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Authorised and notified according
to Article 29 of the Regulation (EU)
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MEMBER OF EOTA



European Technical Assessment ETA-25/1026 of 2025/10/24

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:

IdeeFix, IdeeFix IFK, IdeeFix AR, IdeeFix DWD, ZaFix,
bases

Product family to which the
above construction product
belongs:

Three-dimensional nailing plate (timber to timber
connectors)

Manufacturer:

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Manufacturing plant:

Eurotec GmbH
Manufacturing plant II

This European Technical
Assessment contains:

67 pages including 5 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:

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

IdeeFix IF, IdeeFix DWD connectors are used in timber to timber connections. IdeeFix IFK connectors are used in timber to timber or steel to timber connections.

IdeeFix AR connectors are used as support for hanging loads.

IdeeFix IFS connector is used for a steel cable - timber connection, mainly for transportation.

IdeeFix IF, IdeeFix IFK, IdeeFix DWD and IFS connectors are assembled of a cylindrical part made of steel 1.0715 according to EN 10087, IdeeFix AR is made of carbon steel S235 and self-tapping screws S-Idee, named GoFix HK in ETA-11/0425 with properties assessed in ETA-11/0425.

ZaFix are assembled of a threaded rod 1.0401 according to EN 10277 and a tube 1.0308 according to EN 10216 and EN 10305.

IdeeFix IF and ZaFix connectors can be used as a kit assembled with a post-base.

Post-bases IdeeFix STF and ZaFix STZ are assembled of steel parts made of 1.0038 according to EN 10025 (S235JR); washer nut DIN 6923, property class 8 according EN 20898; threaded rod of 1.0401 according to EN 10277 (C15); counter nut ISO 4035 (DIN 439), property class 4 according to EN 20898; special screw 1.0715 according to EN 10087; tube 1.0308 according to EN 10216 and EN 10305 (E235).

Dimensions and typical installations are shown in annex A to F.

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

The intended use of the connectors is for timber to timber connections as load-bearing elements, and for IdeeFix IFK additionally for steel to timber connections, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Work Requirements 1 of the Regulation 305/2011 (EU) shall be fulfilled.

IdeeFix IF and IFK is mainly used as header - joist connection. It might be used as beam – column connector too. The connector is loaded in tension or by shearing forces, compression loads are not transmitted by IdeeFix IF and IFK but in contact between end-grain of joist and header's side-grain or column's end-grain and beam's side-

grain respectively.

IdeeFix AR is intended to be used as a support for hanging loads.

IdeeFix IFS is intended to be used for bracing by ties. This connector is not applied in the end-grain. Properties of the eye bolt are not assessed within this ETA, verification has to be done according to Eurocode 3.

ZaFix connector is used only as assembled kit with post base.

IdeeFix STF and ZaFix STZ are post bases. The post-base lower part to the upper steel plate, which works as support to the timber column, is identical for both products. The connection to the timber column is either done by IdeeFix IF or by ZaFix.

The connectors are used for timber joints designed according to Eurocode 5; assembled with post-bases the joint to the column is designed according to Eurocode 5 in addition some verifications of the post base have to be done according to Eurocode 3. IdeeFix IF connectors are used for joints of timber or wood-based products.

The connectors can be installed as joint between wood based members such as:

- Structural solid softwood timber according to EN 14081,
- Softwood glulam according to EN 14080,
- Glued solid timber according to EN 14080,

Header-joist or column-beam connections with IdeeFix IF or IFK and joints with IdeeFix IF, IFK might additionally be used with

- 1 Engineered wood products according to European Technical Approval if the ETA of the product includes provisions for the use of self-tapping screws and ring-connectors, the provisions of the ETA of the engineered wood product apply

IdeeFix AR can be used additionally with CLT – products according to European Technical Assessments if the ETA of the product includes provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply.

The annexes state the formulas for the characteristic load-carrying capacities of the connections. The design of the connections shall be in accordance with Eurocode 3, Eurocode 5 or a similar national Code.

It is assumed that the forces acting on the connection are the following F_1 , F_c , F_t and F_2 , F_3 , F_4 , F_5 , F_h . The force F_1 or F_c or F_t acts parallel to the axis of joist or column, F_2 , F_3 , F_4 , F_5 , F_h act perpendicular to the axis of joist or column. It is assumed that the forces are acting right at the end of the joist.

It is assumed that the header beam is prevented from rotating. If the header beam only has installed a connector on one side the eccentricity moment shall be considered where b_H is the header width. The same applies when the header has connections on both sides, but with vertical forces which differ more than 20%.

The connectors are intended for use in connections subject to static or quasi static loading.

The use of IdeeFix-connectors assembled with screws S-Idee made of carbon steel according to ETA-11/0425, named GoFix HK there, is limited to service class 1 and 2.

IdeeFix-connectors and post-bases assembled with screws S-Idee made of stainless steel according to ETA-11/0425 and post-bases with ZaFix can additionally be used in service-class 3.

The fasteners (bolts and washers) to be used shall be made from suitable material.

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

Assumed working life

The assumed intended working life of the connectors 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.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR 1)*)	
Joint Strength - Characteristic load-carrying capacity	See Annex A to F
Joint Stiffness	See Annex A to F
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR 2)	
Reaction to fire	The connectors 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 connectors and post-bases have been assessed as having satisfactory durability and serviceability when used in timber structures using the soft-wood timber species described in Eurocode 5 and subject to the conditions defined by service class 1, 2 or 3 for IdeeFix connections assembled with screws VSS-Idee made of stainless steel according to ETA-11/0425, named GoFix HK there. Kits using screws S-Idee made of carbon steel according to ETA-11/0425 are limited to service class 1 and 2.
Identification	See Annex A, B and C

*) 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 connections with metal fasteners, the steel plates and the timber post.

In the case of timber failure or failure of the metal fasteners, the design values shall be calculated according to EN 1995-1-1 by dividing the characteristic values of the load-carrying capacities by different partial factors for the strength properties, and in addition multiplied with the coefficient k_{mod} .

In the case of steel failure, the design value shall be calculated according to EN 1993-1-1 by reducing the characteristic values of the load-carrying capacity with different partial factors.

The design value of the load-carrying capacity is the smaller value of all load-carrying capacities:

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

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

3.5 Mechanical resistance and stability

See Annex A to F for characteristic load-carrying capacities of the connectors and post-bases.

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

The design models allow the use of fasteners described in annex A to F.

No performance has been assessed 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.

See annex A to E for the joint's stiffness properties - to be used for the analysis of the serviceability limit state.

3.6 Aspects related to the performance of the product

Corrosion protection in service class 1, 2 and 3.

The use of IdeeFix-connectors assembled with screws S-Idee made of carbon steel according to ETA-11/0425, named GoFix HK there, is limited to service class 1 and 2.

IdeeFix-connectors and post-bases assembled with screws S-Idee made of stainless steel according to ETA-11/0425 and post-bases with ZaFix can additionally be used in service-class 3.

The connectors and post-bases with three layered coating are assessed to be equivalent at least to class C4 EN ISO 12944-2. Details of the corrosion protection system are deposited at ETA-Danmark.

3.7 General aspects related to the use of the product

IdeeFix IF, IdeeFix IFK, IdeeFix AR, IdeeFix IFS and post-bases IdeeFix STF, ZaFix STZ 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.

The following provisions concerning product performance apply:

IdeeFix IF, IdeeFix IFK, IdeeFix DWD or IdeeFix IFS Connector joints

A connector joint is deemed fit for its intended use provided:

- 1 The header beam shall be restrained against rotation and be free from wane under the connector.
If the header carries joists only on one side the eccentricity moment from the joists
 $M_{ec} = R_{joist} (b_H/2)$
shall be considered at the strength verification of the header.
 R_{joist} Reaction force from the joists
 b_H Width of header
- 2 For a header with joists from both sides but with different reaction forces a similar consideration applies.
- 3 Connectors are fastened to wood-based members by bolts.
- 4 The characteristic capacity of the connector joint is calculated according to the manufacturer's technical documentation.
- 5 The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- 6 There is no gap between the end of the joist and header, beam – column respectively.
- 7 The height and depth of the joist or header shall be so large that the minimum fastener end and edge distances are observed.

Post-bases IdeeFix STF or ZaFix STZ

- The characteristic capacity of the connector joint is calculated according to

the manufacturer's technical documentation, dated 2013.

- The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
- The post-bases is designed in accordance with Eurocode 3 or an appropriate national code.
- There is no gap between the end of the column and the column support plate of the post-base.
- The height and depth of the column shall be so large that the minimum fastener end and edge distances are observed.

The actual end bearing capacity of the timber member to be used in conjunction with the connector is checked by the designer of the structure to ensure it is not less than the connector capacity and, if necessary, the connector capacity reduced accordingly.

There are no specific requirements relating to preparation of the timber members.

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 Commission, 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 2025-10-24 by

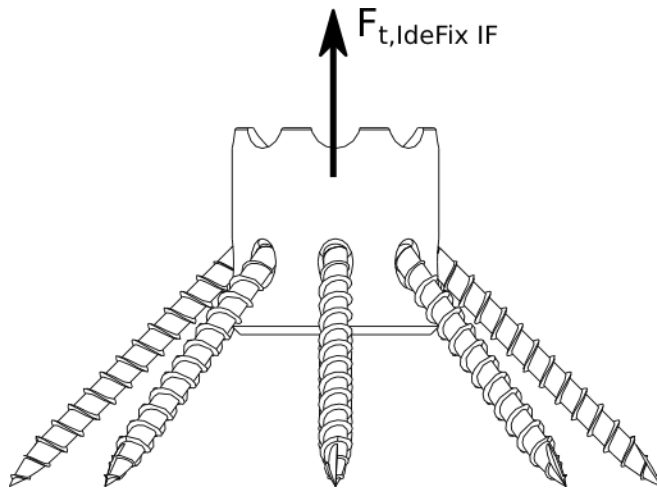


Thomas Bruun
Managing Director, ETA-Danmark

Annex A: IdeeFix IF, IFK

A) Characteristic values of load-carrying-capacities and stiffness

1.1 Loading in tension of IdeeFix IF, IFK



Resistance:

$$F_{t,IdeeFixIF,Rk} = n \cdot (F_{ax,\alpha,Rk} + F_{la,\alpha,Rk}) \cdot \cos(45^\circ)$$

with $F_{ax,\alpha,Rk}$, $F_{la,\alpha,Rk}$ for screws VSS, properties and design according to ETA-11/0024

Stiffness:

$$\frac{n}{K_{IdeeFix}} = \sqrt{\frac{1}{8} \cdot \left(\frac{1}{K_{ax}^2} + \frac{1}{K_{la}^2} \right)}$$

$$\text{with } K_{la} = \rho^{1,5} \cdot d/23;$$

Figure A.1: IdeeFix IF in tension loading

d: diameter of VSS;

n: number of VSS screws

Table 1: characteristic withdrawal resistance of IdeeFix IF or IFK in timber of grade C24

IdeeFix® IF Ø	VSS made of carbon steel according to ETA-11/0425	$F_{t,IdeeFix,Rk}$ [kN], C24	K_{ser} [kN/mm], C24
30 mm	d=5,0 mm, l_{ef} = 34 mm	19,9 kN	30,5 kN/mm
30 mm	d=5,0 mm, l_{ef} = 54 mm	30,2 kN	31,5 kN/mm
30 mm	d=5,0 mm, l_{ef} = 74 mm	38,8 kN	31,8 kN/mm
40 mm	d=6,0 mm, l_{ef} = 53 mm	34,2 kN	37,8 kN/mm
40 mm	d=6,0 mm, l_{ef} = 73 mm	44,9 kN	38,2 kN/mm
40 mm	d=6,0 mm, l_{ef} = 93 mm	54,6 kN	38,4 kN/mm
50 mm	d=8,0 mm, l_{ef} = 81 mm	66,1 kN	51,0 kN/mm
50 mm IFD	d=6,0 mm, l_{ef} = 68 mm	85,0 kN	76,2 kN/mm
50 mm IFD	d=6,0 mm, l_{ef} = 88 mm	104 kN	76,7 kN/mm

For strength classes different to C24 the withdrawal capacity and stiffness might be found according to ETA-11/0024 and the definition of this annex

The load carrying capacity and stiffness according to this annex hold for the timber member the IdeeFix connector is fixed to. For the second member with the bolt further verifications might be compulsory, e.g. for compression strength under the washer or stresses perpendicular to grain.

1.2 Loading of IdeeFix IF, IFK by shearing force

Three different failure modes must be verified.

Mode a) embedding of IdeeFix in end grain

The resistance of IdeeFix IF or IFK is calculated as proposed in EC 5 for ring-connector joints,

$$F_{Rk,IdeeFix,endgrain} = \frac{k_h}{k_{90}} \cdot \min\left\{ \frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot 35 \cdot d_c^{1,5}}{k_1 \cdot k_3 \cdot l_e \cdot 31.5 \cdot d_c} \right\} \text{ with } d_c: \text{IdeeFix diameter},$$

l_e depth of embedment of IdeeFix in joist's end grain and $k_1 = k_2 = k_4 = 1, k_h = 0,65$.

load-carrying capacity of self-tapping screws VSS $F_{v,Rk,VSS}$

The load carrying capacity of VSS $F_{v,Rk,VSS}$ self-tapping screws according to Johansen's equations EC5, 8.2.3 and ETA-11/0024 is added for a reduced number: n=5 screws are supposed to contribute (n=10 for IdeeFix IFD with two rows of screws).

The rod effect $F_{ax}/4$ in these equations is the minimum of either the pull out resistance of all screws or the compression strength of the washer at the side of the bolt:

$$F_{ax} = \min\{n_{screw} \cdot F_{R,ax} \cdot \cos(45^\circ), F_{c,90,washer}\}$$

The strength capacity for mode a) follows as

$$F_{v,Rk,mode a} = F_{Rk,IdeeFix,endgrain} + F_{v,Rk,VSS}$$

Mode b) embedding of bolt and IdeeFix in header or column

The embedding of the bolt is taken into account.

$$F_{v,Rk,bolt} = f_{h,90,bolt} \cdot d_{bolt} \cdot \left(\sqrt{(e_{bolt}^2 + \frac{4 \cdot M_{y,bolt}}{d_{bolt} \cdot f_{h,90,bolt}})} - e_{bolt} \right) + F_{ax}/4 \text{ with } F_{ax} \text{ as defined in failure mode a).}$$

For IdeeFix IF the sunken part in the header or column is added

$$F_{Rk,IF,sidegrain} = \frac{1}{k_{90}} \cdot \min\left\{ \frac{k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot 35 \cdot d_c^{1,5}}{k_1 \cdot k_3 \cdot l_{e,h} \cdot 31.5 \cdot d_c} \right\} \text{ with } l_{e,h} \text{ embedding length of IdeeFix IF in header or column}$$

$$F_{v,Rk,mode b} = F_{Rk,IF,sidegrain} + F_{v,Rk,bolt}$$

Table 2: embedding depth l_e ; distance e_{bolt}

diameter IdeeFix	embedding depth l_e in joist	embedding depth $l_{e,h}$ in header or column	e_{bolt} IF	e_{bolt} IFK
30 mm	20 mm	7 mm	15 mm	8 mm
40 mm	25 mm	10 mm	21 mm	11 mm
50 mm	30 mm	15 mm	32 mm	13 mm
diameter IdeeFix, IFD				
50 mm	35 mm	10 mm	27 mm	

Mode c) tension perpendicular to grain for the joist or header according to EC 5

$$F_{modec,IdexIF,Rk} = 14 \cdot b_{joist} \cdot \sqrt{\frac{h_e}{(1-h_e/h_{joist})}}$$

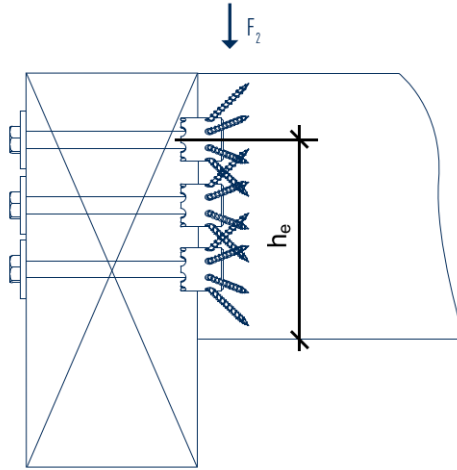


Figure A.2: Verification for stresses perp. to grain according EC5-1-1

The shearing force capacity of IdexIF or IFK in end-grain is the minimum value of these three modes.

Slip modulus for IdexIF connections in end-grain: $K_{ser} = 1,2 \cdot \rho_m \cdot d_c/2$

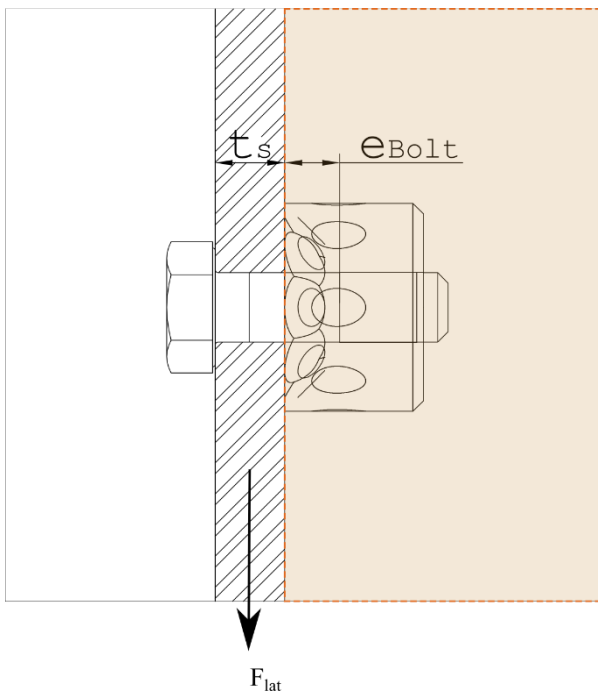
1.3 lateral capacity with IdexIF or IFK in side grain of a timber-to-timber joint

If IdexIF connectors are placed in the side-grain the models of paragraph A.1.2 might be applied, without $k_h = 0,65$. The parameters k_1 , k_2 and k_{90} have to be adjusted accordingly EC 5-1-1, 8.9.

1.4 lateral capacity with IdexIFK in a steel-to-timber joint

Instead of mode b, embedding of IdexIF and bolt in the header, the bending of the bolt is used as a criterion for the bearing capacity.

The lateral resistance of this failure mode is $F_{mode b,Boltsteel} = \frac{M_{y,Rk}}{(t_s/2 + e_{bolt})}$.



Additionally shear and bearing resistance are to be verified according EC3-1-8.

1.5 Combined loading of IdeeFix IF or IFK by shearing force and tension force

Clause 8.3.3, equ. (8.28) of EN 1995-1-1:2010 is applied: $\left(\frac{F_{ax,Ed}}{F_{t,IdeeFix,Rd}}\right)^2 + \left(\frac{F_{V,Ed}}{F_{V,IdeeFix,Rd}}\right)^2 \leq 1,0$

1.6 Multiple IdeeFix IF or IFK connectors per joint

For joints with more than one IdeeFix IF or IFK connector the bearing capacity of the joint is found by multiplying the capacity for one IdeeFix IF with the number of connectors $n_{IdeeFix}$.

For joints loaded by shearing force mode c of Annexe A1.2 as a verification of tension perpendicular to grain shall not be multiplied by $n_{IdeeFix}$.

Verification for wood members according to Eurocode 5 have to be done consciously.

B) IdeeFix IF, product details, definitions and installation

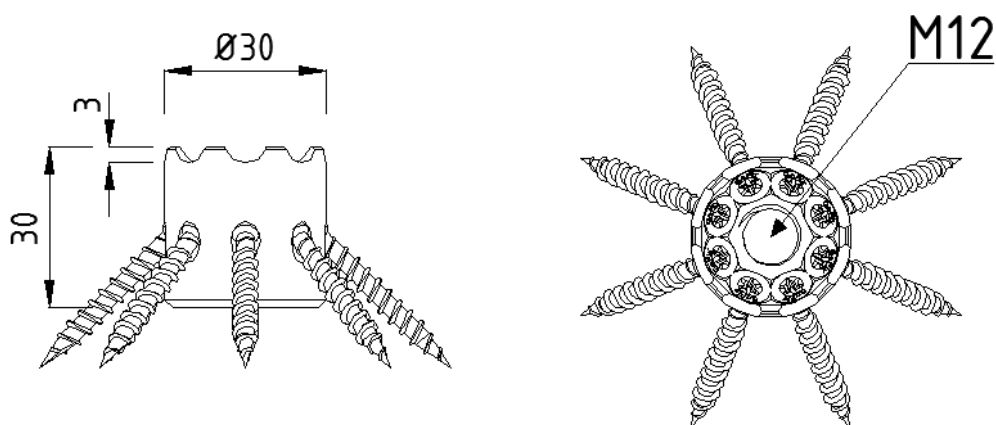


Figure 2: IdeeFix IF series 300

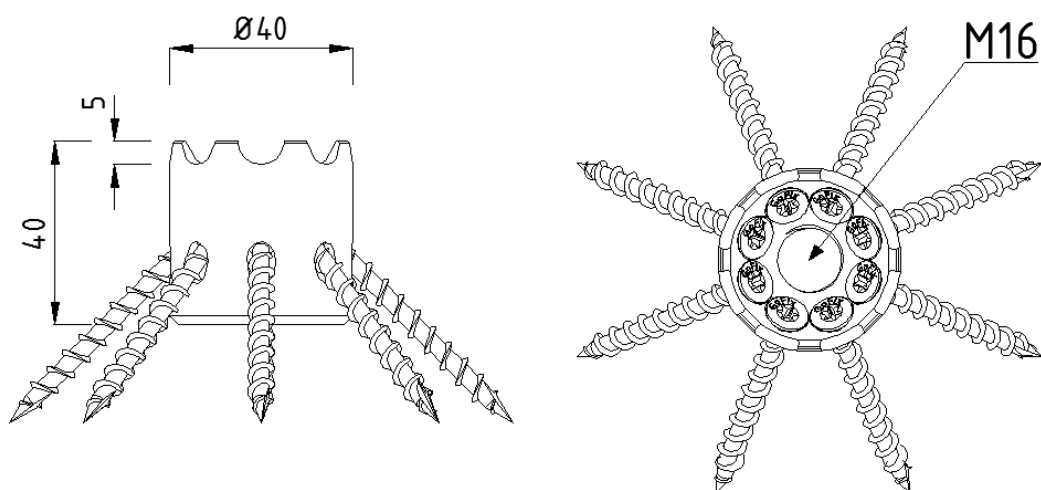


Figure 3: IdeeFix IF series 400

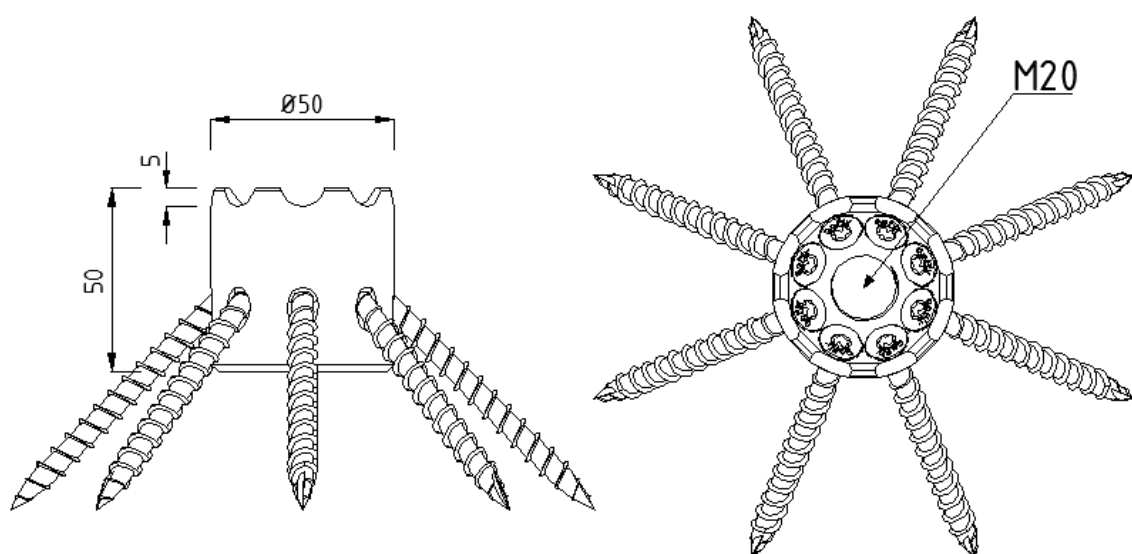
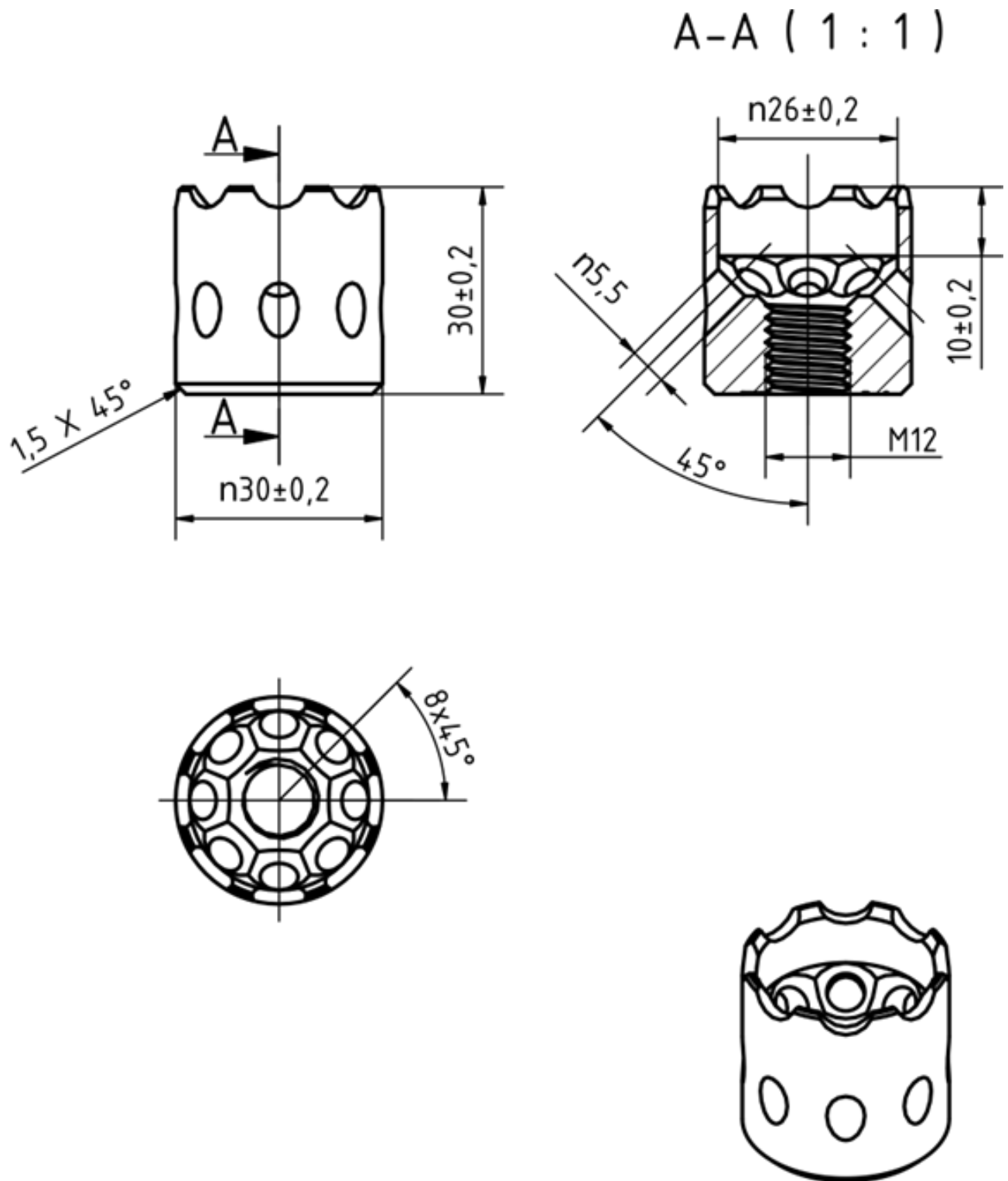


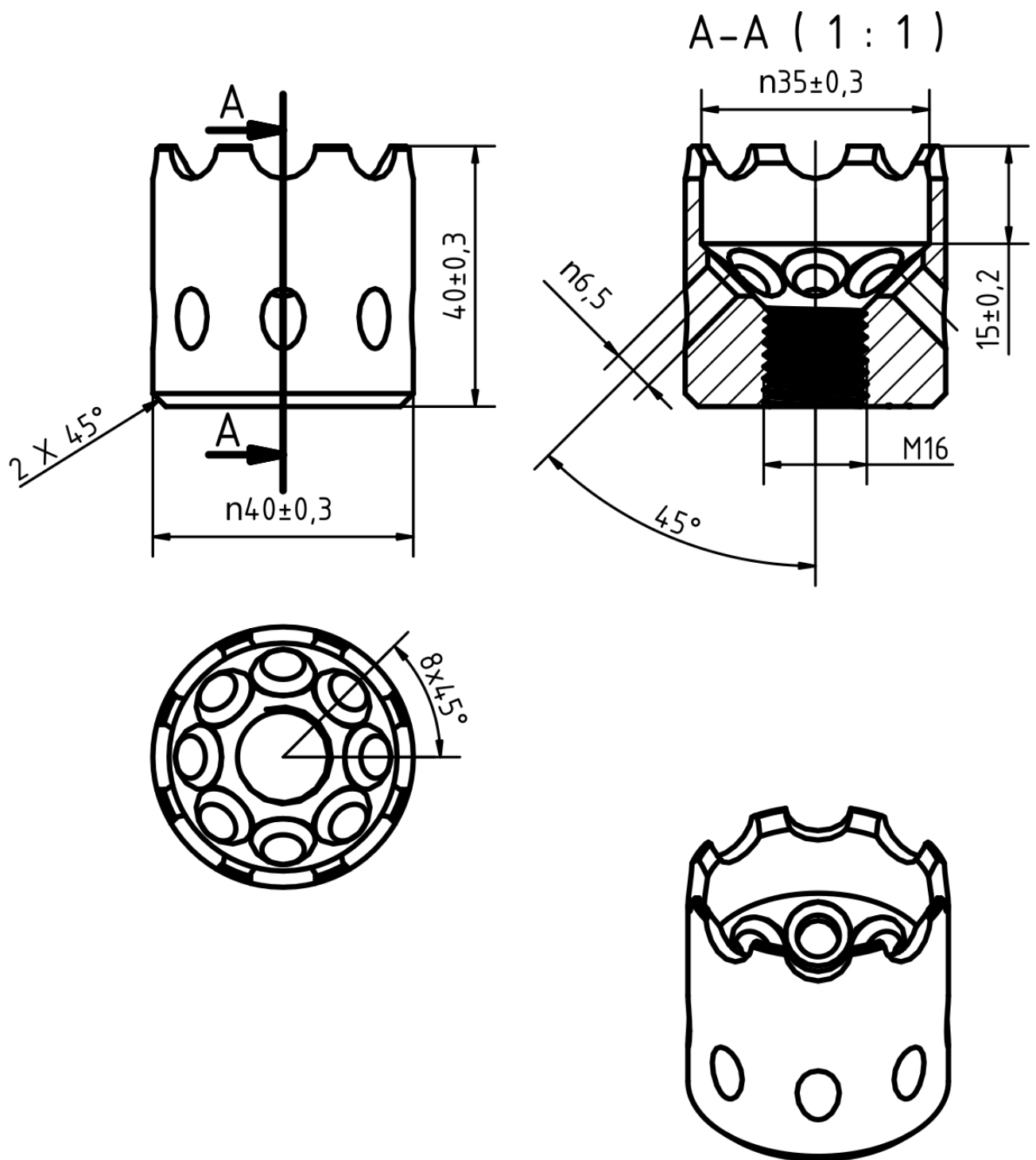
Figure 4: IdeeFix IF series 500

Cylindrical part made of steel 1.0715 according to EN 10087 and self-tapping screws VSS with properties assessed in ETA-11/0024

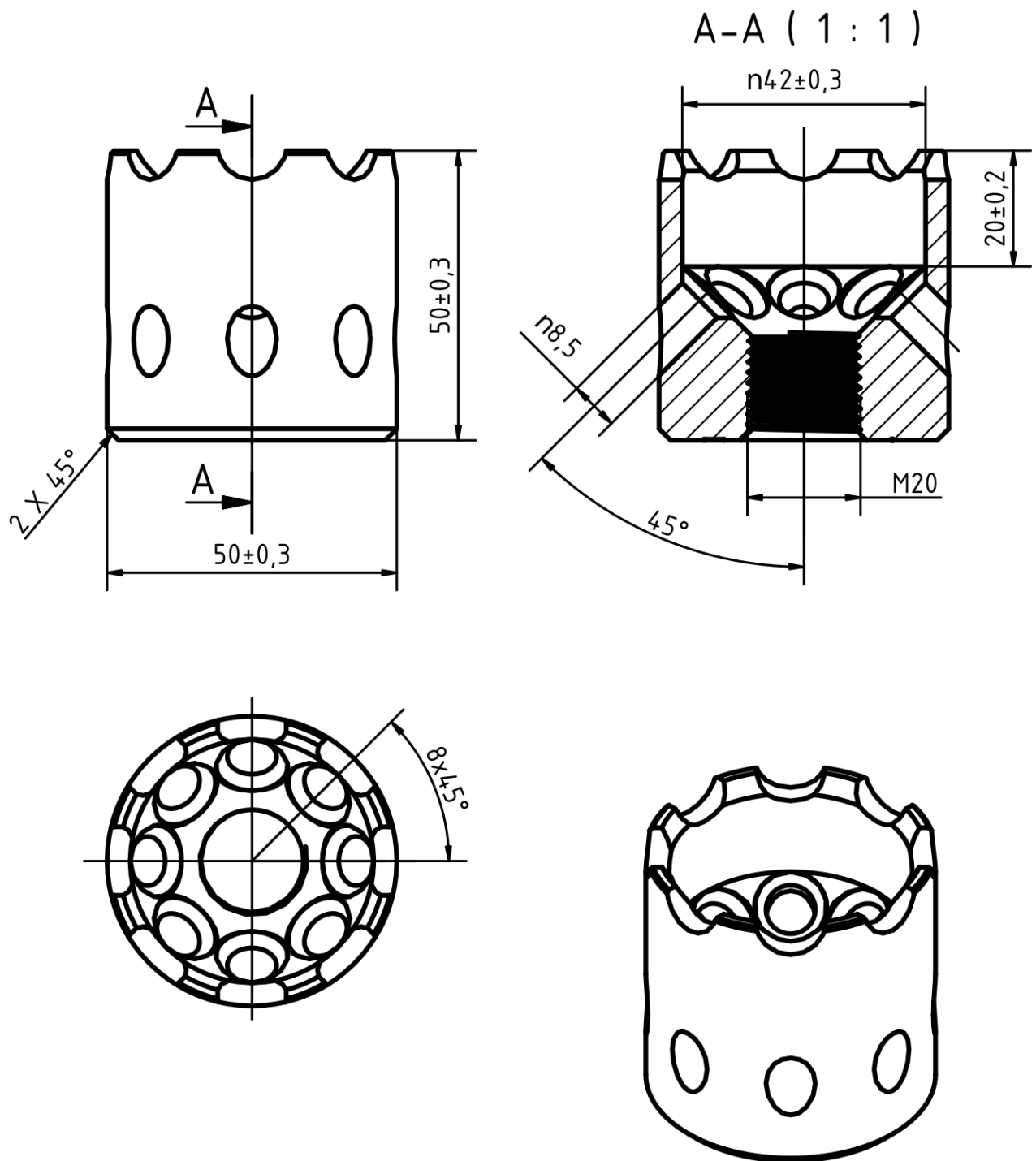
2.1 IdeeFix IF series 300, details:



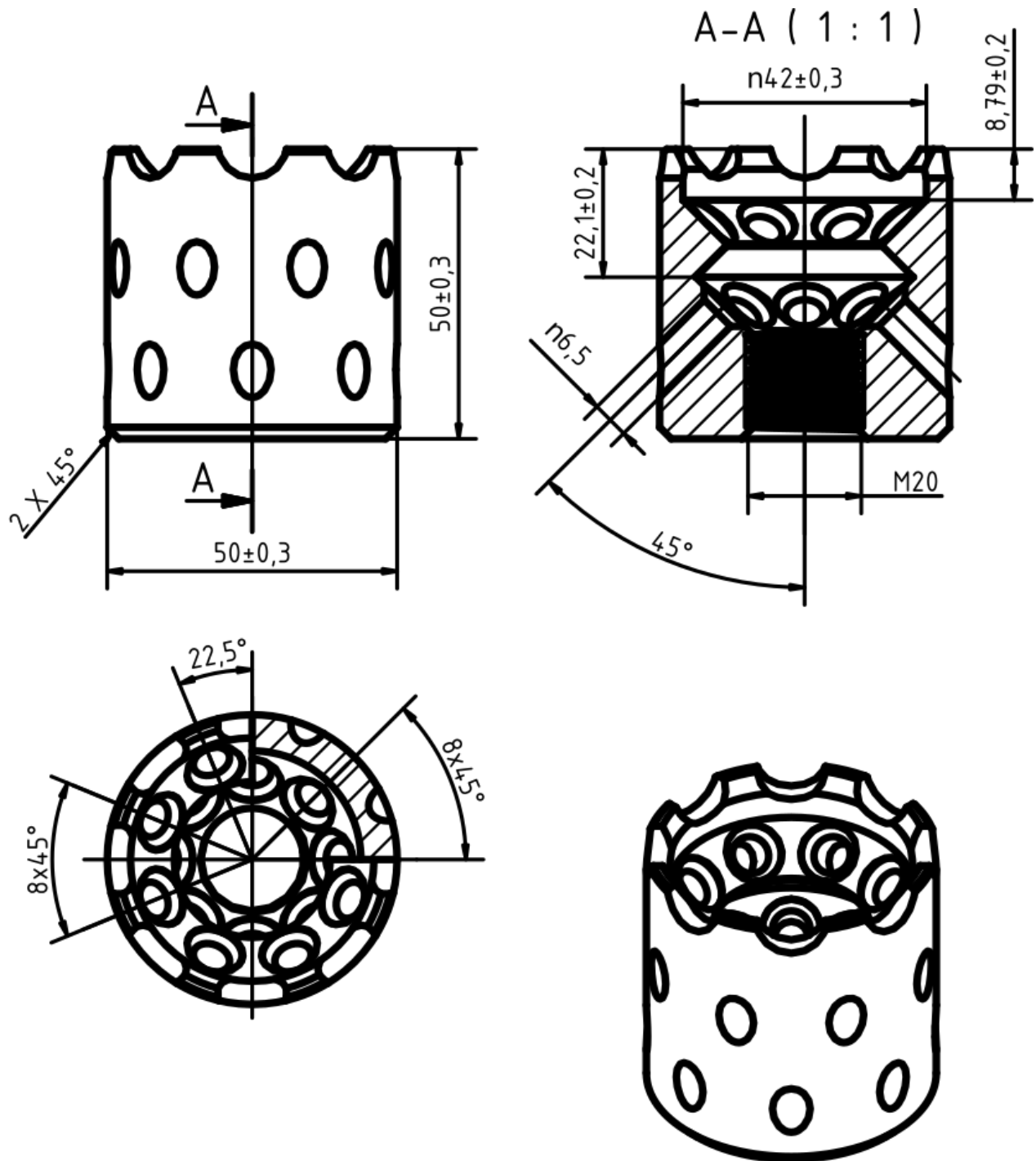
2.2 IdeeFix IF series 400, details:

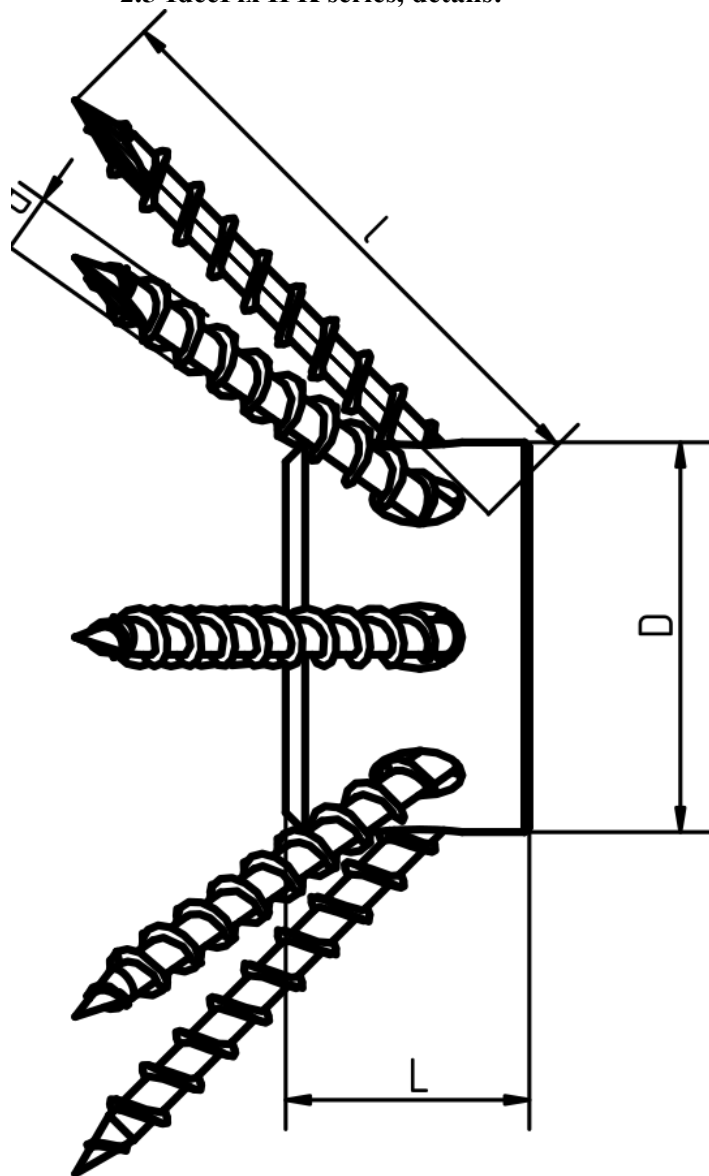


2.3 IdeeFix IF series 500, details:



2.4 IdeeFix IF series 500 with two rows of screws, details:



2.5 IdeeFix IFK series, details:

	IFK30	IFK40	IFK50
Schraubendurchmesser d [mm]	5,0	6,0	8,0
Schraubenlängen l [mm]	40,0 / 60,0 / 80,0	60,0 / 80,0 / 100,0	90,0
Länge L [mm]	20,0	25,0	30,0
Durchmesser D [mm]	30,0	40,0	50,0
Schraubenanzahl [Stk.]	8	8	8

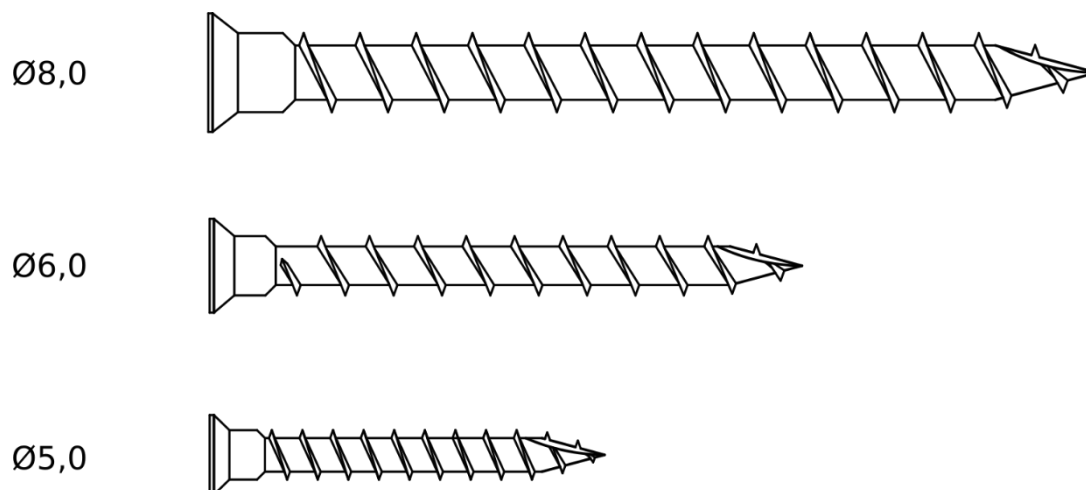
2.6 IdeeFix IF screws, VSS, ETA -11/0024, geometry:

Figure 5: IdeeFix VSS screws

Table 4: IdeeFix VSS screws, details

IdeeFi		VSS HK		
IF	Ø	d	l	lef
304	30	5,0	40	34
306	30	5,0	60	54
308	30	5,0	80	74
406	40	6,0	60	53
408	40	6,0	80	73
410	40	6,0	100	93
509	50	8,0	90	81
IdeeFix IFD		VSS		
508	50	6,0	80	68
510	50	6,0	10	88

2.7 IdeeFix IF installation:

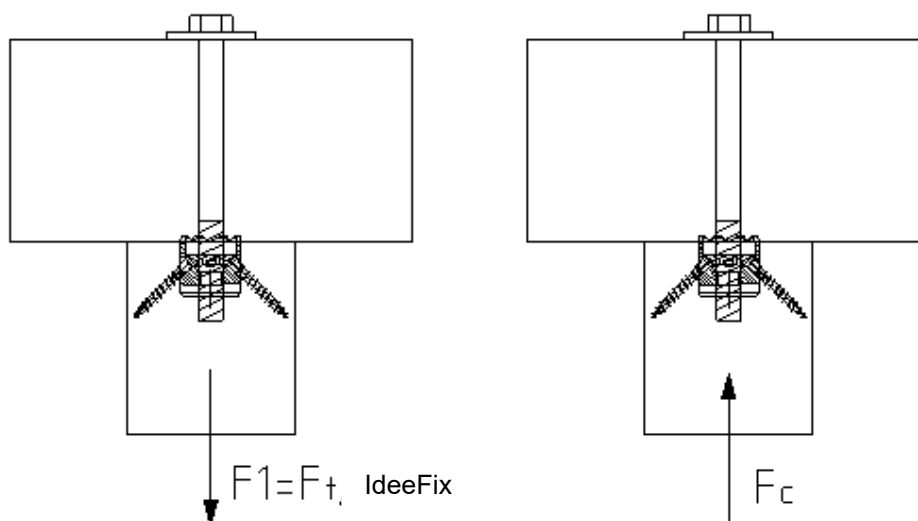


Figure 6: Tension connection with anti-twist protection, bolted joint connection

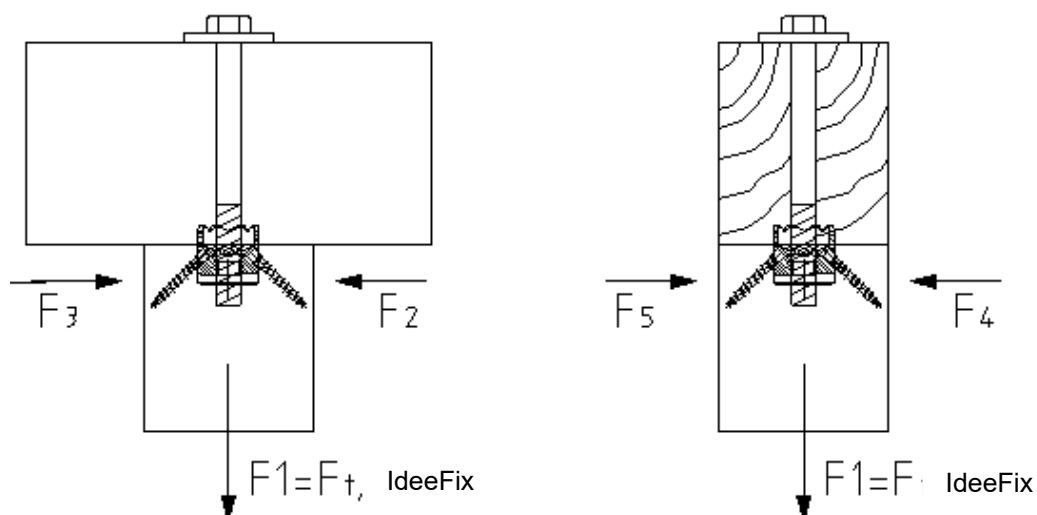


Figure 7: Column to main beam connection with anti-twist protection, bolted joint connection

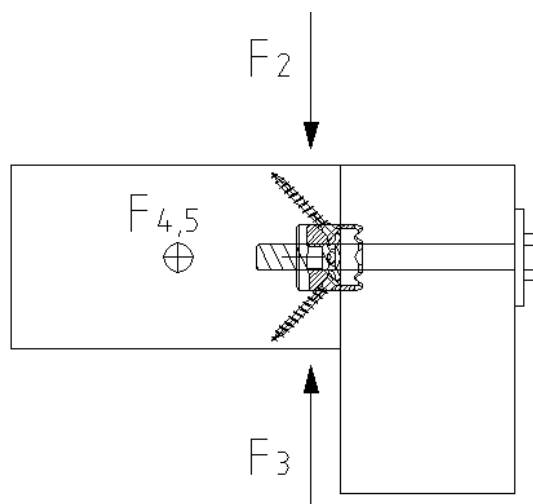
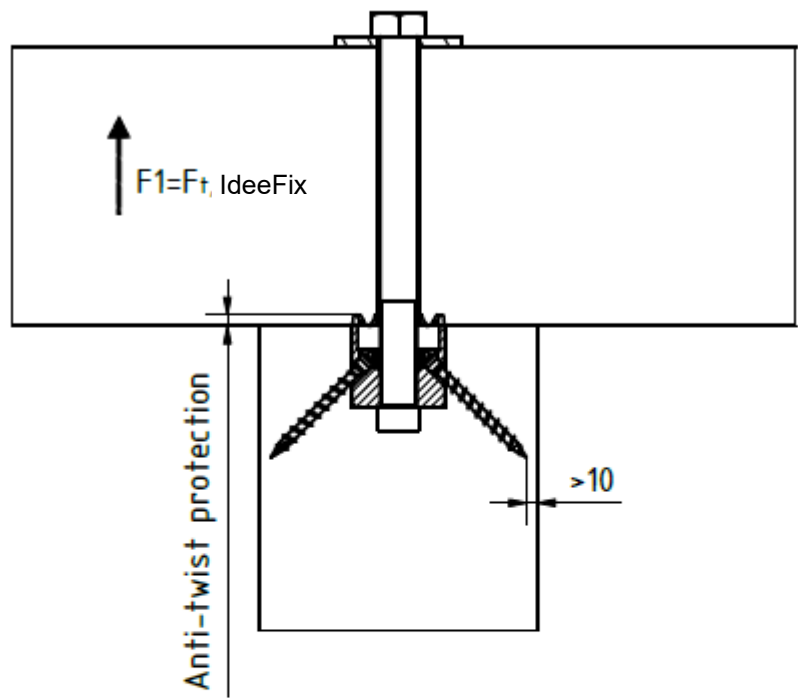
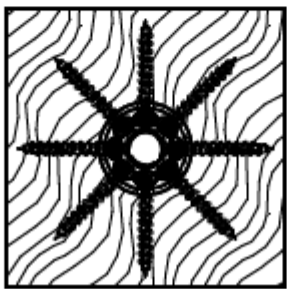


Figure 8: Header- joist connection with anti-twist protection, bolted joint connection

Side View



Hexagon screw with
shank or threaded bar
M12, M16, M20
Washer – DIN 40
IdeeFix - Connector
series IF300, IF400, IF500



Anti-twist protection	
IF 300	3 mm
IF 400	5 mm
IF 500	5 mm

side view

Part screwing

Full screwing

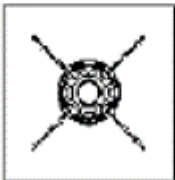
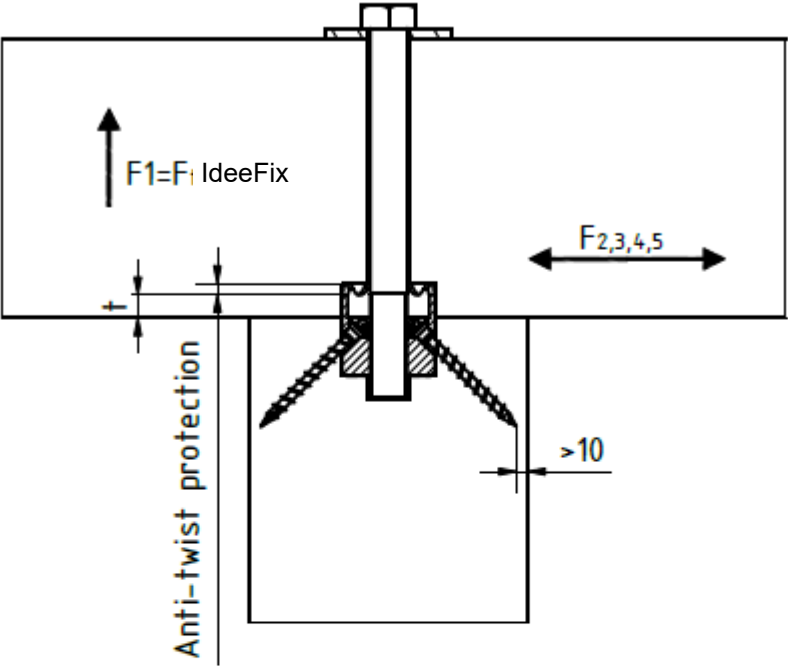
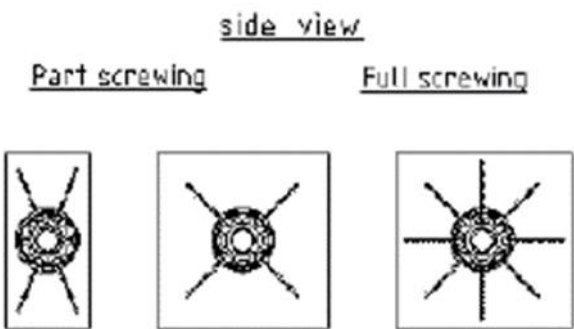
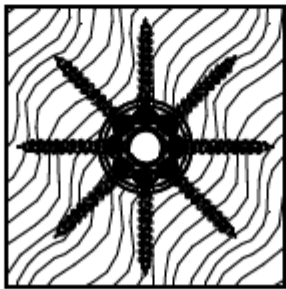


Figure 9: Tension Connection, details



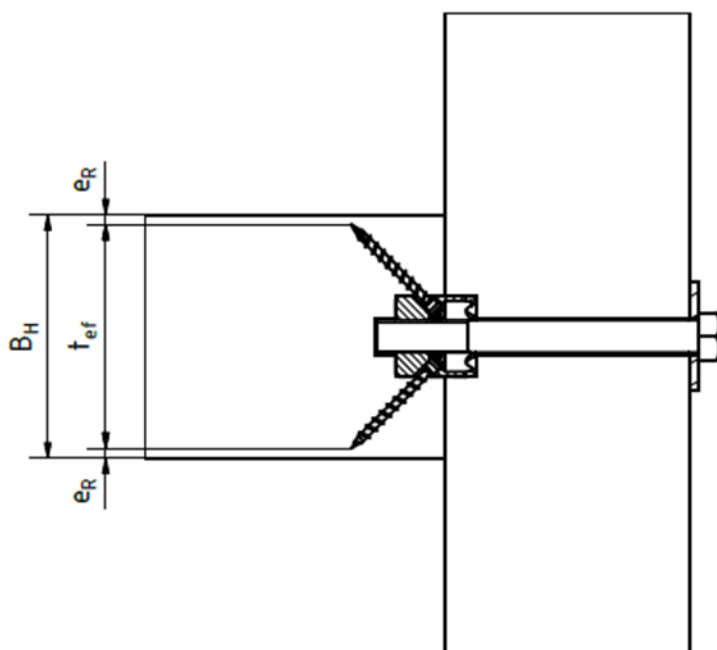
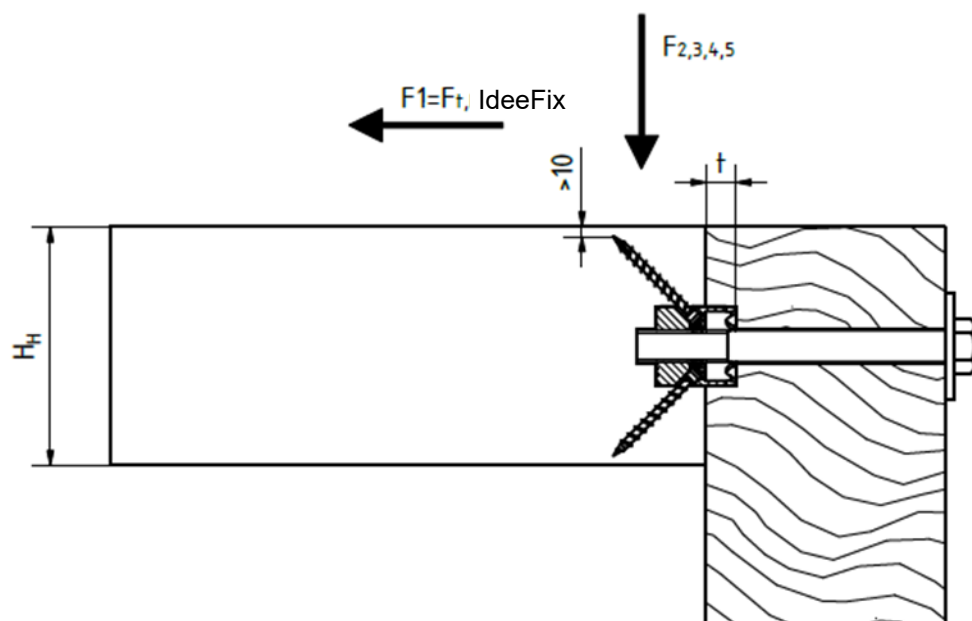
Side view

Hexagon screw with shank or threaded bar M12, M16, M20
washer - DIN 440
IdeeFix — Connector
series IF300, IF400, IFS00



IdeeFix	t	Anti-twist protection
IF 300	7 mm	3 mm
IF 400	10 mm	5 mm
IF 500	15 mm	5 mm
IFD 500	10 mm	5 mm

Figure 10: Bolted Joint Connection,



IdeeFix	Subbeam	Mainbeam [t]
IF 300	20 mm	10 mm
IF 400	25 mm	15 mm
IF 500	30 mm	20 mm
IFD 500	25 mm	15 mm

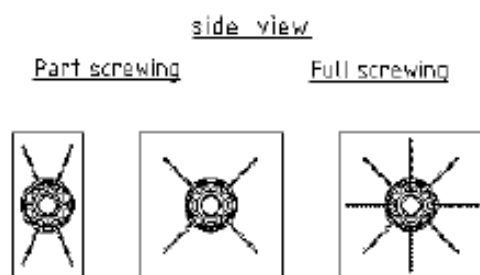
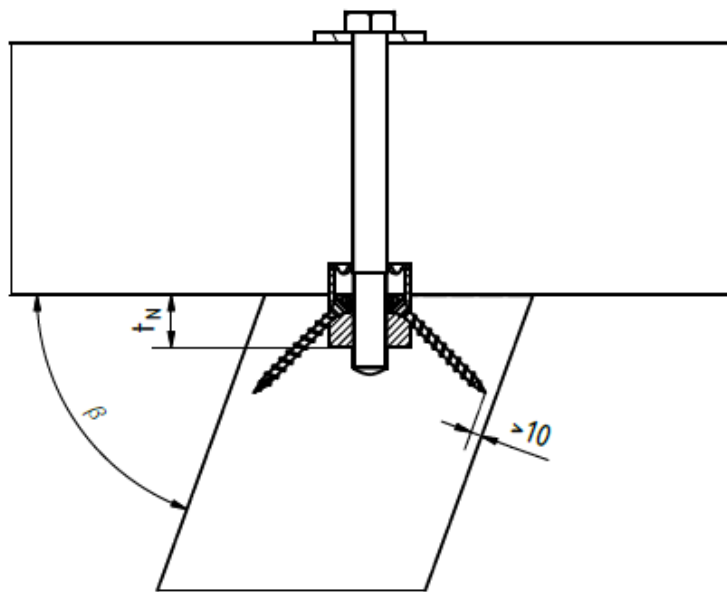
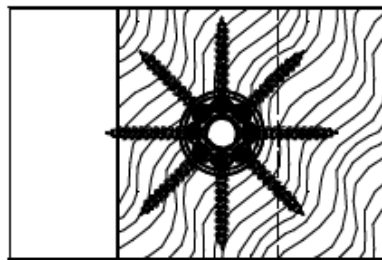


Figure 11: Secondary beam to Mainbeam connection, details



Top view

t_N – mounting depth of the IdeFix connector-sub beam

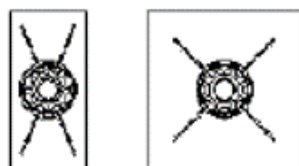


Hexagon screw with shank or threaded bar M12, M16, M20

washer – DIN 440

IdeeFix Connector
series IF300, IF400, IF500

Part screwing



$$45^\circ < \beta < 90^\circ$$

Figure 12: Subbeam to Mainbeam connection- angle, details

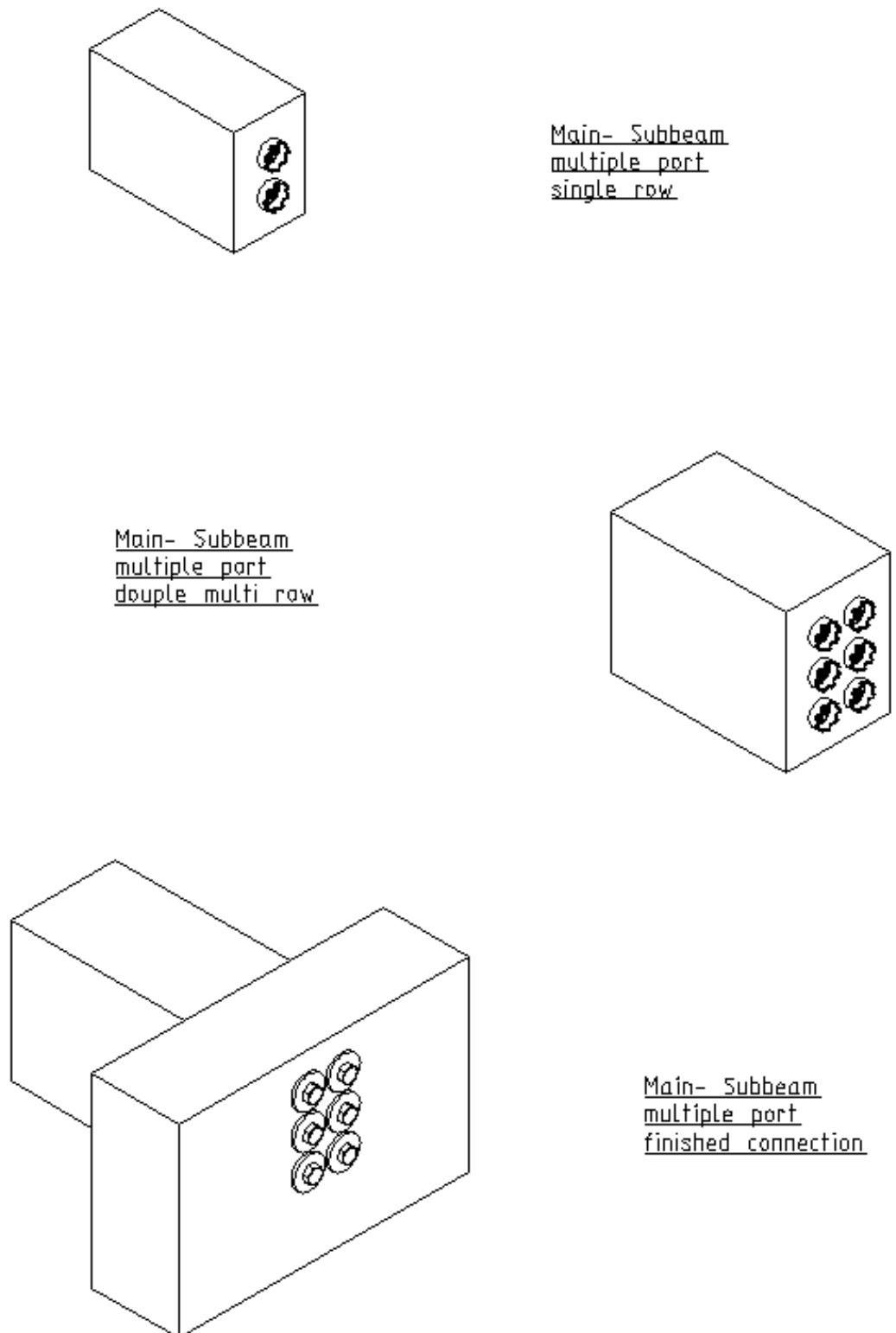
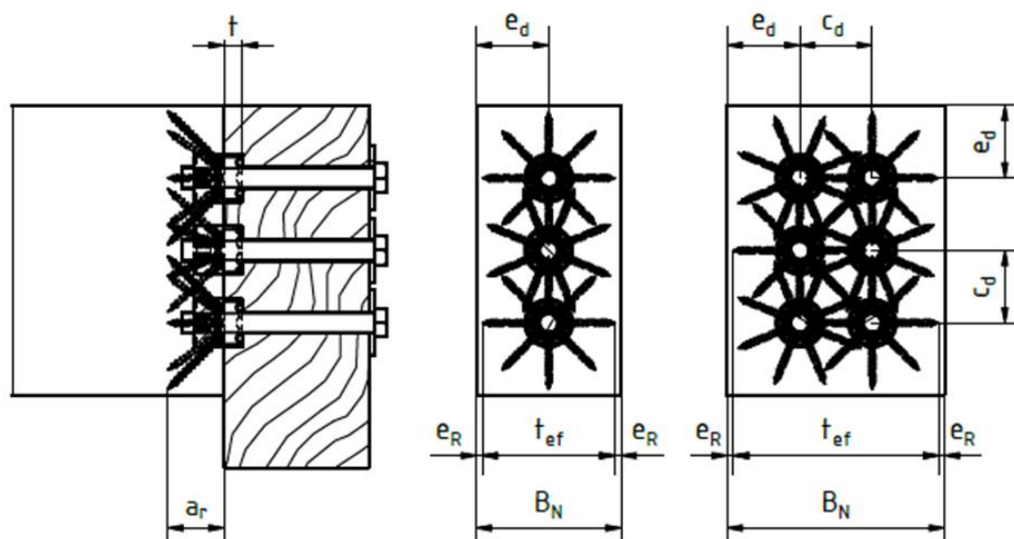


Figure 13: Multiple port connection



IdeeFix	subbeam	mainbeam
IF 300	20 mm	10 mm
IF 400	25 mm	15 mm
IF 500	30 mm	20 mm
IFD 500	25 mm	15 mm

IdeeFix	edge distance [e_d]	center distance [c_d]
IF 304	50 mm	50 mm
IF 306	60 mm	60 mm
IF 308	70 mm	70 mm
IF 406	60 mm	60 mm
IF 408	80 mm	80 mm
IF 410	90 mm	90 mm
IF 509	80 mm	80 mm
IFD 508	80 mm	160 mm
IFD 510	100 mm	200 mm

Figure 14: Multiple port connection, details

Annex B: IdeeFix IFS

1. IdeeFix IFS product details, definitions and installation

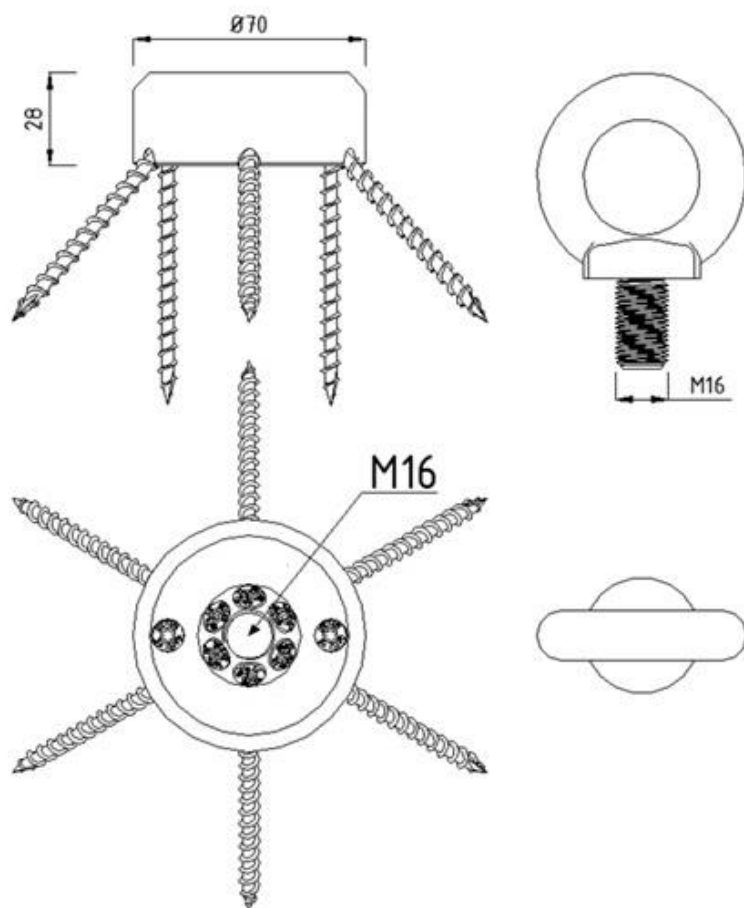


Figure 15: IdeeFix IFS

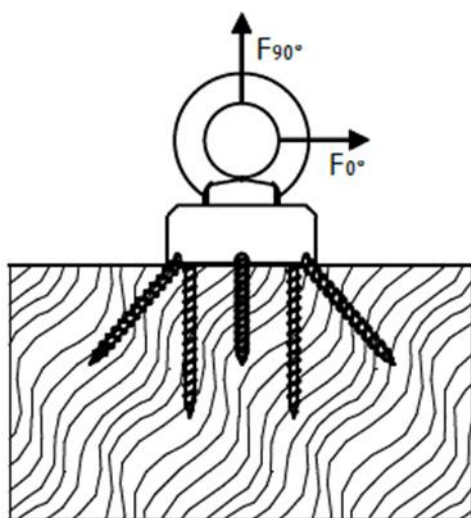


Figure 16: IdeeFix IFS loading

Table 5: IdeeFix IFS geometry, screws

IdeeFix® IFS Ø	VSS ETA-11/0024
70 mm	d=6,0 x 100 mm, l_{ef} = 63 mm for screws with an angle of 45°
70 mm	d=6,0 x 100 mm, l_{ef} = 72 mm for screws with an angle of 90°

Properties of the eye bolt are not assessed within this ETA, verification has to be done according to Eurocode 3. This connector is not applied in the end-grain.

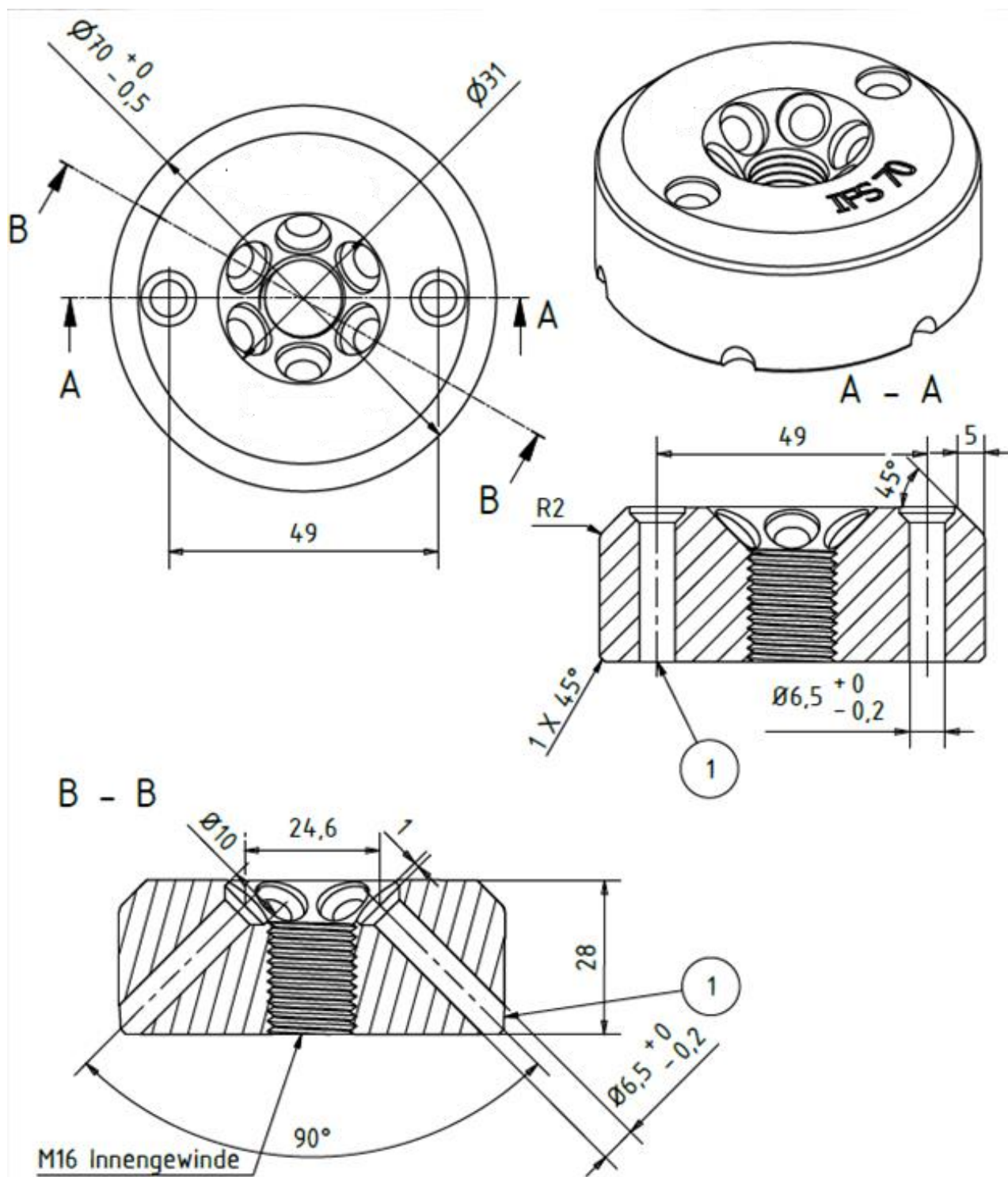


Figure 17: IdeeFix IFS, details

2. IdeeFix IFS Characteristic values of load-carrying-capacities and stiffness

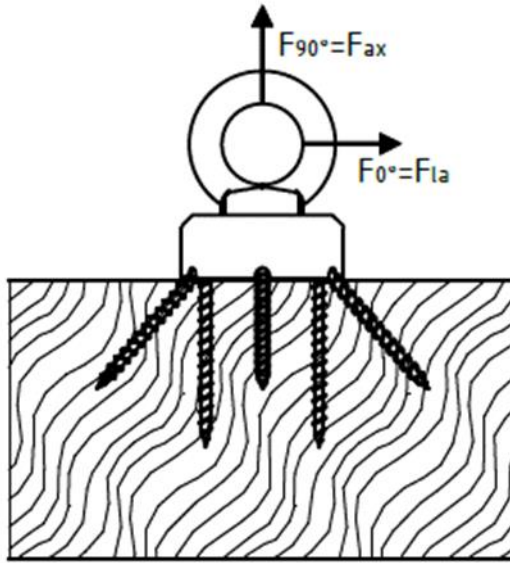


Figure 18: IdeeFix IFS loading

Axial withdrawal resistance

$$F_{ax,IdeeFixIFS} = 6 \cdot (F_{45^\circ,ax,Rk} + F_{45^\circ,la,Rk}) \cdot \cos(45^\circ)$$

with $F_{45^\circ,ax,Rk}$, $F_{45^\circ,la,Rk}$ for screws VSS, properties and design according ETA-11/0024. Without taking in account the rod-effect for $F_{la,\alpha,Rk}$.

Load-carrying capacity for shearing forces

$$F_{la,IdeeFixIFS} = 2 \cdot (F_{45^\circ,ax} + F_{45^\circ,la}) \cdot \cos(45^\circ)$$

Combined loading

$$\left(\frac{F_{ax,Ed}}{F_{ax,IdeeFixIFS,Rd}} \right)^2 + \left(\frac{F_{V,Ed}}{F_{V,IdeeFixIFS,Rd}} \right)^2 \leq 1,0$$

Characteristic values for IdeeFix IFS made of carbon steel according to ETA-11/0024 and timber grade C24

$$F_{ax,IdeeFixIFS,k} = F_{ax,Rk} = 25,5kN$$

$$F_{la,IdeeFixIFS,k} = F_{v,Rk} = 8,5kN$$

$$F_{45^\circ,Rk} = 11,4kN$$

Annex C: ZaFix ZF

1. Characteristic values of load-carrying-capacities and stiffness

1.1 Loading in tension of ZaFix ZF

$$F_{ZaFix, \emptyset 30mm, ax, Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5,70kN; \quad F_{ZaFix, \emptyset 40mm, ax, Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5,70kN$$

$$F_{ZaFix, \emptyset 30mm, C24} = 5,70kN; \quad F_{ZaFix, \emptyset 40mm, C24} = 5,70kN$$

$$K_{ser, ZaFix, \emptyset 30mm} = \frac{\rho_k}{350kg/m^3} \cdot 23,0 kN/mm; \quad K_{ser, ZaFix, \emptyset 40mm} = \frac{\rho_k}{350kg/m^3} \cdot 23,0 kN/mm$$

1.2 Loading of ZaFix ZF by shearing force

Two different failure modes are taken into account:

•

Embedding in column of ZaFix cylinder $F_{modea, ZaFix, V; Rk} = 0,65 \cdot 0,84 \cdot f_{h, EC5, dowel} / 2 \cdot l_{ZaFix} \cdot d_{ZaFix}$

with $f_{h, EC5, dowel} = 0,082 \cdot (1 - 0,01 \cdot d_{ZaFix}) \cdot \rho$

- tension perpendicular to grain for the column according to EC 5

$$F_{modeb, ZaFix, V, Rk} = 14 \cdot b_{column} \cdot \sqrt{\frac{h_e}{(1-h_e/h_{column})}}$$

Table 6: embedding depth of ZaFix l_{ZaFix}

$\emptyset$ ZaFix ZF	embedding in column
30 mm	70 mm
40 mm	90 mm

Slip modulus: $K_{ser} = 2/3 \cdot 1/2 \cdot \rho_m^{1,5} \cdot d_{ZaFix} / 23$

Table 7: characteristic value of shear capacity C24

	$F_{V, k, modela}$	K_{ser}
ZaFix $\emptyset 30$ mm	11,5 kN	3,74 kN/mm
ZaFix $\emptyset 40$ mm	16,9 kN	5,0 kN/mm

1.3 Combined loading of ZaFix ZF by shearing force and tension force

Clause 8.3.3, equ. (8.27) of EN 1995-1-1:2010 is applied: $\frac{F_{ax, Ed}}{F_{ZaFix, t, Rd}} + \frac{F_{V, Ed}}{F_{ZaFix, V, Rd}} \leq 1,0$

2. ZaFix ZF product details, definitions and installation

ZaFix connector is used only as assembled kit with post base.

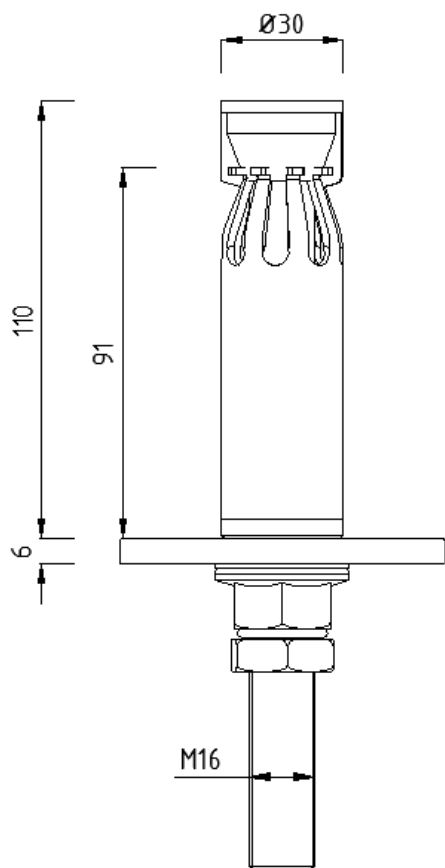


Figure 19: ZaFix ZF d=30

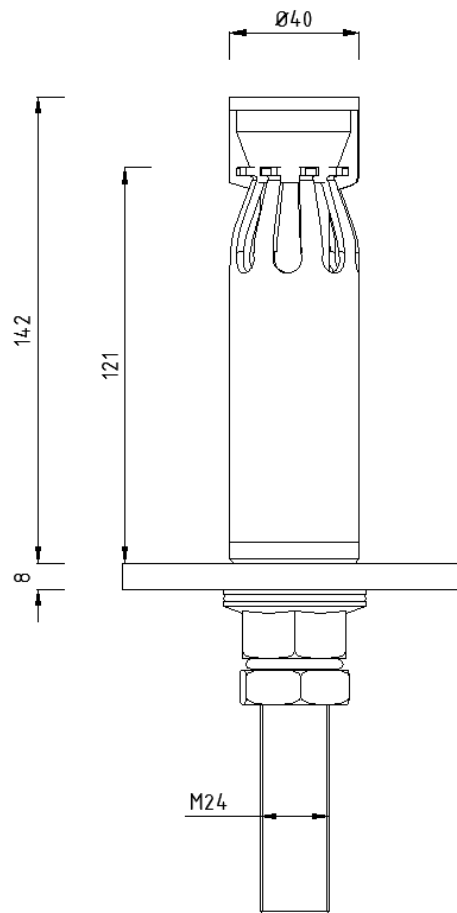
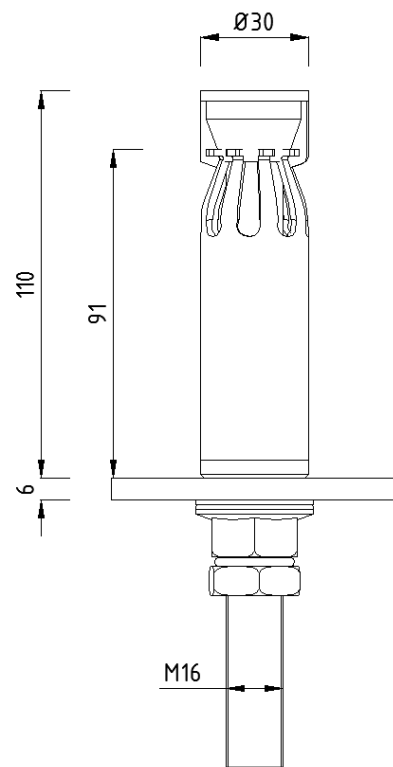


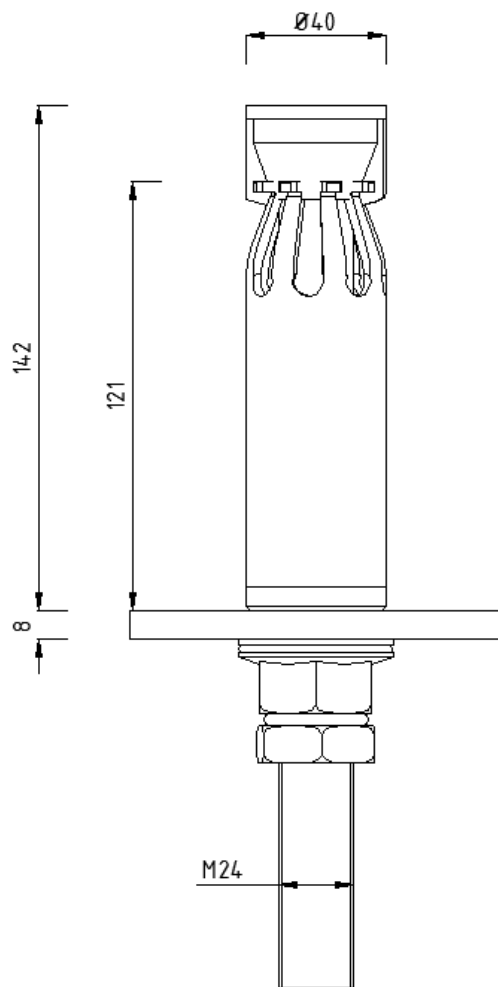
Figure 20: ZaFix ZF d=40

Threaded rod made of 1.0401, EN 10277 (C15); the cone to force the profiled tube outward is formed of this rod. The tube is made from 1.0308, EN 10216, EN 10305 (E235) with $t=2,5$ mm for ZaFix $\varnothing 30$ mm or $t=2,0$ mm for ZaFix $\varnothing 40$ mm.



- threaded rod with expand conus M16
- Tube Ø 30 mm (wall thickness 2,5) E235
- Washer Ø80 x 6 S235JR
- Shouldered nut M16 with O-ring DIN 6923 / FK 8
- O-ring
- Counter nut M16 DIN 439 / FK4

Figure 21: ZaFix



- threaded rod with expand conus M24
- Tube Ø 40 mm (wall thickness 2,0) E235
- Washer Ø95 x 8 S235JR
- Shouldered nut M24 with O-ring DIN 6923 / FK 8
- O-ring
- Counter nut M24 DIN 439 / FK4

Figure 22: ZaFix ZF d=40, details

Annex D: Post-bases

1. Characteristic values of load-carrying-capacities and stiffness

For post-bases loaded in tension or by horizontal shearing forces the connector IdeeFix IF or ZaFix have to be verified according to Annex A or Annex C respectively.

1.1 Post-bases loaded in tension

IdeeFix IF's or ZaFix's withdrawal capacity according to Annex A 1.1 or Annex C 1.1 is to be verified.

1.2 Loading of post-bases by horizontal forces (shearing force)

The verification of the post-base subjected to bending has to be done according to EN 1993-1-1 and EN 1993-1-8. For the bending resistance of the threaded rod and the connection of rod to lower tube the characteristic resistance for bending according to Table 8 is used with $\gamma_{M2} = 1,25$.

Table 8: characteristic values threaded rod

STF	$M_{k,rod}$
STF 300 series	163 kNmm
STF 400 series	318 kNmm
STF 700 series	549 kNmm

1. Post-bases loaded in compression

First failure mode for the post base under compression load is yielding of rod

- $F_{c,k,modea} \leq 0,9 \cdot f_{ub} \cdot A_s = F_{t,Rd}$ with $\gamma_{M2} = 1,25$

Second failure mode for the post base under compression load is yielding of the tube

- $F_{c,k,modeb} \leq f_y \cdot A_{tube}$ with $\gamma_{M0} = 1,0$

Third failure mode is buckling of rod, with buckling length according to Figure 23.

If the column's foot is horizontally fixed, the buckling length might be reduced according to buckling scheme. For threaded rods of higher property class as 4.6 a simplifying approach of taking the complete length of the post base as buckling length for the rod or a more exact calculation according to Eurocode 3 of columns with different cross section is applied for all series.

- $F_{c,k,postbase} = \chi \cdot A \cdot f_y$ with $\gamma_{M1} = 1,1$ mode c) is only to be applied if $\bar{\lambda} > 0,2$

mode d finally takes account of timber's compressive strength.

- IdeeFix: $F_{c,k} = f_{c,0} \cdot \pi/4 \cdot d_a^2$
ZaFix: $F_{c,k} = f_{c,0} \cdot \pi/4 \cdot (d_a^2 - d_{ZaFix}^2)$

γ_M for stresses parallel to grain according to EC5

Verification is done with $F_{post-base,c,Rd} = \min\{F_{c,d,modea}; F_{c,d,modeb}; F_{c,d,modec}; F_{c,d,moded}; \}$

$$\frac{N_{Ed}}{F_{post-base,c,Rd}} \leq 1$$

1.4 Combined loading of post-bases by horizontal force and tension force

The verification has to be done for IdeeFix IF or ZaFix according annex to A 1.3. or annex C 1.3

1.5 Combined loading of post-bases by horizontal force and compression force

$\frac{N_{Ed}}{F_{post-base,c,Rd}} + \frac{M_{Ed}}{M_{c,Rd}} \leq 1$ with $F_{post-base,c,Rd}$ according to annex D 1.3 and $M_{c,Rd}$ according to 1.2

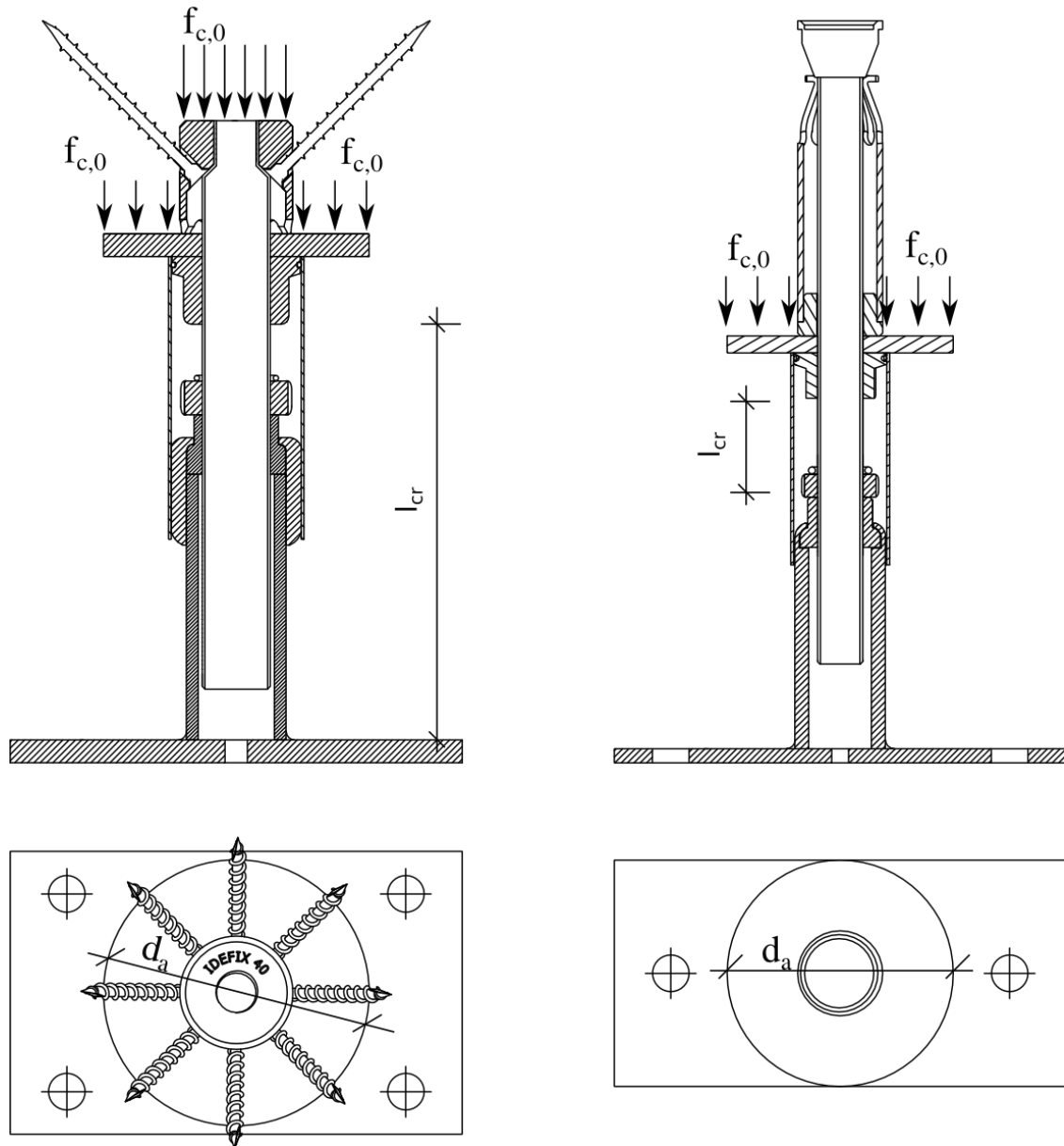


Figure 23: post bases IdeeFix STF and ZaFix STZ 300, 400,700, buckling length and compressive stresses

2. Post bases product details, definitions and installation

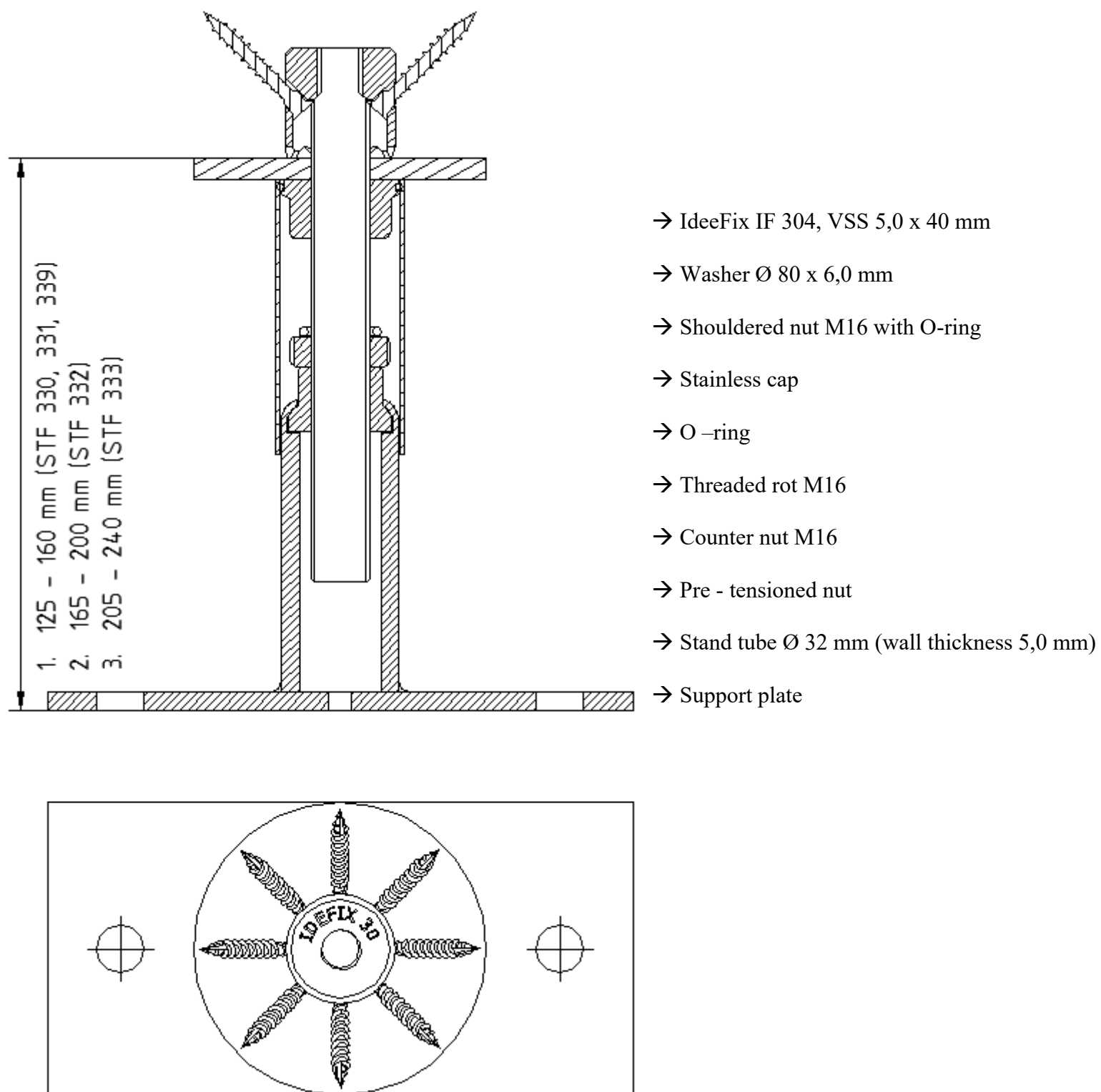
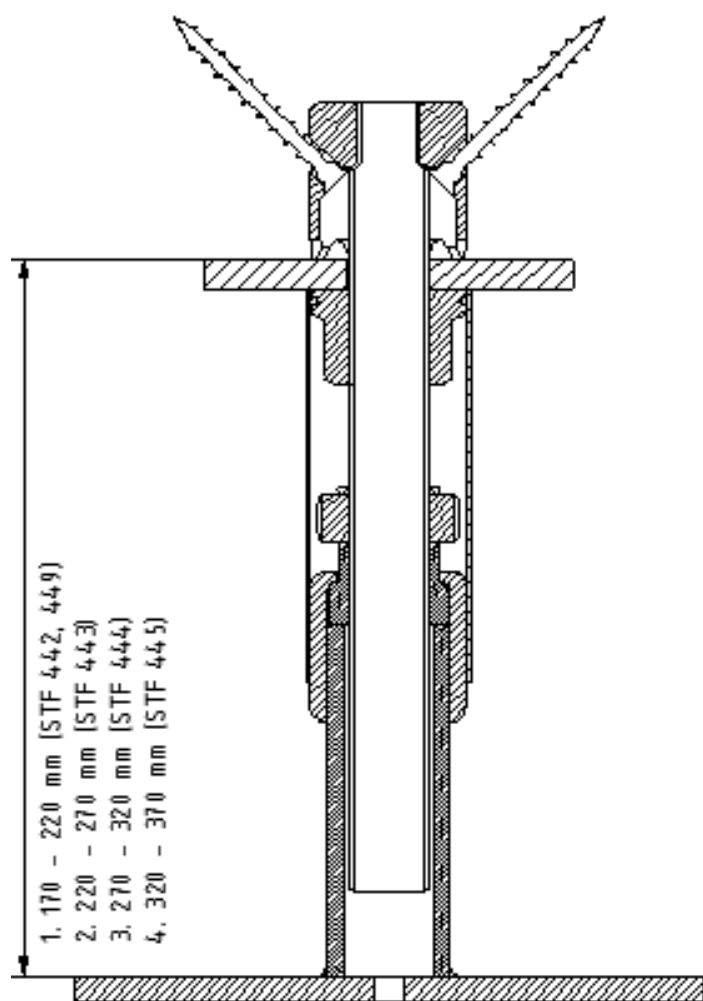


Figure 24: STF / STZ 300 series with IdeeFix IF or ZaFix ZF



→ IdeeFix IF 406, VSS 6,0 x 60 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M20 with O-ring

→ Stainless cap

→ O -ring

→ Threaded rod M20

→ Counter nut M20

→ Pre - tensioned nut

→ Stand tube Ø 33,7 mm (wall thickness 3,25 mm)

→ Support plate

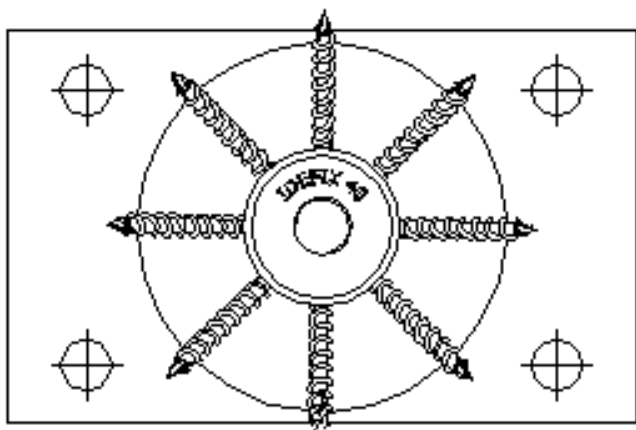


Figure 25: STF / STZ 400 series with IdeeFix IF or ZaFix ZF

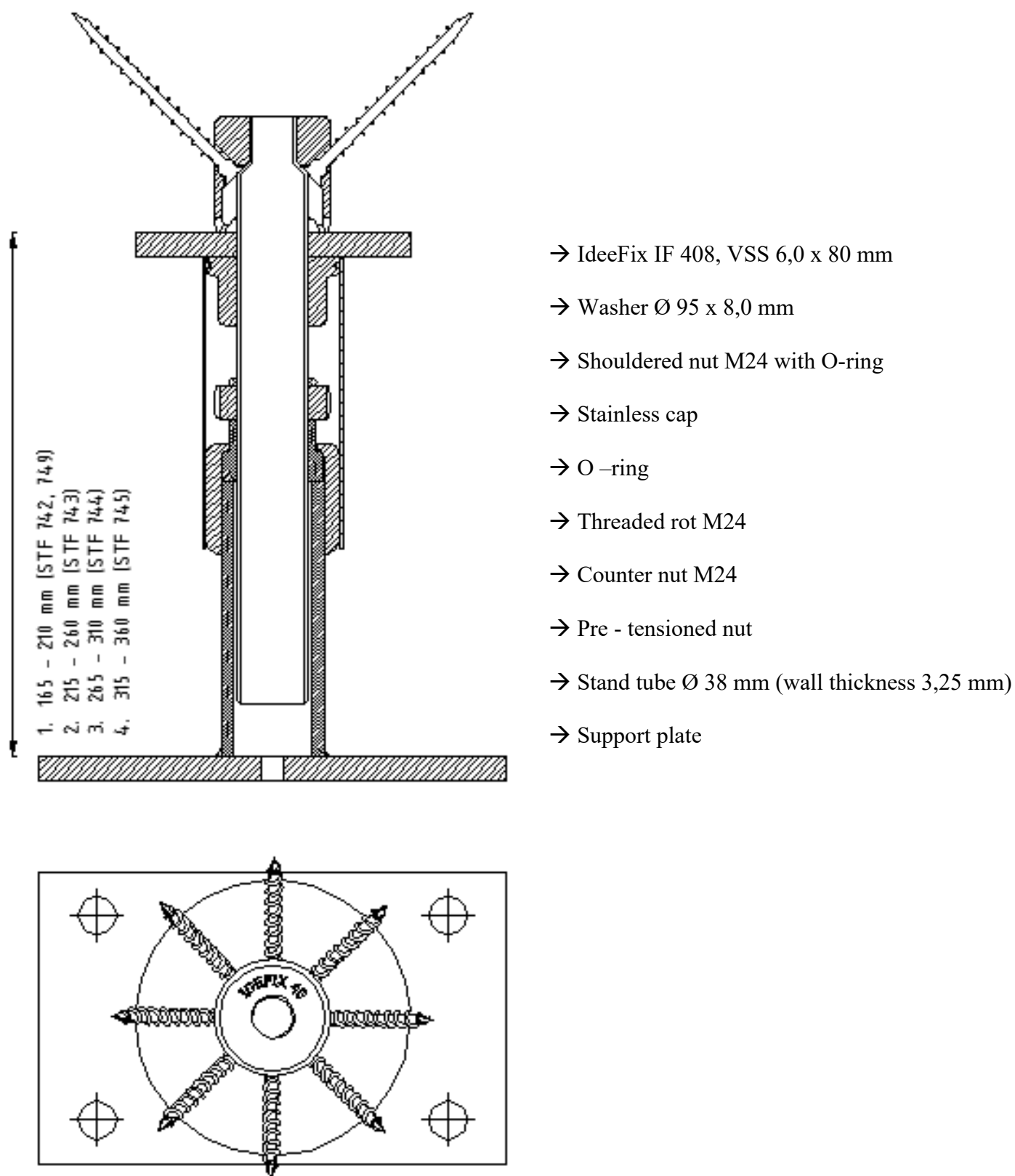
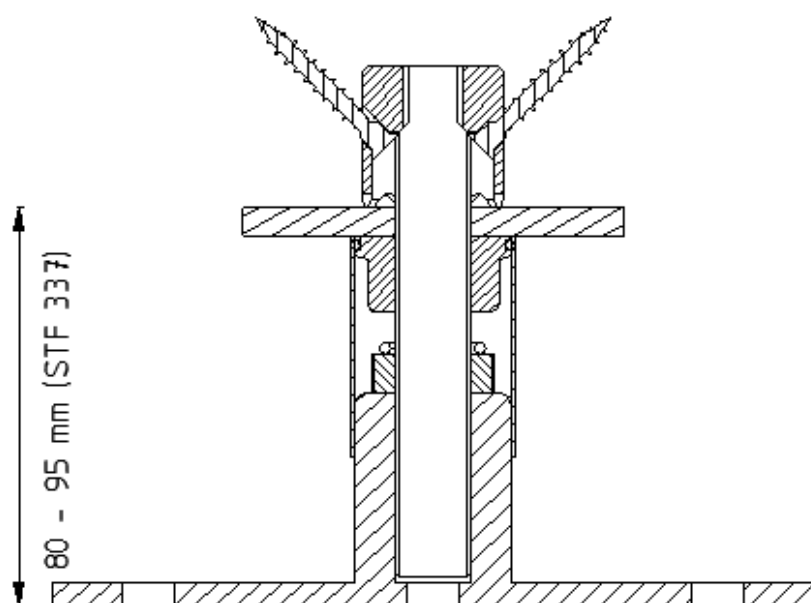


Figure 26: STF / STZ 700 series with IdeeFix IF or ZaFix ZF



- IdeeFix IF 304, VSS 5,0 x 40 mm
- Washer Ø 80 x 6,0 mm
- Shouldered nut M16 with O-ring
- Stainless cap
- O –ring
- Threaded rot M16
- Counter nut M16
- Stand tube Ø 32 mm (wall thickness 5,0 mm)
- Support plate

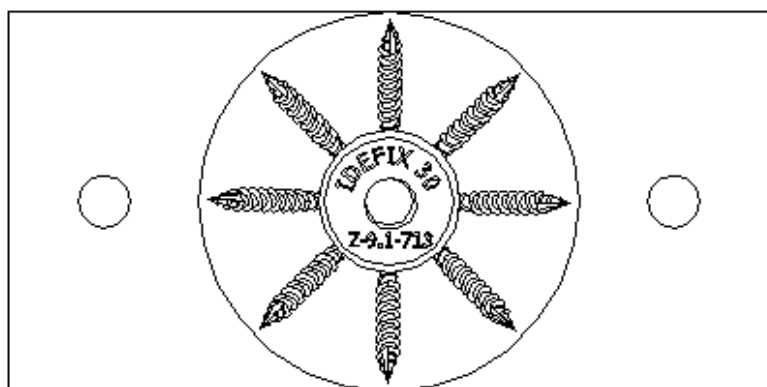


Figure 27: STF 337 with IdeeFix IF

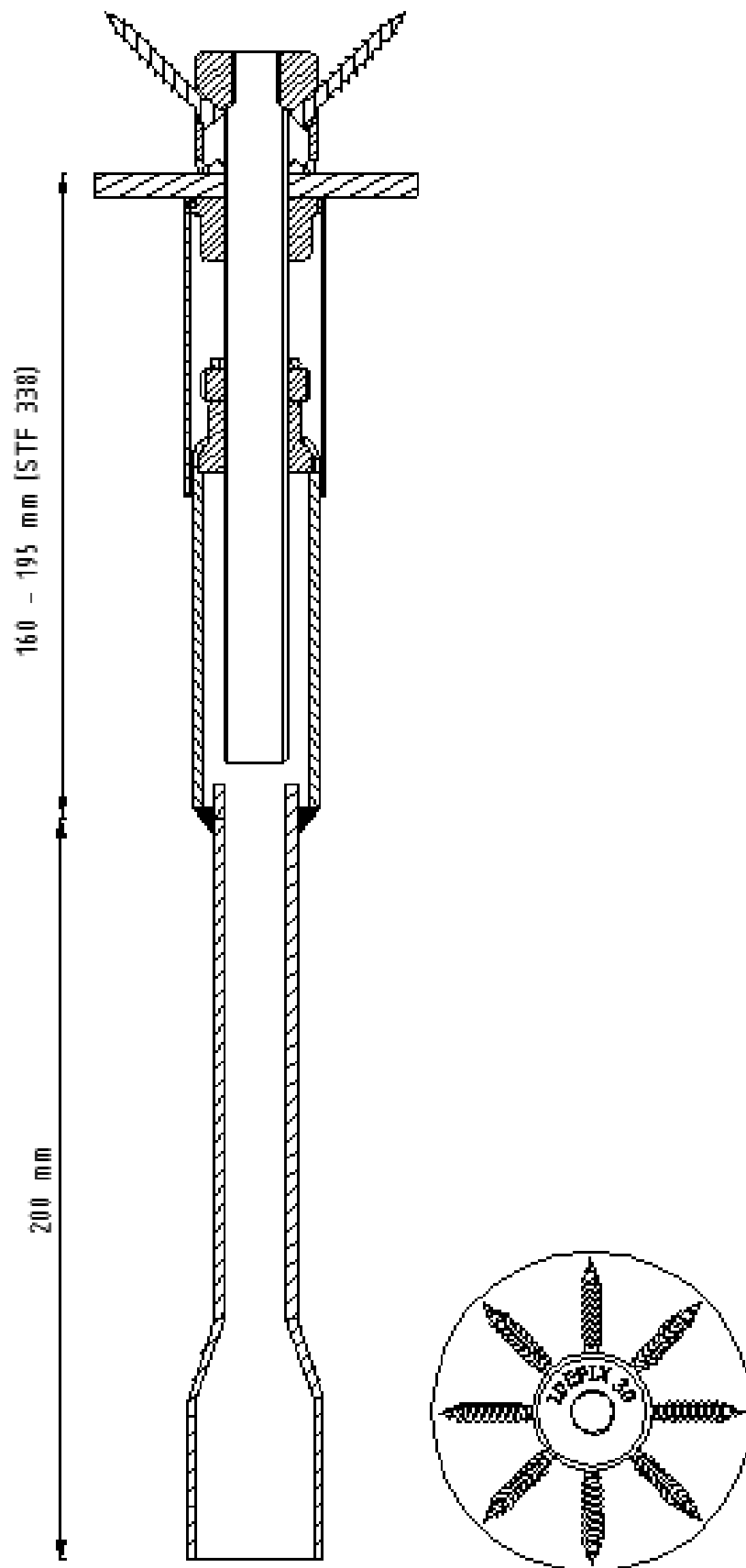


Figure 28: STF /STZ 338 with IdeeFix IF or ZaFix ZF

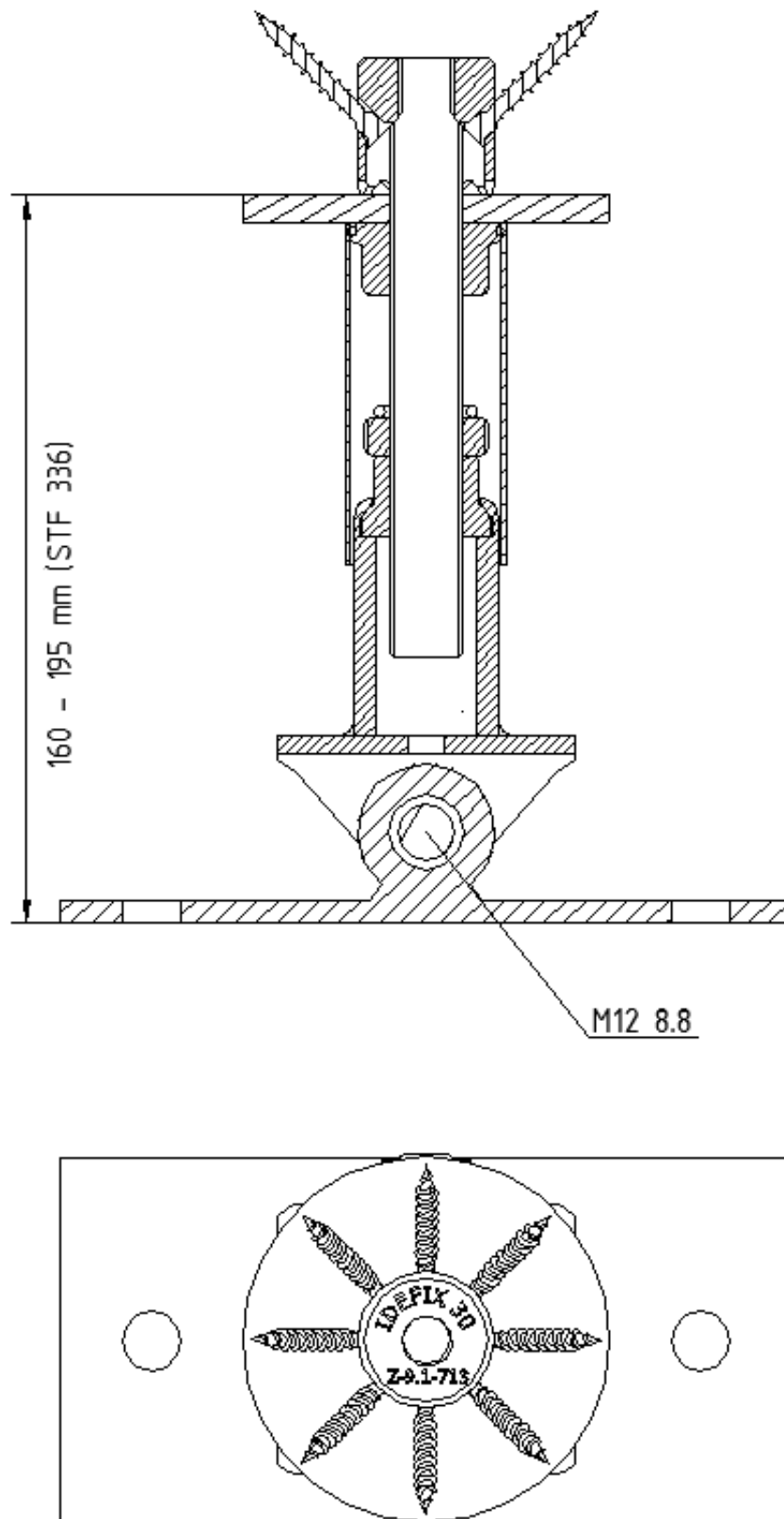


Figure 29: STF /STZ 336 with IdeeFix IF or ZaFix ZF

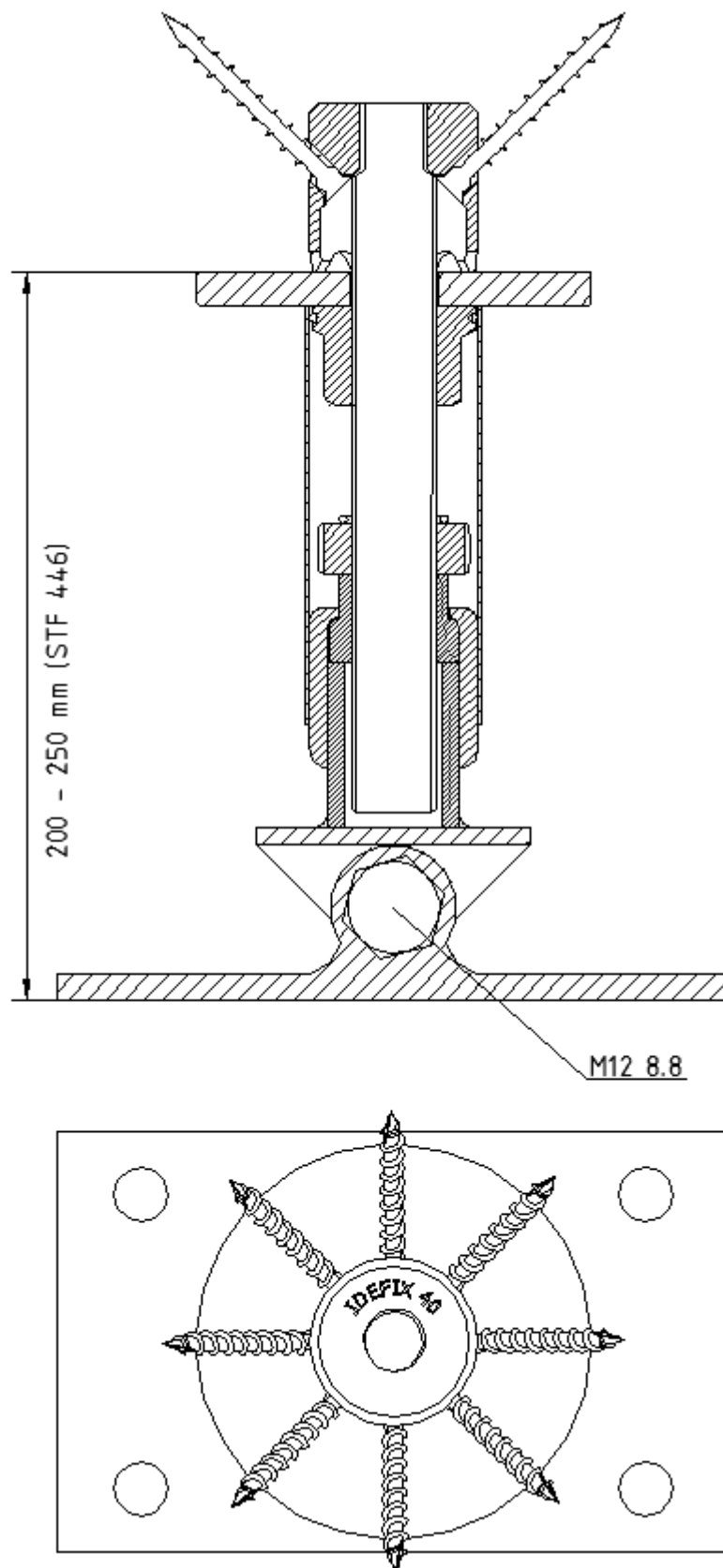


Figure 30: STF /STZ 446 with IdeeFix IF or ZaFix ZF

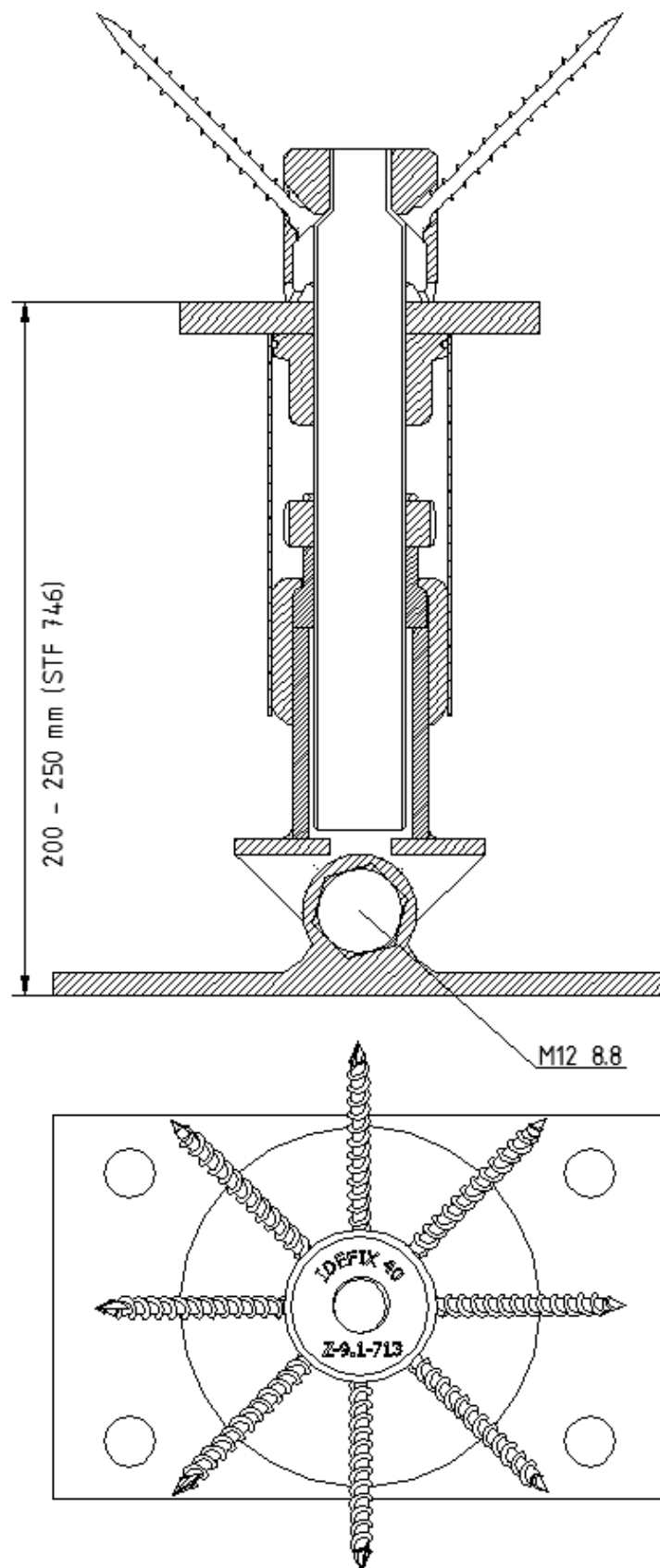


Figure 31: STF /STZ 746 with IdeeFix IF or ZaFix ZF

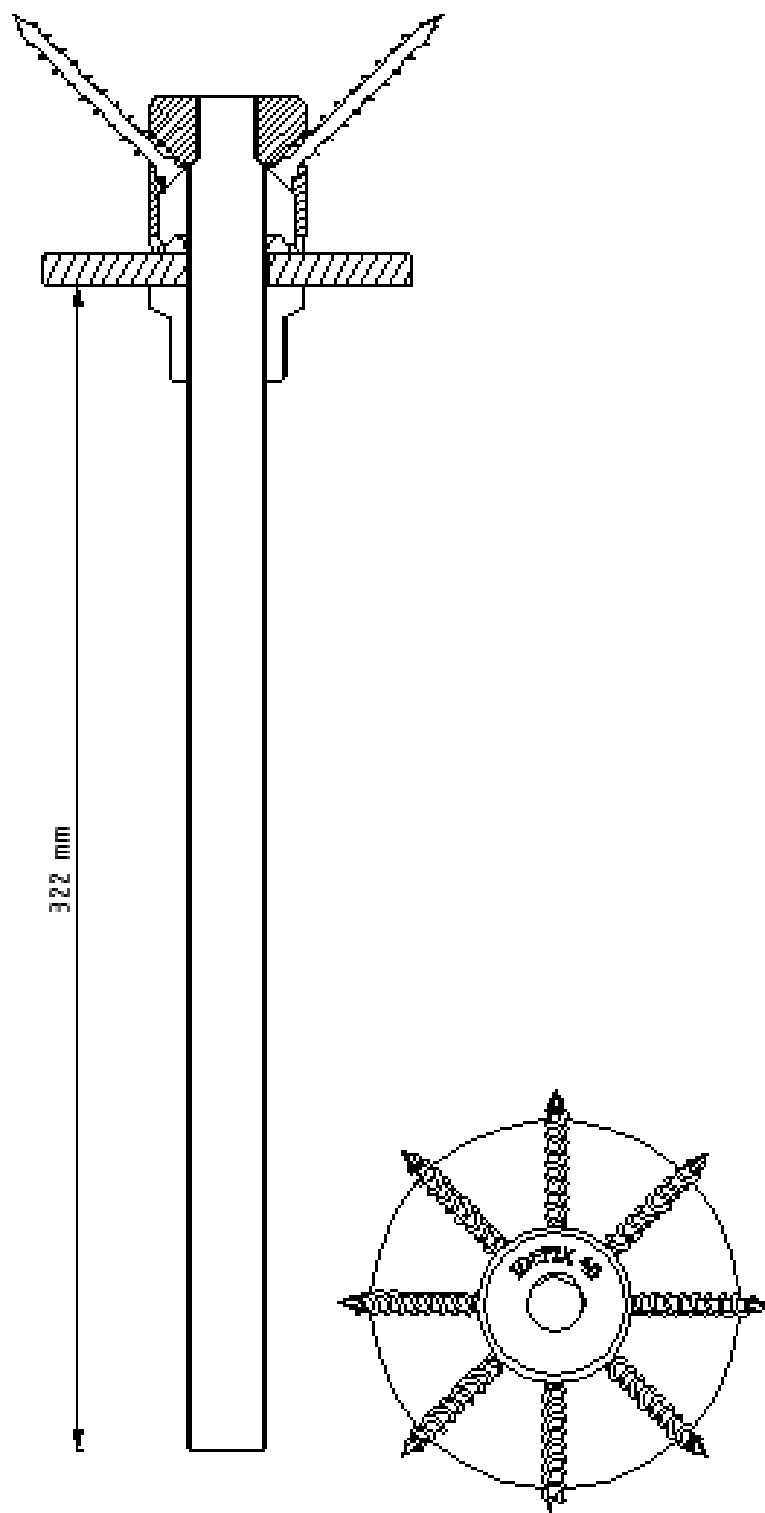


Figure 32: STF 448 with IdeeFix IF

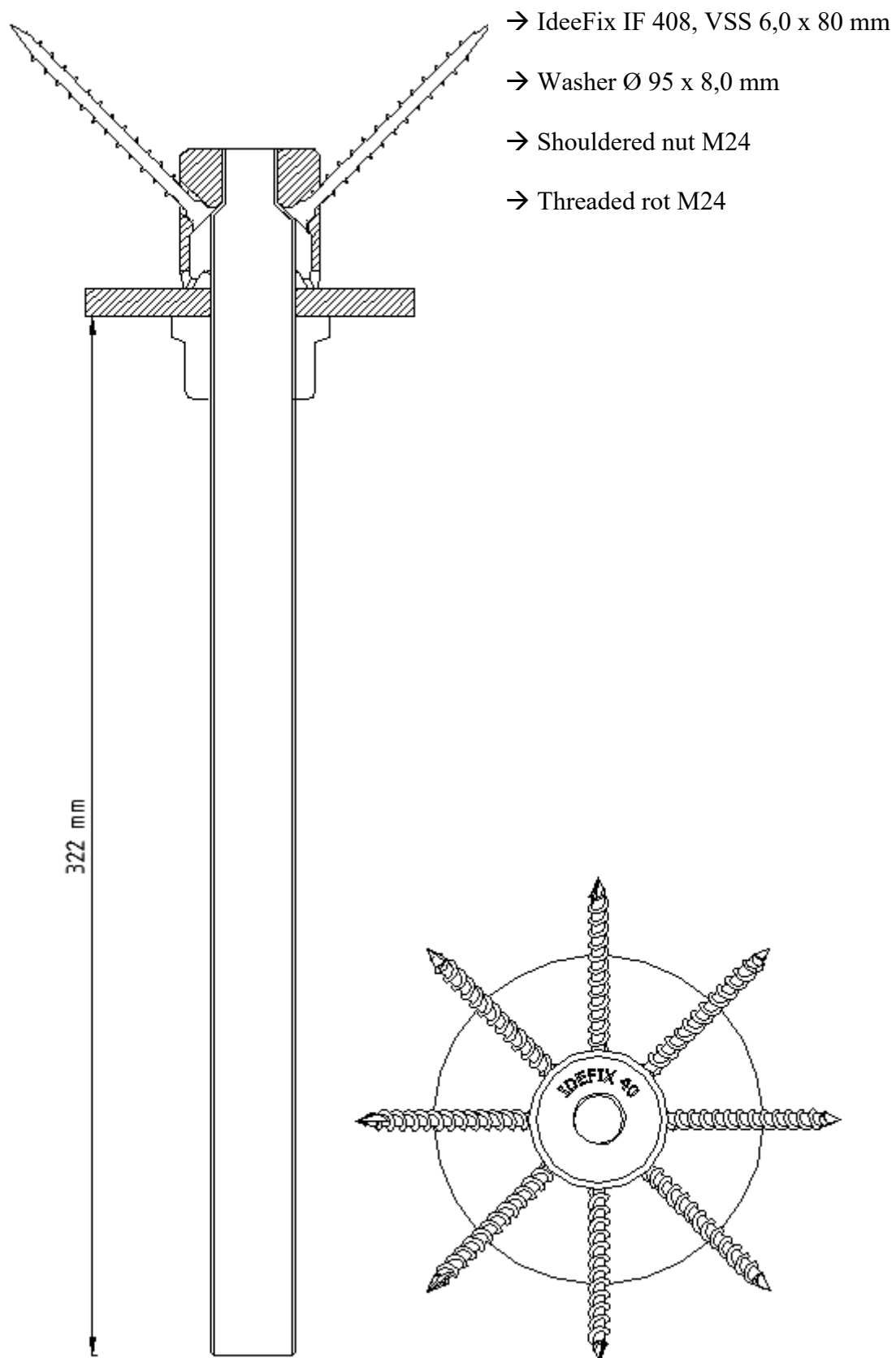


Figure 33: STF 748 with IdeeFix IF

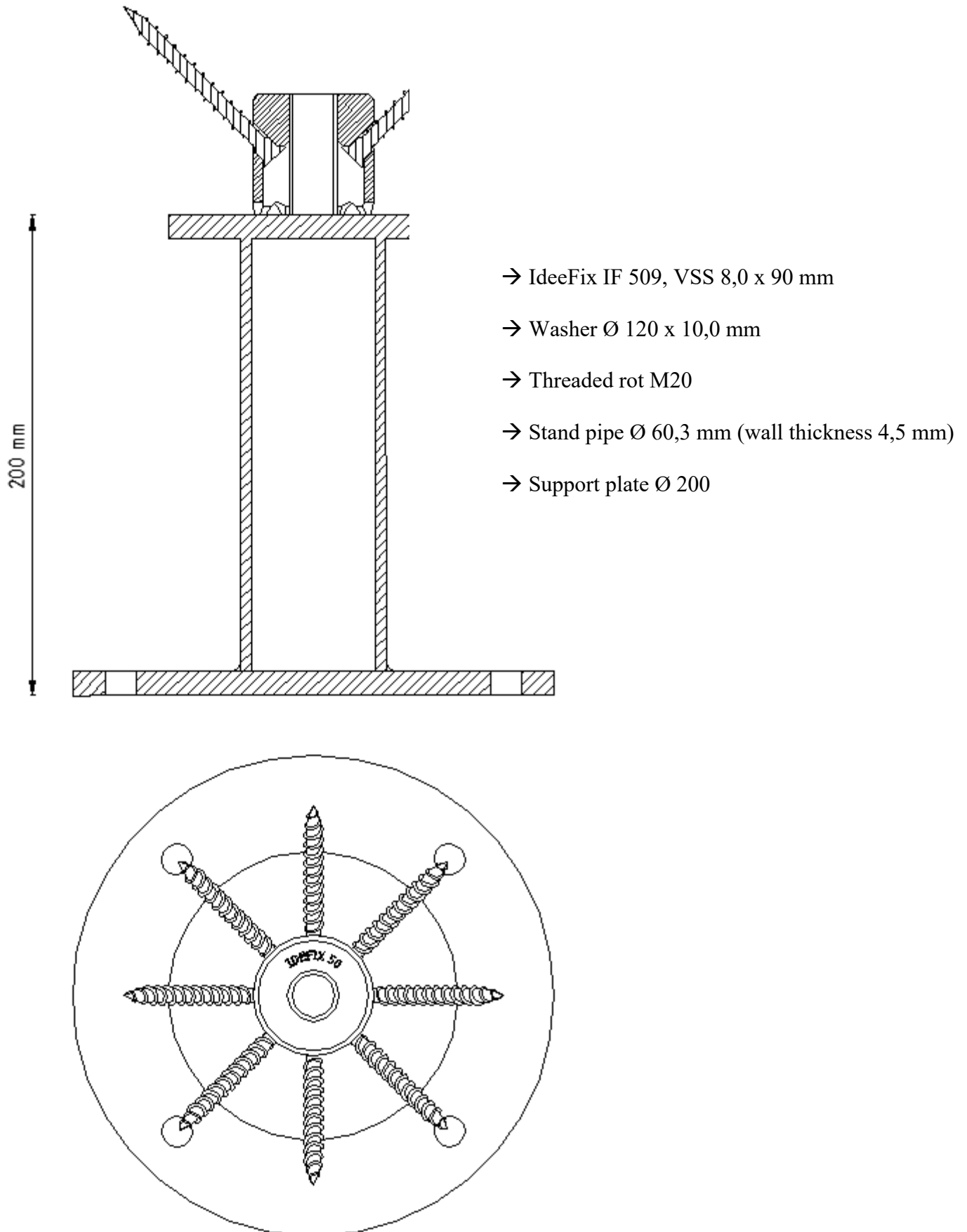
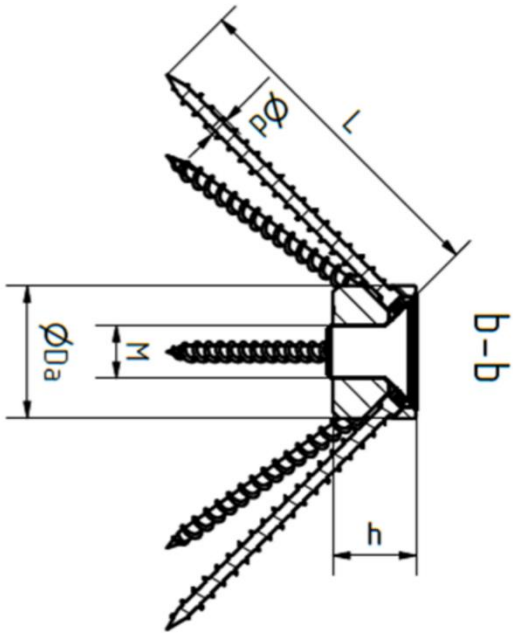
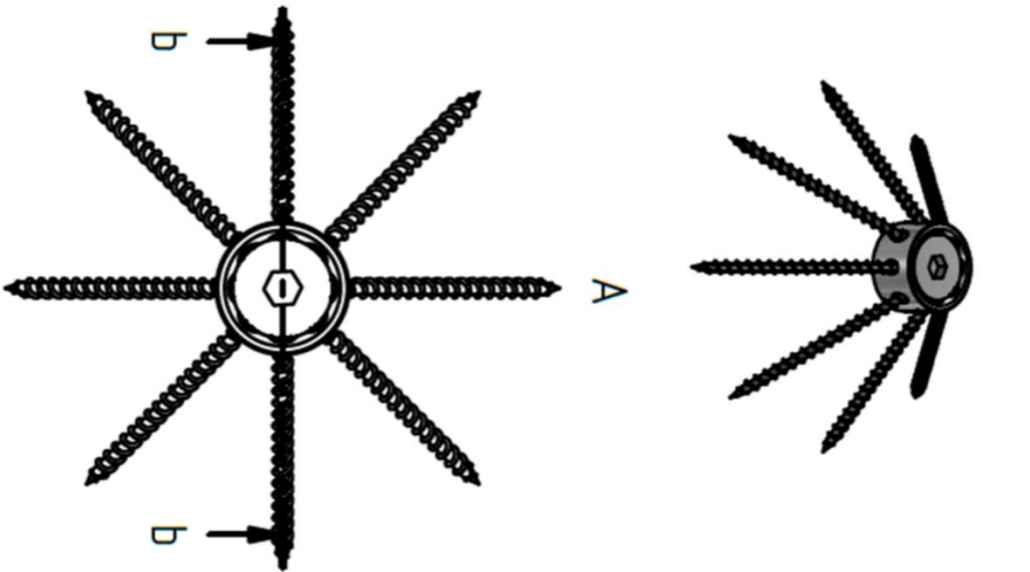


Figure 34: STF 952 with IdeeFix

Annex E: IdeeFix-DWD Connector – Applications and calculation models for Solid Timber (EN 338, EN 15497), Glued-Laminated Timber (EN 14080) and Cross-Laminated Timber



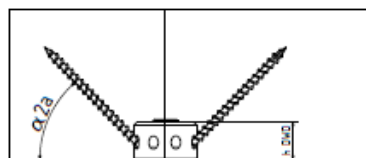
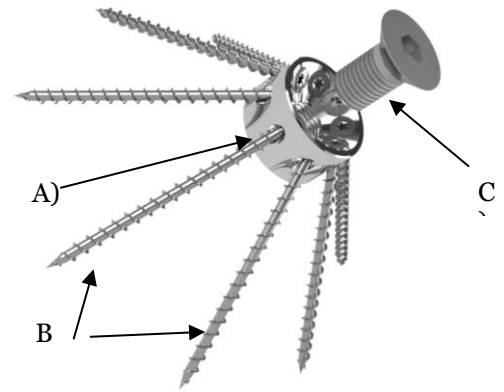
IdeeFix DWD	40/100	40/80	40/60	30/80	30/60	30/40
Da [mm]	40	40	40	30	30	30
h [mm]	25	25	25	20	20	20
L [mm]	100	80	60	80	60	40
d [mm]	6	6	6	5	5	5
M [mm]	16	16	16	12	12	12

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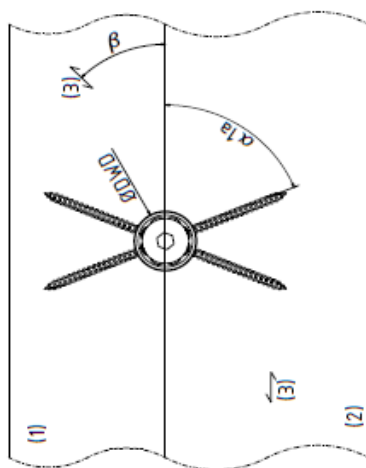
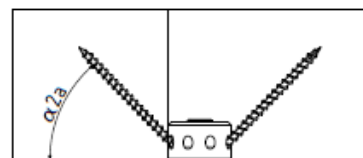
IdeeFix DWD

E.1 Definitions and notations for the calculation models

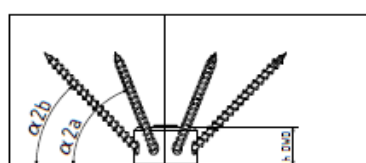
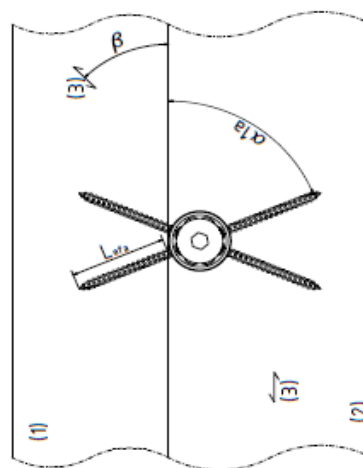
- A) Cylindrical steel part (DWD box) to support the timber screw heads
- B) Self-taping screws, type VSS according to ETA-11/0024
- C) M12;M16 centred to fix the head of the timber screws



$$\alpha 2a = 69,1^\circ$$

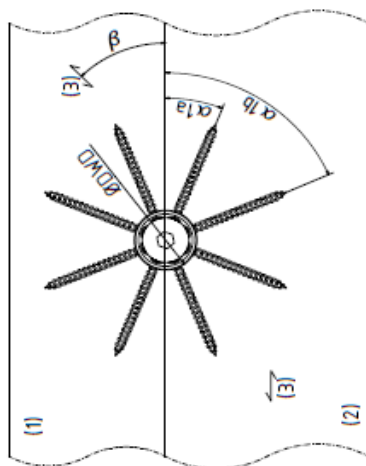
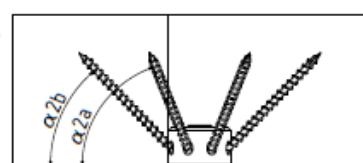


$$\alpha 1a = 67,5^\circ$$

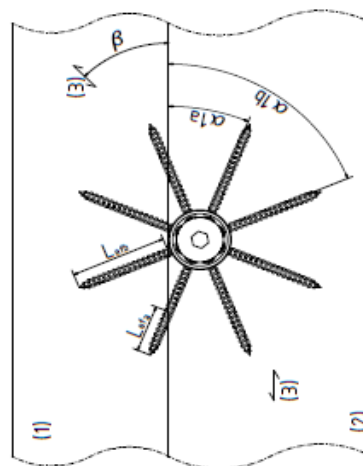


$$\alpha 2a = 69,1^\circ$$

$$\alpha 2b = 47,3^\circ$$



$$\alpha 1a = 22,5^\circ ; \alpha 1b = 67,5^\circ$$



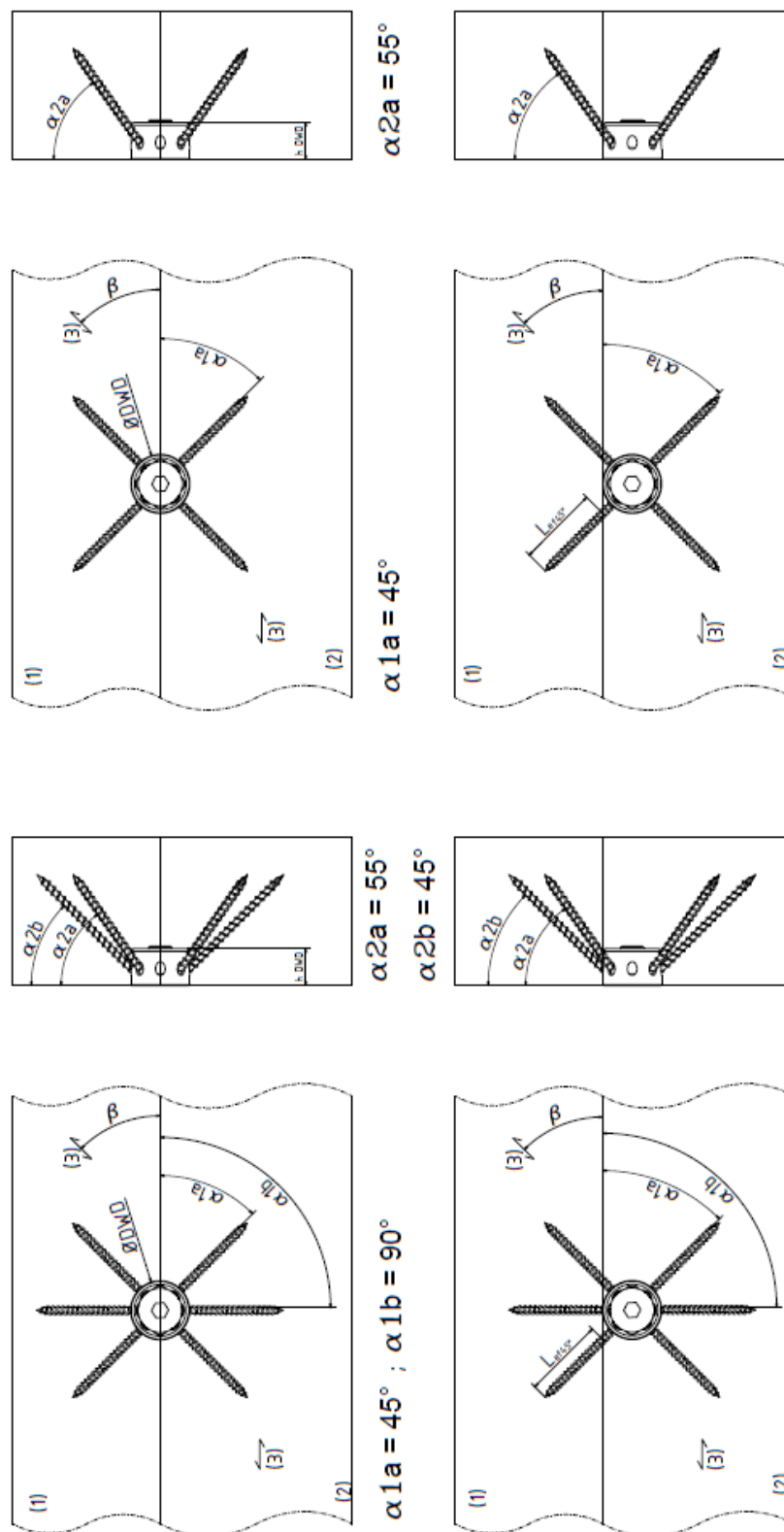


Figure 35: Possible arrangements of the IdeeFix-DWD Connector and notations

Note: Due to the M12;M16 screw (C) (see figure 35) in the center of the DWD box (A) the VSS screws (B) are able to transfer both, tension and compression loads in axial direction. Buckling of the screws in compression must not be considered up to available length given in the ETA-11/0024, 2017.

Abbreviations and parameters for the following calculation in Annex B

- (1) Timber element 1, see Figure 35
 (2) Timber element 2, see Figure 35
 (3) Grain direction, see Figure 35

d	Nominal diameter of the VSS screw [mm]
d_{DWD}	Diameter of the IdeeFix-DWD Connector [mm]
$f_{h,a,k}$	Characteristic embedment strength, considering load-grain direction [N/mm ²]
$f_{h,b,1,k}$	Characteristic embedment strength, considering load-grain direction, timber part 1 [N/mm ²]
$f_{h,b,2,k}$	Characteristic embedment strength, considering load-grain direction, timber part 2 [N/mm ²]
$f_{ax,k}$	Characteristic withdrawal capacity with

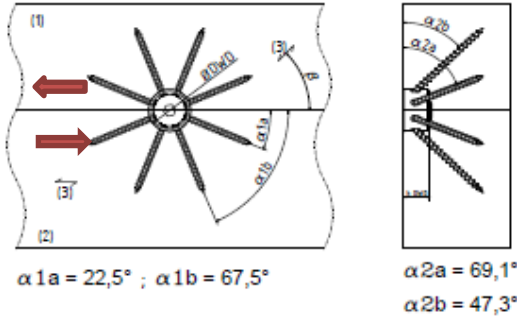
d [mm]	VSS ETA-11/0024
4,0	$f_{ax,k} = 12,9 \text{ N/mm}^2$
5,0	$f_{ax,k} = 12,1 \text{ N/mm}^2$
6,0	$f_{ax,k} = 11,4 \text{ N/mm}^2$
8,0	$f_{ax,k} = 11,1 \text{ N/mm}^2$

L	Length of the the fully threaded VSS screw [mm]
h_{DWD}	Penetration depth of the cylindrical steel part of the IdeeFix-DWD [mm]
$R_{v,0,cen,k}$	Characteristic value of the shear strength of the cylindrical part of the IdeeFix-DWD Connector with load direction parallel to the joint [N]
$R_{qx,cen,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength parallel to the joint of the IdeeFix-DWD with centric assembling to the joint of the timber parts [N]
α_{1a}	Angle between screw and timber joint, see Figure 35
α_{1b}	Angle between screw and timber joint, see Figure 35
α_{2a}	Angle between load and screw axis, see Figure 35
α_{2b}	Angle between load and screw axis, see Figure 35
β_1	Timber grain direction to the joint, timber part 1 [°]
β_2	Timber grain direction to the joint, timber part 2 [°]
$\rho_{1,k}$	Characteristic gross density, timber part 1 [kg/m ³]
$\rho_{2,k}$	Characteristic gross density, timber part 1 [kg/m ³]

E.2 Applications in Solid Timber (EN 338, EN 15497), Softwood

E.2.1 Characteristic shear strength parallel to the joint of the timber parts, with centric arrangement

The characteristic shear strength parallel to the joint of the timber parts, with centric assembling, $R_{v, cen, k}$ can be calculated with the help of equation (1).



$$K_{ser} = 10,5 \text{ kN/mm}$$

$$R_{v, cen, k} = R_{v, 0, cen, k} + R_{v, ax, k} \quad (1)$$

Figure 36: Centric arrangement of the IdeeFix-DWD Connector, shear strength parallel to the timber joint Solid Timber

Hereby the amount of the embedment strength of the IdeeFix-DWD Connector, by considering the load-grain direction for the embedment strength, should be calculated with equation (2).

$$R_{v, 0, cen, k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot \min(f_{h, \beta, 1, k}, f_{h, \beta, 2, k}) \quad (2)$$

With

$$f_{h, \beta, 1, k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_{1, k}}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\beta_1)^2 + \cos(\beta_1)^2} \quad (3)$$

$$f_{h, \beta, 2, k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_{k, 2}}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\beta_2)^2 + \cos(\beta_2)^2} \quad (4)$$

The axial capacity of the screws can be calculated with equation

$$R_{v, ax, k} = 2 \cdot \cos(\alpha_{1a}) \cdot \frac{F_{ax, a, Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{1b}) \cdot \frac{F_{ax, b, Rk}}{\sqrt{2}}$$

With the characteristic withdrawal capacity $F_{ax, Rk}$ for VSS screws according to ETA-11/0024

$$F_{ax, a, Rk} = f_{ax, k} \cdot d \cdot l_{ef, a} \cdot \left(\frac{\min(\rho_{1, k}, \rho_{1, k})}{350} \right)^{0,8} \quad (5)$$

$$F_{ax, b, Rk} = f_{ax, k} \cdot d \cdot l_{ef, b} \cdot \left(\frac{\min(\rho_{1, k}, \rho_{1, k})}{350} \right)^{0,8} \quad (6)$$

L_{ef}

Angle	Effective length L_{ef} [mm]
α_{1a}	$d_{DWD} 40; L_{ef,a} = L - 7$
α_{1a}	$d_{DWD} 30; L_{ef,a} = L - 6$
α_{1b}	$d_{DWD} 40; L_{ef,b} = L - 7$
α_{1b}	$d_{DWD} 30; L_{ef,b} = L - 6$

E.2.2 Characteristic shear strength parallel to the joint of the timber parts, with eccentric arrangement

The characteristic shear strength parallel to the joint of the timber parts, with eccentric arrangement, can be calculated with equation (8).

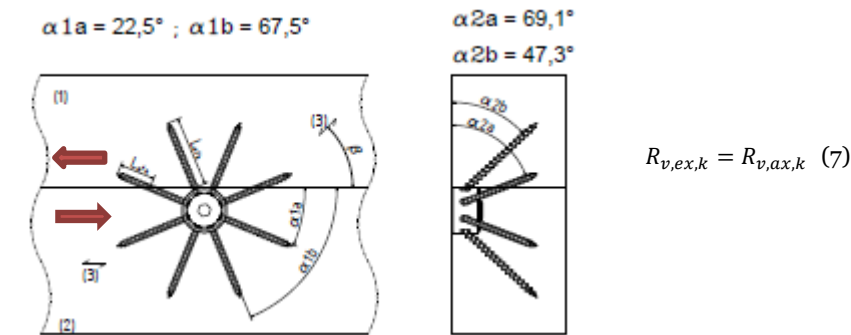


Figure37: Eccentric arrangement of the IdeeFix DWD Connector, shear strength parallel to the timber joint Solid Timber

With

$$R_{v,ax,k} = 2 \cdot \cos(\alpha_{load} - \alpha_{1a}) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{load} - \alpha_{1b}) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}} \quad (8)$$

and the equations in accordance to ETA-11/0024 for VSS screws.

$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (9)$$

$$F_{ax,b,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (10)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the VSS screws are able to transfer both, tension in compression loads. Buckling of the screws in compression must not be considered.

Where

d	Nominal diameter of the VSS screw [mm]
d_{DWD}	Diameter of the IdeeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm ²]
k_{ax}	Coefficient to consider the angel between crew axis and grain-direction [-]

L_{ef}

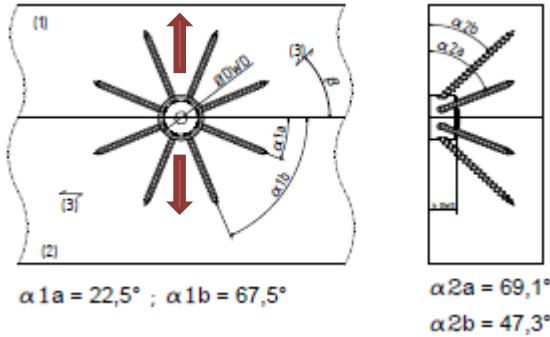
Effective length of the threaded part of the screw in the timber part [mm]

<i>Angle</i>	<i>Effective length L_{ef} [mm] eccentric arrangement</i>
α_{1a}	$d_{DWD} 40; L_{ef45^\circ} = L - 24 > 0$
α_{1a}	$d_{DWD} 30; L_{ef45^\circ} = L - 19 > 0$
α_{1a}	$d_{DWD} 40; L_{efa} = L - 57 > 0$
α_{1a}	$d_{DWD} 30; L_{ef,a} = L - 43 > 0$
α_{1b}	$d_{DWD} 40; L_{ef,b} = L - 7$
α_{1b}	$d_{DWD} 30; L_{ef,b} = L - 6$

d_{DWD}	Diameter of the IdeeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm ²]
h_{DWD}	Penetration depth of the IdeeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeeFix-DWD Connector with centric assembling to the joint of the timber parts [N]
$R_{v,0,k}$	Characteristic value of the embedment strength of the IdeeFix-DWD Connector with $\alpha_{load}=0^\circ$ [N]
k_{ax}	Coefficient to consider the angel between crew axis and grain-direction [-]
α_{load}	Angle load grain-direction [°]
α_{1a}	Angle between screw and timber joint $\alpha_{1a}=22,5^\circ$
α_{2b}	Angle between screw and timber joint $\alpha_{1b}=67,5^\circ$
ρ_k	Characteristic gross density [kg/m ³]

E.2.3 Characteristic tension strength perpendicular to the timber joint of the timber parts, with centric arrangement

The characteristic tension strength perpendicular to joint of the timber parts, with centric arrangement can be calculated with equation (11).



$$R_{t,cen,k} = \min(R_{v,ax,k}, R_{t,90,k}) \quad (11)$$

Figure 38: Centric arrangement of the IdeeFix DWD Connector, tension strength perpendicular to the timber joint

Solid Timber

With

$$R_{v,ax,k} = 2 \cdot \left(\frac{F_{ax,\alpha 1a,k} \cdot F_{v,la,\alpha 1a,k}}{F_{ax,\alpha 1a,k} \cdot \sin^2 \alpha 2a + F_{v,la,\alpha 1a,k} \cdot \cos^2 \alpha 2a} + \frac{F_{ax,\alpha 1b,k} \cdot F_{v,la,\alpha 1b,k}}{F_{ax,\alpha 1b,k} \cdot \sin^2 \alpha 2b + F_{v,la,\alpha 1b,k} \cdot \cos^2 \alpha 2b} \right) \quad (12)$$

$$F_{ax,\alpha 1a,k} = \frac{f_{ax,k} \cdot L_{ef} \cdot d}{\sqrt{2}} \cdot \sin(\alpha 1a) \quad (13)$$

$$F_{ax,\alpha 1b,k} = \frac{f_{ax,k} \cdot L_{ef} \cdot d}{\sqrt{2}} \cdot \sin(\alpha 1b) \quad (14)$$

$$F_{v,la,\alpha 1a,k} = 2,3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45^\circ,k} \cdot d} \quad (16)$$

$$F_{v,la,\alpha 1b,k} = 2,3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45^\circ,k} \cdot d} \quad (17)$$

and the equations in accordance to ETA-11/0024 for VSS screws.

Additionally, the proof for tension perpendicular to the grain direction has to be done according to the table below.

$\frac{a}{h} > 0,7$	$0,2 \leq \frac{a}{h} \leq 0,7$	$a < 0,2 \cdot h$
Proof for tension perpendicular to the grain is not necessary	$R_{t,90,d} = \frac{k_{mod}}{\gamma_M} \cdot k_s \cdot k_r \cdot \left(6,5 + \frac{18 \cdot a^2}{h^2} \right) \cdot (t_{ef} \cdot h)^{0,8} \cdot f_{t,90,k}$ with $k_s = \max \left\{ \begin{array}{l} 1 \\ 0,7 + \frac{1,4 \cdot a_r}{h} \end{array} \right.$ and $k_r = \frac{6}{\sum_{i=1}^n \left(\frac{h_1}{h_i} \right)^2}$ Connections with $a_r > h$ and $F_{t,90,d} > 0,5 \cdot R_{t,90,d}$ must be reinforced.	Only allowed for applications with short-term loads, e.g. wind loads

IdeeFix DWD d_{DWD} [mm]	a [mm]	a_r [mm]	h_1 [mm]
30; 40	$\left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}} \right) \cdot \cos(22,5)$	$2 \cdot \left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}} \right) \cdot \sin(22,5)$	$h - \left(\frac{d_{DWD}}{3} + \frac{L_{ef}}{\sqrt{2}} \right) \cdot \cos(22,5)$

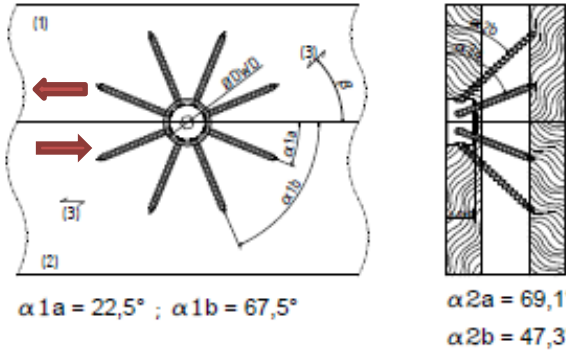
Where

$F_{t,90,d}$	Acting load on the IdeeFix DWD Connector [N]
$R_{t,90,d}$	Load bearing capacity of the IdeeFix-DWD Connector [N]
a	Distance of the screw with the greatest distance to the loaded edge [mm]
h	Height of the timber element [mm]
b	Width of the timber element [mm]
	$\min \left\{ b; \frac{L_{ef}}{\sqrt{2}}; 6 \cdot d \right\}$
t_{ef}	Effective depth of the connection, with uni-laterally connection
$f_{t,90,k}$	Characteristic value of tension strength perpendicular to the grain direction [N/mm ²]
a_r	Distance to the screws with greatest spacings perpendicular to the load direction [mm]
h_1	Distance of the nearest screw to the unloaded edge of the timber element [mm]
h_i	Distances to the unloaded edge of the circular i th arranged screw pair

E.3 Applications with Cross-Laminated Timber (CLT)

E.3.1 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (18).



$$R_{v,cen,k} = R_{v,0,k} + R_{v,ax,k} \quad (18)$$

Figure 39: Centric arrangement of the IdeeFix DWD Connector, shear strength parallel to the CLT panel-joint

The amount of the embedment strength of the IdeeFix-DWD Connector, by considering the load-grain direction, should be calculated with equation (19).

$$R_{v,0,k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot f_{h,\alpha,k} \quad (19)$$

with

$$f_{h,\alpha,k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_k}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\alpha)^2 + \cos(\alpha)^2} \quad (20)$$

and

$$R_{v,ax,k} = 2 \cdot \cos(\alpha_{load} - \alpha_{1a}) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{load} - \alpha_{1b}) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}} \quad (21)$$

For the characteristic withdrawal parameter for VSS screws made of carbon steel according to ETA-11/0024 has to be considered with the equations below.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (22)$$

$$F_{ax,b,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (23)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the VSS screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

Where

d	Nominal diameter of the VSS screw [mm]
d_{DWD}	Diameter of the IdeeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm ²]
h_{DWD}	Penetration depth of the IdeeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeeFix-DWD Connector with centric assembling to the joint of

the timber parts [N]

$R_{v,0,k}$

Characteristic value of the embedment strength of the IdeeFix-DWD Connector with

$\alpha_{load}=0^\circ$

k_{ax}

Coefficient to consider the angel between crew axis and grain-direction [-]

L_{ef}

<i>Angle</i>	<i>Effective length L_{ef} [mm]</i>
α_{1a}	$d_{DWD} 40; L_{ef,a} = L - 7$
α_{1a}	$d_{DWD} 30; L_{ef,a} = L - 6$
α_{1b}	$d_{DWD} 40; L_{ef,b} = L - 7$
α_{1b}	$d_{DWD} 30; L_{ef,b} = L - 6$

α_{load}

Angle load grain-direction [$^\circ$]

α_{1a}

Angle between screw and timber joint $\alpha_{1a}=22,5^\circ$

α_{2b}

Angle between screw and timber joint $\alpha_{1b}=67,5^\circ$

ρ_k

Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

E.3.2 Characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement

The characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement, can be calculated with the help of equation (24).

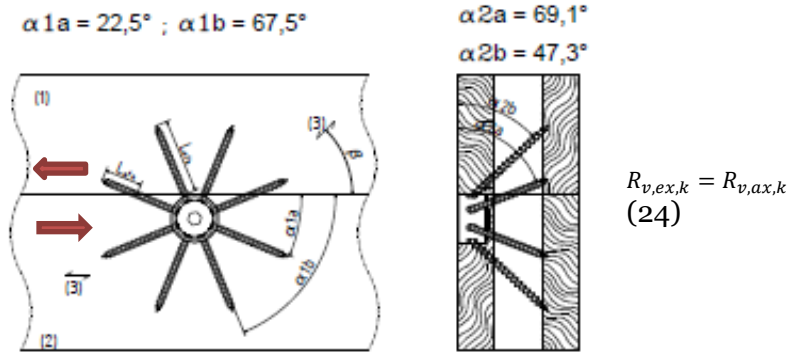


Figure 41: Centric arrangement of the IdeeFix-DWD Connector, shear strength parallel to the CLT panel-joint

With

$$R_{v,ax,k} = 2 \cdot \cos(\alpha_{load} - \alpha_{1a}) \cdot \frac{F_{ax,a,Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{load} - \alpha_{1b}) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}} \quad (25)$$

For the characteristic withdrawal parameter for VSS screws made of carbon steel according to ETA-11/0024 has to be considered with the equations below.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0.8} \quad (26)$$

$$F_{ax,b,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350} \right)^{0.8} \quad (27)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the VSS screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

Where

d	Nominal diameter of the VSS screw [mm]
d_{DWD}	Diameter of the IdeeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm ²]
h_{DWD}	Penetration depth of the IdeeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeeFix-DWD Connector with centric assembling to the joint of the timber parts [N]
$R_{v,0,k}$	Characteristic value of the embedment strength of the IdeeFix-DWD Connector with $\alpha_{load}=0^\circ$
k_{ax}	Coefficient to consider the angel between crew axis and grain-direction [-]
L_{ef}	Effective length of the threaded part of the screw in the timber part [mm]

<i>Angle</i>	<i>Effective length L_{ef} [mm] eccentric arrangement</i>
α_{1a}	$d_{DWD} 40; L_{ef45^\circ} = L - 24 > 0$
α_{1a}	$d_{DWD} 30; L_{ef45^\circ} = L - 19 > 0$
α_{1a}	$d_{DWD} 40; L_{efa} = L - 57 > 0$
α_{1a}	$d_{DWD} 30; L_{ef,a} = L - 43 > 0$
α_{1b}	$d_{DWD} 40; L_{ef,b} = L - 7$
α_{1b}	$d_{DWD} 30; L_{ef,b} = L - 6$

α_{load}	Angle load grain-direction [°]
α_{1a}	Angle between screw and timber joint $\alpha_{1a}=22,5^\circ$
α_{1b}	Angle between screw and timber joint $\alpha_{1b}=67,5^\circ$
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m ³]

E.3.3 Characteristic tension strength perpendicular to the panel joint of CLT elements, with centric arrangement

The characteristic tension strength perpendicular to the panel joint of the CLT panels, with centric arrangement can be calculated with equation (28).

$$R_{t,90,cen,k} = R_{v,ax,k} \quad (28)$$

Figure 42: Centric arrangement of the IdeeFix-DWD Connector, tension strength perpendicular to the CLT panel-joint

With

$$R_{v,ax,k} = 2 \cdot \cos(\alpha_{load} - \alpha_{1a}) \cdot \frac{F_{ax,\alpha,Rk}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{load} - \alpha_{1b}) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}} \quad (29)$$

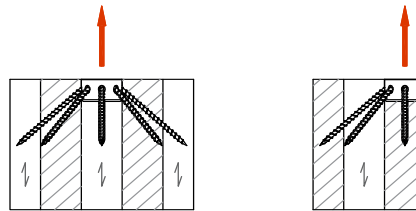
and the equations in accordance to ETA-11/0024 for VSS screws.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (30)$$

$$F_{ax,b,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (31)$$

E.3.4 Characteristic tension strength parallel to the axis of the IdeeFix DWD Connector, arranged in the narrow surface of CLT panels

The characteristic tension strength parallel to the axis of the IdeeFix DWD Connector in the edge surface of CLT panels, can be calculated with equation (32).



$$R_{t,k} = 1.25 \cdot \frac{8}{\sqrt{2}} \cdot F_{ax,Rk} \quad (32)$$

Figure 43: Centric arrangement of the IdeeFix DWD Connector, tension strength parallel to the axis of the DWD box in the edge surface of CLT

With the equations of ETA-11/0024

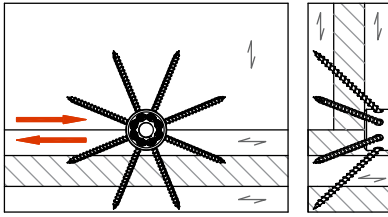
$$F_{ax,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (33)$$

Where

d	Nominal diameter of the VSS screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of VSS screws [N/mm ²]
k_{ax}	Coefficient to consider the angel between crew axis and grain-direction [-]
L_{ef}	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of VSS screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m ³]

E.3.5 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (34).



$$R_{v, cen, k} = R_{v, 0, k} + R_{v, ax, k} \quad (34)$$

Figure 44: Centric arrangement of the IdeeFix-DWD Connector, shear strength parallel to the CLT corner panel-joint

The amount of the embedment strength of the IdeeFix-DWD Connector, by considering the load-grain direction, should be calculated with equation **Fejl! Henvisningskilde ikke fundet..**

$$R_{v, 0, k} = \frac{1}{2} \cdot d_{DWD} \cdot h_{DWD} \cdot f_{h, \alpha, k} \quad (35)$$

With

$$f_{h, \alpha, k} = \frac{0,082 \cdot (1 - 0,01 \cdot d_{DWD}) \cdot \rho_k}{(1,35 + 0,015 \cdot d_{DWD}) \cdot \sin(\alpha)^2 + \cos(\alpha)^2} \quad (36)$$

and

$$R_{v, ax, k} = 2 \cdot \cos(\alpha_{load} - \alpha_{1a}) \cdot \frac{F_{ax, a, k}}{\sqrt{2}} + 2 \cdot \cos(\alpha_{load} - \alpha_{1b}) \cdot \frac{F_{ax, b, k}}{\sqrt{2}} \quad (37)$$

The characteristic withdrawal parameter for VSS screws according to ETA-11/0024 has to be considered with the equations below.

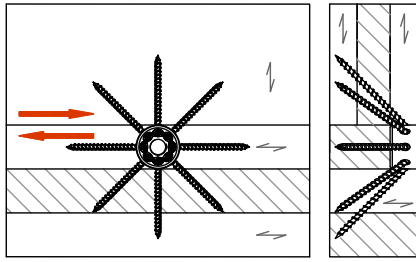
$$F_{ax, a, k} = k_{ax} \cdot f_{ax, k} \cdot d \cdot l_{ef, a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (38)$$

$$F_{ax, b, k} = k_{ax} \cdot f_{ax, k} \cdot d \cdot l_{ef, b} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (39)$$

Note: Due to the use of the M12;M16 screw in the center of the DWD box the VSS screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

E.3.6 Characteristic shear strength parallel to the panel joint of the CLT elements, with eccentric arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with eccentric arrangement, can be calculated with the help of equation (40).



$$R_{v,ex,k} = 2.5 \cdot \frac{F_{ax,a,k}}{\sqrt{2}} \quad (40)$$

Figure 45: Eccentric arrangement of the IdeeFix-DWD Connector, shear strength parallel to the CLT corner panel-joint

With the equation in accordance to ETA-11/0024.

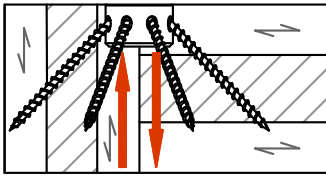
$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (41)$$

Where

d	Nominal diameter of the VSS screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of VSS screws [N/mm ²]
k_{ax}	Coefficient to consider the angel between crew axis and grain-direction [-]
$l_{ef,a}$	Effective length of the threaded part of the screw in the timber part with $l_{ef} \leq 22$ mm [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of VSS screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m ³]

E.3.7 Characteristic shear strength perpendicular to the panel joint of the CLT elements, with centric arrangement

The characteristic shear strength perpendicular to panel joint of the CLT elements, with centric arrangement, can be calculated with the help of equation (42).



$$R_{v,k} = 2.5 \cdot \frac{F_{ax,k}}{\sqrt{2}} \quad (42)$$

Figure 46: Centric arrangement of the IdeeFix-DWD Connector, shear strength parallel to the axis of the DWD box

CLT corner panel-joint

With the equation in accordance to ETA-11/0024.

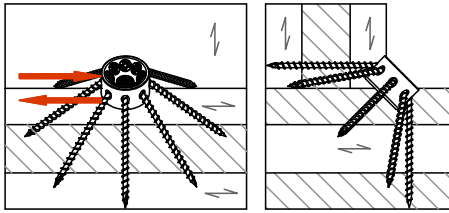
$$F_{ax,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (43)$$

Where

d	Nominal diameter of the VSS screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of VSS screws [N/mm ²]
k_{ax}	Coefficient to consider the angle between crew axis and grain-direction [-]
$l_{ef,a}$	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of VSS screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m ³]

E.3.8 Characteristic shear strength parallel to the panel joint of the CLT elements, with centric and inclined arrangement

The characteristic shear strength parallel to panel joint of the CLT elements, with centric and inclined arrangement, can be calculated with the help of equation (44).



$$R_{v, cen45, k} = R_{v, ax, k} \quad (44)$$

Figure 47 : Centric inclined arrangement of the IdeeFix DWD Connector, shear strength parallel to the CLT corner panel-joint

$$R_{v, ax, k} = 2 \cdot \frac{F_{ax, a, k}}{\sqrt{2}} \quad (45)$$

With the equation in accordance to ETA-11/0024.

$$F_{ax, k} = k_{ax} \cdot f_{ax, k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350} \right)^{0,8} \quad (46)$$

Where

d	Nominal diameter of the VSS screws [mm]
$f_{ax, k}$	Characteristic withdrawal parameter of VSS screws [N/mm ²]
k_{ax}	Coefficient to consider the angle between crew axis and grain-direction [-]
$l_{ef, a}$	Effective length of the threaded part of the screw in the timber part [mm]
$F_{ax, Rk}$	Characteristic withdrawal capacity of VSS screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m ³]

Note: Due to the use of the M12; M16 screw in the center of the DWD box the VSS screws are able to transfer both, tension and compression loads. Buckling of the screws in compression must not be considered.

Annex F: IdeeFix AR

F) Characteristic values of load-carrying-capacities and stiffness

F.1 Loading by forces perpendicular to side grain

The screws under $\alpha = 61^\circ$ of IdeeFix AR in the timber member are loaded by axial F_{ax} and lateral forces F_{la} . The resulting force equals the proportional tensile force F_t/n for n screws at $\alpha = 61^\circ$ and a force F_{ho} acting at the screw's head and the IdeeFix AR connector, see figure 48.

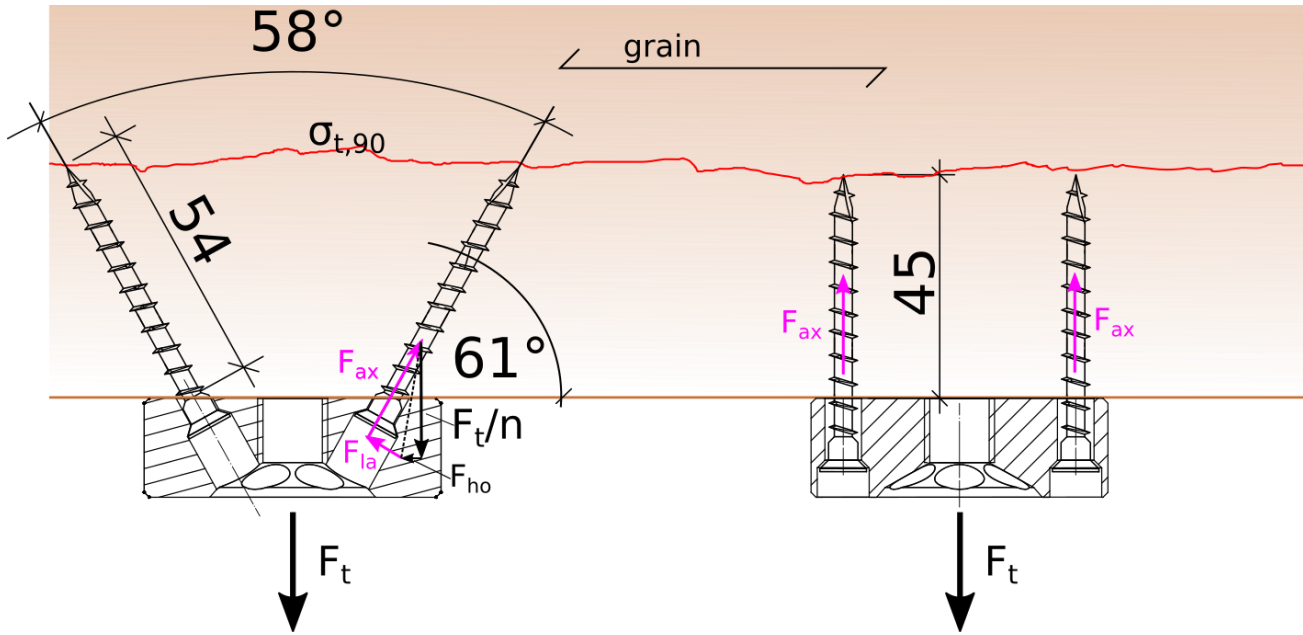


Figure 48: loading of IdeeFix AR by tensile forces

The loading of IdeeFix ARs fixed with inclined screws at $\alpha = 61^\circ$ results: $F_t/n = F_{ax} \cdot \cos(29^\circ) + F_{la} \cdot \sin(29^\circ)$.

And for IdeeFix AR fixed exclusively with 2 screws under $\alpha = 90^\circ$: $F_t/2 = F_{ax}$.

In the section of screws' tips tensile stresses perpendicular to the grain $\sigma_{t,90}$ act.

The bearing strength for IdeeFix AR connectors loaded by a tensile force with n screws under an angle of $\alpha = 61^\circ$ is:

$F_{ax,Adapter,Rk} = (n^{0,9} \cdot F_{ax,screw,Rk} \cdot \cos(29^\circ) + n \cdot F_{la,screw,Rk} \cdot \sin(29^\circ))$ and for connectors fixed with 2 screws perpendicular to side-grain $F_{ax,Adapter,Rk} = 2^{0,9} \cdot F_{ax,screw,Rk}$

The axial resistance $F_{ax,screw,Rk}$ of the screws VSS is determined according to ETA-11/0025.

The lateral load-carrying capacity $F_{la,screw,Rk}$ for screws with $l_{ef,\alpha=61^\circ}$ is found with the parameters according to ETA-11/0024 and Johansen's model for steel-timber joints with thin steel plates according EC5-1-1, 8.2.3.

For IdeeFix AR connectors applied with screws under $\alpha = 90^\circ$ and $\alpha = 61^\circ$ the bearing capacities are not to be added.

The splitting capacity for connection forces perpendicular to grain should be verified according to EC5-1-1, the pull out of bolts M12 or M16 according to EN 1993-1-8.

F.2 Loading by forces parallel to side grain

The load bearing capacity for lateral forces follows as:

$$F_{la,Adapter,Rk} = (n_V \cdot F_{ax,screw,Rk} \cdot \cos(61^\circ) + n_V \cdot F_{la,screw,Rk} \cdot \cos(29^\circ))$$

And for IdeeFix AR fixed with 2 VSS at 90°: $F_{la,Adapter,Rk} = 2 \cdot F_{la,screw,Rk}$

With n_V given in table F.1

Table F.1: Load bearing capacity for forces parallel to side grain $F_{la,Adapter,Rk}$

Screw pattern	n_V
2 x 90°	2
3 x 61°	1
6 x 61°	2

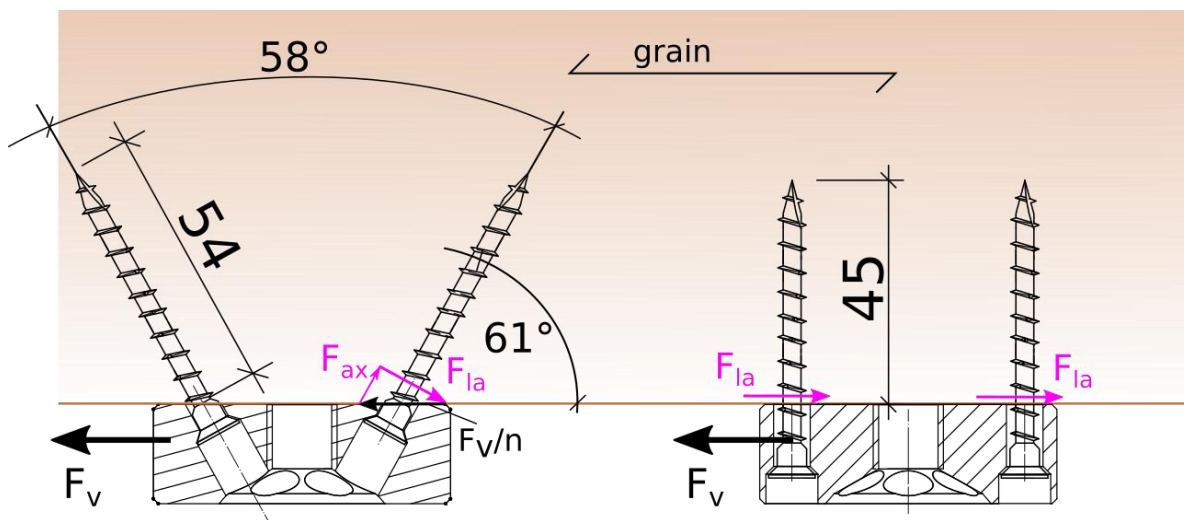


Figure 49: loading of IdeeFix AR by shear forces F_V

F.3 Loading under an arbitrary angle to side grain

The model according annex B.2 for IdeeFix IFS is applied to IdeeFix AR:

$$\left(\frac{F_{t,Ed}}{F_{ax,Adapter,Rd}} \right)^2 + \left(\frac{F_{V,Ed}}{F_{la,Adapter,Rd}} \right)^2$$

F.4 Loading by a moment

No model is assessed for a loading of IdeeFix AR by moments. The load bearing capacities of IdeeFix IFS according to annex B are based on tests with small eccentricities of loads due to an eye bolt.

If the bolts M12 or M16 are loaded by greater bending moments, e.g. due to forces acting in larger distances from the contact area between IdeeFix AR and timber, this would produce additional axial loading of screws and stresses perpendicular to side grain. For this kind of loading a verification according to EC 5-1-1 for the in-site realisation has to be done and the bolts M12 or M16 are to be verified for bending moments.

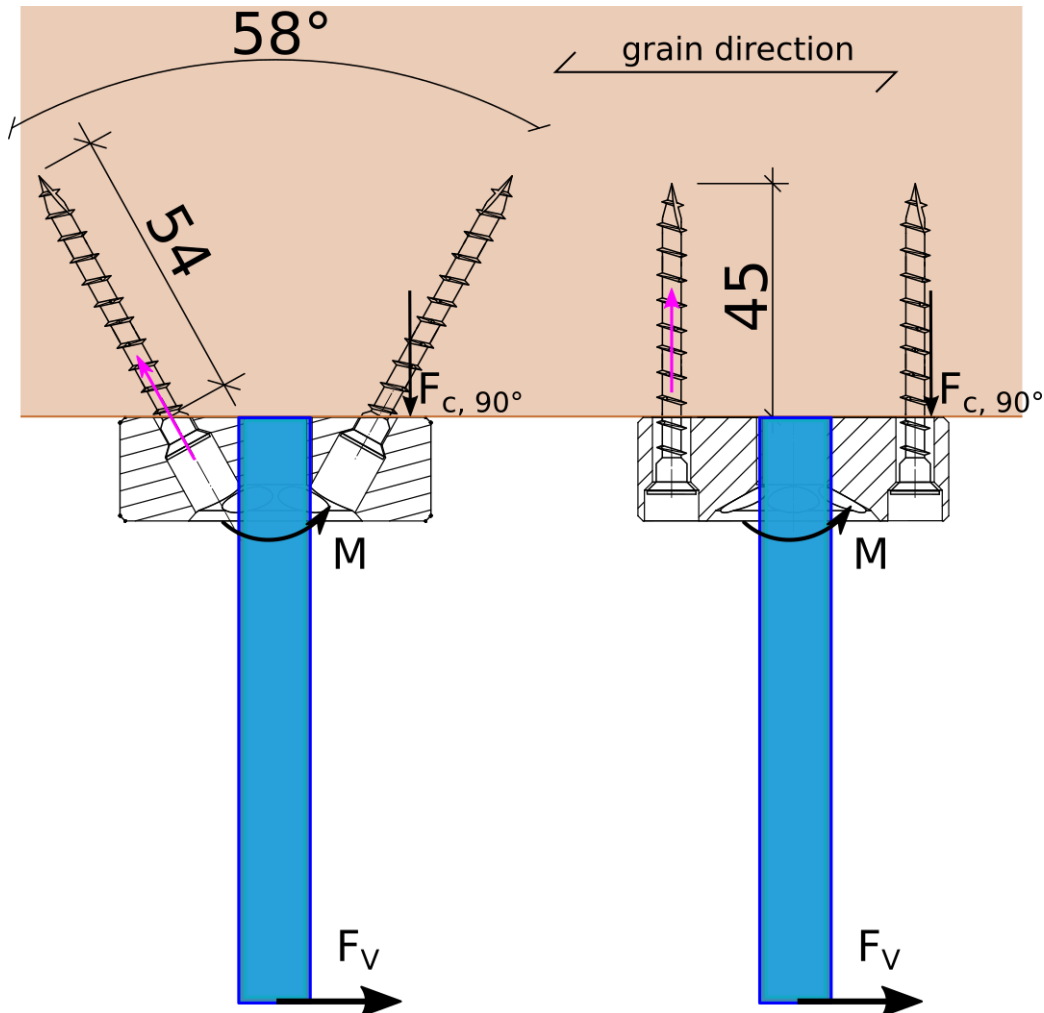
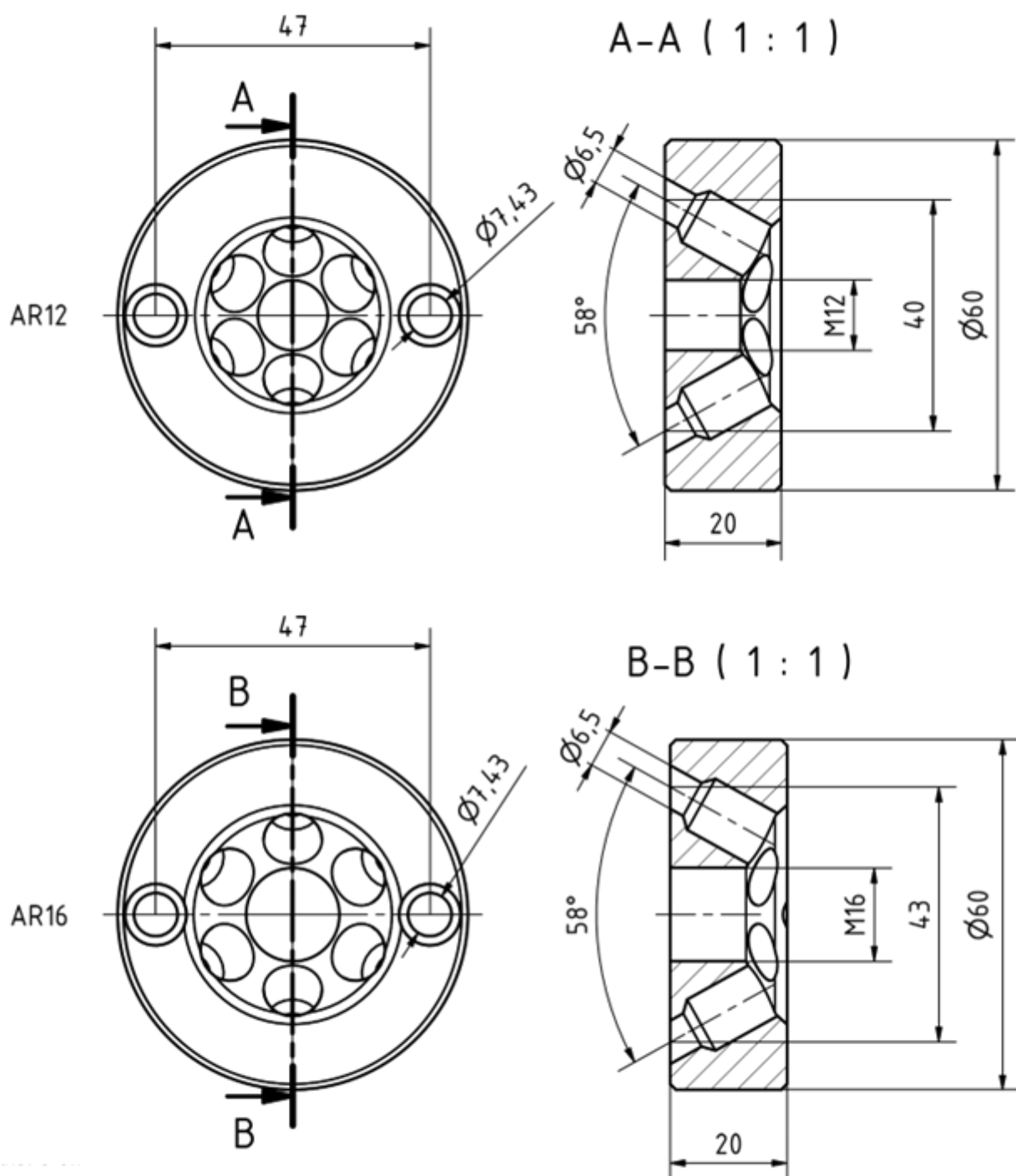


Figure 50: IdeeFix AR and bolt loaded by bending moment due to eccentricity

F.5

IdeeFix AR, product details, definitions and installation



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ETA-11/0024 specifies for screws subjected exclusively to axial forces a minimum distance from the centre of the penetration length to the unloaded edge of $a_{4,c} = 4 \cdot d = 24 \text{ mm}$. Lateral embedding stresses are not considered as these stresses are equalised within the joint area.

For IdeeFix AR fixed with VSS $l = 60 \text{ mm}$ in solid timber, glued laminated timber or glued solid timber the minimum width is $b_{min} = 43 + 2 \cdot (13 + 24) = 117 \text{ mm}$ and for fixing without inclined screws $b_{min} = 47 + 2 \cdot 24 = 95 \text{ mm}$.

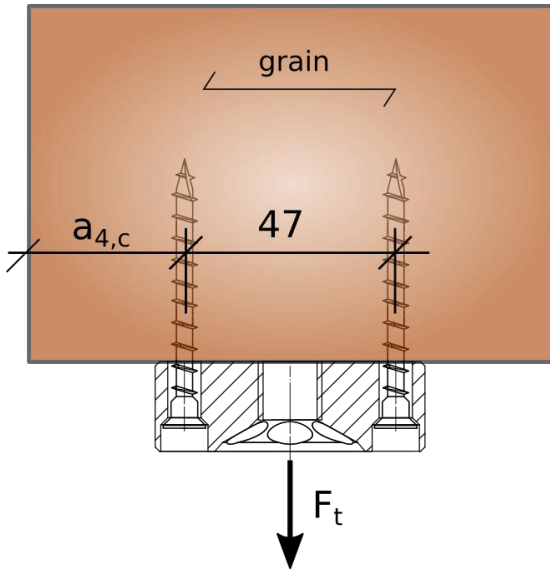


figure 51: minimum distance $a_{4,c}$ for IdeeFix AR loaded exclusively by forces F_t perpendicular to the side.

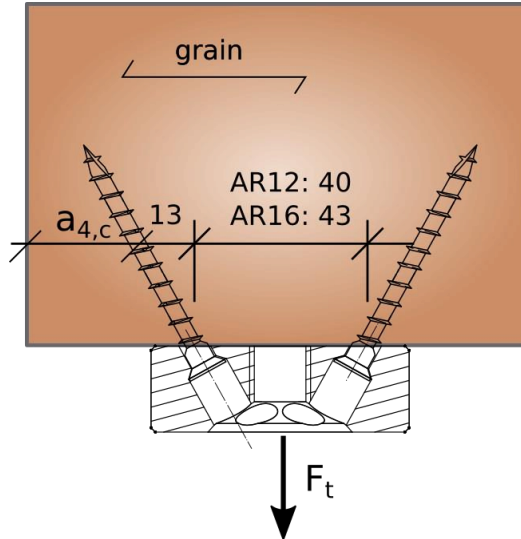


figure 52: minimum distance $a_{4,c}$ for IdeeFix AR loaded exclusively by forces F_t perpendicular to the side.