09  |
| 631 660 25     | 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  |
| 631 680 25     | 60 x 60 x 80 x 2,5 | 1,2,3,4,5,6,7     | 12,13,14,15,16,17,18,19,20,<br>21 | 1,67                     | 1,90  |

|            |                       |  |   |      |      |
|------------|-----------------------|--|---|------|------|
| 631 610 25 | 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,<br>24,25,26,27                                | 2,38 | 2,84 |
| 631 480 25 | 80 x 80 x 40 x 2,5    | 1,2,3,4  | 7,8,9,10,11,12  | 0,64 | 1,37 |
| 631 860 25 | 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,<br>20   | 1,85 | 1,41 |
| 631 880 25 | 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,<br>24,25,26,27,28                             | 2,47 | 1,88 |
| 631 810 25 | 80 x 80 x 100 x 2,5   | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13                | 19,20,21,22,23,24,25,26,27,<br>28,29,30,31,32,33,34,35,36                 | 2,55 | 3,13 |
| 631 160 25 | 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,<br>23,24,25                                   | 1,32 | 1,95 |
| 631 180 25 | 100 x 100 x 80 x 2,5  | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14             | 18,19,20,21,22,23,24,25,26,<br>27,28,29,30,31,32,33,34,35                 | 2,63 | 2,34 |
| 631 110 25 | 100 x 100 x 100 x 2,5 | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14,15,16,17,18 | 24,25,26,27,28,29,30,31,32,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 2,63 | 3,69 |
| 631 554 20 | 50 x 50 x 40 x 2,0    | 1,2,3  | 7,8,9,10,11,12  | 0,57 | 0,88 |
| 634 100 20 | 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 |
| 634 150 20 | 40 x 40 x 150 x 2,0   | 1,2,3  | 11,12,13,14,15,16,17,18,19,<br>20   | 1,43 | 2,60 |
| 634 200 20 | 40 x 40 x 200 x 2,0   | 1,2,3,4,5  | 16,17,18,19,20,21,22,23,24,<br>25,26,27,28,29,30                          | 2,38 | 3,37 |
| 641 035 25 | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 1,06 | 0,78 |
| 641 040 30 | 50 x 50 x 40 x 3,0    | 1,2  | 6,7,9,10  | 0,90 | 0,96 |
| 641 664 30 | 60 x 60 x 45 x 3,0    | 1,2,3,5  | 8,9,13,14   | 1,00 | 1,13 |
| 641 994 30 | 90 x 90 x 40 x 3,0    | 1,2,4,5,6,7                                      | 11,12,14,15,19,20   | 1,15 | 0,91 |
| 641 595 30 | 90 x 50 x 50 x 3,0    | 1,3,5,6,7,8,9                                    | 13,14,16,17,18  | 0,80 | 1,07 |
| 500 313 62 | 90 x 50 x 116 x 3,0   | 1,2,3,5,6,9,11,12,13,14,<br>17,18,20             | 23,24,25,26,31  | 1,31 | 1,28 |
| 641 598 30 | 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 |
| 641 912 30 | 120 x 90 x 40 x 3,0   | 1,2,3,4,5,6,7,8                                  | 10,11,12,13,14,15   | 1,28 | 1,47 |
| 641 690 30 | 90 x 60 x 60 x 2,5    | 1,2,3  | 6,7,8,9   | 0,88 | 0,71 |
| 641 590 30 | 90 x 50 x 50 x 2,5    | 1,3,5,6,7,8,9                                    | 13,14,16,17,18  | 0,79 | 0,74 |
| 641 490 25 | 90 x 40 x 40 x 2,5    | 1,2,3,4  | 8,9,11,12   | 0,91 | 0,84 |
| 641 490 30 | 90 x 40 x 40 x 3,0    | 1,2,3,4  | 8,9,11,12   | 0,91 | 1,21 |
| 651 554 25 | 50 x 50 x 40 x 2,5    | 1,2  | 6,7,9,10  | 0,90 | 0,67 |
| 651 070 25 | 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 | 0,78 |
| 651 994 25 | 90 x 90 x 40 x 2,5    | 1,2,4,5,6,7                                      | 11,12,14,15,19,20   | 1,14 | 0,62 |
| 651 090 25 | 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 |
| 651 105 30 | 105 x 105 x 90 x 3,0  | 1,2,4,5,6,8,10,11,12,13,<br>14,15                | 18,19,20,21,27,28,29,33,34  | 2,43 | 2,25 |
| 641 416 40 | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7,8,9,10                             | 13,14   | 0,70 | 0,72 |
| 631 460 20 | 40 x 40 x 60 x 2,0    | 1,2,3  | 6,7,8,9,10  | 1,58 | 1,13 |
| 631 480 20 | 40 x 40 x 80 x 2,0    | 1,2,3  | 8,9,10,11,12,13,14  | 1,40 | 1,27 |
| 631 610 20 | 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,<br>24,25,26,27                                | 2,41 | 2,00 |
| 631 640 20 | 60 x 60 x 40 x 2,0    | 1,2,3  | 6,7,8,9   | 0,56 | 0,65 |
| 631 650 20 | 60 x 60 x 50 x 2,0    | 1,2,3,4  | 7,8,9,10,11,12  | 1,20 | 1,00 |
| 631 660 20 | 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 |

|            |                       |  |   |      |      |
|------------|-----------------------|--|---|------|------|
| 631 680 20 | 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 |
| 631 810 20 | 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 |
| 631 480 20 | 80 x 80 x 40 x 2,0    | 1,2,3,4                                      | 7,8,9,10,11,12  | 0,64 | 0,88 |
| 631 860 20 | 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 |
| 631 880 20 | 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 |
| 631 140 20 | 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 |
| 631 160 20 | 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 |
| 631 180 20 | 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 |
| 631 110 20 | 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 |
| RHV 60     | 80 x 80 x 60 x 1,5    | 1,3,4,5                                      | 8,9,10,12   | 0,88 | 2,07 |
| RHV 80     | 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 |
| 618 129 40 | 120 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7                                | 8,9,10,14,15  | 0,61 | 2,33 |
| 618 149 40 | 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 |
| 618 165 40 | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9,10                         | 11,12   | 0,69 | 1,25 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0    | 1,2  | 4,5,6   | 1,05 | 0,75 |
| 631 444 25 | 40 x 40 x 40 x 2,5    | 1,2  | 4,5,6   | 1,05 | 1,17 |
| 631 642 20 | 60 x 40 x 25 x 2,0    | 1,2  | 4,5   | 0,50 | 0,43 |
| 631 646 25 | 60 x 40 x 60 x 2,5    | 1,2,3,4,5                                    | 8,9,10,11,12  | 1,47 | 1,41 |
| 631 669 20 | 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 |
| 631 686 25 | 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 |
| 632 060 20 | 60 x 60 x 25 x 2,0    | 1,2  | 4,5,6   | 0,58 | 0,43 |
| 641 035 25 | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 0,96 | 0,63 |
| 641 070 20 | 70 x 70 x 55 x 2,0    | 1,2,3,7,8                                    | 12,13,14,20,21,22   | 1,53 | 0,50 |
| 641 105 20 | 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 | 1,00 |
| 641 140 34 | 40 x 140 x 2,5        | 1,2,4,5,7,8,10,11,13,14,16,17                | 21,22,24,25   | 1,05 | 1,17 |
| 641 412 25 | 40 x 120 x 2,5        | 1,2,4,5,7,8,10,11,13,14                      | 18,19,21,22   | 1,05 | 1,17 |
| 641 416 40 | 40 x 160 x 2,5        | 1,2,4,5,7,8,10,11,13,14,16,17,19,20          | 24,25,27,28   | 1,05 | 1,17 |
| 641 490 42 | 40 x 90 x 2,5         | 2,3,5,6,8,9                                  | 13,14,16,17   | 1,05 | 1,17 |
| 641 553 20 | 50 x 50 x 35 x 2,0    | 1,2  | 6,7,9,10  | 0,96 | 0,27 |
| 641 665 30 | 65 x 65 x 55 x 3,0    | 1,2,3,4                                      | 8,9,13,14   | 1,10 | 1,69 |
| 641 690 25 | 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 |
| 641 691 25 | 60 x 90 x 60 x 2,5    | 1,2,4,5,6,7,9                                | 10,11,13,14,15  | 0,99 | 0,87 |
| 641 692 25 | 60 x 90 x 60 x 2,5    | 1,2,4,5,6                                    | 8,9,11,12,13  | 0,99 | 0,87 |
| 641 860 20 | 83 x 62 x 40 x 2,0    | 1,2,3,4,5                                    | 6,7,8,9,10  | 1,16 | 0,66 |

|            |                      |                         |                            |      |      |
|------------|----------------------|-------------------------|----------------------------|------|------|
| 641 905 25 | 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 |
| 641 912 30 | 90 x 120 x 3,0       | 1,2,4,5,7,8,10,11,13,14 | 18,19,21,22,24,25,27,28    | 1,30 | 1,69 |
| 641 970 20 | 70 x 70 x 55 x 2,0   | 1,2,4,5                 | 8,9,10,11,13,14            | 1,49 | 2,72 |
| 641 971 15 | 70 x 70 x 55 x 1,5   | 1,2,4,5                 | 8,9,10,11,13,14            | 1,49 | 2,10 |
| 641 990 20 | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9             | 12,13,14,15,21,22          | 1,78 | 2,97 |
| 641 991 15 | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9             | 12,13,14,15,21,22          | 1,78 | 2,21 |
| 651 070 25 | 70 x 70 x 55 x 2,5   | 1,2,3                   | 12,13,14,20,21,22          | 1,64 | 0,69 |
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2,7,9,10              | 17,18,21,22,29,30          | 0,81 | 1,74 |
| 651 105 30 | 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 |

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

| Article-No. | Dimension           | Bolt number<br>$n_V$ | Bolt number<br>$n_H$ | $F_{1,Rk}$ [kN]<br>(purlin) |       | Bolt<br>$k_t$ |
|-------------|---------------------|----------------------|----------------------|-----------------------------|-------|---------------|
|             |                     |                      |                      | Timber                      | Steel |               |
| 633 710 66  | 100 x 75 x 60 x 6,0 | 1                    | 2                    | -                           | 7,62  | 0,78          |

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

| Bracket<br>number | Bracket<br>type     | Bolt number<br>$n_V$ | Bolt number<br>$n_H$ | $F_{1,Rk}$ [kN]<br>(purlin) |       | Bolt<br>$k_t$ |
|-------------------|---------------------|----------------------|----------------------|-----------------------------|-------|---------------|
|                   |                     |                      |                      | Timber                      | Steel |               |
| 633 710 66        | 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]<br>(purlin) |
|----------------|-----------------------|--|---|-------------------------------|
|                |                       |  |   | Timber                        |
| 633 553 20     | 50 x 50 x 30 x 2,0    | 1,2  | 5,6   | 2,38                          |
| 633 753 20     | 70 x 50 x 30 x 2,0    | 1,2,3,4,5,6                                      | 7,8   | 2,83                          |
| 633 853 25     | 80 x 50 x 30 x 2,5    | 1,2,3,4,5,6                                      | 9,10  | 2,26                          |
| 631 460 25     | 40 x 40 x 60 x 2,5    | 1,2,3  | 6,7,8,9,10  | 5,31                          |
| 631 480 25     | 40 x 40 x 80 x 2,5    | 1,2,3  | 8,9,10,11,12,13,14  | 6,35                          |
| 631 640 25     | 60 x 60 x 40 x 2,5    | 1,2,3  | 6,7,8,9   | 2,18                          |
| 631 650 25     | 60 x 60 x 50 x 2,5    | 1,2,3,4,5  | 8,9,10,11,12,13,14,15   | 6,27                          |
| 631 660 25     | 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                          |
| 631 680 25     | 60 x 60 x 80 x 2,5    | 1,2,3,4,5,6,7                                    | 12,13,14,15,16,17,18,19,20,<br>21   | 9,22                          |
| 631 610 25     | 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,<br>24,25,26,27                                | 13,8                          |
| 631 480 25     | 80 x 80 x 40 x 2,5    | 1,2,3,4  | 7,8,9,10,11,12  | 3,15                          |
| 631 860 25     | 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,<br>20   | 8,38                          |
| 631 880 25     | 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,<br>24,25,26,27,28                             | 12,9                          |
| 631 810 25     | 80 x 80 x 100 x 2,5   | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13                | 19,20,21,22,23,24,25,26,27,<br>28,29,30,31,32,33,34,35,36                 | 17,7                          |
| 631 160 25     | 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,<br>23,24,25                                   | 8,85                          |
| 631 180 25     | 100 x 100 x 80 x 2,5  | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14             | 18,19,20,21,22,23,24,25,26,<br>27,28,29,30,31,32,33,34,35                 | 15,5                          |
| 631 110 25     | 100 x 100 x 100 x 2,5 | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14,15,16,17,18 | 24,25,26,27,28,29,30,31,32,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 20,2                          |
| 631 554 20     | 50 x 50 x 40 x 2,0    | 1,2,3  | 7,8,9,10,11,12  | 3,35                          |
| 634 100 20     | 40 x 40 x 100 x 2,0   | 1,2,3,4,5  | 10,11,12,13,14,15,16,17,18  | 12,1                          |
| 634 150 20     | 40 x 40 x 150 x 2,0   | 1,2,3  | 11,12,13,14,15,16,17,18,19,<br>20   | 9,69                          |
| 634 200 20     | 40 x 40 x 200 x 2,0   | 1,2,3,4,5  | 16,17,18,19,20,21,22,23,24,<br>25,26,27,28,29,30                          | 16,1                          |
| 641 035 25     | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 2,59                          |
| 641 040 30     | 50 x 50 x 40 x 3,0    | 1,2  | 6,7,9,10  | 2,53                          |
| 641 664 30     | 60 x 60 x 45 x 3,0    | 1,2,3,5  | 8,9,13,14   | 4,23                          |
| 641 994 30     | 90 x 90 x 40 x 3,0    | 1,2,4,5,6,7                                      | 11,12,14,15,19,20   | 4,70                          |
| 641 595 30     | 90 x 50 x 50 x 3,0    | 1,3,5,6,7,8,9                                    | 13,14,16,17,18  | 5,46                          |
| 500 313 62     | 90 x 50 x 116 x 3,0   | 1,2,3,5,6,9,11,12,13,14,<br>17,18,20             | 23,24,25,26,31  | 9,16                          |
| 641 598 30     | 90 x 48 x 76 x 3,0    | 1,2,3,6,7,8,9,10,11,12                           | 16,17,20,21   | 7,78                          |
| 641 912 30     | 120 x 90 x 40 x 3,0   | 1,2,3,4,5,6,7,8                                  | 10,11,12,13,14,15   | 5,68                          |
| 641 690 30     | 90 x 60 x 60 x 2,5    | 1,2,3  | 6,7,8,9   | 2,99                          |
| 641 590 30     | 90 x 50 x 50 x 2,5    | 1,3,5,6,7,8,9                                    | 13,14,16,17,18  | 5,50                          |

|            |                       |  |   |      |
|------------|-----------------------|--|---|------|
| 641 490 25 | 90 x 40 x 40 x 2,5    | 1,2,3,4  | 8,9,11,12   | 3,19 |
| 641 490 30 | 90 x 40 x 40 x 3,0    | 1,2,3,4  | 8,9,11,12   | 3,17 |
| 651 070 25 | 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 |
| 651 090 25 | 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 |
| 651 105 30 | 105 x 105 x 90 x 3,0  | 1,2,4,5,6,8,10,11,12,13,<br>14,15                | 18,19,20,21,27,28,29,33,34  | 11,5 |
| 641 416 40 | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7,8,9,10                             | 13,14   | 2,89 |
| 631 460 20 | 40 x 40 x 60 x 2,0    | 1,2,3  | 6,7,8,9,10  | 5,34 |
| 631 480 20 | 40 x 40 x 80 x 2,0    | 1,2,3  | 8,9,10,11,12,13,14  | 6,67 |
| 631 610 20 | 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,<br>24,25,26,27                                | 14,3 |
| 631 640 20 | 60 x 60 x 40 x 2,0    | 1,2,3  | 6,7,8,9   | 2,20 |
| 631 650 20 | 60 x 60 x 50 x 2,0    | 1,2,3,4  | 7,8,9,10,11,12  | 4,36 |
| 631 660 20 | 60 x 60 x 60 x 2,0    | 1,2,3,4,5,6                                      | 10,12,13,14,15,16,18  | 6,28 |
| 631 680 20 | 60 x 60 x 80 x 2,0    | 1,2,3,4,5,6,7                                    | 12,13,14,15,16,17,18,19,20,<br>21   | 9,22 |
| 631 810 20 | 80 x 80 x 100 x 2,0   | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13                | 19,20,21,22,23,24,25,26,27,<br>28,29,30,31,32,33,34,35,36                 | 17,6 |
| 631 480 20 | 80 x 80 x 40 x 2,0    | 1,2,3,4  | 7,8,9,10,11,12  | 3,17 |
| 631 860 20 | 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,<br>20   | 8,77 |
| 631 880 20 | 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,<br>24,25,26,27,28                             | 13,7 |
| 631 140 20 | 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,<br>20   | 7,06 |
| 631 160 20 | 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,<br>23,24,25                                   | 8,61 |
| 631 180 20 | 100 x 100 x 80 x 2,0  | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14             | 18,19,20,21,22,23,24,25,26,<br>27,28,29,30,31,32,33,34,35                 | 15,6 |
| 631 110 20 | 100 x 100 x 100 x 2,0 | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14,15,16,17,18 | 24,25,26,27,28,29,30,31,32,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 20,9 |
| RHV 60     | 80 x 80 x 60 x 1,5    | 1,3,4,5  | 8,9,10,12   | 3,82 |
| RHV 80     | 120 x 120 x 75 x 1,5  | 1,2,4,6,7,10                                     | 12,13,15,18,19,21,23,24   | 5,76 |
| 618 129 40 | 120 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7                                    | 8,9,10,14,15  | 4,89 |
| 618 149 40 | 140 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9                                | 10,11,12,16,17  | 4,94 |
| 618 165 40 | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9,10                             | 11,12   | 2,80 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0    | 1,2  | 4,5,6   | 2,64 |
| 631 444 25 | 40 x 40 x 40 x 2,5    | 1,2  | 4,5,6   | 2,62 |
| 631 642 20 | 60 x 40 x 25 x 2,0    | 1,2  | 4,5   | 1,82 |
| 631 646 25 | 60 x 40 x 60 x 2,5    | 1,2,3,4,5  | 8,9,10,11,12  | 5,20 |
| 631 669 20 | 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,<br>22,23,24                                   | 12,6 |
| 631 686 25 | 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 |
| 632 060 20 | 60 x 60 x 25 x 2,0    | 1,2  | 4,5,6   | 1,86 |
| 641 035 25 | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 2,82 |

|            |                      |   |                            |      |
|------------|----------------------|---|----------------------------|------|
| 641 070 20 | 70 x 70 x 55 x 2,0   | 1,2,3,7,8                               | 12,13,14,20,21,22          | 5,38 |
| 641 105 20 | 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 |
| 641 140 34 | 40 x 140 x 2,5       | 1,2,4,5,7,8,10,11,13,14,<br>16,17       | 21,22,24,25                | 5,73 |
| 641 412 25 | 40 x 120 x 2,5       | 1,2,4,5,7,8,10,11,13,14                 | 18,19,21,22                | 5,73 |
| 641 416 40 | 40 x 160 x 2,5       | 1,2,4,5,7,8,10,11,13,14,<br>16,17,19,20 | 24,25,27,28                | 5,73 |
| 641 490 42 | 40 x 90 x 2,5        | 2,3,5,6,8,9                             | 13,14,16,17                | 3,95 |
| 641 553 20 | 50 x 50 x 35 x 2,0   | 1,2                                     | 6,7,9,10                   | 2,84 |
| 641 665 30 | 65 x 65 x 55 x 3,0   | 1,2,3,4                                 | 8,9,13,14                  | 5,30 |
| 641 690 25 | 60 x 90 x 60 x 2,5   | 1,2,3,4,5,6,7,9                         | 10,12,14,15,16             | 6,03 |
| 641 691 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6,7,9                           | 10,11,13,14,15             | 5,76 |
| 641 692 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6                               | 8,9,11,12,13               | 5,36 |
| 641 860 20 | 83 x 62 x 40 x 2,0   | 1,2,3,4,5                               | 6,7,8,9,10                 | 4,11 |
| 641 905 25 | 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 |
| 641 912 30 | 90 x 120 x 3,0       | 1,2,4,5,7,8,10,11,13,14                 | 18,19,21,22,24,25,27,28    | 7,60 |
| 641 970 20 | 70 x 70 x 55 x 2,0   | 1,2,4,5                                 | 8,9,10,11,13,14            | 5,49 |
| 641 971 15 | 70 x 70 x 55 x 1,5   | 1,2,4,5                                 | 8,9,10,11,13,14            | 5,56 |
| 641 990 20 | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9                             | 12,13,14,15,21,22          | 6,82 |
| 641 991 15 | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9                             | 12,13,14,15,21,22          | 6,87 |
| 651 070 25 | 70 x 70 x 55 x 2,5   | 1,2,3                                   | 12,13,14,20,21,22          | 2,59 |
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2,7,9,10                              | 17,18,21,22,29,30          | 3,68 |
| 651 105 30 | 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 |

**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)<br>Timber |
| 633 553 20     | 50 x 50 x 30 x 2,0  | 1,2                     | 5,6   | 1,19               |
| 633 753 20     | 70 x 50 x 30 x 2,0  | 1,2,3,4,5,6             | 7,8   | 1,42               |
| 633 853 25     | 80 x 50 x 30 x 2,5  | 1,2,3,4,5,6             | 9,10  | 1,13               |
| 631 460 25     | 40 x 40 x 60 x 2,5  | 1,2,3                   | 6,7,8,9,10                                    | 2,65               |
| 631 480 25     | 40 x 40 x 80 x 2,5  | 1,2,3                   | 8,9,10,11,12,13,14                            | 3,17               |
| 631 640 25     | 60 x 60 x 40 x 2,5  | 1,2,3                   | 6,7,8,9                                       | 1,09               |
| 631 650 25     | 60 x 60 x 50 x 2,5  | 1,2,3,4,5               | 8,9,10,11,12,13,14,15                         | 3,13               |
| 631 660 25     | 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               |
| 631 680 25     | 60 x 60 x 80 x 2,5  | 1,2,3,4,5,6,7           | 12,13,14,15,16,17,18,19,20,<br>21             | 4,61               |
| 631 610 25     | 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,<br>24,25,26,27    | 6,89               |
| 631 480 25     | 80 x 80 x 40 x 2,5  | 1,2,3,4                 | 7,8,9,10,11,12                                | 1,58               |
| 631 860 25     | 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,<br>20             | 4,19               |
| 631 880 25     | 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,<br>24,25,26,27,28 | 6,47               |

|            |                       |  |   |      |
|------------|-----------------------|--|---|------|
| 631 810 25 | 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 |
| 631 160 25 | 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 |
| 631 180 25 | 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 |
| 631 110 25 | 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 |
| 631 554 20 | 50 x 50 x 40 x 2,0    | 1,2,3  | 7,8,9,10,11,12  | 1,68 |
| 634 100 20 | 40 x 40 x 100 x 2,0   | 1,2,3,4,5                                    | 10,11,12,13,14,15,16,17,18  | 6,08 |
| 634 150 20 | 40 x 40 x 150 x 2,0   | 1,2,3  | 11,12,13,14,15,16,17,18,19,20                                     | 4,85 |
| 634 200 20 | 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 |
| 641 035 25 | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 1,29 |
| 641 040 30 | 50 x 50 x 40 x 3,0    | 1,2  | 6,7,9,10  | 1,27 |
| 641 664 30 | 60 x 60 x 45 x 3,0    | 1,2,3,5                                      | 8,9,13,14   | 2,11 |
| 641 994 30 | 90 x 90 x 40 x 3,0    | 1,2,4,5,6,7                                  | 11,12,14,15,19,20   | 2,35 |
| 641 595 30 | 90 x 50 x 50 x 3,0    | 1,3,5,6,7,8,9                                | 13,14,16,17,18  | 2,73 |
| 500 313 62 | 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 |
| 641 598 30 | 90 x 48 x 76 x 3,0    | 1,2,3,6,7,8,9,10,11,12                       | 16,17,20,21   | 3,89 |
| 641 912 30 | 120 x 90 x 40 x 3,0   | 1,2,3,4,5,6,7,8                              | 10,11,12,13,14,15   | 2,84 |
| 641 690 30 | 90 x 60 x 60 x 2,5    | 1,2,3  | 6,7,8,9   | 1,50 |
| 641 590 30 | 90 x 50 x 50 x 2,5    | 1,3,5,6,7,8,9                                | 13,14,16,17,18  | 2,75 |
| 641 490 25 | 90 x 40 x 40 x 2,5    | 1,2,3,4                                      | 8,9,11,12   | 1,59 |
| 641 490 30 | 90 x 40 x 40 x 3,0    | 1,2,3,4                                      | 8,9,11,12   | 1,58 |
| 651 070 25 | 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 |
| 651 090 25 | 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 |
| 651 105 30 | 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 |
| 641 416 40 | 160 x 50 x 40 x 3,0   | 1,2,3,4,5,6,7,8,9,10                         | 13,14   | 1,45 |
| 631 460 20 | 40 x 40 x 60 x 2,0    | 1,2,3  | 6,7,8,9,10  | 2,67 |
| 631 480 20 | 40 x 40 x 80 x 2,0    | 1,2,3  | 8,9,10,11,12,13,14  | 3,34 |
| 631 610 20 | 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 |
| 631 640 20 | 60 x 60 x 40 x 2,0    | 1,2,3  | 6,7,8,9   | 1,10 |
| 631 650 20 | 60 x 60 x 50 x 2,0    | 1,2,3,4                                      | 7,8,9,10,11,12  | 2,18 |
| 631 660 20 | 60 x 60 x 60 x 2,0    | 1,2,3,4,5,6                                  | 10,12,13,14,15,16,18  | 3,14 |
| 631 680 20 | 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 |
| 631 810 20 | 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 |
| 631 480 20 | 80 x 80 x 40 x 2,0    | 1,2,3,4                                      | 7,8,9,10,11,12  | 1,59 |
| 631 860 20 | 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 |
| 631 880 20 | 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 |

|            |                       |  |   |      |
|------------|-----------------------|--|---|------|
| 631 140 20 | 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 |
| 631 160 20 | 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 |
| 631 180 20 | 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 |
| 631 110 20 | 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 |
| RHV 60     | 80 x 80 x 60 x 1,5    | 1,3,4,5                                      | 8,9,10,12   | 1,91 |
| RHV 80     | 120 x 120 x 75 x 1,5  | 1,2,4,6,7,10                                 | 12,13,15,18,19,21,23,24   | 2,88 |
| 618 129 40 | 120 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7                                | 8,9,10,14,15  | 2,44 |
| 618 149 40 | 140 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9                            | 10,11,12,16,17  | 2,47 |
| 618 165 40 | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9,10                         | 11,12   | 1,40 |
| 618 166 40 | 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 |
| 618 168 40 | 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 |
| 631 444 20 | 40 x 40 x 40 x 2,0    | 1,2  | 4,5,6   | 1,32 |
| 631 444 25 | 40 x 40 x 40 x 2,5    | 1,2  | 4,5,6   | 1,31 |
| 631 642 20 | 60 x 40 x 25 x 2,0    | 1,2  | 4,5   | 0,91 |
| 631 646 25 | 60 x 40 x 60 x 2,5    | 1,2,3,4,5                                    | 8,9,10,11,12  | 2,60 |
| 631 669 20 | 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 |
| 631 686 25 | 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 |
| 632 060 20 | 60 x 60 x 25 x 2,0    | 1,2  | 4,5,6   | 0,93 |
| 641 035 25 | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 1,41 |
| 641 070 20 | 70 x 70 x 55 x 2,0    | 1,2,3,7,8                                    | 12,13,14,20,21,22   | 2,69 |
| 641 105 20 | 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 |
| 641 140 34 | 40 x 140 x 2,5        | 1,2,4,5,7,8,10,11,13,14,16,17                | 21,22,24,25   | 2,87 |
| 641 412 25 | 40 x 120 x 2,5        | 1,2,4,5,7,8,10,11,13,14                      | 18,19,21,22   | 2,87 |
| 641 416 40 | 40 x 160 x 2,5        | 1,2,4,5,7,8,10,11,13,14,16,17,19,20          | 24,25,27,28   | 2,87 |
| 641 490 42 | 40 x 90 x 2,5         | 2,3,5,6,8,9                                  | 13,14,16,17   | 1,98 |
| 641 553 20 | 50 x 50 x 35 x 2,0    | 1,2  | 6,7,9,10  | 1,42 |
| 641 665 30 | 65 x 65 x 55 x 3,0    | 1,2,3,4                                      | 8,9,13,14   | 2,65 |
| 641 690 25 | 60 x 90 x 60 x 2,5    | 1,2,3,4,5,6,7,9                              | 10,12,14,15,16  | 3,01 |
| 641 691 25 | 60 x 90 x 60 x 2,5    | 1,2,4,5,6,7,9                                | 10,11,13,14,15  | 2,88 |
| 641 692 25 | 60 x 90 x 60 x 2,5    | 1,2,4,5,6                                    | 8,9,11,12,13  | 2,68 |
| 641 860 20 | 83 x 62 x 40 x 2,0    | 1,2,3,4,5                                    | 6,7,8,9,10  | 2,05 |
| 641 905 25 | 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 |
| 641 912 30 | 90 x 120 x 3,0        | 1,2,4,5,7,8,10,11,13,14                      | 18,19,21,22,24,25,27,28   | 3,80 |
| 641 970 20 | 70 x 70 x 55 x 2,0    | 1,2,4,5                                      | 8,9,10,11,13,14   | 2,75 |
| 641 971 15 | 70 x 70 x 55 x 1,5    | 1,2,4,5                                      | 8,9,10,11,13,14   | 2,78 |
| 641 990 20 | 90 x 90 x 65 x 2,0    | 1,2,6,7,8,9                                  | 12,13,14,15,21,22   | 3,41 |
| 641 991 15 | 90 x 90 x 65 x 1,5    | 1,2,6,7,8,9                                  | 12,13,14,15,21,22   | 3,43 |
| 651 070 25 | 70 x 70 x 55 x 2,5    | 1,2,3  | 12,13,14,20,21,22   | 1,30 |

|            |                      |                |                            |      |
|------------|----------------------|----------------|----------------------------|------|
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2,7,9,10     | 17,18,21,22,29,30          | 1,84 |
| 651 105 30 | 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 |

**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]<br>(purlin) |       |
|----------------|-----------------------|--|---|-------------------------------|-------|
|                |                       |  |   | Timber                        | Steel |
| 633 553 20     | 50 x 50 x 30 x 2,0    | 1,2  | 5,6   | 4,09                          | 1,14  |
| 633 753 20     | 70 x 50 x 30 x 2,0    | 1,2,3,4,5,6                                      | 7,8   | 4,28                          | 1,14  |
| 633 853 25     | 80 x 50 x 30 x 2,5    | 1,2,3,4,5,6                                      | 9,10  | 4,15                          | 1,52  |
| 631 460 25     | 40 x 40 x 60 x 2,5    | 1,2,3  | 6,7,8,9,10  | 7,22                          | 3,20  |
| 631 480 25     | 40 x 40 x 80 x 2,5    | 1,2,3  | 8,9,10,11,12,13,14  | 10,6                          | 4,77  |
| 631 640 25     | 60 x 60 x 40 x 2,5    | 1,2,3  | 6,7,8,9   | 3,56                          | 2,49  |
| 631 650 25     | 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  |
| 631 660 25     | 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  |
| 631 680 25     | 60 x 60 x 80 x 2,5    | 1,2,3,4,5,6,7                                    | 12,13,14,15,16,17,18,19,20,<br>21   | 8,50                          | 5,07  |
| 631 610 25     | 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,<br>24,25,26,27                                | 11,4                          | 6,31  |
| 631 480 25     | 80 x 80 x 40 x 2,5    | 1,2,3,4  | 7,8,9,10,11,12  | 4,04                          | 2,59  |
| 631 860 25     | 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,<br>20   | 8,11                          | 3,98  |
| 631 880 25     | 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,<br>24,25,26,27,28                             | 11,0                          | 5,27  |
| 631 810 25     | 80 x 80 x 100 x 2,5   | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13                | 19,20,21,22,23,24,25,26,27,<br>28,29,30,31,32,33,34,35,36                 | 12,7                          | 4,75  |
| 631 160 25     | 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,<br>23,24,25                                   | 7,36                          | 3,88  |
| 631 180 25     | 100 x 100 x 80 x 2,5  | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14             | 18,19,20,21,22,23,24,25,26,<br>27,28,29,30,31,32,33,34,35                 | 6,01                          | 3,96  |
| 631 110 25     | 100 x 100 x 100 x 2,5 | 1,2,3,4,5,6,7,8,9,10,11,<br>12,13,14,15,16,17,18 | 24,25,26,27,28,29,30,31,32,<br>33,34,35,36,37,38,39,40,41,<br>42,43,44,45 | 13,2                          | 7,64  |
| 618 129 40     | 120 x 90 x 40 x 4,0   | 1,2,3,4,5,6,7                                    | 8,9,10,14,15  | 4,86                          | 4,96  |
| 618 149 40     | 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  |
| 618 165 40     | 160 x 50 x 40 x 4,0   | 1,2,3,4,5,6,7,8,9,10                             | 11,12   | 4,21                          | 5,03  |
| 618 166 40     | 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                          | 7,17  |
| 618 168 40     | 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                          | 9,39  |
| 631 444 20     | 40 x 40 x 40 x 2,0    | 1,2  | 4,5,6   | 3,46                          | 1,52  |
| 631 444 25     | 40 x 40 x 40 x 2,5    | 1,2  | 4,5,6   | 4,08                          | 1,93  |
| 631 642 20     | 60 x 40 x 25 x 2,0    | 1,2  | 4,5   | 2,51                          | 1,12  |
| 631 646 25     | 60 x 40 x 60 x 2,5    | 1,2,3,4,5  | 8,9,10,11,12  | 6,85                          | 3,60  |
| 631 669 20     | 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,<br>22,23,24                                   | 7,64                          | 4,02  |
| 631 686 25     | 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                          | 3,58  |
| 632 060 20     | 60 x 60 x 25 x 2,0    | 1,2  | 4,5,6   | 2,51                          | 1,10  |
| 641 035 25     | 50 x 50 x 35 x 2,5    | 1,2  | 6,7,9,10  | 3,39                          | 1,77  |
| 641 070 20     | 70 x 70 x 55 x 2,0    | 1,2,3,7,8  | 12,13,14,20,21,22   | 5,57                          | 2,60  |
| 641 105 20     | 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  |

|            |                      |                                     |                            |      |      |
|------------|----------------------|-------------------------------------|----------------------------|------|------|
| 641 140 34 | 40 x 140 x 2,5       | 1,2,4,5,7,8,10,11,13,14,16,17       | 21,22,24,25                | 5,15 | 2,53 |
| 641 412 25 | 40 x 120 x 2,5       | 1,2,4,5,7,8,10,11,13,14             | 18,19,21,22                | 5,13 | 2,54 |
| 641 416 40 | 40 x 160 x 2,5       | 1,2,4,5,7,8,10,11,13,14,16,17,19,20 | 24,25,27,28                | 5,06 | 2,55 |
| 641 490 42 | 40 x 90 x 2,5        | 2,3,5,6,8,9                         | 13,14,16,17                | 5,01 | 2,58 |
| 641 553 20 | 50 x 50 x 35 x 2,0   | 1,2                                 | 6,7,9,10                   | 2,93 | 0,94 |
| 641 665 30 | 65 x 65 x 55 x 3,0   | 1,2,3,4                             | 8,9,13,14                  | 6,69 | 3,70 |
| 641 690 25 | 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 |
| 641 691 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6,7,9                       | 10,11,13,14,15             | 7,65 | 3,62 |
| 641 692 25 | 60 x 90 x 60 x 2,5   | 1,2,4,5,6                           | 8,9,11,12,13               | 7,05 | 3,53 |
| 641 860 20 | 83 x 62 x 40 x 2,0   | 1,2,3,4,5                           | 6,7,8,9,10                 | 4,81 | 2,48 |
| 641 905 25 | 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 |
| 641 912 30 | 90 x 120 x 3,0       | 1,2,4,5,7,8,10,11,13,14             | 18,19,21,22,24,25,27,28    | 5,86 | 2,94 |
| 641 970 20 | 70 x 70 x 55 x 2,0   | 1,2,4,5                             | 8,9,10,11,13,14            | 6,74 | 4,25 |
| 641 971 15 | 70 x 70 x 55 x 1,5   | 1,2,4,5                             | 8,9,10,11,13,14            | 6,64 | 3,34 |
| 641 990 20 | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9                         | 12,13,14,15,21,22          | 8,18 | 4,97 |
| 641 991 15 | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9                         | 12,13,14,15,21,22          | 8,28 | 3,76 |
| 651 070 25 | 70 x 70 x 55 x 2,5   | 1,2,3                               | 12,13,14,20,21,22          | -    | -    |
| 651 090 25 | 90 x 90 x 65 x 2,5   | 1,2,7,9,10                          | 17,18,21,22,29,30          | -    | -    |
| 651 105 30 | 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<sub>4</sub> Purlin, 1 angle bracket / connection, timber-timber

| Bracket number | Bracket type         | Nail number n <sub>v</sub> | Nail number n <sub>H</sub> | F <sub>4,Rk</sub> [kN] (purlin) |       |
|----------------|----------------------|----------------------------|----------------------------|---------------------------------|-------|
|                |                      |                            |                            | Timber                          | Steel |
| 641 860 20     | 83 x 62 x 40 x 2,0   | 1,2,3,4,5                  | 6,7,8,9,10                 | 4,22                            | 1,53  |
| 641 905 25     | 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  |
| 641 970 20     | 70 x 70 x 55 x 2,0   | 1,2,4,5                    | 8,9,10,11,13,14            | 7,03                            | 3,26  |
| 641 971 15     | 70 x 70 x 55 x 1,5   | 1,2,4,5                    | 8,9,10,11,13,14            | 6,68                            | 2,59  |
| 641 990 20     | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9                | 12,13,14,15,21,22          | 7,68                            | 3,89  |
| 641 991 15     | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9                | 12,13,14,15,21,22          | 7,67                            | 2,98  |

**Table B.13:** Basic Force F<sub>5</sub> Purlin, 1 angle bracket / connection, timber-timber

| Bracket number | Bracket type         | Nail number n <sub>v</sub> | Nail number n <sub>H</sub> | F <sub>5,Rk</sub> [kN] (purlin) |       |
|----------------|----------------------|----------------------------|----------------------------|---------------------------------|-------|
|                |                      |                            |                            | Timber                          | Steel |
| 641 860 20     | 83 x 62 x 40 x 2,0   | 1,2,3,4,5                  | 6,7,8,9,10                 | 1,03                            | 0,42  |
| 641 905 25     | 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                            | 3,64  |
| 641 970 20     | 70 x 70 x 55 x 2,0   | 1,2,4,5                    | 8,9,10,11,13,14            | 1,57                            | 1,27  |
| 641 971 15     | 70 x 70 x 55 x 1,5   | 1,2,4,5                    | 8,9,10,11,13,14            | 1,49                            | 0,98  |
| 641 990 20     | 90 x 90 x 65 x 2,0   | 1,2,6,7,8,9                | 12,13,14,15,21,22          | 1,78                            | 1,70  |
| 641 991 15     | 90 x 90 x 65 x 1,5   | 1,2,6,7,8,9                | 12,13,14,15,21,22          | 1,72                            | 1,25  |



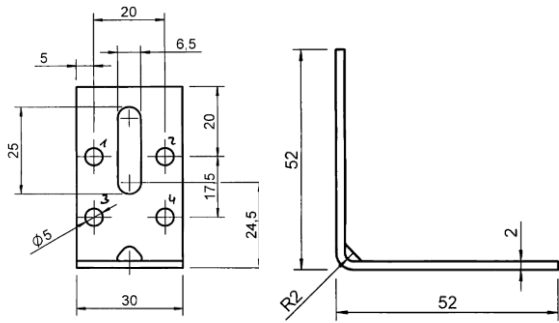


Figure B. 1 Dimensions of Angle Bracket 633 553 20

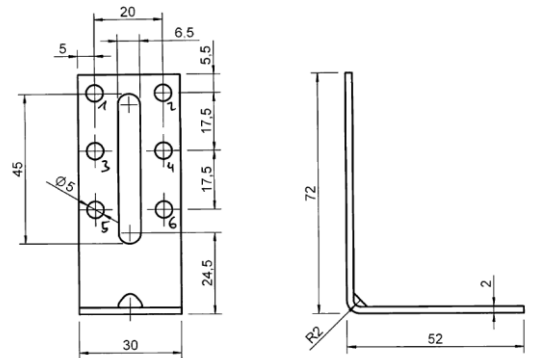


Figure B. 2 Dimensions of Angle Bracket 633 753 20

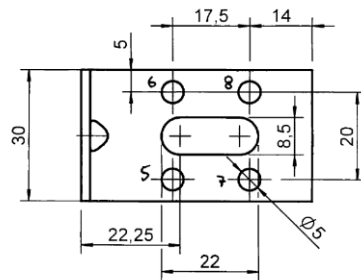


Figure B. 3 Dimensions of Angle Bracket 633 853 25

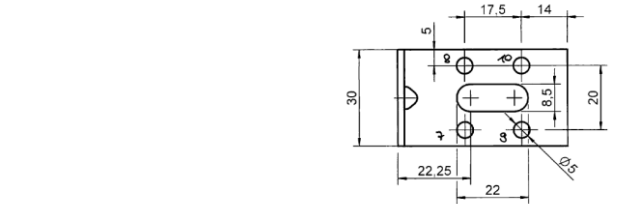


Figure B. 4 Dimensions of Angle Bracket 631 460 25

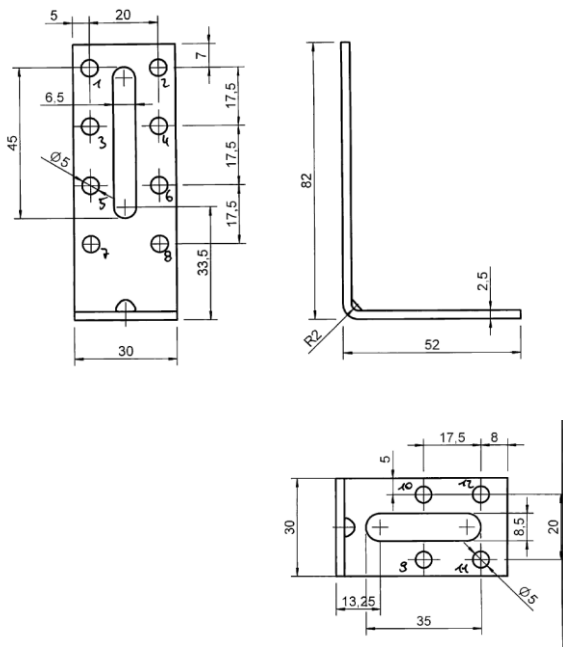


Figure B. 3 Dimensions of Angle Bracket 633 853 25

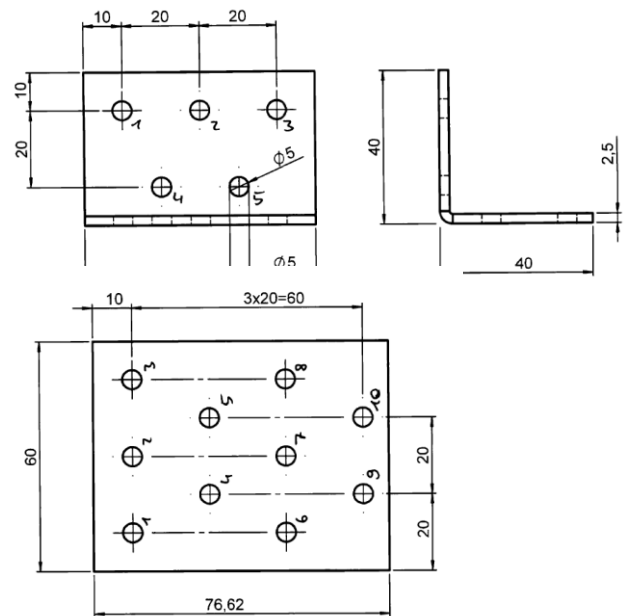


Figure B. 4 Dimensions of Angle Bracket 631 460 25

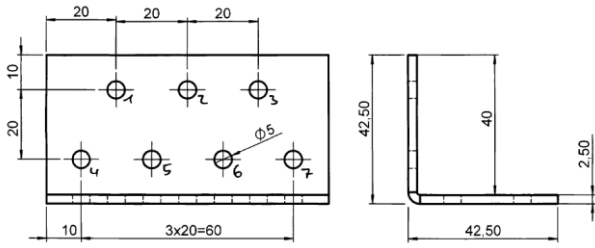


Figure B. 5 Dimensions of Angle Bracket 631 480 25

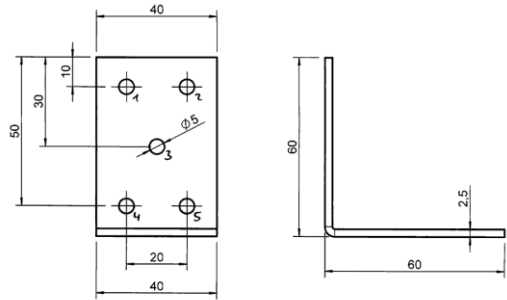


Figure B. 6 Dimensions of Angle Bracket 631 640 25

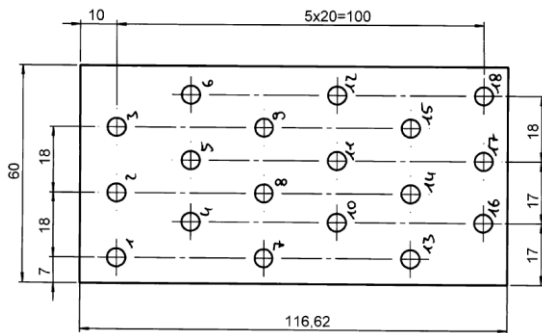
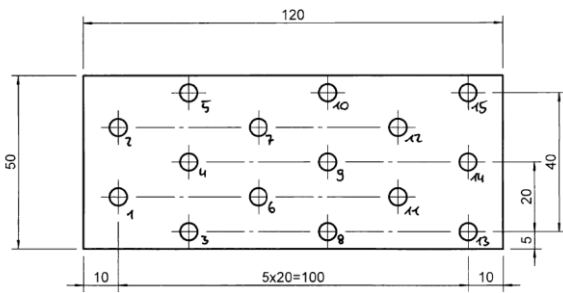
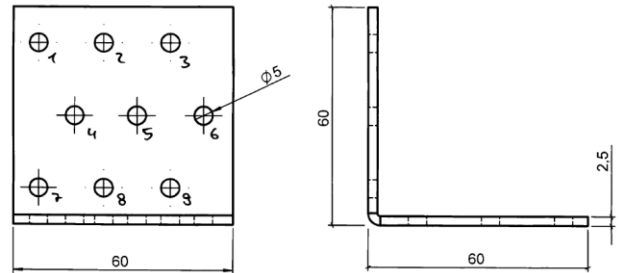
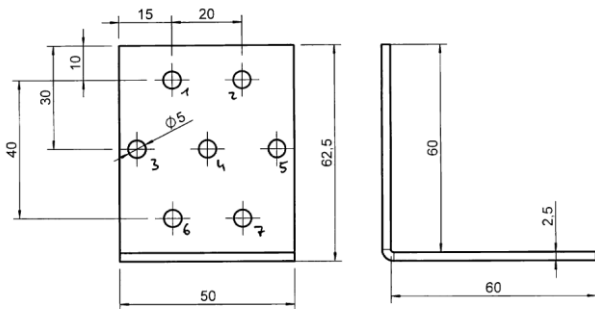
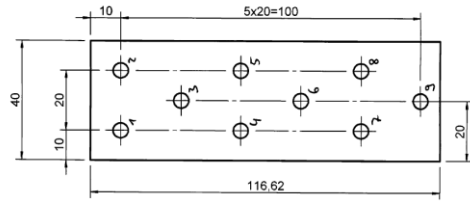
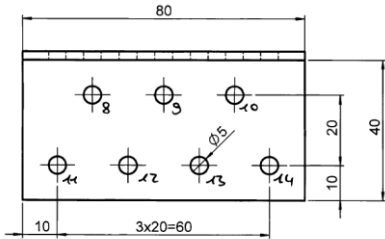


Figure B. 7 Dimensions of Angle Bracket 631 650 25

Figure B. 8 Dimensions of Angle Bracket 631 660 25

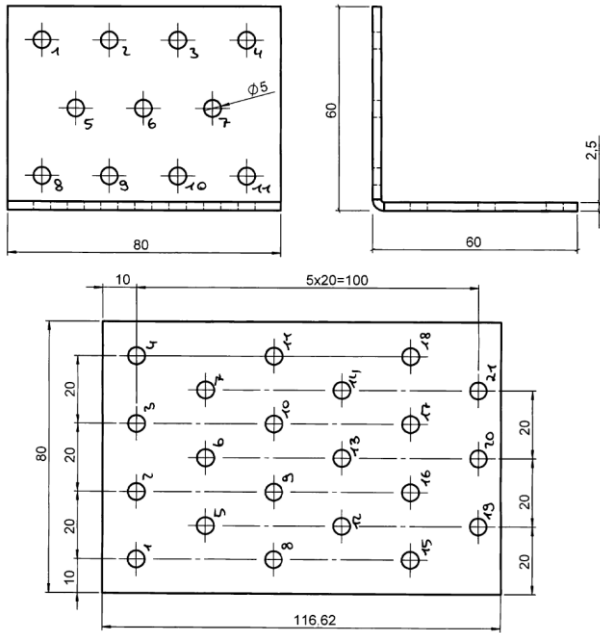


Figure B. 9 Dimensions of Angle Bracket 631 680 25

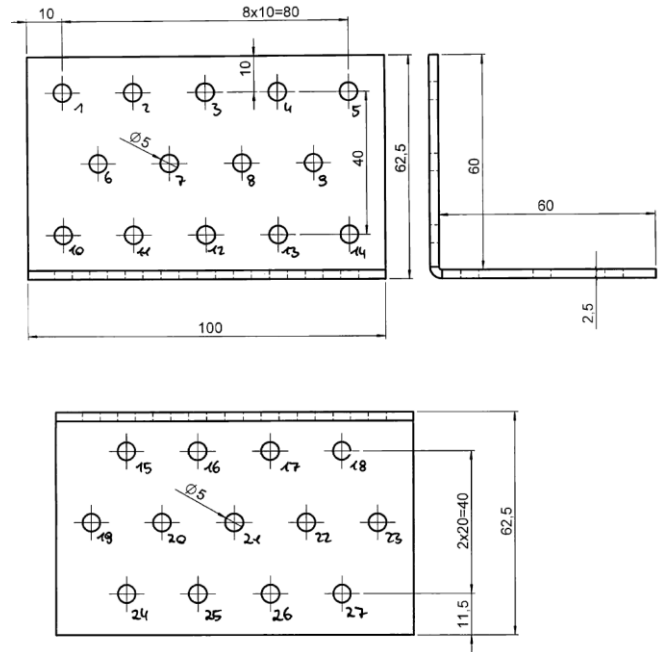


Figure B. 10 Dimensions of Angle Bracket 631 610 25

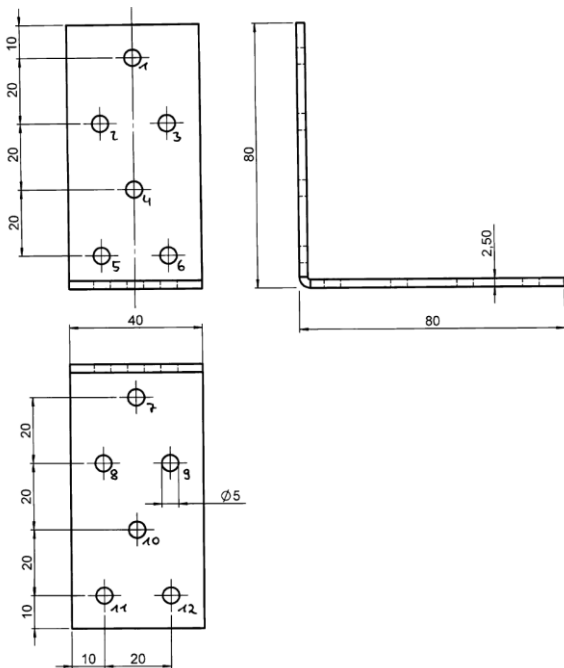


Figure B. 11 Dimensions of Angle Bracket 631 480 25

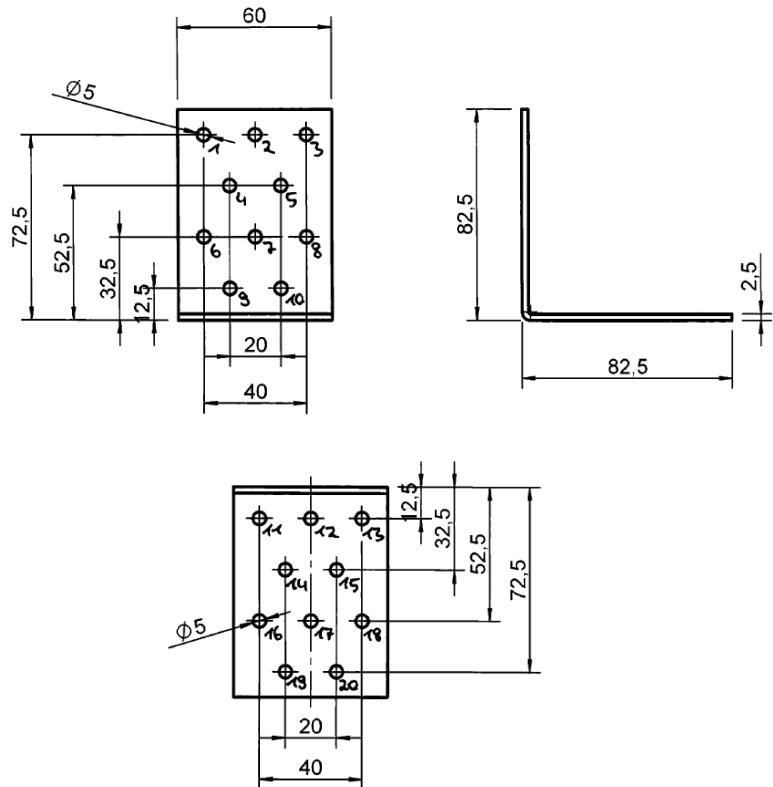


Figure B. 12 Dimensions of Angle Bracket 631 860 25

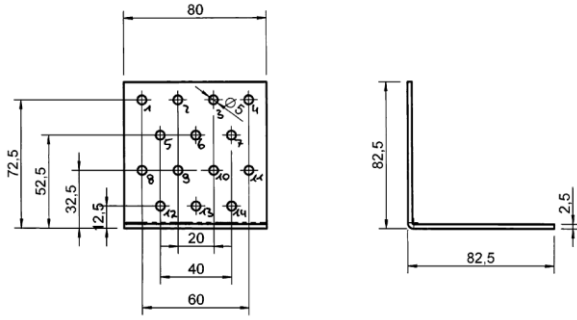


Figure B. 13 Dimensions of Angle Bracket 631 880 25

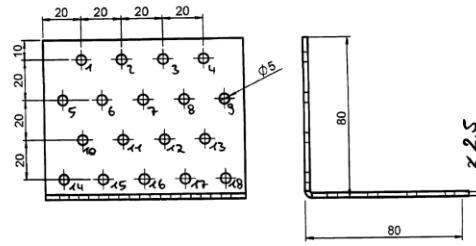


Figure B. 14 Dimensions of Angle Bracket 631 810 25

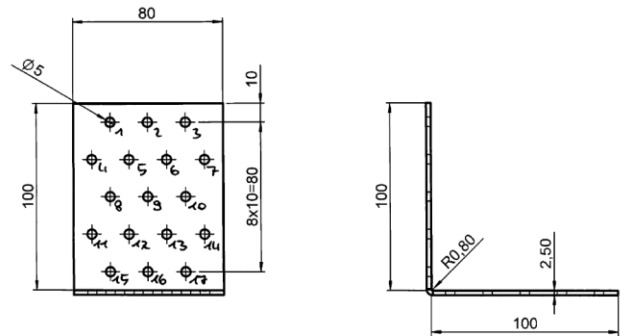
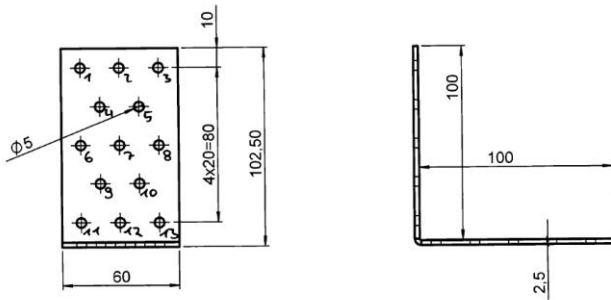
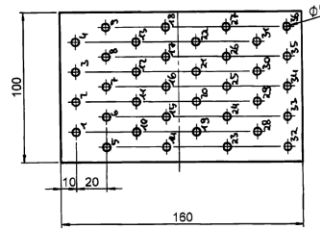
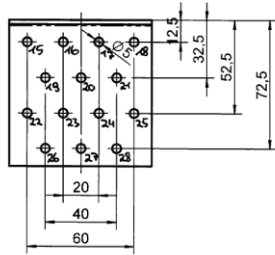
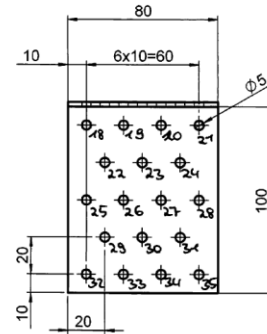
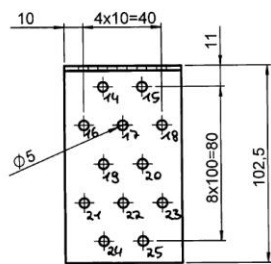


Figure B. 15 Dimensions of Angle Bracket 631 160 25

Figure B. 16 Dimensions of Angle Bracket 631 180 25



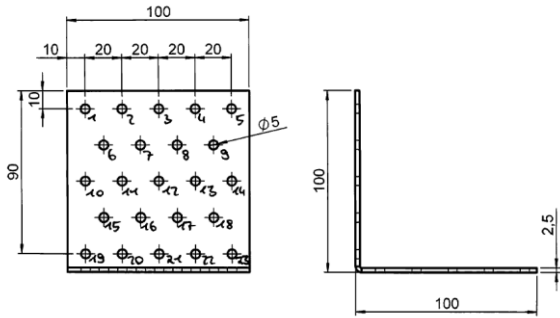


Figure B. 17 Dimensions of Angle Bracket 631 110 25

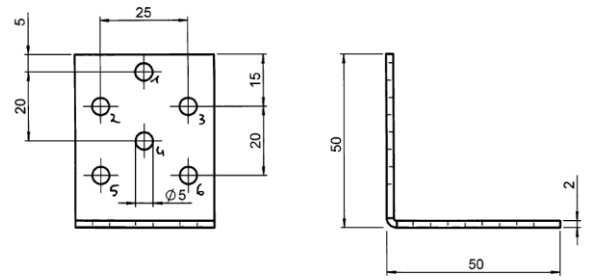


Figure B. 18 Dimensions of Angle Bracket 631 554 20

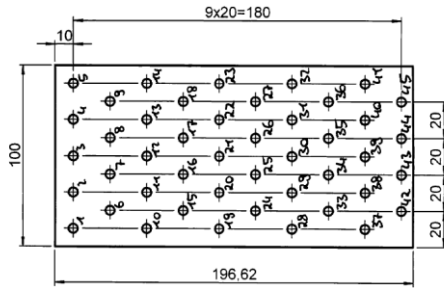


Figure B. 19 Dimensions of Angle Bracket 634 100 20

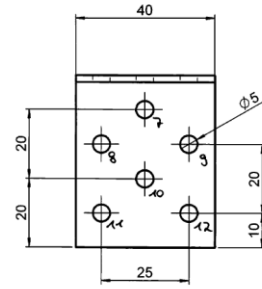
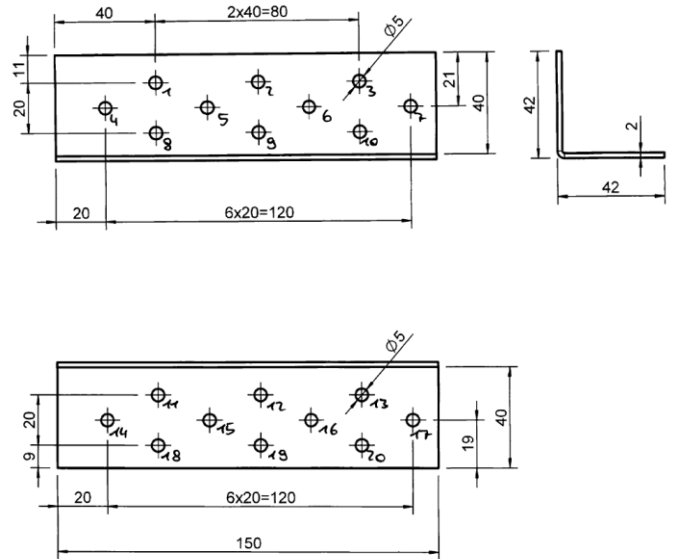
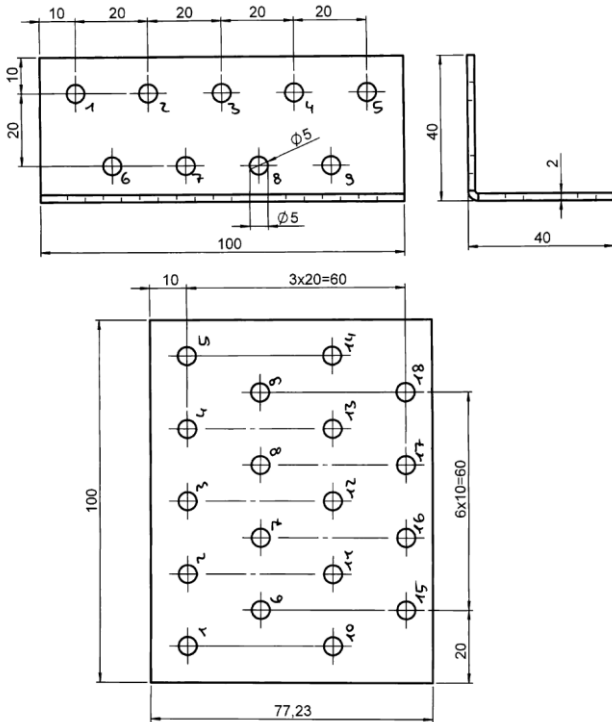


Figure B. 20 Dimensions of Angle Bracket 634 150 20



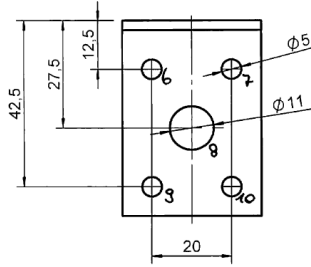
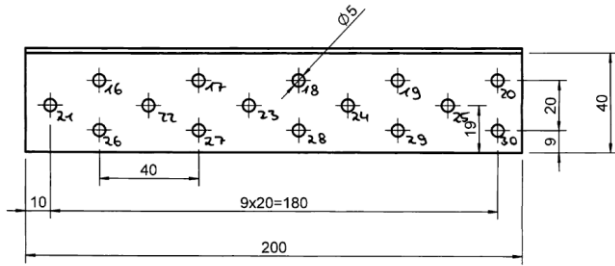
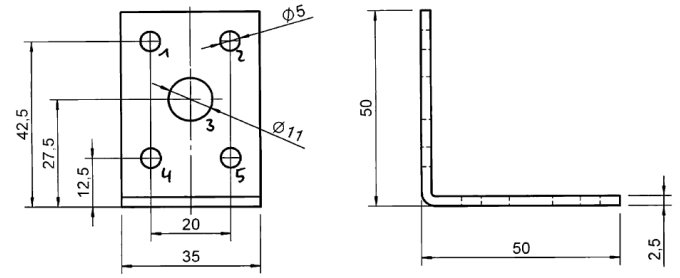
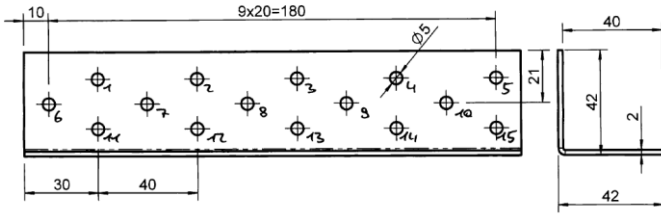


Figure B. 21 Dimensions of Angle Bracket 631 200 20

Figure B. 22 Dimensions of Angle Bracket 641 035 25

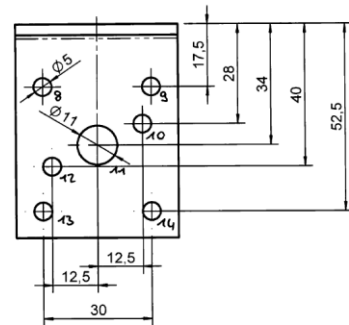
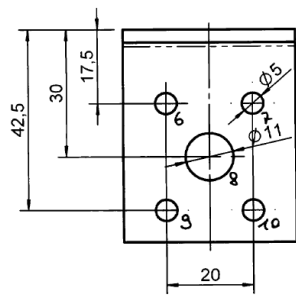
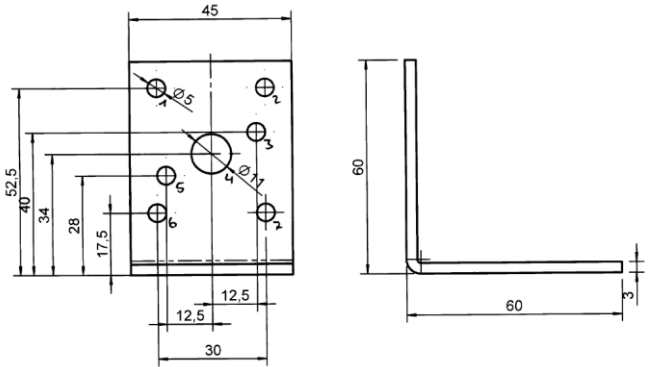
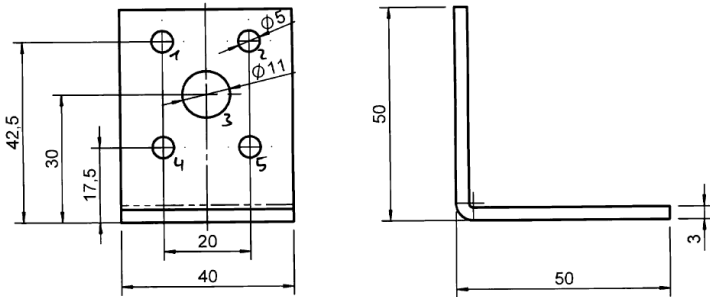


Figure B. 23 Dimensions of Angle Bracket 641 040 30

Figure B. 24 Dimensions of Angle Bracket 641 664 30

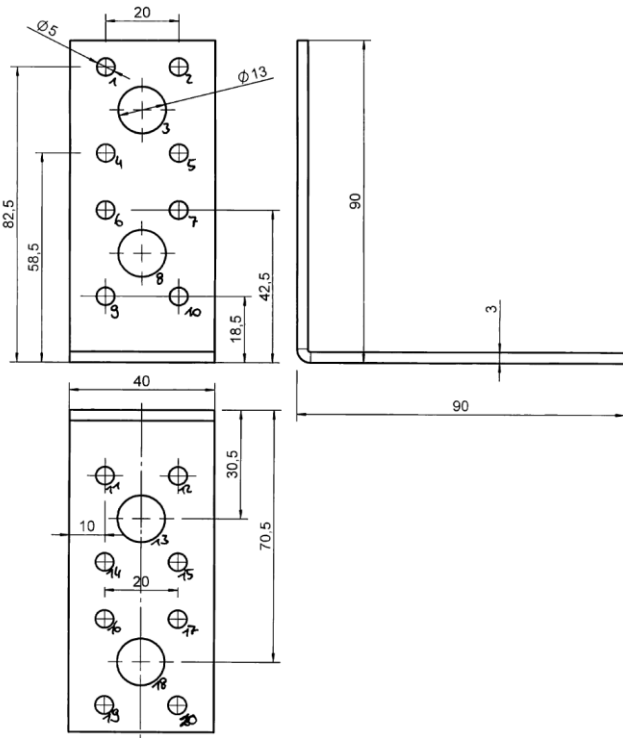


Figure B. 25 Dimensions of Angle Bracket 641 994 30

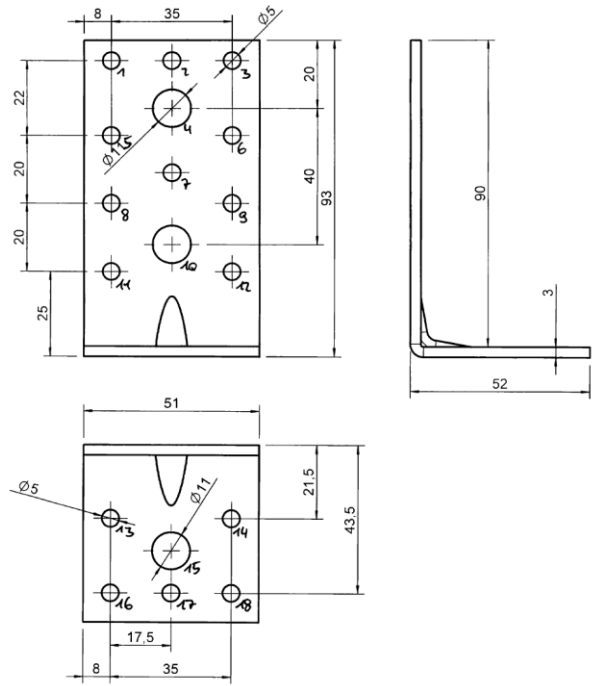


Figure B. 26 Dimensions of Angle Bracket 641 595 30

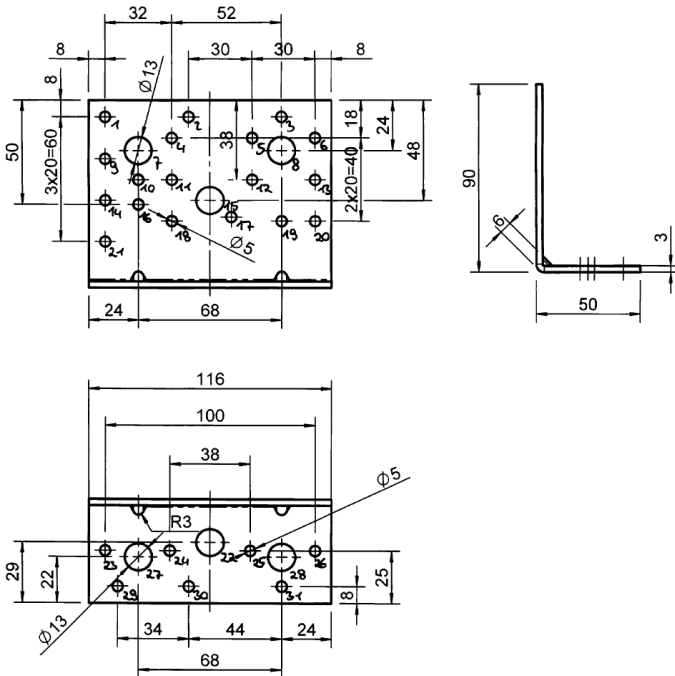


Figure B. 27 Dimensions of Angle Bracket 500 313 62

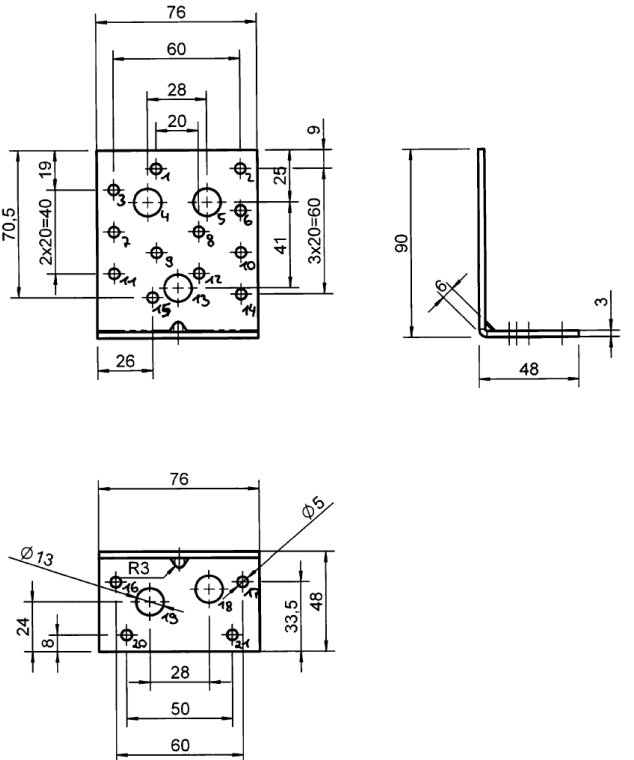


Figure B. 28 Dimensions of Angle Bracket 641 598 30

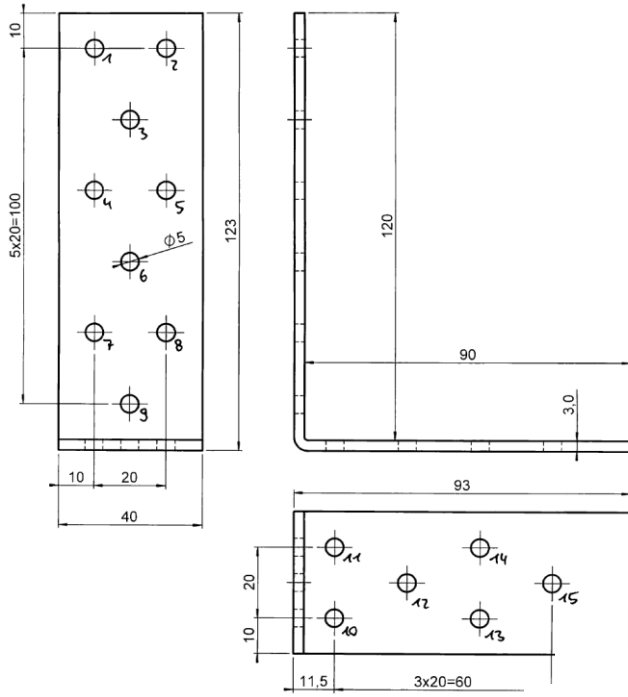


Figure B. 29 Dimensions of Angle Bracket 641 912 30

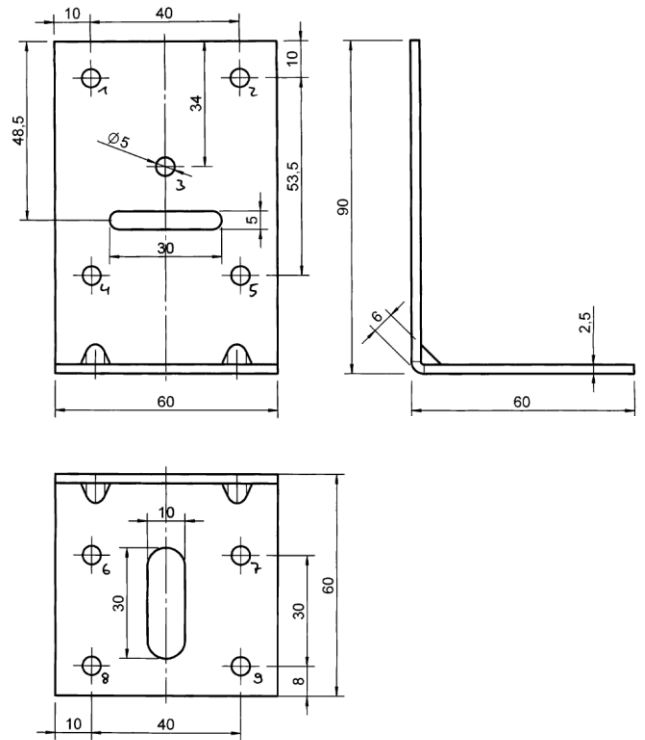


Figure B. 30 Dimensions of Angle Bracket 641 690 30

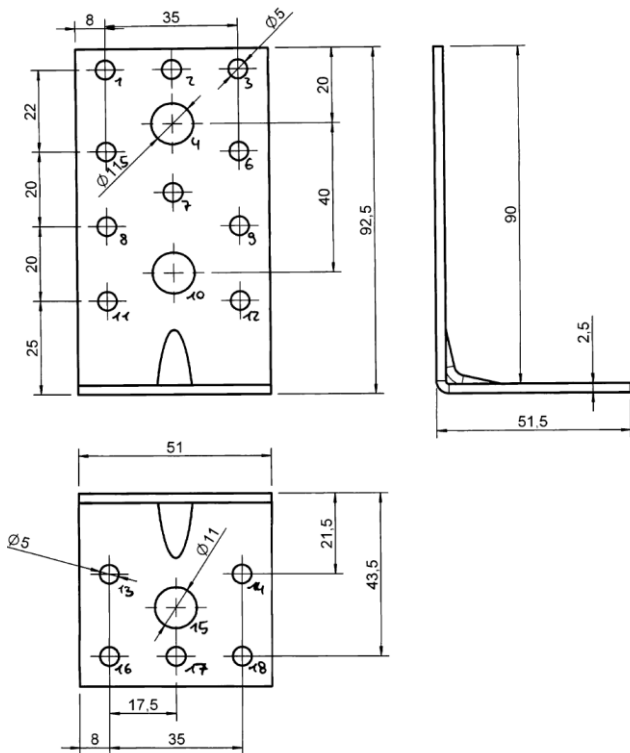


Figure B. 31 Dimensions of Angle Bracket 641 590 30

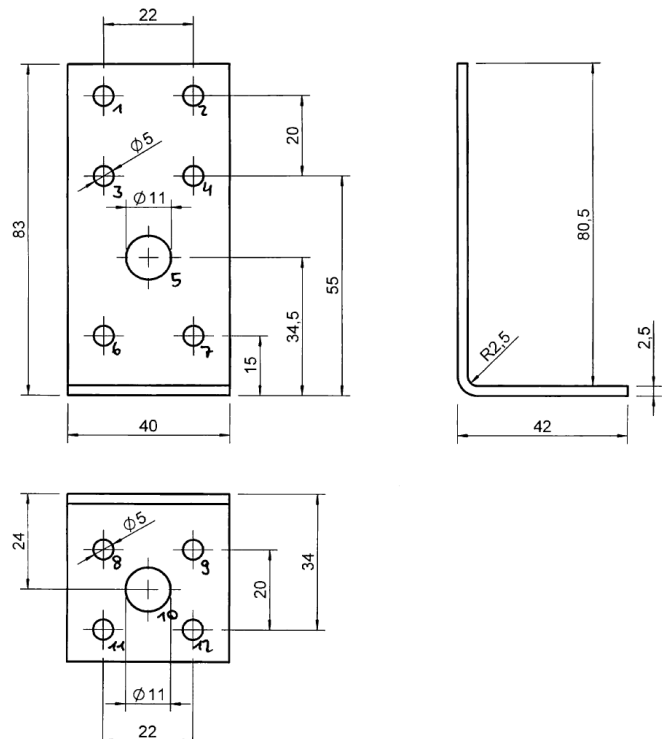


Figure B. 32 Dimensions of Angle Bracket 641 490 25



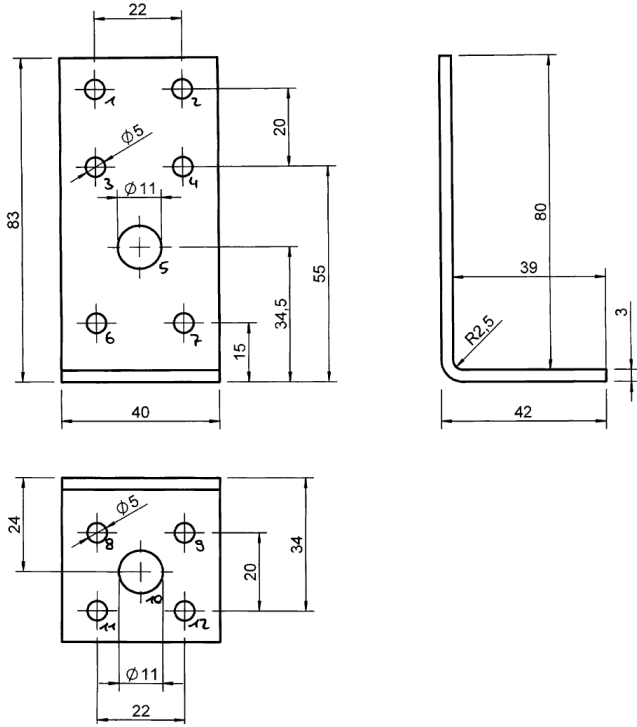


Figure B. 33 Dimensions of Angle Bracket 641 490 30

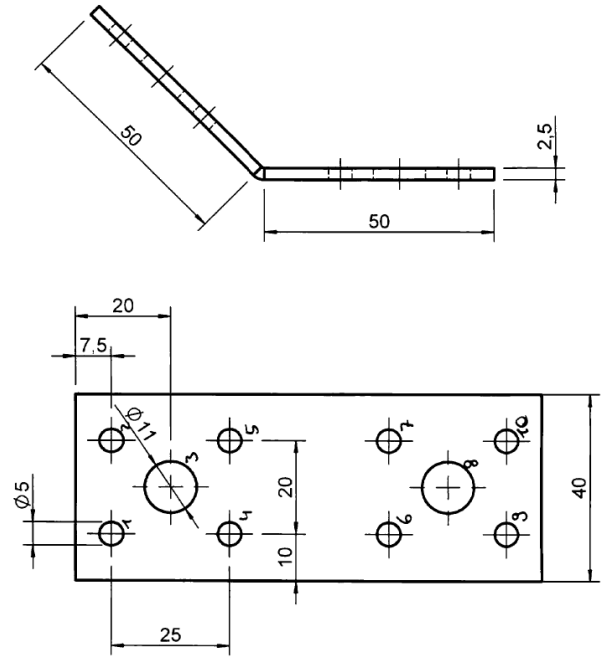


Figure B. 34 Dimensions of Angle Bracket 651 554 25

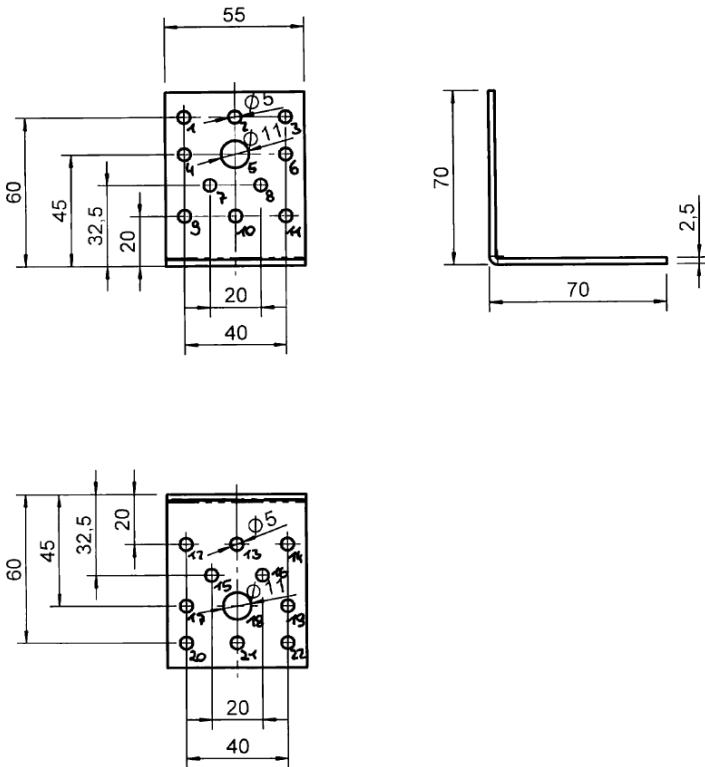


Figure B. 35 Dimensions of Angle Bracket 651 070 25

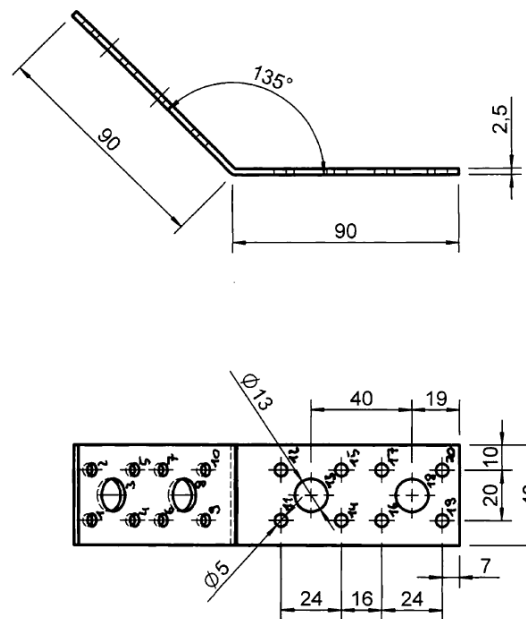


Figure B. 36 Dimensions of Angle Bracket 651 994 25

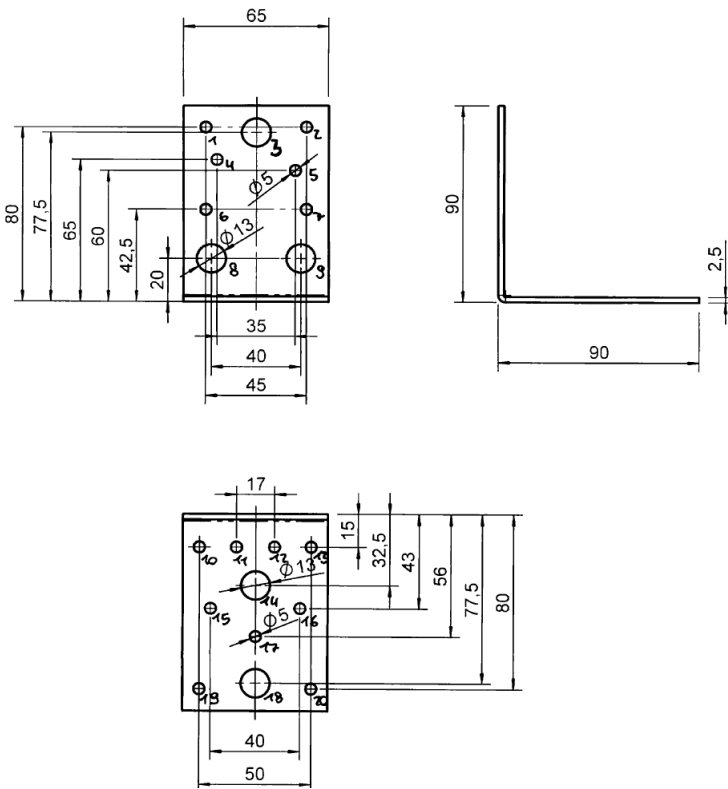


Figure B. 37 Dimensions of Angle Bracket 651 090 25

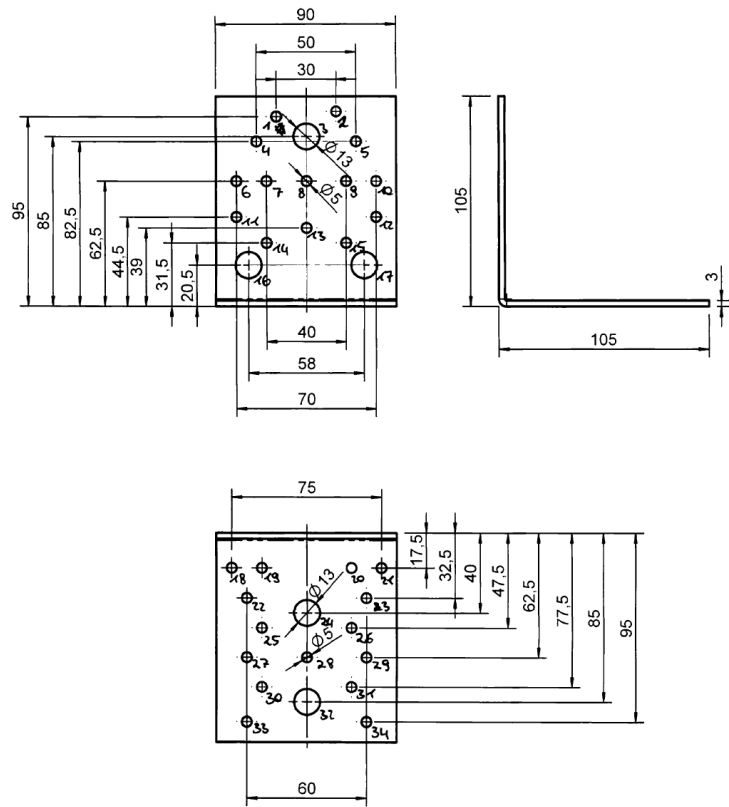


Figure B. 38 Dimensions of Angle Bracket 651 105 30

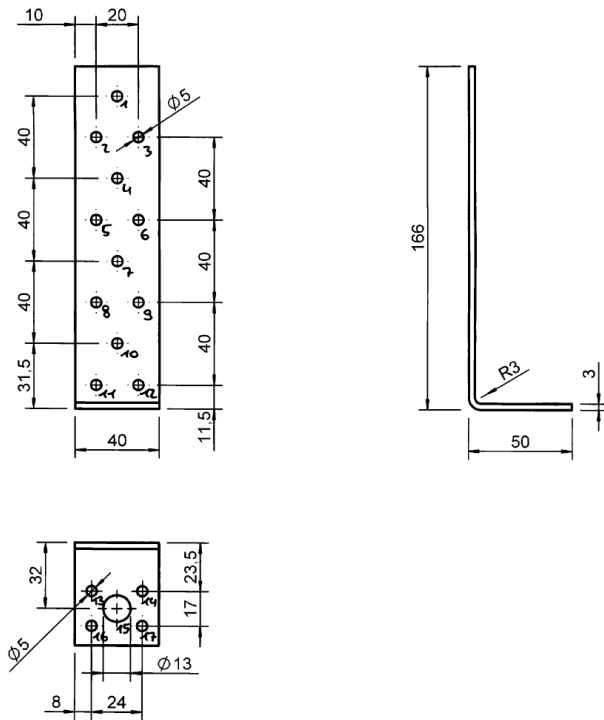


Figure B. 39 Dimensions of Angle Bracket 641 416 40

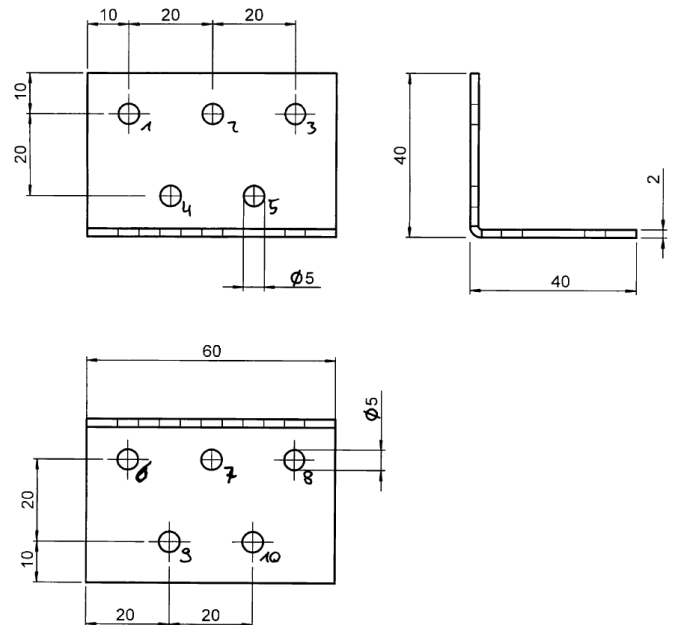


Figure B. 40 Dimensions of Angle Bracket 631 460 20

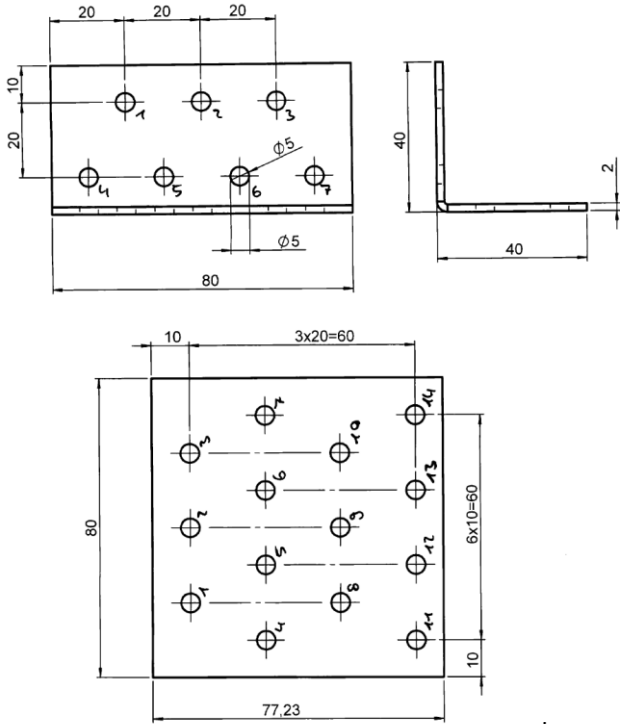


Figure B. 41 Dimensions of Angle Bracket 631 480 20

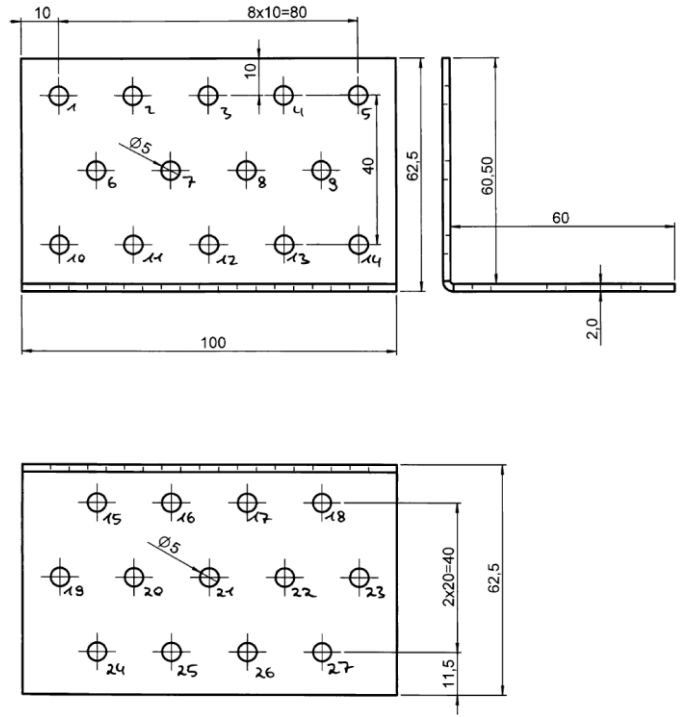


Figure B. 42 Dimensions of Angle Bracket 631 610 20

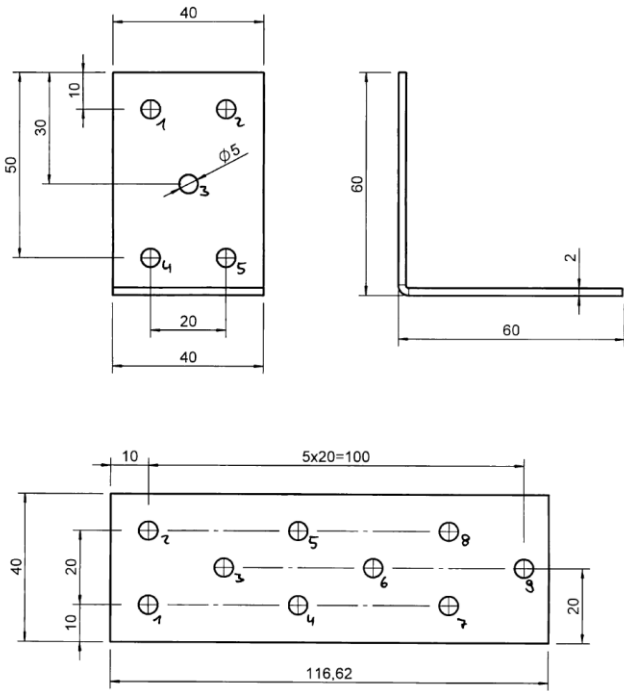


Figure B. 43 Dimensions of Angle Bracket 631 640 20

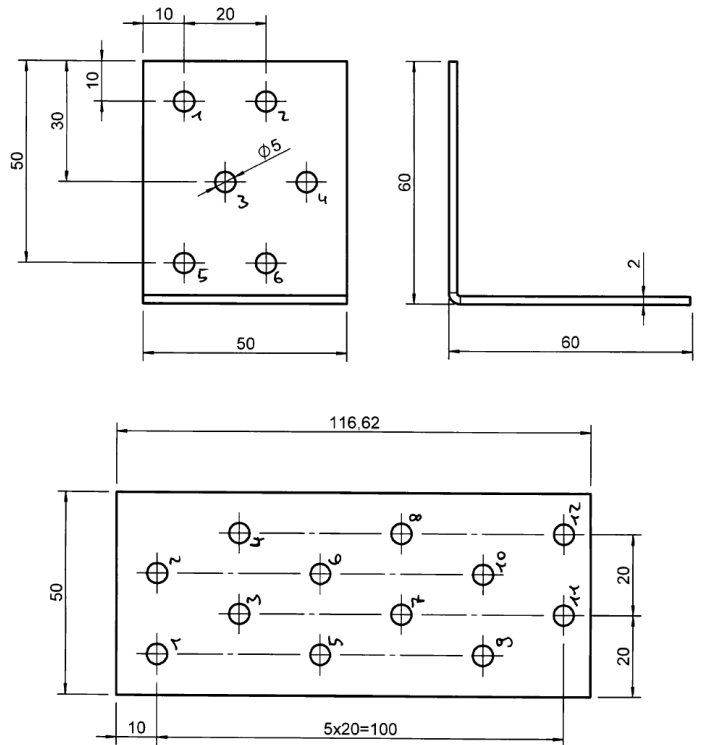


Figure B. 44 Dimensions of Angle Bracket 631 650 20

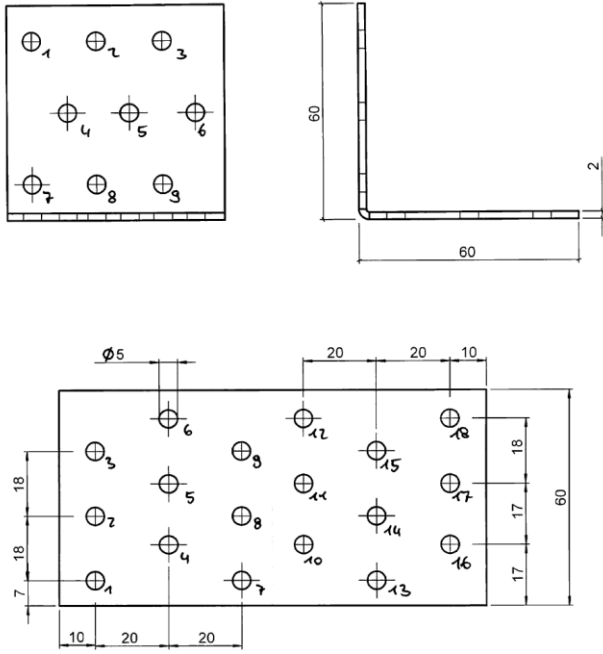


Figure B. 45 Dimensions of Angle Bracket 631 660 20

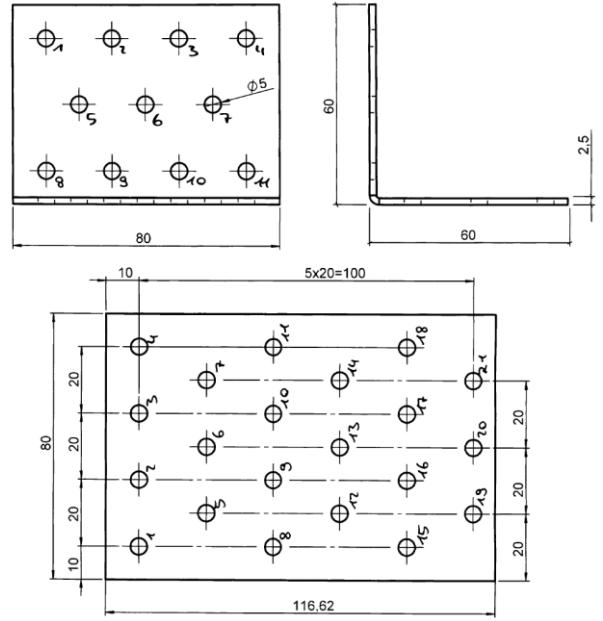


Figure B. 46 Dimensions of Angle Bracket 631 680 20

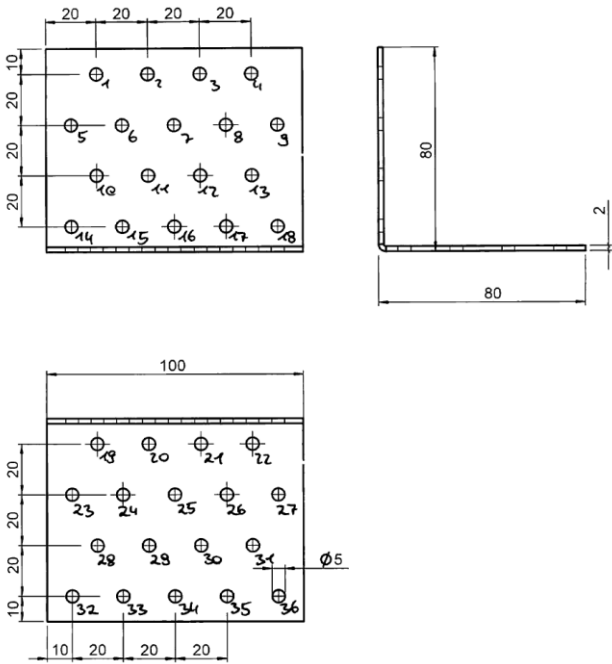


Figure B. 47 Dimensions of Angle Bracket 631 810 20

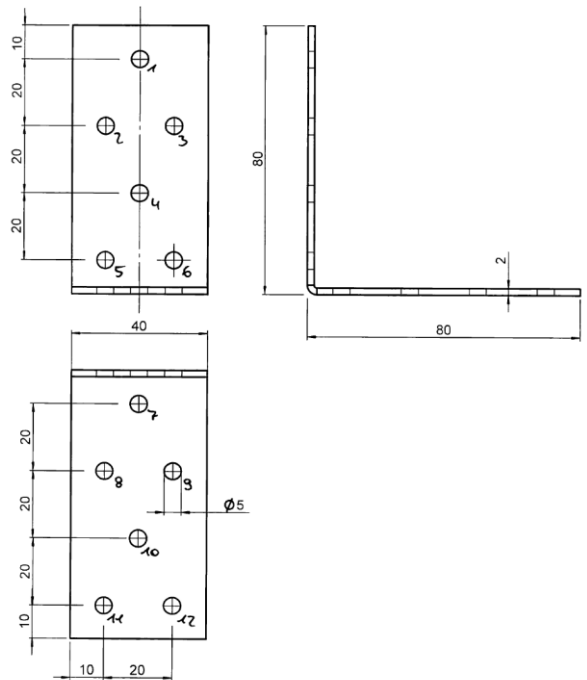


Figure B. 48 Dimensions of Angle Bracket 631 480 20

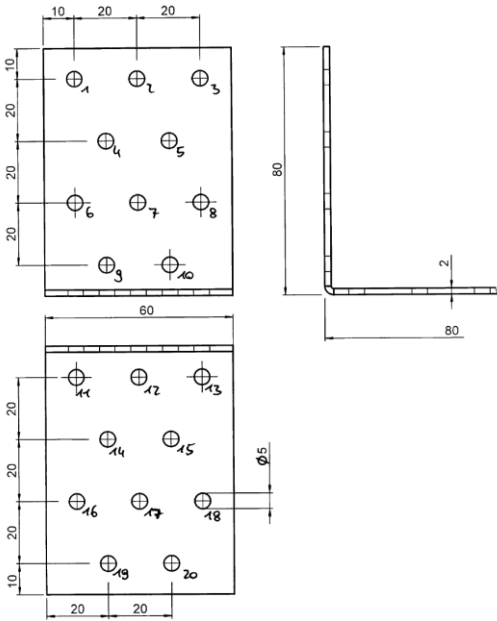


Figure B. 49 Dimensions of Angle Bracket 631 860 20

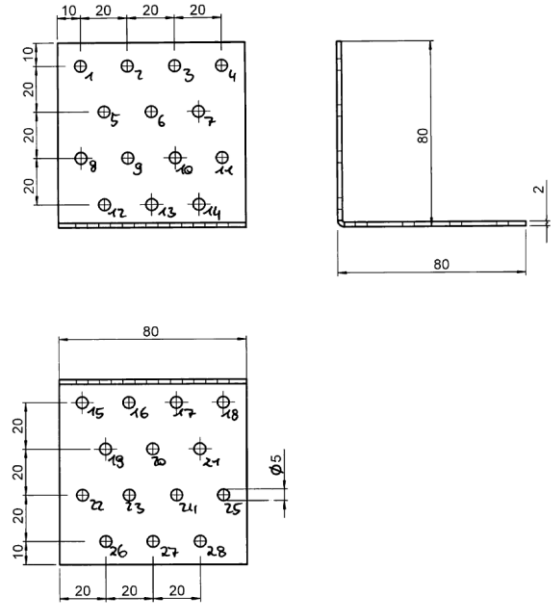


Figure B. 50 Dimensions of Angle Bracket 631 880 20

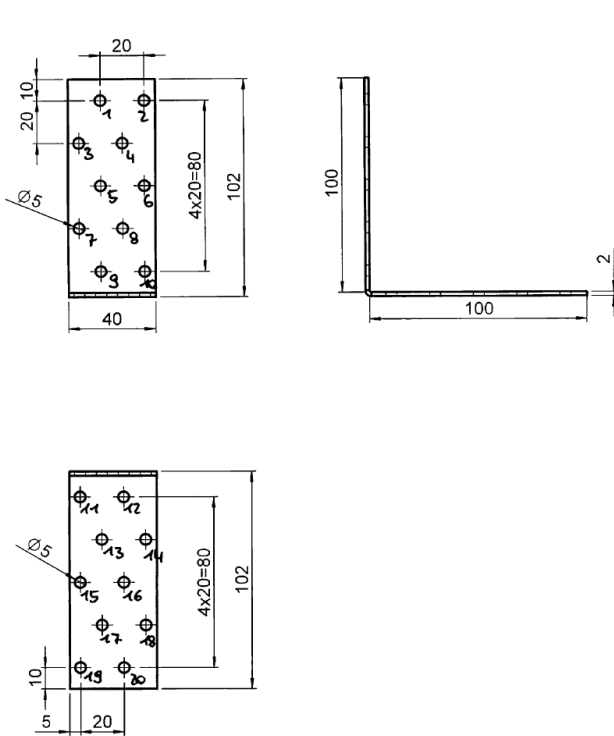


Figure B. 51 Dimensions of Angle Bracket 631 140 20

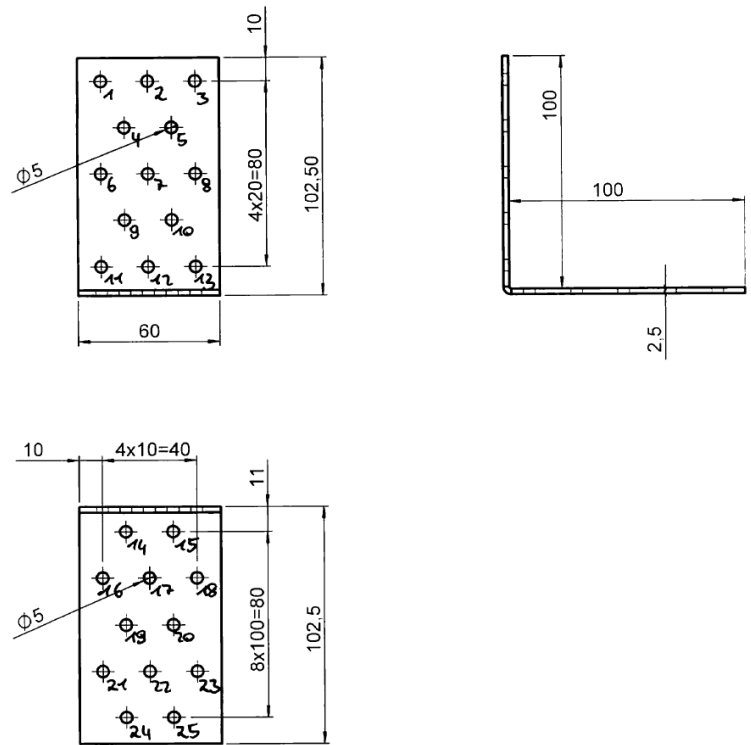


Figure B. 52 Dimensions of Angle Bracket 631 160 20

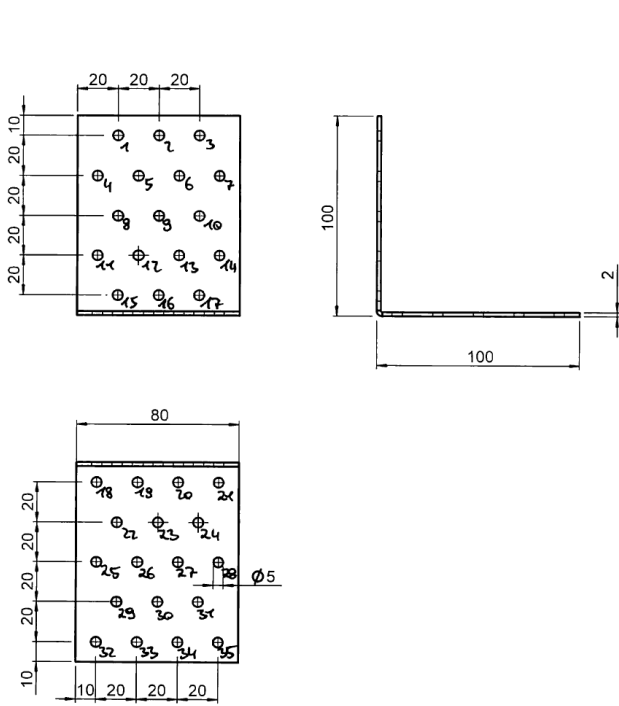


Figure B. 53 Dimensions of Angle Bracket 631 180 20

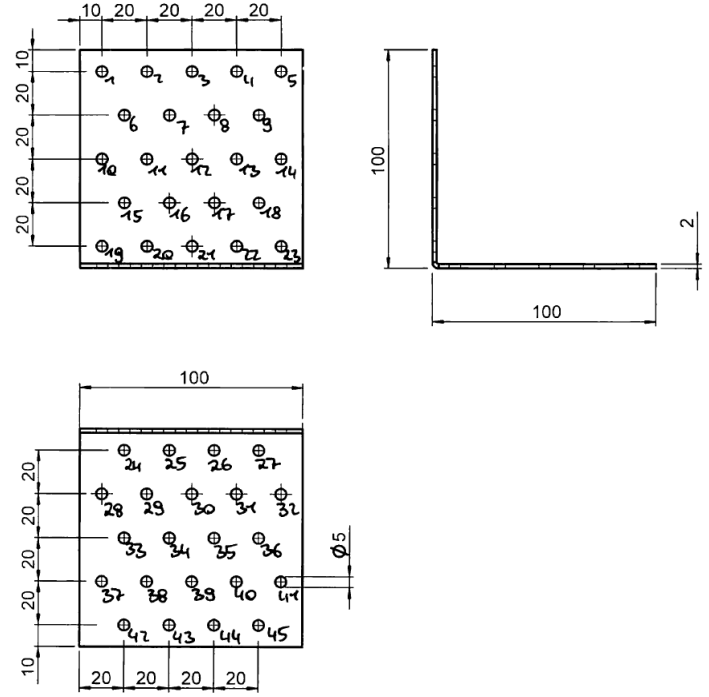


Figure B. 54 Dimensions of Angle Bracket 631 110 20

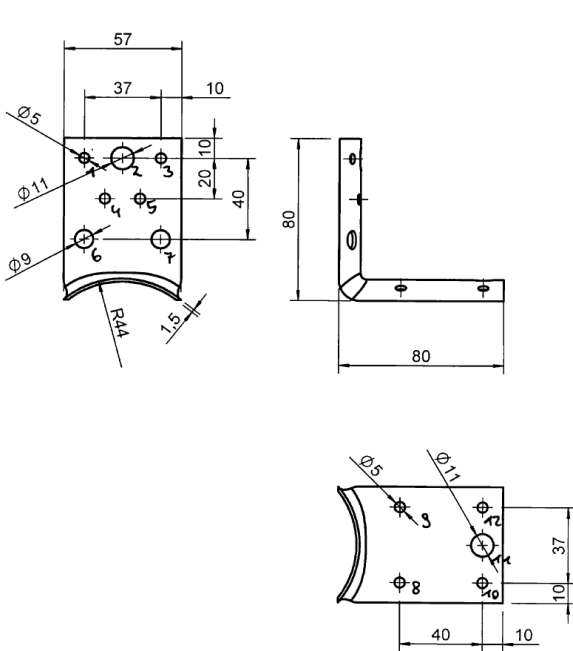


Figure B. 55 Dimensions of Angle Bracket RHV 60

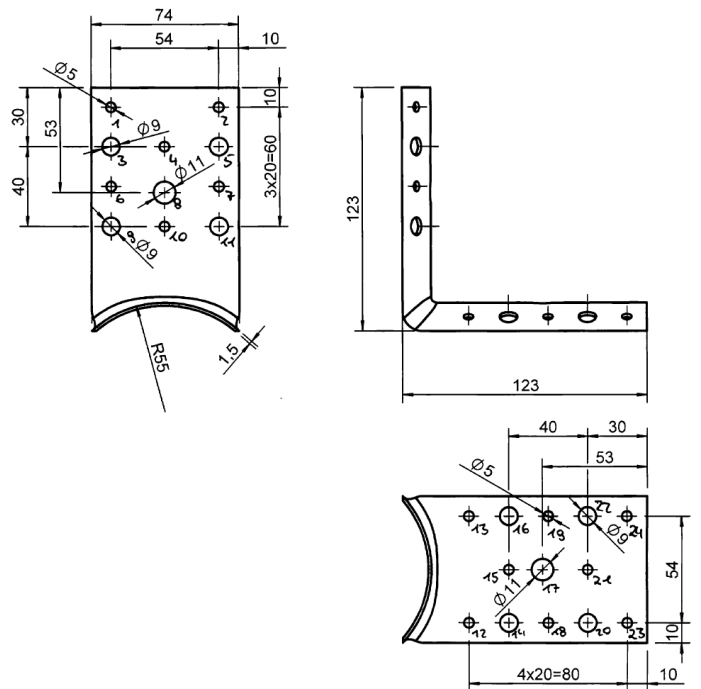


Figure B. 56 Dimensions of Angle Bracket RHV 80

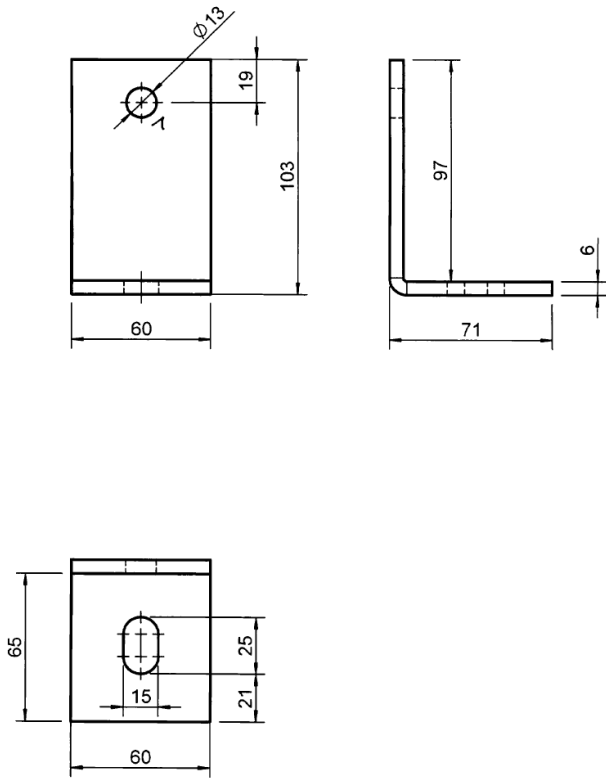


Figure B. 57 Dimensions of Angle Bracket 633 710 66

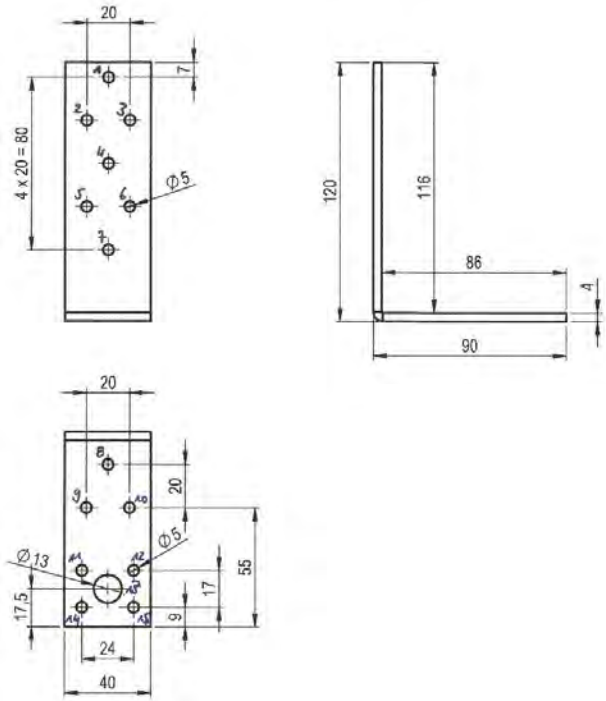


Figure B. 58 Dimensions of Angle Bracket 618 129 40

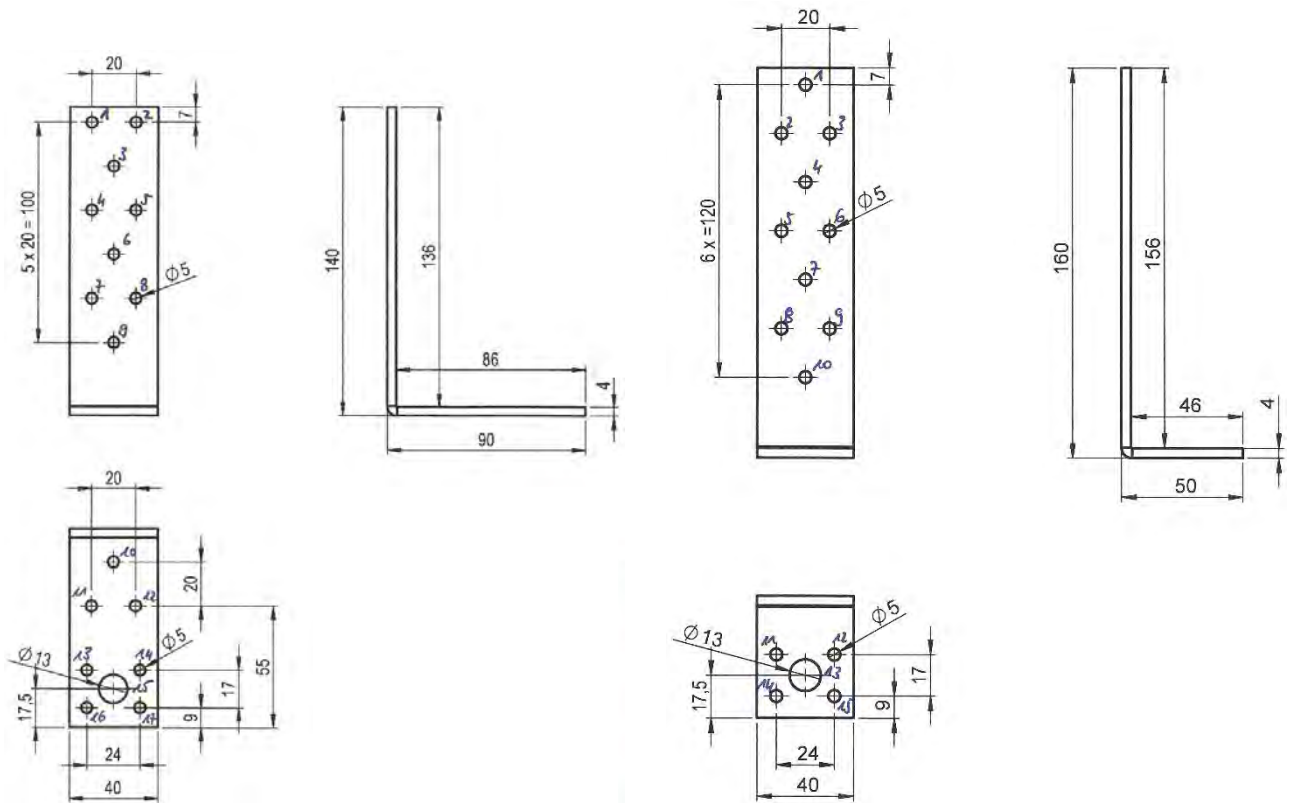


Figure B. 59 Dimensions of Angle Bracket 618 149 40

Figure B. 60 Dimensions of Angle Bracket 618 165 40

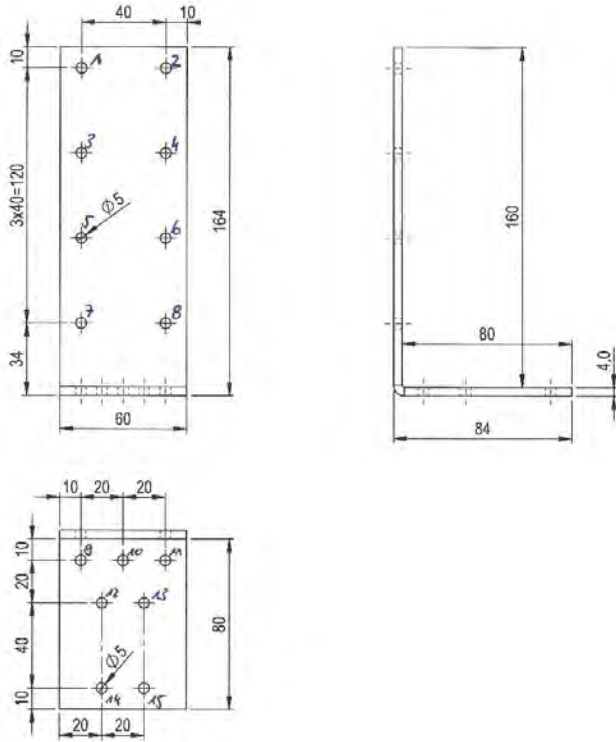


Figure B. 61 Dimensions of Angle Bracket 618 166 40

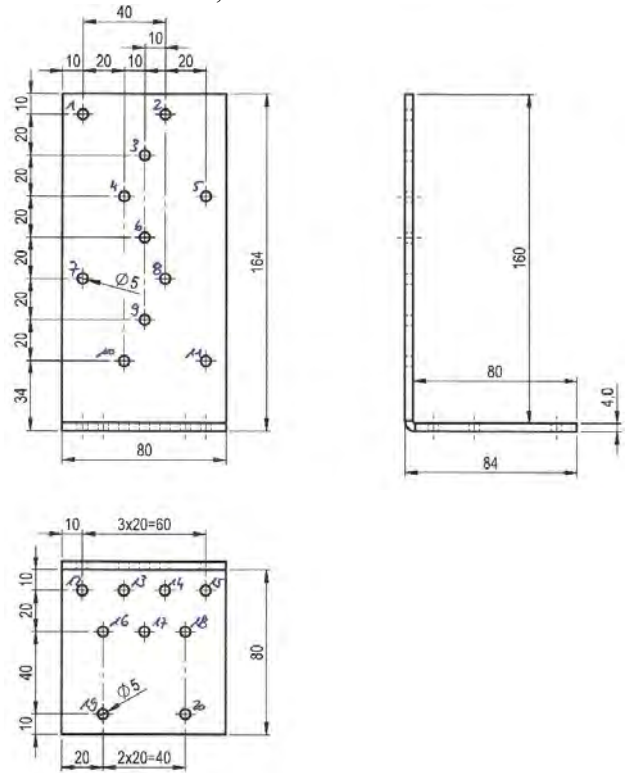


Figure B. 62 Dimensions of Angle Bracket 618 168 40

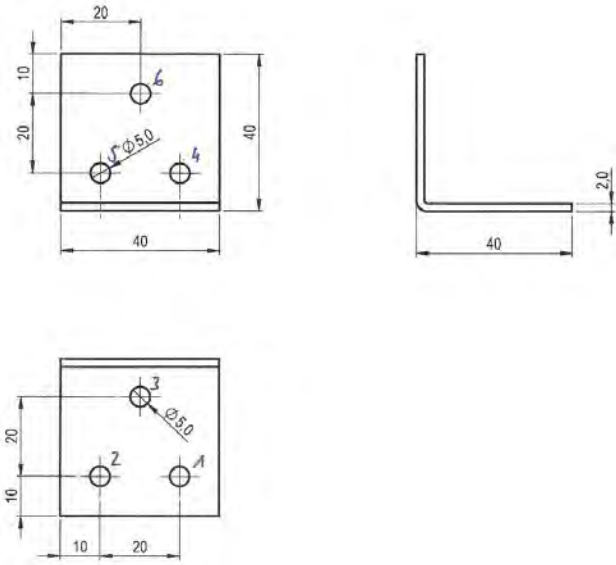


Figure B. 63 Dimensions of Angle Bracket 631 444 20

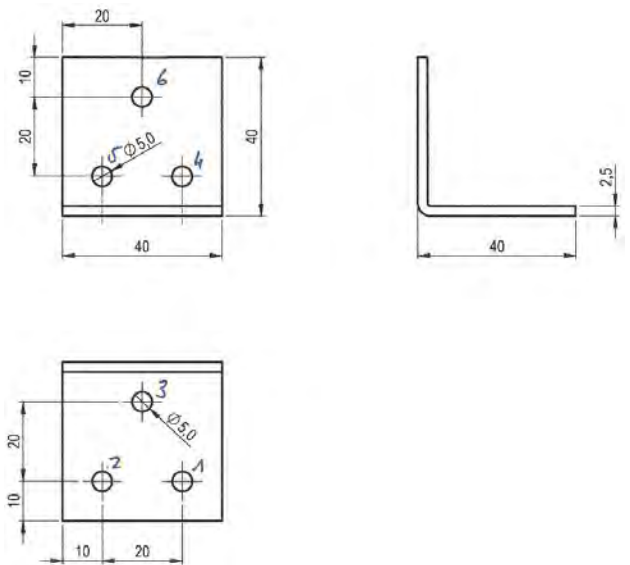


Figure B. 64 Dimensions of Angle Bracket 631 444 25



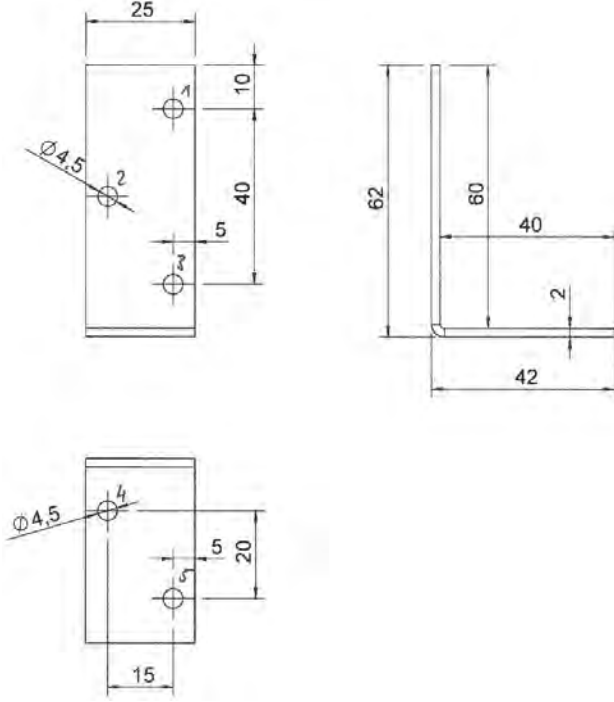


Figure B. 65 Dimensions of Angle Bracket 631 642 20

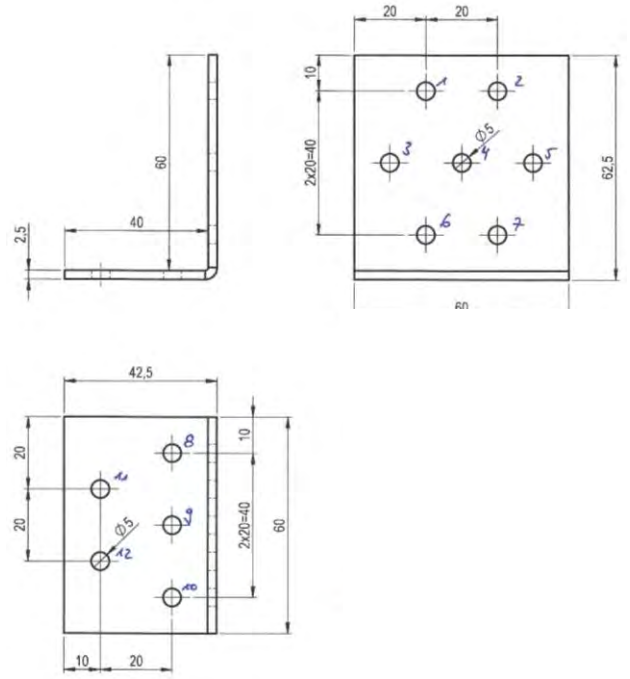


Figure B. 66 Dimensions of Angle Bracket 631 646 25

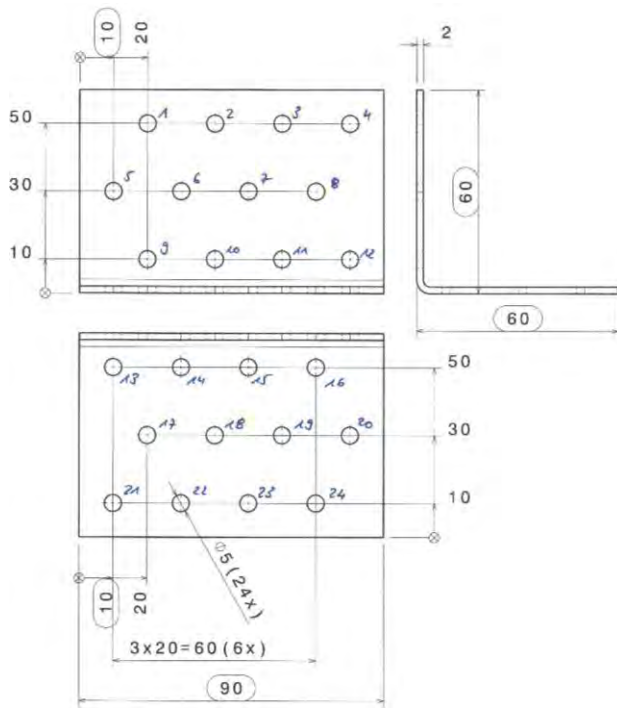


Figure B. 67 Dimensions of Angle Bracket 631 669 20

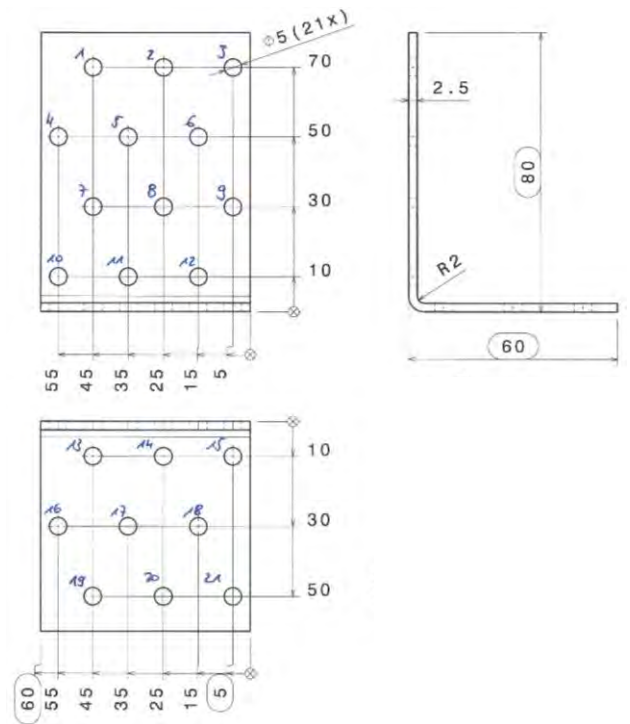


Figure B. 68 Dimensions of Angle Bracket 631 686 25

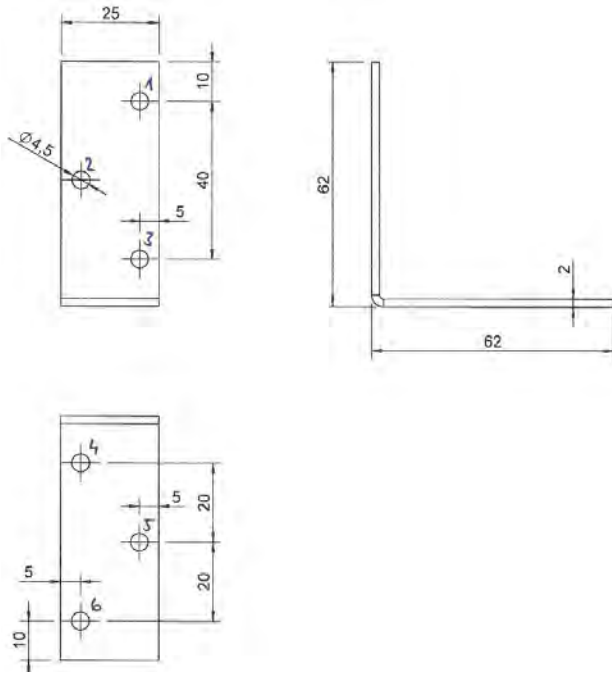


Figure B. 69 Dimensions of Angle Bracket 632 060 20

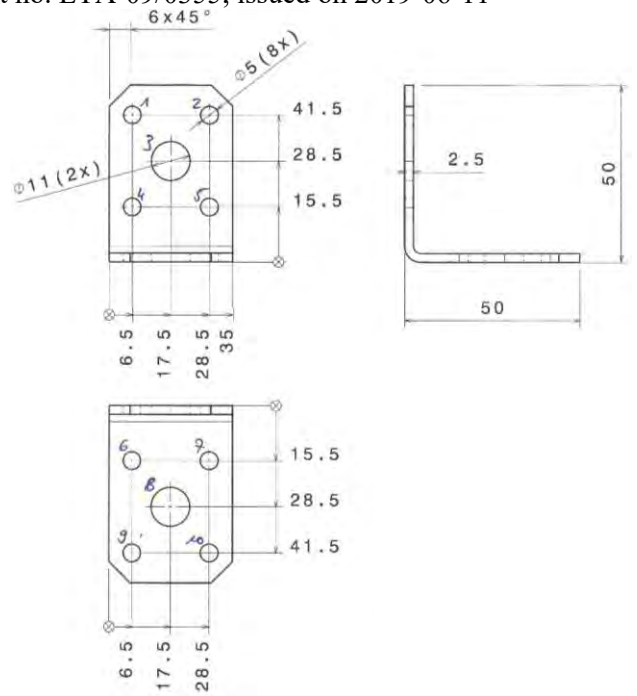


Figure B. 70 Dimensions of Angle Bracket 641 035 25

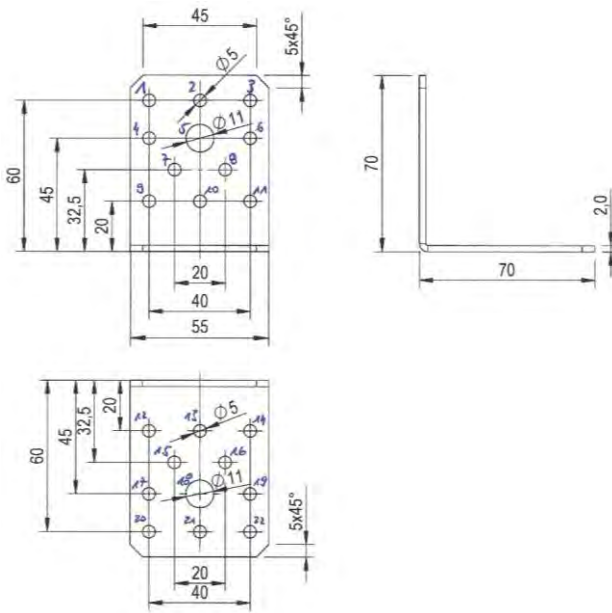


Figure B. 71 Dimensions of Angle Bracket 641 070 20

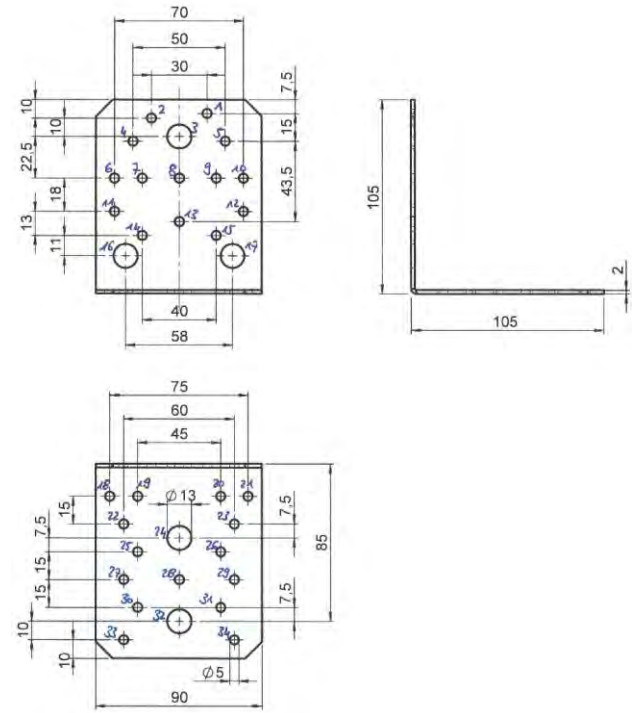


Figure B. 72 Dimensions of Angle Bracket 641 105 20

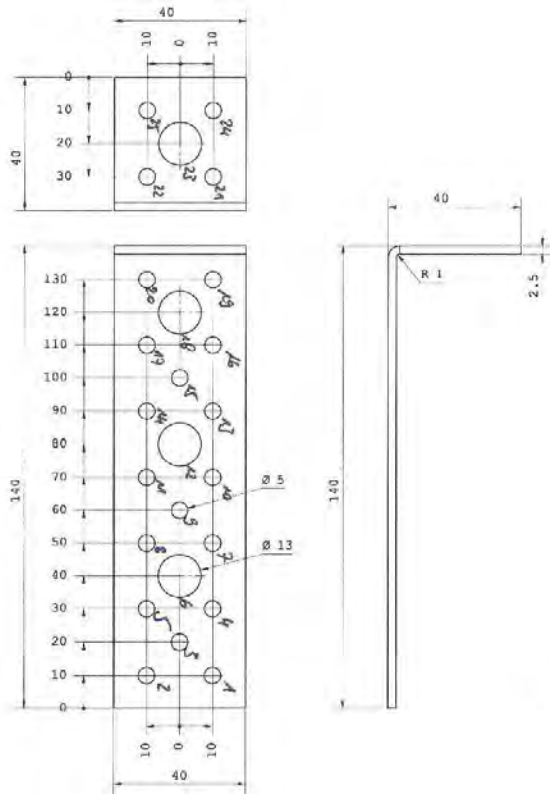


Figure B. 73 Dimensions of Angle Bracket 641 140 34

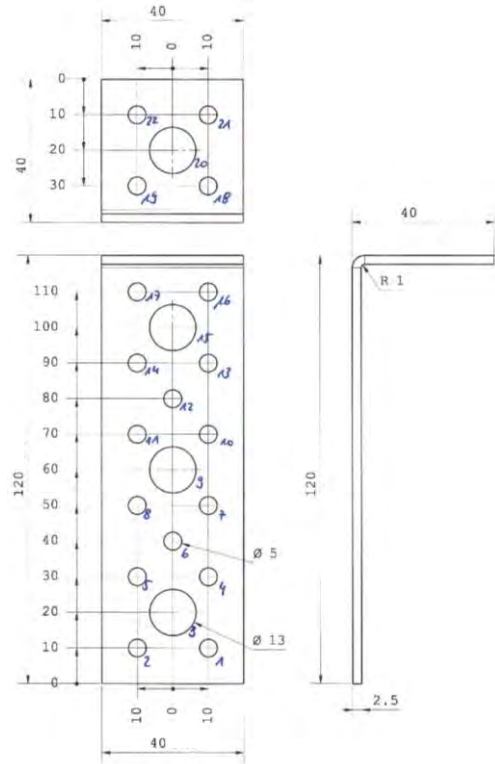


Figure B. 74 Dimensions of Angle Bracket 641 412 25

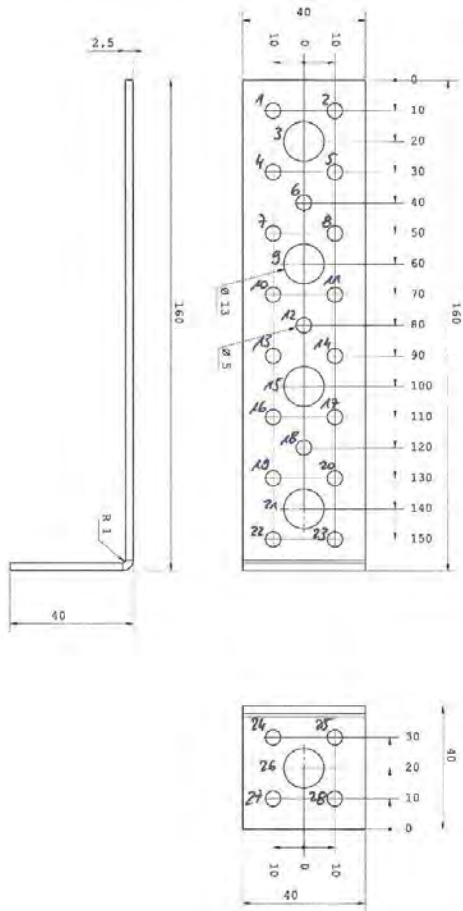


Figure B. 75 Dimensions of Angle Bracket 641 416 40

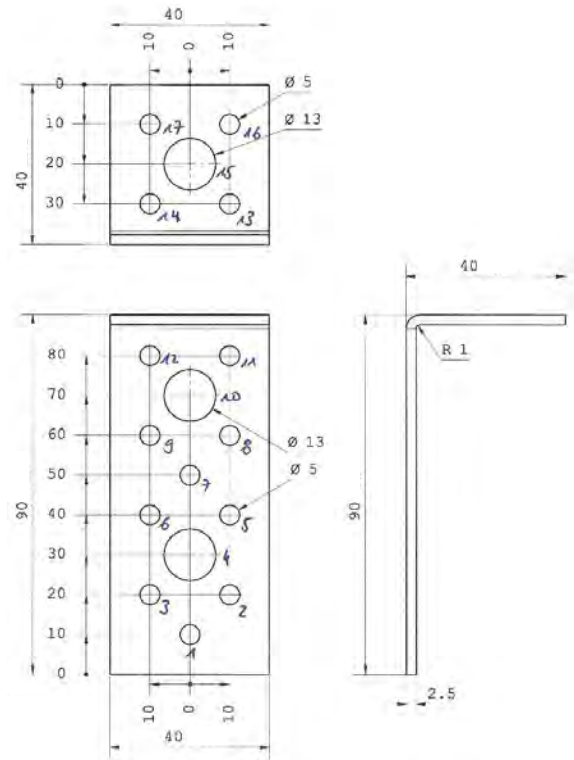


Figure B. 76 Dimensions of Angle Bracket 641 490 42

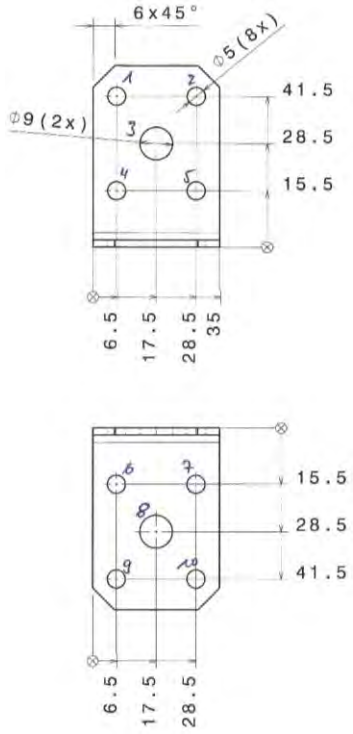


Figure B. 77 Dimensions of Angle Bracket 641 553 20

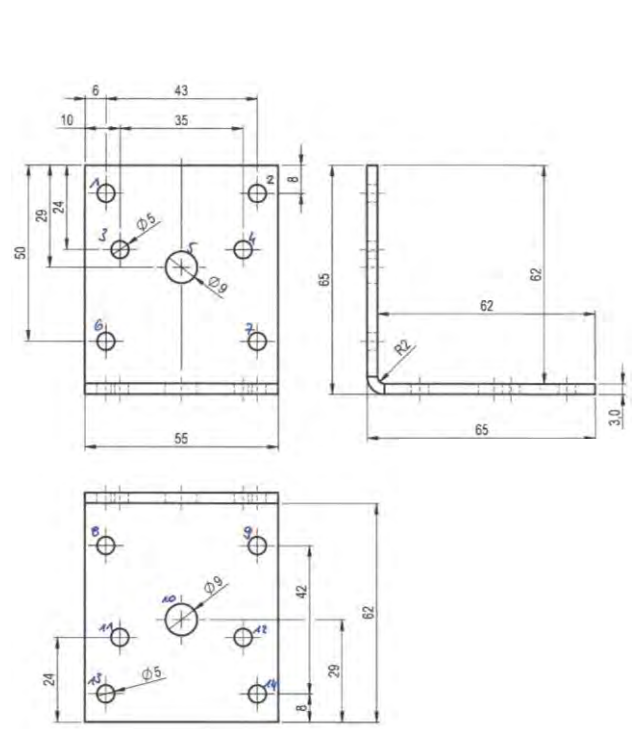


Figure B. 78 Dimensions of Angle Bracket 641 665 30

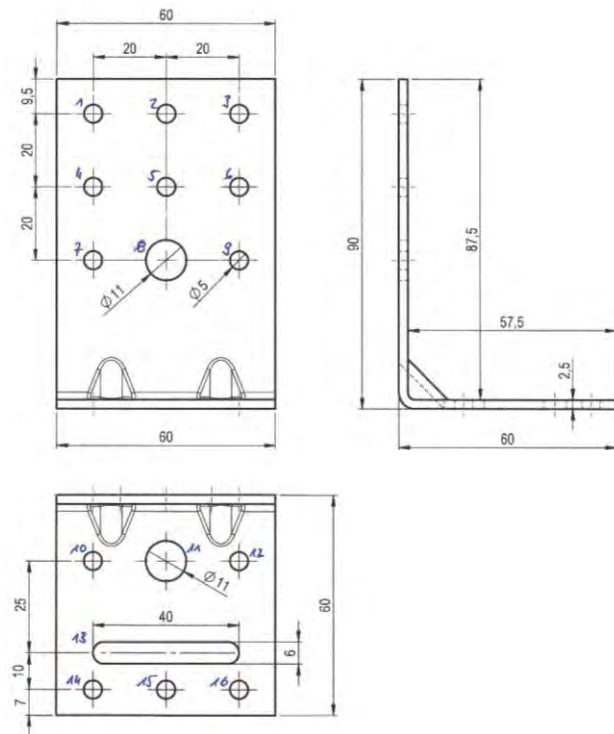


Figure B. 79 Dimensions of Angle Bracket 641 690 25

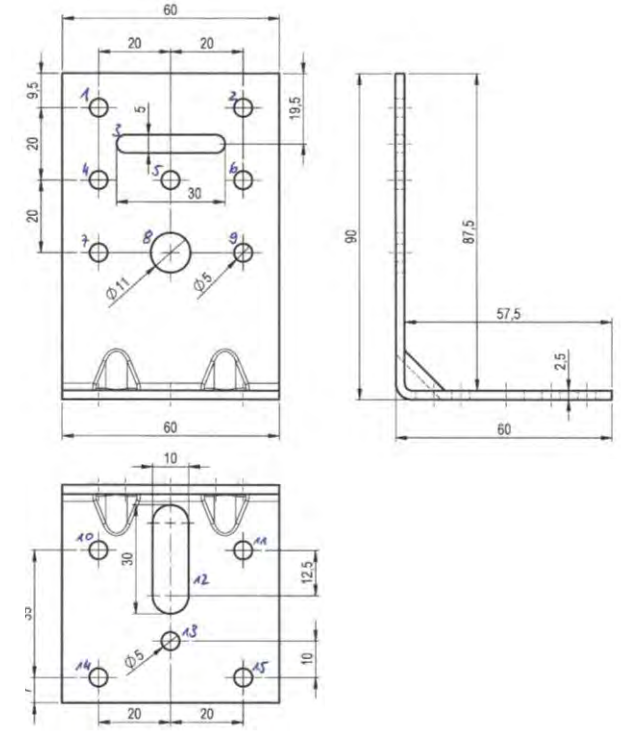


Figure B. 80 Dimensions of Angle Bracket 641 691 25

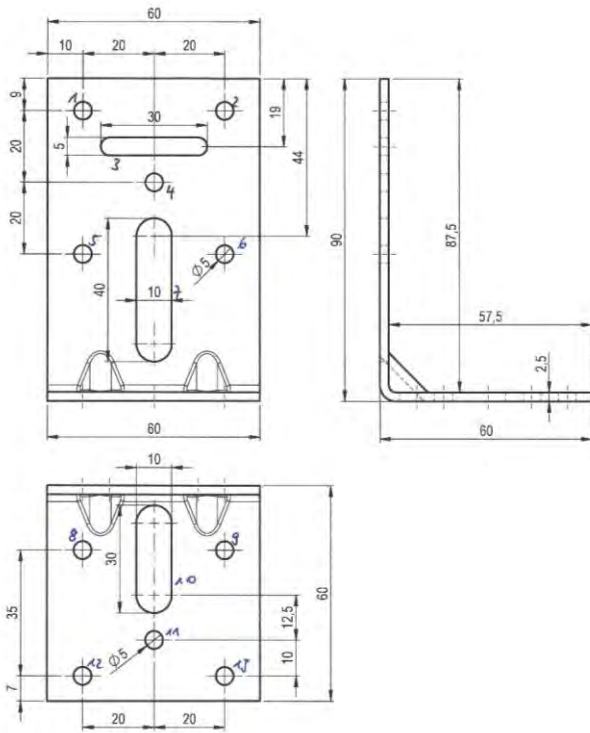


Figure B. 81 Dimensions of Angle Bracket 641 692 25

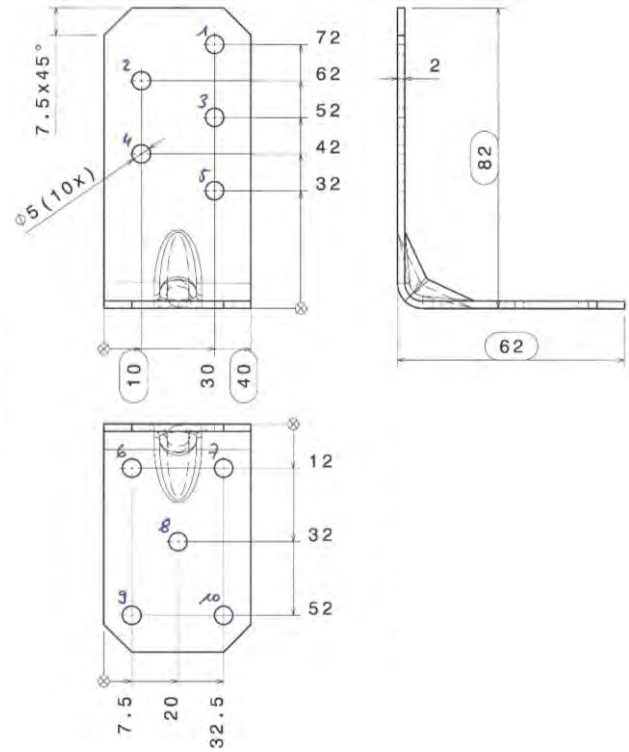


Figure B. 82 Dimensions of Angle Bracket 641 860 20

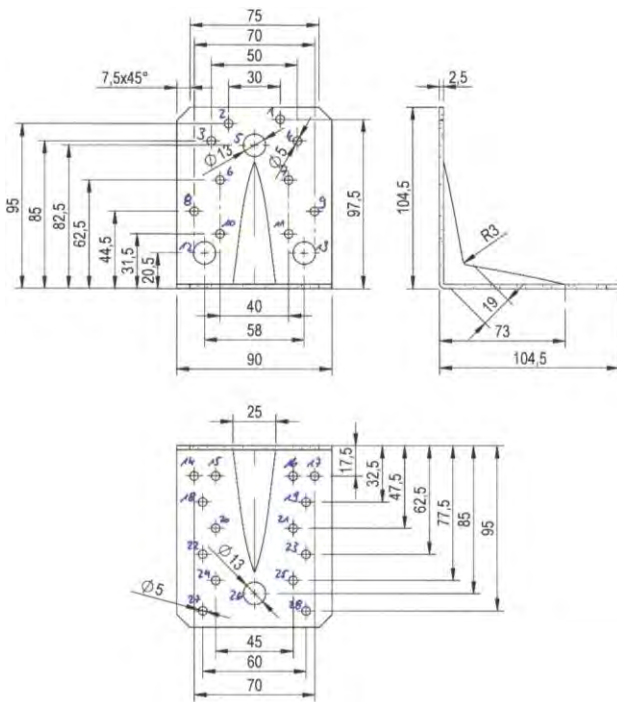


Figure B. 83 Dimensions of Angle Bracket 641 905 25

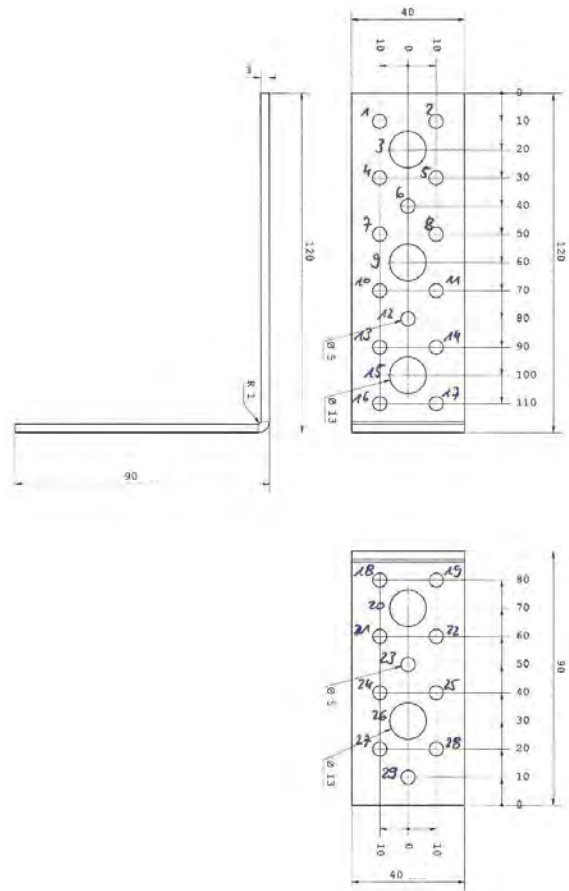


Figure B. 84 Dimensions of Angle Bracket 641 912 30

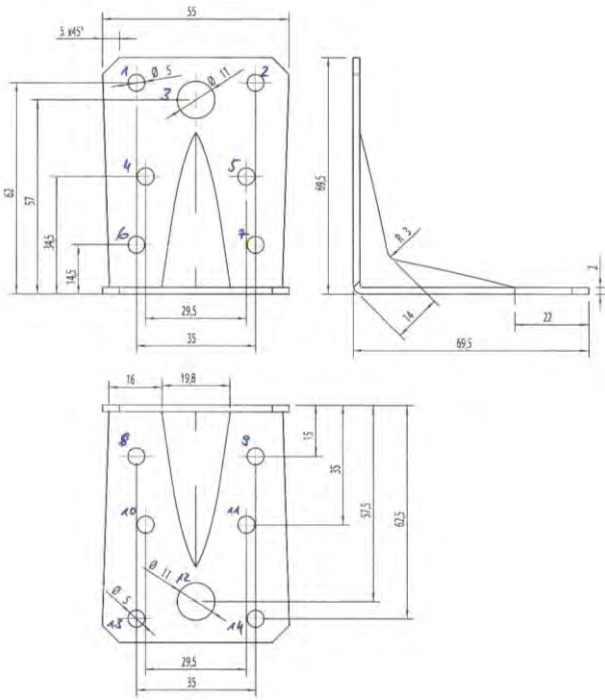


Figure B. 85 Dimensions of Angle Bracket 641 970 20

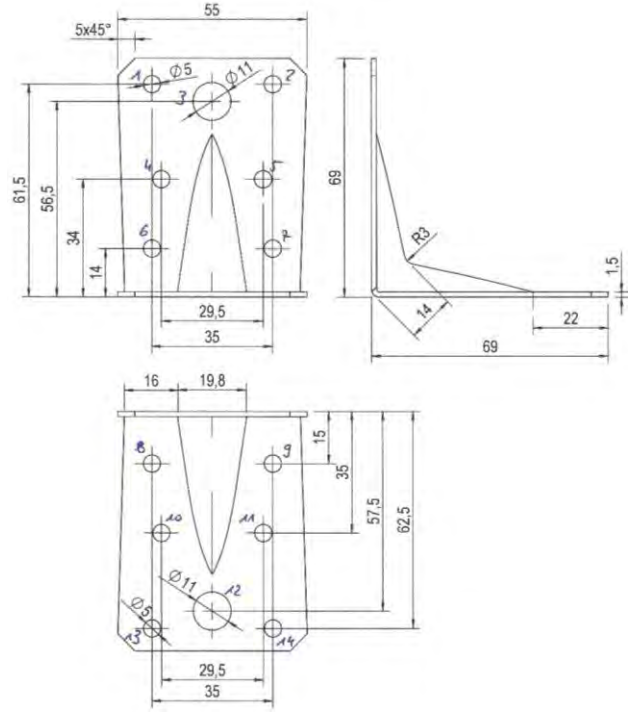


Figure B. 86 Dimensions of Angle Bracket 641 971 15

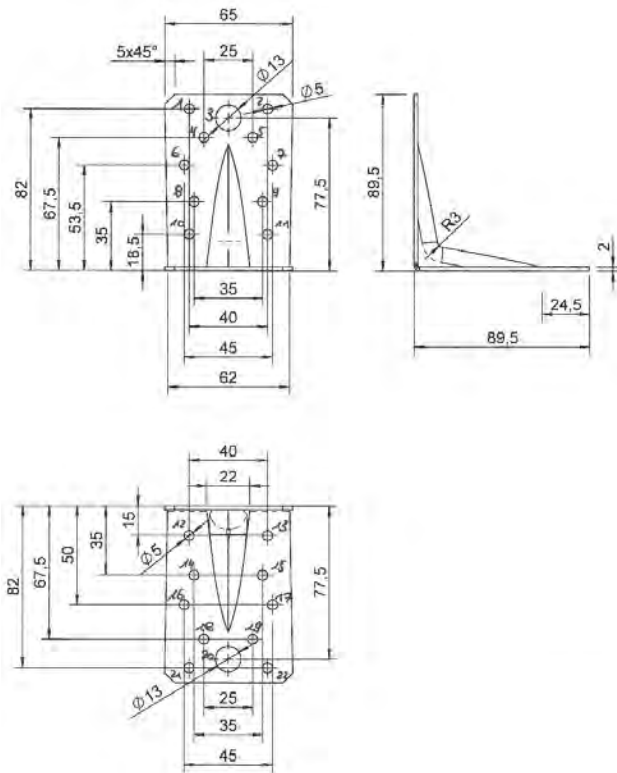


Figure B. 87 Dimensions of Angle Bracket 641 990 20

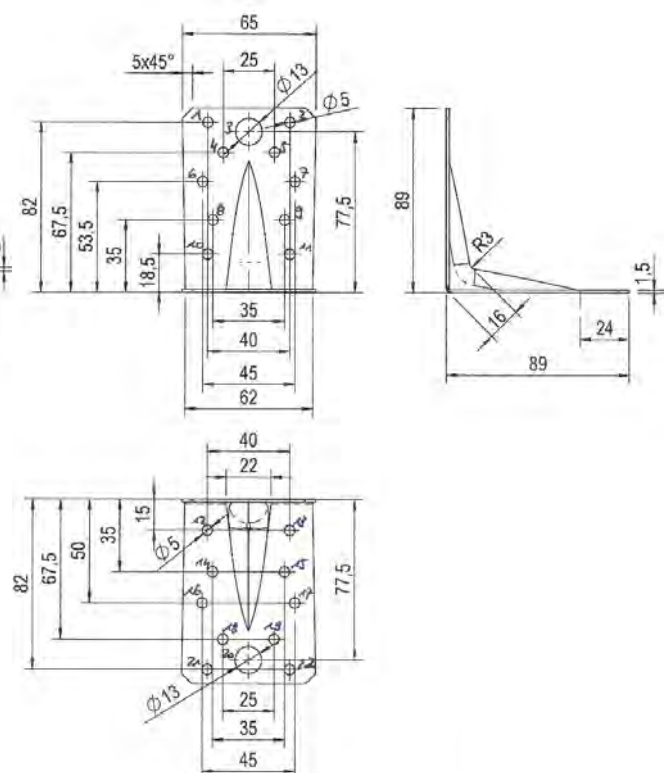


Figure B. 88 Dimensions of Angle Bracket 641 991 15

