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

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

MEMBER OF EOTA

European Technical Approval ETA-11/0496

This ETA replaces the previous ETA with the same number and validity from 2012-01-18 to 2016-01-18

Trade name:	Rotho Blaas TITAN Angle Brackets *)
Holder of approval:	Rotho Blaas s.r.l Via dell'Adige 2/1 IT-39040 Cortaccia (BZ) Tel. + 39 0471 818450 Fax + 39 0471 818484 Internet www.rothoblaas.com
Generic type and use of construction product:	Three-dimensional nailing plate (Angle Bracket for timber-to-timber or timber-to-concrete or steel connections)
Valid from: to:	2018-01-18
Manufacturing plant:	Rotho Blaas s.r.l Manufacturing Plants: T1, T2, T3
This European Technical Approval contains:	18 pages including 2 annexes which form an integral part of the document

*) See section II.1 of this ETA

I LEGAL BASIS AND GENERAL CONDITIONS

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

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

- Bekendtgørelse 559 af 27-06-1994 (afløser bekendtgørelse 480 af 25-06-1991) om ikraf01ttræden af EF direktiv af 21. december 1988 om indbyrdes tilnærmelse af medlemsstaternes love og administrative bestemmelser om byggevarer.

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

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

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

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

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

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

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

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

II SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

Definition of the product

This ETA covers the following angle bracket types; type TITAN TTN160, TTN200, TTN240, TTS140, TTS195, TTS245, TCN160, TCN200, TCN240, TCS140, TCS195, TCS245, TTF200 and TCF200

Rotho Blaas TITAN angle brackets are one-piece non-welded, face-fixed angle brackets to be used in timber to timber or in timber to concrete or to steel connections. They are connected to construction members made of timber or wood-based products with profiled (ringed shank) nails or screws according to EN 14592 or ETA-11/0030 or screws type HBS+ according to ETA-11/0030 and to concrete or steel members with bolts or metal anchors.

The angle brackets with a steel plate thickness of up to 3 mm are made from pre-galvanized steel S355 / Z 275 or FeZn12c according to EN 10025:2005 with $R_e \geq 355$ N/mm², $R_m \leq 630$ N/mm² and $A_{80} \geq 22\%$ or from pre-galvanized steel S235 / Z 275 according to EN 10025:2005 with $R_e \geq 235$ N/mm², $R_m \leq 510$ N/mm² and $A_{80} \geq 26\%$ or from pre-galvanized steel S275 / Z 275 according to EN 10025:2005 with $R_e \geq 275$ N/mm², $R_m \leq 560$ N/mm² and $A_{80} \geq 23\%$ or from steel DX51D / Z275 according to EN 10346:2009 with $R_e \geq 220$ N/mm², $R_m \leq 500$ N/mm² and $A_{80} \geq 22\%$ or from steel S250GD / Z275 according to EN 10346:2009 with $R_e \geq 250$ N/mm², $R_m \leq 470$ N/mm² and $A_{80} \geq 19\%$ or from stainless steel with $R_e \geq 355$ N/mm², $R_m \leq 630$ N/mm² and $A_{80} \geq 22\%$. Dimensions, hole positions and typical installations are shown in Annex B. Rotho Blaas TITAN angle brackets are made from steel with tolerances according to EN 10143.

Intended use

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

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

The static and kinematical behaviour of the timber members or the supports shall be as described in Annex A and 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 classified to C14-C40 according to EN 338 / EN 14081,
- Glulam classified to GL24-GL36 according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- 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/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 the 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.

The angle brackets may also be used for connections between a timber member and a member of concrete or steel (TITAN TCN, TCS and TCF).

Assumed working life

The assumed intended working life of concealed beam hangers for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

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

2 Characteristics of product and assessment

ETAG paragraph	Characteristic		Assessment of characteristic
	2.1	**Mechanical resistance and stability*)**	
6.1.1		Characteristic load-carrying capacity	See Annex B
6.1.2		Stiffness	No performance determined
6.1.3		Ductility in cyclic testing	No performance determined
	2.2	**Safety in case of fire**	
6.2.1		Reaction to fire	The angle brackets are made from aluminium classified as **Euroclass A1** in accordance with EN 1350-1
	2.3	**Hygiene, health and the environment**	
6.3.1		Influence on air quality	No dangerous materials **)
	2.4	**Safety in use**	Not relevant
	2.5	**Protection against noise**	Not relevant
	2.6	**Energy economy and heat retention**	Not relevant
	2.7	**Related aspects of serviceability**	
6.7.1		Durability	The angle brackets have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
6.7.2		Serviceability	
6.7.3		Identification	See Annex A

*) See page 5 of this ETA

**) In accordance with http://europa.eu.int-/comm/enterprise/construction/internal/dangsub/dangmain.htm In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Safety principles and partial factors
The characteristic load-carrying capacities are based on the characteristic values of the nail connections and the steel plates. To obtain design values the capacities have to be 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 timber or steel, respectively, are also correctly taken into account.

2.1 Mechanical resistance and stability

See annex B for the characteristic load-carrying capacity in the different directions F_2 and F_3.

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.

2.7 Related aspects of serviceability

2.7.1 Corrosion protection in service class 1, 2 and 3.
In accordance with ETAG 015 the angle bracket have a zinc coating weight of min Z275. The steel employed is S355 / Z 275 or FeZn12c according to EN 10025:2005 with $R_e \geq 355$ N/mm², $R_m \leq 630$ N/mm² and $A_{80} \geq 22\%$ or from pre-galvanized steel S235 / Z 275 according to EN 10025:2005 with $R_e \geq 235$ N/mm², $R_m \leq 510$ N/mm² and $A_{80} \geq 26\%$ or from pre-galvanized steel S275 / Z 275 according to EN 10025:2005 with $R_e \geq 275$ N/mm², $R_m \leq 560$ N/mm² and $A_{80} \geq 23\%$ or from steel DX51D / Z275 according to EN 10346:2009 with $R_e \geq 220$ N/mm², $R_m \leq 500$ N/mm² and $A_{80} \geq 22\%$ or from steel

3 Attestation of Conformity and CE marking

3.1 Attestation of Conformity system

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

a) Tasks for the manufacturer:

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

b) Tasks for the notified body:

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

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

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

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

The manufactured components are checked visually and for dimensions.

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

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

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

The records shall be presented to ETA Danmark on request.

3.2.1.1 Initial type testing of the product

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

3.2.2. Tasks of notified bodies

3.2.2.1 Initial inspection of the factory and the factory production control

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

3.2.2.2 Continuous surveillance

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

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

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

of conformity shall be withdrawn by the approved body.

3.3 CE marking

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

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

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

4.1 Manufacturing

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

4.2 Installation

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

The following provisions concerning installation apply:

The structural members – the components 1 and 2 shown in the figure on page 13 - to which the brackets are fixed shall be:

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

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

4.3 Maintenance and repair

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

Thomas Bruun
Manager, ETA-Danmark

Annex A
Product details definitions

Table A.1 Materials specification

Angel Bracket type	Thickness (mm)	Steel specification	Coating specification
Titan TTN160	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTN200	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTN240	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTS140	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTS195	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTS245	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCN160	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCN200	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCN240	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCS140	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCS195	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCS245	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TTF200	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275
Titan TCF200	3,0	S235/S275/S355/DX51D/S250GD	FeZn12c / Z 275

Table A.2 Range of sizes

Angel Bracket type	Height (mm) vertical		Height (mm) horizontal		Width (mm)	
Titan TTN160	119	121	92	94	159	161
Titan TTN200	119	121	92	94	199	201
Titan TTN240	119	121	92	94	239	241
Titan TTS140	129	131	129	131	139	141
Titan TTS195	129	131	129	131	194	196
Titan TTS245	129	131	129	131	244	246
Titan TCN160	119	121	102	104	159	161
Titan TCN200	119	121	102	104	199	201
Titan TCN240	119	121	122	124	239	241
Titan TCS140	129	131	102	104	139	141
Titan TCS195	129	131	102	104	194	196
Titan TCS245	129	131	122	124	244	246
Titan TTF200	70	72	70	72	199	201
Titan TCF200	70	72	102	104	199	201

Table A.3 Fastener specification

Fasterner	Length	Nail type
Nail 4.0 mm	60 mm	Ringed shank nails according to EN 14592
Screw 5.0 mm	50 mm	Self-tapping screws according to EN 14592 or ETA-11/0030
Rotho Blaas screw 8.0 mm, type HBS+	80 mm	Self-tapping screws according to ETA-11/0030

In the load-carrying-capacities of the nailed or with 5.0 mm screwed connection in Annex B the capacities calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral fastener load-carrying-capacity. For the connection with 8.0 mm screws a thin steel plate is assumed. The load-carrying-capacities of the angle brackets have been determined based on the use of connector nails ø 4.0 mm in accordance with the German national approval for the nails. The characteristic withdrawal capacity of the nails or screws has to be determined by calculation in accordance with EN 1995-1-1:2010, paragraph 8.3.2 (head pull-through is not relevant):

$F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen}$ for the nails 4.0 mm

$F_{ax,Rk} = \frac{n_{ef} \cdot f_{ax,k} \cdot d \cdot \ell_{ef}}{1,2 \cdot \cos^2 \alpha + \sin^2 \alpha} \left(\frac{\rho_k}{\rho_a} \right)^{0,8}$ for the screws

where:

n_{ef} Effective number of fasteners
$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2
d Nail or screw diameter in mm
t_{pen} Penetration depth of the profiled shank in mm; (4.0 x 60 mm: $t_{pen} \geq 50$ mm)
ρ_k Characteristic density of the timber in kg/m^3
ρ_a Characteristic density of the timber in kg/m^3 according to $f_{ax,k}$

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 can be calculated as:
$f_{ax,k} = 50 \cdot 10^{-6} \cdot \rho_k{}^2$

Based on tests by Versuchsanstalt für Stahl, Holz und Steine, Karlsruhe Institute of Technology, the characteristic value of the withdrawal resistance and the characteristic value of fastener's yield moment for the screws d = 5.0 mm used may be calculated as:
$f_{ax,k}$ = 15,0 N/mm²
$M_{y,k}$ = 5810 Nmm

Based on the ETA-11/0030 the characteristic value of the withdrawal resistance for the screws type HBS+ d = 8.0 mm used may be calculated as:
$f_{ax,k}$ = 11,7 N/mm²

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

Bolts diameter	Correspondent hole diameter	Bolts type
12.0 and 16.0 mm	Max. 2 mm larger than the bolt diameter	See specification of the manufacturer

Metal Anchors diameter	Correspondent Hole diameter	Anchors type
12.0 and 16.0 mm	Max. 2 mm larger than the anchor diameter	See specification of the manufacturer

Annex B
Characteristic load-carrying capacities

Table 1: Force $F_{2,3}$, 1 angle bracket / timber-timber connection

Type	number n_V	number n_H	Nails Ø4 x 60		Screws Ø5 x 50		Screws Ø8 x 80	
			e_1 [mm]	$F_{2,3Rk}$ [kN]	e_1 [mm]	$F_{2,3Rk}$ [kN]	e_1 [mm]	$F_{2,3Rk}$ [kN]
Titan TTN160	24	24	60,5	19,3	57,4	24,0	-	-
Titan TTN200	30	30	60,2	28,0	57,3	34,7	-	-
Titan TTN240	36	36	60,0	37,9	57,3	46,7	-	-
Titan TTS140	8	8	-	-	-	-	78,5	10,7
Titan TTS195	11	11	-	-	-	-	78,5	17,1
Titan TTS245	14	14	-	-	-	-	78,5	25,0
Titan TTF200, h=9cm*)	30	30	42,0	35,5	42,0	42,5	-	-
Titan TTF200, h=8cm*)	25	25	38,5	31,0	38,5	37,2	-	-
Titan TTF200, h=7cm*)	15	15	31,5	20,9	31,5	25,1	-	-
Titan TTF200, h=6cm*)	10	10	28,0	15,1	28,0	18,1	-	-

*) h = height of purlin (see Figure B.16, Annex B)

Table 2: Force $F_{2,3}$, 2 angle brackets / timber-timber connection

Type	number n_V	number n_H	Nails Ø4 x 60		Screws Ø5 x 50		Screws Ø8 x 80	
			e_1 [mm]	$F_{2,3Rk}$ [kN]	e_1 [mm]	$F_{2,3Rk}$ [kN]	e_1 [mm]	$F_{2,3Rk}$ [kN]
Titan TTN160	48	48	60,5	38,6	57,4	47,9	-	-
Titan TTN200	60	60	60,2	56,1	57,3	69,4	-	-
Titan TTN240	72	72	60,0	75,7	57,3	93,3	-	-
Titan TTS140	16	16	-	-	-	-	78,5	21,3
Titan TTS195	22	22	-	-	-	-	78,5	34,3
Titan TTS245	28	28	-	-	-	-	78,5	50,0
Titan TTF200, h=9cm*)	60	60	42,0	70,9	42,0	85,0	-	-
Titan TTF200, h=8cm*)	50	50	38,5	62,0	38,5	74,3	-	-
Titan TTF200, h=7cm*)	30	30	31,5	41,9	31,5	50,2	-	-
Titan TTF200, h=6cm*)	20	20	28,0	30,2	28,0	36,2	-	-

*) h = height of purlin (see Figure B.16, Annex B)

Table 3: Force $F_{2,3}$, 1 angle bracket / timber-concrete or steel connection

Type	number n_V	number n_H	Nails Ø4 x 60	Screws Ø5 x 50	Screws Ø8 x 80	Bolts inward	Bolts outward
			$F_{2,3Rk}$ [kN]	$F_{2,3Rk}$ [kN]	$F_{2,3Rk}$ [kN]	$k_{t,\perp}$	$k_{t,\perp}$
Titan TCN160	24	2	15,1	18,1	-	0,85	1,14
Titan TCN200	30	2	22,1	26,5	-	0,76	0,97
Titan TCN240	36	2	30,3	36,3	-	0,74	1,00
Titan TCS140	8	2	-	-	10,7	0,93	1,28
Titan TCS195	11	2	-	-	17,1	0,77	0,98
Titan TCS245	14	2	-	-	25,0	0,74	0,98
Titan TCF200, h=9cm*)	30	2	35,5	42,5	-	0,75	0,96
Titan TCF200, h=8cm*)	25	2	31,0	37,2	-	0,75	0,96
Titan TCF200, h=7cm*)	15	2	20,9	25,1	-	0,76	0,97
Titan TCF200, h=6cm*)	10	2	15,1	18,1	-	0,75	0,96

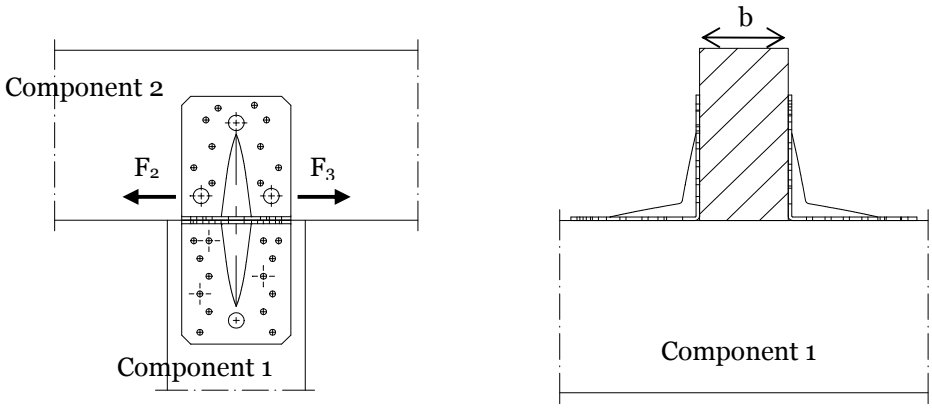
*) h = height of purlin (see Figure B.16, Annex B)

Table 4: Force $F_{2,3}$, 2 angle brackets / timber-concrete or steel connection

Type	number n_V	number n_H	Nails Ø4 x 60	Screws Ø5 x 50	Screws Ø8 x 80	Bolts inward	Bolts outward
			$F_{2,3Rk}$ [kN]	$F_{2,3Rk}$ [kN]	$F_{2,3Rk}$ [kN]	$k_{t,\perp}$	$k_{t,\perp}$
Titan TCN160	48	4	30,2	36,1	-	0,43	0,57
Titan TCN200	60	4	44,3	53,0	-	0,38	0,48
Titan TCN240	72	4	60,5	72,5	-	0,37	0,50
Titan TCS140	16	4	-	-	21,3	0,46	0,64
Titan TCS195	22	4	-	-	34,3	0,38	0,49
Titan TCS245	28	4	-	-	50,0	0,37	0,49
Titan TCF200, h=9cm*)	60	4	70,9	85,0	-	0,38	0,48
Titan TCF200, h=8cm*)	50	4	62,0	74,3	-	0,38	0,48
Titan TCF200, h=7cm*)	30	4	41,9	50,2	-	0,38	0,48
Titan TCF200, h=6cm*)	20	4	30,2	36,2	-	0,38	0,48

*) h = height of purlin (see Figure B.16, Annex B)

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 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_2 and F_3 Lateral force acting in the joint between the component 2 and component 1 in the component 2 direction

Single angle bracket per connection
Acting forces
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.

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. Lifting force F_1 is not allowed for the angle brackets in this ETA.

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:

$$F_{B,v,Ed} = k_{t,\perp} \cdot F_{Ed}$$

where:

$F_{B,v,Ed}$ Bolt shear load in N
$k_{t,\perp}$ Coefficient taking into account the moment arm
F_{Ed} Load on vertical flap of the angle bracket(s) in N

Rotho Blaas Angle Brackets

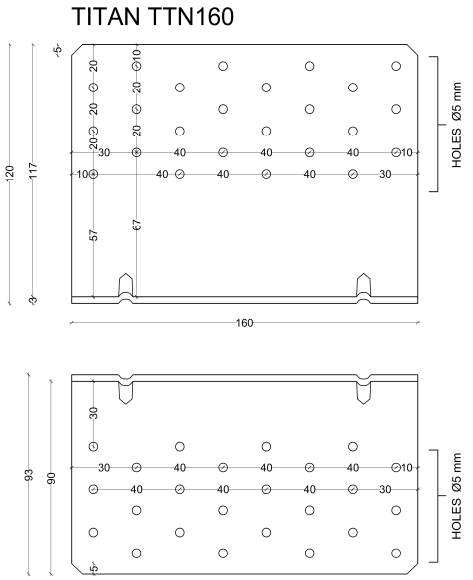


Figure B. 1 Dimensions of Angle Bracket Titan TTN160

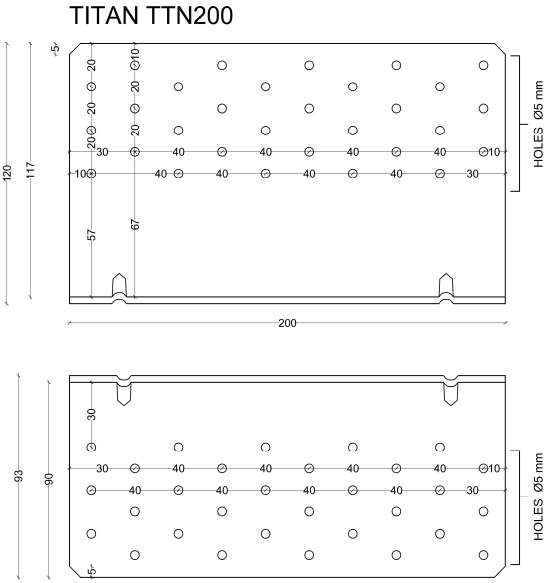


Figure B. 2 Dimensions of Angle Bracket Titan TTN200

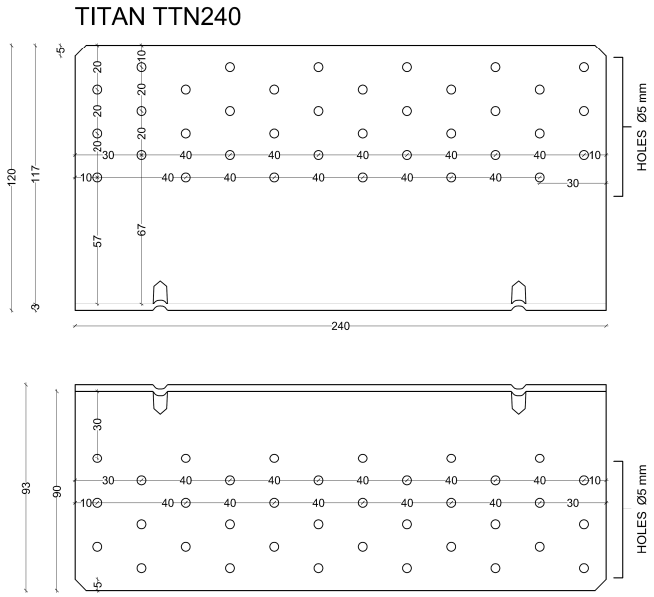


Figure B. 3 Dimensions of Angle Bracket Titan TTN240

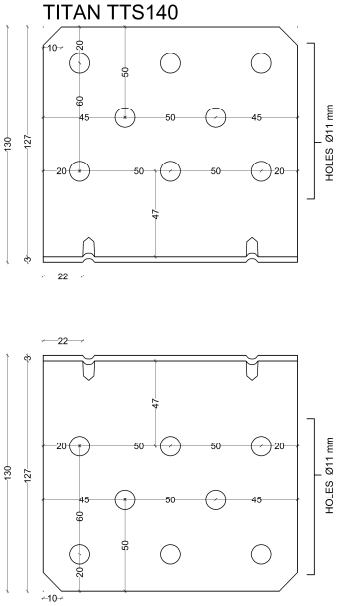


Figure B. 4 Dimensions of Angle Bracket Titan TTS140

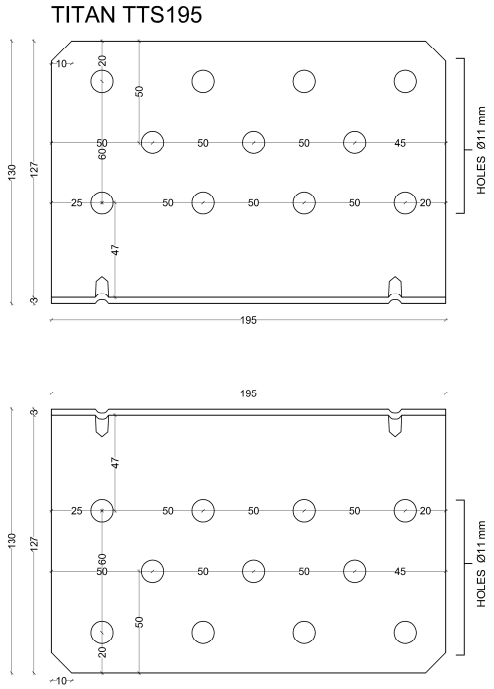


Figure B. 5 Dimensions of Angle Bracket Titan TTS195

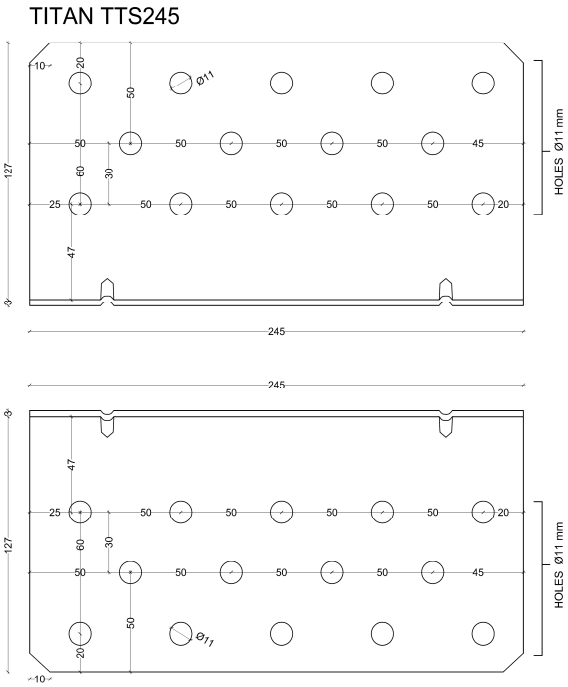


Figure B. 6 Dimensions of Angle Bracket Titan TTS245

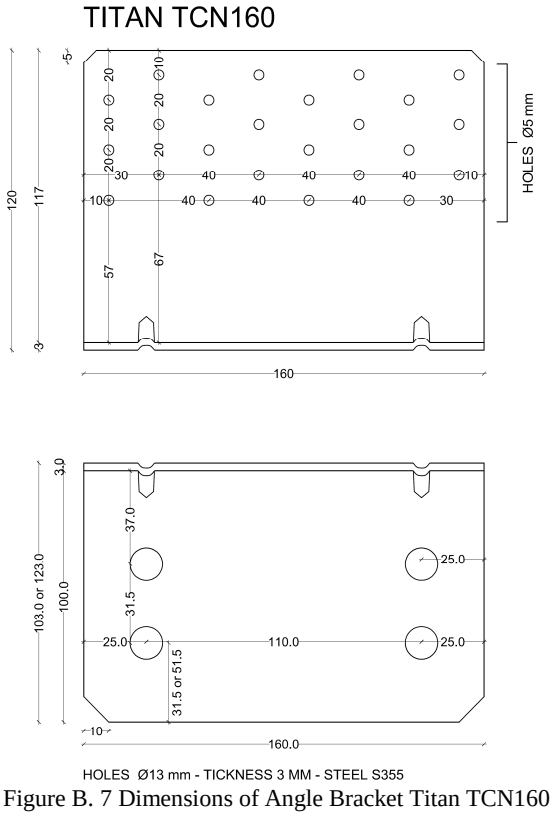


Figure B. 7 Dimensions of Angle Bracket Titan TCN160

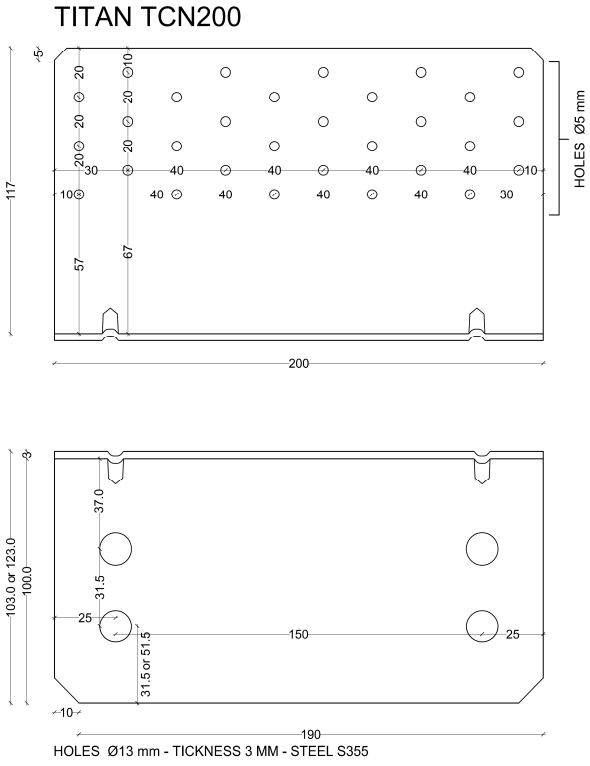


Figure B. 8 Dimensions of Angle Bracket Titan TCN200

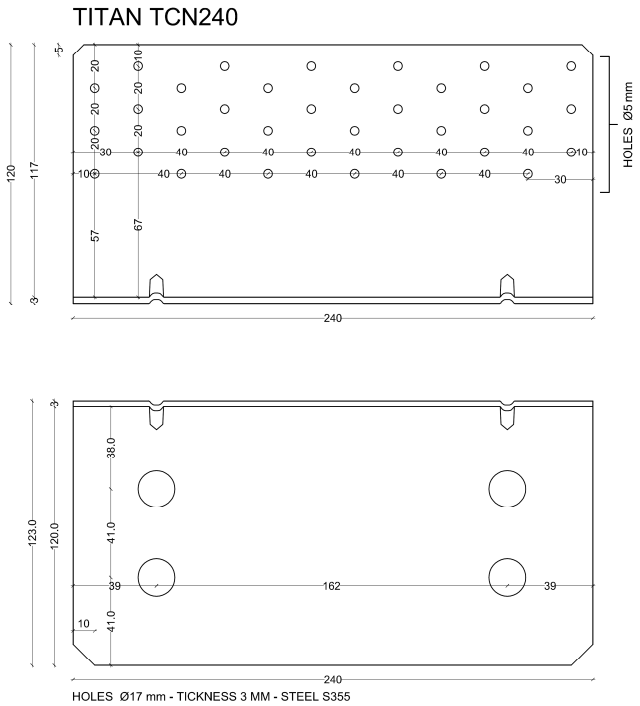


Figure B. 9 Dimensions of Angle Bracket Titan TCN240

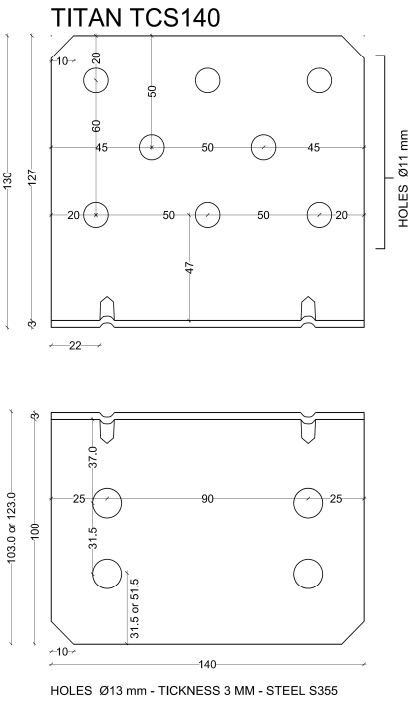


Figure B. 10 Dimensions of Angle Bracket Titan TCS140

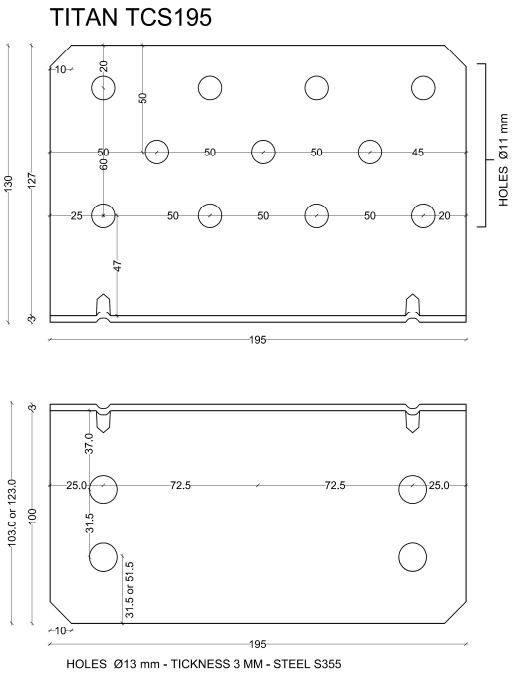


Figure B. 11 Dimensions of Angle Bracket Titan TCS195

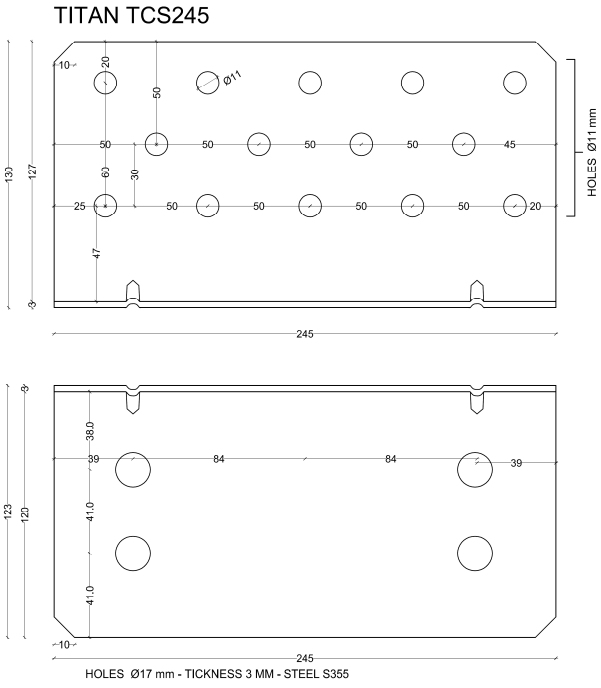


Figure B. 12 Dimensions of Angle Bracket Titan TCS245

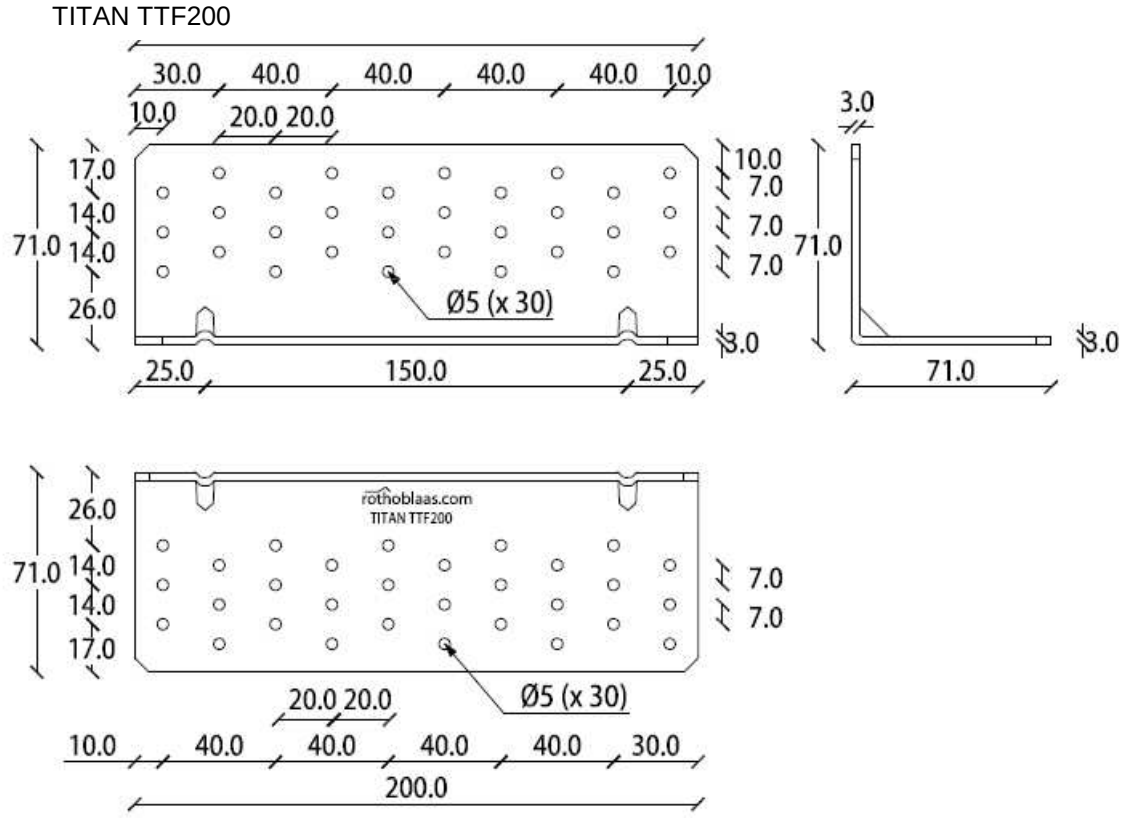


Figure B. 13 Dimensions of Angle Bracket Titan TTF200

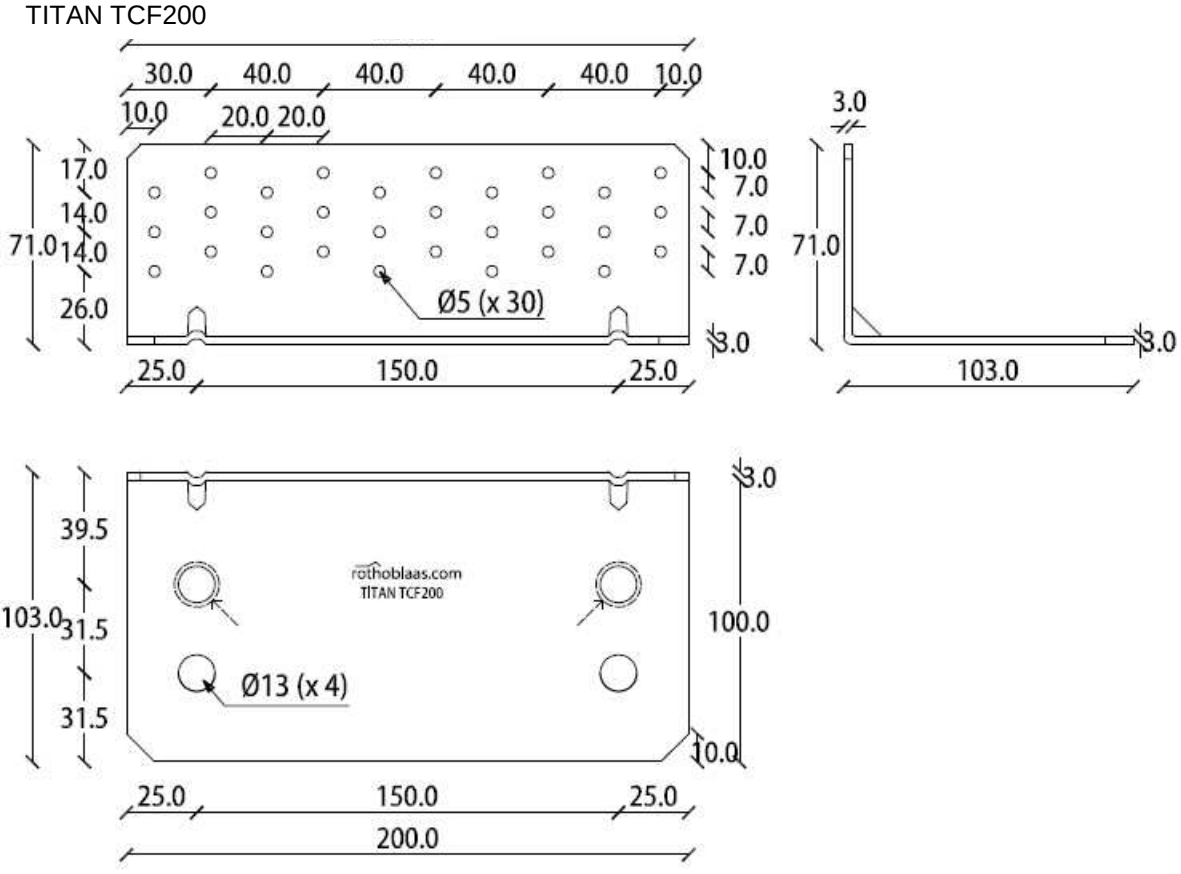


Figure B. 14 Dimensions of Angle Bracket Titan TCF200

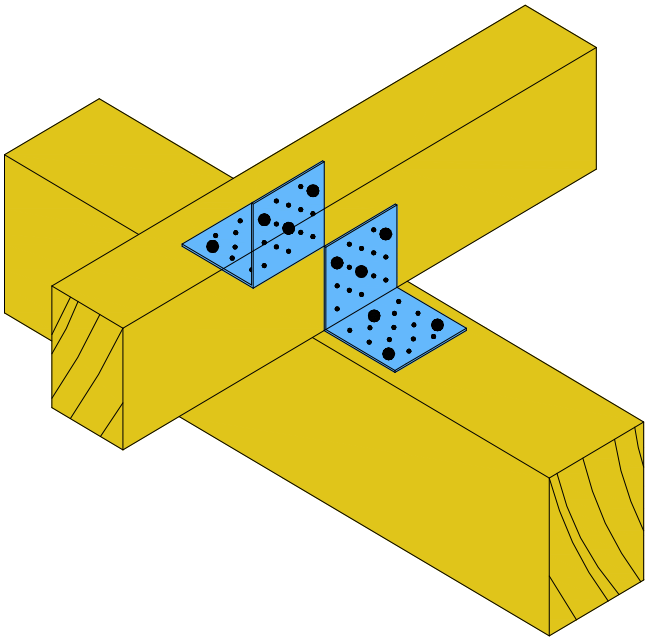


Figure B. 15 Typical installation

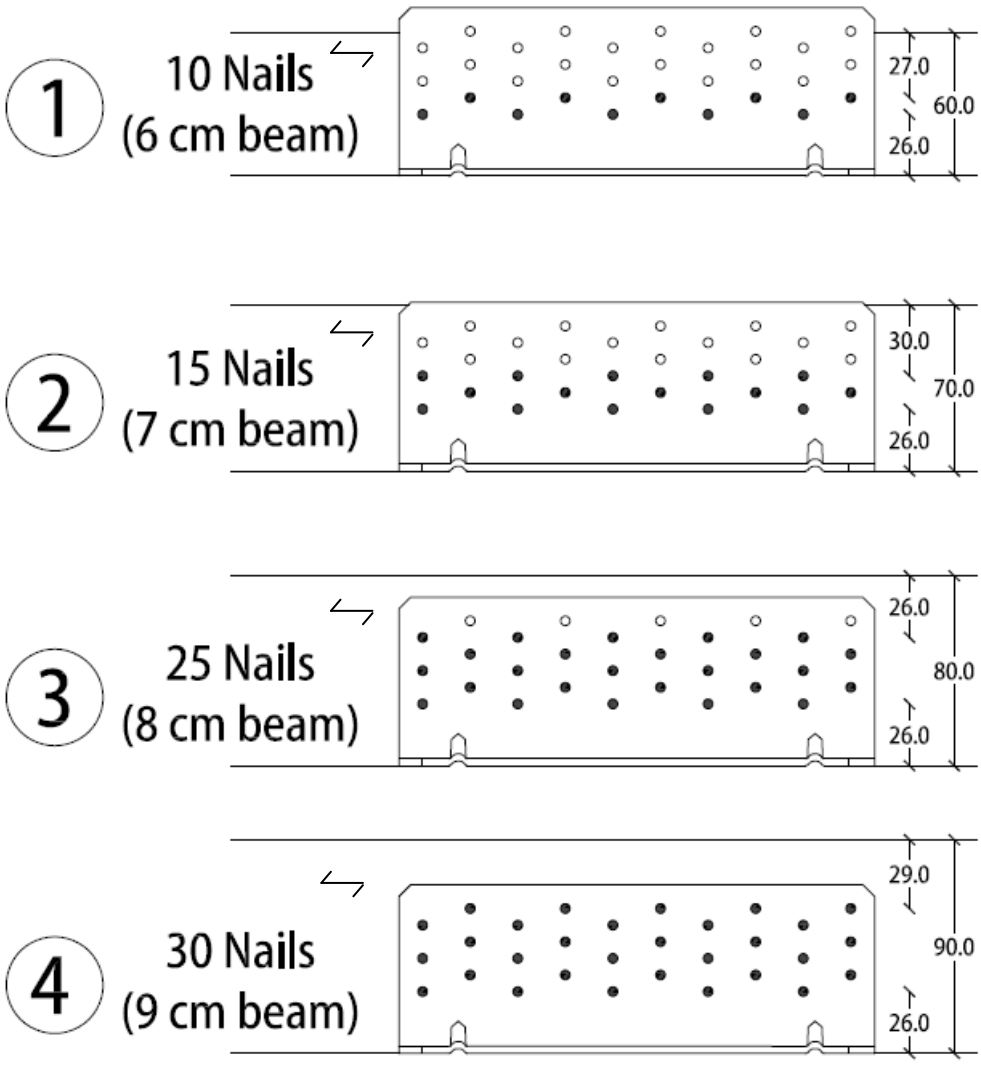


Figure B.16 Typical installation for Angle Bracket TITAN TTF200 and TCF200
(for TTF200: symmetrical hole-pattern for horizontal and vertical flange)