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

European Technical Assessment ETA-24/0409 of 2024/06/11

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:	BREKAR Angle Brackets
Product family to which the above construction product belongs:	Three-dimensional nailing plate (Angle Bracket for timber-to-timber or timber-to-concrete or steel connections)
Manufacturer:	BREKAR S.A.S 2 rue Marthe Aureau F-77400 LAGNY SUR MARNE
Manufacturing plant:	BREKAR S.A.S 1-3 Impasse Dorothée Le Maitre F-77700 SERRIS
This European Technical Assessment contains:	11 pages including 2 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

BREKAR angle brackets are one-piece non-welded, face-fixed angle brackets to be used in timber to timber or in timber to concrete or timber to steel connections. They are connected to construction members made of timber or wood-based products with threaded (ringed shank) nails according to EN 14592 or ETA and to concrete or steel members with bolts or metal anchors.

The angle brackets with a steel plate thickness of 1,5 mm are made from the following material:

- steel S280GD / Z 275 according to EN 10346:2015 with $R_e \geq 280$ N/mm², $R_m \leq 360$ N/mm² and $A_{80} \geq 18\%$

Dimensions and hole positions are shown in Annex B. BREKAR angle brackets are made from steel with tolerances according to EN 10143.

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

The angle brackets are intended for use in making connections in load bearing timber structures, as a connection between a beam and a purlin, or as a connection between wall and floor elements or as wall-to-wall connection and on concrete/steel elements, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 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 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. The wood members may be of Laminated Veneer Lumber (LVL) with a characteristic density up to 500 kg/m^3 with nails in the wide face of the LVL component. This requirement to the material of the wood members can be fulfilled by using the following materials:

- Structural solid timber according to EN 14081,
- Glulam according to EN 14080,
- Glued solid timber according to EN 14080,
- LVL according to EN 14374 or ETA,
- Cross laminated timber according to ETA,
- Plywood according to EN 636 or ETA.

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 or higher characteristic density than 350 kg/m^3 the load-carrying capacities shall be converted by the factor k_{dens}:

In load case F_1:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,8} \quad \text{for } 290 \text{ kg/m}^3 \leq \rho_k \leq 350 \text{ kg/m}^3$$

$$k_{dens} = 1 \quad \text{for } \rho_k > 350 \text{ kg/m}^3$$

In load case $F_{2/3}$, F_4 and F_{45} for timber materials except LVL:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,5} \quad \text{for } 290 \text{ kg/m}^3 \leq \rho_k \leq 420 \text{ kg/m}^3$$

In load case $F_{2/3}$, F_4 and F_{45} for LVL:

$$k_{dens} = \left(\frac{\rho_k}{350}\right)^{0,5} \quad \text{for LVL with } \rho_k \leq 500 \text{ kg/m}^3$$

where ρ_k is the characteristic density of the timber material 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. This includes seismic actions.

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 strength 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.

The scope of the angle brackets regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the angle brackets 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)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The angle brackets are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed
3.3 General aspects related to the performance of the product	The angle brackets have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2

*) See additional information in section 3.4 – 3.7.

3.4 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 must be divided by partial factors for the material properties, in case of failure of connections between the angle bracket to a timber member 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 combined timber and steel plate failure $F_{Rk,T}$ (obtaining the compressive strength perpendicular to grain or the embedment strength of fasteners subjected to shear or the withdrawal capacity of the most loaded fastener, respectively) as well as for pure concrete or steel plate failure $F_{Rk,C/S}$. The design value of the load–carrying capacity is the smaller value of both load–carrying capacities.

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

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

3.5 Mechanical resistance and stability

See annex B for the characteristic load-carrying capacity in the different directions F_1, F_2, F_3, F_4 and F_5.

The characteristic capacities of the angle brackets are determined by testing as described in the EAD 130186-00-0603. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

No performance has been determined in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

Other connector nails according to EN 14592 or ETA with the same or better performance than the fasteners given in table A.4 may be used.

3.6 Aspects related to the performance of the product

3.6.1 Corrosion protection in service class 1 and 2.

In accordance with EAD 130186-00-0603 the angle brackets are produced from:

- steel S280GD / Z 275 according to EN 10346:2015 with $R_e \geq 280$ N/mm², $R_m \leq 360$ N/mm² and $A_{80} \geq 18\%$

3.7 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 as defined in Annex A.

The following provisions apply:

- The structural members – the components 1 and 2 shown in the figure on page 10 - to which the brackets are fixed shall be:
  - Restrained against rotation.
  - 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 minimum nail's end and edge distances according to EN 1995-1-1:2010 or ETA have to be provided for.
- There are no specific requirements relating to preparation of the timber members.

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

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

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 provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2024-06-11 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details definitions

Table A.1 Materials specification

Angle Bracket type	Thickness (mm)	Steel specification	Coating specification
BREKAR	1,5	S280GD	FeZn12c / Z 275

Table A.2 Range of sizes

Angle Bracket type	Height (mm) vertical		Height (mm) horizontal		Width (mm)	
BREKAR	71	73	49	51	59	61

Table A.3 Fastener specification

Fastener	Minimum Length	Minimum Threaded Length	Fastener type
BREKAR nail 4.0 mm	35 mm	29 mm	Ringed shank nails according to EN 14592

The load-carrying-capacities of the angle brackets have been determined based on the use of BREKAR nail 4.0 mm in accordance with EN 14592. The characteristic withdrawal capacity of the nails has to be determined by calculation in accordance with EN 1995-1-1:2010, paragraph 8.3.2:

$$F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen} \left(\frac{\rho_k}{350} \right)^{0,8}$$ for the nails 4.0 mm

where:

$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2
d Nail diameter in mm
t_{pen} Penetration depth of the ringed shank including the nail tip in mm
ρ_k Characteristic density of the timber in kg/m^3

Based on EN 14592 the characteristic value of the withdrawal resistance for the BREKAR nail 4.0 mm is:
$f_{ax,k}$ = 6,39 N/mm² (with ρ_k =350 kg/m^3)

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

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

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

Annex B
Characteristic load-carrying capacities and slip moduli

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

Angle bracket	Nailing pattern	Timber-to-timber connection ρ_k = 350 kg/m³	
		$F_{1,Rk}$ [kN]	$K_{1,ser}$ [kN/mm]
BREKAR	Full	2,35	4,3
Load-carrying capacity and stiffness is based on nails 4x35.			

Table B.2: Force F_1, 1 angle bracket / Load-carrying capacity of fasteners in the vertical flange and of the steel - connection timber to steel or concrete

Angle bracket	Nailing pattern	Timber-to-concrete or steel connection ρ_k = 350 kg/m³	
		$F_{1,Rk}$ [kN]	$K_{1,ser}$ [kN/mm]
BREKAR	Full	5,58	1,0
Load-carrying capacity and stiffness is based on nails 4x35.			

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

Angle bracket	Nailing pattern	Timber-to-timber connection ρ_k = 350 kg/m³	
		$F_{2/3,Rk}$ [kN]	$K_{1,ser}$ [kN/mm]
BREKAR	Full	5,00	1,0
Load-carrying capacity and stiffness is based on nails 4x35.			

Table B.4: Force $F_{2/3}$, 1 angle bracket / Load-carrying capacity of fasteners in the vertical flange and of the steel - connection timber to steel or concrete

Angle bracket	Nailing pattern	Timber-to-concrete or steel connection ρ_k = 350 kg/m³	
		$F_{2/3,Rk}$ [kN]	$K_{1,ser}$ [kN/mm]
BREKAR	Full	2,71	0,9
Load-carrying capacity and stiffness is based on nails 4x35.			

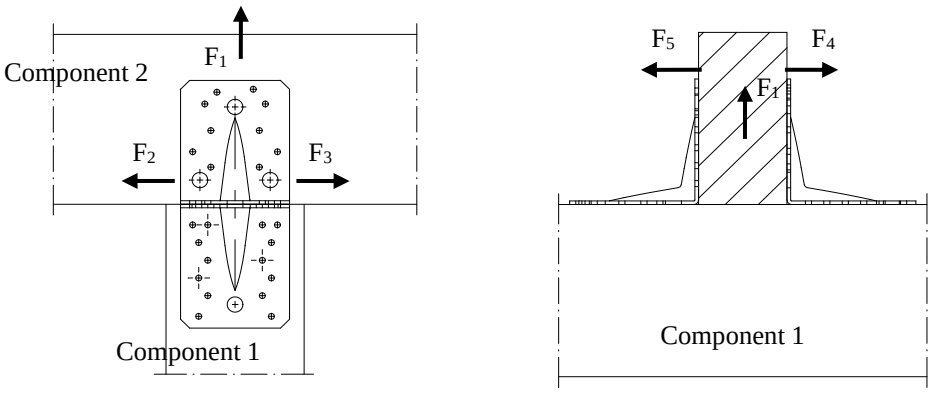
Table B.5: 1 angle bracket for force F_4 and F_5, and 2 angle brackets for force F_{45} / connection timber to timber

Angle bracket	Nailing pattern	Timber-to-timber connection ρ_k = 350 kg/m³					
		$F_{4,Rk}$ [kN]	$F_{5,Rk}$ [kN]	$F_{45,Rk}$ [kN]	$K_{4,ser}$ [kN/mm]	$K_{5,ser}$ [kN/mm]	$K_{45,ser}$ [kN/mm]
BREKAR	Full	7,36	1,55	8,92	2,5	0,4	5,8
Load-carrying capacity and stiffness is based on nails 4x35.							

Table B.6: 1 angle bracket for force F_4 and F_5, and 2 angle brackets for force F_{45} / Load-carrying capacity of fasteners in the vertical flange and of the steel - connection timber to steel or concrete

Angle bracket	Nailing pattern	Timber-to-concrete or steel connection ρ_k = 350 kg/m³					
		$F_{4,Rk}$ [kN]	$F_{5,Rk}$ [kN]	$F_{45,Rk}$ [kN]	$K_{4,ser}$ [kN/mm]	$K_{5,ser}$ [kN/mm]	$K_{45,ser}$ [kN/mm]
BREKAR	Full	9,26	1,03	10,3	4,3	0,9	10,4
Load-carrying capacity and stiffness is based on nails 4x35.							

Definitions of forces and their directions
Forces - Beam to beam connection



Fastener specification
Nailing pattern is a full pattern with nails in all 5 mm holes.

Double angle brackets per connection
The angle brackets must be placed at each side opposite to each other, symmetrically to the component axis.
Acting forces

F_1	Lifting force acting along the central axis of the joint.
F_2 and F_3	Lateral force acting in the joint between the component 2 and component 1 in the component 2 direction
F_4 and F_5	Lateral force acting in the component 1 direction along the central axis of the joint.

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.
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.
F_4 and F_5	Lateral force acting in the component 1 direction along the central axis of the joint. The components must be prevented from rotation. F_4 causes compression between the angle bracket or hold-down and component 2; F_5 causes tension between the angle bracket and component 2.

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

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

Combined forces
If the forces F_1 and F_2/F_3 or F_4/F_5 act at the same time, the following inequality shall be fulfilled:

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

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

BREKAR Angle Brackets

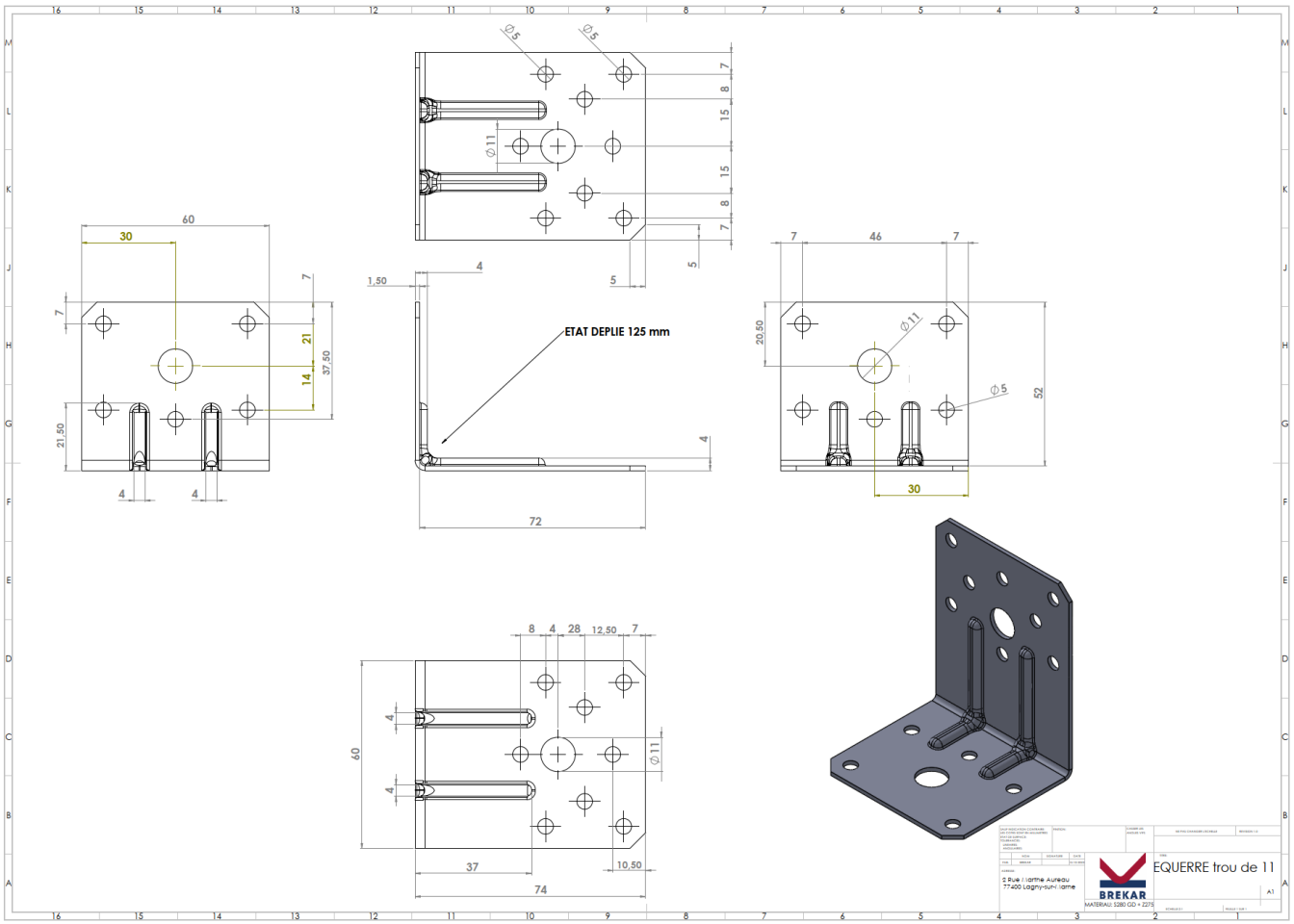


Figure B.1 Dimensions of BREKAR Angle Bracket

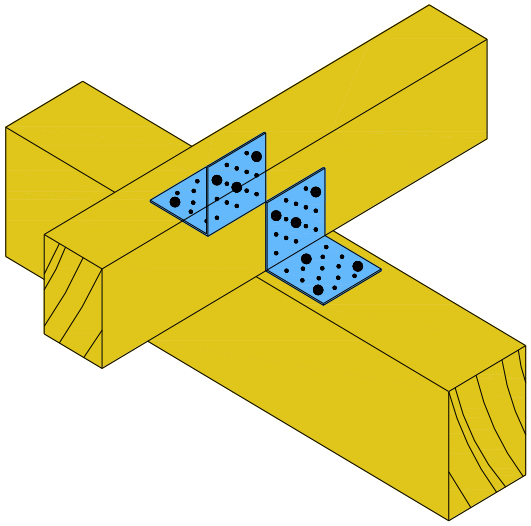


Figure B.2 Typical installation of BREKAR angle brackets