Technical and Test Institute for Construction Prague
Prosecká 811/76a
190 00 Prague
Czech Republic
eota@tzus.cz

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA

www.eota.eu

European Technical Assessment

ETA 15/0225 of 11/05/2015

General part

Technical Assessment Body issuing the ETA:	**Technický a zkušební ústav stavební Praha, s. p.**
Trade name of the construction product	Angle Brackets, types: ZK 1190, ZK 9965, ZK 150150, ZS 70 ZK 1190WZ, ZK 9965 WZ, ZK 8646, ZS 90 ZK 7755, ZK 12546, ZN 5905, ZS 994 ZK 7755WZ, ZK 12555, ZN 6906, ZS 105 ZK 9960
Product family to which the construction product belongs	Three-dimensional nailing plates
Manufacturer	**Yancheng Jiahe Hardware Manufacturing Co., Ltd.** Shuguang Industrial Park, Nanyang, Yancheng, Jiangsu, China
Manufacturing plant	Shuguang Industrial Park, Nanyang, Yancheng, Jiangsu, China
This European Technical Assessment contains	29 pages including Annexes A and B which form an integral part of this assessment. Annex C contains Control Plan with confidential information and is not included in the European Technical Assessment when that assessment is publicly disseminated.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	ETAG 015, edition November 2012, used as European Assessment Document (EAD) according to Article 66 (3) of the Regulation (EU) No. 305/2011

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

Specific part

1 Technical description of the product

Angle Brackets ZK 1190, ZK 1190WZ, ZK 7755, ZK 7755WZ, ZK 9960, ZK 9965, ZK 9965WZ, ZK 12546, ZK 12555, ZK 150150, ZK 8646, ZN 5905, ZN 6906 and inclined Angle Brackets ZS 70, ZS, 90, ZS 994, ZS 105 are face-fixed, one-piece, cold-formed, non-welded, zinc-coated, steel angle brackets with or without stiffening by embossed rib.

The brackets are made of steel that complies with grade DX51D+Z275 according to EN 10346:2009 with R_e≥290 MPa, R_m≥400 MPa and A_{80}≥22%. The source material is continuously hot-dip zinc-coated steel sheet or strip with tolerances that correspond to the requirements of EN 10143.

Dimensions of the products are given in Annex A.

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

The Angle Brackets are intended for timber-to-timber connections fastened by a group of wood screws.

They are used for connecting load bearing elements, where requirements for mechanical resistance and stability and specific aspects of safety in use (aspects related to the mechanical resistance), in the sense of the Basic Requirements for Construction Works 1 and 4 of Annex I in Regulation (EU) No. 305/2011 (CPR), shall be fulfilled.

The connection with rectangular angle brackets may be with a single angle bracket or with a bracket on each side of the fastened wood member. The inclined angle brackets are fixed on the side of a diagonal structural member that forms an obtuse angle with the continuous structural member.

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural products with a characteristic density between 290 and 420 kg/m^3.

This requirement to the material of the wood members can be fulfilled by using the following materials:

- Solid timber classified to C14-C40 according to EN 338 / EN 14081
- Glued members of timber classified to C14-C40 according to EN 338 / EN 14081 when structural adhesives are used
- Glued laminated timber classified to GL24c or better according to EN 14080
- Solid Wood Panels, SWP according to EN 13353
- Laminated Veneer Lumber LVL according to EN 14374
- Plywood according to EN 636

2.1 Specifications on design of works

In Annex B there are stated the characteristic load-bearing capacities of the Angle Brackets for a characteristic density of wood members 350 kg/m^3 and for fasteners as specified in Annex A. The rectangular angle brackets are intended for loading by uplift force F_1, defined as the lifting force acting parallel to vertical arm of the rectangular bracket.

The inclined angle brackets are intended to be loaded by force F_4 acting paralel with the continuous timber member pressing the inclined arm to the sharp edge of the connected diagonal member.

For timber or wood based material with a lower characteristic density than 350 kg/m^3 the load-bearing capacities shall be reduced by a coefficient k_{dens}.

$k_{dens}=\rho_k/350,$ when the failure is governed by pull out strength of screws or/and contact compression perpendicular to grain.

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

The given characteristic load-bearing capacities are conditioned by the use of fasteners, fastener patterns, support conditions of the connected members and the other conditions as summarized in Annexes A and B.

Namely, it is presumed that no rotation of the connected timber member occurs. The rotation is hindered by other structural links.

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code, such as DIN 1052:2004. The reliability management of design and execution of the timber structure shall comply with the requirements stipulated in Cl. 2.2 of EN 1990.

The minimum thickness of the wood members shall be larger than the penetration depth of the fasteners. Where relevant, possible splitting of the timber member by the tensile force component perpendicular to grain and block shear or plug shear failure shall be assessed.

The intended use of the Angle Brackets is for connections subjected to static or quasi-static loading.

Their inherent corrosion resistance conforms to the use in timber structures subjected to the dry, internal conditions defined by service class 1 and 2 of Eurocode 5.

The angle brackets can also be used in the connections of outdoor timber structures, service class 3, provided these are adequately protected against corrosion as stipulated in Eurocode 5.

2.2 Specifications on installation of the products on site

The following provisions concerning installation apply:

- *Fastener distribution*

  The minimum fastener distribution patterns to be used are specified in Annex B. The fasteners shall comply with the specification in Annex A of this ETA. The other minimum spacing and edge and end distances shall comply with the requirements of the respective Timber Code.

- *Support conditions*

  The members connected by the angle brackets shall be prevented from rotation.

- *Wood members*

  Strength class C14 as a minimum, see above. Free from wane under the angle bracket. Splits, knots and other defects shall be limited such that the load-bearing capacity of the connection is not affected. If single angle bracket per connection is used the members shall have thickness greater than the penetration depth of the fasteners. In case double angle bracket connection is used overlapping of the fasteners shall comply with 8.3.1.1 (7) in EN 1995-1-1:2004/A1.

- *Gap size between members*

  It is supposed the angle bracket is placed in contact with surfaces of the connected members. The gap between connected members does not exceed 3 mm.

- *Contact with preservative-treated timbers*

  If preservative treated timber is used it shall comply with EN 15228. The preservative used shall be compatible with the corrosion protection coating of the connector and fasteners. Note: Protection by zinc coating Z275 is normally considered as sufficient when copper salts or organic substances are used as treatment in service classes 1 and 2.

- *Additional conditions*

  The execution of the connection shall comply with the ETA holder's technical instructions.

2.3 Assumed working life

The assumed working life for the intended use, as foreseen period of time throughout which the construction product, as installed into a construction work, will keep its performances allowing the construction work, behaving under predictable actions and with normal maintenance, to meet the basic requirements for construction works, is 50 years.

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

Basic Requirement for the construction work	EAD: ETAG 015, section:	Essential Characteristic	Performance
Mechanical resistance and stability (BR 1)			For details of assessment procedure refer to section 3.1.1 of this ETA
	2.4.1.2.1	Strength	Refer to Annex B in this ETA
	2.4.1.2.2	Stiffness	*No performance determined*
	2.4.1.2.3	Ductility in cyclic testing	*No performance determined*
Safety in case of fire (BR 2)			
	2.4.2.1	Reaction to fire	The angle brackets are made of steel classified as **Euroclass A1** in accordance with EN 13501-1+A1 and EC Decision 96/603/EC, as amended
	2.4.2.2	Fire resistance	*No performance determined* Fire resistance would be determined for the complete structural element with associated finishes, not for a separate connector. Therefore no performance has been determined.
Hygiene, health and environment (BR 3)			
	2.4.3	Content and/or release of dangerous substances	*No performance determined* – additional assessment is necessary regarding the use category - refer to section 3.1.2 of this ETA
Safety and accessibility in use (BR 4)			*Not relevant* Note: specific aspects of BR 4 related to mechanical resistance are assessed under BR 1
Protection against noise (BR 5)			*Not relevant*
Energy economy and heat retention (BWR 6)			*Not relevant*
Sustainable use of natural resources (BR 7)			*No performance determined* Note: specific aspects of BR 7 – durability and environmental compatibility are assessed under BR 3 and the following General aspects
		General aspects relating to intended use (durability, serviceability and identification)	
	2.4.7	Durability, resistance to corrosion and deterioration	Refer to section 3.1.3 of this ETA
	2.4.8	Dimensional stability	Refer to section 3.1.4 of this ETA
		Serviceability	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 dry internal conditions defined by service class 1 and 2
	5.1, 5.2	Identification of the product	Refer to Annex A in this ETA

3.1 Methods of assessment

3.1.1 Mechanical resistance and stability

For determining the load-bearing capacities of the angle brackets method calculation assisted by testing, as described in the EOTA Guideline 015 clause 2.4.1.1.2, was used.

Numerical values of the characteristic load-bearing capacities as given in Annex B were calculated using the verified calculation model considering characteristic yield strength of steel stated above and the characteristic pull-out and lateral load-bearing capacities (thin steel plate assumed) of the fasteners determined according to Eurocode 5 in conjunction with EN 14592, as amended.

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 stiffness properties of the connections.

3.1.2 Content and/or release of dangerous substances

In case of three-dimensional nailing plates the release scenarios of dangerous substances shall be considered as relevant that correspond to the use categories IA1, IA2 and IA3 according to EOTA TR 034, edition 03/2012, which stand for conditions pertaining to the *Products with direct contact to indoor air*; *Product with no direct contact to (e.g. covered products) but possible impact on indoor air* and *Product with no contact to and no impact on indoor air,* respectively. With zinc coated steel products it is basically the relative content of cadmium (Cd) and lead (Pb) in zinc coating that is a matter of concern depending on the release scenario/use category and the notified regulations relevant for the place of use.

According to the chemical constitution and composition of the materials and components of the product submitted by the ETA-holder to the TAB it is to be stated that coating of primary zinc to EN 1179 or of secondary zinc to EN 13283 may be used regarding the use category, place of the use and the relevant regulatory requirements.

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

It is stated that the ETA holder will meet the requirements for information about dangerous substances when declaring the relative content of lead and cadmium in the zinc coating.

3.1.3 Durability, resistance to corrosion and deterioration

As a minimum, the respective characteristics of the material employed are that of DX51D+Z275, according to EN 10346:2009, thickness being less then 3 mm. This complies with the requirements of ETAG 015 for minimum zinc coating mass in service class 2 which is Z275.

Corrosion protection of the angle brackets complies with service classes 1 and 2.

3.1.4 Dimensional stability

It is stated that there is a negligible risk of a zipper-like failure when row of fasteners goes parallel to the grain.

With rows of fasteners oriented perpendicular to the grain of solid wood or similar wood member situated in service class 1 or 2 with the length of fastener alignment less than 600 mm, which is well complied with in case of the Angle Brackets in question, the risk of the zipper-like failure due to varying moisture content and induced shrinkage and swelling is also negligible.

If in a specific case the conditions for use of an angle bracket might fall beyond the scope specified above the possible effect of moisture induced deformations on uneven distribution of lateral force among fasteners shall be taken into account in the design.

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

According to Decision 97/638/EC of the Commission of 1 October 1997, published in the Official Journal of the European Communities L 268/36 of 1/10/1997, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011, as amended) given in the following table applies.

Product	Intended use	Level or class	System
Three-dimensional nailing plates (with fasteners specified)	For structural timber products	Reaction to fire class and resistance to fire classes according to EN 13501-2	2+

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

5.1 Tasks of the manufacturer

The manufacturer may only use initial and constituent materials stated in the technical documentation of this European Technical Assessment.

The European Technical Assessment is issued for the product on the basis of agreed data, deposited with TZÚS Praha, s. p., which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data being incorrect, shall be notified to TZÚS Praha, s. p., before the changes are introduced. TZÚS Praha, s. p., will decide whether or not such changes affect the assessment.

Apart from marking and performance information of the products as required in EAD, the manufacturer shall provide technical instructions on design and installation of the products in works complying with the conditions stipulated in this ETA. These shall be made available, e. g. in accompanying documents to the products.

5.2 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall ensure that the product is in conformity with this European Technical Assessment.

The factory production control shall be in accordance with the "Control plan for three-dimensional nailing plates, Yancheng Jiahe Hardware Manufacturing Co., Ltd." of 02.03.2015 that is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with TZÚS Praha, s. p.[1]

Issued in Prague on 11.05.2015

signed by

Ing. Mária Schaan

Head of the Technical Assessment Body

[1] The control plan is a confidential part of the European Technical Assessment and only handed over to the notified body or bodies involved in the procedure of Assessment and Verification of Constancy of Performance of the products.

Annex A
Product details and specifications

Table A.1 Dimensions and parent material specification

Connector Code No.	Type dimensions (mm)	Thickness (mm)	Stiffening	Steel specification	Coating specification
ZK 1190	100x100x90	2.5		DX51D	Z275
ZK 1190WZ	105x105x90	2.5	rib	DX51D	Z275
ZK 7755	70x70x55	2.5		DX51D	Z275
ZK 7755WZ	70x70x55	2.5	rib	DX51D	Z275
ZK 9960	90x90x60	2.5		DX51D	Z275
ZK 9965	90x90x65	2.5		DX51D	Z275
ZK 9965 WZ	90x90x65	2.5		DX51D	Z275
ZK 12546	125x125x46	2.5	rib	DX51D	Z275
ZK 12555	125x125x55	2.5	rib	DX51D	Z275
ZK 150150	150x150x60	2.5	rib	DX51D	Z275
ZK 8646	80x60x46	2.5	2 impresses	DX51D	Z275
ZN 5905	90x50x50	2.5	2 impresses	DX51D	Z275
ZN 6906	90x60x60	2.5	2 impresses	DX51D	Z275
ZS 70	70x70x55	2.5		DX51D	Z275
ZS 90	90x90x65	2.5		DX51D	Z275
ZS 994	90x90x40	2.5		DX51D	Z275
ZS 105	105x105x90	2.5		DX51D	Z275

Table A.2 Tolerances

Connector	Height vertical or inclined (mm)	Length horizontal (mm)	Width (mm)	Hole position and spacing (mm)	Hole diameter (mm)
All types	-1/+2	-1/+2	-1/+2	±1	±0.2

Table A.3 Fastener specification

Fastener type	Fastener size (mm)		Minimum characteristic withdrawal capacity [1)] (N)	Finish
wood screw	Diameter	Length		
self-drilling with cut for pre-drilling effect	4.0	50	1560	Zinc-coated
self-drilling with cut for pre-drilling effect	4.5	70	2320	Zinc-coated

Note: [1)] For a single screw and characteristic density of wood 350 kg/m^3

As for an example the fasteners considered are construction screws of the following manufacturer:
Hašpl a. s., Ke koupališti 172, 549 32 Velké Poříčí, Czech Republic

Performances of the screws are attested in the Report on assessing the performance of construction product No. 30-1010219/1 and /2 from 27.06.2014, issued by Notified Body No. 1015 – Strojírenský zkušební ústav, s. p., Hudcova 424/56b, 621 00 Brno, Czech Republic, to EN 14592:2008+A1:2012

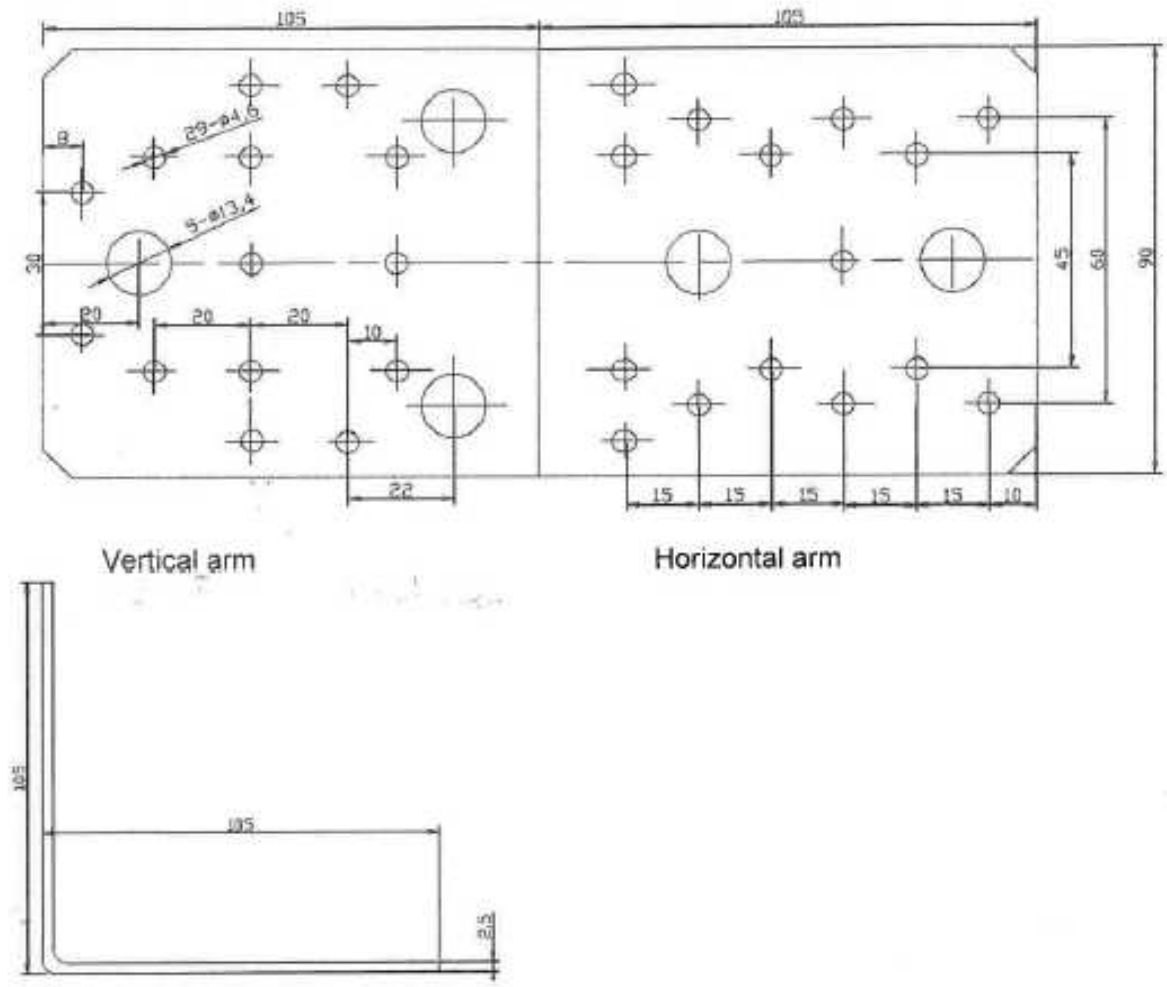
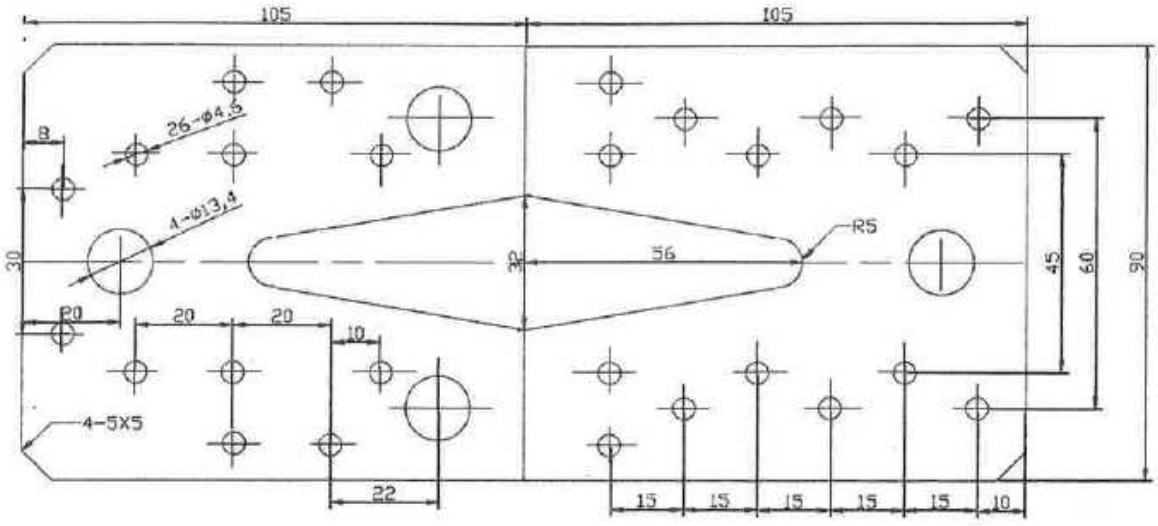


Fig. A.1 ZK 1190



Vertical arm

Horizontal arm

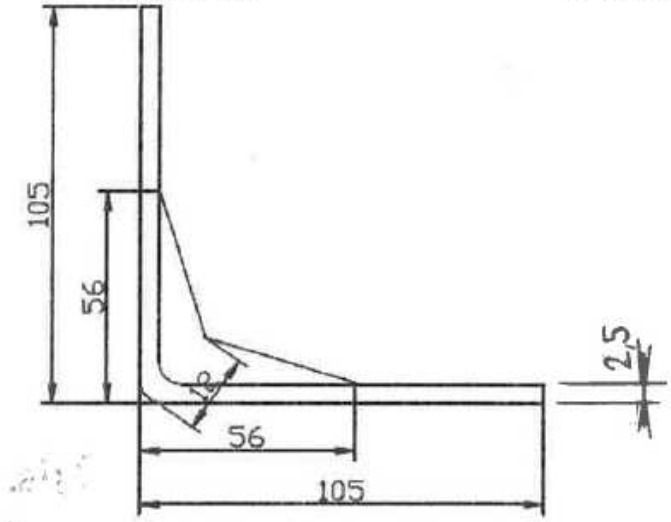


Fig. A.2 ZK 1190WZ

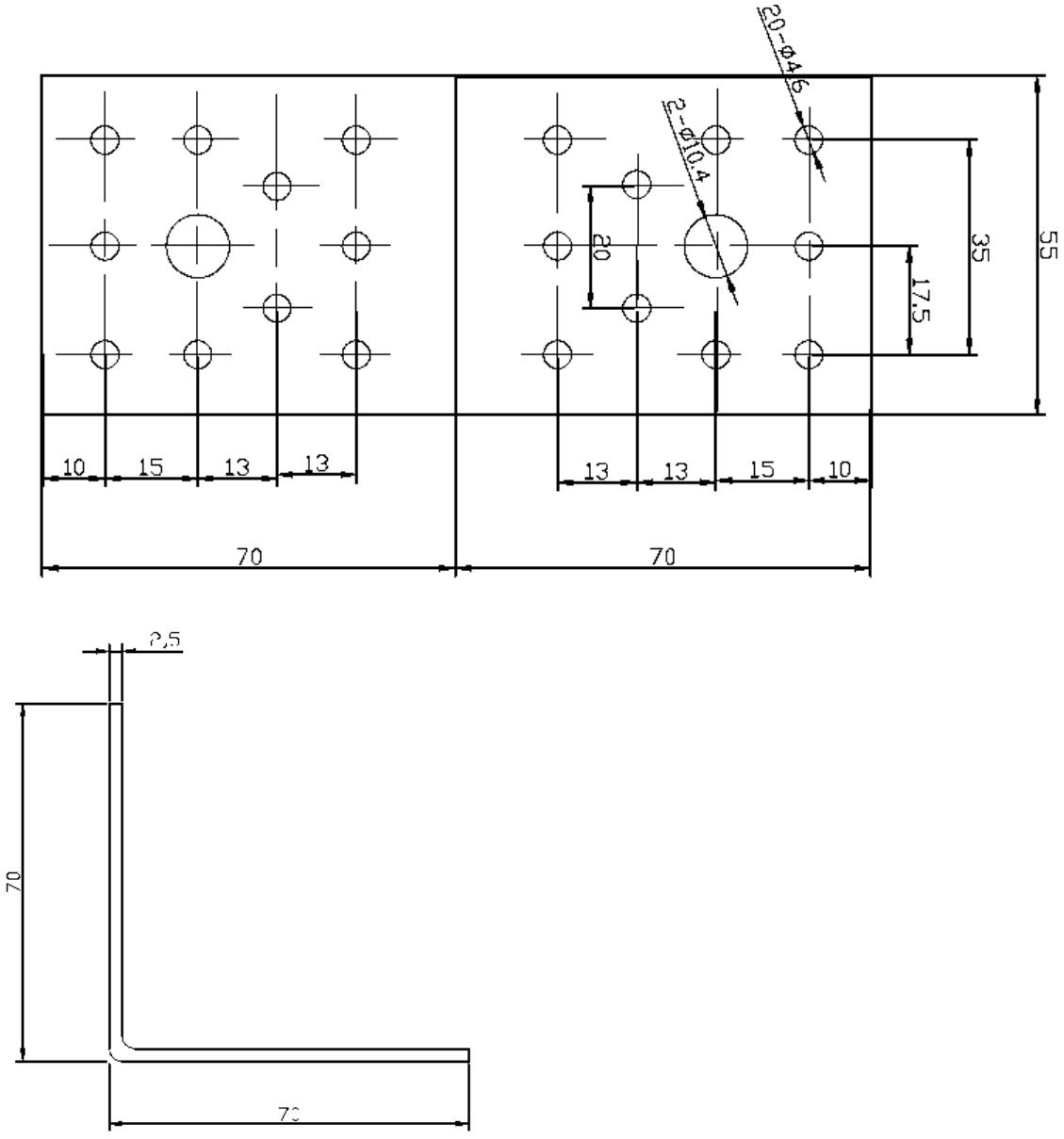


Fig. A.3 ZK 7755

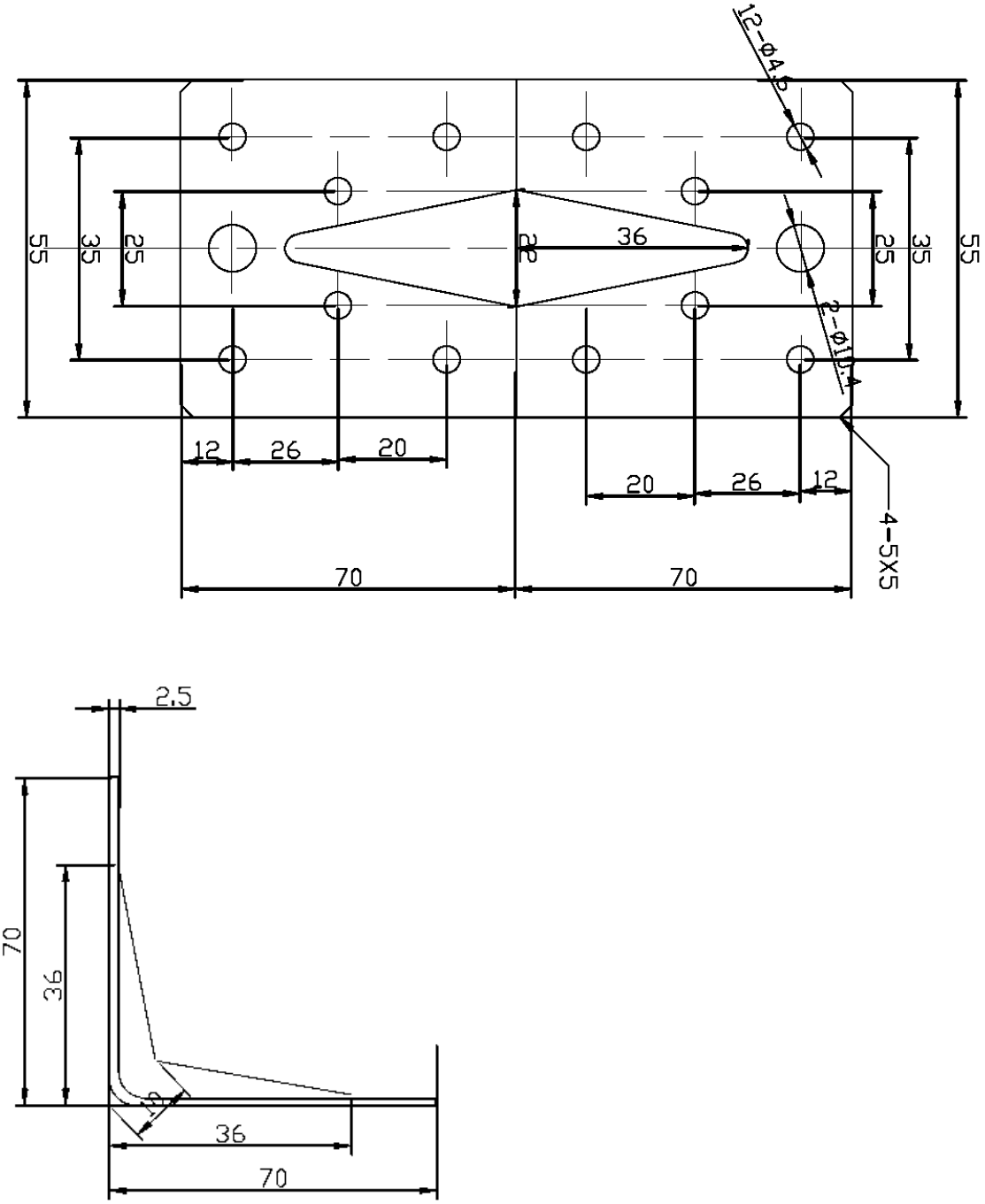
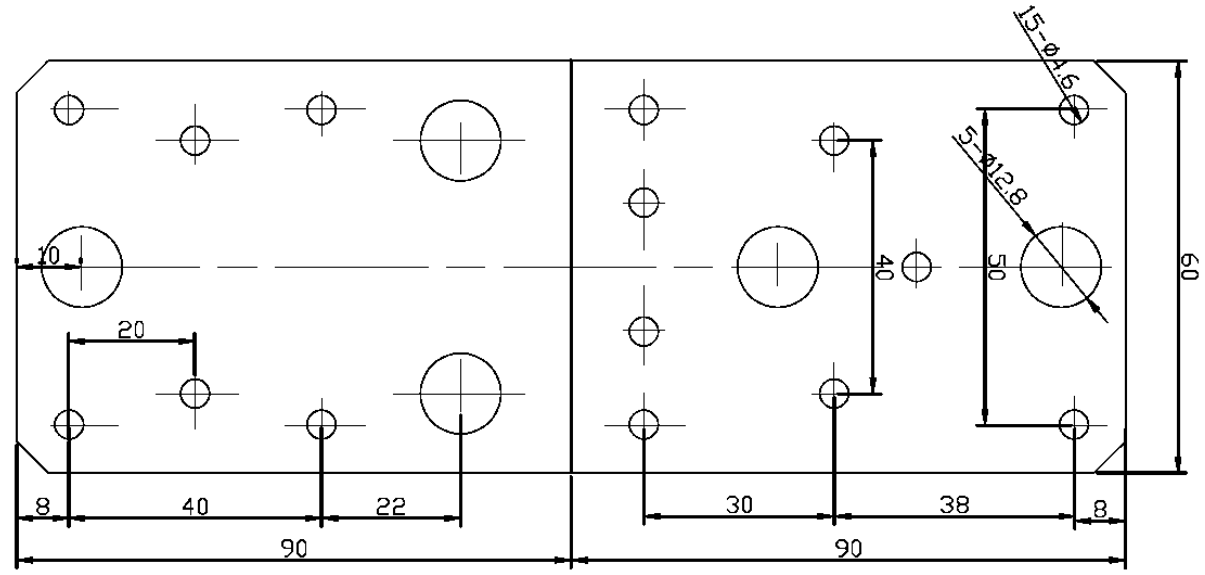


Fig. A.4 ZK 7755WZ



Vertical arm Horizontal arm

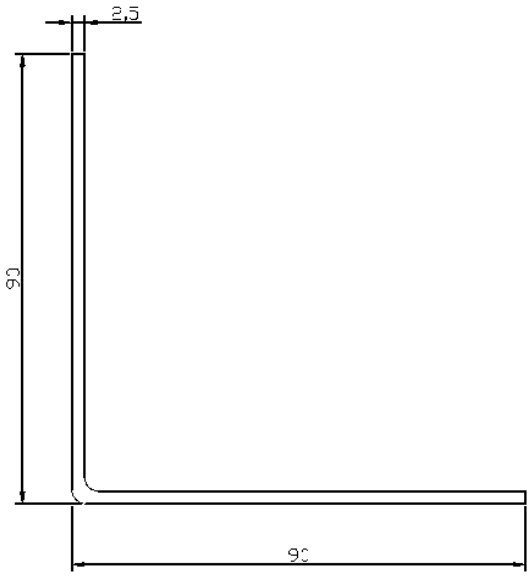
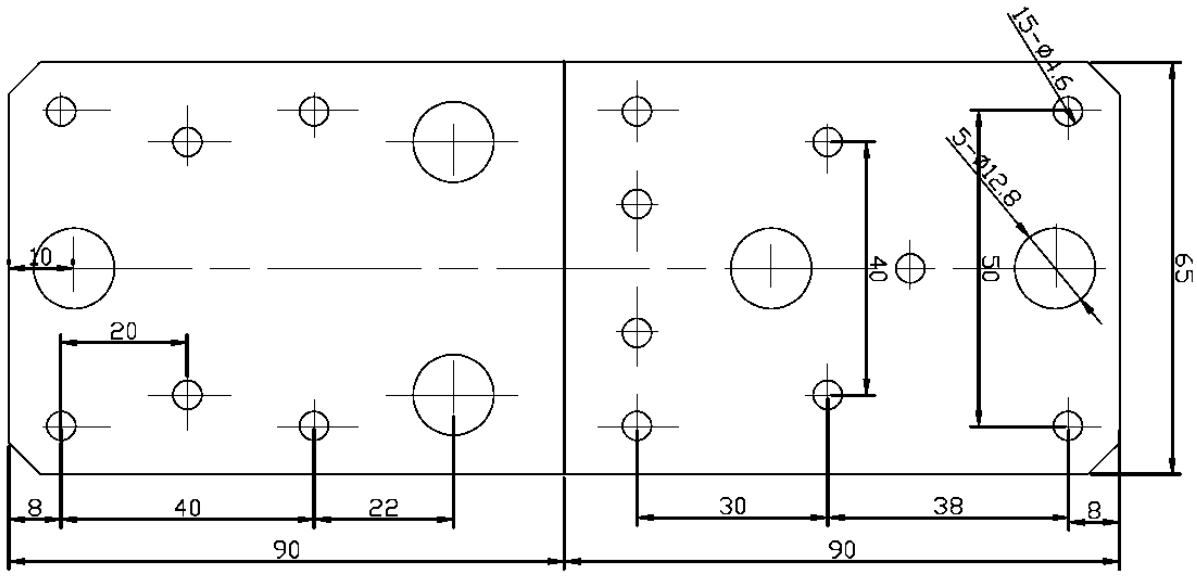


Fig. A.5 ZK 9960



Vertical arm Horizontal arm

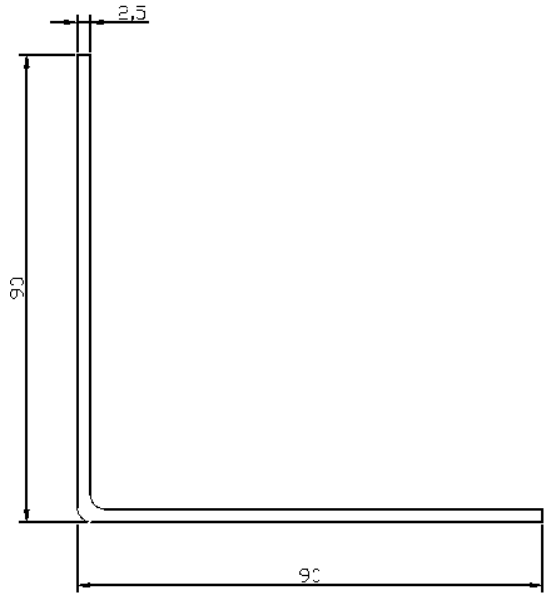
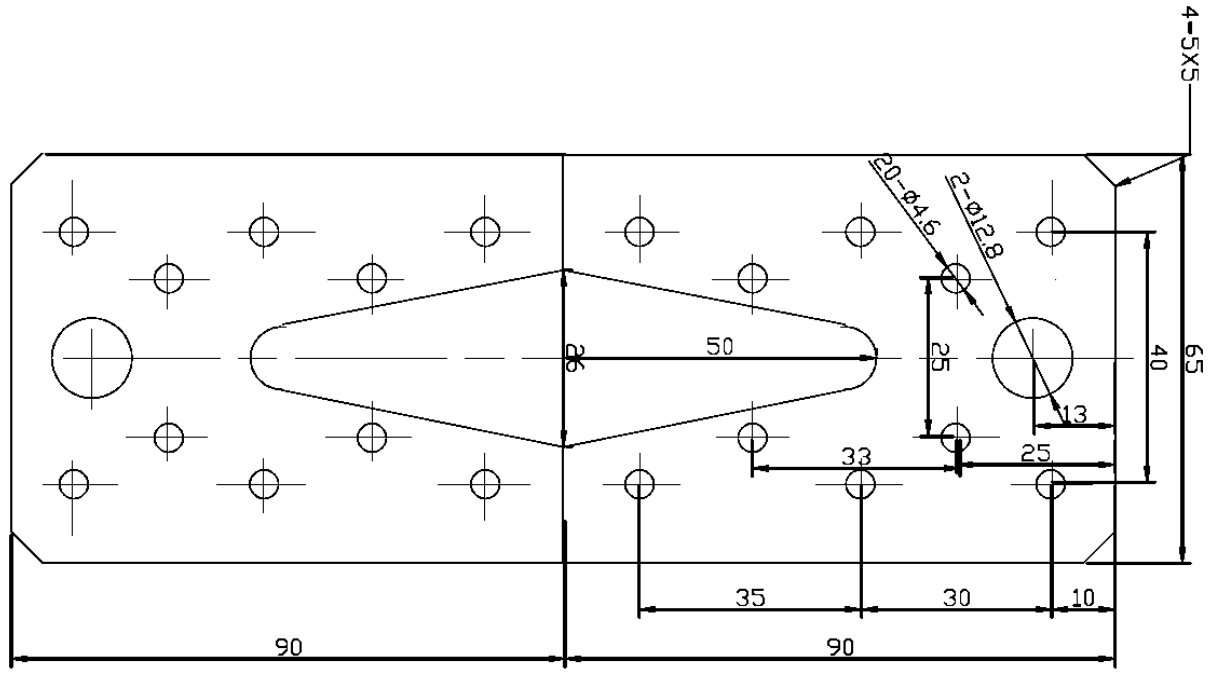


Fig. A.6 ZK 9965



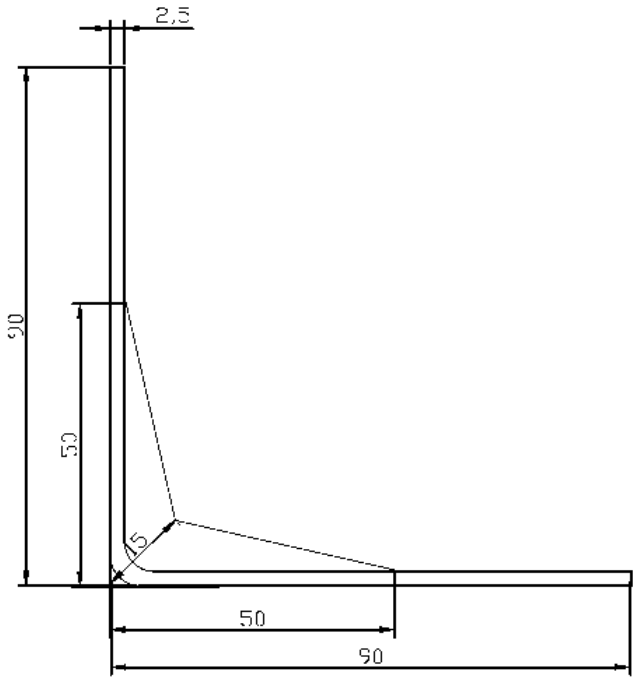


Fig. A.7 ZK 9965WZ

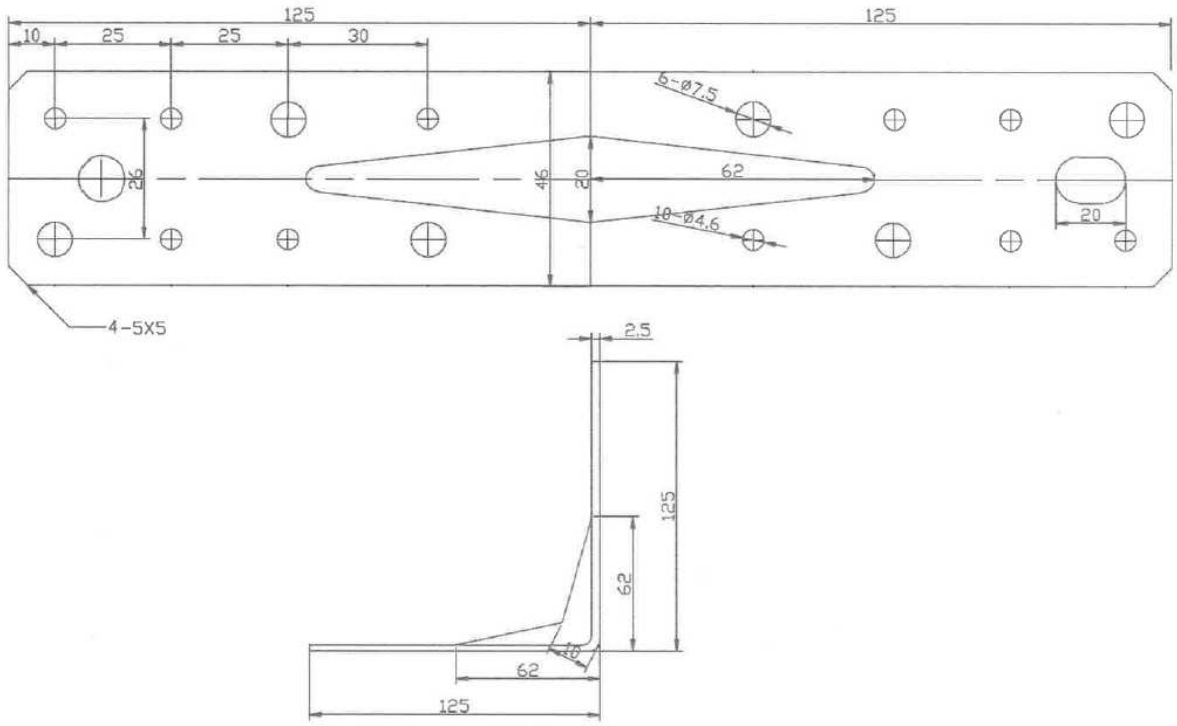


Fig. A.8 ZK 12546

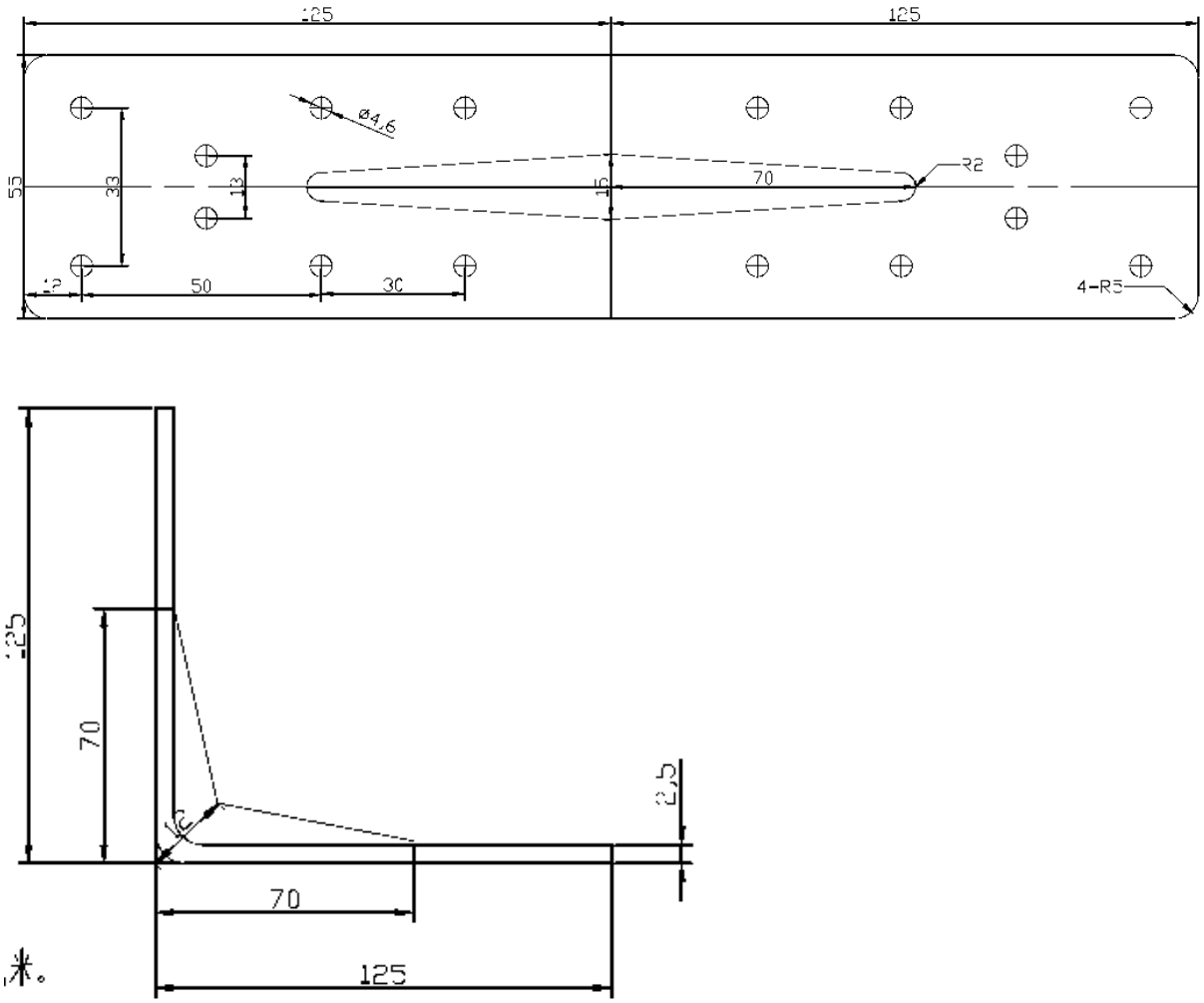


Fig. A.9 ZK 12555

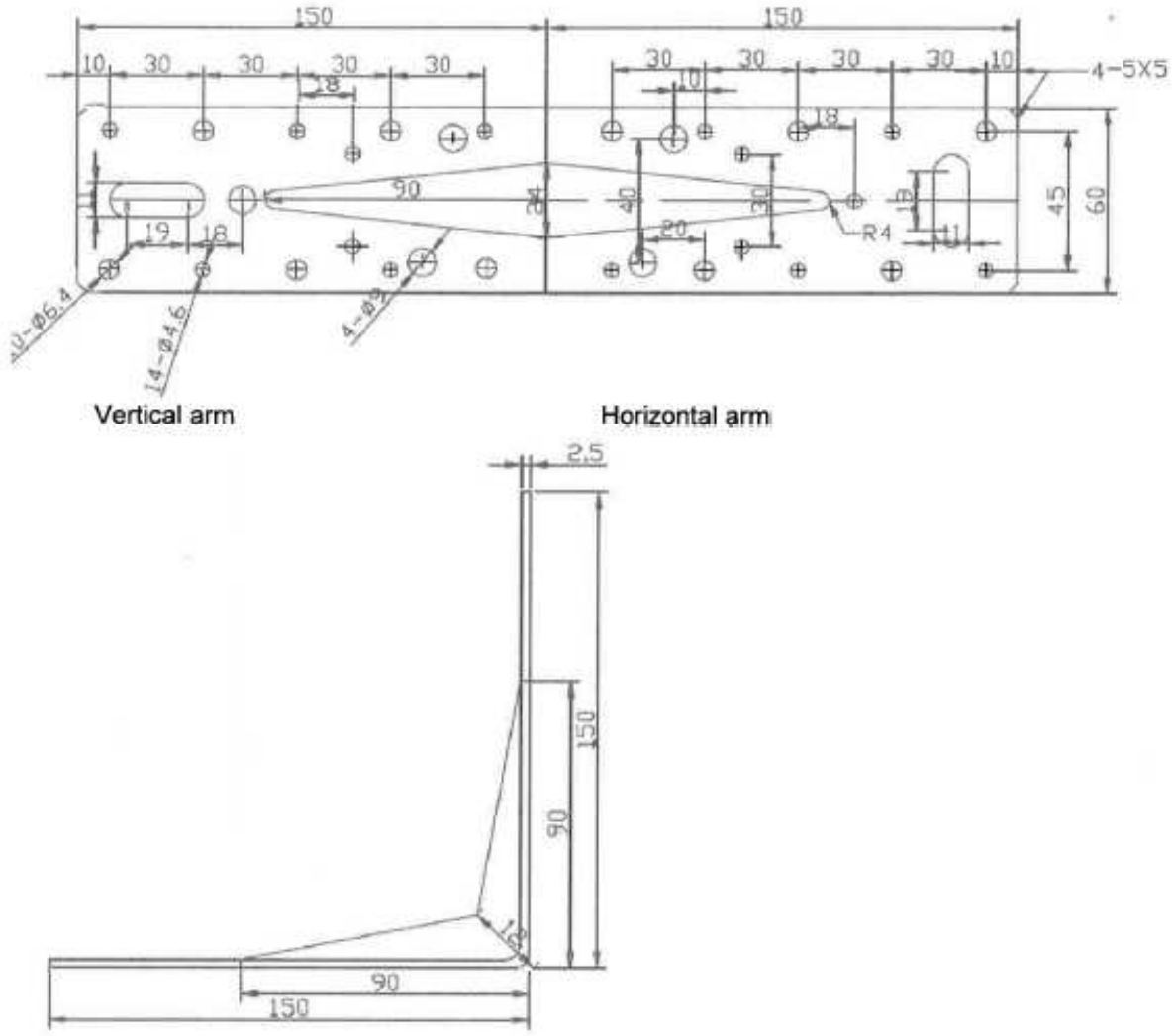
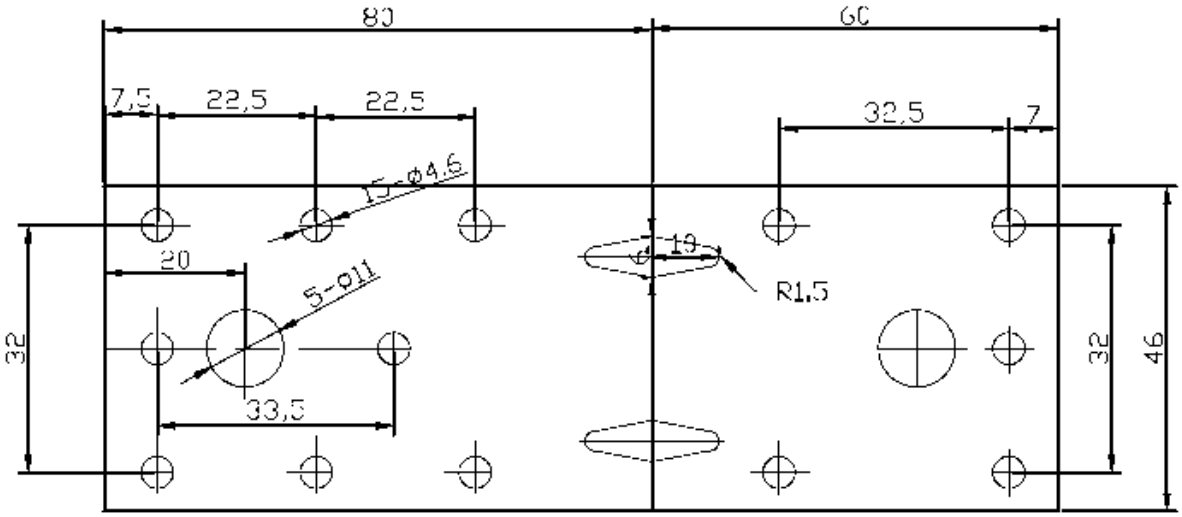


Fig. A.10 ZK 150150



Vertical arm Horizontal arm

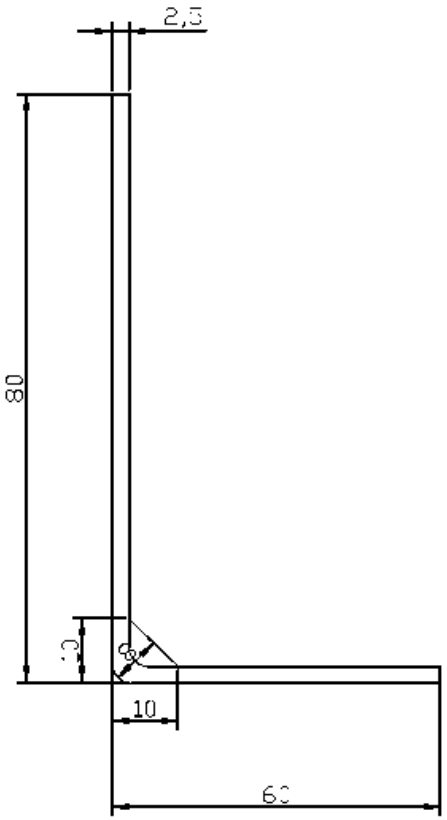
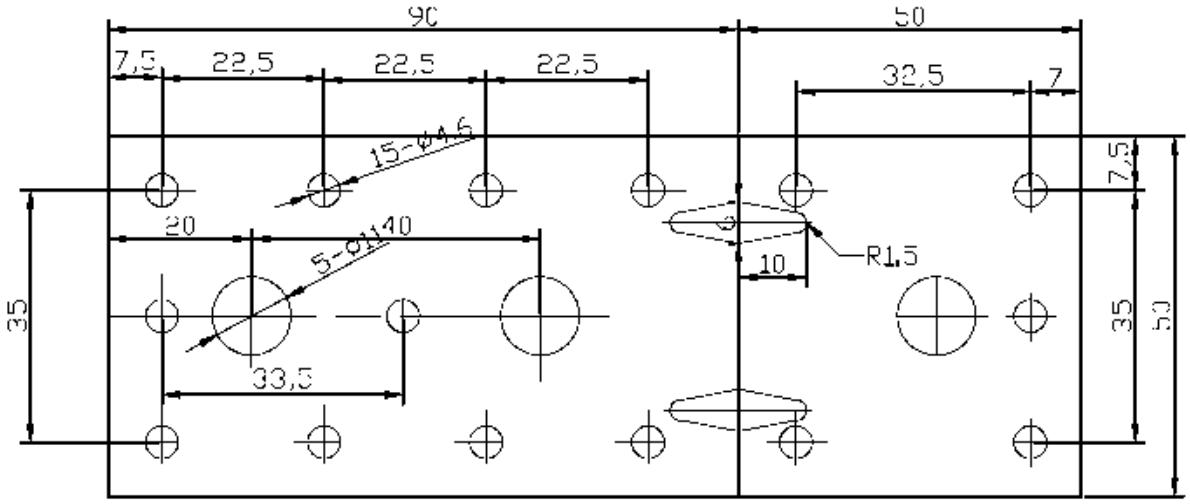


Fig. A.11 ZK 8646



Vertical arm Horizontal arm

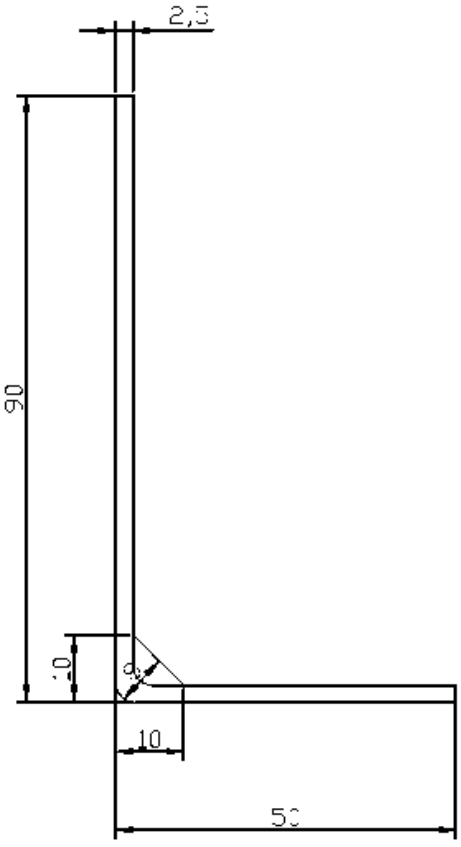
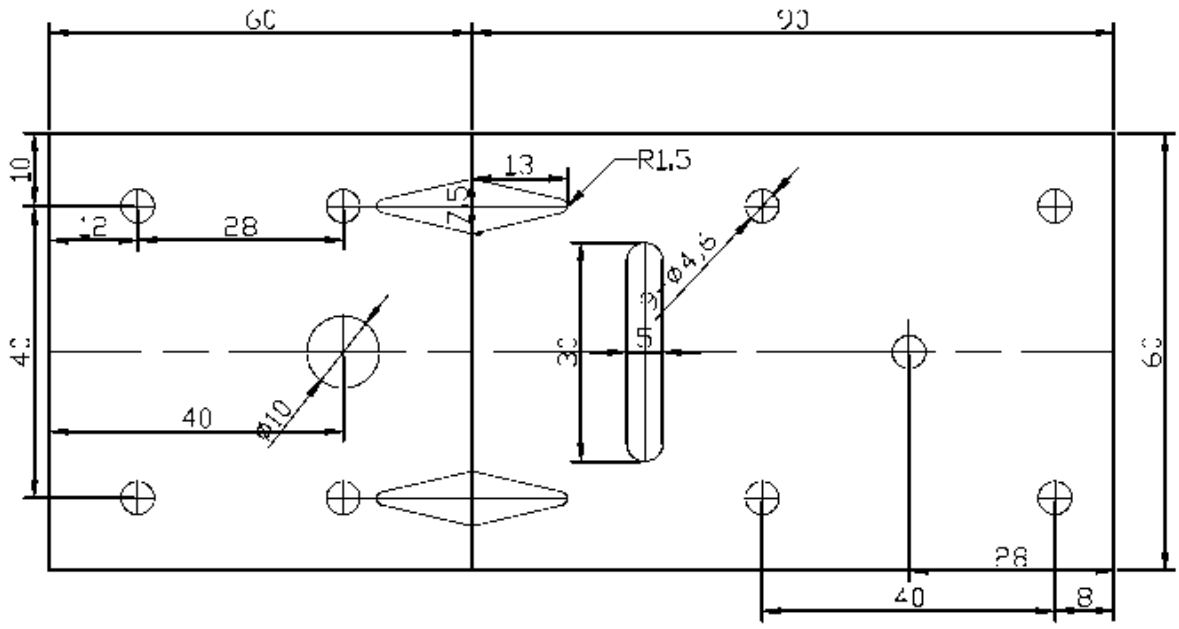


Fig. A.12 ZN 5905



Horizontal arm

Vertical arm

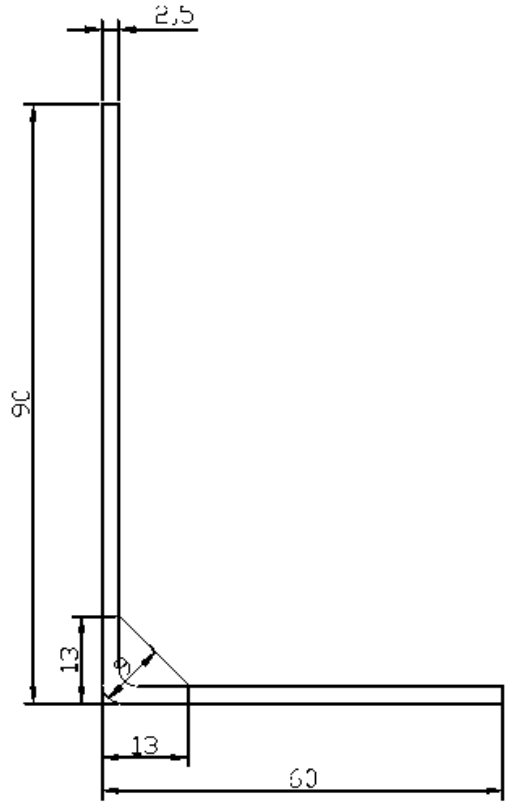


Fig. A.13 ZN 6906

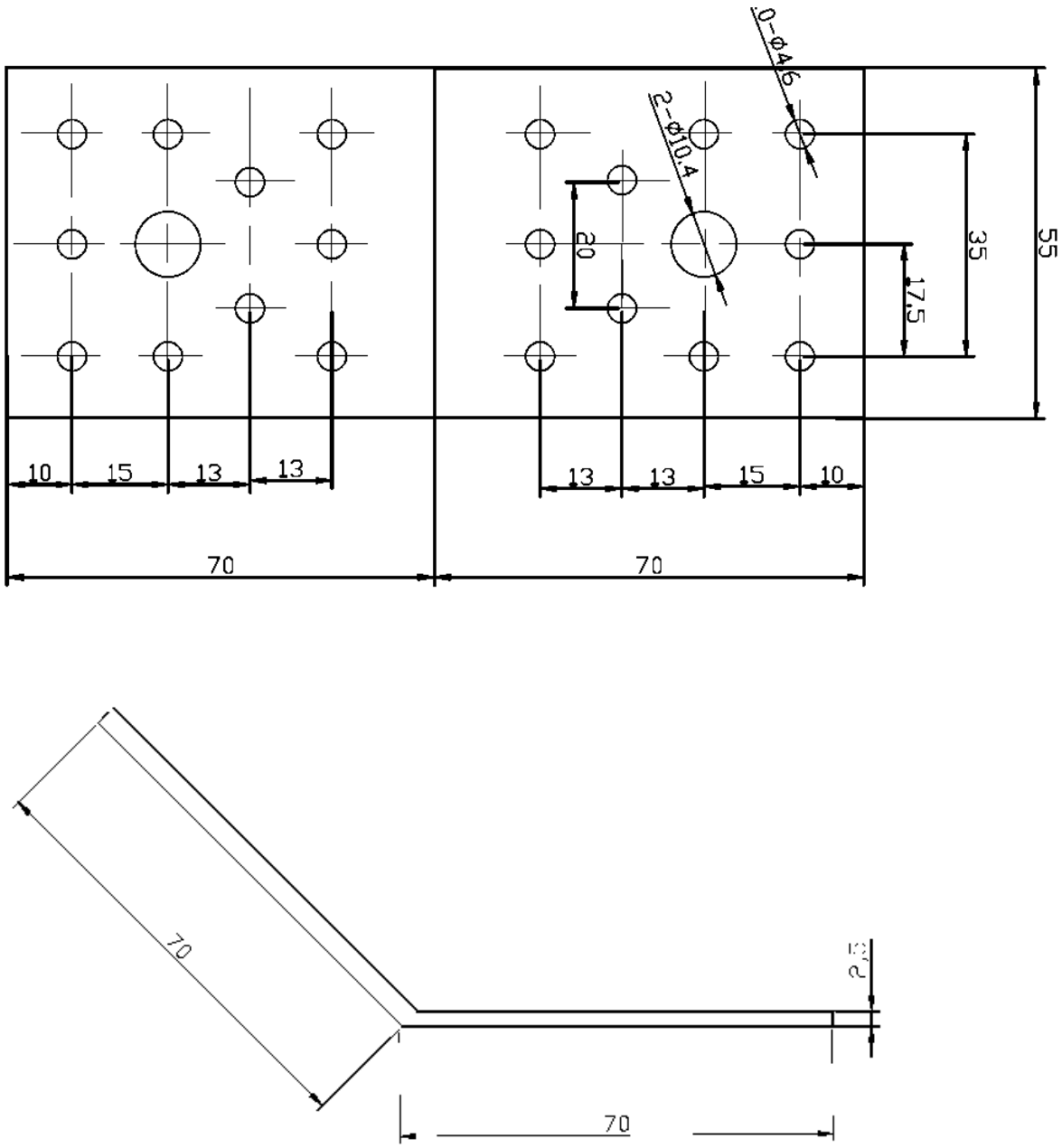


Fig. A.14 ZS 70

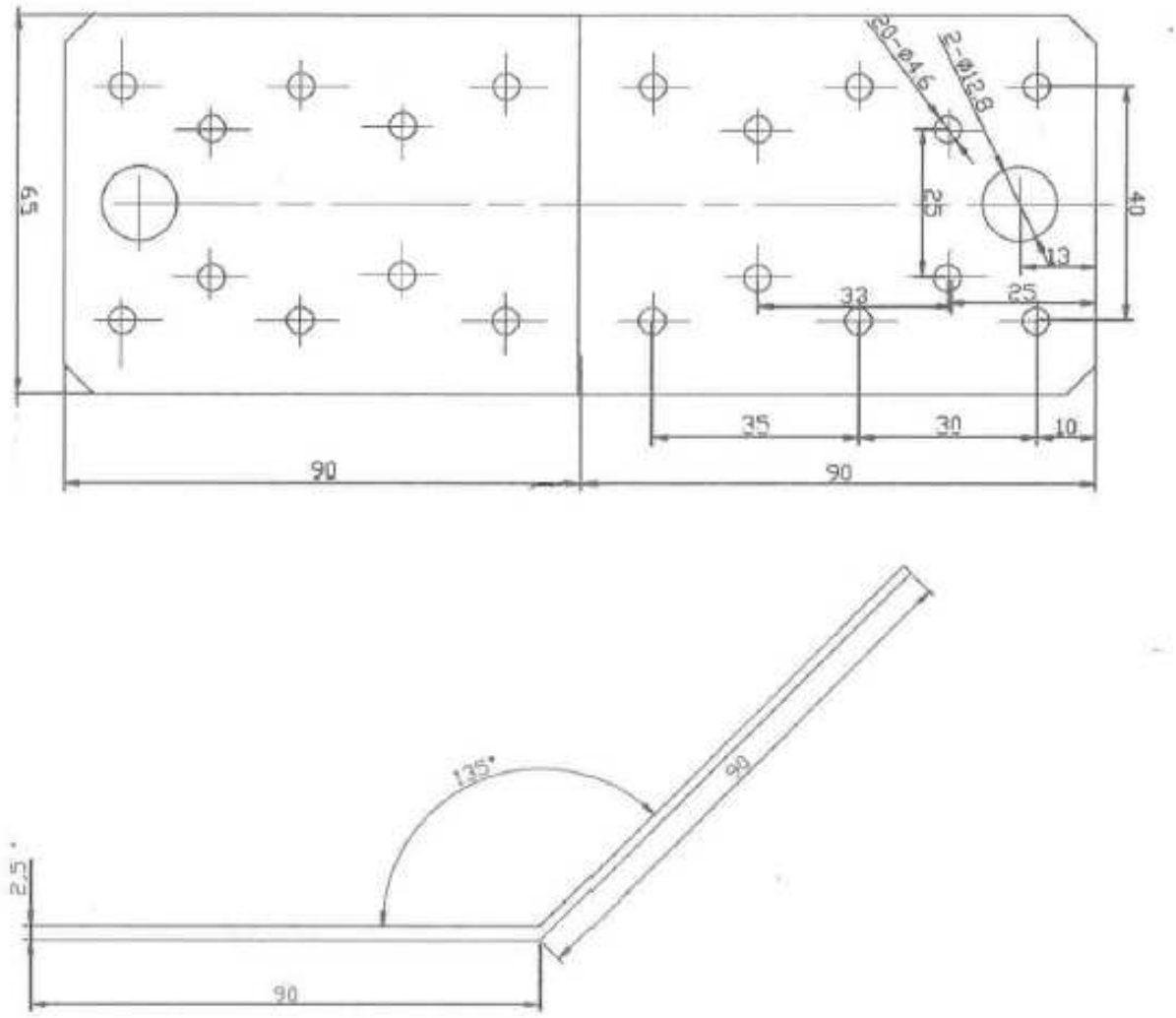


Fig. A.15 ZS 90

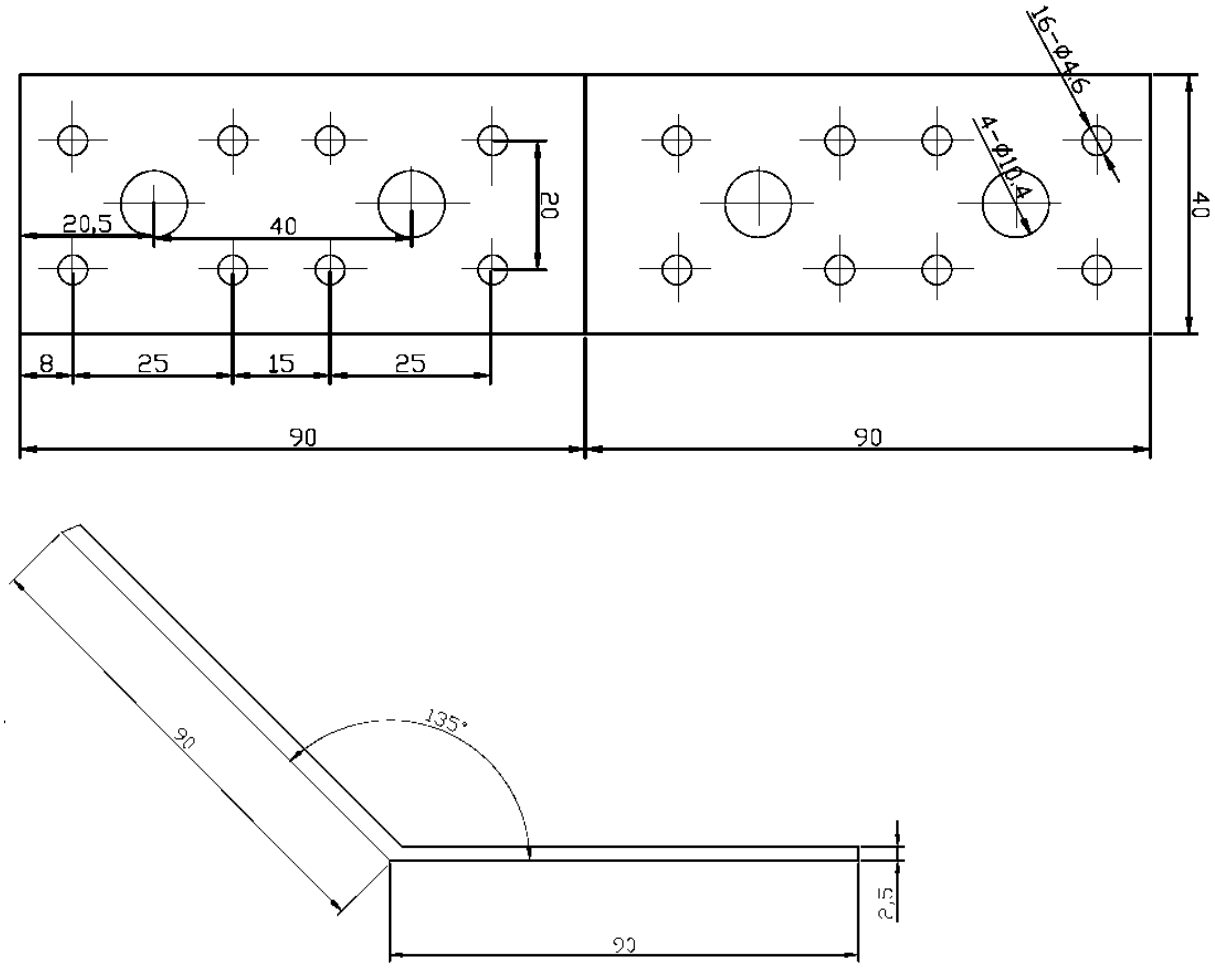


Fig. A.16 ZS 994

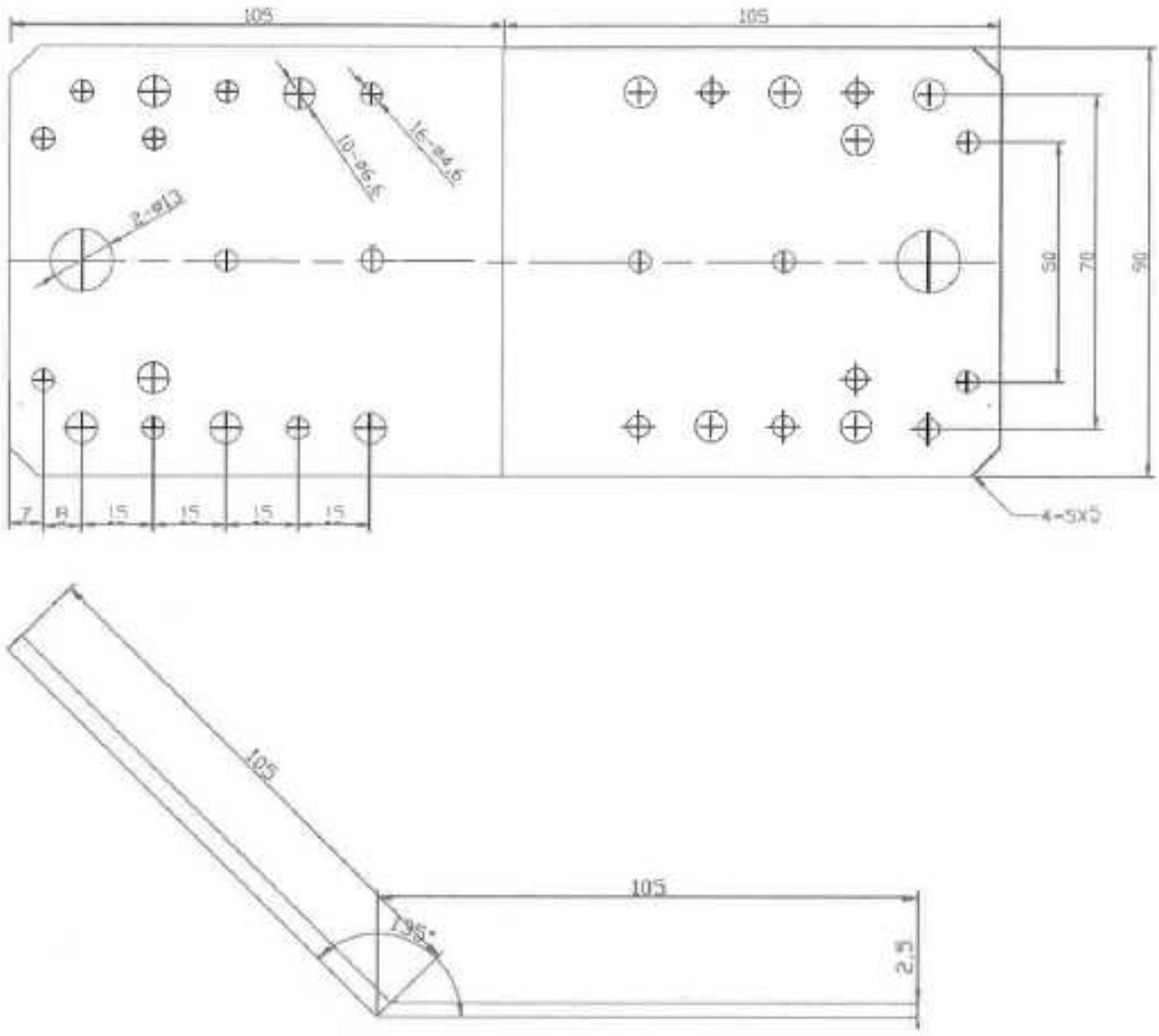


Fig. A.17 ZS 105

Annex B

Load-bearing capacities of the Angle Brackets

Values of maximum characteristic load-bearing capacities stated in Tables B.1 and B.2 for uplift force F_1, as depicted in Fig. B.1, and shear force F_4, as depicted in Fig. B.2, respectively, are given for one bracket and for the characteristic density of wood members of 350 kg/m^3. They are valid on condition that:

- the brackets are affixed by fastener types specified in Annex A with minimum numbers and distribution as determined in the tables
- there is no wane in the region of the connection and splits, knots or other defects are limited so as the capacity is not reduced
- the connected wood member is prevented from rotation by other structural links
- the possibility of splitting the wood member and block or plug shear shall be checked, see 8.1.4 and Annex A in EN 1995-1-1
- the possibility of dimensional instability of the wood member shall be taken into account where relevant, refer to clause 3.1.4 of this ETA
- the other instructions regarding design and installation as stipulated in Cl. 2.1 and 2.2 of this ETA are followed.

Table B.1 Angle Brackets 90º, distribution of fasteners and characteristic capacities for the uplift force

Connector Code No	Screws	Distribution[2] of screws, from the angle[3]		characteristic capacity $F_{1,Rk}$ (N)
		horizontal arm	vertical arm	
ZK 1190	50 x 4.0	4 2 0 2 0 0 2	0 3 2 0 2 0 0	4860
ZK 1190WZ	50 x 4.0	4 2 2 0 0 0 2	0 2 2 4 2 0 0	7900
ZK 7755	50 x 4.0	3 0 0 2 0 0 0	0 2 2 1 0 0 0	3000
ZK 7755WZ	50 x 4.0	2 2 2 0 0 0 0	0 2 2 0 0 0 0	4280
ZK 9960	50 x 4.0	4 0 2 0 2 0 0	0 2 2 2 0 0 0	3600
ZK 9965	50 x 4.0	4 0 2 0 2 0 0	0 2 2 2 0 0 0	3800
ZK 9965 WZ	50 x 4.0	2 2 2 0 0 2 0	0 2 2 2 0 0 0	5470
ZK 12546	70 x 4.5[4]	1 1 0 0 1 0 0	1 1 0 0 1 0 0	2400
ZK 12555	50 x 4.0	2 2 0 2 0 0 0	2 2 0 2 0 0 0	2940
ZK 150150	50 x 4.0	2 0 0 2 0 2 0 0 0 2	2 0 0 2 0 2 0 0 0 0	3960
ZK 8646	50 x 4.0	2 0 2 0 0 0 0	2 0 2 0 0 0 0	2460
ZN 5905	50 x 4.0	2 0 2 0 0 0 0	0 0 2 0 2 0 0	2870
ZN 6906	50 x 4.0	2 2 0 0 0 0 0	0 2 1 0 0 0 0	2260

Notes: [2] In the Table there is determined the minimum number of fasteners to be used for development of the stated capacity. Adding more fasteners does not increase the maximum capacity to be attained. Nevertheless, the post-critical behaviour of the connection might be positively influenced.

[3] For example of coding the fastener distribution refer to Fig. B.3.

[4] Fasteners 70 x 4.5 are in the holes ø 7.5 mm distributed in zigzag manner.

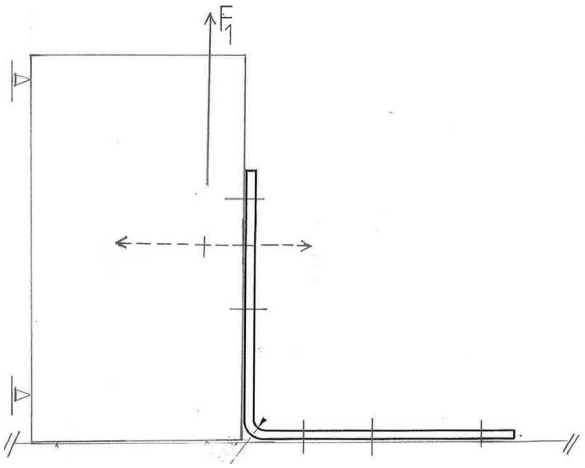


Fig. B.1 Angle brackets 90º. Definition of force F_1

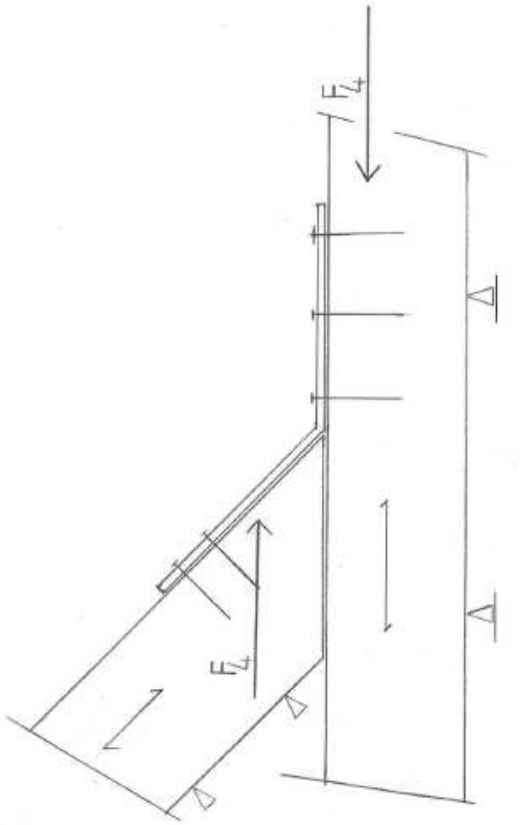
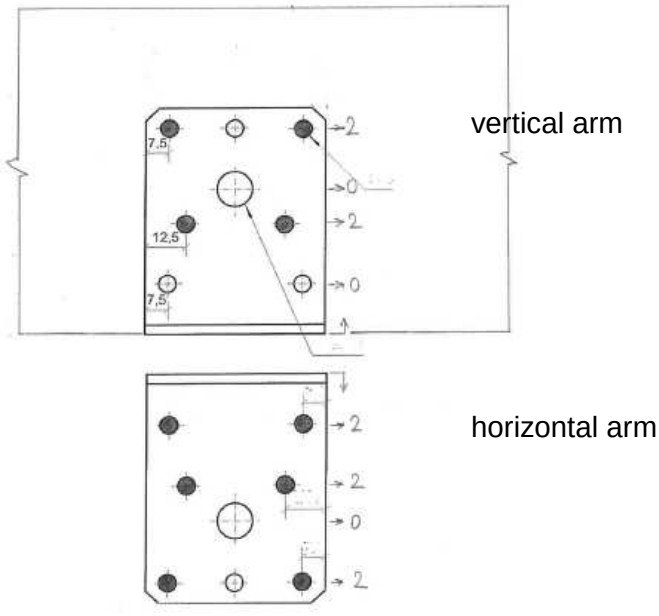


Fig. B.2 Angle brackets 135º. Definition of force F_4



vertical arm

horizontal arm

coding: 2 2 0 2 | 0 2 0 2

Fig. B.3 Example of coding the fasteners distribution

Table B.2 Angle Brackets 135º, distribution of fasteners and characteristic capacities for the uplift force

Connector Code No	Screws	Distribution[2)] of screws, from the angle[3)]		characteristic capacity $F_{4,Rk}$ (N)
		inclined arm	vertical arm	
ZS 70	50 x 4.0	0 0 0 3 0 0 0	3 0 2 1 0 0 0	5520
ZS 90	50 x 4.0	0 0 0 2 0 2 0	2 0 2 0 0 2 0	6730
ZS 994	50 x 4.0	0 0 0 2 0 2 0	2 0 1 1 0 2 0	4000
ZS 105	50 x 4.0	0 0 0 2 0 2 0	2 1 2 2 1 2 0	9290

Notes: [2)] In the Table there is determined the minimum number of fasteners to be used for development of the stated capacity. Adding more fasteners does not increase the maximum capacity to be attained. Nevertheless, the post-critical behaviour of the connection might be positively influenced.

[3)] For example of coding the fastener distribution refer to Fig. B.3. Positions of inclined and vertical arm are as indicated in Fig. B.2.

Design values of the load-bearing capacity of a connection

To obtain design values the characteristic capacities have to be divided by the respective partial factors for the material properties. Moreover, since load bearing capacities are governed by wood failure as is normally the case of fasteners, the coefficient k_{mod} depending on the load duration class and service class shall apply.

$$F_{1,Rd} = k_{mod} \cdot F_{1,Rk} / \gamma_M \qquad (B.1)$$

- For design value the relation (B.1) applies with values $\gamma_M = 1.3$ and k_{mod} depending on the load duration and moisture content, refer to EN 1995-1-1.
- For timber or wood based material with the characteristic density ρ_k lower than 350 kg/m^3 the load-bearing capacities shall be moreover reduced by coefficient $k_{dens}=\rho_k/350$.