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

MEMBER OF EOTA

European Technical Assessment ETA-14/0160 of 2022/05/17

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:	IdeFix, IdeFix DWD, ZaFix, bases
Product family to which the above construction product belongs:	Three-dimensional nailing plate (timber to timber connectors)
Manufacturer:	SIHGA GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf Tel. +49 7612 / 74370 - 0 Fax +49 7612 / 74370 - 10 Internet www.sihga.com
Manufacturing plant:	SIHGA GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf
This European Technical Assessment contains:	62 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:	The ETA with the same number issued on 2014-06-26

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Technical description of the product
IdeFix IF, IdeFix DWD connectors are used in timber to timber connections.

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

IdeFix IF, IdeFix DWD and IFS connectors are assembled of a cylindrical part made of steel 1.0715 according to EN 10087 and self-tapping screws GoFix HK 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.

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

Post-bases IdeFix 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 D.

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, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Work Requirements 1 and 4 of the Regulation 305/2011 (EU) shall be fulfilled.

IdeFix IF 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 IdeFix IF but in contact between end-grain of joist and header's side-grain or column's end-grain and beam's side-grain respectively.

IdeFix 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.

IdeFix 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 IdeFix 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. IdeFix 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 IdeFix IF and joints with IdeFix IF 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

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 IdeFix-connectors assembled with screws GoFix HK made of carbon steel according to ETA-11/0425 is limited to service class 1 and 2.

IdeFix-connectors and post-bases assembled with screws GoFix HK 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 E
Joint Stiffness	See Annex A to E
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 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
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 IdeFix connections assembled with screws GoFix HK made of stainless steel according to ETA-11/0425. Kits using screws GoFix HK 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:

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

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 D 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 D.

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.

See annex E to H 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 IdeFix-connectors assembled with screws GoFix HK made of carbon steel according to ETA-11/0425 is limited to service class 1 and 2.

IdeFix-connectors and post-bases assembled with screws GoFix HK 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

IdeFix IF, IdeFix IFS and post-basis IdeFix 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:

IdeFix If, IdeFix DWD or IdeFix IFS Connector joints

A connector joint is deemed fit for its intended use provided:
2   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

3   For a header with joists from both sides but with different reaction forces a similar consideration applies.
4   Connectors are fastened to wood-based members by bolts.
5   The characteristic capacity of the connector joint is calculated according to the manufacturer's technical documentation, dated 2013
6   The connector joint is designed in accordance with Eurocode 5 or an appropriate national code.
7   There is no gap between the end of the joist and header, beam – column respectively.
8   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 IdeFix 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 (AVCP)

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

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

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

Issued in Copenhagen on 2022-05-17 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A: IdeFix IF

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

1.1 Loading in tension of IdeFix IF
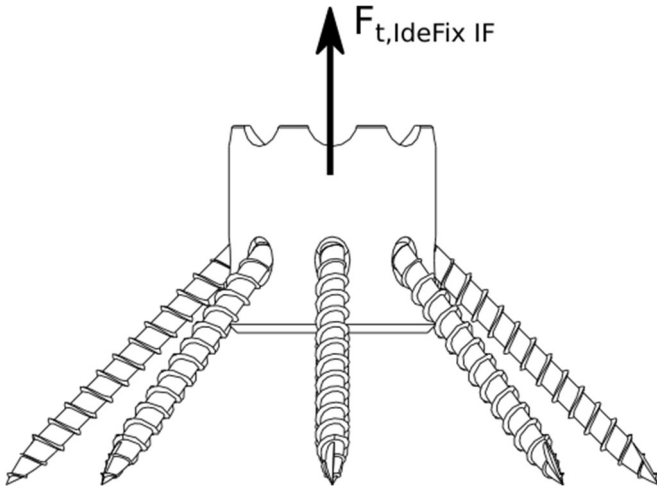
Figure 1: IdeFix IF in tension loading

Resistance:

$$F_{t,IdeFixIF,Rk} = n \cdot (F_{ax,\alpha,Rk} + F_{la,\alpha,Rk}) \cdot \cos(45°)$$

with $F_{ax,\alpha,Rk}, F_{la,\alpha,Rk}$ for screws GoFix HK, properties and design according ETA-11/0425. Without taking in account the rod-effect for $F_{la,\alpha,Rk}$.

Stiffness:

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

with $K_{la} = \rho^{1,5} \cdot d/23$; $K_{ax} = 780 \cdot d^{0.2} \cdot l_{ef}^{0.4}$

d: diameter of GoFix HK;

n: number of GoFix HK screws

Table 1: characteristic withdrawal resistance of IdeFix IF in timber of grade C24

IdeFix® IF Ø	GoFix HK made of carbon steel according to ETA-11/0425	$F_{t,IdeFix,Rk}$[kN], C24	K_{ser}[kN/mm], C24
30 mm	d=5,0 mm, l_{ef}= 34 mm	17,00 kN	30,7 kN/mm
30 mm	d=5,0 mm, l_{ef}= 54 mm	25,60 kN	31,1 kN/mm
30 mm	d=5,0 mm, l_{ef}= 74 mm	32,40 kN	31,3 kN/mm
40 mm	d=6,0 mm, l_{ef}= 53 mm	29,00 kN	36,9 kN/mm
40 mm	d=6,0 mm, l_{ef}= 73 mm	37,90 kN	37,3 kN/mm
40 mm	d=6,0 mm, l_{ef}= 93 mm	45,60 kN	37,5 kN/mm
50 mm	d=8,0 mm, l_{ef}= 81 mm	56,00 kN	48,9 kN/mm
50 mm IFD	d=6,0 mm, l_{ef}= 68 mm	71,90 kN	74,3 kN/mm
50 mm IFD	d=6,0 mm, l_{ef}= 88 mm	87,30 kN	74,9 kN/mm

1.2 Loading of IdeFix IF by shearing force

Three different failure modes have to be verified.

Mode a) *embedding of IdeFix IF in end-grain of joist or column*

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

$$V_{90} = \frac{k_h}{k_{90}} \cdot min \begin{Bmatrix} k_1 \cdot k_2 \cdot k_3 \cdot k_4 \cdot 35 \cdot d_c^{1,5} \\ k_1 \cdot k_3 \cdot h_e \cdot 31.5 \cdot d_c \end{Bmatrix} \text{ with } d_c: IdeFix \text{ diameter}, h_e \text{ depth of embedment and}$$

$$k_1 = k_2 = k_4 = 1, k_h = 0{,}65.$$

> *load-carrying capacity of self-tapping screws GoFix HK*

n=5 screws are supposed to contribute (n=10 for IdeFix IF 500 with two rows of screws).
The screws' load carrying capacity is calculated according to EC5 clause 8.2.3, equation (8.10) and ETA-11/0425.

$$F_{modea,IdeFixIF,Rk} = V_{90} + F_{V,Rk,ETA-11/0425}$$

Mode b)

$$F_{modeb,IdeFixIF,Rk} = f_{h,90,bolt} \cdot d_{bolt} \cdot \left(\sqrt{(e_{bolt}^2 + \frac{2 \cdot M_y}{d_{bolt} \cdot f_{h,90,bolt}})} - e_{bolt} \right) + F_{ax,screws}/4.$$

Rod effect is taken into account as $F_{ax,screws}/4$ with n=5 screws (n=10 for IdeFix IF 500 with two rows of screws) contributing and the screws' load carrying capacity according to ETA-11/0425.

Table 2: embedding depth h_e; distance e_bolt

diameter IdeFix IF	embedding depth h_e in joist or column	e_{bolt}
30 mm	20 mm	10 mm
40 mm	25 mm	15 mm
50 mm	30 mm	20 mm
diameter IdeFix, IFD		
50 mm	35 mm	15 mm

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

$$F_{modec,IdeFixIF,Rk} = 14 \cdot b_{joist} \cdot \sqrt{\frac{h_e}{(1-h_e/h_{joist})}}.$$
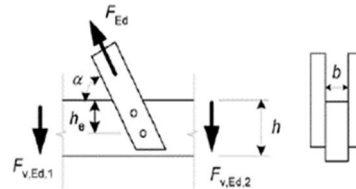
The shearing force capacity of IdeFix IF in end-grain is the minimum value of these three modes.

Slip modulus for IdeFix IF connections in end-grain: $K_{ser} = 1{,}2 \cdot \rho_m^{1,5} \cdot d_c/2$

Table 3: characteristic shearing force capacity of IdeFix IF in timber grade C24

IdeFix® IF Ø	GoFix HK made of carbon steel according to ETA-11/0425	$b_{NT} = h_{NT}$	$F_{V90,IdeFix,Rk}$, C24	K_{ser}, C24
30 mm	d=5,0 mm, l_{ef}= 34 mm	100 mm	10,1 kN (mode a)	7,56 kN/mm
30 mm	d=5,0 mm, l_{ef}= 54 mm	120 mm	12,3 kN (mode b)	7,56 kN/mm
30 mm	d=5,0 mm, l_{ef}= 74 mm	140 mm	13,8 kN (mode b)	7,56 kN/mm
40 mm	d=6,0 mm, l_{ef}= 53 mm	120 mm	13,0 kN (mode c)	10,1 kN/mm
40 mm	d=6,0 mm, l_{ef}= 73 mm	160 mm	18,8 kN (mode b)	10,1 kN/mm
40 mm	d=6,0 mm, l_{ef}= 93 mm	180 mm	20,5 kN (mode b)	10,1 kN/mm
50 mm	d=8,0 mm, l_{ef}= 81 mm	160 mm	20,5 kN (mode c)	12,6 kN/mm
IdeFix® IFD Ø				
50 mm	d=6,0 mm l_{ef}= 68 mm	160 mm	20,5 kN (mode c)	12,6 kN/mm
50 mm	d=6,0 mm l_{ef}= 88 mm	200 mm	30,7 kN (mode c)	12,6 kN/mm

1.3 Combined loading of IdeFix IF by shearing force and tension force

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

1.4 Multiple IdeFix IF connectors per joint

For joints with more than one IdeFix IF connector the bearing capacity of the joint is found by multiplying the capacity for one IdeFix IF with the number of connectors n_{IdeFix}.
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_{IdeFix}.
Verification for wood members according to Eurocode 5 have to be done consciously.

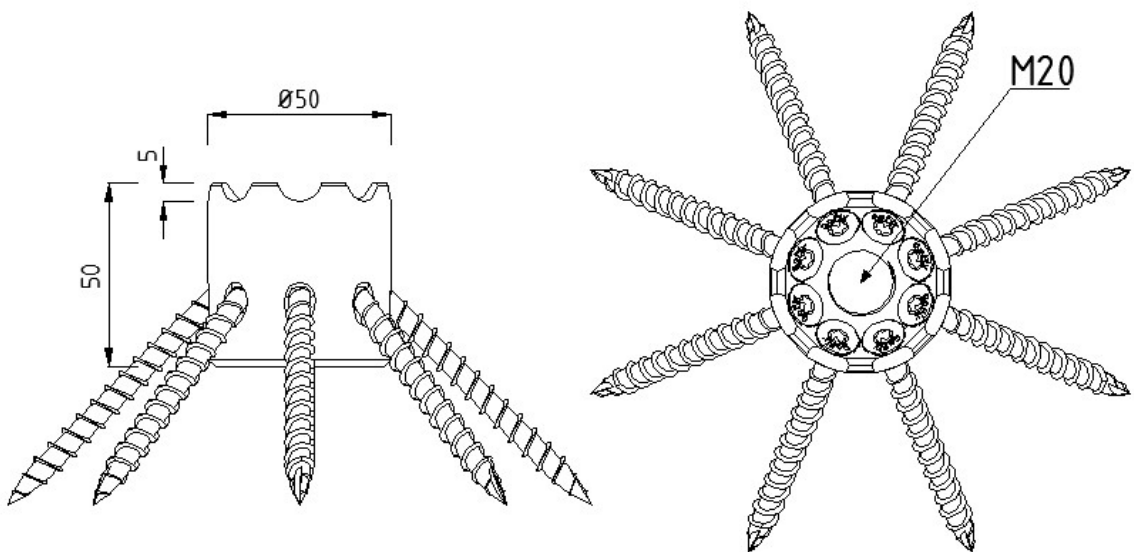**B) IdeFix IF, product details, definitions and installation**
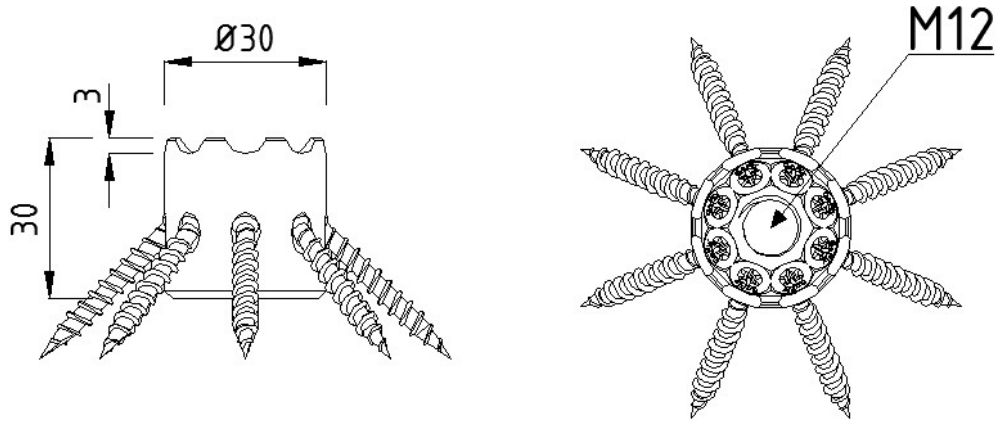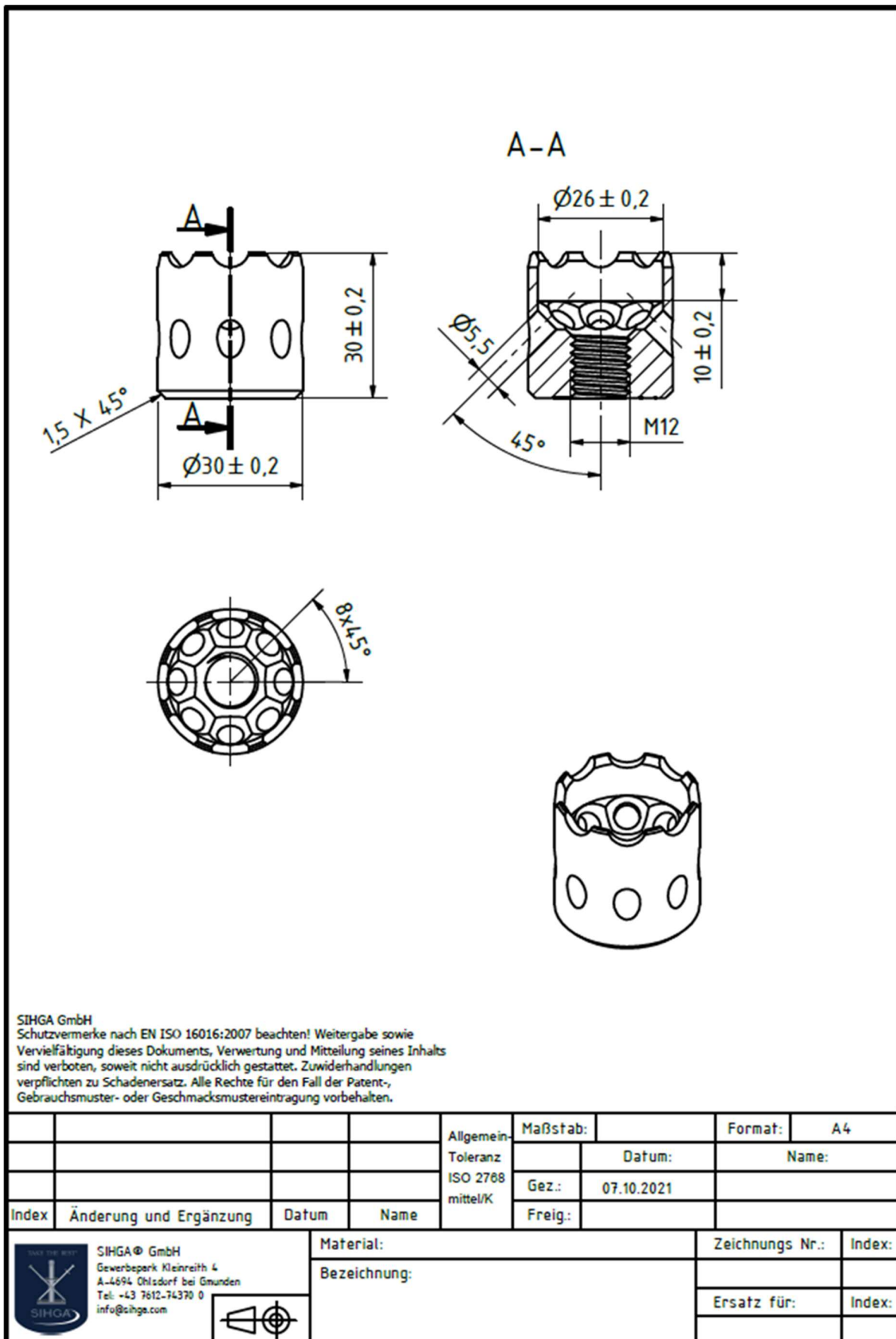
Figure 2:

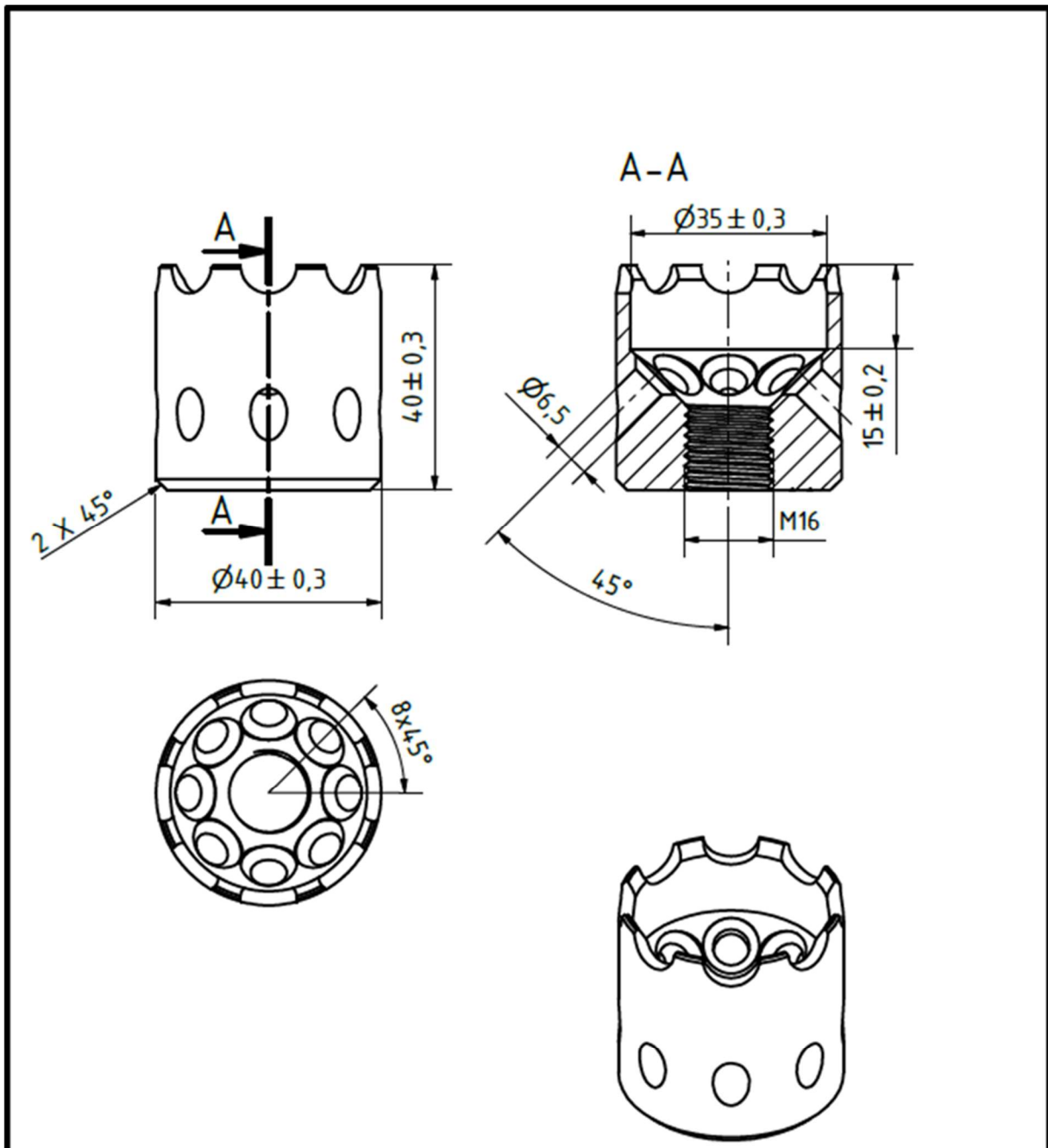**IdeFix IF series 300**
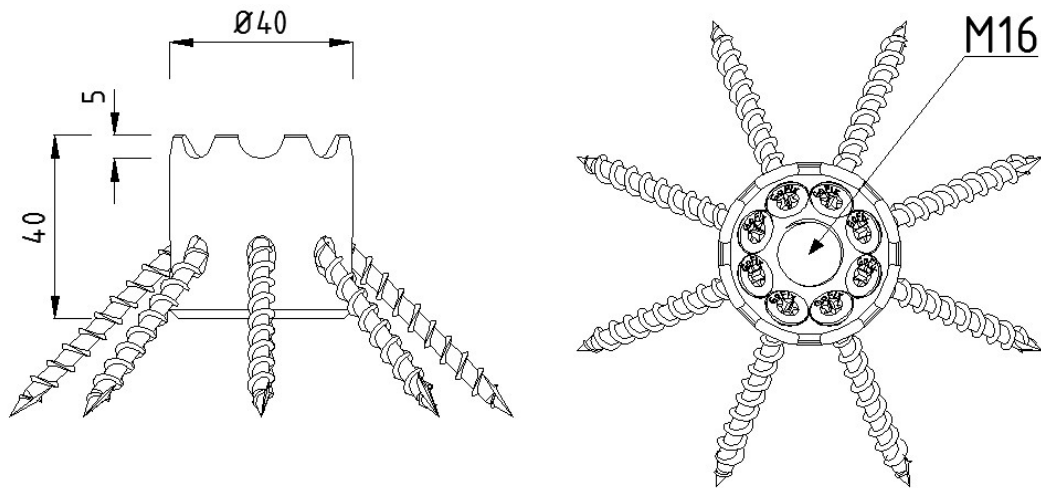
Figure 3: IdeFix IF series 400

Figure 4: IdeFix IF series 500

Cylindrical part made of steel 1.0715 according to EN 10087 and self-tapping screws GoFix HK with properties assessed in ETA-11/0425
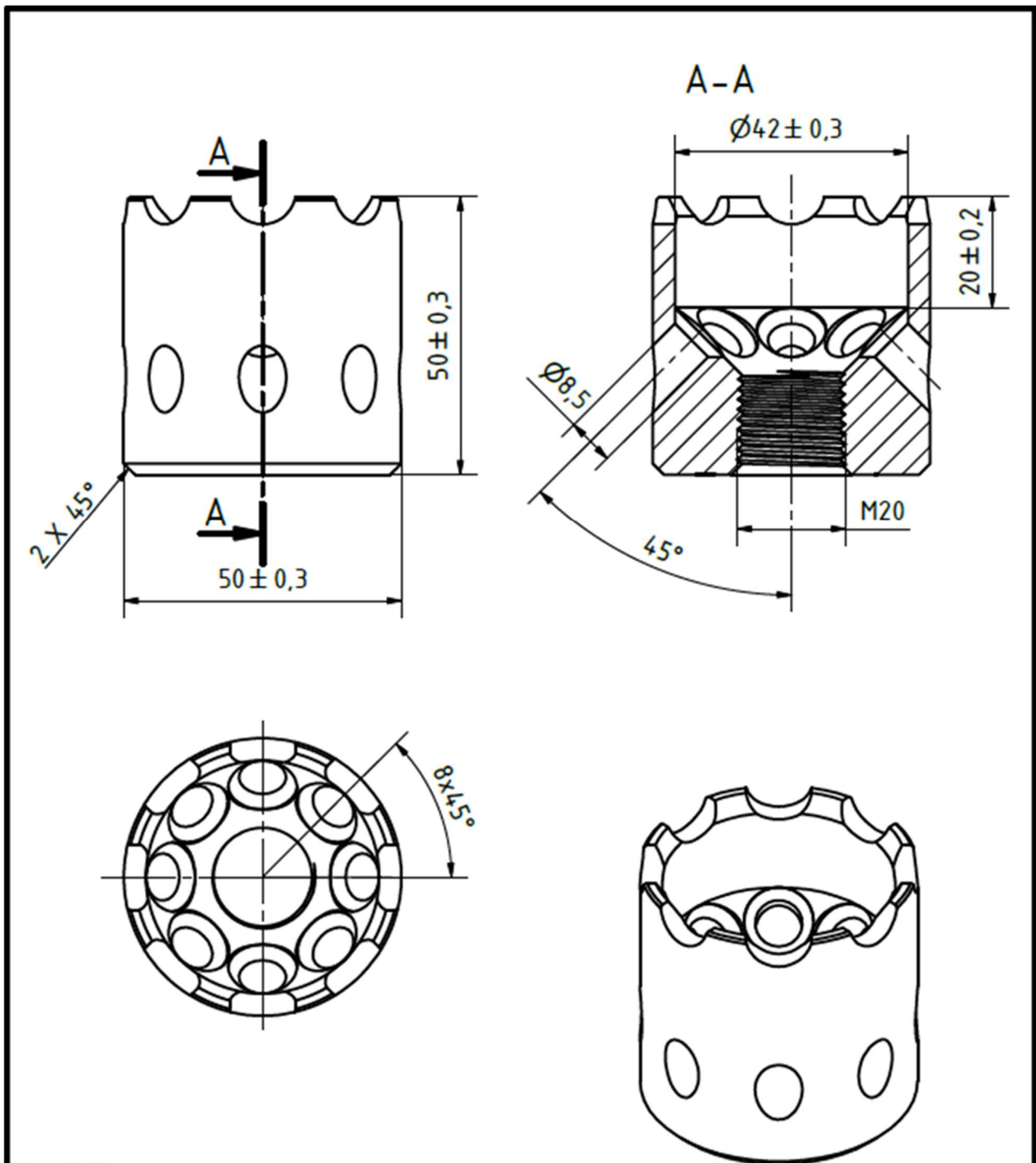
2.1 IdeFix IF series 300, details:

A–A

Ø26 ± 0,2

Ø5,5

30 ± 0,2

10 ± 0,2

M12

45°

1,5 X 45°

Ø30 ± 0,2

8×45°

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						Gez.:	07.10.2021		
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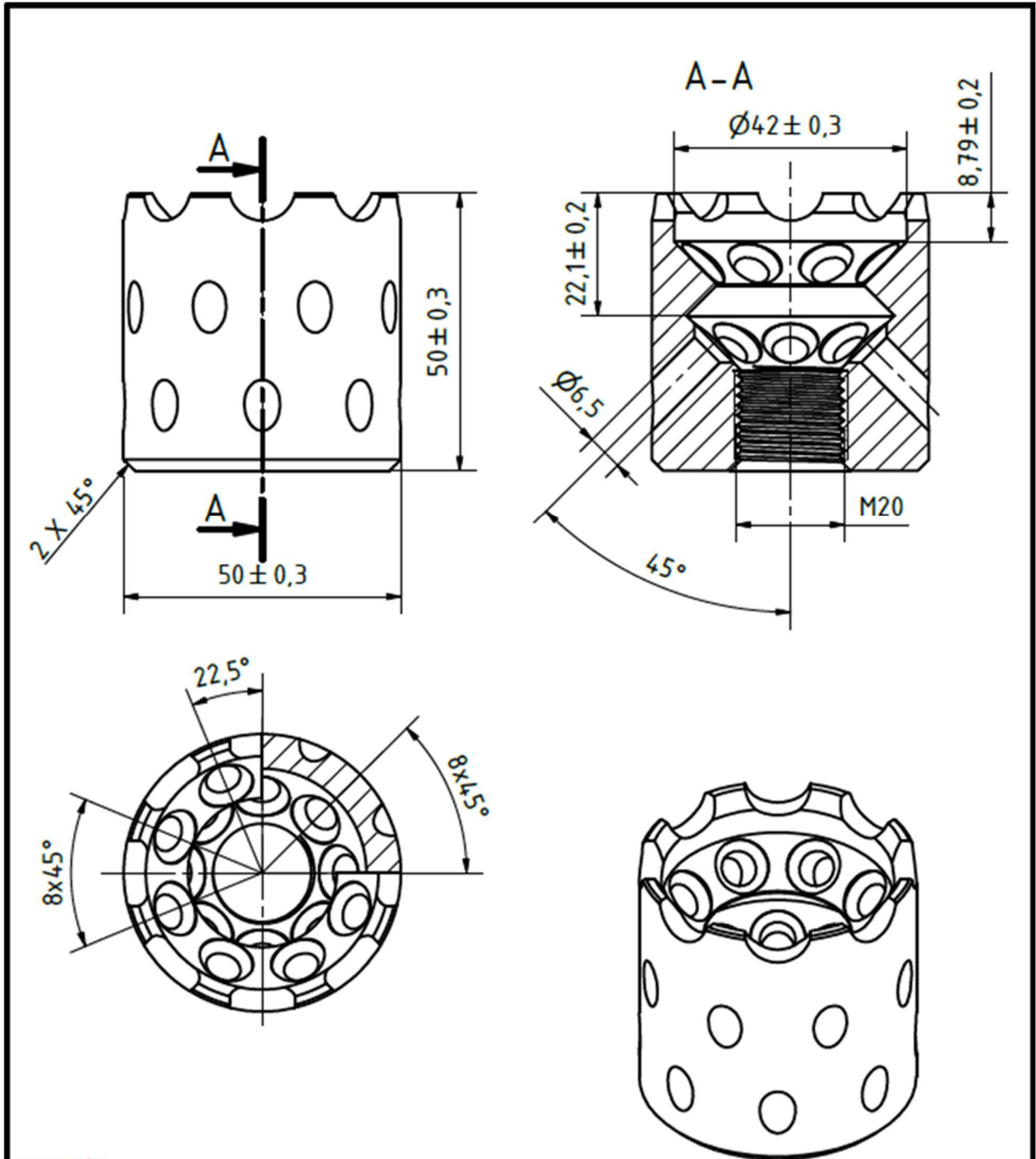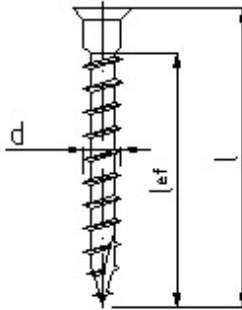Tel: +43 7612-74370 0
info@sihga.com

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2.2 IdeFix IF series 400, details:

A–A

Ø35 ± 0,3

Ø6,5

15 ± 0,2

M16

45°

A

A

40 ± 0,3

2 X 45°

Ø40 ± 0,3

8x45°

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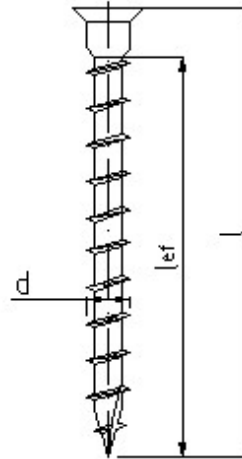| SIHGA® GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf bei Gmunden Tel: +43 7612-74370 0 info@sihga.com	Material:	Zeichnungs Nr.:	Index:
	Bezeichnung:		
		Ersatz für:	Index:

2.3 IdeFix IF series 500, details:

Index	Änderung und Ergänzung	Datum	Name	Allgemein-Toleranz ISO 2768 mittel/K	Maßstab:		Format: A4
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				Gez.:	07.10.2021		
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2.4 IdeFix IF series 500 with two rows of screws, details:

Index	Änderung und Ergänzung	Datum	Name	Allgemein-Toleranz ISO 2768 mittel/K	Maßstab:		Format:	A4
					Datum:		Name:	
					Gez.:	07.10.2021		
					Freig.:			

SIHGA® GmbH Gewerbepark Kleinreith 4 A-4694 Ohlsdorf bei Gmunden Tel: +43 7612-74370 0 info@sihga.com	Material:	Zeichnungs Nr.:	Index:
	Bezeichnung:		
		Ersatz für:	Index:

2.5 IdeFix IF screws, GoFix HK, ETA -11 / 0425, geometry:

GoFix HK 5,0   GoFix HK 6,0   GoFix HK 8,0
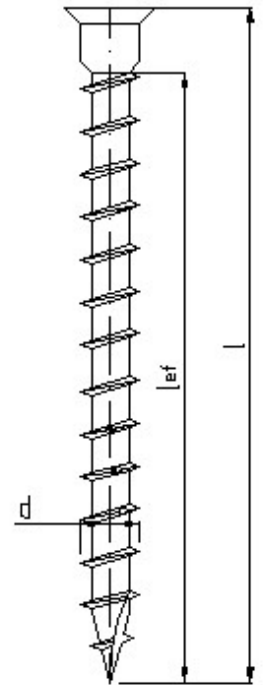
Figure 5: IdeFix IF screws

Table 4: IdeFix IF screws, details

IdeFix		GoFix 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
IdeFix IFD		**GoFix HK**		
508	50	6,0	80	68
510	50	6,0	100	88

2.6 IdeFix IF installation:
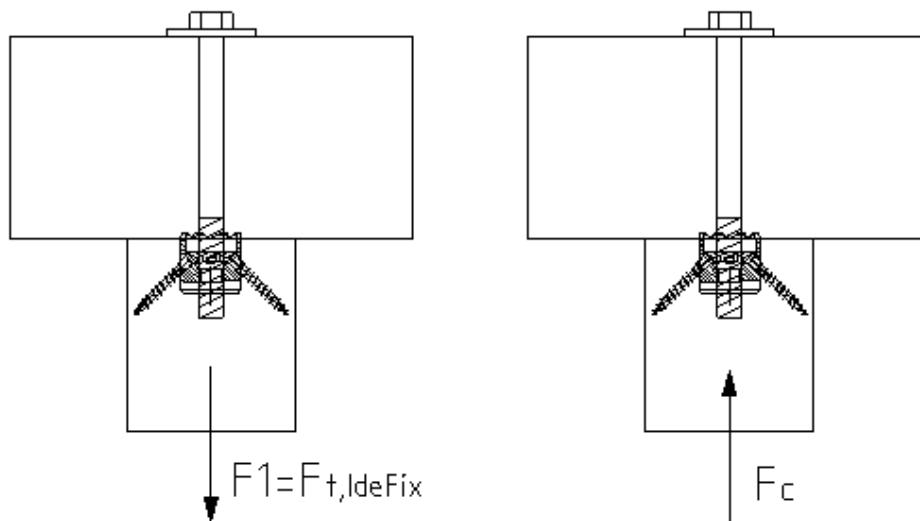
Figure 6: Tension connection with anti-twist protection, bolted joint connection
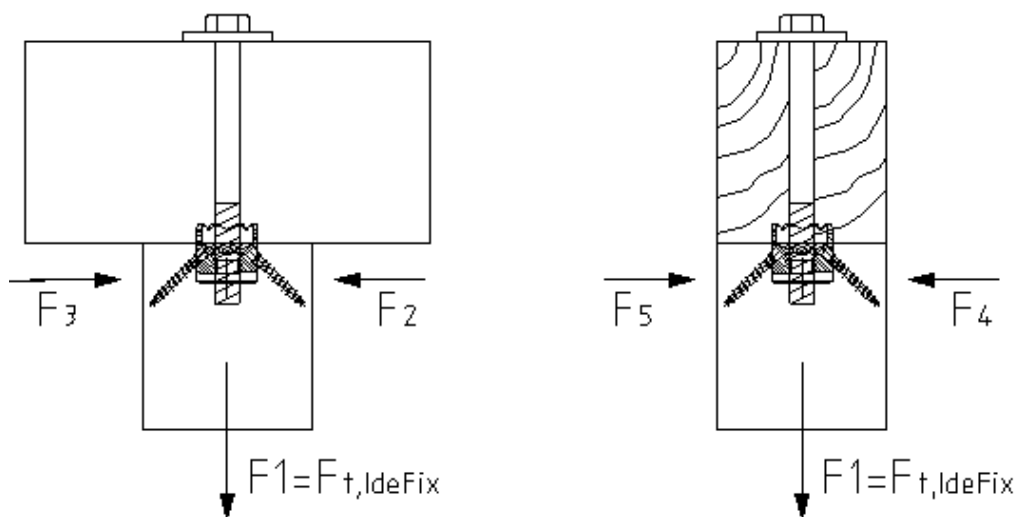
Figure 7: Column to main beam connection with anti-twist protection, bolted joint connection
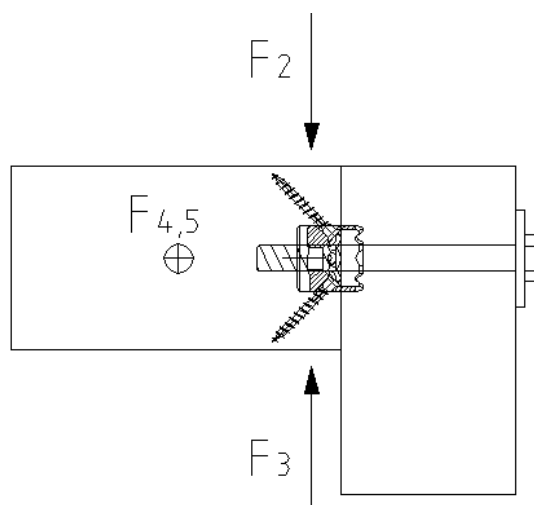
Figure 8: Header- joist connection with anti-twist protection, bolted joint connection

<u>Side View</u>

$F1=F_{t,IdeFix}$

Anti-twist protection

>10
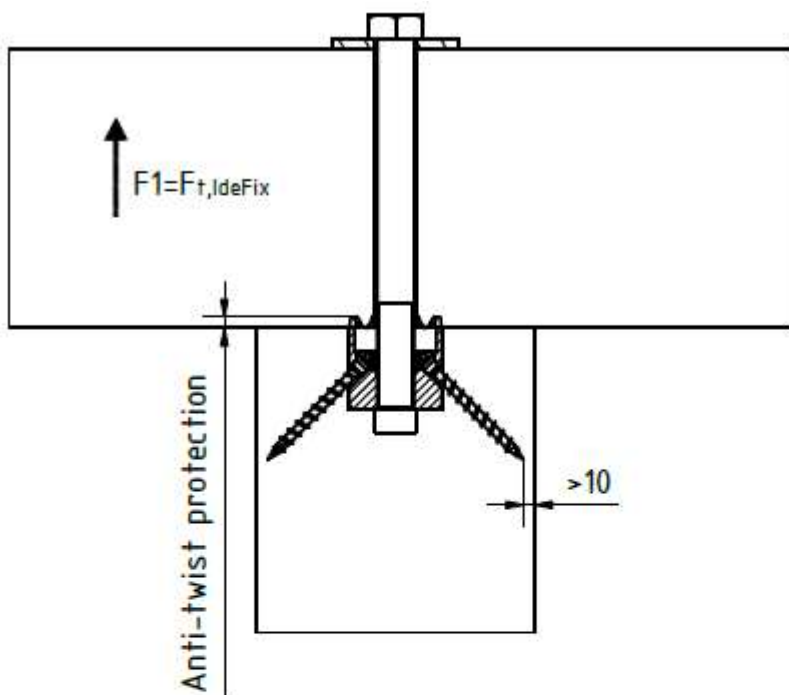
Hexagon screw with shank or threaded bar M12, M16, M20
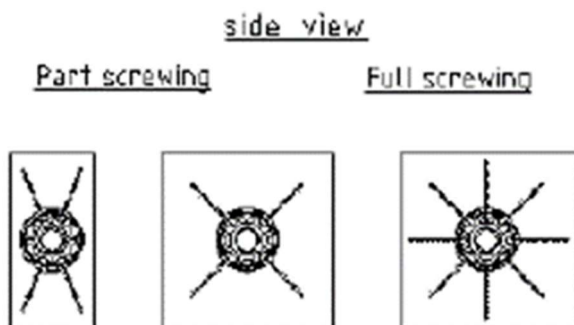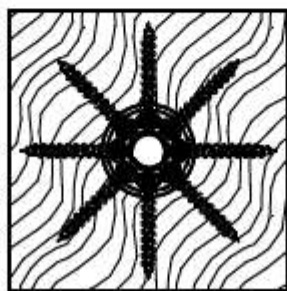Washer – DIN 40
Idefix - Connector series IF300, IF400, IFSOO
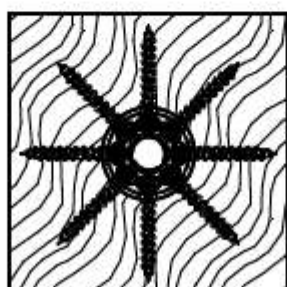
Anti-twist protection	
IF 300	3 mm
IF 400	5 mm
IF 500	5 mm

side view

Part screwing   Full screwing

Figure 9: Tension Connection, details
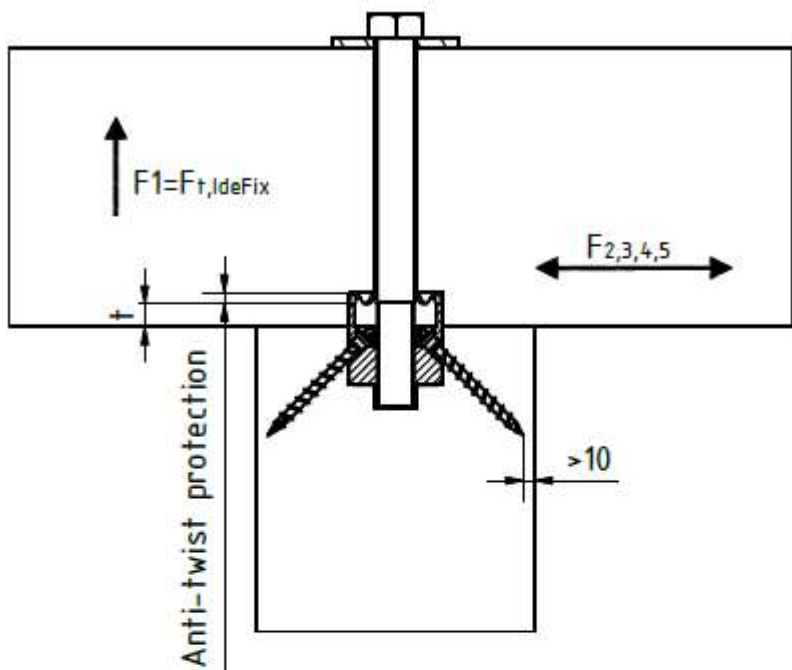
Side view
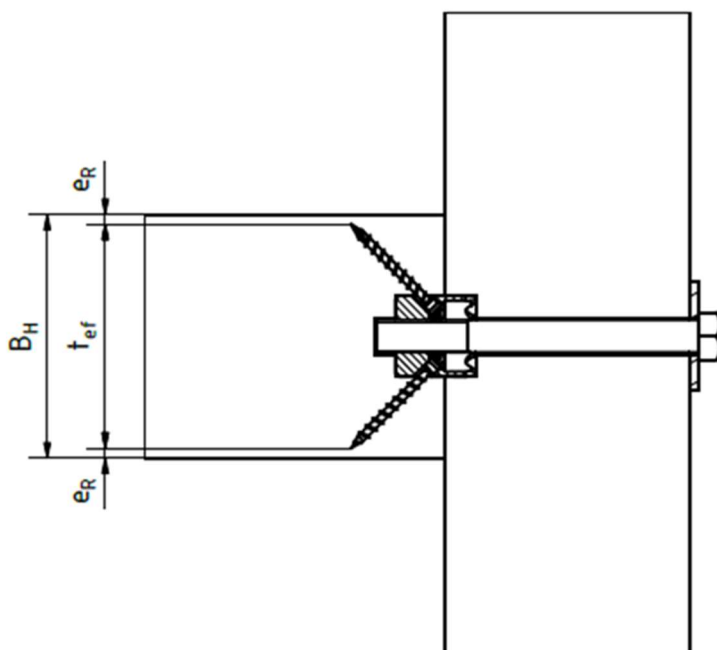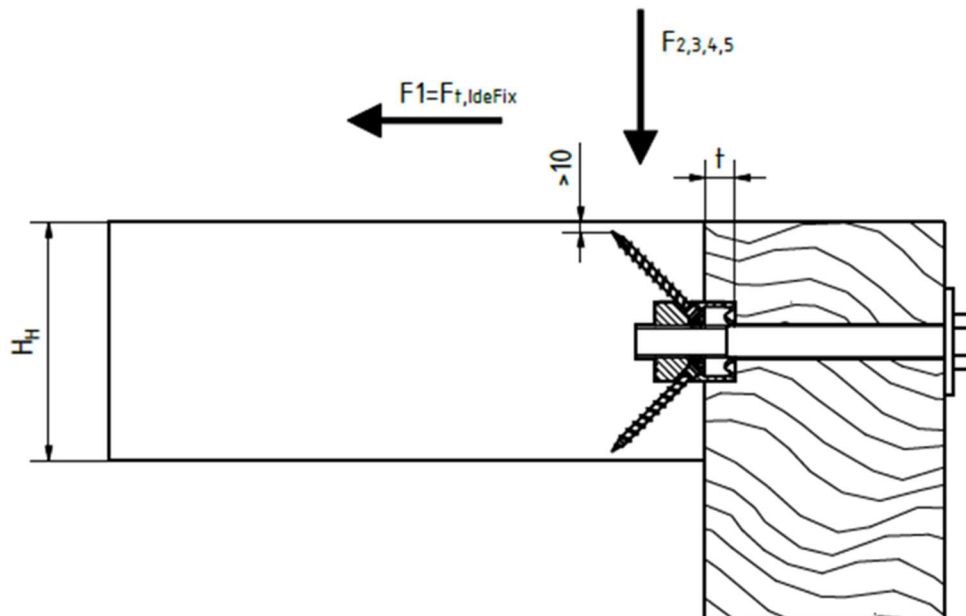
Hexagon screw with shank or threaded bar M12, M16, M20

washer – DIN 440

ldeFix – Connector
series IF300, IF400, IFS00

IfeFix	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,
d etails**

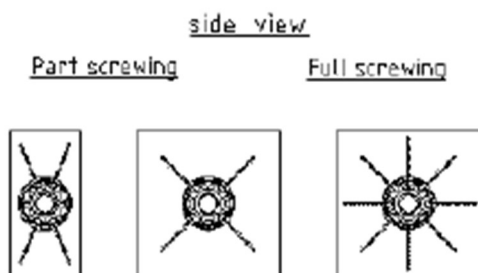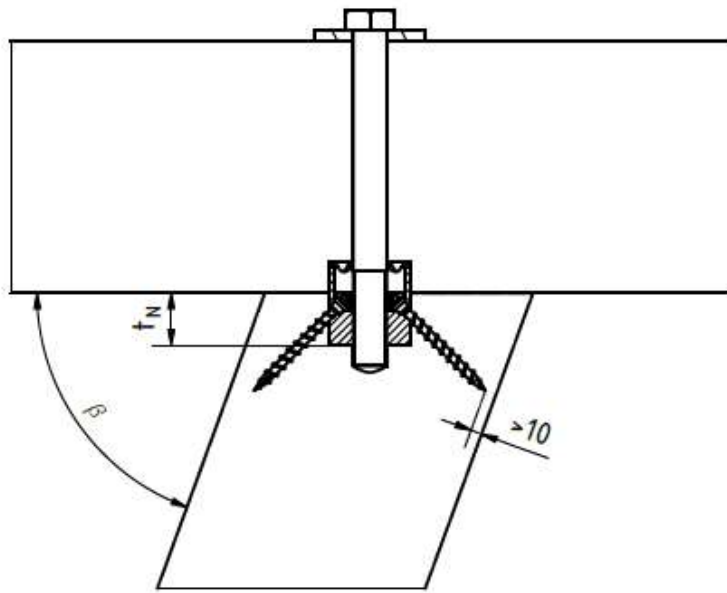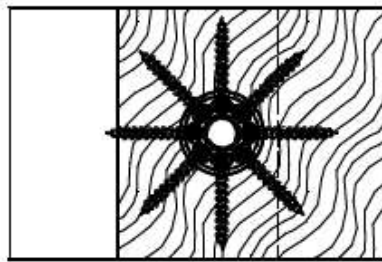| IdeFix	Subbeam	Mainbeam [t]
IF 300	20 mm	10 mm
IF 400	25 mm	15 mm
IF 500	30 mm	20 mm
IFD 500	25 mm	15 mm

Figure 11: Secondary beam to Mainbeam connection, details

Top view

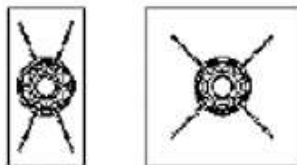t_N – mounting depth of the 1deFix
connector –sub beam

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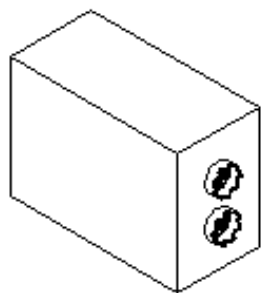threaded bar   M12, M16, M20

washer – DIN 440

1defix – Connert or
series IF300, IF400, IFSOO

Part screwing
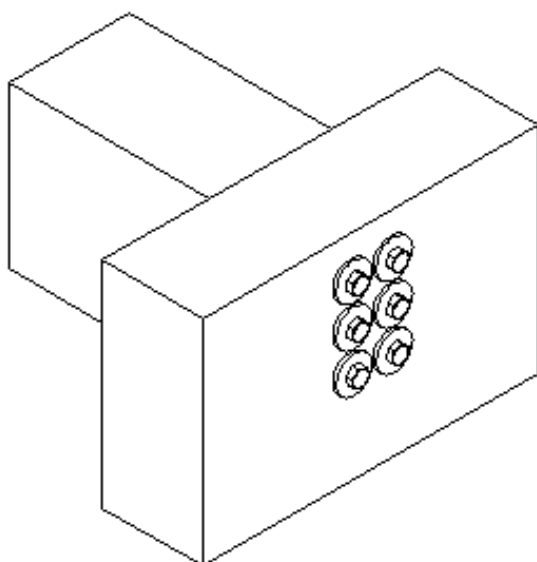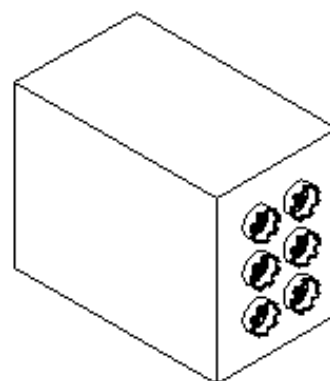
$45° < \square < 90°$

Fjgure 12: Subheam to Mainbeam connection- angle, details

Main- Subbeam
multiple port
single row

Main- Subbeam
multiple port
douple multi row

Main- Subbeam
multiple port
finished connection

Figure 13: Multiple port connection
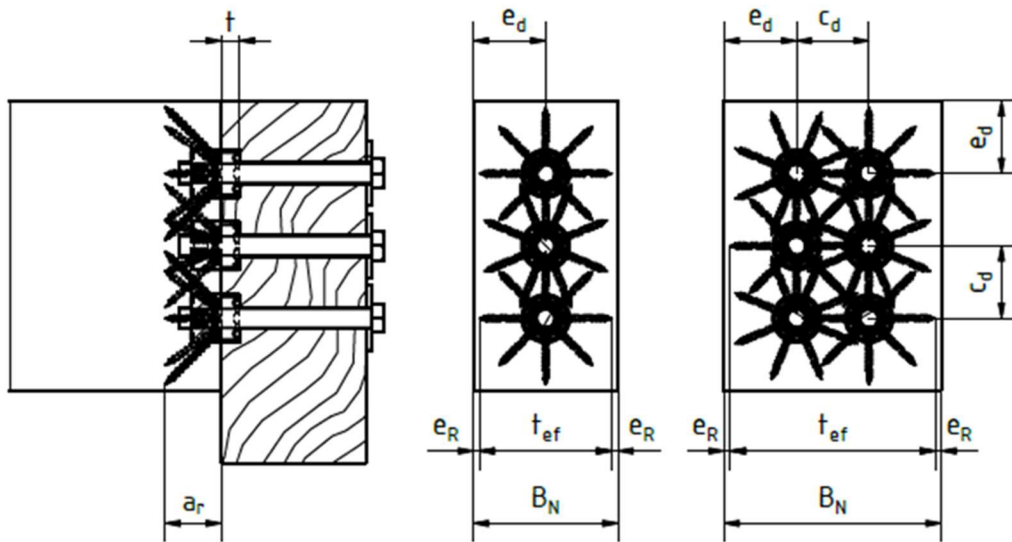
IdeFix	subbeam	mainbeam
IF 300	20 mm	10 mm
IF 400	25 mm	15 mm
IF 500	30 mm	20 mm
IFD 500	25 mm	15 mm

IdeFix	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: IdeFix IFS

1. IdeFix IFS product details, definitions and installation
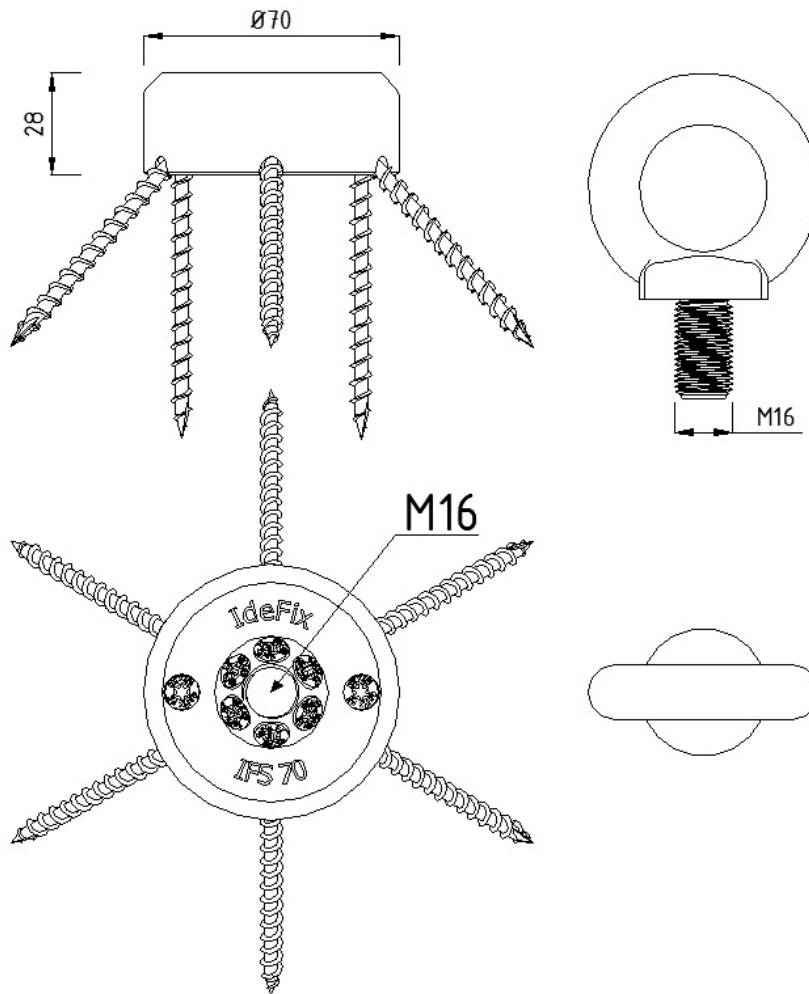
Figure 15: IdeFix IFS
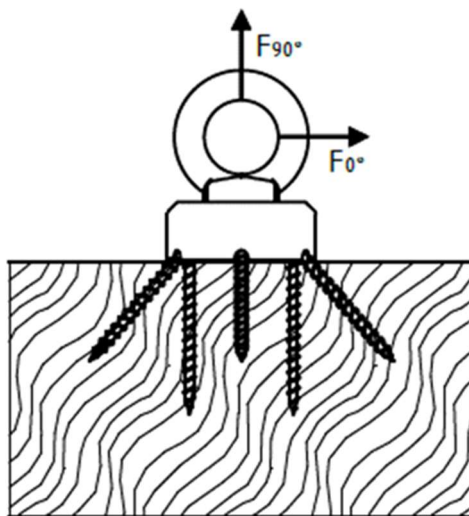
Figure 16: IdeFix IFS loading

Table 5: IdeFix IFS geometry, screws

IdeFix® IFS Ø	GoFix HK ETA-11/0425
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.

Ø70 $^{+0}_{-0,5}$

Ø31

IdeFix

IFS 70

B

A

A

B

49

IdeFix

IFS 70

A – A

49

5

45°

R2

1 X 45°

Ø6,5 $^{+0}_{-0,2}$

1

B – B

Ø10

24,6

1

28

1

Ø6,5 $^{+0}_{-0,2}$

90°

M16 Innengewinde

Index	Änderung und Ergänzung	Datum	Name	Allgemein-Toleranz ISO 2768 mittel/K	Maßstab:		Format:	A4
					Datum:		Name:	
				Gez.:				
				Gepr.:				

SIHGA Handels GmbH
Gewerbepark Kleinreith 4
A-4694 Ohlsdorf bei Gmunden
Tel: +43 (0) 7612-7430 Fax: DW 10
info@sihga.com

Material:

Bezeichnung:

IdeFix IFS 70

Zeichnungs Nr.: | Index:
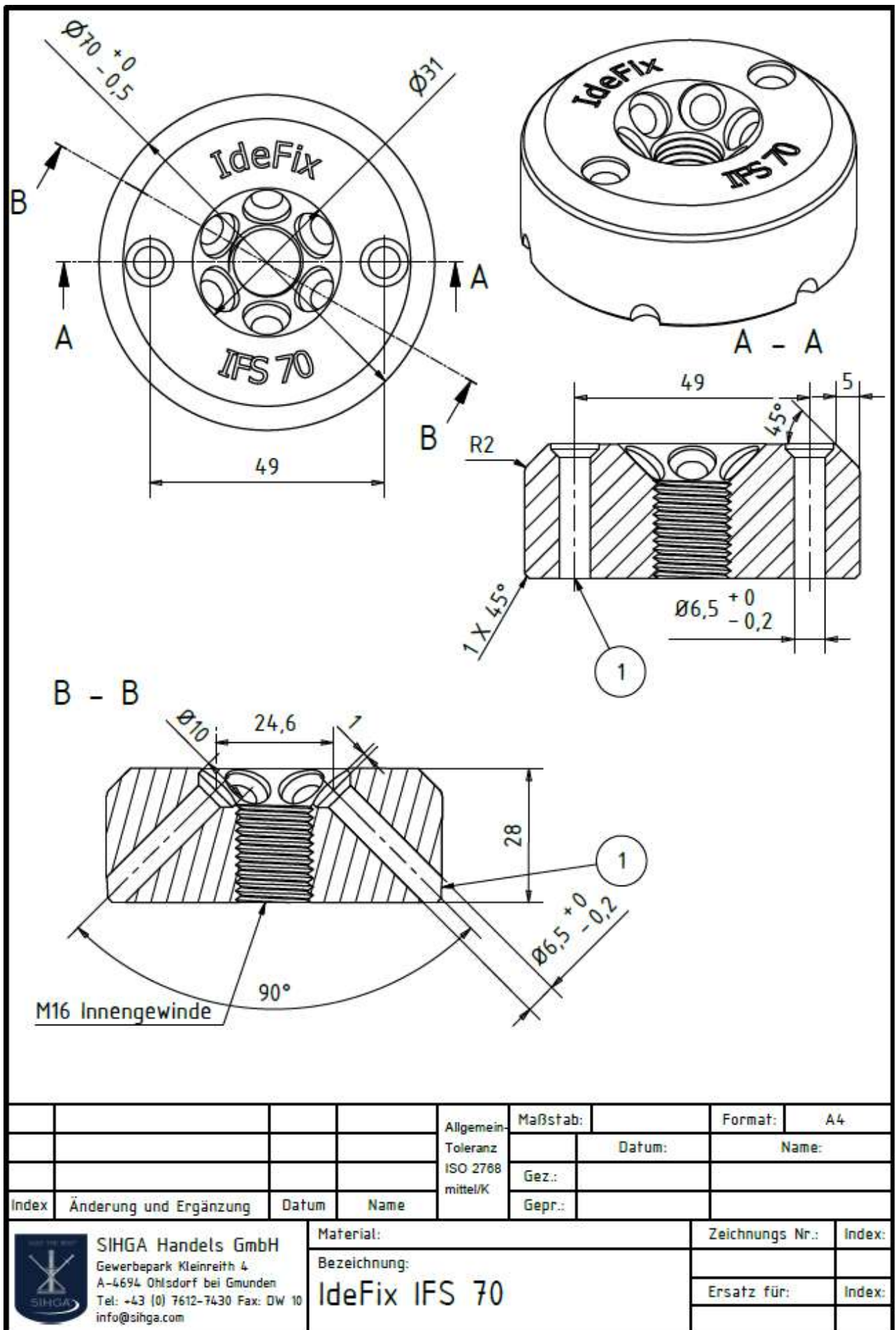
Ersatz für: | Index:

Figure 17: IdeFix IFS, details

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

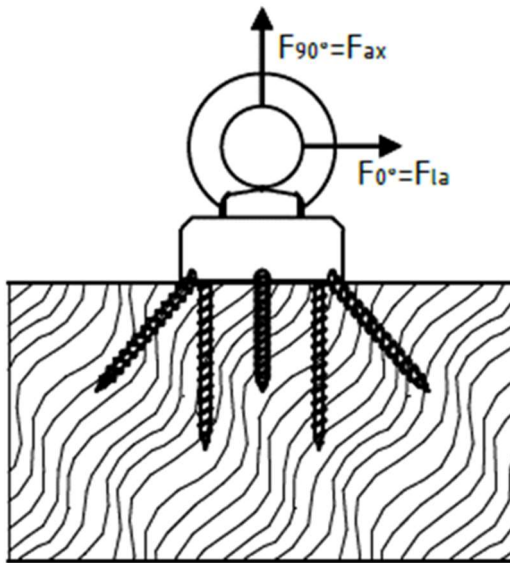**Figure 18: IdeFix IFS loading**

Axial withdrawal resistance

$$F_{ax,IdeFixIFS} = 6 \cdot (F_{45°,ax,Rk} + F_{45°,la,Rk}) \cdot \cos(45°)$$

with $F_{45°,ax,Rk}, F_{45°,la,Rk}$ for screws GoFix HK, properties and design according ETA-11/0425. Without taking in account the rod-effect for $F_{la,\alpha,Rk}$.

Load-carrying capacity for shearing forces

$$F_{la,IdeFixIFS} = 2 \cdot (F_{45°,ax} + F_{45°,la}) \cdot \cos(45°)$$

Combined loading

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

Characteristic values for IdeFix IFS made of carbon steel according to ETA-11/0425 and timber grade C24

$$F_{ax,IdeFixIFS,k} = F_{ax,Rk} = 25,5 \; kN$$

$$F_{la,IdeFixIFS,k} = F_{v,Rk} = 8,5 \; kN$$

$$F_{45°,Rk} = 11,4 \; kN$$

Annex C: ZaFix ZF

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

1.1 Loading in tension of ZaFix ZF

$$F_{ZaFix,\emptyset30mm,ax,Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5{,}70 \ kN; \qquad\qquad F_{ZaFix,\emptyset40mm,ax,Rk} = \frac{\rho_k}{350kg/m^3} \cdot 5{,}70 \ kN$$

$$F_{ZaFix,\emptyset30mm,C24} = 5{,}70 \ kN; \qquad\qquad F_{ZaFix,\emptyset40mm,C24} = 5{,}70 \ kN$$

$$K_{ser,ZaFix,\emptyset30mm} = \frac{\rho_k}{350kg/m^3} \cdot 23{,}0 \ kN/mm; \qquad K_{ser,ZaFix,\emptyset40mm} = \frac{\rho_k}{350k \ / \ 3} \cdot 23{,}0 \ kN/mm$$

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}

⌀ 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 ⌀30 mm	11,5 kN	3,74 kN/mm
ZaFix ⌀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: $\frac{F_{ax,Ed}}{F_{ZaFix,t,Rd}} + \frac{F_{V,Ed}}{F_{ZaFix,V,Rd}} \leqslant 1{,}0$

2. ZaFix ZF product details, definitions and installation

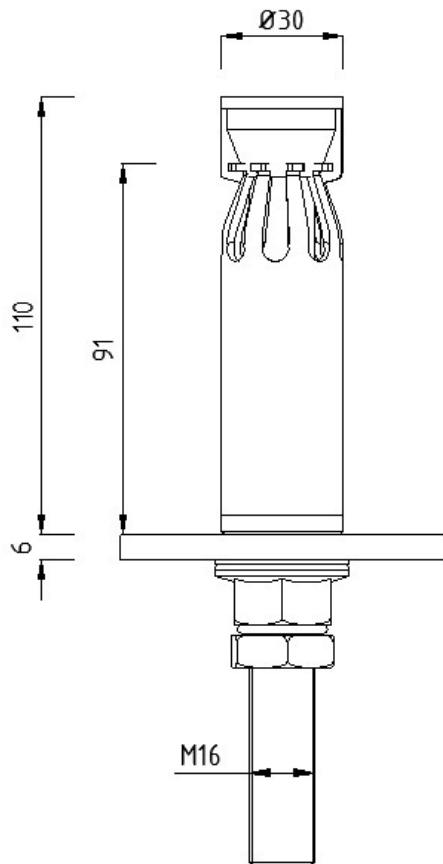ZaFix connector is used only as assembled kit with post base.
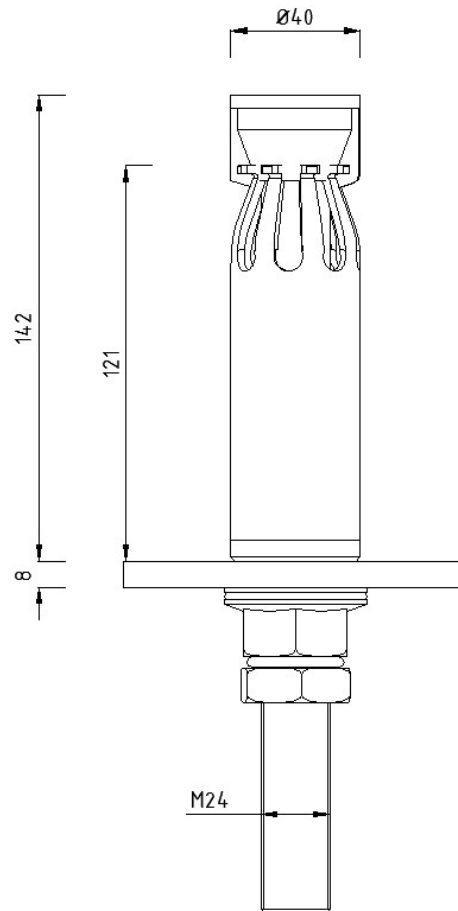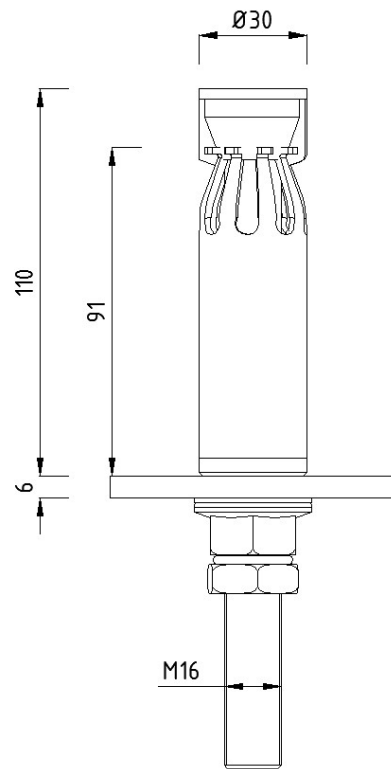
Figure 19: ZaFix ZF d=30   Figure 20: ZaFix ZF d=40

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 Ø30mm or t=2,0 mm for ZaFix Ø40mm.

→ 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
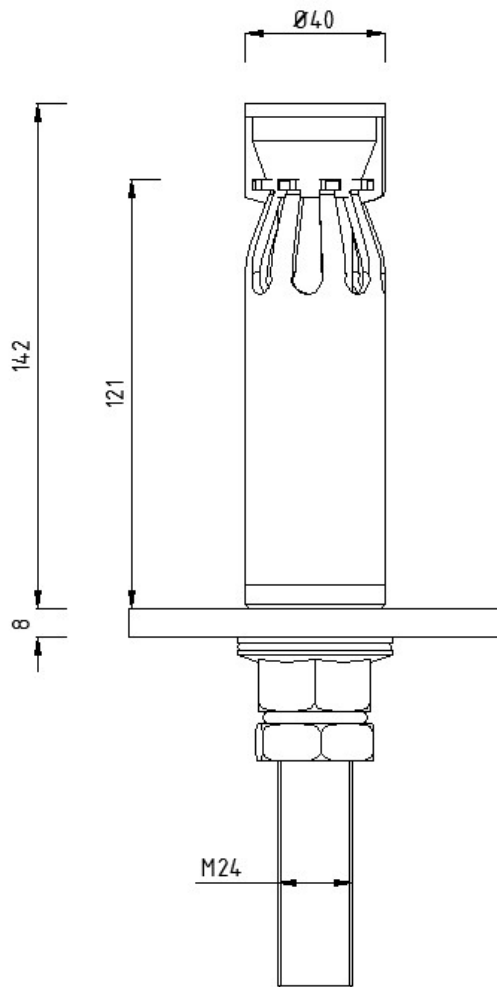
→ threaded rod with expand conus M24

→ 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 IdeFix IF or ZaFix have to be verified according to Annex A or Annex C respectively.

1.1 Post-bases loaded in tension

IdeFix 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

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

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

- $F_{c,k,modeb} \leqslant f_y \cdot A_{tube}$ 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.

- IdeFix: $F_{c,k} = f_{c,0} \cdot \pi/4 \cdot d_a^2$

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

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

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

The verification has to done for IdeFix 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

$\dfrac{N_{Ed}}{F_{post-base,c,Rd}} + \dfrac{M_{Ed}}{M_{c,Rd}} \leqslant 1$ with $F_{post-base,c,Rd}$ according to annex D 1.3 and $M_{c,Rd}$ according to 1.2
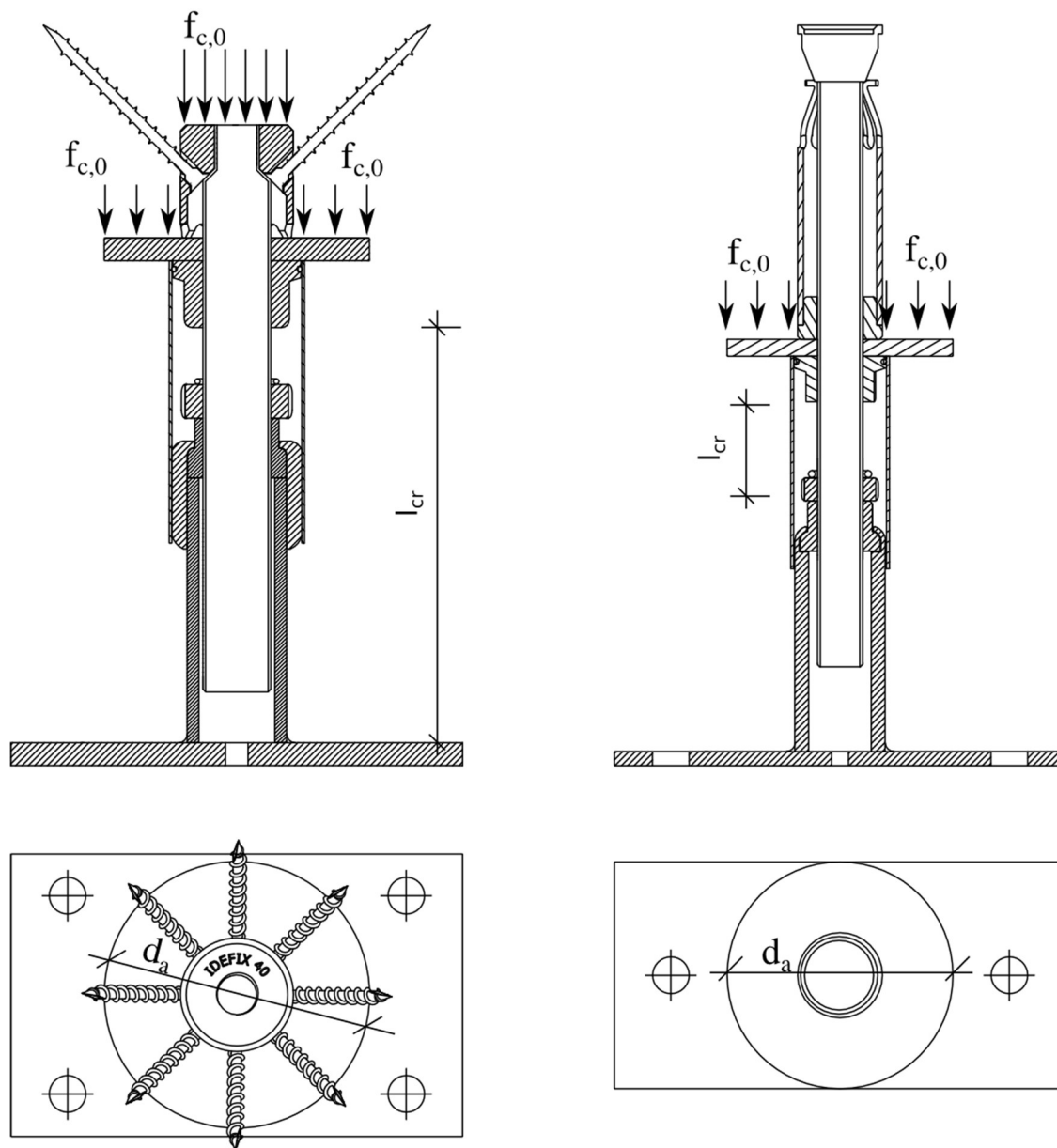
Figure 23: post bases IdeFix STF and ZaFix STZ 300, 400,700, buckling length and compressive stresses

2. **Post bases product details, definitions and installation**

→ IdeFix IF 304, GoFix HK 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

→ Pre - tensioned nut

→ Stand tube Ø 32 mm (wall thickness 5,0 mm)

→ Support plate

1. 125 – 160 mm (STF 330, 331, 339)
2. 165 – 200 mm (STF 332)
3. 205 – 240 mm (STF 333)

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

→ IdeFix IF 406, GoFix HK 6,0 x 60 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M20 with O-ring

→ Stainless cap

→ O –ring

→ Threaded rot M20

→ Counter nut M20

→ Pre - tensioned nut

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

→ Support plate

1. 170 – 220 mm (STF 442, 449)
2. 220 – 270 mm (STF 443)
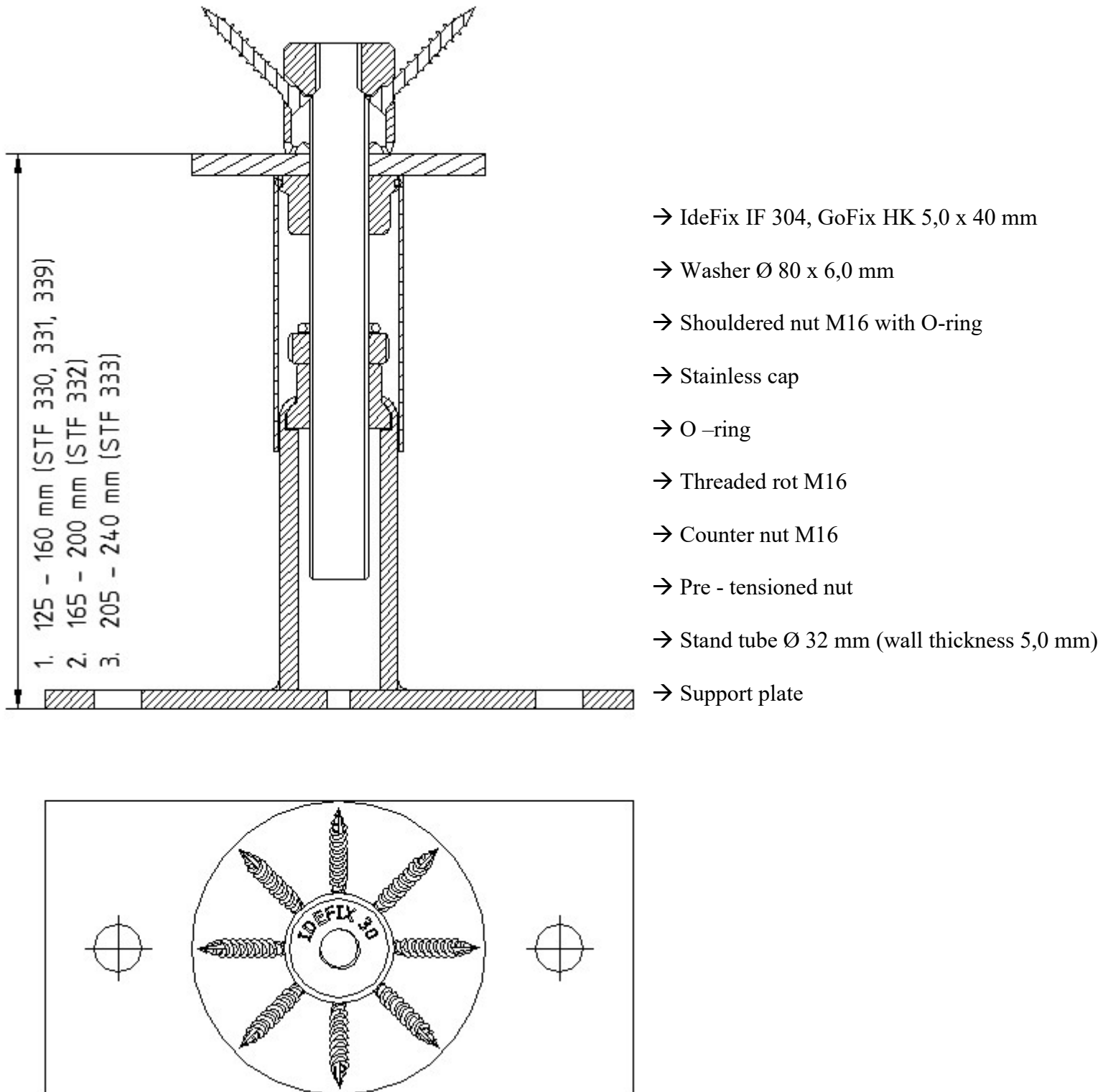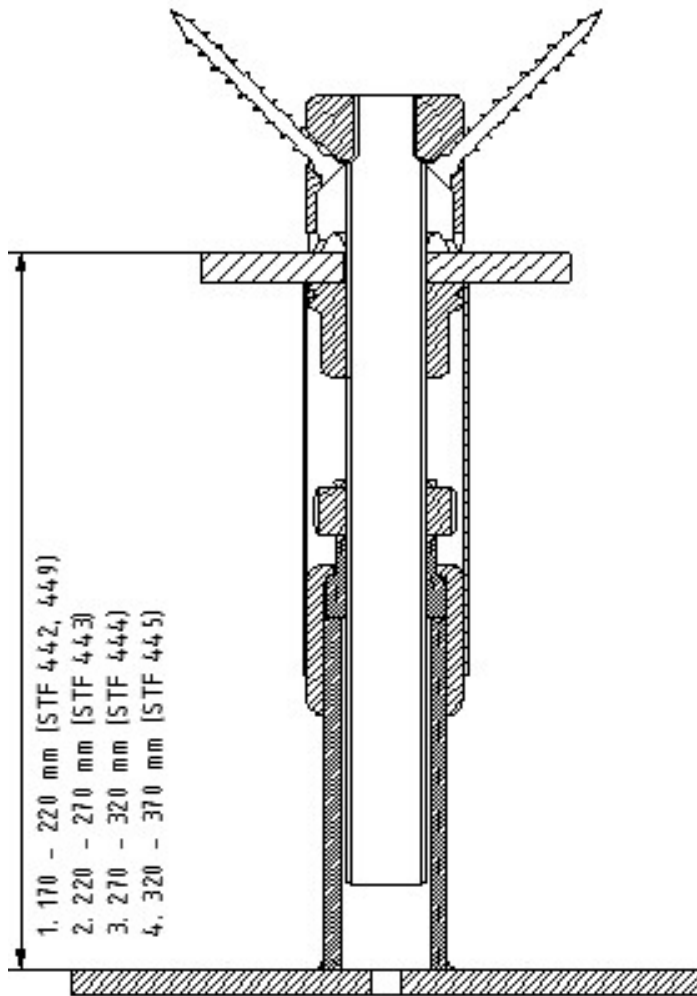3. 270 – 320 mm (STF 444)
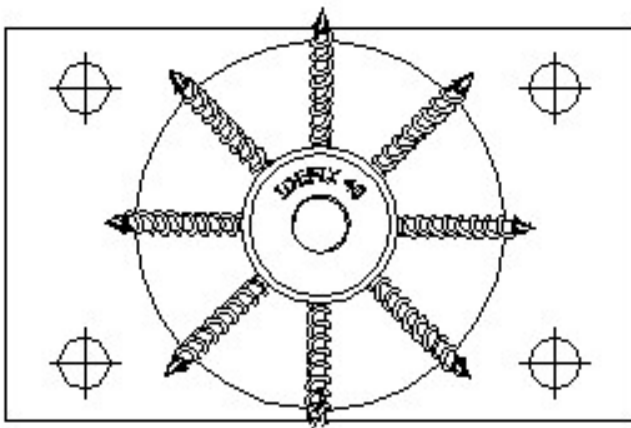4. 320 – 370 mm (STF 445)

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

→ IdeFix IF 408, GoFix HK 6,0 x 80 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M24 with O-ring

→ Stainless cap

→ O –ring

→ Threaded rot M24

→ Counter nut M24

→ Pre - tensioned nut

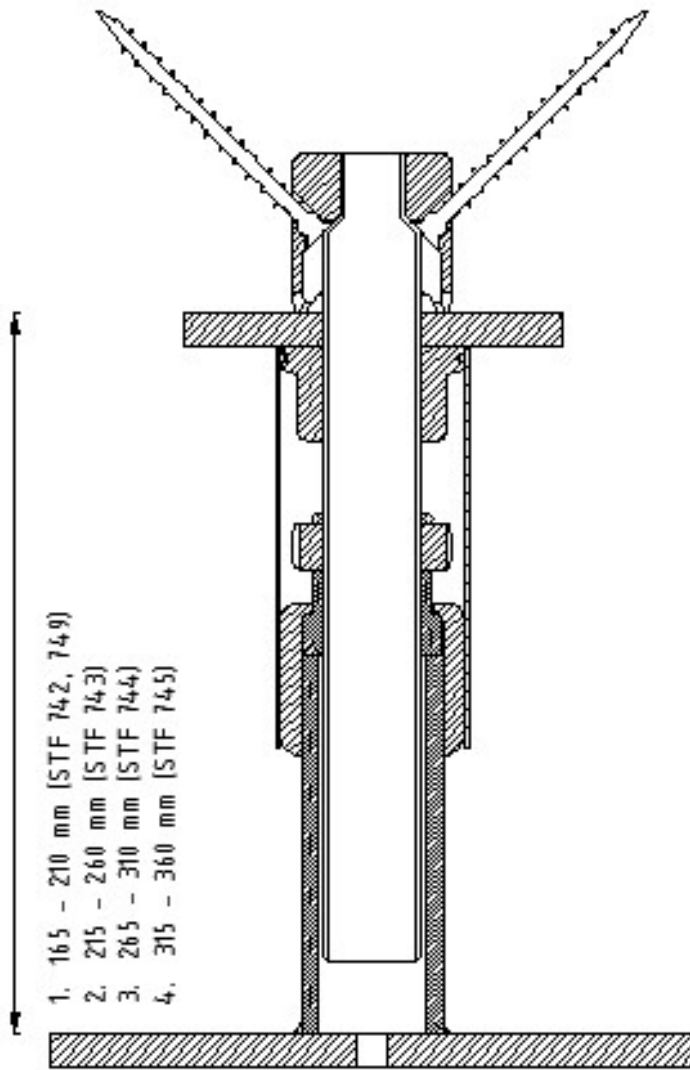→ Stand tube Ø 38 mm (wall thickness 3,25 mm)

→ Support plate

1. 165 – 210 mm (STF 742, 749)
2. 215 – 260 mm (STF 743)
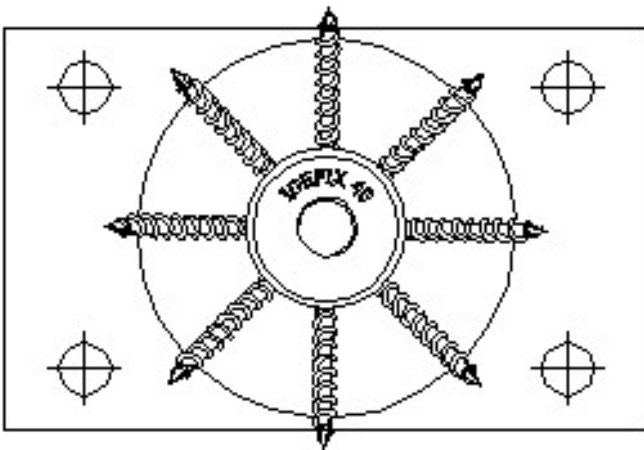3. 265 – 310 mm (STF 744)
4. 315 – 360 mm (STF 745)

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

→ IdeFix IF 304, GoFix HK 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 IdeFix IF

→ IdeFix IF 304, GoFix HK 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)

→ Tube to embed in concrete Ø 21,3
   (wall thickness 2,65 mm)

160 – 195 mm (STF 338)

200 mm
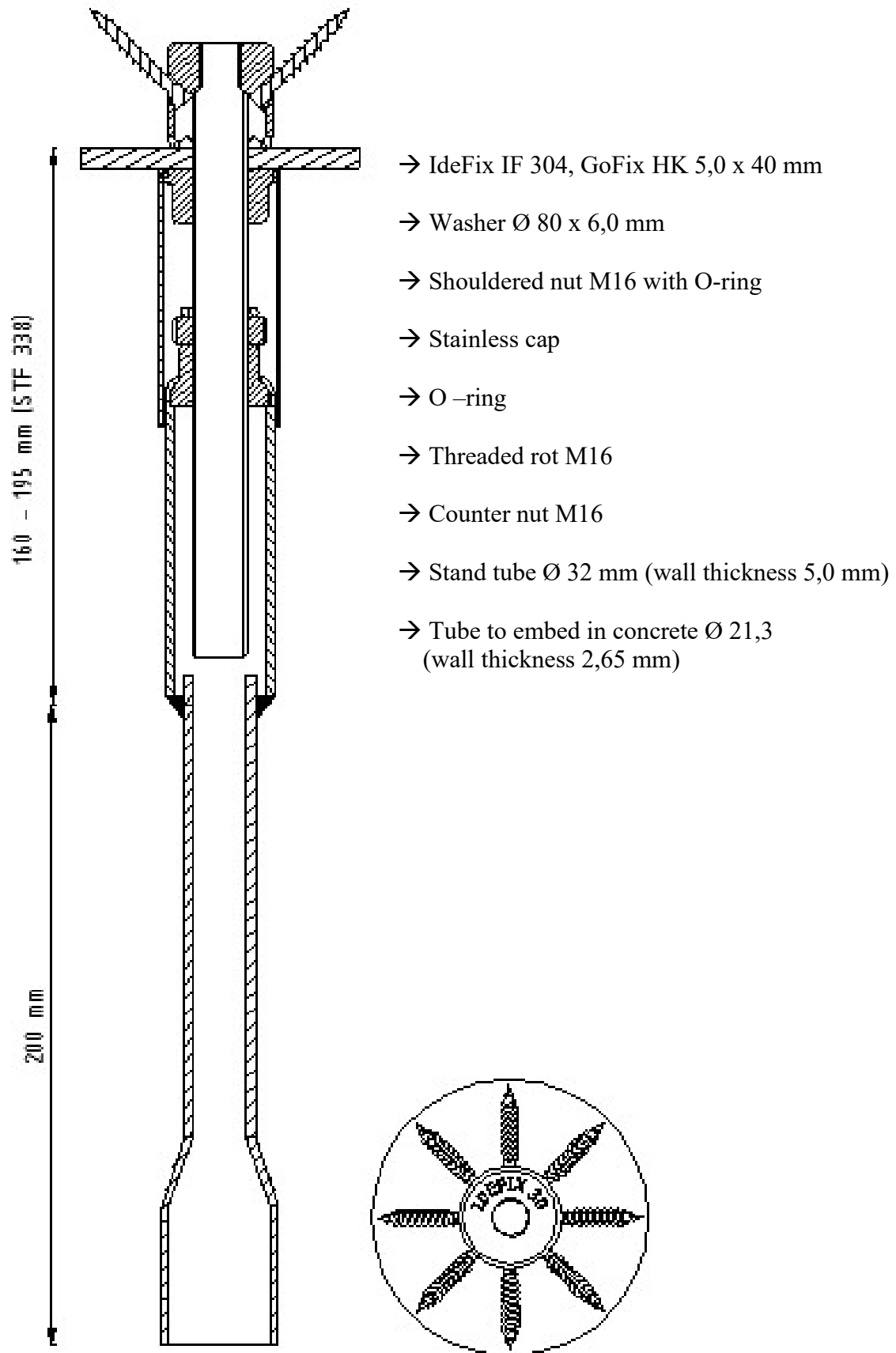
Figure 28: STF /STZ 338 with IdeFix IF or ZaFix ZF

→ IdeFix IF 304, GoFix HK 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

160 – 195 mm (STF 336)

M12 8.8
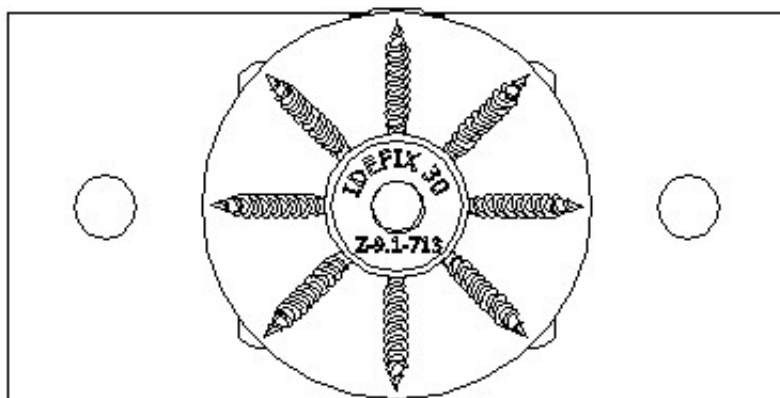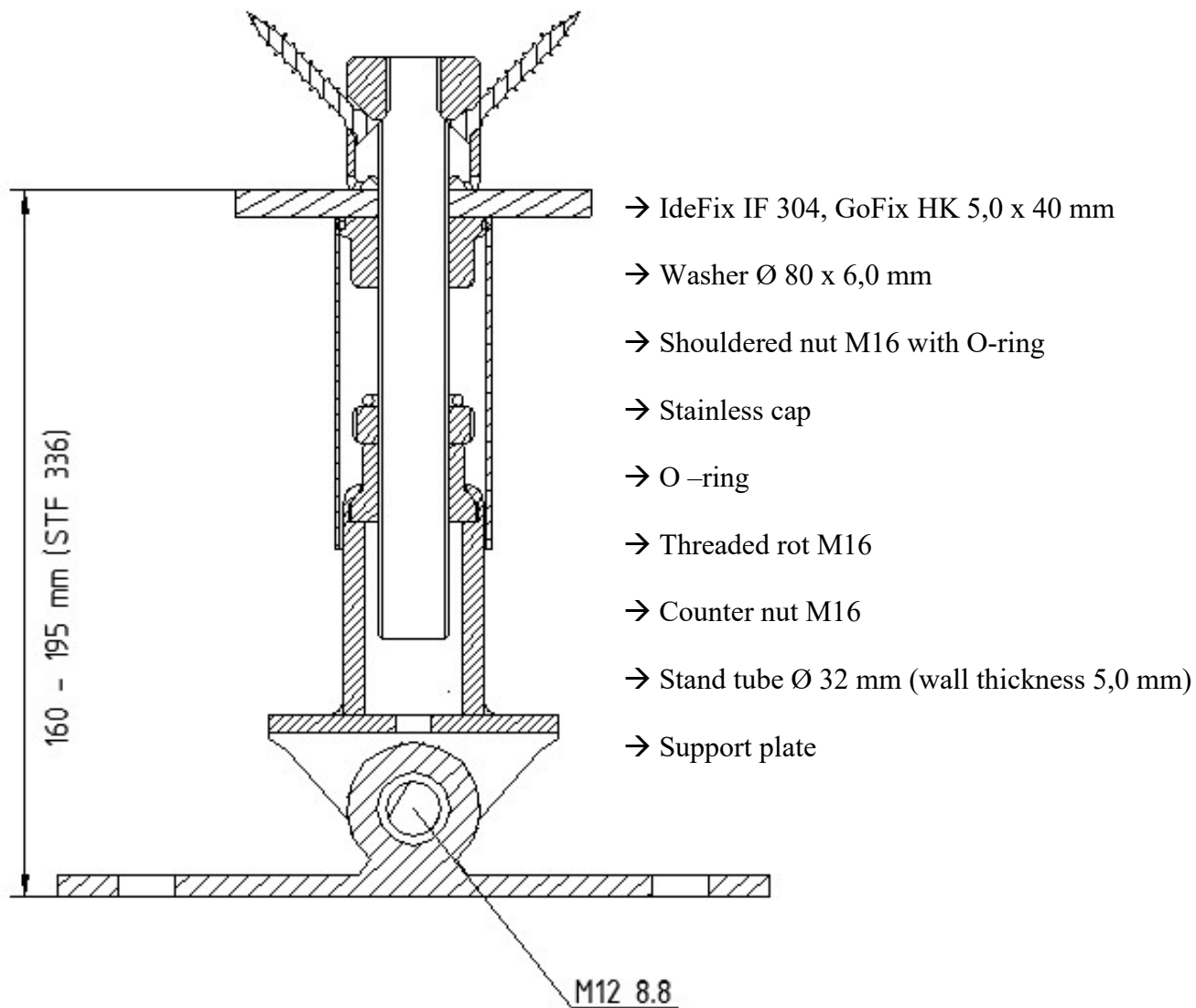
Figure 29: STF /STZ 336 with IdeFix IF or ZaFix ZF

→ IdeFix IF 406, GoFix HK 6,0 x 60 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M20 with O-ring

→ Stainless cap

→ O –ring

→ Threaded rot M20

→ Counter nut M20

→ Pre - tensioned nut

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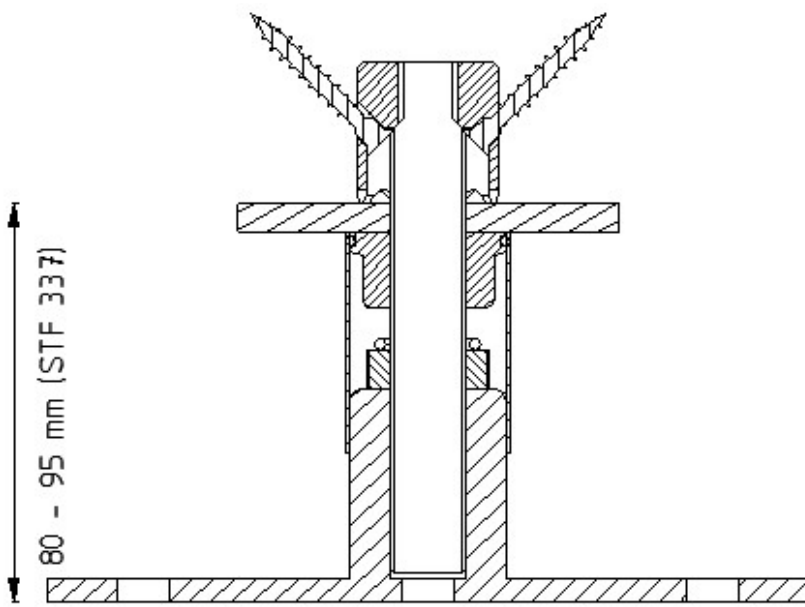
→ Support plate

200 – 250 mm (STF 446)

M12 8.8
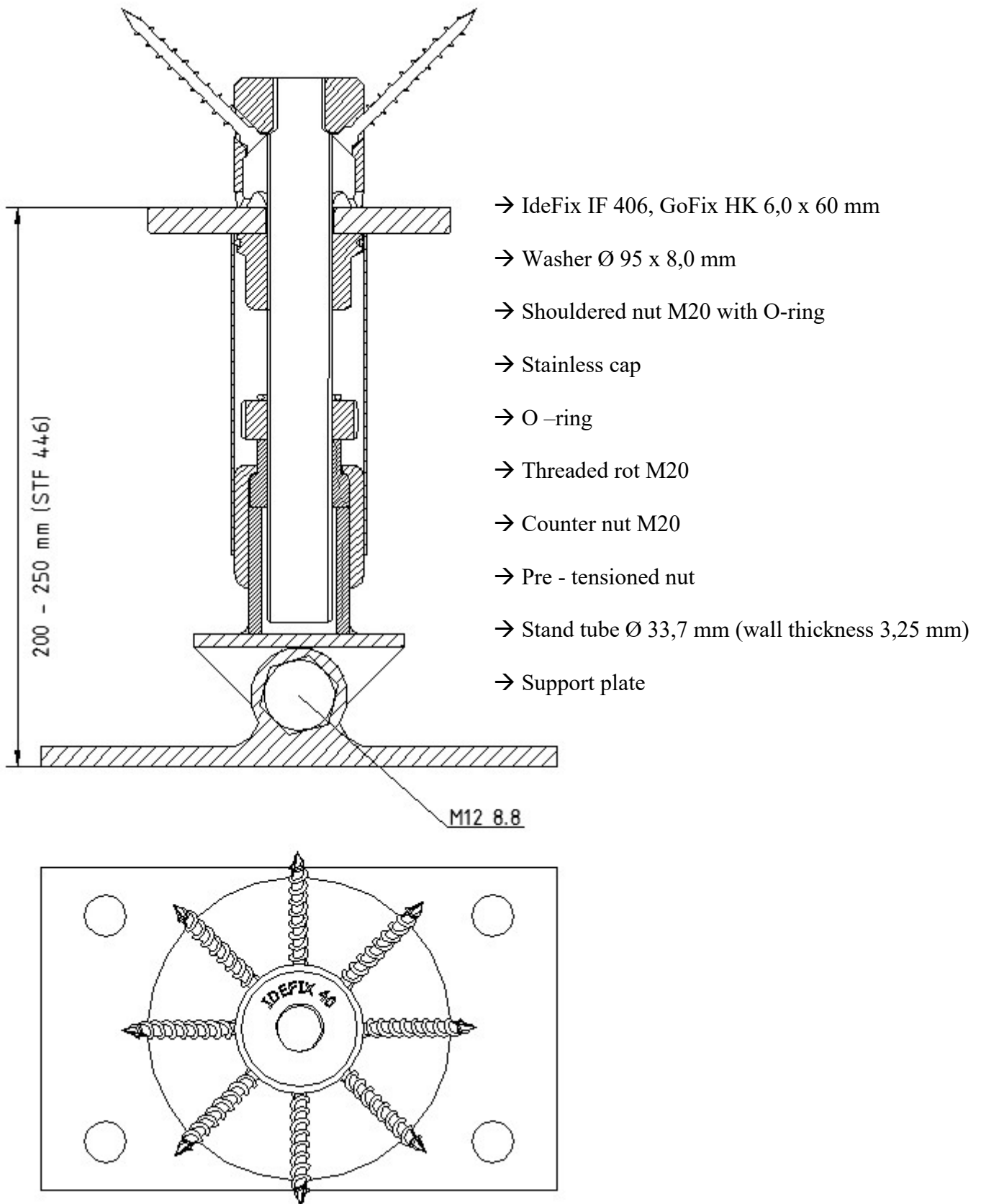
Figure 30: STF /STZ 446 with IdeFix IF or ZaFix ZF

→ IdeFix IF 408, GoFix HK 6,0 x 80 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M24 with O-ring

→ Stainless cap

→ O –ring

→ Threaded rot M24

→ Counter nut M24

→ Pre - tensioned nut

→ Stand tube Ø 38 mm (wall thickness 3,25 mm)

→ Support plate

200 – 250 mm (STF 746)

M12 8.8
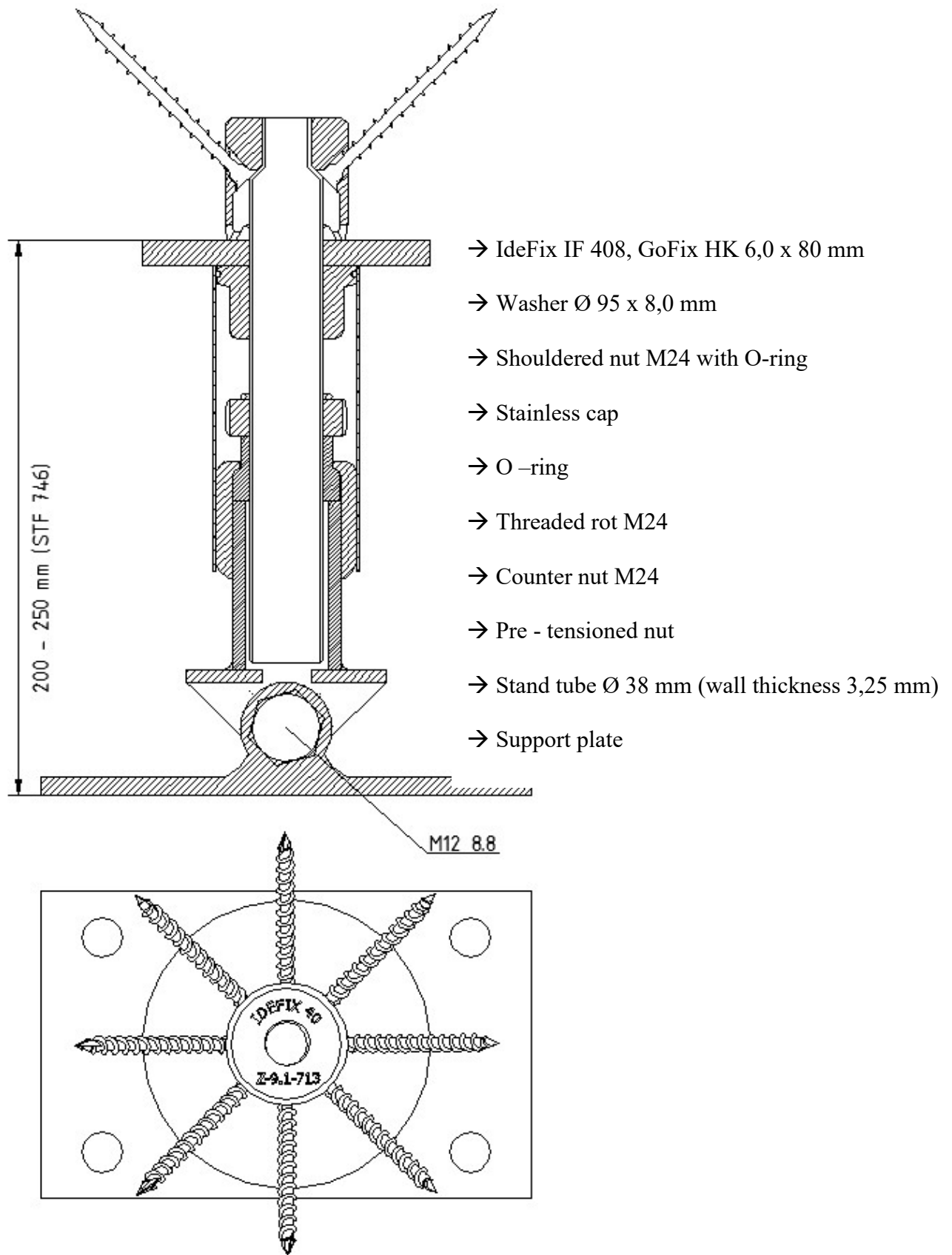
Figure 31: STF /STZ 746 with IdeFix IF or ZaFix ZF

→ IdeFix IF 406, GoFix HK 6,0 x 60 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M20

→ Threaded rot M20
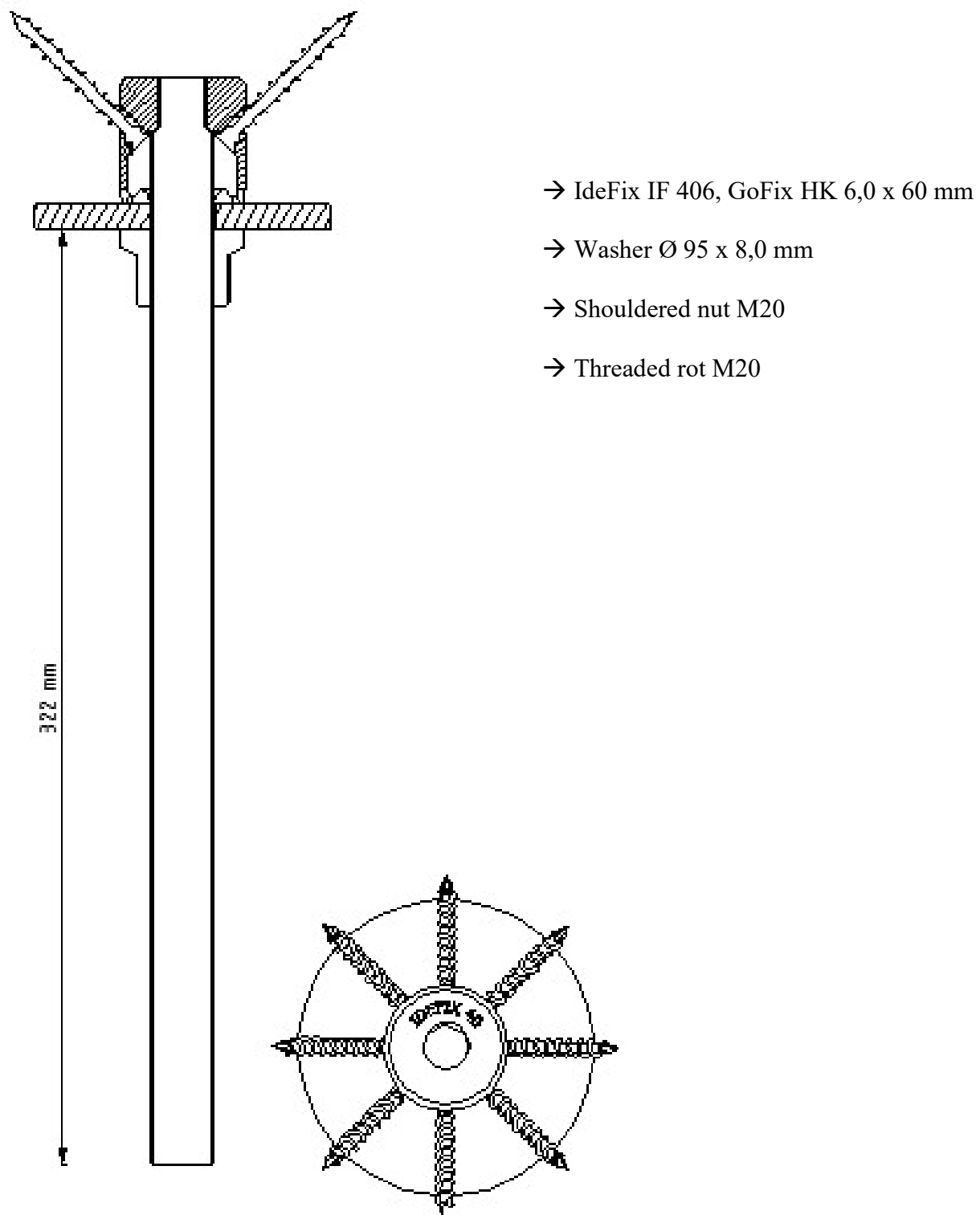
Figure 32: STF 448 with IdeFix IF

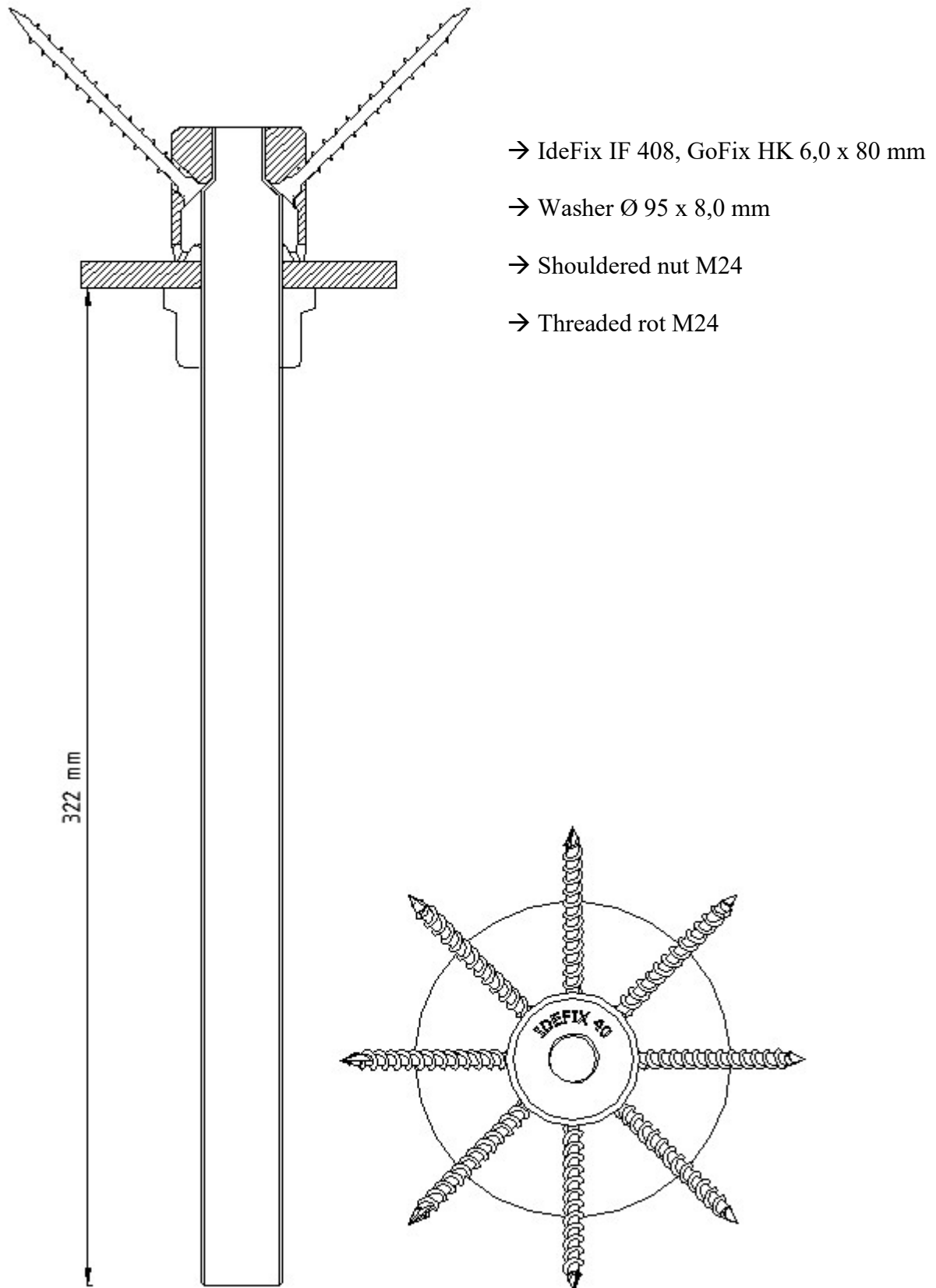→ IdeFix IF 408, GoFix HK 6,0 x 80 mm

→ Washer Ø 95 x 8,0 mm

→ Shouldered nut M24

→ Threaded rot M24

Figure 33: STF 748 with IdeFix IF

→ IdeFix IF 509, GoFix HK 8,0 x 90 mm

→ Washer Ø 120 x 10,0 mm

→ Threaded rot M20

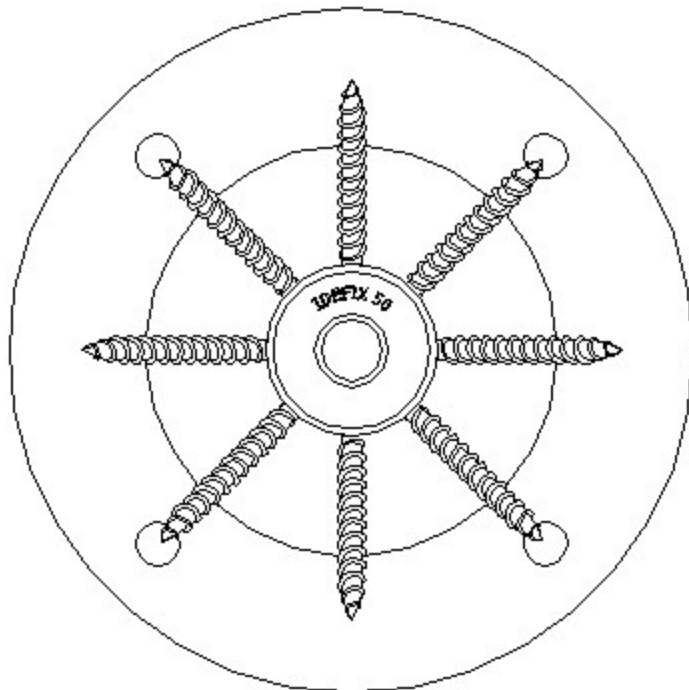→ Stand pipe Ø 60,3 mm (wall thickness 4,5 mm)
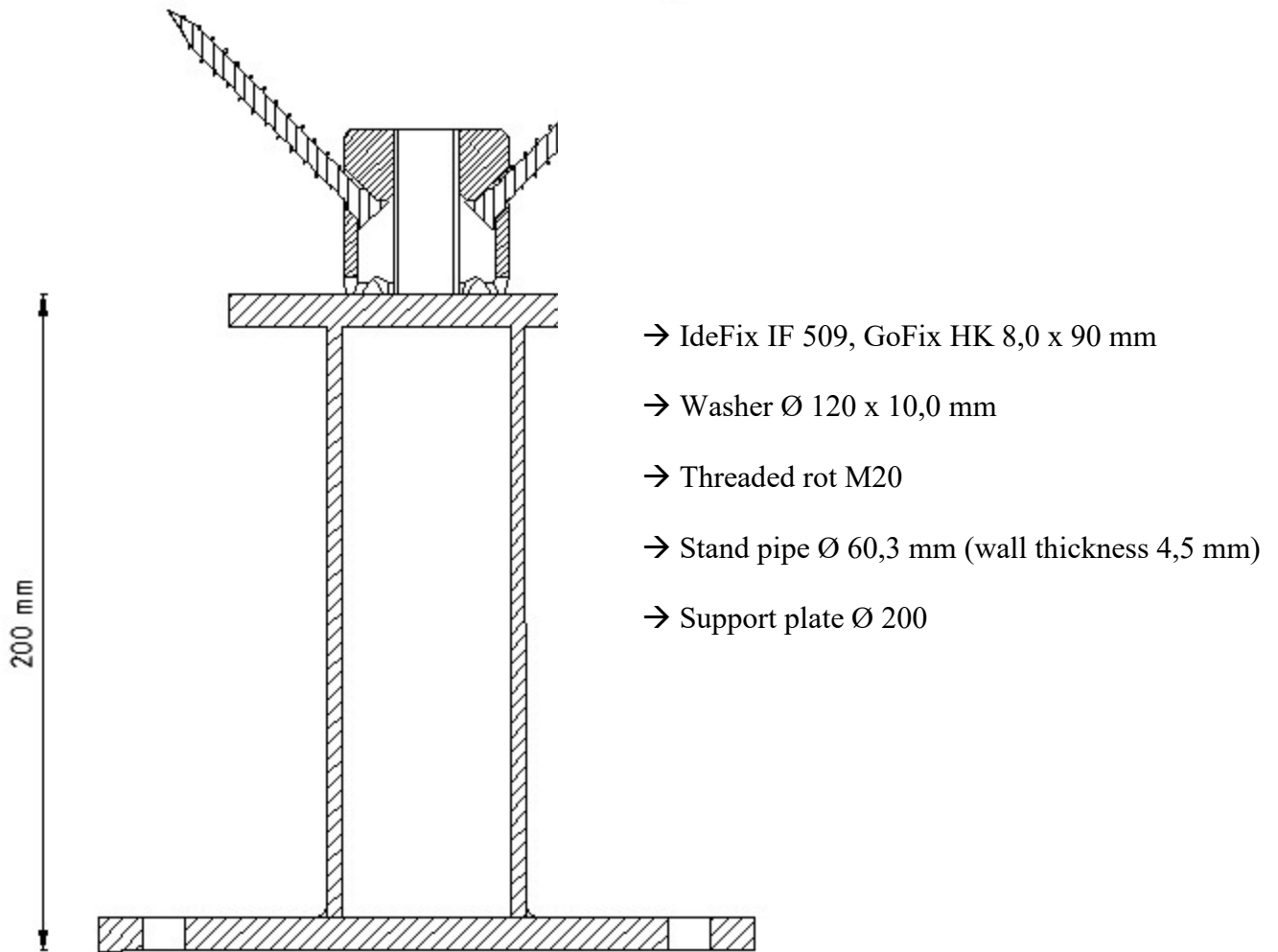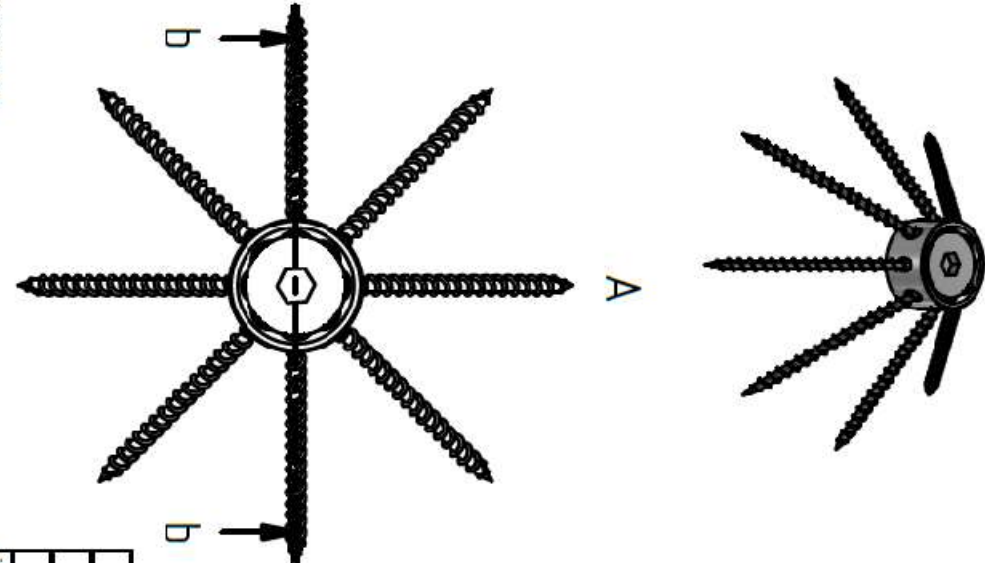
→ Support plate Ø 200

200 mm
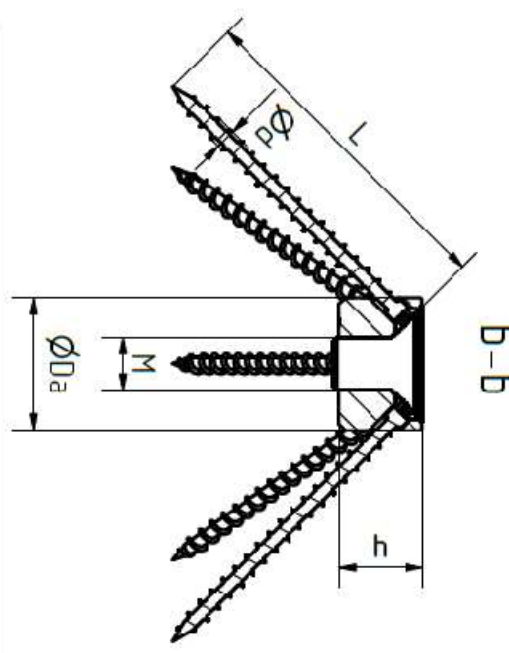
Figure 34: STF 952 with IdeFix

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

IdeFix 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

index | change and addition | date | name

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Tel: +43 7612-74370 0
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material: mittel/K
designation: IdeFix DwD

general-tolerances ISO 2768
drawn: 05.11.2019
appr.:
scale:
format:
name:
drawing number: index:
replacement for: index:

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 GoFix HK
   according to ETA-11/0425
C) M12;M16 centred to fix the head
   of the timber screws
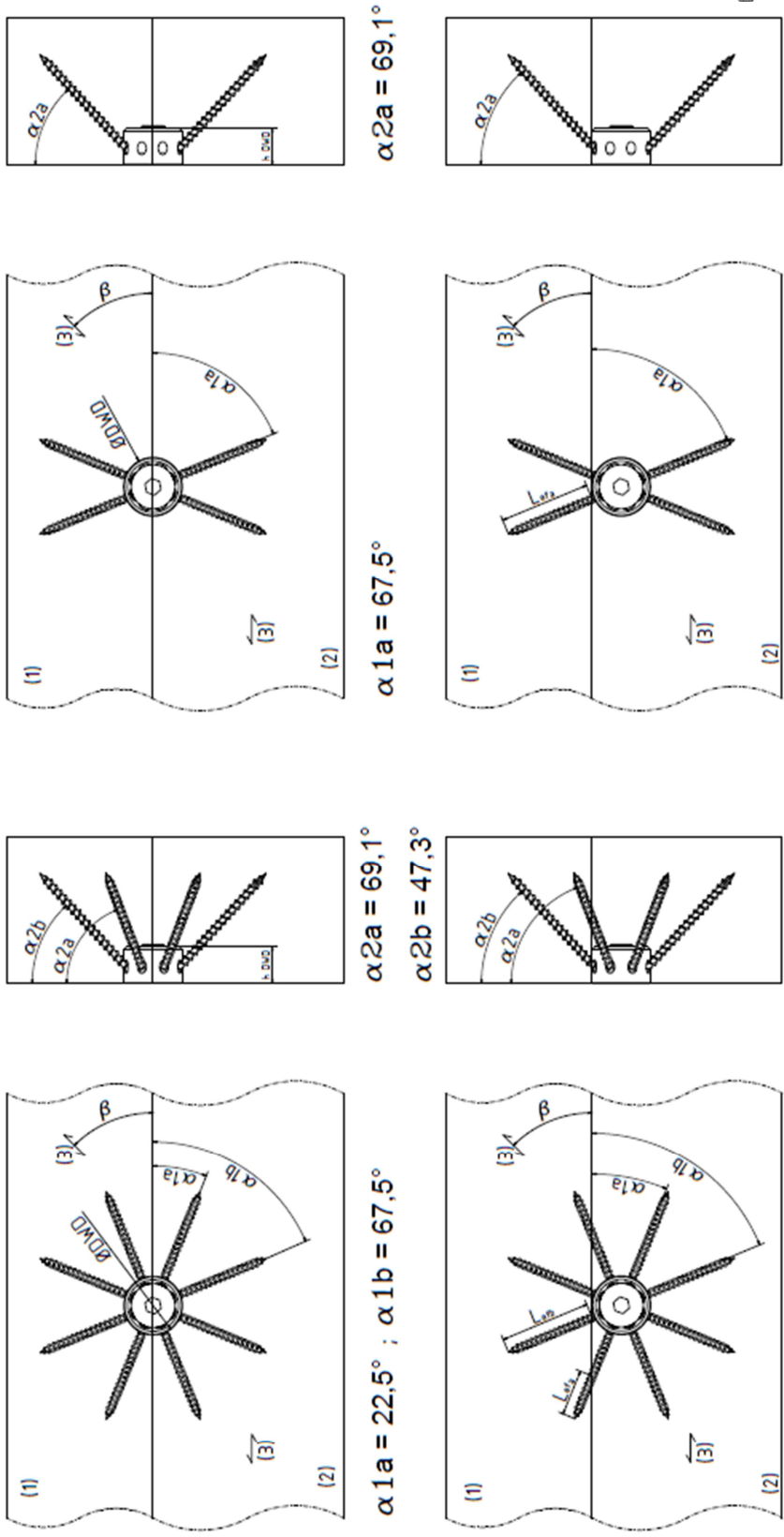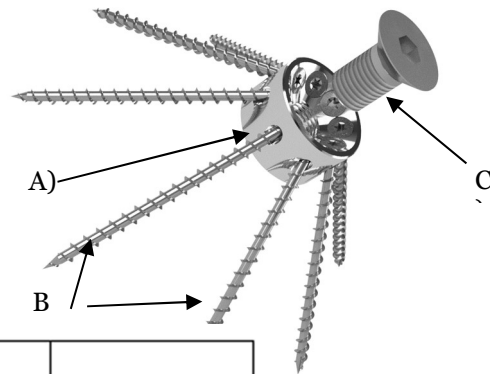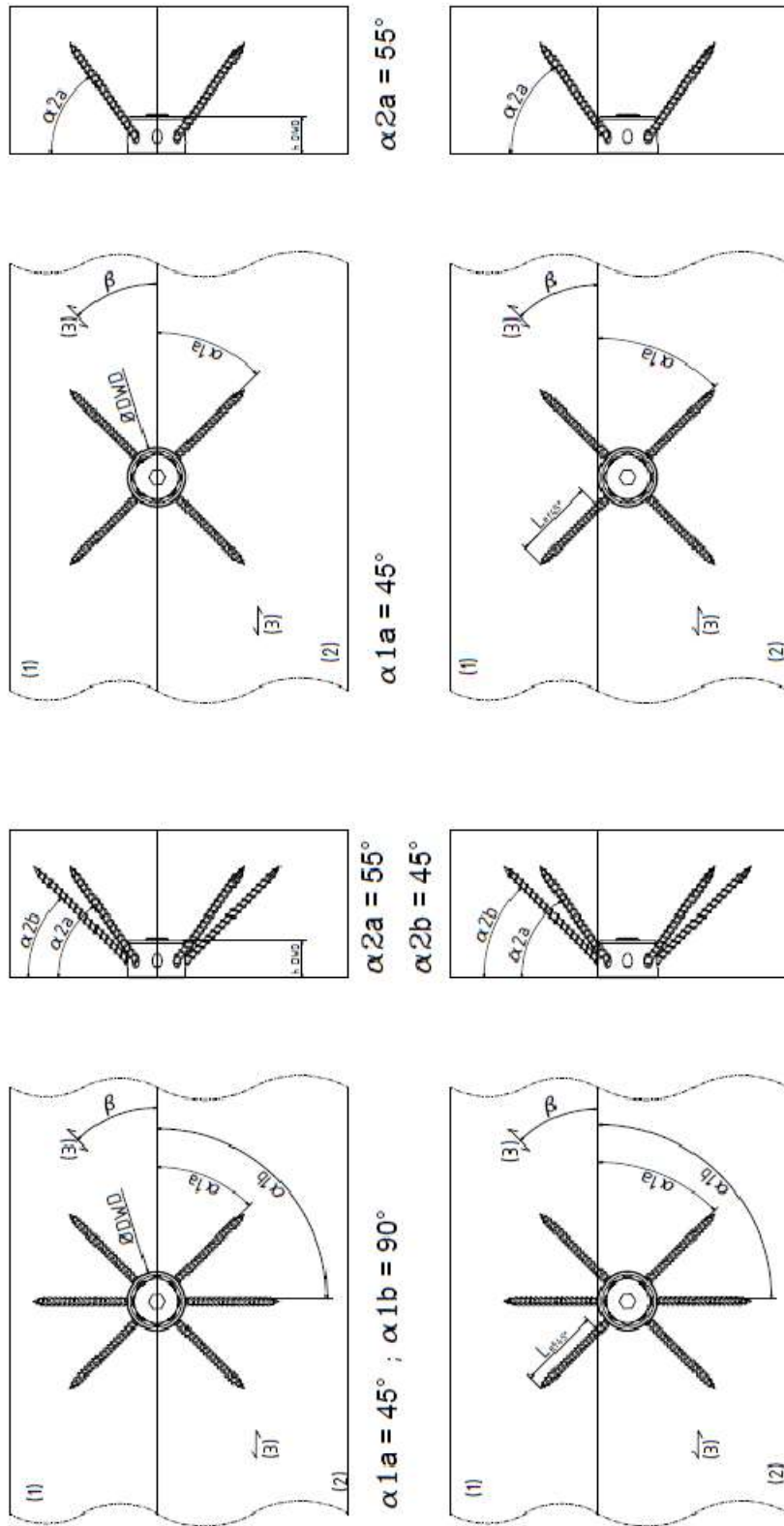
Figure 35: Possible arrangements of the IdeFix-DWD Connector and notations

Note: Due to the M12;M16 screw (C) (see figure 35) in the center of the DWD box (A) the GoFix HK 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-11/0425, 2017.

Abbreviations and parameters for the following calculation in Annex B

(1)	Timber element 1, see Figure
(2)	Timber element 2, see Figure
(3)	Grain direction, see Figure
d	Nominal diameter of the *GoFix HK* screw [mm]
d_{DWD}	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,a,k}$	Characteristic embedment strength, considering load-grain direction [N/mm²]
$f_{h,b,1,k}$	Characteristic embedment strength, considering load-grain direction, timber part 1 [N/mm²]
$f_{h,b,2,k}$	Characteristic embedment strength, considering load-grain direction, timber part 2 [N/mm²]
$f_{ax,k}$	Characteristic withdrawal capacity with

d [mm]	*GoFix HK* ETA-11/0425
4,0	$f_{ax,k} = 12,9\ N/mm^2$
5,0	$f_{ax,k} = 12,1\ N/mm^2$
6,0	$f_{ax,k} = 11,4\ N/mm^2$
8,0	$f_{ax,k} = 11,1\ N/mm^2$

L	Length of the the fully threaded *GoFix HK* screw [mm]
h_{DWD}	Penetration depth of the cylindrical steel part of the IdeFix-DWD [mm]
$R_{v,0,cen,k}$	Characteristic value of the shear strength of the cylindrical part of the IdeFix-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 IdeFix-DWD with centric assembling to the joint of the timber parts [N]
α_{1a}	Angle between screw and timber joint, see Figure
α_{1b}	Angle between screw and timber joint, see Figure
α_{2a}	Angle between load and screw axis, see Figure
α_{2b}	Angle between load and screw axis, see Figure
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/m³]
$\rho_{2,k}$	Characteristic gross density, timber part 1 [kg/m³]

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).

$$K_{ser} = 10,5 \text{ kN/mm}$$
$$R_{v,cen,k} = R_{v,0,cen,k} + R_{v,ax,k} \qquad (1)$$

α1a = 22,5° ; α1b = 67,5°

α2a = 69,1°
α2b = 47,3°

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

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

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

With

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

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

The axial capacity of the screws can be calculated with equation **Fejl! Henvisningskilde ikke fundet.**.

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

(5)

With the characteristic withdrawal capacity $F_{ax,Rk}$ for *GoFix HK* screws according to ETA-11/0425

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

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

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).

$$R_{v,ex,k} = R_{v,ax,k} \quad (7)$$
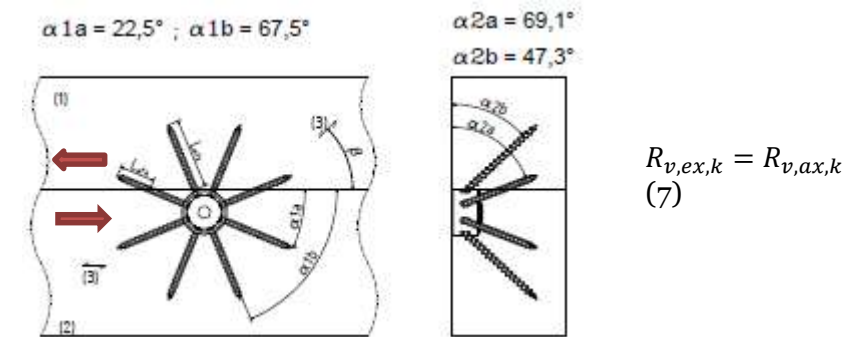
Figure37: Eccentric arrangement of the IdeFix DWD Connector, shear strength parallel to the timber joint

Solid Timber

With

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

and the equations in accordance to ETA-11/0425 for GoFix HK screws.

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

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

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK 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 GoFix HK screw [mm]
d_{DWD}	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm²]
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]

Angle	Effective length L_{ef} [mm] eccentric arrangement
α_{1a}	d_{DWD} 40; $L_{ef\,45°} = L - 24 > 0$
α_{1a}	d_{DWD} 30; $L_{ef45°} = L - 19 > 0$
α_{1a}	d_{DWD} 40; $L_{ef\,a} = L - 57 > 0$
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 IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$ Characteristic embedment strength, considering load-grain direction [N/mm²]
h_{DWD} Penetration depth of the IdeFix-DWD Connector [mm]
$R_{v,ax,k}$ Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$ Characteristic shear strength of the IdeFix-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 IdeFix-DWD Connector with $\alpha_{load}=0°$ [N]
k_{ax} Coefficient to consider the angel between crew axis and grain-direction [-]
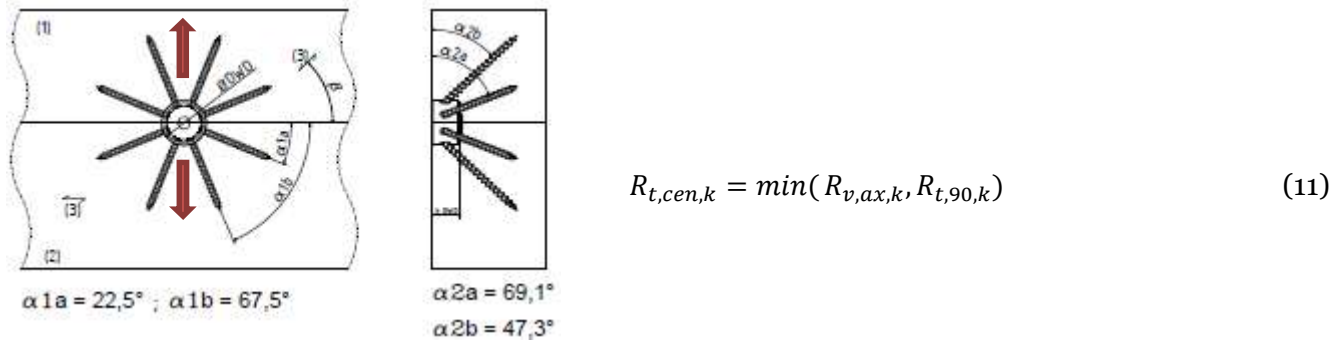α_{load} Angle load grain-direction [°]
α_{1a} Angle between screw and timber joint $\alpha_{1a}=22,5°$
α_{2b} Angle between screw and timber joint $\alpha_{1b}=67,5°$
ρ_k Characteristic gross density [kg/m³]

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 (12).

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

$\alpha 1a = 22{,}5°\ ;\ \alpha 1b = 67{,}5°$

$\alpha 2a = 69{,}1°$
$\alpha 2b = 47{,}3°$

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

Solid Timber

With

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

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

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

$$F_{v,la,\alpha 1a,k} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45°,k} \cdot d} \tag{16}$$
$$F_{v,la,\alpha 1b,k} = 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,45°,k} \cdot d} \tag{17}$$

and the equations in accordance to ETA-11/0425 for GoFix HK screws.

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

$\dfrac{a}{h} > 0,7$	$0,2 \leq \dfrac{a}{h} \leq 0,7$	$a < 0,2 \cdot h$
Proof for tension perpendicular to the grain is not necessary	$R_{t,90,d} = \dfrac{k_{mod}}{\gamma_M} \cdot k_s \cdot k_r \cdot \left(6,5 + \dfrac{18 \cdot a^2}{h^2}\right) \cdot \left(t_{ef} \cdot h\right)^{0,8} \cdot f_{t,90,k}$ with $k_s = \max \begin{cases} 1 \\ 0,7 + \dfrac{1,4 \cdot a_r}{h} \end{cases}$ and $k_r = \dfrac{6}{\sum\limits_{i=1}^{n} \left(\dfrac{h_1}{h_i}\right)^2}$ 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

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

Where

$F_{t,90,d}$ Acting load on the IdeFix DWD Connector [N]

$R_{t,90,d}$ Load bearing capacity of the Idefix-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]

t_{ef} Effective depth of the connection, with uni-laterally connection $\min \left\{ b; \dfrac{L_{ef}}{\sqrt{2}}; 6 \cdot d \right\}$

$f_{t,90,k}$ Characteristic value of tension strength perpendicular to the grain direction [N/mm²]

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).

$$R_{v,cen,k} = R_{v,0,k} + R_{v,ax,k} \tag{18}$$

α1a = 22,5° ; α1b = 67,5°

α2a = 69,1°
α2b = 47,3°

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

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

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

with

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

and

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

For the characteristic withdrawal parameter for GoFix HK screws made of carbon steel according to ETA-11/0425 has to be considered with the equations below.

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

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

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK 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 GoFix HK screw [mm]
d_{DWD}	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm²]
h_{DWD}	Penetration depth of the IdeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeFix-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 IdeFix-DWD Connector with $\alpha_{load}=0°$

k_{ax} Coefficient to consider the angel between crew axis and grain-direction [-]

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; $L_{ef,b} = L - 6$

α_{load} Angle load grain-direction [°]

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

α_{2b} Angle between screw and timber joint $\alpha_{1b}=67,5°$

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).

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

$\alpha 2a = 69,1°$
$\alpha 2b = 47,3°$

$$R_{v,ex,k} = R_{v,ax,k}$$
(24)
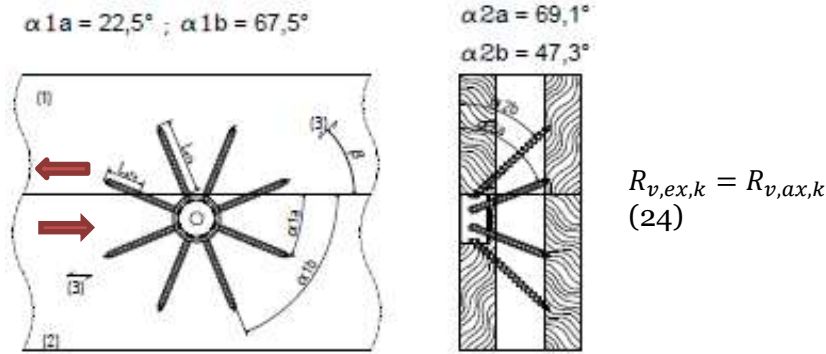
Figure 41: Centric arrangement of the IdeFix-DWD Connector, shear strength parallel to the CLT panel-joint

With

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

For the characteristic withdrawal parameter for GoFix HK screws made of carbon steel according to ETA-11/0425 has to be considered with the equations below.

$$F_{ax,a,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350} \right)^{0,8}$$
(26)

$$F_{ax,b,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,b} \cdot \left(\frac{\rho_k}{350} \right)^{0,8}$$
(27)

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

Where

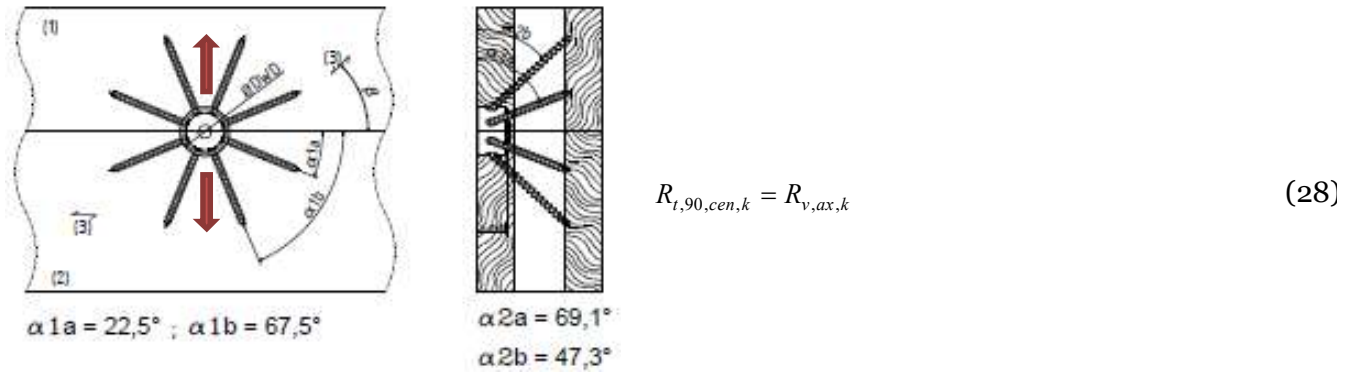|	
d	Nominal diameter of the GoFix HK screw [mm]
d_{DWD}	Diameter of the IdeFix-DWD Connector [mm]
$f_{h,\alpha,k}$	Characteristic embedment strength, considering load-grain direction [N/mm²]
h_{DWD}	Penetration depth of the IdeFix-DWD Connector [mm]
$R_{v,ax,k}$	Characteristic withdrawal-capacity of the screws [N]
$R_{v,cen,k}$	Characteristic shear strength of the IdeFix-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 IdeFix-DWD Connector with $\alpha_{load}=0°$
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]

Angle	Effective length L_{ef} [mm] eccentric arrangement
α_{1a}	d_{DWD} 40; $L_{ef\,45°} = L - 24 > 0$
α_{1a}	d_{DWD} 30; $L_{ef45°} = L - 19 > 0$
α_{1a}	d_{DWD} 40; $L_{ef\,a} = L - 57 > 0$
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 $\alpha_{1a}=22,5°$
α_{1b}	Angle between screw and timber joint $\alpha_{1b}=67,5°$
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

E.3.3 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).

$$R_{t,90,cen,k} = R_{v,ax,k} \tag{28}$$

$\alpha 1a = 22{,}5° \; ; \; \alpha 1b = 67{,}5°$

$\alpha 2a = 69{,}1°$
$\alpha 2b = 47{,}3°$

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

With

$$R_{v,ax,k} = 2 \cdot \cos\left(\alpha_{load} - \alpha_{1a}\right) \cdot \frac{F_{ax,\alpha,Rk}}{\sqrt{2}} + 2 \cdot \cos\left(\alpha_{load} - \alpha_{1b}\right) \cdot \frac{F_{ax,b,Rk}}{\sqrt{2}} \tag{29}$$
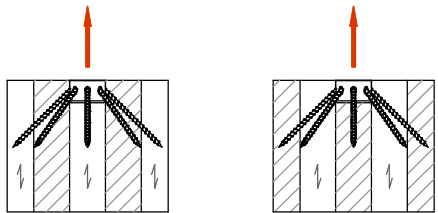
and the equations in accordance to ETA-11/0425 for GoFix HK screws.

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

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

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

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

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

(32)

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

With the equations of ETA-11/0425

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

(33)

Where
d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm²]
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 GoFix HK screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

E.3.5   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).
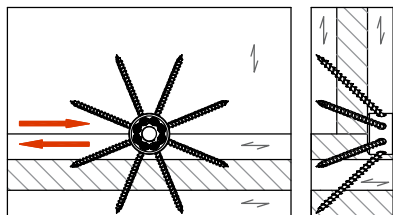
$$R_{v,cen,k} = R_{v,0,k} + R_{v,ax,k}$$
$$(34)$$

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

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

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

With

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

and

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

The characteristic withdrawal parameter for GoFix HK screws according to ETA-11/0425 has to be considered with the equations below.
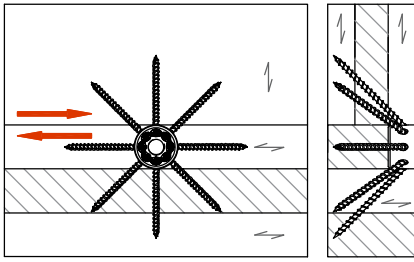
$$F_{ax,a,k} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,a} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$$
$$(38)$$

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

Note: Due to the use of the M12;M16 screw in the center of the DWD box the GoFix HK 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).

$$R_{v,ex,k} = 2.5 \cdot \frac{F_{ax,a,k}}{\sqrt{2}}$$
(4

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

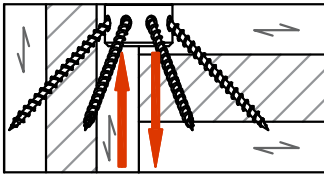With the equation in accordance to ETA-11/0425.

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

Where
d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm²]
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}=22 mm [mm]
$F_{ax,Rk}$	Characteristic withdrawal capacity of GoFix HK screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

E.3.7   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).

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

(4

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

CLT corner panel-joint
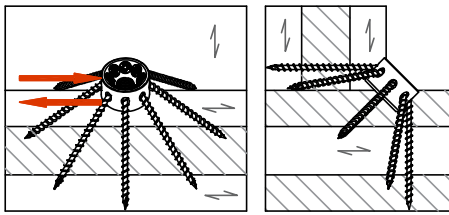
With the equation in accordance to ETA-11/0425.

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

(43)

Where
d	Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$	Characteristic withdrawal parameter of GoFix HK screws [N/mm²]
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 GoFix HK screws [N]
ρ_k	Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

E.3.8 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).

$$R_{v,cen45,k} = R_{v,ax,k}$$

$$(44)$$

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

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

$$(45)$$

With the equation in accordance to ETA-11/0425.

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

$$(46)$$

Where
d Nominal diameter of the GoFix HK screws [mm]
$f_{ax,k}$ Characteristic withdrawal parameter of GoFix HK screws [N/mm²]
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 GoFix HK screws [N]
ρ_k Density of the CLT panels, for inhomogeneous assembling the density of the outer layer should be taken into account [kg/m³]

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