



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 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-13/0900 of 10/04/2014

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:

GH Angle Brackets (see types in section II.1)

Product family to which the above construction product belongs:

Three-dimensional nailing plate (Angle brackets and hold-downs for timber-to-timber or timber-to-concrete or steel connections)

Manufacturer:

GH-Baubeschläge GmbH
Austraße 34
D-73235 Weilheim/Teck
Tel. +49 7023 743323 0
Fax +49 7023 743323 90
Internet www.holzverbinder.de

Manufacturing plant:

Werk 1, Werk 2

This European Technical Assessment contains:

60 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 2014-02-20

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

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full (excepted the confidential Annex(es) referred to above). However, partial reproduction may be made, with the written consent of the issuing Technical Assessment Body. Any partial reproduction has to be identified as such.

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

The following bracket types are covered by this assessment:

GH Standardwinkelverbinder (55/02S, 55/01S (with rib), 55/02S15, 55/01S15 (with rib), 65/04S, 65/03S (with rib), 65/04S15, 65/03S15 (with rib), 90/04S, 90/03S (with rib), 90/04S20, 90/03S20 (with rib))

GH Konsolenwinkel (Typ 120, Typ 140, Typ 160, Typ 180, Typ 200)

GH Zuganker (HS) (943, 944, 945)

GH Lochplattenwinkel (10499, 10500, 10501, 10521, 10502, 10503, 10504, 10518, 10519, 10527, 10522, 10523, 10524, 10525, 10526, 10505, 10506, 10507, 10508, 10509, 10510, 10511, 10512, 10513, 10514, 10515, 10516, 10517)

GH Winkelverbinder $t = 4,0$ mm (1884, 12116186, 12116188, 12116181)

GH Winkelverbinder 60 / 100

GH Winkelverbinder 692

GH angle brackets or hold-downs, respectively, 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 according to ETA-13/0523 or profiled (ringed shank) nails according to EN 14592 or screws according to ETA-13/0523 and to concrete or steel members with bolts or metal anchors

The angle brackets with a steel plate thickness of 1.5 mm to 4 mm are made from:

- pre-galvanized steel S250 GD / Z 275 according to EN 10346:2009, or steel grade DX 51 D / Z 275 according to EN 10327:2004 with $R_e \geq 250$ N/mm², $R_m \geq 360$ N/mm² and $A_{80} \geq 19\%$ or
- pre-galvanized steel S350 GD / Z 275 according to EN 10346:2009, with $R_e \geq 350$ N/mm², $R_m \geq 420$ N/mm² and $A_{80} \geq 16\%$ or
- Steel type 1.4571 (Stainless Steel) according to EN 10088:2005 with $R_e \geq 240$ N/mm², $R_m \geq 540$ N/mm², $A_{80} \geq 40\%$

Dimensions, hole positions and typical installations are shown in Annex A and B. GH angle brackets are made from steel with tolerances according to EN 10143.

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 column or a purlin and a concrete or steel member, 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 shall be fulfilled.

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/m³ to 420 kg/m³. 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 14081,
- Glulam classified to GL24-GL36 according to EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Glued solid timber according to EN 14080,
- Cross laminated timber,
- Plywood according to EN 636

Annex B states the load-carrying capacities of the angle bracket connections for a characteristic density of 350 kg/m³. For timber or wood based material with a lower characteristic density than 350 kg/m³ the load-carrying capacities shall be reduced by the k_{dens} factor:

$$k_{dens} = \left(\frac{\rho_k}{350} \right)^{0,8}$$

Where ρ_k is the characteristic density of the timber in kg/m³.

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 fasteners 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 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. If a stainless steel with a lower characteristic yield or ultimate strength is employed, the load-carrying capacities $R_{1,k}$, $R_{2/3,k}$ or $R_{4/5,k}$ in Tables 1 through 66 (see annex B) are to be reduced proportionally.

The scope of the post bases 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 angle brackets may also be used for connections between two timber members.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the post bases of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance determined
Ductility in cyclic testing	No performance determined
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The angle brackets are made from steel classified as Euroclass A1 in accordance with EN 1350-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
3.3 Hygiene, health and the environment (BWR3)	
Influence on air quality	No dangerous materials
3.7 Sustainable use of natural resources (BWR7)	No performance determined
3.8 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 3.9 – 3.12.

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.

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 $F_{Rk,H}$ (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.

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.

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 the angle brackets are produced from:

- pre-galvanized steel S250 GD / Z 275 according to EN 10346:2009, or steel grade DX 51 D / Z 275 according to EN 10327:2004 with $R_e \geq 250$ N/mm², $R_m \geq 360$ N/mm² and $A_{80} \geq 19\%$ or
- pre-galvanized steel S350 GD / Z 275 according to EN 10346:2009, with $R_e \geq 350$ N/mm², $R_m \geq 420$ N/mm² and $A_{80} \geq 16\%$ or
- Steel type 1.4571 (Stainless Steel) according to EN 10088:2005 with $R_e \geq 240$ N/mm², $R_m \geq 540$ N/mm², $A_{80} \geq 40\%$

3.12 General aspects related to the use of the product

The 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 apply:

The structural members – the components 1 and 2 shown in the figure on page 14 - 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.
- Strength class C14 or better, see section II.2 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)

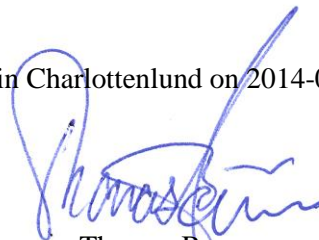
4.1 AVCP system

According to the decision 97/638/EC of the European 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

Issued in Charlottenlund on 2014-04-10 by



Thomas Bruun
Manager, ETA-Danmark

Annex A
Product details and definitions

Table A.1 Materials specification

Bracket type	Thickness (mm)	Steel specification	Coating specification
Standardwinkelverbinder			
55/02S 70 x 70 x 55 mm	2,0 / 2,5 / 3,0	S250 GD or DX51D or 1.4571	Z 275
55/01S 70 x 70 x 55 mm (with rib)	2,0 / 2,5 / 3,0	S250 GD or DX51D or 1.4571	Z 275
55/02S15 70 x 70 x 55 mm	1,5	S350 GD	Z 275
55/01S15 70 x 70 x 55 mm (with rib)	1,5	S350 GD	Z 275
65/04S 90 x 90 x 65 mm	2,5 / 3,0	S250 GD or DX51D or 1.4571	Z 275
65/03S 90 x 90 x 65 mm (with rib)	2,5 / 3,0	S250 GD or DX51D or 1.4571	Z 275
65/04S15 90 x 90 x 65 mm	1,5 / 2,0	S350 GD	Z 275
65/03S15 90 x 90 x 65 mm (with rib)	1,5 / 2,0	S350 GD	Z 275
90/04S 105 x 105 x 90 mm	3,0	S250 GD or DX51D or 1.4571	Z 275
90/03S 105 x 105 x 90 mm (with rib)	3,0	S250 GD or DX51D or 1.4571	Z 275
90/04S20 105x105x90	2,0 / 2,5	S350 GD	Z 275
90/03S20 105x105x 90 mm (with rib)	2,0 / 2,5	S350 GD	Z 275
Konsolenwinkel			
Typ 120 120 x 54 x 60 x 2,5 mm	2,5	S350 GD or 1.4571	Z 275 or stainless steel
Typ 140 140 x 54 x 60 x 2,5 mm	2,5		
Typ 160 160 x 54 x 60 x 2,5 mm	2,5		
Typ 180 180 x 54 x 60 x 2,5 mm	2,5		
Typ 200 200 x 54 x 60 x 2,5 mm	2,5		
Zuganker (HS)			
943 90 x 35 x 40 x 3,0 mm	3,0	S250 GD or DX51D or 1.4571	Z 275 or stainless steel
944110 x 35 x 40 x 3,0 mm	3,0		
945130 x 35 x 40 x 3,0 mm	3,0		

Continuation of Table A.1 Materials specification

Bracket type	Thickness (mm)	Steel specification	Coating specification
Lochplattenwinkel			
10499 40 x 40 x 20 x 2,0 mm	2,0	S250 GD or DX51D or 1.4571	Z 275 or stainless steel
10500 40 x 40 x 40 x 2,0 mm	2,0		
10501 40 x 40 x 60 x 2,0 mm	2,0		
10521 50 x 50 x 40 x 2,0 mm	2,0		
10502 60 x 60 x 40 x 2,0 mm	2,0		
10503 60 x 60 x 50 x 2,0 mm	2,0		
10504 60 x 60 x 60 x 2,0 mm	2,0		
10518 60 x 60 x 80 x 2,0 mm	2,0		
10519 80 x 80 x 60 x 2,0 mm	2,0		
10527 80 x 80 x 80 x 2,0 mm	2,0		
10522 40 x 40 x 60 x 2,5 mm	2,5		
10523 50 x 50 x 40 x 2,5 mm	2,5		
10524 60 x 60 x 40 x 2,5 mm	2,5		
10525 60 x 60 x 50 x 2,5 mm	2,5		
10526 60 x 60 x 60 x 2,5 mm	2,5		
10505 60 x 60 x 80 x 2,5 mm	2,5		
10506 60 x 60 x 100 x 2,5 mm	2,5		
10507 80 x 80 x 60 x 2,5 mm	2,5		
10508 80 x 80 x 80 x 2,5 mm	2,5		
10509 80 x 80 x 100 x 2,5 mm	2,5		
10510 100 x 100 x 60 x 2,5 mm	2,5		
10511 100 x 100 x 80 x 2,5 mm	2,5		
10512 100 x 100 x 100 x 2,5 mm	2,5		
10513 90 x 90 x 40 x 2,5 mm	2,5		
10514 60 x 40 x 60 x 2,5 mm	2,5		
10515 80 x 60 x 60 x 2,5 mm	2,5		
10516 100 x 60 x 60 x 2,5 mm	2,5		
10517 200 x 100 x 100 x 2,5 mm	2,5		
Winkelverbinder t = 4,0 mm			
1884 130 x 70 x 80 x 4,0 mm	4,0	S250 GD or DX51D	Z 275
12116186 160 x 80 x 60 x 4,0 mm	4,0		
12116188 160 x 80 x 80 x 4,0 mm	4,0		
12116181 160 x 80 x 100 x 4,0 mm	4,0		
Winkelverbinder 60 / 100			
60/100 100 x 60 x 60 x 2,5 mm	2,5	S250 GD or DX51D or 1.4571	Z 275 or stainless steel
Winkelverbinder 692			
692 65 x 65 x 90 x 2,0 mm	2,0	S250 GD or DX51D or 1.4571	Z 275 or stainless steel

Table A.2 Range of sizes

Bracket type	Height (mm) vertical		Height (mm) horizontal		Width (mm)	
	min	max	min	max	min	max
Standardwinkelverbinder						
55/02S 70 x 70 x 55 mm	69	71	69	71	54	56
55/01S 70 x 70 x 55 mm (with rib)	69	71	69	71	54	56
55/02S15 70 x 70 x 55 mm	69	71	69	71	54	56
55/01S15 70 x 70 x 55 mm (with rib)	69	71	69	71	54	56
65/04S 90 x 90 x 65 mm	89	91	89	91	64	66
65/03S 90 x 90 x 65 mm (with rib)	89	91	89	91	64	66
65/04S15 90 x 90 x 65 mm	89	91	89	91	64	66
65/03S15 90 x 90 x 65 mm (with rib)	89	91	89	91	64	66
90/04S 105 x 105 x 90 mm	104	106	104	106	89	91
90/03S 105 x 105 x 90 mm (with rib)	104	106	104	106	89	91
90/04S20 105x105x90	104	106	104	106	89	91
90/03S20 105x105x 90 mm (with rib)	104	106	104	106	89	91
Konsolenwinkel						
Typ 120 120 x 54 x 60 x 2,5 mm	119	121	53	55	59	61
Typ 140 140 x 54 x 60 x 2,5 mm	139	141	53	55	59	61
Typ 160 160 x 54 x 60 x 2,5 mm	159	161	53	55	59	61
Typ 180 180 x 54 x 60 x 2,5 mm	179	181	53	55	59	61
Typ 200 200 x 54 x 60 x 2,5 mm	199	201	53	55	59	61
Zuganker (HS)						
943 90 x 35 x 40 x 3,0 mm	89	91	34	36	39	41
944110 x 35 x 40 x 3,0 mm	109	111	34	36	39	41
945130 x 35 x 40 x 3,0 mm	129	131	34	36	39	41

Continuation of Table A.2 Range of Sizes

Bracket type	Height (mm) vertical		Height (mm) horizontal		Width (mm)	
	min	max	min	max	min	max
Lochplattenwinkel						
10499 40 x 40 x 20 x 2,0 mm	39	41	39	41	19	21
10500 40 x 40 x 40 x 2,0 mm	39	41	39	41	39	41
10501 40 x 40 x 60 x 2,0 mm	39	41	39	41	59	61
10521 50 x 50 x 40 x 2,0 mm	49	51	49	51	39	41
10502 60 x 60 x 40 x 2,0 mm	59	61	59	61	39	41
10503 60 x 60 x 50 x 2,0 mm	59	61	59	61	49	51
10504 60 x 60 x 60 x 2,0 mm	59	61	59	61	59	61
10518 60 x 60 x 80 x 2,0 mm	59	61	59	61	79	81
10519 80 x 80 x 60 x 2,0 mm	79	81	79	81	59	61
10527 80 x 80 x 80 x 2,0 mm	79	81	79	81	79	81
10522 40 x 40 x 60 x 2,5 mm	39	41	39	41	59	61
10523 50 x 50 x 40 x 2,5 mm	49	51	49	51	39	41
10524 60 x 60 x 40 x 2,5 mm	59	61	59	61	39	41
10525 60 x 60 x 50 x 2,5 mm	59	61	59	61	49	51
10526 60 x 60 x 60 x 2,5 mm	59	61	59	61	59	61
10505 60 x 60 x 80 x 2,5 mm	59	61	59	61	79	81
10506 60 x 60 x 100 x 2,5 mm	59	61	59	61	99	101
10507 80 x 80 x 60 x 2,5 mm	79	81	79	81	59	61
10508 80 x 80 x 80 x 2,5 mm	79	81	79	81	79	81
10509 80 x 80 x 100 x 2,5 mm	79	81	79	81	99	101
10510 100 x 100 x 60 x 2,5 mm	99	101	99	101	59	61
10511 100 x 100 x 80 x 2,5 mm	99	101	99	101	79	81
10512 100 x 100 x 100 x 2,5 mm	99	101	99	101	99	101
10513 90 x 90 x 40 x 2,5 mm	89	91	89	91	39	41
10514 60 x 40 x 60 x 2,5 mm	59	61	39	41	59	61
10515 80 x 60 x 60 x 2,5 mm	79	81	59	61	59	61
10516 100 x 60 x 60 x 2,5 mm	99	101	59	61	59	61
10517 200 x 100 x 100 x 2,5 mm	199	201	99	101	99	101
Winkelverbinder t = 4,0 mm						
1884 130 x 70 x 80 x 4,0 mm	129	131	69	71	79	81
12116186 160 x 80 x 60 x 4,0 mm	159	161	79	81	59	61
12116188 160 x 80 x 80 x 4,0 mm	159	161	79	81	79	81
12116181 160 x 80 x 100 x 4,0 mm	159	161	79	81	99	101
Winkelverbinder 60 / 100						
60/100 100 x 60 x 60 x 2,5 mm	99	101	59	61	59	61
Winkelverbinder 692						
692 65 x 65 x 90 x 2,0 mm	64	66	64	65	89	91

Table A.3 Fastener specification

FASTENER	Length Min – max	Profiled length	Fastener type
GH-nail 4.0 mm	40 mm – 100 mm	according to ETA-13/0523	profiled nails according to ETA-13/0523
GH-screw 5.0 mm	40 mm – 70 mm	according to ETA-13/0523	screws according to ETA-13/0523
profiled nail 4.0 mm	40 mm – 100 mm	min. $0,7 \times L$	profiled nails according to EN 14592

Unless otherwise indicated, the load-carrying-capacities in Annex B are calculated based on a connection with profiled GH-nails according to ETA-13/0523.

If profiled nails according to EN 145592 shall be used as fasteners, the load-carrying capacity of timber in Annex B has to be reduced with the reduction factor given in table B.1

In steel-to-timber-connections with steel plates $t \geq 2,0$ mm, $\varnothing 4,0 \times 40$ mm GH-nails may be replaced by $\varnothing 5,0 \times 40$ mm GH-screws and $\varnothing 4,0 \times 60$ mm GH-nails may be replaced by $\varnothing 5,0 \times 70$ mm GH-screws according to ETA 13/0523 without reduction.

The reduction factor has been determined based on the use of profiled nails $\varnothing 4,0$ mm in accordance with EN 1995-1-1:2004 and EN 14592 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/mm²

d Nail diameter in mm

t_{pen} Penetration depth of the profiled shank including the nail point in mm

Based on tests by Versuchsanstalt für Stahl, Holz und Steine, Karlsruhe Institute of Technology, the characteristic value of the withdrawal resistance for the threaded nails used in timber with a characteristic density can be assumed as:

$$f_{ax,k} = 6,125 \text{ N/mm}^2$$

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.

BOLTS diameter	Correspondent Hole diameter	Bolt type
8.0 - 12.0 mm	Max. 2 mm. larger than the bolt diameter	Bolt according to EN 14592

METAL ANCHORS diameter	Correspondent Hole diameter	Anchor type
8.0 - 12.0 mm	Max. 2 mm. larger than the anchor diameter	See specification of the manufacturer

Annex B
Characteristic load-carrying capacities

Reduction factor**Table B.1:** reduction factor for connections with different fasteners

fastener type	reduction factor	
	t=1,5 mm	t=2,0 mm
GH-nail Ø4,0 x 40 mm according to ETA 13/0523	-	-
GH-screw Ø5,0 x 40 mm according to ETA 13/0523	0,72	-
threaded nail Ø4,0 x 40 mm according to EN 14592	0,76	0,76
GH-nail Ø4,0 x 60 mm according to ETA 13/0523	-	-
GH-screw Ø5,0 x 70 mm according to ETA 13/0523	0,82	-
threaded nail Ø4,0 x 60 mm according to EN 14592	0,69	0,69

Standardwinkelverbinder timber to timber**Table B.2:** Force F_1 Column, 2 angle brackets / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)		
			GH-Nails 4x40 mm		GH-Nails 4x60 mm
			Timber	Steel	Timber
55/02S 70x70x55x2,0 mm	1,2,3	9,10,14,15,16	1,72**	0,83	-
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-		9,7
55/02S15 70x70x55x1,5 mm	1,2,3	12,13,15,16,17,18,19	2,10	0,6	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-		9,7
65/04S 90x90x65x2,5 mm	1,2	14,15,19,20,21,25,26	2,34**	2,46	--
65/03S 90x90x65x2,5 mm	1,2	12,13,16,17,21,22	2,42**	11,2	10,7 *
65/04S15 90x90x65x1,5 mm	1,2,6	18,19,21,22,24,25,27,28	5,93	0,55	-
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,18,19, 21,22	-		10,7
90/04S 105x105x90x3,0 mm	1,2,4,5,6	12,13,14,15,16,17,20,21, 22,24,25	7,69**	5,40	21,3 *
90/03S 105x105x90x3,0 mm	1,2,6,7	14,15,16,17,20,21,27,28	4,85**	21,5	15,0 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		21,3
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		15,0

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Table B.3: Force F_1 Column, 1 angle bracket / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)		
			GH-Nails 4x40 mm		GH-Nails 4x60 mm
			Timber	Steel	Timber
55/02S 70x70x55x2,0 mm	1,2,3	9,10,14,15,16	0,86**	0,42	
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-		4,8
55/02S15 70x70x55x1,5 mm	1,2,3	12,13,15,16,17,18,19	1,05	0,33	
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-		4,8
65/04S 90x90x65x2,5 mm	1,2	14,15,19,20,21,25,26	1,17**	1,23	
65/03S 90x90x65x2,5 mm	1,2	12,13,16,17,21,22	1,21**	5,61	5,3 *
65/04S15 90x90x65x1,5 mm	1,2,6	18,19,21,22,24,25,27,28	2,97	0,28	
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,18,19, 21,22	-		5,3
90/04S 105x105x90x3,0 mm	1,2,4,5,6	12,13,14,15,16,17,20,21, 22,24,25	3,85**	2,70	10,6 *
90/03S 105x105x90x3,0 mm	1,2,6,7	14,15,16,17,20,21,27,28	2,43**	10,7	7,5 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		10,6
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		7,5

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Table B.4: Force F_1 Purlin, 2 angle brackets / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (purlin)		
			GH-Nails 4x40 mm		GH-Nails 4x60 mm
			Timber	Steel	Timber
55/02S 70x70x55x2,0 mm	1,2,3,4,5	9,10,14,15,16	1,72**	0,83	-
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-		9,7
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	12,13,15,16,17,18,19	2,10	0,66	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-		9,7
65/04S 90x90x65x2,5 mm	1,2, 4,5,7,8,9,11	14,15,19,20,21,25,26	2,34**	2,46	-
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	12,13,16,17,21,22	2,42**	11,2	10,7 *
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	18,20,21,22,24,25,27,28	5,93	0,55	-
65/03S15 90x90x65x1,5 mm	Full nailing	Full nailing	-		10,7
90/04S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,20,21,2 2,24,25	7,69**	5,40	21,3 *
90/03S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9,10,1 1	14,15,16,17,20,21,27,28	4,85**	21,5	15,0 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		21,3
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		15,0

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Table B.5: Force F_1 Purlin, 1 angle bracket / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (purlin)		
			GH-Nails 4x40 mm		GH-Nails 4x60 mm
			Timber	Steel	Timber
55/02S 70x70x55x2,0 mm	1,2,3,4,5	9,10,14,15,16	0,86**	0,42	-
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-		4,8
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	12,13,15,16,17,18,19	1,05	0,33	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-		4,8
65/04S 90x90x65x2,5 mm	1,2, 4,5,7,8,9,11	14,15,19,20,21,25,26	1,17**	1,23	-
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	12,13,16,17,21,22	1,21**	5,61	5,3 *
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	18,20,21,22,24,25,27,28	2,97	0,28	-
65/03S15 90x90x65x1,5 mm	Full nailing	Full nailing	-		5,3
90/04S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,20,21,2 2,24,25	3,85**	2,70	10,6 *
90/03S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9,10,1 1	14,15,16,17,20,21,27,28	2,43**	10,7	7,5 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		10,6
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		7,5

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

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

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	
			GH-Nails 4x40 mm	GH-Nails 4x60 mm
			Timber	Timber
55/02S 70x70x55x2,0 mm	1,2,3,4,5	9,10,14,15,16	4,66**	-
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-	10,2
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	12,13,15,16,17,18,19	8,03	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-	10,2
65/04S 90x90x65x2,5 mm	1,2, 4,5,7,8,9,11	14,15,19,20,21,25,26	7,29**	-
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	12,13,16,17,21,22	7,45**	13,5 *
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	18,20,21,22,24,25,27,28	8,22	-
65/03S15 90x90x65x1,5 mm	Full nailing	Full nailing	-	13,5
90/04S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,20,21,22,24,25	11,31**	19,1 *
90/03S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9,10,11	14,15,16,17,20,21,27,28	8,36**	20,5 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-	19,1
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-	20,5

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Table B.7: Force $F_{2/3}$, 1 angle bracket / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	
			GH-Nails 4x40 mm	GH-Nails 4x60 mm
			Timber	Timber
55/02S 70x70x55x2,0 mm	1,2,3,4,5	9,10,14,15,16	2,33**	-
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-	5,1
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	12,13,15,16,17,18,19	4,02	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-	5,1
65/04S 90x90x65x2,5 mm	1,2, 4,5,7,8,9,11	14,15,19,20,21,25,26	3,64**	-
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	12,13,16,17,21,22	3,72**	6,7 *
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	18,20,21,22,24,25,27,28	4,11	-
65/03S15 90x90x65x1,5 mm	Full nailing	Full nailing	-	6,7
90/04S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,20,21,22,24,25	5,66**	9,5 *
90/03S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9,10,11	14,15,16,17,20,21,27,28	4,18**	10,2 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-	9,5
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-	10,2

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Table B.8: Basic Force $F_{4/5,2}$ angle brackets / connection, timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{4/5,k}$ [kN]		
			GH-Nails 4x40 mm		GH-Nails 4x60 mm
			Timber	Steel	Timber
55/02S 70x70x55x2,0 mm	1,2,3,4,5	9,10,14,15,16	6,49**	3,28	
55/01S 70x70x55x2,0 mm	Full nailing	Full nailing	-		11,1
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	12,13,15,16,17,18,19	5,99	2,51	-
55/01S15 70x70x55x1,5 mm	Full nailing	Full nailing	-		11,1
65/04S 90x90x65x2,5 mm	1,2, 4,5,7,8,9,11	14,15,19,20,21,25,26	6,40**	4,35	-
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	12,13,16,17,21,22	9,42**	5,06	11,7 *
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	18,20,21,22,24,25,27,28	8,44	2,96	-
65/03S15 90x90x65x1,5 mm	Full nailing	Full nailing	-		11,7
90/04S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9	12,13,14,15,16,17,20,21, 22,24,25	8,82**	6,06	16,5 *
90/03S 105x105x90x3,0 mm	1,2,4,5,6,7,8,9,10,11	14,15,16,17,20,21,27,28	12,4**	12,8	12,4 *
90/04S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		16,5
90/03S20 105x105x90x2,0 mm	Full nailing	Full nailing	-		12,4

* Full nailing

** Values are also valid with profiled nails 4,0 x 40 according to EN 14592 and have not to be reduced according to table B.1

Standardwinkelverbinder timber to concrete**Table B.9:** Force F_1 Column, 2 angle brackets / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)		Bolt
			Timber	Steel	k_t ll
55/02S 70x70x55x2,0 mm	1,2,3	14	11,3	0,72	1,20
55/01S 70x70x55x2,0 mm	1,2	16	7,56	0,43	4,33
55/02S15 70x70x55x1,5 mm	1,2,3	14	11,3	0,59	1,20
55/01S15 70x70x55x1,5 mm	1,2	16	7,56	0,35	4,33
65/04S 90x90x65x2,5 mm	1,2	16,17	7,56	6,23	0,61
65/03S 90x90x65x2,5 mm	1,2	20	7,56	0,48	5,31
65/04S15 90x90x65x1,5 mm	1,2	16,17	7,56	3,27	0,61
65/03S15 90x90x65x1,5 mm	1,2	20	7,56	0,31	5,31
90/04S 105x105x90x3,0 mm	1,2,3,4,5	18,19	18,9	3,22	0,77
90/03S 105x105x90x3,0 mm	22,23,27,28	12,13	15,1	18,2	0,63
90/04S20 105x105x90x2,0 mm	1,2,3,4,5	18,19	18,9	2,09	0,77
90/03S20 105x105x90x2,0 mm	22,23,27,28	12,13	15,1	19,0	0,63

Table B.10: Force F_1 Column, 1 angle bracket / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)		Bolt k_t II
			Timber	Steel	
55/02S 70x70x55x2,0 mm	1,2,3	14	5,67	0,36	2,41
55/01S 70x70x55x2,0 mm	1,2	16	3,78	0,22	8,67
55/02S15 70x70x55x1,5 mm	1,2,3	14	5,67	0,29	2,41
55/01S15 70x70x55x1,5 mm	1,2	16	3,78	0,18	8,67
65/04S 90x90x65x2,5 mm	1,2	16,17	3,78	3,12	1,21
65/03S 90x90x65x2,5 mm	1,2	20	3,78	0,24	10,6
65/04S15 90x90x65x1,5 mm	1,2	16,17	3,78	1,64	1,21
65/03S15 90x90x65x1,5 mm	1,2	20	3,78	0,15	10,6
90/04S 105x105x90x3,0 mm	1,2,3,4,5	18,19	9,45	1,61	1,54
90/03S 105x105x90x3,0 mm	22,23,27,28	12,13	7,56	9,08	1,27
90/04S20 105x105x90x2,0 mm	1,2,3,4,5	18,19	9,45	1,04	1,54
90/03S20 105x105x90x2,0 mm	22,23,27,28	12,13	7,56	9,48	1,27

Table B.11: Force F_1 Purlin, 2 angle brackets / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (purlin)		Bolt k_t II
			Timber	Steel	
55/02S 70x70x55x2,0 mm	1,2,3,4,5,7,8	14	26,5	0,72	1,20
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	22,7	0,43	4,33
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	14	26,5	0,59	1,20
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	22,7	0,35	4,33
65/04S 90x90x65x2,5 mm	1,2,4,5,7,8,9,11	16,17	30,2	6,23	0,61
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	30,2	0,48	5,31
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	16,17	30,2	3,27	0,61
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	30,2	0,31	5,31
90/04S 105x105x90x3,0 mm	1,2,3,4,5,6,7,8	18,19	30,2	3,22	0,77
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	37,8	18,2	0,63
90/04S20 105x105x90x2,0 mm	1,2,3,4,5,6,7,8	18,19	30,2	2,09	0,77
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	37,8	19,0	0,63

Table B.12: Force F_1 Purlin, 1 angle bracket / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (purlin)		Bolt k_t II
			Timber	Steel	
55/02S 70x70x55x2,0 mm	1,2,3,4,5,7,8	14	13,2	0,36	2,41
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	11,3	0,22	8,67
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	14	13,2	0,29	2,41
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	11,0	0,18	8,67
65/04S 90x90x65x2,5 mm	1,2,4,5,7,8,9,11	16,17	15,1	3,12	1,21
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	15,1	0,29	10,6
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	16,17	15,1	1,64	1,21
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	15,1	0,15	10,6
90/04S 105x105x90x3,0 mm	1,2,3,4,5,6,7,8	18,19	15,1	1,61	1,54
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	18,9	9,08	1,27
90/04S20 105x105x90x2,0 mm	1,2,3,4,5,6,7,8	18,19	15,1	1,04	1,54
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	18,9	9,48	1,27

Table B.13: Force $F_{2/3}$, 2 angle brackets / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	Bolt
			Timber	$k_t \perp$
55/02S 70x70x55x2,0 mm	1,2,3,4,5,7,8	14	3,36	0,50
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	2,11	0,50
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	14	3,36	0,50
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	2,11	0,50
65/04S 90x90x65x2,5 mm	1,2,4,5,7,8,9,11	16,17	6,88	0,30
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	2,10	0,50
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	16,17	6,88	0,30
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	2,10	0,50
90/04S 105x105x90x3,0 mm	1,2,3,4,5,6,7,8	18,19	10,3	0,43
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	12,4	0,32
90/04S20 105x105x90x2,0 mm	1,2,3,4,5,6,7,8	18,19	10,3	0,43
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	12,4	0,32

Table B.14: Force $F_{2/3}$, 1 angle bracket / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	Bolt
			Timber	$k_t \perp$
55/02S 70x70x55x2,0 mm	1,2,3,4,5,7,8	14	1,68	1,0
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	1,05	1,0
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	14	1,68	1,0
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	1,05	1,0
65/04S 90x90x65x2,5 mm	1,2,4,5,7,8,9,11	16,17	3,44	0,60
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	1,05	1,0
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	16,17	3,44	0,60
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	1,05	1,0
90/04S 105x105x90x3,0 mm	1,2,3,4,5,6,7,8	18,19	5,15	0,86
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	6,21	0,63
90/04S20 105x105x90x2,0 mm	1,2,3,4,5,6,7,8	18,19	5,15	0,86
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	6,21	0,63

Table B.15: Basic Force $F_{4/5,2}$ angle brackets / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail Number n_v	Bolt number n_h	$R_{4/5,k}$ [kN]		Bolt	
			Timber	Steel	$k_t \perp$	$k_t \parallel$
55/02S 70x70x55x2,0 mm	1,2,3,4,5,7,8	14	5,36	2,39	0,75	0,14
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	6,79	4,00	0,71	0,20
55/02S15 70x70x55x1,5 mm	1,2,3,4,5,7,8	14	4,78	2,29	0,80	0,12
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	6,76	4,37	0,73	0,19
65/04S 90x90x65x2,5 mm	1,2,4,5,7,8,9,11	16,17	7,15	3,37	0,40	0,14
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	6,98	4,48	0,71	0,14
65/04S15 90x90x65x1,5 mm	1,2,4,5,7,8,9,11	16,17	5,03	2,71	0,43	0,10
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	7,06	6,06	0,76	0,17
90/04S 105x105x90x3,0 mm	1,2,3,4,5,6,7,8	18,19	8,78	6,15	0,40	0,08
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	5,80	36,8	0,45	0,08
90/04S20 105x105x90x2,0 mm	1,2,3,4,5,6,7,8	18,19	7,33	5,71	0,42	0,06
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	5,78	27,8	0,45	0,07

Table B.16: Basic Force F_4 , langle bracket / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail Number n_v	Bolt number n_h	$R_{5,k}$ [kN]		Bolt	
			Timber	Steel	$k_t \perp$	
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	7,33	3,36	1,0	
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	6,92	3,63	1,0	
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	8,34	4,22	1,0	
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	8,57	4,54	1,0	
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	5,44	32,9	0,5	
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	5,44	27,8	0,5	

Table B.17: Basic Force F_5 , langle bracket / connection, timber to concrete; GH-Nails 4,0x40 mm

Bracket type	Nail Number n_v	Bolt number n_h	$R_{5,k}$ [kN]		Bolt	
			Timber	Steel	$k_t \perp$	$k_t \parallel$
55/01S 70x70x55x2,0 mm	1,2,4,5,6,7	16	1,97	1,19	1,0	0,67
55/01S15 70x70x55x1,5 mm	1,2,4,5,6,7	16	1,79	1,16	1,0	0,72
65/03S 90x90x65x2,5 mm	1,2,4,5,6,7,8,9	20	2,03	1,30	1,0	0,58
65/03S15 90x90x65x1,5 mm	1,2,4,5,6,7,8,9	20	1,69	0,96	1,0	0,58
90/03S 105x105x90x3,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	1,77	4,73	0,5	0,79
90/03S20 105x105x90x2,0 mm	18,19,20,21,22,23,24, 25,27,28	12,13	1,62	5,41	0,5	,078

Konsolenwinkel**Table B.18:** Force F_1 Column, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4,6,7	1,89	2,36	0,8	1,5
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	1,89	2,36	0,8	1,5
Typ 160 160 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5
Typ 180 180 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5
Typ 200 200 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5

Table B.19: Force F_1 Column, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4,6,7	1,89	2,36	0,4	3,0
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	1,89	2,36	0,4	3,0
Typ 160 160 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0
Typ 180 180 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0
Typ 200 200 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0

Table B.20: Force F_1 Purlin, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4,6,7	1,89	2,36	0,8	1,5
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	1,89	2,36	0,8	1,5
Typ 160 160 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5
Typ 180 180 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5
Typ 200 200 x 54 x 60 x 2,5 mm		1,89	2,36	0,8	1,5

Table B.21: Force F_1 Purlin, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4,6,7	1,89	2,36	0,4	3,0
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	1,89	2,36	0,4	3,0
Typ 160 160 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0
Typ 180 180 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0
Typ 200 200 x 54 x 60 x 2,5 mm		1,89	2,36	0,4	3,0

Table B.22: Force $F_{2/3}$, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			GH-Nails 4x40	GH-Nails 4x60	$k_t \perp$
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	4,58	6,54	0,5
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	4,17	5,80	0,5
Typ 160 160 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	3,80	5,18	0,5
Typ 180 180 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	3,47	4,67	0,5
Typ 200 200 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	3,19	4,23	0,5

Table B.23: Force $F_{2/3}$, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			GH-Nails 4x40	GH-Nails 4x60	$k_t \perp$
Typ 120 120 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	2,29	3,27	1,0
Typ 140 140 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	2,09	2,90	1,0
Typ 160 160 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	1,90	2,59	1,0
Typ 180 180 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	1,74	2,33	1,0
Typ 200 200 x 54 x 60 x 2,5 mm	1,2,3,4, 6,7,8,9	12	1,59	2,12	1,0

Zuganker (HS)**Table B.24:** Force F_1 Column, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
943 90 x 35 x 40 x 3,0 mm	1,2,3,	1,89	2,36	1,80	1,2
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5	1,89	2,36	1,80	1,2
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	1,89	2,36	1,80	1,2

Table B.25: Force F_1 Column, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
943 90 x 35 x 40 x 3,0 mm	1,2,3,	1,89	2,36	0,90	2,4
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5	1,89	2,36	0,90	2,4
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	1,89	2,36	0,90	2,4

Table B.26: Force F_1 Purlin, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
943 90 x 35 x 40 x 3,0 mm	1,2,3,	1,89	2,36	1,80	1,2
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5	1,89	2,36	1,80	1,2
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	1,89	2,36	1,80	1,2

Table B.27: Force F_1 Purlin, 1 angle brackets / connection, Timber to timber

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		GH-Nails 4x40	GH-Nails 4x60		k_t
943 90 x 35 x 40 x 3,0 mm	1,2,3,	1,89	2,36	0,90	2,4
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5	1,89	2,36	0,90	2,4
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	1,89	2,36	0,90	2,4

Table B.28: Force $F_{2/3}$, 2 angle brackets / connection

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			Timber -Concrete		
			GH-Nails 4x40	GH-Nails 4x60	$k_t \perp$
943 90 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	8	3,39	5,13	0,5
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7,8,9	10	4,45	6,68	0,5
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7,8,9,10,11	12	5,51	8,23	0,5

Table B.29: Force $F_{2/3}$, 1 angle bracket / connection

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			Timber -Concrete		
			GH-Nails 4x40	GH-Nails 4x60	$k_t \perp$
943 90 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7	8	1,70	2,57	1,0
944 110 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7,8,9	10	2,22	3,34	1,0
945 130 x 35 x 40 x 3,0 mm	1,2,3,4,5,6,7,8,9,10,11	12	2,75	4,11	1,0

Lochplattenwinkel**Table B.30:** Force F₁ Column, 2 angle brackets / connection, Timber to timber; GH-Nails 4,0x40 mm

Bracket type	Nail number n _v	Nail number n _H	R _{1,k} [kN] (column)	
			Timber	Steel
10499 40 x 40 x 20 x 2,0 mm	---	101,111	---	---
10500 40 x 40 x 40 x 2,0 mm	---	101,102, 111,112	---	---
10501 40 x 40 x 60 x 2,0 mm	---	101,102,103, 111,112,113	---	---
10521 50 x 50 x 40 x 2,0 mm	---	101,102, 111,112	---	---
10502 60 x 60 x 40 x 2,0 mm	---	101,102,111,112, 121,122	---	---
10503 60 x 60 x 50 x 2,0 mm	---	101,102,103, 111,112,121,122,123	---	---
10504 60 x 60 x 60 x 2,0 mm	---	101,102,103,111,112,113, 121,122,123	---	---
10518 60 x 60 x 80 x 2,0 mm	---	101,102,103,104,111,112,113,114,121, 122,123,124	---	---
10519 80 x 80 x 60 x 2,0 mm	31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	4,68	2,16
10527 80 x 80 x 80 x 2,0 mm	31,32,33,34	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134	6,24	2,88
10522 40 x 40 x 60 x 2,5 mm	---	101,102,103, 111,112,113	---	---
10523 50 x 50 x 40 x 2,5 mm	---	101,102, 111,112	---	---
10524 60 x 60 x 40 x 2,5 mm	---	101,102, 111,112,121,122	---	---
10525 60 x 60 x 50 x 2,5 mm	---	101,102,103, 111,112,121,122,123	---	---
10526 60 x 60 x 60 x 2,5 mm	---	101,102,103, 111,112,113,121,122,123	---	---
10505 60 x 60 x 80 x 2,5 mm	---	101 ÷ 104, 111 ÷ 114, 121 ÷ 124	---	---
10506 60 x 60 x 100 x 2,5 mm	---	101 ÷ 105, 111 ÷ 115, 121 ÷ 125	---	---
10507 80 x 80 x 60 x 2,5 mm	31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	4,68	3,38
10508 80 x 80 x 80 x 2,5 mm	31,32,33,34	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134	5,14	4,50
10509 80 x 80 x 100 x 2,5 mm	31,32,33,34,35	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135	7,80	5,63
10510 100 x 100 x 60 x 2,5 mm	31,32,33, 41,42,43	101,102,103,111,112,113,121,122,123, 131,132,133,141,142,143	4,83	3,38
10511 100 x 100 x 80 x 2,5 mm	31,32,33,34, 41,42,43,44	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134, 141 ÷ 144	6,44	4,50
10512 100 x 100 x 100 x 2,5 mm	31,32,33,34,35,41 ,42,43,44,45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135,141 ÷ 145	8,05	5,63
10513 90 x 90 x 40 x 2,5 mm	31,32	101,102,111,112,121,122,131,132	2,27	1,13
10514 60 x 40 x 60 x 2,5 mm	---	101,102,103, 111,112,113	---	---

10515 80 x 60 x 60 x 2,5 mm	31,32,33	101,102,103,111,112,113, 121,122,123	4,42	3,38
10516 100 x 60 x 60 x 2,5 mm	31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	4,42	3,38
10517 200 x 100 x 100 x 2,5 mm	31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	8,05	5,63

Table B.31: Force F_1 Column, 1 angle bracket / connection, Timber to timber; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
10499 40 x 40 x 20 x 2,0 mm	---	101,111	---	---
10500 40 x 40 x 40 x 2,0 mm	---	101,102, 111,112	---	---
10501 40 x 40 x 60 x 2,0 mm	---	101,102,103, 111,112,113	---	---
10521 50 x 50 x 40 x 2,0 mm	---	101,102, 111,112	---	---
10502 60 x 60 x 40 x 2,0 mm	---	101,102, 111,112, 121,122	---	---
10503 60 x 60 x 50 x 2,0 mm	---	101,102,103, 111,112,121,122,123	---	---
10504 60 x 60 x 60 x 2,0 mm	---	101,102,103,111,112,113, 121,122,123	---	---
10518 60 x 60 x 80 x 2,0 mm	---	101,102,103,104,111,112,113,114,121, 122,123,124	---	---
10519 80 x 80 x 60 x 2,0 mm	31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	2,34	1,08
10527 80 x 80 x 80 x 2,0 mm	31,32,33,34	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134	3,12	1,44
10522 40 x 40 x 60 x 2,5 mm	---	101,102,103, 111,112,113	---	---
10523 50 x 50 x 40 x 2,5 mm	---	101,102, 111,112	---	---
10524 60 x 60 x 40 x 2,5 mm	---	101,102, 111,112,121,122	---	---
10525 60 x 60 x 50 x 2,5 mm	---	101,102,103, 111,112,121,122,123	---	---
10526 60 x 60 x 60 x 2,5 mm	---	101,102,103, 111,112,113,121,122,123	---	---
10505 60 x 60 x 80 x 2,5 mm	---	101 ÷ 104, 111 ÷ 114, 121 ÷ 124	---	---
10506 60 x 60 x 100 x 2,5 mm	---	101 ÷ 105, 111, ÷ 115, 121 ÷ 125	---	---
10507 80 x 80 x 60 x 2,5 mm	31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	2,34	1,69
10508 80 x 80 x 80 x 2,5 mm	31,32,33,34	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134	2,57	2,25
10509 80 x 80 x 100 x 2,5 mm	31,32,33,34,35	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135	3,90	2,81

10510 100 x 100 x 60 x 2,5 mm	31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	2,42	1,69
10511 100 x 100 x 80 x 2,5 mm	31,32,33,34, 41,42,43,44	101 ÷ 104, 111 ÷ 114, 121 ÷ 124, 131 ÷ 134, 141 ÷ 144	3,22	2,25
10512 100 x 100 x 100 x 2,5 mm	31,32,33,34,35,41 ,42,43,44,45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	4,03	2,81
10513 90 x 90 x 40 x 2,5 mm	31,32	101,102,111,112, 121,122,131,132	1,13	0,56
10514 60 x 40 x 60 x 2,5 mm	---	101,102,103, 111,112,113	---	---
10515 80 x 60 x 60 x 2,5 mm	31,32,33	101,102,103,111,112,113, 121,122,123	2,21	1,69
10516 100 x 60 x 60 x 2,5 mm	31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	2,21	1,69
10517 200 x 100 x 100 x 2,5 mm	31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	4,03	2,81

Table B.32: Force F_1 Purlin, 2 angle brackets / connection, Timber to timber; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
10499 40 x 40 x 20 x 2,0 mm	11	101,111	1,29	0,72
10500 40 x 40 x 40 x 2,0 mm	11,12	101,102, 111,112	2,57	1,44
10501 40 x 40 x 60 x 2,0 mm	11,12,13	101,102,103, 111,112,113	3,86	2,16
10521 50 x 50 x 40 x 2,0 mm	11,12	101,102, 111,112	2,00	0,72
10502 60 x 60 x 40 x 2,0 mm	11,12, 21,22	101,102,111,112, 121,122	2,95	1,44
10503 60 x 60 x 50 x 2,0 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	4,42	1,68
10504 60 x 60 x 60 x 2,0 mm	11,12,13, 21,22,23	101,102,103,111,112,113, 121,122,123	4,42	2,16
10518 60 x 60 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24	101,102,103,104,111,112,113,114,121, 122,123,124	5,89	2,88
10519 80 x 80 x 60 x 2,0 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	4,68	2,16
10527 80 x 80 x 80 x 2,0 mm	11 ÷ 14, 21 ÷ 24, 31 ÷ 34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	6,24	2,88
10522 40 x 40 x 60 x 2,5 mm	11,12,13	101,102,103, 111,112,113	3,86	3,38
10523 50 x 50 x 40 x 2,5 mm	11,12	101,102, 111,112	2,00	1,13
10524 60 x 60 x 40 x 2,5 mm	11,12, 21,22	101,102, 111,112,121,122	2,95	2,25
10525 60 x 60 x 50 x 2,5 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	4,42	2,63
10526 60 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113,121,122,123	4,42	3,38

10505 60 x 60 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24	101,102,103,104, 111,112,113,114,121,122,123,124	5,89	4,50
10506 60 x 60 x 100 x 2,5 mm	11,12,13,14,15,21 ,22,23,24,25	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125	7,36	5,63
10507 80 x 80 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	4,68	3,38
10508 80 x 80 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	5,14	4,50
10509 80 x 80 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135,	7,80	5,63
10510 100 x 100 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	4,83	3,38
10511 100 x 100 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34, 41,42,43,44	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134,141,142, 143,144	6,44	4,50
10512 100 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	8,05	5,63
10513 90 x 90 x 40 x 2,5 mm	11,12, 21,22, 31,32	101,102,111,112, 121,122,131,132	2,27	1,13
10514 60 x 40 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113	3,86	3,38
10515 80 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123	4,42	3,38
10516 100 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	4,42	3,38
10517 200 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	8,05	5,63

Table B.33: Force F_1 Purlin, 1 angle bracket / connection, Timber to timber; GH-Nails 4,0x40 mm

Bracket type	Nail number n_v	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
10499 40 x 40 x 20 x 2,0 mm	11	101,111	0,64	0,36
10500 40 x 40 x 40 x 2,0 mm	11,12	101,102, 111,112	1,29	0,72
10501 40 x 40 x 60 x 2,0 mm	11,12,13	101,102,103, 111,112,113	1,93	1,08
10521 50 x 50 x 40 x 2,0 mm	11,12	101,102, 111,112	1,00	0,36
10502 60 x 60 x 40 x 2,0 mm	11,12, 21,22	101,102, 111,112, 121,122	1,47	0,72
10503 60 x 60 x 50 x 2,0 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	2,21	0,84
10504 60 x 60 x 60 x 2,0 mm	11,12,13, 21,22,23	101,102,103,111,112,113, 121,122,123	2,21	1,08
10518 60 x 60 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24	101,102,103,104,111,112,113,114,121, 122,123,124	2,95	1,44
10519 80 x 80 x 60 x 2,0 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	2,34	1,08
10527 80 x 80 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	3,12	1,44
10522 40 x 40 x 60 x 2,5 mm	11,12,13	101,102,103, 111,112,113	1,93	1,69
10523 50 x 50 x 40 x 2,5 mm	11,12	101,102, 111,112	1,00	0,56
10524 60 x 60 x 40 x 2,5 mm	11,12, 21,22	101,102, 111,112,121,122	1,47	1,13
10525 60 x 60 x 50 x 2,5 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	2,21	1,31
10526 60 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113,121,122,123	2,21	1,69
10505 60 x 60 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24	101,102,103,104, 111,112,113,114,121,122,123,124	2,95	2,25
10506 60 x 60 x 100 x 2,5 mm	11,12,13,14,15,21, 22,23,24,25	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125	3,68	2,81
10507 80 x 80 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	2,34	1,69
10508 80 x 80 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	2,57	2,25
10509 80 x 80 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135	3,90	2,81
10510 100 x 100 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	2,42	1,69

10511 100 x 100 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34, 41,42,43,44	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134,141,142, 143,144	3,22	2,25
10512 100 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	4,03	2,81
10513 90 x 90 x 40 x 2,5 mm	11,12, 21,22, 31,32	101,102,111,112, 121,122,131,132	1,13	0,56
10514 60 x 40 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113	1,93	1,69
10515 80 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123	2,21	1,69
10516 100 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	2,21	1,69
10517 200 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	4,03	2,81

Table B.34: Force $F_{2/3}$, 2 angle brackets / connection; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]
			Timber
10499 40 x 40 x 20 x 2,0 mm	11	101,111	---
10500 40 x 40 x 40 x 2,0 mm	11,12	101,102, 111,112	3,80
10501 40 x 40 x 60 x 2,0 mm	11,12,13	101,102,103, 111,112,113	7,18
10521 50 x 50 x 40 x 2,0 mm	11,12	101,102, 111,112	2,94
10502 60 x 60 x 40 x 2,0 mm	11,12, 21,22	101,102, 111,112, 121,122	5,14
10503 60 x 60 x 50 x 2,0 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	7,35
10504 60 x 60 x 60 x 2,0 mm	11,12,13, 21,22,23	101,102,103,111,112,113, 121,122,123	9,45
10518 60 x 60 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24	101,102,103,104,111,112,113,114,121, 122,123,124	14,88
10519 80 x 80 x 60 x 2,0 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	11,90
10527 80 x 80 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	18,22
10522 40 x 40 x 60 x 2,5 mm	11,12,13	101,102,103, 111,112,113	7,18
10523 50 x 50 x 40 x 2,5 mm	11,12	101,102, 111,112	2,94
10524 60 x 60 x 40 x 2,5 mm	11,12, 21,22	101,102, 111,112,121,122	5,14

10525 60 x 60 x 50 x 2,5 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	7,35
10526 60 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113,121,122,123	9,45
10505 60 x 60 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24	101,102,103,104, 111,112,113,114,121,122,123,124	14,88
10506 60 x 60 x 100 x 2,5 mm	11,12,13,14,15,21 ,22,23,24,25	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125	21,30
10507 80 x 80 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	11,90
10508 80 x 80 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	15,37
10509 80 x 80 x 100 x 2,5 mm	11,12,13,14,15,21 ,22,23,24,25,31,3 2,33,34,35	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125, 131,132,133,134,135	25,73
10510 100 x 100 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	14,41
10511 100 x 100 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34, 41,42,43,44	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134,141,142, 143,144	21,50
10512 100 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	29,82
10513 90 x 90 x 40 x 2,5 mm	11,12, 21,22, 31,32	101,102,111,112, 121,122,131,132	5,10
10514 60 x 40 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113	8,62
10515 80 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123	10,86
10516 100 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	12,71
10517 200 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	35,27

Table B.35: Force $F_{2/3}$, 1 angle bracket / connection; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]
			Timber
10499 40 x 40 x 20 x 2,0 mm	11	101,111	---
10500 40 x 40 x 40 x 2,0 mm	11,12	101,102,111,112	1,90
10501 40 x 40 x 60 x 2,0 mm	11,12,13	101,102,103,111,112,113	3,59
10521 50 x 50 x 40 x 2,0 mm	11,12	101,102,111,112	1,47
10502 60 x 60 x 40 x 2,0 mm	11,12,21,22	101,102,111,112,121,122	2,57
10503 60 x 60 x 50 x 2,0 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	3,68
10504 60 x 60 x 60 x 2,0 mm	11,12,13, 21,22,23	101,102,103,111,112,113, 121,122,123	4,72
10518 60 x 60 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24	101,102,103,104,111,112,113,114,121, 122,123,124	7,44
10519 80 x 80 x 60 x 2,0 mm	11,12,13,21,22, 23,31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	5,95
10527 80 x 80 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	9,11
10522 40 x 40 x 60 x 2,5 mm	11,12,13	101,102,103, 111,112,113	3,59
10523 50 x 50 x 40 x 2,5 mm	11,12	101,102, 111,112	1,47
10524 60 x 60 x 40 x 2,5 mm	11,12, 21,22	101,102, 111,112,121,122	2,57
10525 60 x 60 x 50 x 2,5 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	3,68
10526 60 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113,121,122,123	4,73
10505 60 x 60 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24	101,102,103,104, 111,112,113,114,121,122,123,124	7,44
10506 60 x 60 x 100 x 2,5 mm	11,12,13,14,15, 21,22,23,24,25	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125	10,65
10507 80 x 80 x 60 x 2,5 mm	11,12,13,21,22, 23,31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	5,95
10508 80 x 80 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	7,68
10509 80 x 80 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135,	12,87
10510 100 x 100 x 60 x 2,5 mm	11,12,13,21,22, 23,31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	7,20
10511 100 x 100 x 80 x 2,5 mm	11 ÷ 14, 21 ÷ 24, 31 ÷ 34, 41 ÷ 44	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134,141,142, 143,144	10,75
10512 100 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	14,91

10513 90 x 90 x 40 x 2,5 mm	11,12, 21,22, 31,32	101,102,111,112, 121,122,131,132	2,55
10514 60 x 40 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113	4,31
10515 80 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123	5,43
10516 100 x 60 x 60 x 2,5 mm	11,12,13,21,22, 23,31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	6,35
10517 200 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	17,63

Table B.36: Basic Force $F_{4/5}$, 2 angle brackets / connection; GH-Nails 4,0x40 mm

Bracket type	Nail number n_V	Nail number n_H	$R_{4/5,k}$ [kN] (column)	
			Timber	Steel
10499 40 x 40 x 20 x 2,0 mm	11	101,111	3,28	0,80
10500 40 x 40 x 40 x 2,0 mm	11,12	101,102, 111,112	3,28	1,60
10501 40 x 40 x 60 x 2,0 mm	11,12,13	101,102,103, 111,112,113	9,84	2,40
10521 50 x 50 x 40 x 2,0 mm	11,12	101,102, 111,112	7,29	1,86
10502 60 x 60 x 40 x 2,0 mm	11,12,21,22	101,102,111,112,121,122	5,19	1,81
10503 60 x 60 x 50 x 2,0 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	5,85	2,09
10504 60 x 60 x 60 x 2,0 mm	11,12,13, 21,22,23	101,102,103,111,112,113, 121,122,123	7,79	2,72
10518 60 x 60 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24	101,102,103,104,111,112,113,114,121, 122,123,124	10,39	3,63
10519 80 x 80 x 60 x 2,0 mm	11,12,13,21,22, 23,31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	8,20	2,80
10527 80 x 80 x 80 x 2,0 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	11,52	3,69
10522 40 x 40 x 60 x 2,5 mm	11,12,13	101,102,103, 111,112,113	9,09	3,10
10523 50 x 50 x 40 x 2,5 mm	11,12	101,102, 111,112	7,61	2,23
10524 60 x 60 x 40 x 2,5 mm	11,12, 21,22	101,102, 111,112,121,122	5,19	1,81
10525 60 x 60 x 50 x 2,5 mm	11,12, 21,22,23	101,102,103, 111,112,121,122,123	5,48	2,53
10526 60 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113,121,122,123	7,17	3,29
10505 60 x 60 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24	101,102,103,104, 111,112,113,114,121,122,123,124	9,56	4,39

10506 60 x 60 x 100 x 2,5 mm	11,12,13,14,15,21 ,22,23,24,25	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125	12,44	5,67
10507 80 x 80 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123,131,132,133	7,47	3,53
10508 80 x 80 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134	10,43	4,66
10509 80 x 80 x 100 x 2,5 mm	11,12,13,14,15,21 ,22,23,24,25,31,3 2,33,34,35	101,102,103,104,105, 111,112,113,114,115, 121,122,123,124,125, 131,132,133,134,135	13,68	5,98
10510 100 x 100 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123,131,132,133, 141,142,143	31,76	3,58
10511 100 x 100 x 80 x 2,5 mm	11,12,13,14, 21,22,23,24, 31,32,33,34, 41,42,43,44	101,102,103,104,111,112,113,114,121, 122,123,124,131,132,133,134,141,142, 143,144	11,79	4,77
10512 100 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	14,80	7,46
10513 90 x 90 x 40 x 2,5 mm	11,12, 21,22, 31,32	101,102,111,112, 121,122,131,132	6,64	2,40
10514 60 x 40 x 60 x 2,5 mm	11,12,13, 21,22,23	101,102,103, 111,112,113	6,95	3,92
10515 80 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33	101,102,103,111,112,113, 121,122,123	7,87	3,65
10516 100 x 60 x 60 x 2,5 mm	11,12,13, 21,22,23, 31,32,33, 41,42,43	101,102,103,111,112,113, 121,122,123	8,26	3,67
10517 200 x 100 x 100 x 2,5 mm	11 ÷ 15, 21 ÷ 25, 31 ÷ 35, 41 ÷ 45 51 ÷ 55, 61 ÷ 65, 71 ÷ 75, 81 ÷ 85, 91 ÷ 95	101 ÷ 105, 111 ÷ 115, 121 ÷ 125, 131 ÷ 135, 141 ÷ 145	14,80	7,46

Winkelverbinder t = 4,0 mm**Table B.37:** Force F_1 Column, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n_v	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 40 mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	5,65	8,57
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	7,80	15,0
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	6,24	8,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	6,24	12,0
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 60 mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	9,42	8,57
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	13,00	15,0
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	10,40	8,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	10,40	12,0

Table B.38: Force F_1 Column, 1 angle bracket / connection, Timber to timber

Bracket type	Nail number n_v	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 40 mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	2,82	4,29
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	3,90	7,50
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	3,12	4,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	3,12	6,00
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 60 mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	4,71	4,29
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	6,50	7,50
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	5,20	4,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	5,20	6,00

Table B.39: Force F_1 Purlin, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 40$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	5,65	8,57
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	7,80	15,0
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	6,24	8,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	6,24	12,0
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 60$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	9,42	8,57
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	13,00	15,0
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	10,40	8,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	10,40	12,0

Table B.40: Force F_1 Purlin, 1 angle brackets / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 40$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	2,82	4,29
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	3,90	7,50
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	3,12	4,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	3,12	6,00
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 60$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	4,71	4,29
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	6,50	7,50
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	5,20	4,00
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	5,20	6,00

Table B.41: Force $F_{2/3}$, 2 angle brackets / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]
			Timber
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 40 mm			
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	13,26
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	16,42
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	9,60
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	11,89
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 60 mm			
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	16,86
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	20,94
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	12,17
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	15,15

Table B.42: Force $F_{2/3}$, 1 angle bracket / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]
			Timber
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 40 mm			
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	6,63
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	8,21
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	4,80
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	5,94
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 60 mm			
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	8,43
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	10,47
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	6,08
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	7,58

Table B.43: Basic Force $F_{4/5}$, 2 angle brackets / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{4/5,k}$ [kN]	
			Timber	Steel
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 40$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	9,15	11,21
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	9,30	11,77
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	5,91	7,14
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	7,45	9,22
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 60$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	11,71	11,37
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	11,31	12,45
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	7,21	7,55
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	9,01	9,75

Table B.44: Basic Force F_4 , 1 angle bracket / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{4,k}$ [kN]	
			Timber	Steel
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 40$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	9,15	8,03
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	9,30	8,69
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	5,91	5,19
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	7,45	6,78
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times 60$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	11,71	11,37
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	11,31	12,45
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	7,21	7,55
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	9,01	9,75

Table B.45: Basic Force F_5 , 1 angle bracket / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{5,k}$ [kN]	
			Timber	Steel
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times \mathbf{40}$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	2,59	3,47
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	2,43	3,98
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	1,61	2,32
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	1,98	2,99
Winkelverbinder $t = 4,0$ mm, GH-Nails $4,0 \times \mathbf{60}$ mm				
1884 130 x 70 x 80 x 4,0 mm	1,2,3,4,5,6	12,13,14,15,16,17,18,19,20	3,67	3,57
12116186 160 x 80 x 60 x 4,0 mm	1,2,3,4,5,6	9,10,11,12,13,14	3,43	4,16
12116188 160 x 80 x 80 x 4,0 mm	1,2,3,4,5,6,7,8	12,13,14,15,16,17,18,19,20	2,26	2,46
12116181 160 x 80 x 100 x 4,0 mm	1,2,3,4,5,6,7,8,9	13,14,15,16,17,18,19,20,21,22,23	2,75	3,14

Winkelverbinder 60/100**Winkelverbinder 60/100 Force F_1 (Timber to timber)****Table B.46:** Force F_1 Column, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	16,17,18,19,20,22,23,24	4,17	2,70
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	16,17,18,19,20,22,23,24	6,96	2,70

Table B.47: Force F_1 Column, 1 angle bracket / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	16,17,18,19,20,22,23,24	2,09	1,35
Winkelverbinder 60/100, GH-GH-Nails 4,0 x 60 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	16,17,18,19,20,22,23,24	3,48	1,35

Table B.48: Force F_1 Purlin, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7, 8,9,11,12	16,17,18,19,20,22,23,24	4,17	2,70
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7, 8,9,11,12	16,17,18,19,20,22,23,24	6,96	2,70

Table B.49: Force F_1 Purlin, 1 angle bracket / connection, Timber to timber

Bracket type	Nail number n_V	Nail number n_H	$R_{1,k}$ [kN] (column)	
			Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7, 8,9,11,12	16,17,18,19,20,22,23,24	2,09	1,35
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7, 8,9,11,12	16,17,18,19,20,22,23,24	3,48	1,35

Winkelverbinder 60/100 Force F₁ (Timber to concrete)**Table B.50:** Force F₁ Column, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n _v	Nail failure (R _{v,Rk}) per Nail [kN]		Steel failure [kN]	Bolt
		4x40	4x60		k _t
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	1,08	0,65
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	1,08	0,65

Table B.51: Force F₁ Column, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n _v	Nail failure (R _{v,Rk}) per Nail [kN]		Steel failure [kN]	Bolt
		4x40	4x60		k _t
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	0,54	1,3
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	0,54	1,3

Table B.52: Force F₁ Purlin, 2 angle brackets / connection, Timber to concrete

Bracket type	Nail number n _v	Nail failure (R _{v,Rk}) per Nail [kN]		Steel failure [kN]	Bolt
		4x40	4x60		k _t
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	1,08	0,65
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	1,08	0,65

Table B.53: Force F_1 Purlin, 1 angle bracket / connection, Timber to concrete

Bracket type	Nail number n_v	Nail failure ($R_{v,Rk}$) per Nail [kN]		Steel failure [kN]	Bolt
		4x40	4x60		k_t
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	0,54	1,30
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6	1,89	2,36	0,54	1,30

Winkelverbinder 60/100 Force $F_{2/3}$ (Timber to timber)**Table B.54:** Force $F_{2/3}$, 2 angle brackets / connection (timber to timber)

Bracket type	Nail number n_v	Nail number n_H	$R_{2/3,k}$ [kN]
			Timber
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm			
60/100 100 x 60 x 60 x 2,5 mm	,2,3,5,6,7,8,9,11,12	16,17,18,19,20,22,23,24	11,1
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm			
60/100 100 x 60 x 60 x 2,5 mm	,2,3,5,6,7,8,9,11,12	16,17,18,19,20,22,23,24	14,3

Table B.55: Force $F_{2/3}$ 1 angle bracket / connection (timber to timber)

Bracket type	Nail number n_v	Nail number n_H	$R_{2/3,Rk}$ [kN]
			Timber
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm			
60/100 100 x 60 x 60 x 2,5 mm	,2,3,5,6,7,8,9,11,12	16,17,18,19,20,22,23,24	5,56
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm			
60/100 100 x 60 x 60 x 2,5 mm	,2,3,5,6,7,8,9,11,12	16,17,18,19,20,22,23,24	7,16

Winkelverbinder 60/100 Force $F_{2/3}$ (Timber to concrete)

Table B.56: Force $F_{2/3}$, 2 angle brackets / connection (timber to concrete)

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			Timber -Concrete	Timber - Concrete	
			4x40	4x60	
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6, 7,8,9,11,12	21	6,44	9,24	$k_t \perp$ 0,5

Table B.57: Force $F_{2/3}$, 1 angle bracket / connection (timber to concrete)

Bracket type	Nail number n_v	Bolt-Nr. n_H	$R_{2/3,k}$ [kN]		Bolt
			Timber -Concrete	Timber - Concrete	
			4x40	4x60	
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6, 7,8,9,11,12	21	3,22	4,62	$k_t \perp$ 1,00

Winkelverbinder 60/100 Force $F_{4/5}$ (timber to timber)

Table B.58: Basic Force $F_{4/5}$, 2 angle brackets / connection (timber to timber)

Bracket type	Nail number n_v	Nail number n_H	$R_{4/5,k}$ [kN]	
			Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7,8,9, 11,12	16,17,18,19,20,22,23,24	6,61	3,78
Winkelverbinder t = 4,0 mm, GH-Nails 4,0 x 60 mm				
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6,7,8,9, 11,12	16,17,18,19,20,22,23,24	8,08	3,93

Winkelverbinder 60/100 Force $F_{4/5}$ (timber to concrete)

Table B.59: Basic Force $F_{4/5}$, 2 angle brackets / connection (timber to concrete)

Bracket type	Nail number n_v	$k_t \perp$	$k_t \parallel$	$R_{4/5,k}$ [kN]	
				Timber	Steel
Winkelverbinder 60/100, GH-Nails 4,0 x 40 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6, 7,8,9,11,12	0,76	0,17	6,93	3,35
Winkelverbinder 60/100, GH-Nails 4,0 x 60 mm					
60/100 100 x 60 x 60 x 2,5 mm	1,2,3,5,6, 7,8,9,11,12	0,73	0,18	8,54	3,47

Winkelverbinder 692**Winkelverbinder 692 Force F₁ (Timber to timber)****Table B.60:** Force F₁ Column, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n _v	Nail number n _H	R _{1,k} [kN] (column)	
			Timber	Steel
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	---	9,10,11,12,13,14,15,16	---	---
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	---	9,10,11,12,13,14,15,16	---	---

Table B.61: Force F₁ Column, 1 angle bracket / connection, Timber to timber

Bracket type	Nail number n _v	Nail number n _H	R _{1,k} [kN] (column)	
			Timber	Steel
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	---	9,10,11,12,13,14,15,16	---	---
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	---	9,10,11,12,13,14,15,16	---	---

Table B.62: Force F₁ Purlin, 2 angle brackets / connection, Timber to timber

Bracket type	Nail number n _v	Nail number n _H	R _{1,k} [kN] (column)	
			Timber	Steel
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	4,20	1,34
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	7,00	1,34

Table B.63: Force F₁ Purlin, 1 angle bracket / connection, Timber to timber

Bracket type	Nail number n _v	Nail number n _H	R _{1,k} [kN] (column)	
			Timber	Steel
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	2,10	0,67
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	3,50	0,67

Winkelverbinder 692 Force $F_{2/3}$ (Timber to timber)**Table B.64:** Force $F_{2/3}$, 2 angle brackets / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	
			Timber	
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	7,64	
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	10,4	

Table B.65: Force $F_{2/3}$, 1 angle bracket / connection

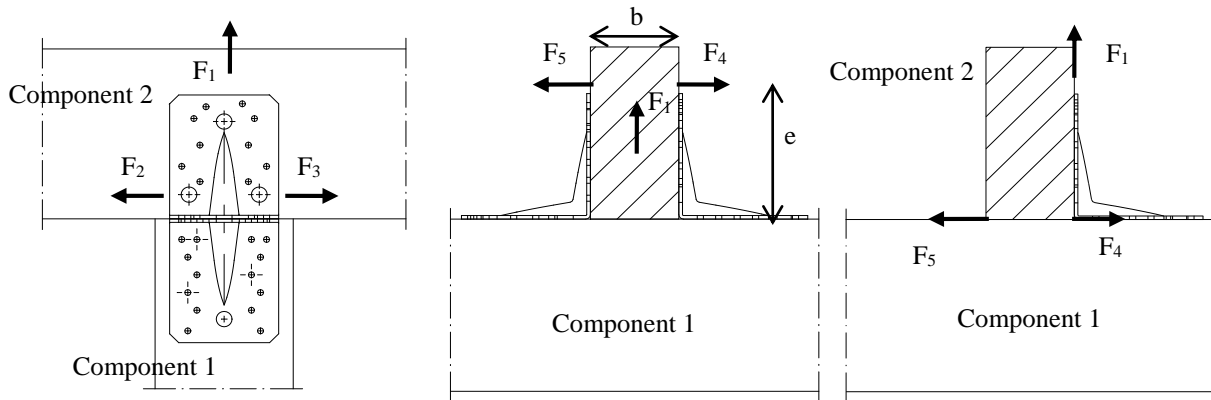
Bracket type	Nail number n_V	Nail number n_H	$R_{2/3,k}$ [kN]	
			Timber	
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	3,82	
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	5,19	

Winkelverbinder 692 Force $F_{4/5}$ (timber to timber)**Table B.66:** Basic Force $F_{4/5}$, 2 angle brackets / connection

Bracket type	Nail number n_V	Nail number n_H	$R_{4/5,k}$ [kN]	
			Timber	Steel
Winkelverbinder 692, GH-Nails 4,0 x 40 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	12,6	5,01
Winkelverbinder 692, GH-Nails 4,0 x 60 mm				
692 65 x 65 x 90 x 2,0 mm	1,2,3,4	9,10,11,12,13,14,15,16	12,8	5,13

Definitions of forces, their directions and eccentricity

Forces - Beam to beam connection



Fastener specification

Holes are marked with numbers referring to the nailing pattern in Figures B.1 to B.17.

Double angle brackets per connection

The angle brackets must be placed at each side opposite each other, symmetric to the component axis.

Acting forces

- F_1 Lifting force acting along the central axis of the joint.
- $F_{2/3}$ Lateral force acting in the joint between the component 2 and component 1 in the component 2 direction
- $F_{4/5}$ Lateral force acting in the component 1 direction along the central axis of the joint. 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 the central axis of the angle bracket. The component 2 shall be prevented from rotation. If the component 2 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 in the joint between the component 2 and the component 1 in the component 2 direction. The component 2 shall be prevented from rotation. If the component 2 is prevented from rotation the load-carrying capacity will be half of a connection with double angle brackets.
- F_4 and F_5 Lateral force acting in the component 1 direction. F_4 is the lateral force towards the angle bracket; F_5 is the lateral force away from the angle bracket. Component 2 shall be prevented from rotation, therefore eccentricity e equals zero. Only the 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

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.

Connection to timber, concrete or steel with a bolt or metal anchor

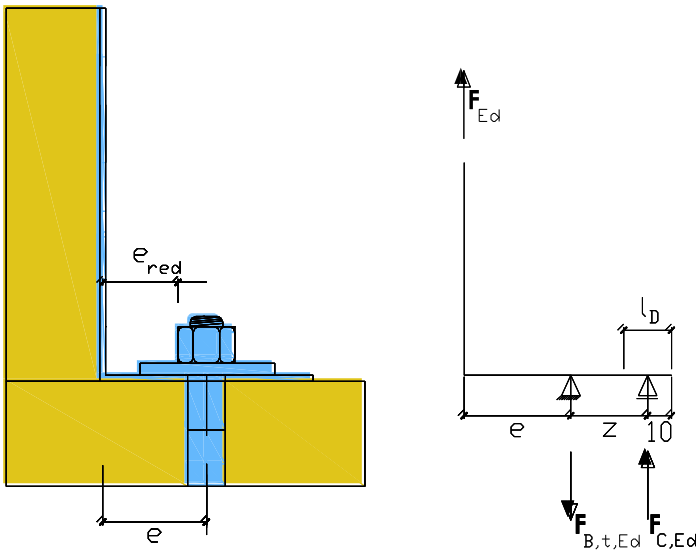
The load $F_{B,Ed}$ for the design of a bolt or metal anchor is calculated as:

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

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

Where:

- $F_{B,t,Ed}$ Bolt tensile load in N of the maximally loaded bolt in the group
- $F_{B,v,Ed}$ Bolt shear load in N of the maximally loaded bolt in the group
- k_t Coefficient taking into account the moment arm or hole tolerance, respectively
- F_{Ed} Total force acting on the single angle bracket or couple of angle brackets i.e. tensile load F_1 or shear load $F_{2/3}$ or shear load $F_{4/5}$ in N



Combined forces

If the forces F_1 and F_2/F_3 act at the same time, the following inequality shall be fulfilled:

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

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 , respectively, 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 $F_{4/5}$ 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 .

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

B is the width of component 2.

GH Angle Brackets

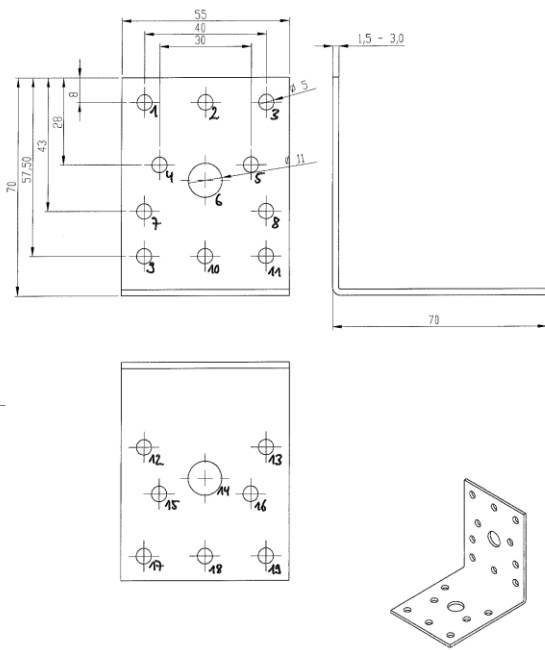


Figure B. 1: 55/02S, 55/02S15 70 x 70 x 55 mm

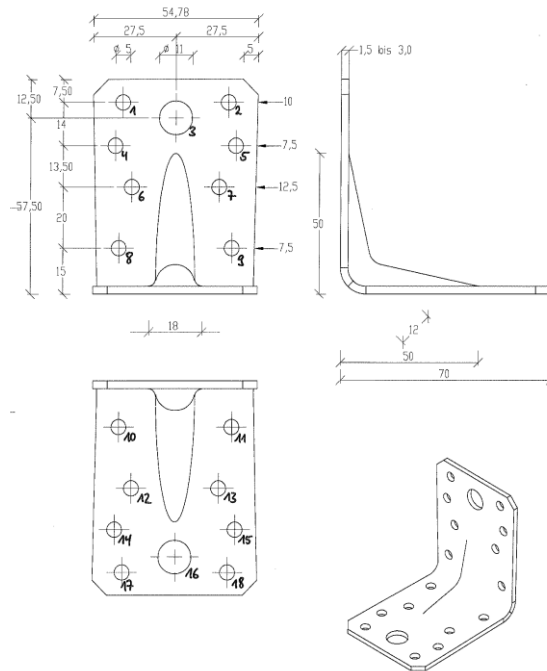


Figure B. 2: 55/01S, 55/01S15 70 x 70 x 55 mm

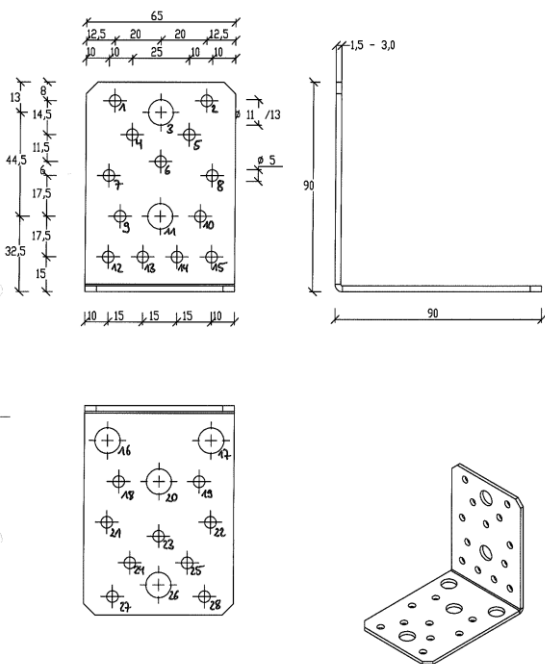


Figure B. 3: 65/04S, 65/04S15 90 x 90 x 65 mm

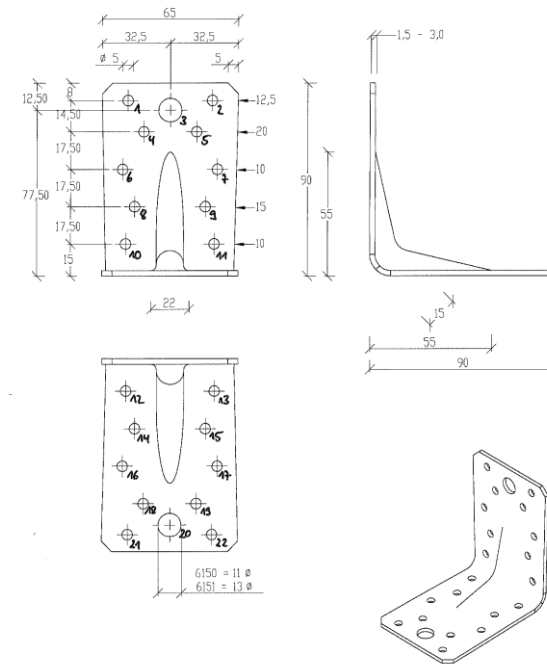


Figure B. 4: 65/03S, 65/03S15 90 x 90 x 65 mm

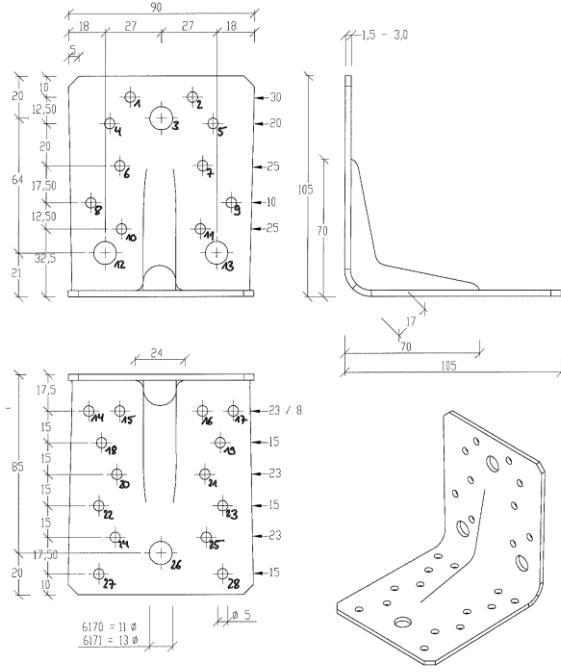
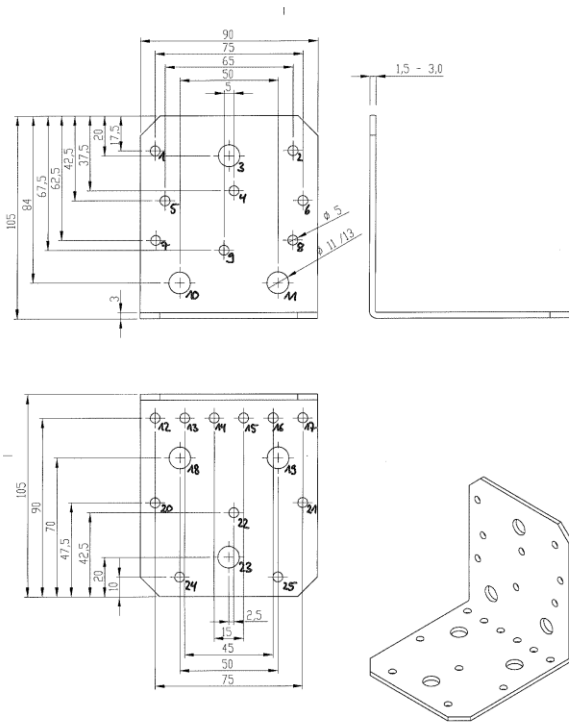
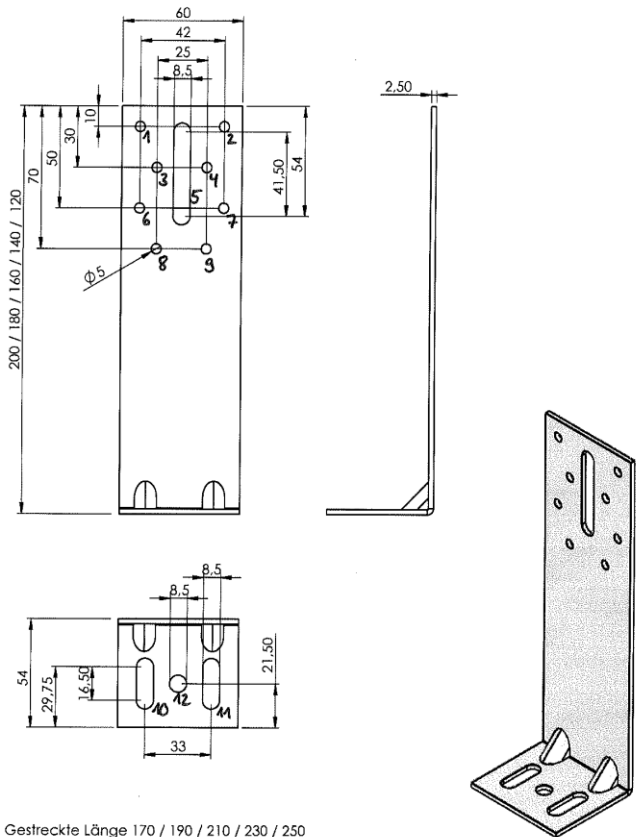


Figure B. 5: 90/04S, 90/04S20 105 x 105 x 90 mm

Figure B. 6: 90/03S, 90/03S20 105 x 105 x 90 mm



Gestreckte Länge 170 / 190 / 210 / 230 / 250

Figure B. 7: Konsolenwinkel (Typ 120, 140, 160, 180, 200) L x 54 x 60 x 2,5 mm

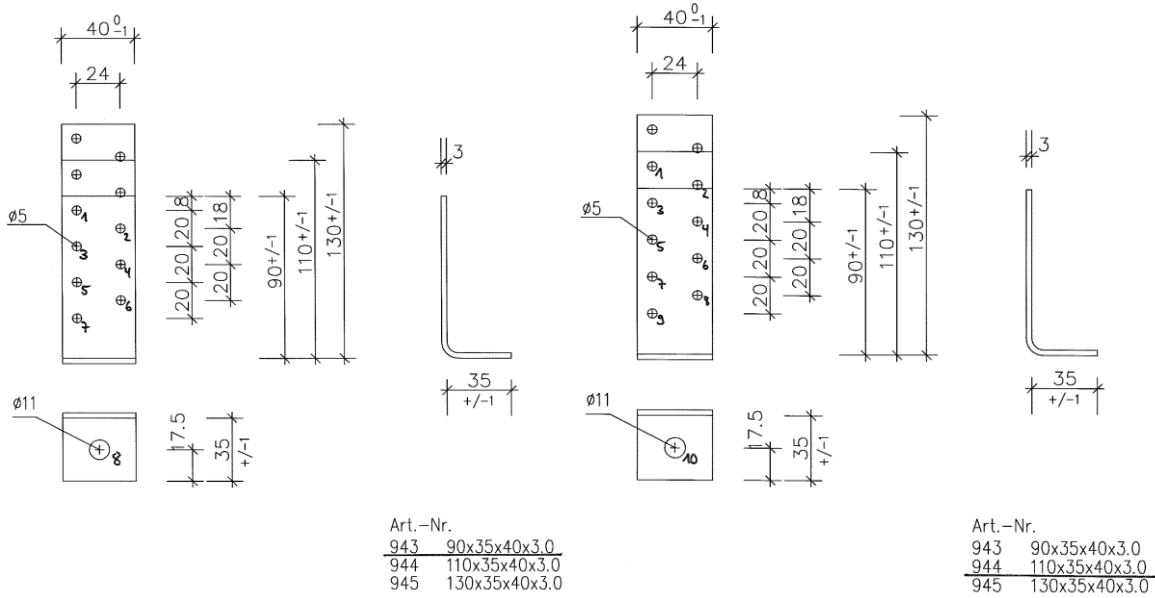


Figure B. 8: Zuganker 943 90 x 35 x 40 x 3,0 mm **Figure B. 9:** Zuganker 944 110 x 35 x 40 x 3,0 mm

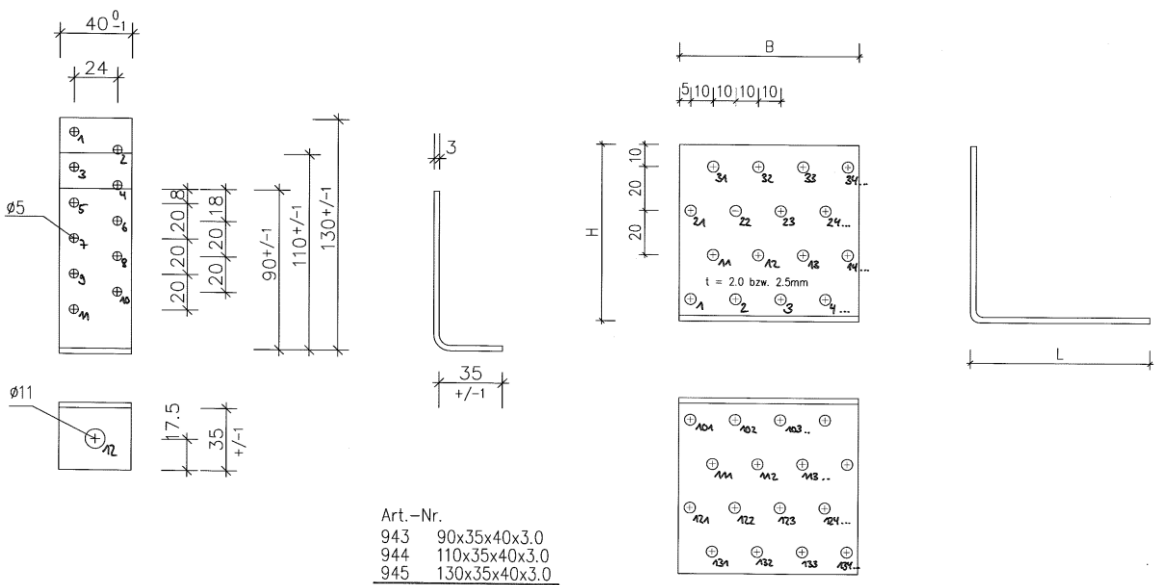


Figure B. 10: Zuganker 945 130 x 35 x 40 x 3,0 mm **Figure B. 11:** Lochplattenwinkel (all Types) H x L x B x t

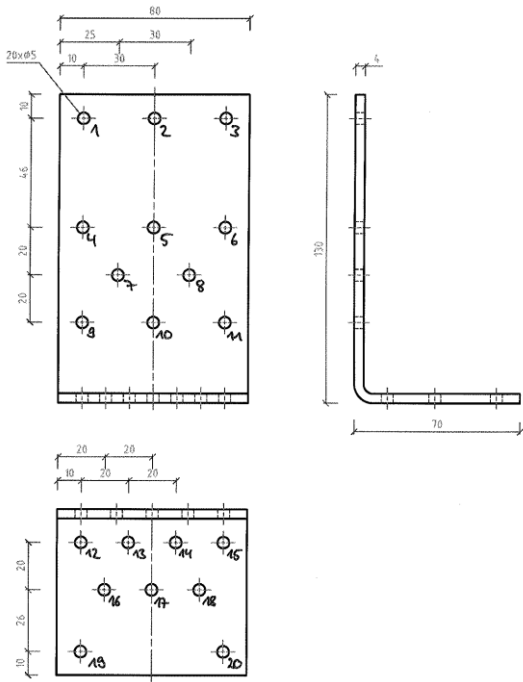


Figure B. 12: 1884 130 x 70 x 80 x 4,0 mm

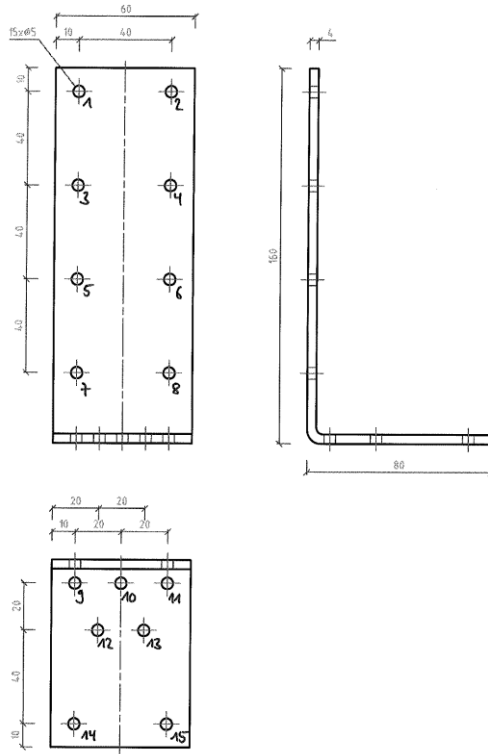


Figure B. 13: 12116186 160 x 80 x 60 x 4,0 mm

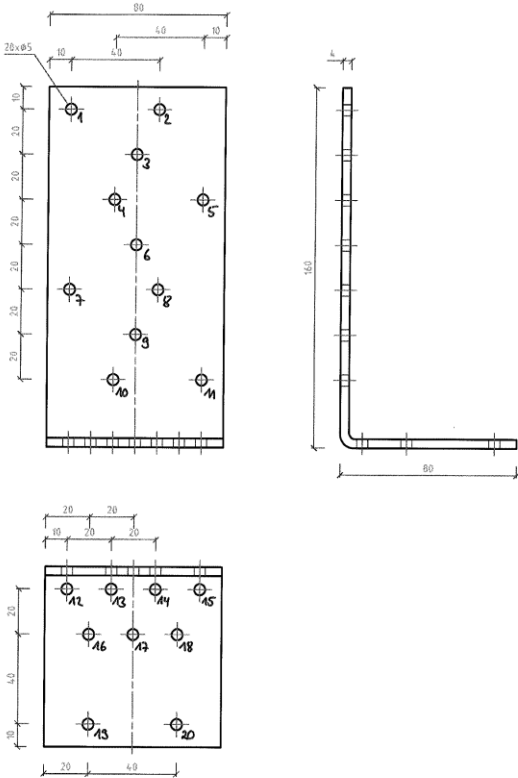


Figure B. 14: 12116188 160 x 80 x 80 x 4,0 mm

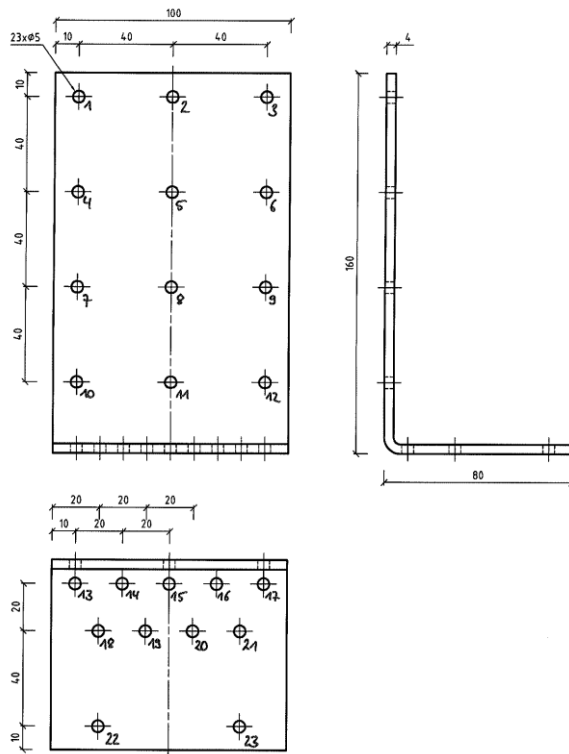


Figure B. 15: 12116181 160 x 80 x 100 x 4,0 mm

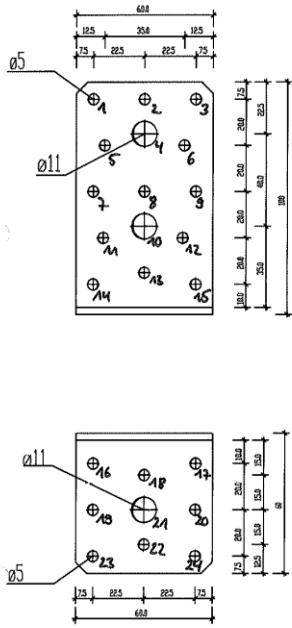


Figure B. 16: 60 / 100 100 x 60 x 60 x 2,5 mm

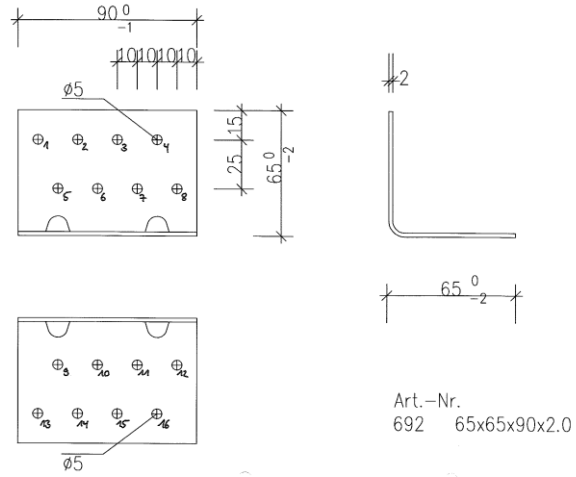


Figure B. 17: 692 65 x 65 x 90 x 2,0 mm

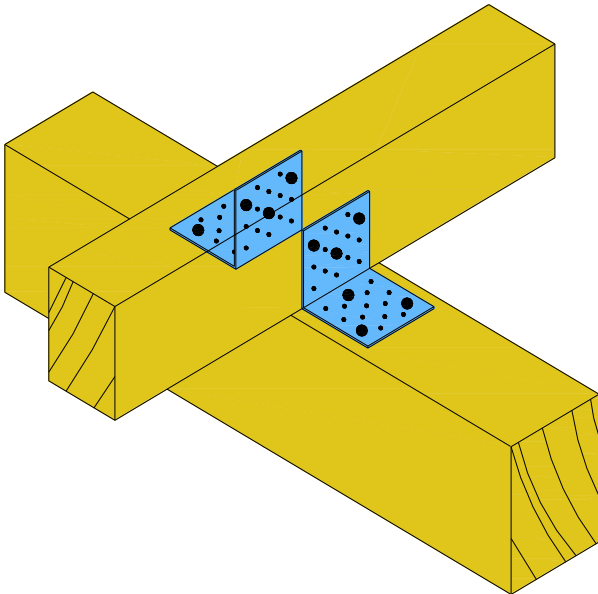


Figure B. 18: Typical installation