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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-09/0214 of 2022/05/08

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:	Drüeke & Springob Angle Brackets (type 1111, 1112, 1113, 1131, 1132, 1133)
Product family to which the above construction product belongs:	Three-dimensional nailing plate (Angle Bracket for timber-to-timber or timber-to-concrete connections)
Manufacturer:	Drüeke & Springob GmbH Bahnstrasse 19 57439 Attendorn - Kraghammer Tel. +49 02722 - 7771 Fax +49 02722 – 7922
Manufacturing plant:	Drüeke & Springob GmbH Bahnstrasse 19 57439 Attendorn - Kraghammer
This European Technical Assessment contains:	17 pages including 2 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	The ETA with the same number issued on 2015-10-15

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Drüeke & Springob angle brackets with and without rib 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 are made from pre-galvanized steel DX51D / Z275 according to EN 10346 with $R_e \geq 295$ N/mm², $R_m \geq 360$ N/mm² and tolerances according to EN 10143. Dimensions, hole positions and typical installations are shown in Annex A.

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 where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Work Requirements 1 and 4 of the Regulation 305/2011 (EU) 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 angle brackets may also be used for connections between a timber member and a member of concrete or steel.

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

The wood members may 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 according to EN 14081,
- Glulam classified 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 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 classes 1 and 2 of Eurocode 5 and for connections subject to static or quasi-static loading.

The angle brackets can also be used in outdoor timber structures, service class 3, when a corrosion protection in accordance with 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 connectors regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2.

The provisions made in this European Technical Assessment are based on an assumed working life of the three-dimensional nailing plates of 50 years. The real working life may be, in normal conditions, considerably longer without major degradation affecting the essential requirements of the works. The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR 1)*)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR 2)	
Reaction to fire	The angle brackets are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
3.3 General aspects related to the performance of the product	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 3.4 – 3.7.

3.9 Methods of verification

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 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 $F_{Rk,T}$ (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.

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

In the case of timber failure, the design value shall be calculated according to EN 1995-1-1 by dividing the characteristic value of the load-carrying capacity by the partial factor for the material property and by multiplying with the coefficient k_{mod}, taking the load duration class and the service class into account.

In the case of steel failure, the design value shall be calculated according to EN 1993-1-1 by reducing the characteristic values of the load-carrying capacity with partial factor $\gamma_{M,S} = \gamma_{M0}$.

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 EAD 130186-00-0603. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

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

Corrosion protection in service class 1 and 2.
In accordance with EAD 130186-00-0603 the angle brackets are made from pre-galvanized steel DX51D / Z275 according to EN 10346.

3.12 General aspects related to the use of the product

Drüeke & Springob 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 design models allow the use of fasteners defined in table A.3.
The nailing pattern is defined in Annex B.

The following provisions concerning installation apply:

The structural members – the components 1 and 2 shown in Annex B - to which the brackets are fixed shall be:

- Restrained against rotation. At a load F_4/F_5, the component 2 is allowed to be restrained against rotation by the angle brackets.
- Free from wane under the bracket.
- The actual end bearing capacity of the timber member to be used in conjunction with the bracket is checked by the designer of the structure to ensure it is not less than the bracket capacity and, if necessary, the bracket capacity reduced accordingly.
- The gap between the timber members does not exceed 3 mm.
- There are no specific requirements relating to preparation of the timber members.

The execution of the connection shall be in accordance with the assessment holder’s technical literature.

4 Assessment and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/638/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

5 Technical details necessary for the implementation of the AVCP system, as 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 2022-05-08 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details definitions

Table A.1: Material specification

Bracket number	Bracket type	Thickness [mm]	Steel specification	Coating specification
1131	70 x 70 x 55	2,5	DX51D	Z275
1111	70 x 70 x 55 with rib	2,5	DX51D	Z275
1132	90 x 90 x 65	2,5	DX51D	Z275
1112	90 x 90 x 65 with rib	2,5	DX51D	Z275
1133	105 x 105 x 90	3,0	DX51D	Z275
1113	105 x 105 x 90 with rib	3,0	DX51D	Z275

Table A.2: Range of sizes

Bracket number	Bracket type	Height [mm] vertical		Height [mm] horizontal		Width [mm]	
1131	70 x 70 x 55	69	71	69	71	54	56
1111	70 x 70 x 55 with rib	69	71	69	71	51,5	56
1132	90 x 90 x 65	89	91	89	91	64	66
1112	90 x 90 x 65 with rib	89	91	89	91	59	66
1133	105 x 105 x 90	104	106	104	106	89	91
1113	105 x 105 x 90 with rib	104	106	104	106	83	91

Table A.3 Fastener specification

<table>
<tr><td rowspan="3">Nails</td><td>Diameter [mm]</td><td>Length [mm]</td><td>Profiled length [mm]</td><td>Withdrawal resistance</td><td>Nail type</td></tr>
<tr><td>4.0</td><td>40</td><td>31</td><td>$f_{ax,k} \geq 6,13\ N/mm^2$</td><td>Ringed shank nails according to EN 14592</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="2">Bolts, Metal anchors</td><td>Diameter [mm]</td><td colspan="3">Correspondent hole diameter</td><td>type</td></tr>
<tr><td>12.0</td><td colspan="3">Max. 2 mm. larger than the bolt/anchor diameter</td><td>See specification of the manufacturer</td></tr>
</table>

Drüeke & Springob Angle Brackets

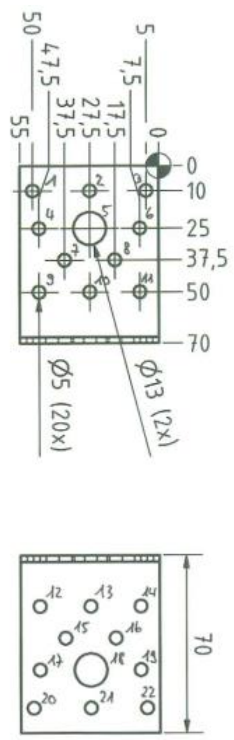


Figure A. 1 Dimensions of Angle Bracket 1131

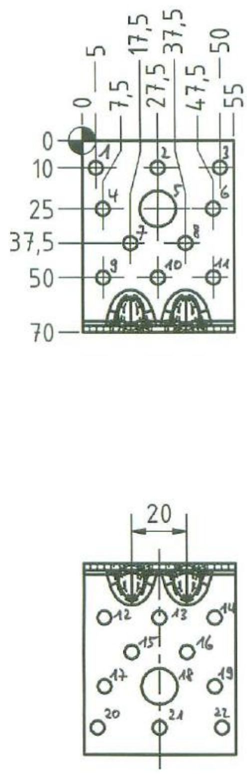


Figure A. 2 Dimensions of Angle Bracket 1111

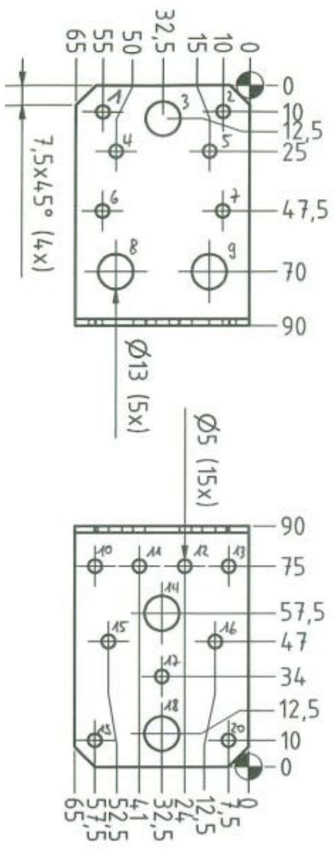


Figure A. 3 Dimensions of Angle Bracket 1132

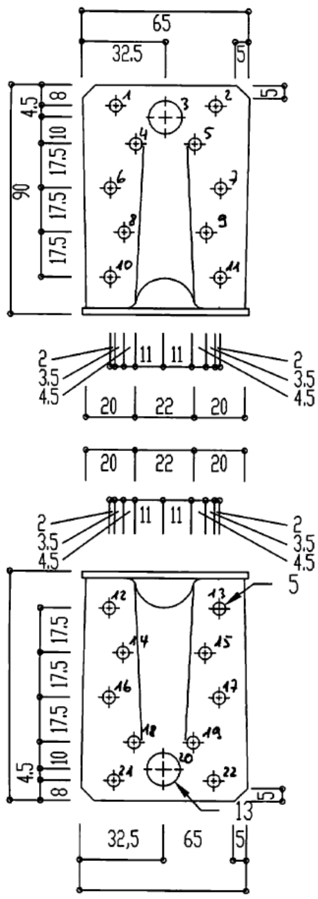


Figure A. 4 Dimensions of Angle Bracket 1112

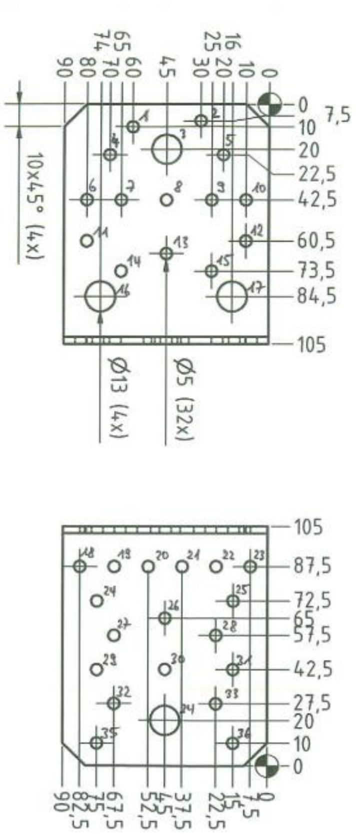


Figure A. 5 Dimensions of Angle Bracket 1133

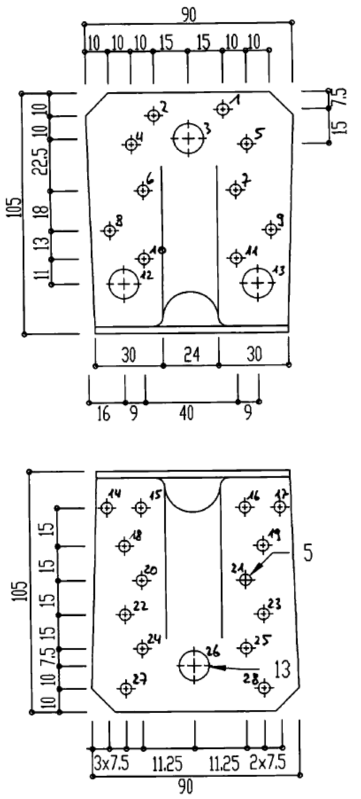


Figure A. 6 Dimensions of Angle Bracket 1113

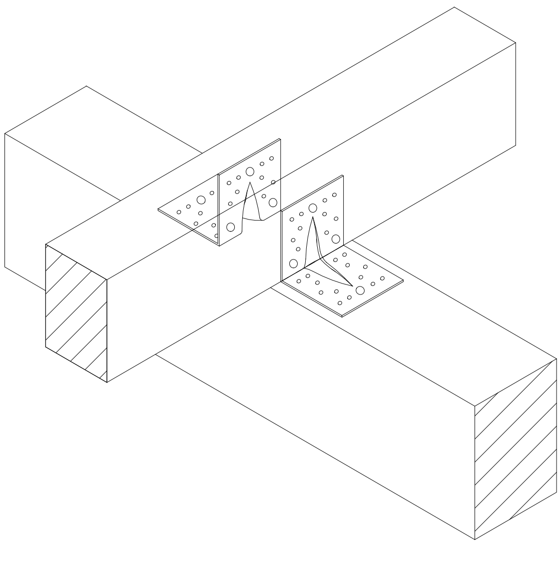
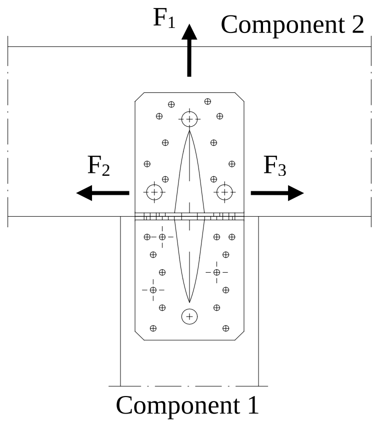
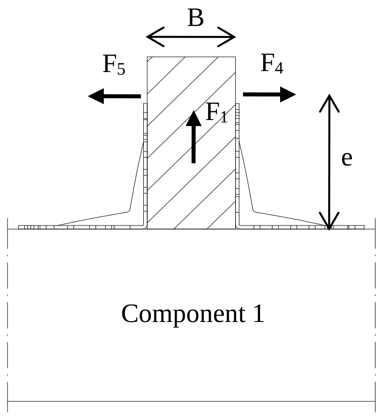


Figure A. 7 Typical installation

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 given in the tables 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	Centrical lifting force acting in component 2.
$F_{2/3}$	Centrical lateral force acting in component 2 in axial direction of component 2.
$F_{4/5}$	Centrical 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.
$F_{2/3}$	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 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:

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

$$F_{B,v,Ed} = k_{t,\perp} \cdot F_{Ed} \quad \text{for shear load}$$

Where:

$F_{B,t,Ed}$	Bolt tensile load in N
$F_{B,v,Ed}$	Bolt shear load in N
k_t	Coefficient, according to the tables B.10 to B.18
F_{Ed}	Load on vertical flap of the angle bracket in N

Combined forces

If the forces F_1 and $F_{2/3}$ and $F_{4/5}$ or F_4 or F_5 act at the same time, the following inequality shall be fulfilled:

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

If the load $F_{4/5}$ is applied with an eccentricity e, a design for combined loading **for connections with double angle brackets** is required. Here, an additional force $\Delta F_{1,Ed}$ has to be added to the existing force $F_{1,Ed}$.

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

B is the width of component 2.

Characteristic load-carrying capacities timber to timber

Table B.1: Force F_1 Column, 2 angle brackets per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel
1131	70x70x55	1,2,3	12,13,14,15,16,20,21,22	3,15	1,84
1111	70x70x55 with rib	1,2,3	12,13,14,15,16,20,21,22	3,15	1,84
1132	90x90x65	1,2	10,11,12,13,15,16,17,19,20	5,00	2,77
1112	90x90x65 with rib	1,2	12,13,16,17,21,22	2,50	6,31
1133	105x105x90	1,2,4,5,6,8,10	18,19,20,21,22,23,26,27,28, 30,35,36	7,52	4,55
1113	105x105x90 with rib	1,2,4,5,6,7	14,15,16,17,20,21,27,28	5,01	15,8

Table B.2: Force F_1 Column, 1 angle bracket per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (column)	
				Timber	Steel
1131	70x70x55	1,2,3	12,13,14,15,16,20,21,22	1,58	0,92
1111	70x70x55 with rib	1,2,3	12,13,14,15,16,20,21,22	1,58	0,92
1132	90x90x65	1,2	10,11,12,13,15,16,17,19,20	2,50	1,38
1112	90x90x65 with rib	1,2	12,13,16,17,21,22	1,25	3,15
1133	105x105x90	1,2,4,5,6,8,10	18,19,20,21,22,23,26,27,28, 30,35,36	3,76	2,28
1113	105x105x90 with rib	1,2,4,5,6,7	14,15,16,17,20,21,27,28	2,51	7,91

Table B.3: Force F_1 Purlin, 2 angle brackets per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
1131	70x70x55	1,2,3,7,8	12,13,14,15,16,20,21,22	3,15	1,84
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	3,15	1,84
1132	90x90x65	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	5,00	2,77
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	2,50	6,31
1133	105x105x90	1,2,4,5,6,8,10, 11,12,14,15	18,19,20,21,22,23,26,27,28, 30,35,36	7,52	4,55
1113	105x105x90 with rib	1,2,4,5,6,7,8, 9,10,11	14,15,16,17,20,21,27,28	5,01	15,8

Table B.4: Force F_1 Purlin, 1 angle bracket per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{1,Rk}$ [kN] (purlin)	
				Timber	Steel
1131	70x70x55	1,2,3,7,8	12,13,14,15,16,20,21,22	1,58	0,92
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	1,58	0,92
1132	90x90x65	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	2,50	1,38
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	1,25	3,15
1133	105x105x90	1,2,4,5,6,8,10, 11,12,14,15	18,19,20,21,22,23,26,27, 28,30,35,36	3,76	2,28
1113	105x105x90 with rib	1,2,4,5,6,7,8, 9,10,11	14,15,16,17,20,21,27,28	2,51	7,91

Table B.5: Force $F_{2/3}$, 2 angle brackets per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{2/3,Rk}$ [kN]
				Timber
1131	70x70x55	1,2,3,7,8	12,13,14,15,16,20,21,22	5,80
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	5,80
1132	90x90x65	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	7,34
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	7,06
1133	105x105x90	1,2,4,5,6,8,10, 11,12,14,15	18,19,20,21,22,23,26,27, 28,30,35,36	11,9
1113	105x105x90 with rib	1,2,4,5,6,7,8, 9,10,11	14,15,16,17,20,21,27,28	10,1

Table B.6: Force $F_{2/3}$, 1 angle bracket per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{2/3,Rk}$ [kN]
				Timber
1131	70x70x55	1,2,3,7,8	12,13,14,15,16,20,21,22	2,90
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	2,90
1132	90x90x65	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	3,67
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	3,53
1133	105x105x90	1,2,4,5,6,8,10, 11,12,14,15	18,19,20,21,22,23,26,27, 28,30,35,36	5,94
1113	105x105x90 with rib	1,2,4,5,6,7,8, 9,10,11	14,15,16,17,20,21,27,28	5,06

Table B.7: Force $F_{4/5}$, 2 angle brackets per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{4/5,Rk}$ [kN]	
				Timber	Steel
1131	70x70x55	1,2,3,7,8	12,13,14,15,16,20,21,22	5,34	4,34
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	5,85	4,02
1132	90x90x65	1,2,4,5,6,7	10,11,12,13,15,16,17,19,20	7,82	4,45
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	7,03	4,17
1133	105x105x90	1,2,4,5,6,8,10, 11,12,14,15	18,19,20,21,22,23,26,27, 28,30,35,36	9,30	8,46
1113	105x105x90 with rib	1,2,4,5,6,7,8, 9,10,11	14,15,16,17,20,21,27,28	9,96	13,1

Table B.8: Force F_4, 1 angle bracket per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{4,Rk}$ [kN]	
				Timber	Steel
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	5,85	3,08
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	7,03	3,66
1113	105x105x90 with rib	1,2,4,5,6,7,8,9,10,11	14,15,16,17,20,21,27,28	9,96	9,21

Table B.9: Force F_5, 1 angle bracket per connection, timber to timber

Bracket number	Bracket type	Nail number n_V	Nail number n_H	$F_{5,Rk}$ [kN]	
				Timber	Steel
1111	70x70x55 with rib	1,2,3,7,8	12,13,14,15,16,20,21,22	1,38	1,19
1112	90x90x65 with rib	1,2,4,6,7,8,9	12,13,16,17,21,22	1,98	1,17
1113	105x105x90 with rib	1,2,4,5,6,7,8,9,10,11	14,15,16,17,20,21,27,28	2,95	4,82

Characteristic load-carrying capacities timber to concrete/steel

Table B.10: Force F_1 Column, 2 angle brackets per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (column)		Bolt
				Timber	Steel	$k_{t,\parallel}$
1131	70x70x55	1,2,3	18	9,65	0,82	1,6
1111	70x70x55 with rib	1,2,3	18	9,65	0,82	1,6
1132	90x90x65	1,2	14	6,43	2,04	0,8
1112	90x90x65 with rib	1,2	20	3,66	1,70	1,6
1133	105x105x90	35,36,29,30,31	16,17	16,0	7,39	0,3
1113	105x105x90 with rib	22,23,27,28	12,13	12,8	20,6	0,3

Table B.11: Force F_1 Column, 1 angle bracket per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (column)		Bolt
				Timber	Steel	$k_{t,\parallel}$
1131	70x70x55	1,2,3	18	4,83	0,41	3,3
1111	70x70x55 with rib	1,2,3	18	4,83	0,41	3,3
1132	90x90x65	1,2	14	3,22	1,02	1,6
1112	90x90x65 with rib	1,2	20	1,83	0,85	3,3
1133	105x105x90	35,36,29,30,31	16,17	7,98	3,69	0,6
1113	105x105x90 with rib	22,23,27,28	12,13	6,38	10,3	0,6

Table B.12: Force F_1 Purlin, 2 angle brackets per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (purlin)		Bolt
				Timber	Steel	$k_{t,\parallel}$
1131	70x70x55	1,2,3,7,8	18	16,1	0,82	1,6
1111	70x70x55 with rib	1,2,3,7,8	18	16,1	0,82	1,6
1132	90x90x65	1,2,4,5,6,7	14	19,3	2,04	0,8
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	6,92	1,79	1,6
1133	105x105x90	24,25,26,29,30,31,35,36	16,17	25,5	7,39	0,3
1113	105x105x90 with rib	18,19,20,21,22,23,24,25,27,28	12,13	31,9	20,6	0,3

Table B.13: Force F_1 Purlin, 1 angle bracket per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{1,Rk}$ [kN] (purlin)		Bolt
				Timber	Steel	$k_{t,\parallel}$
1131	70x70x55	1,2,3,7,8	18	8,04	0,41	3,3
1111	70x70x55 with rib	1,2,3,7,8	18	8,04	0,41	3,3
1132	90x90x65	1,2,4,5,6,7	14	9,65	1,02	1,6
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	3,46	0,90	3,2
1133	105x105x90	24,25,26,29,30,31,35,36	16,17	12,8	3,69	0,6
1113	105x105x90 with rib	18,19,20,21,22,23,24,25,27,28	12,13	16,0	10,3	0,6

Table B.14: Force $F_{2/3}$, 2 angle brackets per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{2/3,Rk}$ [kN]	Bolt
				Timber	$k_{t,\perp}$
1131	70x70x55	1,2,3,7,8	18	1,66	0,5
1111	70x70x55 with rib	1,2,3,7,8	18	1,66	0,5
1132	90x90x65	1,2,4,5,6,7	14	3,87	0,5
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	1,82	0,5
1133	105x105x90	24,25,26,29,30,31,35,36	16,17	8,27	0,3
1113	105x105x90 with rib	18,19,20,21,22,23,24,25,27,28	12,13	10,4	0,3

Table B.15: Force $F_{2/3}$, 1 angle bracket per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{2/3,Rk}$ [kN]	Bolt
				Timber	$k_{t,\perp}$
1131	70x70x55	1,2,3,7,8	18	0,83	1,0
1111	70x70x55 with rib	1,2,3,7,8	18	0,83	1,0
1132	90x90x65	1,2,4,5,6,7	14	1,94	1,0
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	0,91	1,0
1133	105x105x90	24,25,26,29,30,31,35,36	16,17	4,13	0,6
1113	105x105x90 with rib	18,19,20,21,22,23,24,25,27,28	12,13	5,21	0,6

Table B.16: Force $F_{4/5}$, 2 angle brackets per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{4/5,Rk}$ [kN]		Bolt	
				Timber	Steel	$k_{t,\perp}$	$k_{t,\parallel}$
1131	70x70x55	1,2,3,7,8	18	5,45	3,72	0,8	0,2
1111	70x70x55 with rib	1,2,3,7,8	18	5,60	3,99	0,7	0,2
1132	90x90x65	1,2,4,5,6,7	14	6,76	4,03	0,8	0,2
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	6,15	4,04	0,7	0,2
1133	105x105x90	24,25,26,29,30,31,35,36	16,17	8,83	7,79	0,4	0,2
1113	105x105x90 with rib	18,19,20,21,22,23,24,25, 27,28	12,13	10,8	9,76	0,4	0,2

Table B.17: Force F_4, 1 angle bracket per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{4,Rk}$ [kN]		Bolt	
				Timber	Steel	$k_{t,\perp}$	$k_{t,\parallel}$
1111	70x70x55 with rib	1,2,3,7,8	18	6,29	3,48	1,0	0,0
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	13,4	2,74	1,0	0,0
1113	105x105x90 with rib	18,19,20,21,22,23, 24,25,27,28	12,13	13,3	7,20	0,5	0,1

Table B.18: Force F_5, 1 angle bracket per connection, timber to concrete/steel

Bracket number	Bracket type	Nail number n_V	Bolt number n_H	$F_{5,Rk}$ [kN]		Bolt	
				Timber	Steel	$k_{t,\perp}$	$k_{t,\parallel}$
1111	70x70x55 with rib	1,2,3,7,8	18	1,45	1,03	1,0	0,9
1112	90x90x65 with rib	1,2,4,6,7,8,9	20	1,99	1,91	1,0	0,7
1113	105x105x90 with rib	18,19,20,21,22,23, 24,25,27,28	12,13	2,84	4,76	0,5	0,9