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

Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

MEMBER OF EOTA

European Technical Approval ETA-08/0214

Trade name:	Angle Bracket KR 95 Angle Bracket KR 135 Angle Bracket KR 285
Holder of approval:	BB Stanz- und Umformtechnik Nordhäuser Str. 42 D-06536 Berga Tel. +49 34651 2988 0 Fax +49 34651 2988 20 Internet www.bb-berga.de
Generic type and use of construction product:	Three-dimensional nailing plate (angle bracket for wood to wood connections and timber-to-steel connections)
Valid from: to:	2008-09-18 2013-09-18
Manufacturing plant:	BB Stanz- und Umformtechnik Nordhäuser Str. 42 D-06536 Berga
This European Technical Approval contains:	18 pages including 2 annexes which form an integral part of the document

I LEGAL BASIS AND GENERAL CONDITIONS

1 This European Technical Approval is issued by ETA-Danmark A/S in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1)], as amended by Council Directive 93/68/EEC of 22 July 1993[2)].

- Bekendtgørelse 559 af 27-06-1994 (afløser bekendtgørelse 480 af 25-06-1991) om ikrafttræden af EF direktiv af 21. december 1988 om indbyrdes tilnærmelse af medlemsstaternes love og administrative bestemmelser om byggevarer.

- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[3)].

- EOTA Guideline ETAG 015 *Three-dimensional nailing plates,* September 2002 edition.

2 ETA-Danmark A/S is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by ETA-Danmark A/S pursuant to Article 5(1) of Council Directive89/106/EEC.

5 Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of ETA-Danmark A/S. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6 This European Technical Approval is issued by ETA-Danmark A/S in English.
This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1) Official Journal of the European Communities N° L40, 11 Feb 1989, p 12.
2) Official Journal of the European Communities N° L220, 30 Aug 1993, p 1.
3) Official Journal of the European Communities N° L 17, 20 Jan 1994, p 34.

I SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

Definition of the product
Angle Brackets Type KR 95, 135 and 285 are one-piece non-welded, face-fixed angle brackets to be used in timber to concrete and timber to steel connections. They are connected to the timber elements by ringed shank nails and to the concrete and steel elements by bolts.

The angle brackets are made from steel DD 11 according to EN 10111:1998. Dimensions and hole are shown in Annex A. The angle brackets are made from steel with tolerances according to EN 10143.

Intended use
The angle brackets are intended for use in making connections in load bearing structures, as a connection between a timber component and a concrete or steel component, where requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106/EEC shall be fulfilled.

The connection may be with a single angle bracket or with an angle bracket on each side of the fastened timber member (see Annex B).

The static and kinematic behaviour of the timber members or the supports shall be as described in Annex B.

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a characteristic density from 290 kg/m^3 to 420 kg/m^3. This requirement to the material of the wood members can be fulfilled by using the following materials:

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

Annex B states the characteristic values of the load-carrying capacities of the angle bracket connections for a characteristic density of 350 kg/m^3. For timber or wood based material with a lower characteristic density than 350 kg/m^3 the load-carrying capacities shall be reduced by the k_{dens} factor:

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

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

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code. The wood members shall have a thickness which is larger than the penetration depth of the nails into the members.

The angle brackets are primarily for use in timber structures subject to the dry, internal conditions defined by service class 1 and 2 of Eurocode 5 and for connections subject to static or quasi-static loading.

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

Assumed working life
The assumed intended working life of the angle brackets for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

The information on the working life should not be regarded as a guarantee provided by the manufacturer or ETA Danmark. An "assumed intended working life" means that it is expected that, when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

2 Characteristics of product and assessment

ETAG paragraph	Characteristic		Assessment of characteristic
	2.1	**Mechanical resistance and stability*)**	
6.1.1		Characteristic load-carrying capacity	See Annex B
6.1.2		Stiffness	No performance determined
6.1.3		Ductility in cyclic testing	No performance determined
	2.2	**Safety in case of fire**	
6.2.1		Reaction to fire	The angle brackets are made from steel classified as **Euroclass A1** in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
	2.3	**Hygiene, health and the environment**	
6.3.1		Influence on air quality	No dangerous materials **)
	2.4	**Safety in use**	Not relevant
	2.5	**Protection against noise**	Not relevant
	2.6	**Energy economy and heat retention**	Not relevant
	2.7	**Related aspects of serviceability**	
6.7.1		Durability	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
6.7.2		Serviceability	
6.7.3		Identification	See Annex A

*) See page 5 of this ETA

**) In accordance with http://europa.eu.int-/comm/enterprise/construction/internal/dangsub/dangmain.htm In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, 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 EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Safety principles and partial factors

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

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity can be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Thus, the characteristic values of the load–carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of nails subjected to shear or the withdrawal capacity of the most loaded nail, respectively) as well as for steel plate failure $F_{Rk,S}$. The design value of the load–carrying capacity is the smaller value of both load–carrying capacities.

$$F_{Rd} = \min\left\{\frac{k_{mod} \cdot F_{Rk,H}}{\gamma_{M,H}}; \frac{F_{Rk,S}}{\gamma_{M,S}}\right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber, respectively, are also correctly taken into account.

2.1 Mechanical resistance and stability

See annex B for the characteristic load-carrying capacity in the different directions F_1 to F_7.

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 prEN 14592
In the formulas in Annex B the capacities for threaded nails calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral nail load-carrying-capacity.

The load bearing capacities of the brackets has been determined based on the use of connector nails 4,0 x 40 mm in accordance with the German national approval for the nails.

The characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1: 2004, paragraph 8.3.2 (head pull-through is not relevant):

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

Where:

$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2
d Nail diameter in mm
t_{pen} Penetration depth of the profiles shank in mm $t_{pen} \geq$ 30 mm

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

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

Where:

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

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

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.

2.7 Related aspects of serviceability

2.7.1 Corrosion protection in service class 1 and 2.
In accordance with ETAG 015 the angle brackets are made from steel DD 11 according to EN 10111:1998 + Z 275 according to EN 10327:2004

3 Attestation of Conformity and CE marking

3.1 Attestation of Conformity system

The system of attestation of conformity is 2+ described in Council Directive 89/106/EEC (Construction Products Directive) Annex III.

a) Tasks for the manufacturer:

(1) Factory production control,
(2) Initial type testing of the product,

b) Tasks for the notified body:

(1) Initial inspection of the factory and the factory production control,
(2) Continuous surveillance

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan[4]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of materials, such as sheet metal, shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. chemical composition, mechanical properties and zinc coating thickness.

The manufactured components are checked visually and for dimensions.

The control plan, which is part of the technical documentation of this European Technical Approval, includes details of the extent, nature and frequency of testing and controls to be performed within the factory production control and has been agreed between the approval holder and ETA Danmark.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- Designation of the product, basic material and components;
- Type of control or testing;
- Date of manufacture of the product and date of testing of the product or basic material and components;
- Result of control and testing and, if appropriate, comparison with requirements;
- Signature of person responsible for factory production control.

The records shall be presented to ETA Danmark on request.

3.2.1.1 Initial type testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type testing has to be agreed between ETA Danmark and the notified body.

3.2.2. Tasks of notified bodies

3.2.2.1 Initial inspection of the factory and the factory production control

The approved body should ascertain that, in accordance with the control plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the angle brackets with the specifications given in part 2.

3.2.2.2 Continuous surveillance

The approved body shall visit the factory at least twice a year for routine inspections. It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the control plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body to ETA Danmark. Where the provisions of the European Technical Approval and the control plan are no longer fulfilled, the certificate

4 The control plan has been deposited at ETA-Danmark and is only made available to the approved bodies involved in the conformity attestation procedure.

of conformity shall be withdrawn by the approved body.

3.3 CE marking

The CE marking shall be affixed on each packaging of angle brackets. The initials "CE" shall be followed by the identification number of the notified body and shall be accompanied by the following information:

- Name or identifying mark of the manufacturer
- The last two digits of the year in which the marking was affixed
- Number of the European Technical Approval
- Name and size of product
- Number of the ETA Guideline (ETAG no. 015)
- Number of the EC Certificate of Conformity

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

BB angle brackets KR are manufactured in accordance with the provisions of this European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

4.2 Installation

The nailing pattern used shall be either the maximum or the minimum pattern as defined in Annex A.

The following provisions concerning installation apply:

The structural members – the components 1 and 2 shown in the figure on page 32 - to which the brackets are fixed shall be:

- Restrained against rotation.
- Strength class C14 or better, see section 1 of this ETA
- Free from wane under the bracket.
- The actual end bearing capacity of the timber member to be used in conjunction with the bracket is checked by the designer of the structure to ensure it is not less than the bracket capacity and, if necessary, the bracket capacity reduced accordingly.
- The gap between the timber members does not exceed 3 mm.
- There are no specific requirements relating to preparation of the timber members.

The execution of the connection shall be in accordance with the approval holder's technical literature.

4.3 Maintenance and repair

Maintenance is not required during the assumed intended working life. Should repair prove necessary, it is normal to replace the angle bracket.

Thomas Bruun
Manager, ETA-Danmark

Annex A

Product details

Product details definitions

Table A.1 Materials specification

Bracket type	Thickness (mm)	Steel specification	Coating specification
KR 95	4,0	DD 11	Z275
KR 135	4,0	DD 11	Z275
KR 285	4,0	DD 11	Z275

Table A.2 Range of sizes

Bracket type	Height (mm)		Width (mm)	
	Min	max	min	max
KR 95	94	96	64	66
KR 135	134	136	64	66
KR 285	284	286	64	66

Table A.3 Fastener specification

Nail type	Nail size (mm)		Finish
According to prEN 14592	Diameter	Length	
Threaded nail	4,0	40	Electroplated zinc

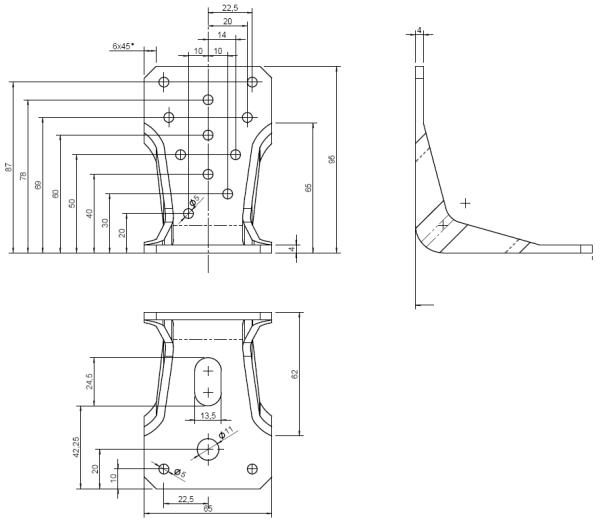

Figure A.1 Dimensions of Angle Bracket KR 95

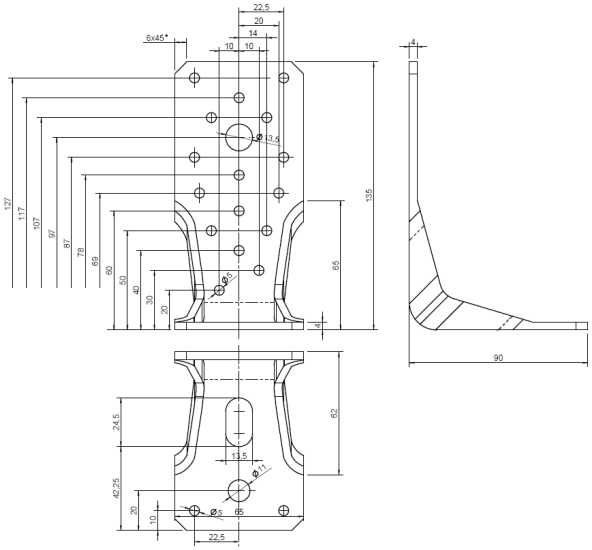

Figure A.2 Dimensions of Angle Bracket 135

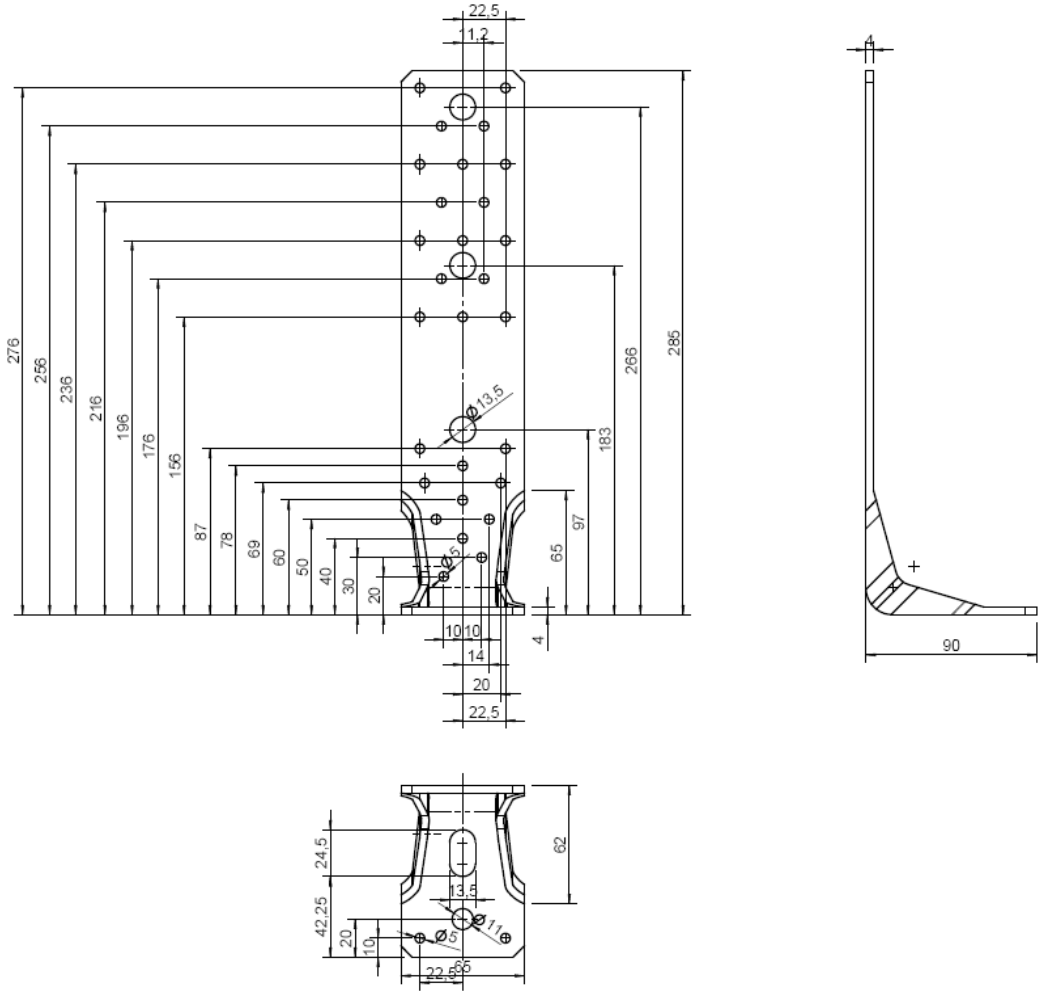

Figure A.3 Dimensions of Angle Bracket KR 285

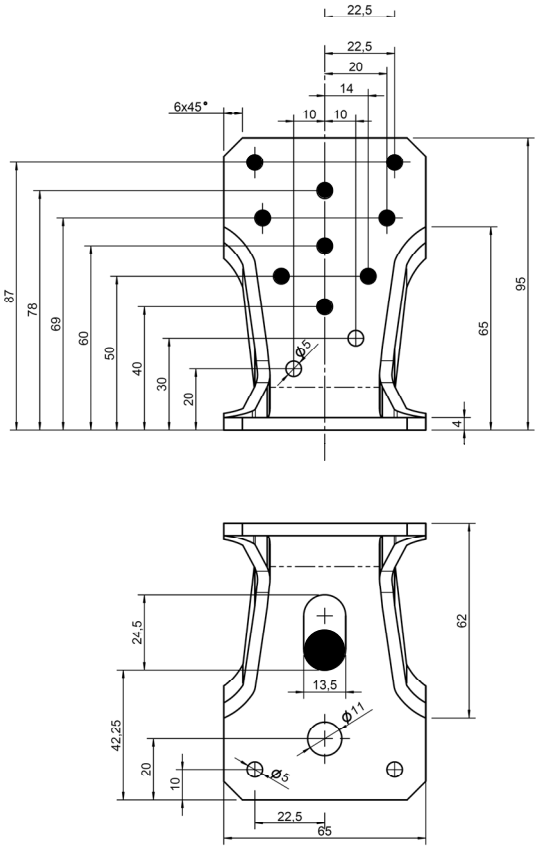

Figure A.4 Nail Patterns of Angle Bracket KR 95 – purlin connection

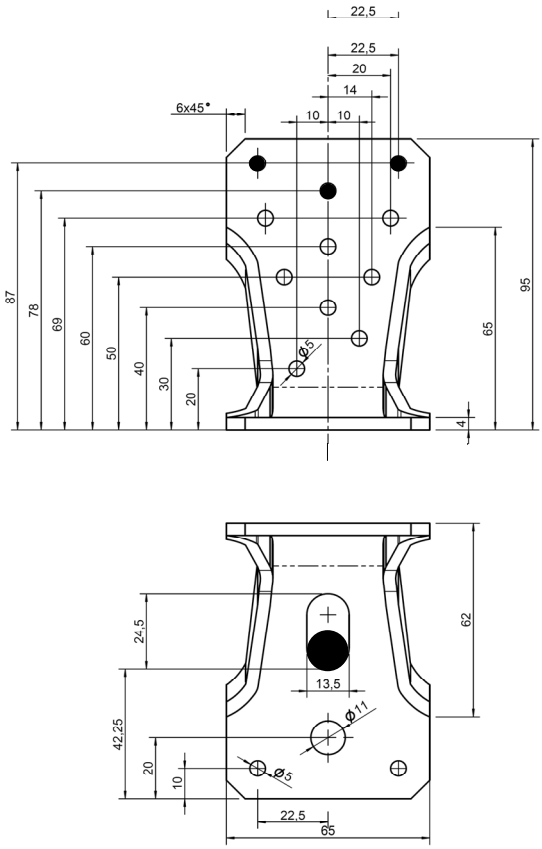

Figure A.5 Nail Patterns of Angle Bracket KR 95 – column connection

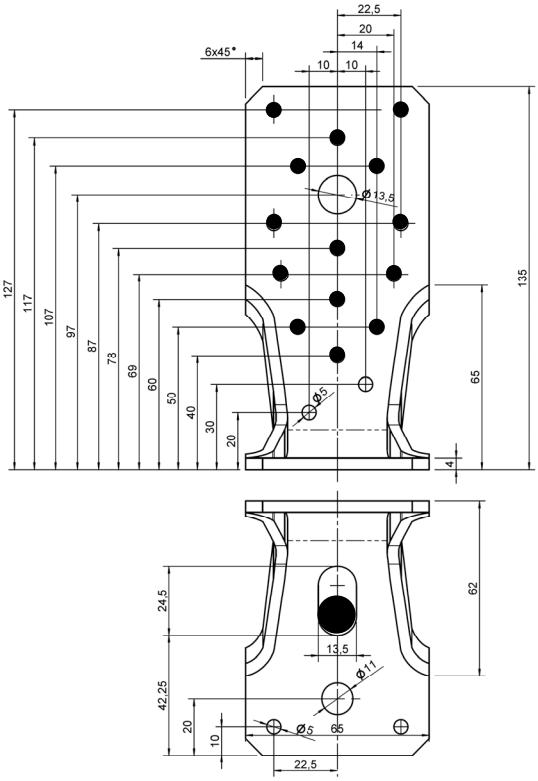

Figure A.6 Nail Patterns of Angle Bracket KR 135 - purlin connection

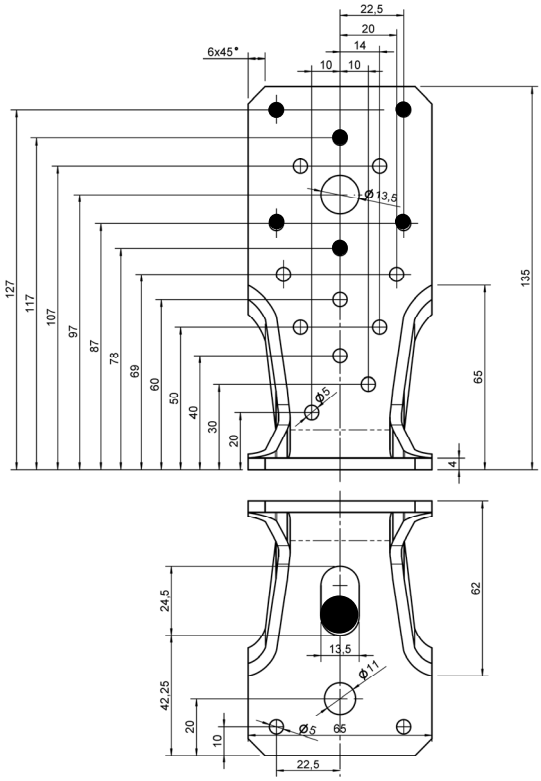

Figure A.7 Nail Patterns of Angle Bracket KR 135 - column connection

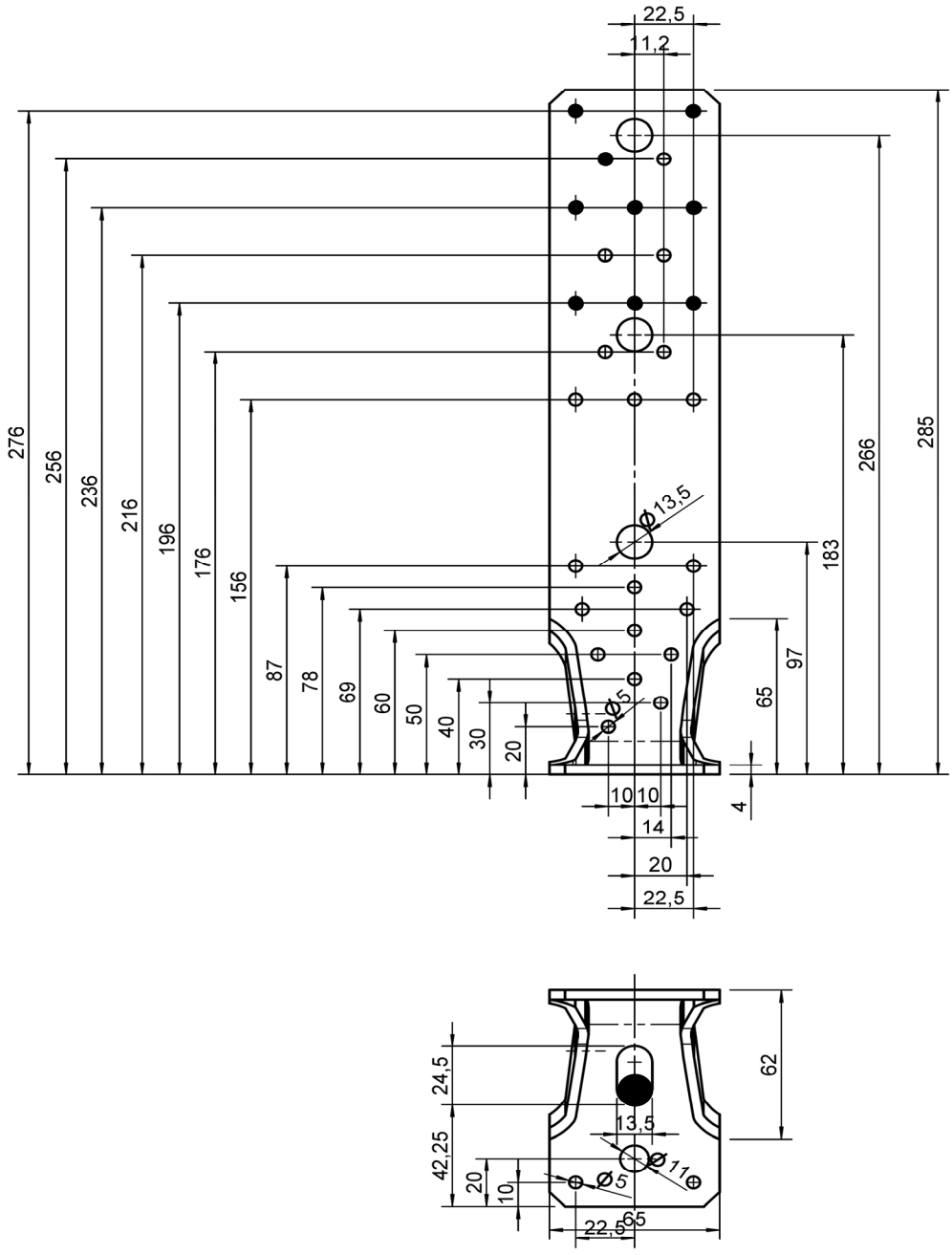

Figure A.8 Nail Patterns of Angle Bracket KR 285 - column connection

Annex B
Characteristic load-carrying capacities

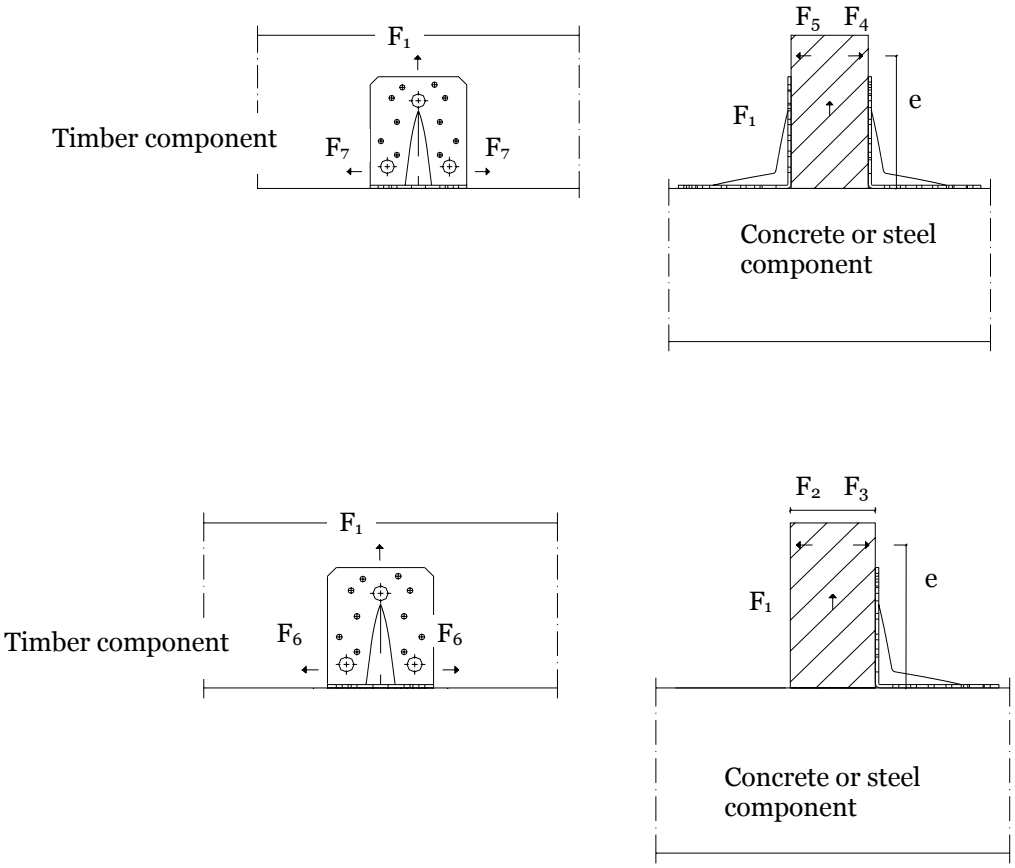

Figure B.1 Definitions of forces, their directions and eccentricity for timber to concrete and timber to steel connections

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

Double angle brackets per connection
The angle brackets must be placed symmetrically to the component axis.

Acting forces

F_1	Lifting force acting along the central axis of the joint.
F_4 and F_5	Lateral force acting perpendicular to the central axis of timber component. If the load is applied with an eccentricity e, a design for combined loading is required.
F_6	Lateral force acting in the timber component direction.

Single angle bracket per connection
Acting forces

F_1	Lifting force acting in the central axis of the angle bracket. The timber component shall be prevented from rotation. If the timber component is prevented from rotation the load-carrying capacity will be half of a connection with double angle brackets.
F_2 and F_3	Lateral force acting perpendicular to the central axis of timber component in the distance e to the joint. F_2 is the lateral force away from the angle bracket, F_3 is the lateral force towards the angle bracket
F_7	Lateral force acting in the timber component direction. The timber component shall be prevented from rotation. The load-carrying capacity will be half of a connection with double angle brackets.

Wane
Wane is not allowed, the timber has to be sharp-edged in the area of the angle brackets.

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

Combined forces

If the forces F_1, F_2/F_3 and F_7 act at the same time to a single angle bracket connection, the following inequality shall be fulfilled:

$$\left(\frac{F_{1,d}}{F_{Rd,1}}\right)^2+\left(\frac{F_{2,d}}{F_{Rd,2}}\right)^2+\left(\frac{F_{3,d}}{F_{Rd,3}}\right)^2+\left(\frac{F_{7,d}}{F_{Rd,7}}\right)^2 \le 1$$

If the forces F_1, F_4/F_5 und F_6 act at the same time to a double angle bracket connection, the following inequality shall be fulfilled:

$$\left(\frac{F_{1,d}}{F_{Rd,1}}\right)^2+\left(\frac{F_{4,d}}{F_{Rd,4}}\right)^2+\left(\frac{F_{5,d}}{F_{Rd,5}}\right)^2+\left(\frac{F_{6,d}}{F_{Rd,6}}\right)^2 \le 1$$

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, respectively, and F_4 or F_5, respectively, is able to act simultaneously with F_1, F_6 or F_7, while the other shall be set to zero.

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

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

B is the width of the timber component.

Load-carrying capacities with 1 or 2 angle brackets per connection

Table B.1: Characteristic values in the F1a - purlin, 1 angle bracket / connection

Angle Bracket	Number of nails	$F_{1a,k}$ in kN	k_t
KR 95	9	13,7	2,85
KR 135	14	21,2	

Table B.2: Characteristic values in the F1b - column, 1 angle bracket / connection

Angle Bracket	Number of nails	$F_{1b,k}$ in kN	k_t
KR 95	3	4,6	2,85
KR 135	6	9,1	
KR 285	9	13,7	

Table B.3: Characteristic values in the F1a - purlin, 2 angle brackets / connection

Angle Bracket	Number of nails	$F_{1a,k}$ in kN	k_t
KR 95	9	27,4	1,43
KR 135	14	42,4	

Table B.4: Characteristic values in the F1b - column, 2 angle brackets / connection

Angle Bracket	Number of nails	$F_{1b,k}$ in kN	k_t
KR 95	3	9,2	1,43
KR 135	6	18,3	
KR 285	9	27,5	

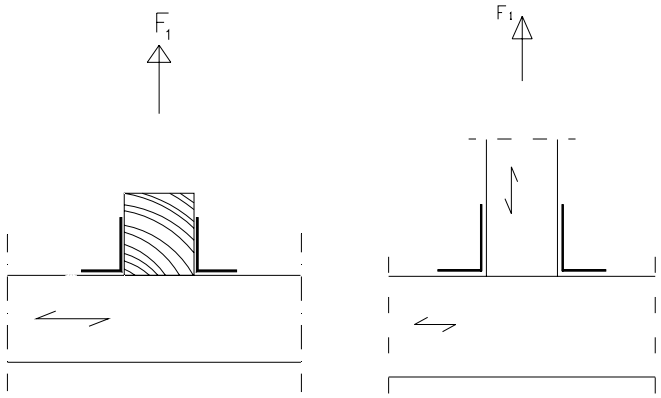

Figure B.2 Load F_1, purlin (left) and column (right)

Table B.5: Characteristic values in the F2 for KR 95, 1 angle bracket / connection

KR 95			
	$F_{2,Rk}$ in kN		
	H in m		
B in m	**0,12**	**0,14**	**0,18**
0,06	4,29	4,58	4,68
0,10	3,72	3,81	3,98
0,14	3,56	3,61	3,70

Table B.6: Factor k_t for angle bracket KR 95 force F2

KR 95			
	k_t		
	H in m		
B in m	**0,12**	**0,14**	**0,18**
0,06	2,16	2,24	2,44
0,10	2,05	2,08	2,15
0,14	2,01	2,03	2,07

Table B.7: Characteristic values F2 for KR 135, 1 angle bracket / connection

KR 135			
	$F_{2,Rk}$ in kN		
	H in m		
B in m	**0,16**	**0,18**	**0,22**
0,06	4,45	4,94	5,03
0,10	3,91	3,98	4,06
0,14	3,73	3,77	3,83

Table B.8: Factor k_t for angle bracket KR 135 force 2

KR 135			
	k_t		
	H in m		
B in m	**0,16**	**0,18**	**0,22**
0,06	1,94	2,82	4,50
0,10	2,02	2,06	2,04
0,14	1,94	1,97	2,02

Table B.9: Characteristic values F3 for KR 95, 1 angle bracket / connection

KR 95		
H in m	**$F_{3,Rk}$ in kN**	
	Steel	Timber
0,12	1,15	2,06
0,14	0,90	1,35
0,18	0,62	0,79

Table B.10: Characteristic values F3 for KR 135, 1 angle bracket / connection

KR 135	
H in m	**$F_{3,Rk}$ in kN**
	Steel
0,16	1,24
0,18	0,94
0,22	0,48

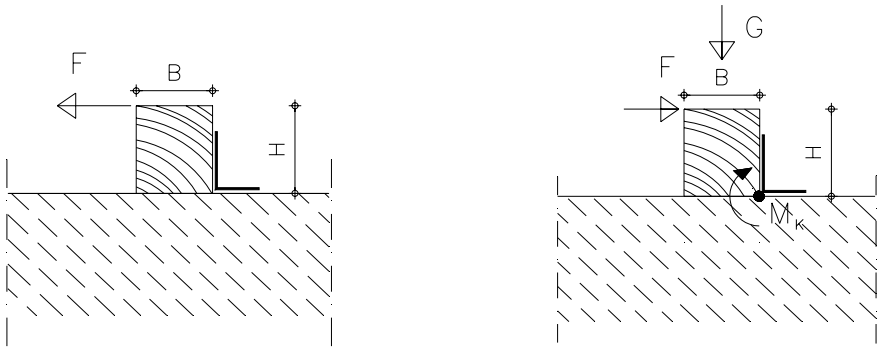

Figure B.3 Load F_2 (left) and Load F_3 (right)

Table B.11: Characteristic values for Interaction according to eq. (41), Force F4/F5

Angle Bracket	**$F_{4/5,Rk}$ in kN**	**$F_{1,Rk}$ in kN**
KR 95	7,58	27,4
KR 135	7,99	42,4

For different purlin widths and depths, the interaction equations were evaluated. The results are given in the tables 12 and 13.

Table B.12: Characteristic values F4/F5 for KR 95

KR 95			
	$F_{4,5Rk}$ in kN		
	H in m		
B in m	**0,12**	**0,14**	**0,18**
0,06	6,63	6,37	5,83
0,10	7,19	7,07	6,79
0,14	7,38	7,31	7,14

Table B.13: Characteristic values F4/F5 for KR 135

KR 135			
	$F_{4/5,Rk}$ in kN		
	H in m		
B in m	**0,16**	**0,18**	**0,22**
0,06	7,14	6,96	6,57
0,10	7,65	7,57	7,38
0,14	7,81	7,77	7,66

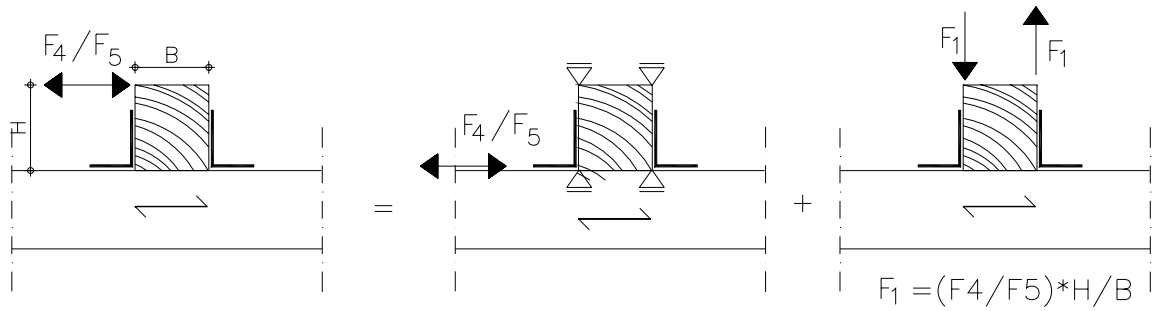

Figure B.4 Load Case F_4/F_5 reduced to two basic load cases

Table B.14: Characteristic values F6 (1 angle bracket / connection) and F7 (2 angle brackets / connection)

Angle Bracket	**$F_{6,Rk}$ in kN**	**$F_{7,Rk}$ in kN**
KR 95	1,72	3,44
KR 135	2,76	5,53