Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-98/0004 of 16 June 2021

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	fischer-Zykon-Anchor FZA, FZA-D, FZA-I, FZA ST
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	fischerwerke GmbH & Co. KG Klaus-Fischer-Straße 1 72178 Waldachtal DEUTSCHLAND
Manufacturing plant	fischerwerke
This European Technical Assessment contains	33 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330232-01-0601, Edition 05/2021
This version replaces	ETA-98/0004 issued on 18 February 2020

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Specific Part

1 Technical description of the product

The fischer-Zykon-Anchor FZA, FZA-D, FZA-I and FZA ST is an anchor made of galvanised or stainless or high corrosion resistant steel which is placed in an undercut hole and anchored by mechanical interlock with displacement-controlled installation.

The bolt projection anchor FZA and the through bolt anchor FZA-D consists of a conical bolt with external thread, an expansion sleeve and a hexagon nut with washer. The internal threaded anchor FZA-I consists of a conical bolt with internal thread and an expansion sleeve. The bold projecting anchor FZA ST consists of a conical bolt with hexagon projecting end, an expansion sleeve with colour marking, a hexagon nut with washer and a plastic sleeve.

The anchor is anchored by impact acting on the expansion sleeve over the cone bolts in the undercuts of the borehole.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the fastener is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the fastener of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading) Method A	See Annex C1 to C3, Annex C7
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C4 to C6
Displacements	See Annex C14 and C15
Characteristic resistance and displacements for seismic performance category C1 and C2	See Annex C8 to C11

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C12 and C13

3.3 Aspects of durability linked with the Basic Works Requirements

Essential characteristic	Performance
Durability	See Annex B1

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

In accordance with the European Assessment Document EAD 330232-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 16 June 2021 by Deutsches Institut für Bautechnik

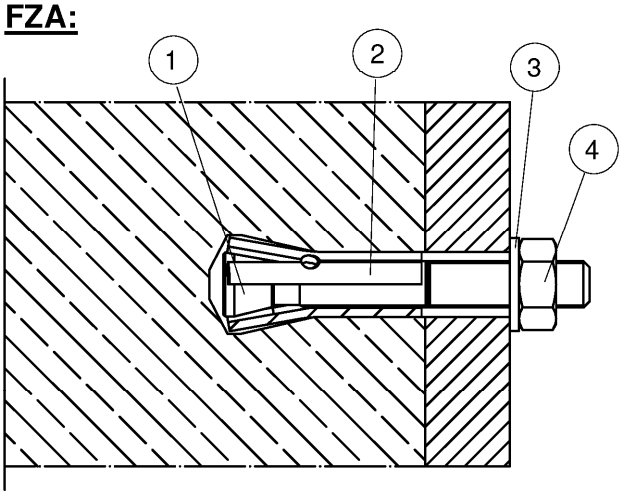
Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

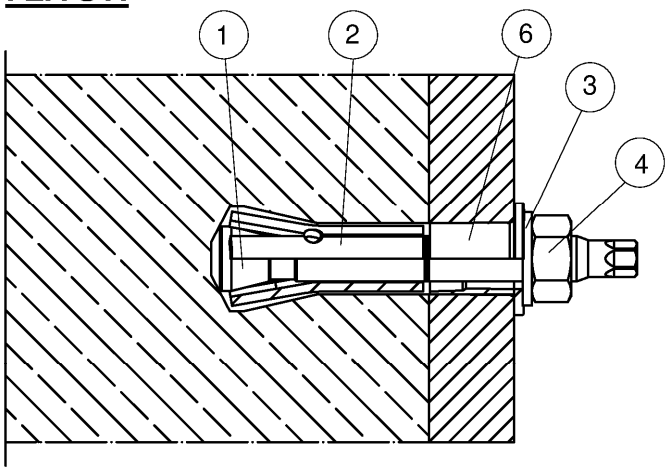
Deutsches Institut für Bautechnik DIBt

Bolt projecting anchor

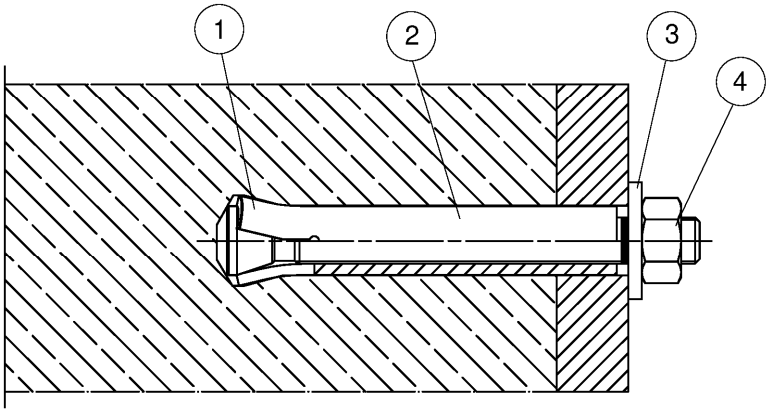
FZA:



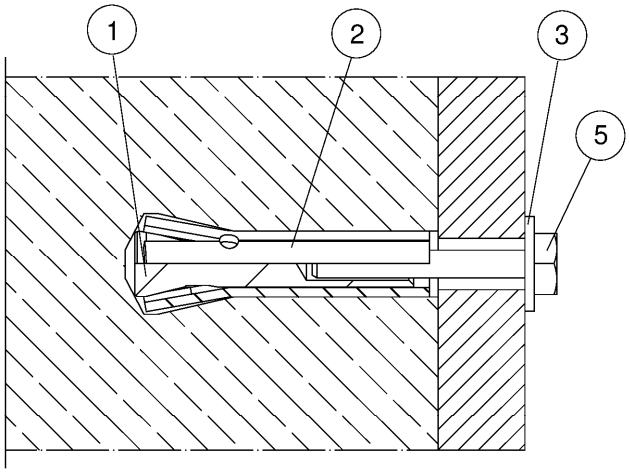
FZA ST:



Through bolt anchor FZA D



Internal thread anchor FZA I



(1) = Cone bolt
(2) = Expansion sleeve
(3) = Washer
(4) = Hexagon nut
(5) = Hexagonal screw
(6) = Plastic sleeve

(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

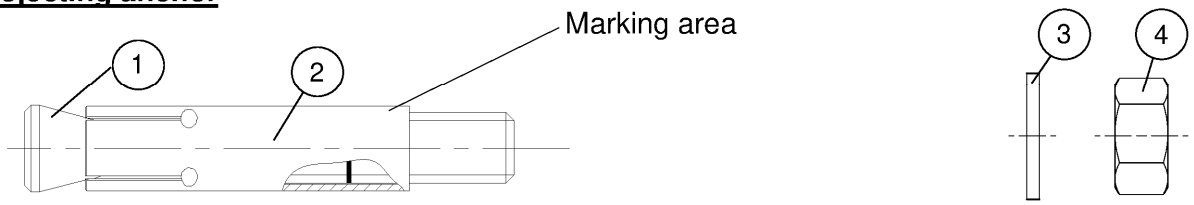
Product description
Installed condition

Annex A 1

Deutsches Institut für Bautechnik DIBt

Bolt projecting anchor

FZA:

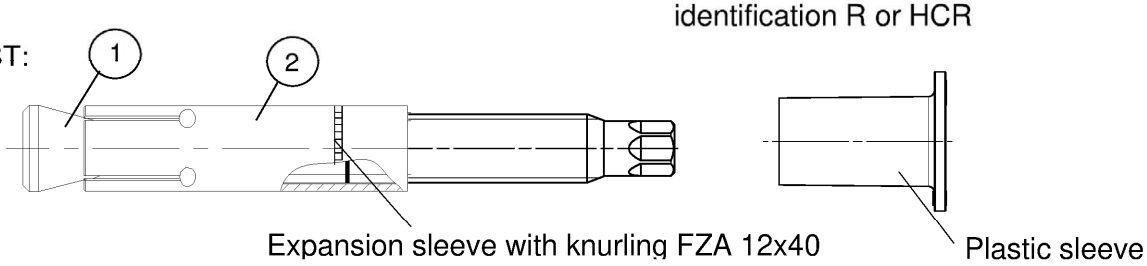


Product marking, example: FZA 12x40 R

Brand | type of fastener

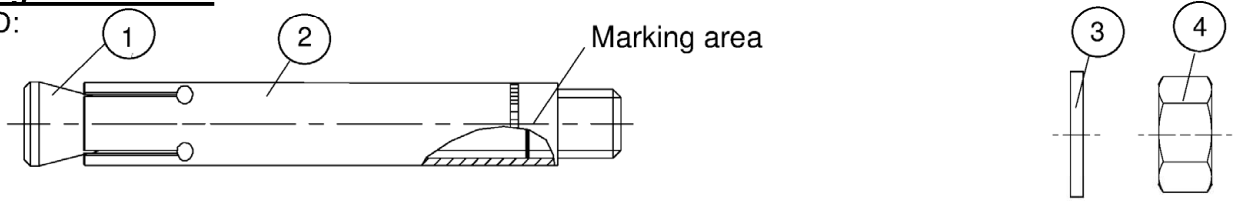
Diameter x length expansion sleeve identification R or HCR

FZA ST:



Through bolt anchor

FZA D:



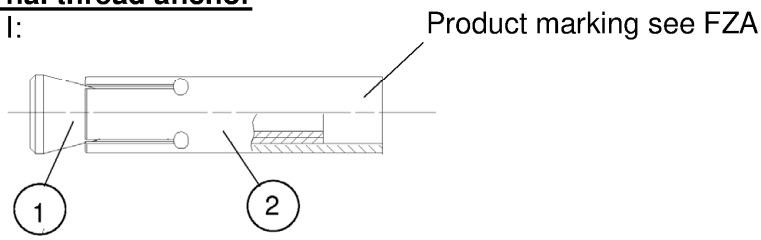
Product marking, example: FZA 12x50 D/10 R

Brand | type of fastener

Diameter x length expansion sleeve D / max. thickness of fixture (t_{fix}) identification R or HCR

Internal thread anchor

FZA I:



FZA:	Carbon steel, galvanised
FZA HDG:	Carbon steel, hot dip galvanised
FZA R:	Stainless steel
FZA HCR:	High corrosion resistant steel

(figure not to scale)

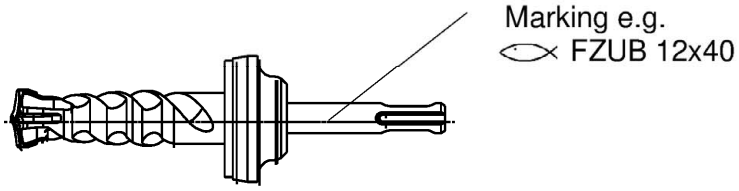
fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Product description
Types of fastener

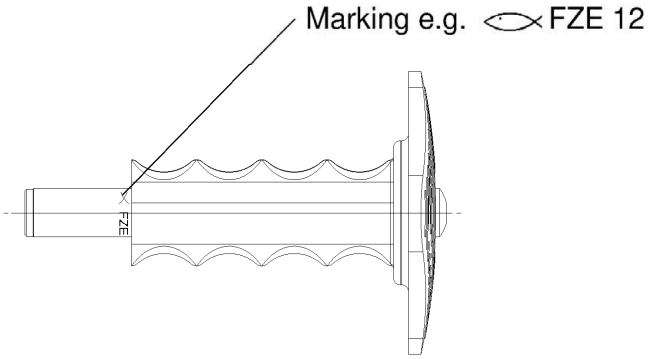
Annex A 2

Deutsches Institut für Bautechnik DIBt

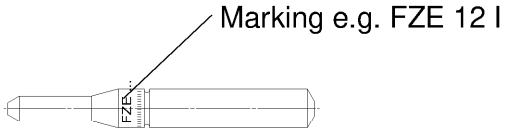
ZYKON drill
FZUB:



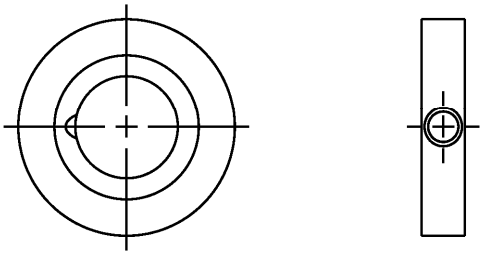
Setting tool FZE Plus



Centring pin
for internal thread anchor



Filling disk FFD
Optional e.g. for seismic application



(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Product description
Drill FZUB, setting tool FZE Plus and filling disk

Annex A 3

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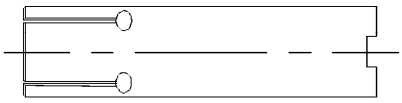
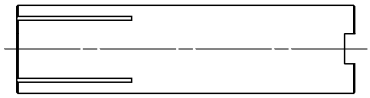
Types of expansion sleeve



manufactured by punching



manufactured by turning

FZA

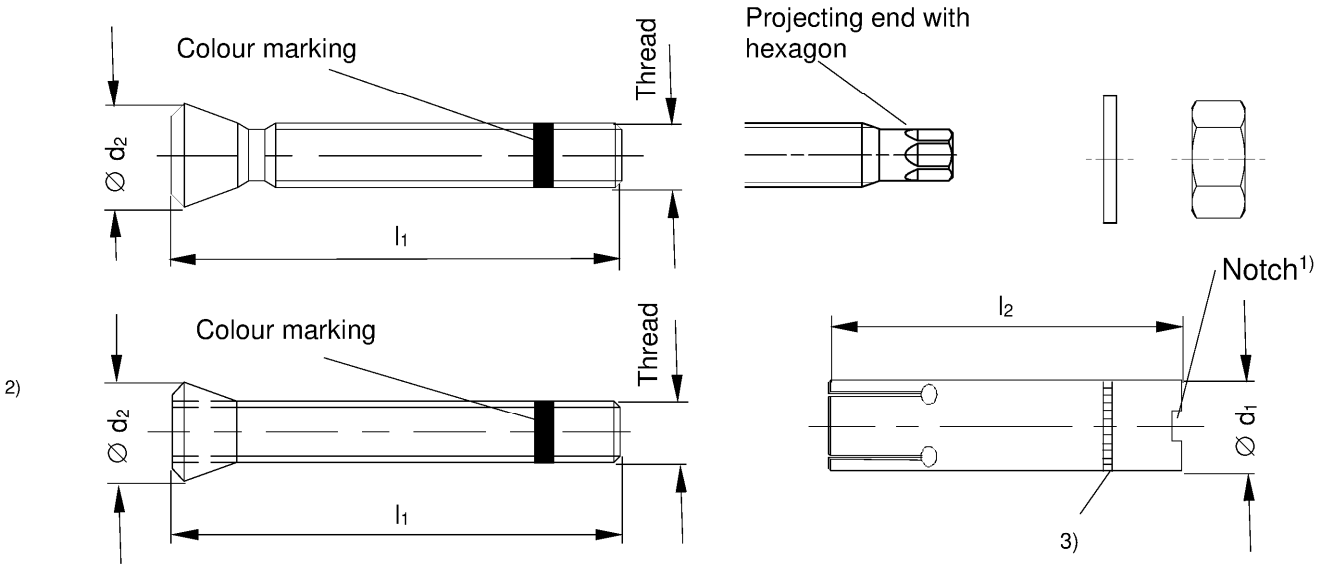


Table A4.1: Dimension bolt projecting FZA [mm]

Type of fastener	Thread	l_1 min	l_1 max	l_2	∅ d_1	∅ d_2
FZA 10 x 40 M 6 / t_{fix} [1)]	M6	50	100	40	10	
FZA 12 x 40 M 8 / t_{fix} [1)]	M8	52	154		12	
FZA 14 x 40 M 10 / t_{fix} [1)]	M10	54	204		14	
FZA 12 x 50 M 8 / t_{fix}	M8	62	164	50	12	
FZA 14 x 60 M 10 / t_{fix}	M10	80	232	60	14	
FZA 18 x 80 M 12 / t_{fix}	M12	99	301	80	18	
FZA 22 x 100 M16 / t_{fix}	M16	122	374	100	22	
FZA 22 x 125 M16 / t_{fix} [1)]		147	399	125		
FZA 12 x 40 ST [1)]	M8	62	164	50[3)]	12	
FZA 14 x 40 ST [1)]	M10	54	204	40	14	
FZA 14 x 60 ST		80	232	60		

[1)] Expansion sleeve with notch
[2)] Design: threaded bolt with cone nut
[3)] Expansion sleeve with knurling at FZA 12x40 ST

(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Product description
Fastener dimensions

Annex A 4

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FZA D

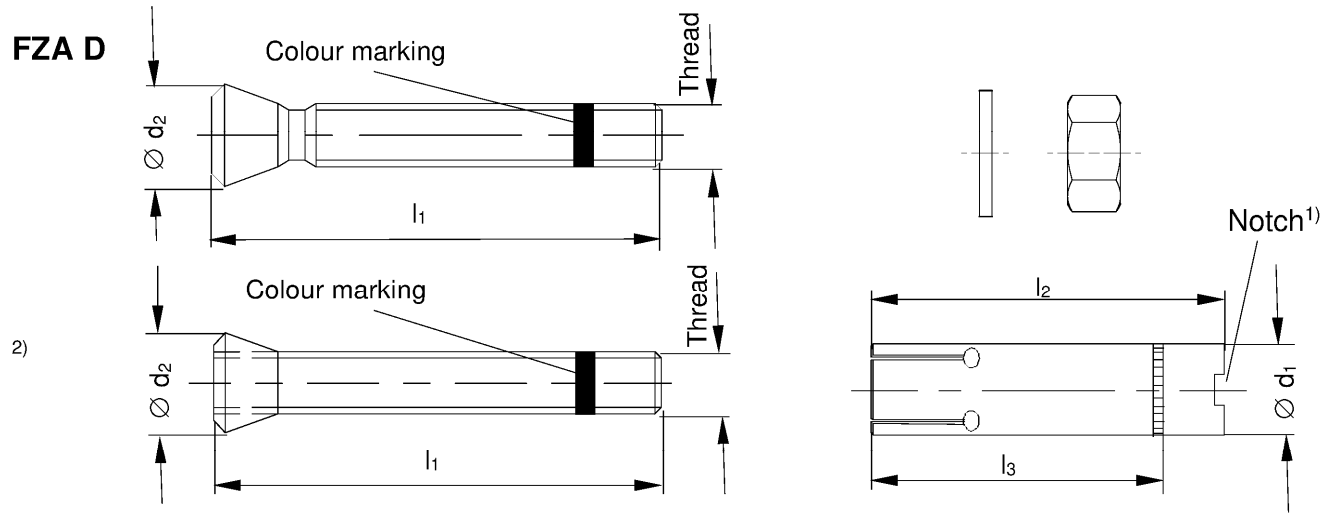

Table A5.1: Dimensions through bolt anchor FZA D [mm]

Type of fastener	Thread	l_1	l_2	l_3	∅ d_1	∅ d_2
FZA 12 x 50 M 8 D/10 1)	M8	69	50	40	12	
FZA 12 x 60 M 8 D/10		79	60	50		
FZA 12 x 80 M 8 D/30		99	80			
FZA 14 x 80 M 10 D/20	M10	102		60	14	
FZA 14 x 100 M 10 D/40		126	100			
FZA 18 x 100 M 12 D/20	M12	126		80	18	
FZA 18 x 130 M 12 D/50		156	130			
FZA 22 x 125 M 16 D/25	M16	156	125	100	22	

1) Expansion sleeve with notch
2) Design: threaded bolt with cone nut

FZA I

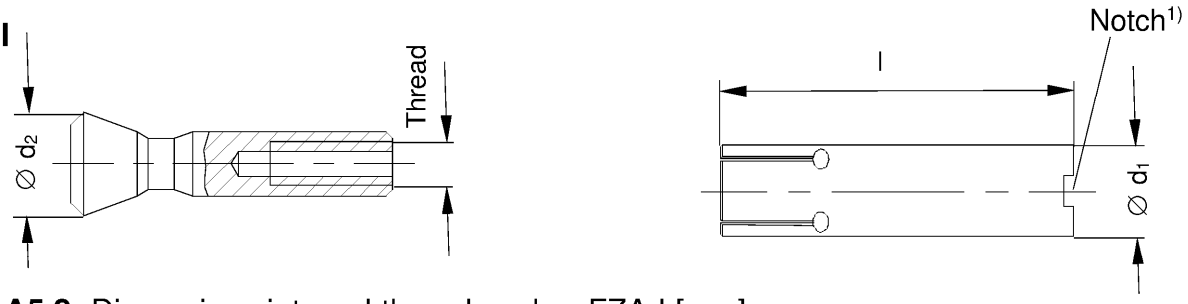

Table A5.2: Dimensions internal thread anchor FZA I [mm]

Type of fastener	Gewinde	l	∅ d_1	∅ d_2
FZA 12 x 40 M 6 I 1)	M6	40	12	
FZA 12 x 50 M 6 I		50		
FZA 14 x 60 M 8 I	M8	60	14	
FZA 18 x 80 M 10 I	M10	80	18	
FZA 22 x 100 M 12 I	M12	100	22	
FZA 22 x 125 M 12 I 1)		125		

1) Expansion sleeve with notch

(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Product description
Anchor dimensions

Annex A 5

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ZYKON drill FZUB

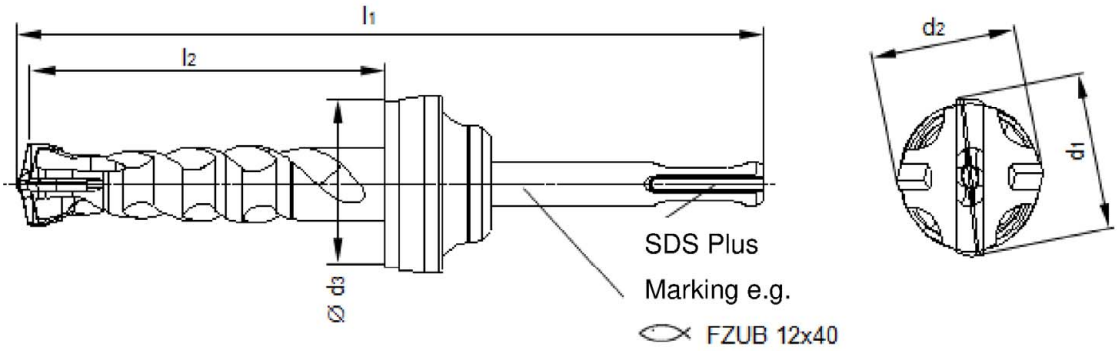
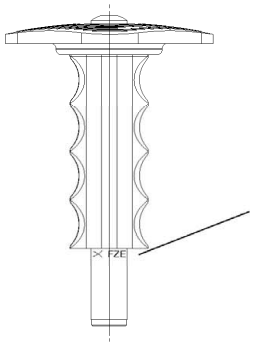


Table A6.1: Dimensions ZYKON drill FZUB [mm]

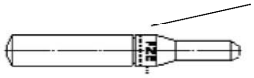
Type of drill	Connection	l_1	$l_2 \geq$	d_1	d_2	$\varnothing d_3 \leq$
FZUB 10 x 40	SDS plus	126	40	10,35 - 10,80	$d_2 \leq d_1$	39,5
FZUB 12 x 40		127		12,45 - 12,85		
FZUB 12 x 50		137	50			
FZUB 12 x 60		147	60			
FZUB 12 x 80		167	80			
FZUB 14 x 40		130	40	14,45 - 14,85		
FZUB 14 x 60		152	60			
FZUB 14 x 80		172	80			
FZUB 14 x 100		192	100			
FZUB 18 x 80		172	80	18,75 - 19,15		
FZUB 18 x 100		192	100			
FZUB 18 x 130		222	130			
FZUB 22 x 100		197	100	22,45 - 22,95		43,5
FZUB 22 x 125		222	125			

For assignment of the ZYKON FZUB drill bits and the FZE-Plus setting tools to be used to the respective fastener types and sizes, acc. to Annex B 2

Setting tool FZE Plus:



Centring pin for setting tool FZE Plus:



(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Product description
ZYKON drill FZUB and setting tool FZE Plus

Annex A 6

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Table A7.1: Materials FZA, FZA D, FZA I [1] (galvanised ≥ 5µm, ISO 4042:2018)
FZA HDG, FZA D HDG (hot-dip galavanised [2], ISO 10684:2011)

Part	Designation	Material
1	Cone bolt with external thread	Cold form steel or free cutting steel Nominal steel tensile strength: f_{uk} ≤ 1000 N/mm²
	Conical bolt with internal thread	Steel, EN 10277:2018 Nominal steel tensile strength f_{uk} ≤ 1000 N/mm²
2	Expansion sleeve seamless or rolled	Steel
3	Washer [1]	Cold strip, EN 10139:2016
4	Hexagon nut	Steel, property class 8, EN ISO 898-2:2012
5	Screw / threaded rod with nut [1]	Steel, property class ≥ 5.8
-	Filling disk FFD [3]	Steel

Table A7.2: Materials FZA R, FZA D R, FZA I R [1], FZA ST R

Part	Designation	Material Stainless steel acc. to EN 10088:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2015
1	Cone bolt with external thread	Stainless steel EN 10088:2014
	Conical bolt with internal thread	
2	Expansion sleeve seamless or rolled	
3	Washer [1]	
4	Hexagon nut	Stainless steel EN 10088:2014; ISO 3506-2:2018; property class ≥ 70
5	Screw / threaded rod with nut [1]	Stainless steel EN 10088:2014; property class ≥ 50
-	Filling disk FFD [3]	Stainless steel EN 10088:2014

Table A7.3: Materials FZA HCR, FZA D HCR, FZA I HCR [1]

Part	Designation	Material High corrosion resistant steel acc. to EN 10088:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4:2015
1	Cone bolt with external thread	High corrosion resistant steel EN 10088:2014
	Conical bolt with internal thread	
2	Expansion sleeve seamless or rolled	
3	Washer [1]	
4	Hexagon nut	High corrosion resistant steel EN 10088:2014; ISO 3506-2:2018; property class ≥ 70
5	Screw / threaded rod with nut [1]	High corrosion resistant steel EN 10088:2014; property class ≥ 50
-	Filling disk FFD [3]	High corrosion resistant steel EN 10088:2014

[1] FZA I: Washers and screws or threaded rods with hexagon nuts are not included in the scope of delivery
[2] Alternative method sherardised, EN 13811:2003
[3] Optional for e.g. seismic application

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex A 7**
Product description Materials	

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Specifications of intended use

Anchorages subject to:

Size	FZA				
	10x40 M6 12x40 M8 12x40 ST M8 12x50 M8	**14x40 M10 14x40 M10 ST 14x60 M10 14x60 M10 ST 18x80 M12 22x100 M12 22x125 M12**	**12x50 M8 D 12x60 M8 D 12x80 M8 D**	**14x80 M10 D 14x100 M10 D 18x100 M12 D 18x130 M12 D 22x125 M16 D**	**12x40 M6 I 12x50 M6 I 14x60 M8 I 18x80 M10 I 22x100 M12 I 22x125 M12 I**
Static and quasi-static loads	✓	✓	✓	✓	✓
Cracked and uncracked concrete					
Fire exposure					
Seismic performance category C1	1)		1)		1)
Seismic performance category C2					

1) No performance assessed

Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres (cracked and uncracked) of strength classes C20/25 to C50/60 according to EN 206:2013+A1:2016

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions:

  FZA, FZA D, FZA HDG, FZA D HDG, FZA I

- For all other conditions according to EN 1993-1-4:2015-10 corresponding to corrosion resistance class:
  - **CRC III**: **FZA R, FZA D R, FZA I R, FZA ST R**
  - **CRC V**: **FZA HCR, FZA D HCR, FZA I HCR**

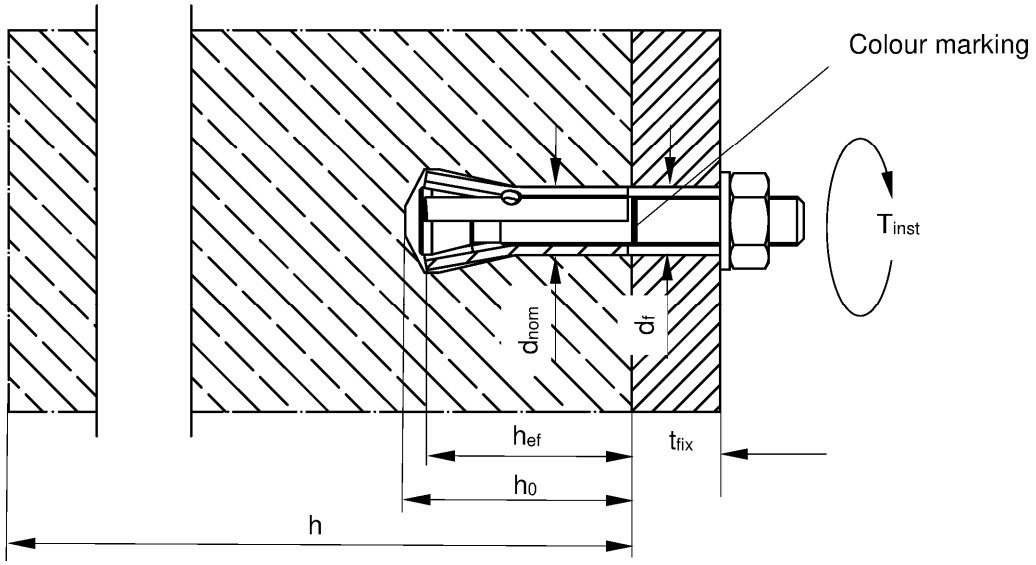
Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- For the internally threaded anchors FZA I the characteristic resistances against steel failure for screws or threaded rods must be designed additionally from the construction site. Screw lengths are to be determined by the planning engineer taking into account the thickness of the component to be connected, the thickness of the washers and the required screw-in depth (according to Annex B4) and tolerances
- Design of fastenings according to EN 1992-4:2018 and EOTA Technical Report TR 055, Edition February 2018

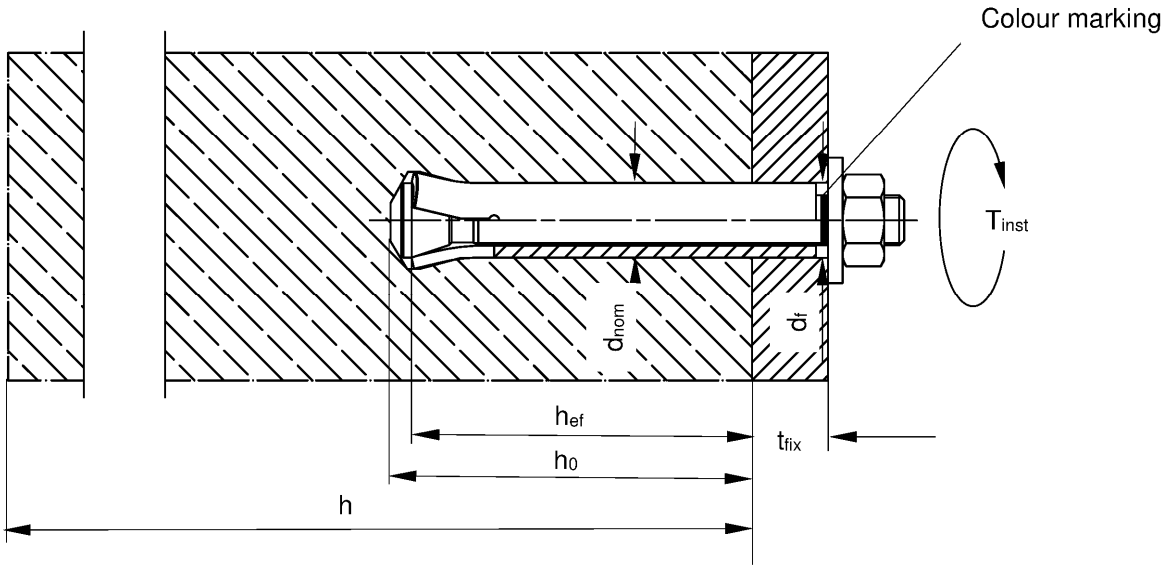
fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex B 1**
Intended Use Specifications	

Deutsches Institut für Bautechnik DIBt

Bolt projecting anchor FZA:



Through bolt anchor FZA D:

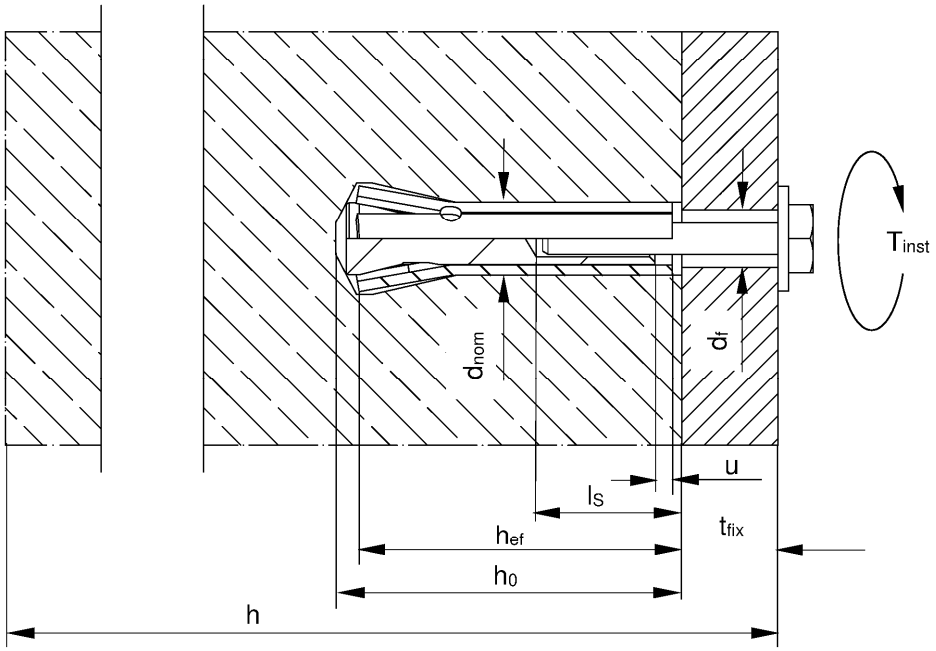


(figure not to scale)

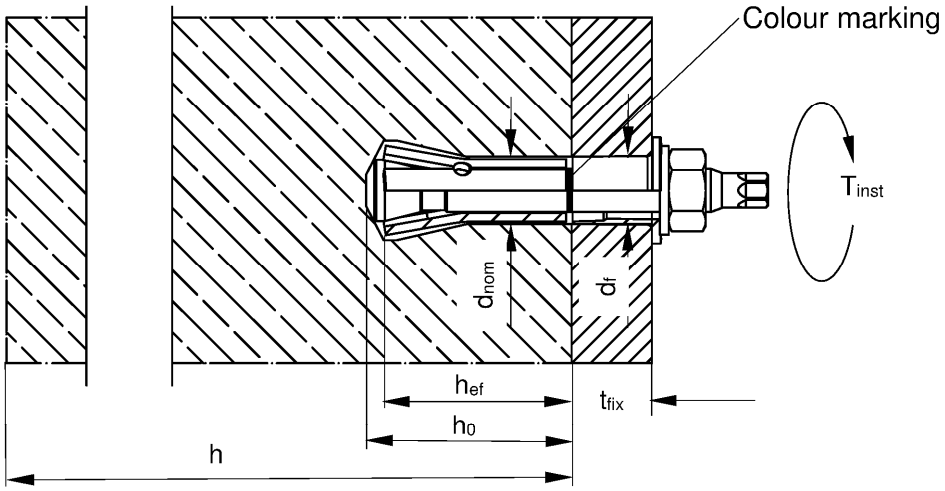
fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex B 2**
Intended Use Installation parameters	

Deutsches Institut für Bautechnik DIBt

Internal thread anchor FZA I:



Bolt projecting anchor FZA ST:



Legend:
- h_{ef} = Effective embedment depth
- t_{fix} = Thickness of fixture
- d_f = Diameter of the clearance hole in the fixture
- u = Gap between conical bolt with internal thread and expansion sleeve (FZA I)
- h = Thickness of concrete member
- T_{inst} = Required torque moment
- l_s = Screw-in depth (FZA I)
- d_{nom} = Nominal anchor diameter
- h_0 = Drill hole depth

(figure not to scale)

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Intended Use
Installation parameters

Annex B 3

Deutsches Institut für Bautechnik DIBt

Table B4.1: Installation parameters for FZA, FZA D, FZA I, FZA ST

Type of fastener	Drill hole depth	t_{fix} [mm]		Drill	Setting tool	d_f [2]	T_{inst} [1]	Gap	Screw-in depth l_S [mm]	
	≥ h_0 [mm]	min	max	FZUB	FZE Plus	≤ [mm]	[Nm]	u [mm]	max	min
FZA 10 x 40 M 6 / t_{fix}	43	1	50	10x40	10	7	8,5	-		
FZA 12 x 40 M 8 / t_{fix}			100	12x40	12	9	20			
FZA 14 x 40 M 10 / t_{fix}			150	14x40	14	12	40			
FZA 12 x 50 M 8 / t_{fix}	54		100	12x50	12	9	20			
FZA 14 x 60 M 10 / t_{fix}	63		150	14x60	14	12	40			
FZA 18 x 80 M 12 / t_{fix}	83		200	18x80	18	14	60			
FZA 22 x 100 M16 / t_{fix}	103		250	22x100	22	18	100			
FZA 22 x 125 M16 / t_{fix}	127		250	22x125						
FZA 12 x 40 ST	43	1	100	12x40	12	17	20	-		
FZA 14 x 40 ST			150	14x40	14					
FZA 14 x 60 ST	63		150	14x60						
FZA 12 x 50 M 8 D/10	43	1	10	12x50	12	14	20	-		
FZA 12 x 60 M 8 D/10	53		10	12x60						
FZA 12 x 80 M 8 D/30			30	12x80						
FZA 14 x 80 M 10 D/20	63		20	14x80	14	16	40			
FZA 14 x 100 M 10 D/40			40	14x100						
FZA 18 x 100 M 12 D/20	83		20	18x100	18	20	60			
FZA 18 x 130 M 12 D/50			50	18x130						
FZA 22 x 125 M 16 D/25	105		25	22x125	22	24	100			
FZA 12 x 40 M 6 I	43	-	-	12x40	12 + FZE 12 I	7	8,5	0 – 4,0	15	10
FZA 12 x 50 M 6 I	53			12x50						
FZA 14 x 60 M 8 I	63			14x60	14 + FZE	9	15		18	12
FZA 18 x 80 M 10 I	83			18x80	18 + FZE	12	30	0 – 4,5	24	16
FZA 22 x 100 M 12 I	103			22x100	22 + FZE 22 I	14	60		26	
FZA 22 x 125 M 12 I	127			22x125						

[1] When using the internal thread anchor FZA I with threaded rods or screws according to Annex A 7, the specified installation torque must also be applied

[2] Diameter of the clearance hole in the fixture

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Intended Use
Installation parameters

Annex B 4

Deutsches Institut für Bautechnik DIBt

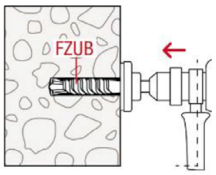
Installation instructions for FZA, FZA D, FZA I, FZA ST

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Use of the anchor only as supplied by the manufacturer without exchanging the components of the anchor
- Checking before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply
- Check of concrete being well compacted, e.g. without significant voids
- Drill hole created perpendicular +/- 5° to concrete surface, positioning without damaging the reinforcement
- In case of aborted hole: new drilling at a minimum distance twice the depth of the aborted drill hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application
- Anchor must be installed to comply with the correct anchorage depth. This is assured when the front face of the sleeve, for the internal thread, is approximately 1mm below the concrete surface or, in the case of the through bolt versions, approximately 1mm below the front surface of fixture. When using the FZA 12x40 ST the knurling on the sleeve is flush or below the concrete surface. For the bolt and through bolt version the anchor is correctly expanded if the colour marking on the thread of the tapered bolt is visible.

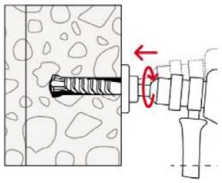
fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex B 5**
Intended Use Installation instructions	

Deutsches Institut für Bautechnik DIBt

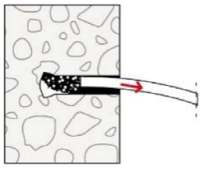
Pre-positioned installation FZA, FZA I and FZA ST



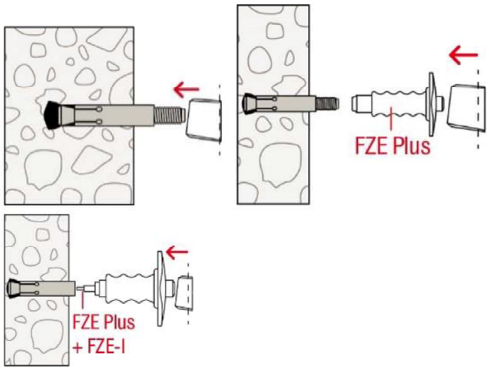
1.: The drill hole must be drilled at right angles (+/- 5°) to the surface of the anchor base with a hammer drill using the corresponding ZYKON FZUB drill bit. The required drilling depth is reached when the depth stop of the FZUB is in contact with the concrete.



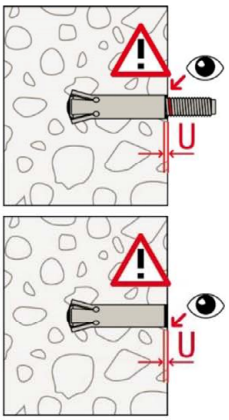
2.: Once the FZUB depth stop meets the concrete, create the drill hole undercut by making circular swiveling movements with the hammer drill while the hammer mechanism is engaged. Press the hammer drill firmly against the anchor base: 1 - 2 swiveling movements are sufficient for ∅ 14 mm, with 3 - 5 movements for ∅ 18 mm and ∅ 22 mm.

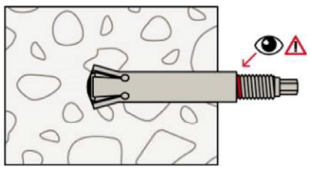


3.: Clean drill hole.

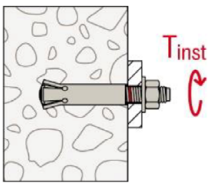


4.: Insert the anchor into the drill hole and then drive the expansion sleeve in with hammer-set device FZE Plus, using a manual hammer.

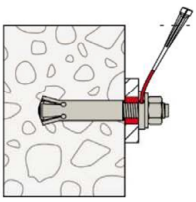




5.: The anchor is correctly expanded if the colour marking on the thread of the tapered bolt is visible or the gap u between conical bolt with internal thread and expansion sleeve (FZA I) is fulfilled. When using the FZA 12x40 ST the knurling on the sleeve is flush or below the concrete surface.



6.: Mount installation object (e.g. anchor plate), washer and nut, screw (for FZA I) or threaded rod with washer and nut (for FZA I) and apply installation torque with torque spanner.



Optional: The gap between bolt and fixture may be filed with mortar (compressive strength ≥ 50 N/mm² e.g. FIS SB) after step 6 (for eliminating the annular gap). The filling disc is additional to the standard washer. The thickness of the filling disc must be considered for definition of t_{fix}. Countersunk of the filling disc in direction to the anchor plate.

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex B 6**
Intended Use Installation instructions	

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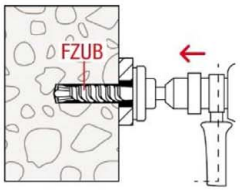
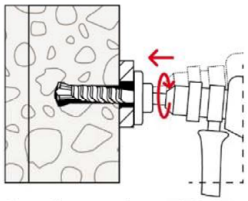
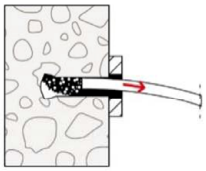
Push-through installation FZA D



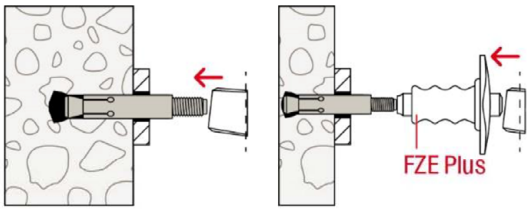
1.: Create a drill hole through the installation object perpendicular to the surface of the anchor base with a hammer drill, using the corresponding Zykon universal drill bit FZUB. The required drill depth is reached once the FZUB depth stop meets the fixture.



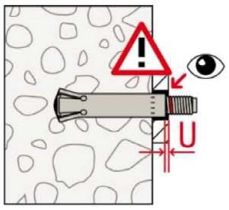
2.: Once the FZUB depth stop meets the fixture, create the drill hole undercut by making circular swiveling movements with the hammer drill while the hammer mechanism is engaged. Press the hammer drill firmly against the anchor base: 1 - 2 swiveling movements are sufficient for ∅ 14 mm, with 3 - 5 movements for ∅ 18 mm and ∅ 22 mm.



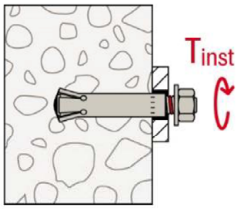
3.: Clean drill hole.



4.: Insert the anchor into the drill hole through the installation object (e.g. anchor plate) and then drive the expansion sleeve in with hammer-set device FZE Plus, using a manual hammer.



5.: The anchor is correctly expanded if the colour marking on the thread of the tapered bolt is visible.



6.: Mount installation object (e.g. anchor plate), washer and nut and apply installation torque with torque spanner.

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST	**Annex B 7**
Intended Use Installation instructions	

Deutsches Institut für Bautechnik DIBt

Table C1.1: Characteristic values of **tension** resistance under static and quasi-static action for **bolt projecting anchor FZA, FZA ST**

Type of anchor / size			FZA (bolt projecting anchor)							
			10x40 M6	**12x40 12x40 ST M8**	**14x40 14x40 ST M10**	**12x50 M8**	**14x60 14x60 ST M10**	**18x80 M12**	**22x100 M16**	**22x125 M16**
Steel failure for FZA										
Characteristic resistance	$N_{Rk,s}$	[kN]	16,1	29,3	46,4	29,3	46,4	67,4	125,6	
Partial factor	γ_{Ms}	[-]	1,5							
Steel failure for FZA HDG										
Characteristic resistance	$N_{Rk,s}$	[kN]	13,1	25,0	40,7	25,0	40,7	60,1	115	
Partial factor	γ_{Ms}	[-]	1,5							
Steel failure for FZA R										
Characteristic resistance	$N_{Rk,s}$	[kN]	14,1	25,6	40,6	25,6	40,6	59,0	109,9	
Partial factor	γ_{Ms}	[-]	1,87							
Steel failure for FZA HCR										
Characteristic resistance	$N_{Rk,s}$	[kN]	14,1	25,6	40,6	25,6	40,6	59,0	109,9	
Partial factor	γ_{Ms}	[-]	1,5							
Modulus of elasticity	E_s	[N/mm²]	210.000							
Pullout failure for FZA, FZA HDG, FZA R, FZA HCR										
Characteristic resistance in concrete C20/25	cracked	$N_{Rk,p}$ [kN]	6			9	12	24	40	
	uncracked		12			17,4	22,9	35,2	49,2	68,8
Increasing factors concrete	ψ_c [-]	C25/30	1,12							
		C30/37	1,22							
		C35/45	1,32							
		C40/50	1,41							
		C45/55	1,50							
		C50/60	1,58							
Installation factor	γ_{inst}	[-]	1,2			1,0				
Concrete cone failure and splitting failure for FZA, FZA HDG, FZA R, FZA HCR										
Effective embedment depth	h_{ef}	[mm]	40			50	60	80	100	125
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0							
Factor for cracked concrete	$k_{cr,N}$		7,7							
Minimum thickness of concrete member	h_{min}	[mm]	100			110	130	160	200	250
Characteristic spacing	$s_{cr,N} = s_{cr,sp}$		3 h_{ef}							
Characteristic edge distance	$c_{cr,N} = c_{cr,sp}$		1,5 h_{ef}							
Characteristic resistance to splitting	$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ [1)]							

[1)] $N^0_{Rk,c}$ acc. to EN 1992-4:2018

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values of resistance under tension loads for bolt projecting anchor FZA

Annex C 1

Deutsches Institut für Bautechnik DIBt

Table C2.1: Characteristic values of **tension** resistance under static and quasi-static action for **through bolt anchor FZA D**

Type of anchor / size			FZA D (through bolt anchor)							
			12x50 M8D/10	**12x60 M8D/10**	**12x80 M8D/30**	**14x80 M10D/20**	**14x100 M10D/40**	**18x100 M12D/20**	**18x130 M12D/50**	**22x125 M16D/25**
Steel failure for FZA D										
Characteristic resistance	$N_{Rk,s}$	[kN]	29,3			46,4		67,4		125,6
Partial factor	γ_{Ms}	[-]	1,5							
Steel failure for FZA D HDG										
Characteristic resistance	$N_{Rk,s}$	[kN]	25,0			40,7		60,1		115,0
Partial factor	γ_{Ms}	[-]	1,5							
Steel failure for FZA D R										
Characteristic resistance	$N_{Rk,s}$	[kN]	25,6			40,6		59,0		109,9
Partial factor	γ_{Ms}	[-]	1,87							
Steel failure for FZA HCR										
Characteristic resistance	$N_{Rk,s}$	[kN]	25,6			40,6		59,0		109,9
Partial factor	γ_{Ms}	[-]	1,5							
Modulus of elasticity	E_s	[N/mm²]	210.000							
Pullout failure for FZA D, FZA D HDG, FZA D R, FZA D HCR										
Characteristic resistance in concrete C20/25	cracked / uncracked $N_{Rk,p}$	[kN]	6	9		12		24		40
			12	17,4		22,9		35,2		49,2
Increasing factors concrete	ψ_c	C25/30	1,12							
		C30/37	1,22							
		C35/45	1,32							
		C40/50	1,41							
		C45/55	1,50							
		C50/60	1,58							
Installation factor	γ_{inst}	[-]	1,2	1,0						
Concrete cone failure and splitting failure for FZA D, FZA D HDG, FZA D R, FZA D HCR										
Effective embedment depth	h_{ef}	[mm]	40	50		60		80		100
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0							
Factor for cracked concrete	$k_{cr,N}$		7,7							
Minimum thickness of concrete member	h_{min}	[mm]	100	110		130		160		200
Characteristic spacing	$s_{cr,N} = s_{cr,sp}$		3 h_{ef}							
Characteristic edge distance	$c_{cr,N} = c_{cr,sp}$		1,5 h_{ef}							
Characteristic resistance to splitting	$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ [1)]							

[1)] $N^0_{Rk,c}$ acc. to EN 1992-4:2018

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values of resistance under tension loads for through bolt anchor FZA D

Annex C 2

Deutsches Institut für Bautechnik DIBt

Table C3.1: Characteristic values of **tension** resistance under static and quasi-static action for **internal thread anchor FZA I**

Type of anchor / size				FZA I (internal thread anchor) 12x40 M6 I	12x50 M6 I	14x60 M8 I	18x80 M10 I	22x100 M12 I	22x125 M12 I
Steel failure for FZA I [1]									
Characteristic resistance		$N_{Rk,s}$	[kN]	21,7		28,7	37,4	84,2	
Partial factor		γ_{Ms}	[-]	1,5					
Steel failure for FZA I R [1]									
Characteristic resistance		$N_{Rk,s}$	[kN]	22,2		26,8	34,9	61,7	
Partial factor		γ_{Ms}	[-]	1,5					
Steel failure for FZA I HCR [1]									
Characteristic resistance		$N_{Rk,s}$	[kN]	19,4		26,8	34,9	78,5	
Partial factor		γ_{Ms}	[-]	1,5					
Modulus of elasticity		E_s	[N/mm²]	210.000					
Pullout failure for FZA I, FZA I R, FZA I HCR									
Characteristic resistance in concrete C20/25	cracked	$N_{Rk,p}$	[kN]	6	9	12	24	40	
	uncracked			12	17,4	22,9	35,2	49,2	68,8
Increasing factors concrete		ψ_c [-]	C25/30	1,12					
			C30/37	1,22					
			C35/45	1,32					
			C40/50	1,41					
			C45/55	1,50					
			C50/60	1,58					
Installation factor		γ_{inst}	[-]	1,2	1,0				
Concrete cone failure and splitting failure for FZA I, FZA I R, FZA I HCR									
Effective embedment depth		h_{ef}	[mm]	40	50	60	80	100	125
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0					
Factor for cracked concrete		$k_{cr,N}$		7,7					
Min. thickness of concrete member		h_{min}	[mm]	100	110	130	160	200	250
Characteristic spacing		$s_{cr,N} = s_{cr,sp}$		3 h_{ef}					
Characteristic edge distance		$c_{cr,N} = c_{cr,sp}$		1,5 h_{ef}					
Characteristic resistance to splitting		$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ [2]					

[1] The characteristic resistances against steel failure for screws or threaded rods must be designed additionally from the construction site - these values could become decisive

[2] $N^0_{Rk,c}$ acc. to EN 1992-4:2018

Deutsches Institut für Bautechnik DIBt

Table C4.1: Characteristic values of **shear** resistance under static and quasi-static action for **bolt projecting anchor FZA, FZA ST**

Type of anchor / size			FZA (bolt projecting anchor)							
			10x40 M6	12x40 12x40 ST M8	14x40 14x40 ST M10	12x50 M8	14x60 14x60 ST M10	18x80 M12	22x100 M16	22x125 M16
Steel failure without lever arm FZA, FZA HDG										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	8,8	16,1	25,5	16,1	25,5	37,1	69,1	
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7	[-]	1,0							
Steel failure with lever arm FZA, FZA HDG										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	12,2	30,0	59,8	30,0	59,8	104,8	266,4	
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7	[-]	1,0							
Steel failure without lever arm FZA R										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	9,2	16,7	26,4	16,7	26,4	38,4	76,9	
Partial factor	γ_{Ms}	[-]	1,56							
Factor for ductility	k_7	[-]	1,0							
Steel failure with lever arm FZA R										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	10,7	26,2	52,3	26,2	52,3	91,7	233,1	
Partial factor	γ_{Ms}	[-]	1,56							
Factor for ductility	k_7	[-]	1,0							
Steel failure without lever arm FZA HCR										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	9,2	16,7	26,4	16,7	26,4	38,4	76,9	
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7	[-]	1,0							
Steel failure with lever arm FZA HCR										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	10,7	26,2	52,3	26,2	52,3	91,7	233,1	
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7	[-]	1,0							
Concrete pryout failure FZA, FZA HDG, FZA R, FZA HCR										
Factor for pryout failure	k_8	[-]	1,3		2,4	1,3	3,1			
Concrete edge failure										
Effective length in concrete	l_f	[mm]	40			50	60	80	100	125
Effective diameter of anchor	d_{nom}	[mm]	10	12	14	12	14	18	22	
Installation factor	γ_{inst}	[-]	1,0							

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values of resistance under shear loads for bolt projecting anchor FZA

Annex C 4

Deutsches Institut für Bautechnik DIBt

Table C5.1: Characteristic values of **shear** resistance under static and quasi-static action for **through bolt anchor FZA D**

Type of anchor / size			FZA D (through bolt anchor)							
			12x50 M8D/ 10	**12x60 M8D/ 10**	**12x80 M8D/ 30**	**14x80 M10D/ 20**	**14x100 M10D/ 40**	**18x100 M12D/ 20**	**18x130 M12D/ 50**	**22x125 M16D/ 25**
Steel failure without lever arm FZA D, FZA D HDG										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	26,2			41,4		64,9		104,8
Partial factor	γ_{Ms}	[-]	1,26							
Factor for ductility	k_7		1,0							
Steel failure with lever arm FZA D, FZA D HDG										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	30,0			59,8		104,8		266,4
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7		1,0							
Steel failure without lever arm FZA D R										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	30,4			43,2		88,3		141,0
Partial factor	γ_{Ms}	[-]	1,96			1,92		1,56		
Factor for ductility	k_7		1,0							
Steel failure with lever arm FZA D R										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	26,2			52,3		91,7		233,1
Partial factor	γ_{Ms}	[-]	1,56							
Factor for ductility	k_7		1,0							
Steel failure without lever arm FZA D HCR										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	30,4			43,2		88,3		141,0
Partial factor	γ_{Ms}	[-]	1,85			1,79		1,44		1,46
Factor for ductility	k_7		1,0							
Steel failure with lever arm FZA D HCR										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	26,2			52,3		91,7		233,1
Partial factor	γ_{Ms}	[-]	1,25							
Factor for ductility	k_7		1,0							
Concrete pryout failure FZA D, FZA D HDG, FZA D R, FZA D HCR										
Factor for pryout failure	k_8	[-]	1,3			3,1				
Concrete edge failure										
Effective length in concrete	l_f	[mm]	40	50		60		80		100
Effective diameter of anchor	d_{nom}		12			14		18		22
Installation factor	γ_{inst}	[-]	1,0							

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values of resistance under shear loads for through bolt anchor FZA D

Annex C 5

Deutsches Institut für Bautechnik DIBt

Table C6.1: Characteristic values of **shear** resistance under static and quasi-static action for **internal thread anchor FZA I**

Type of anchor / size			FZA I (internal thread anchor)					
			12x40 M6 I	12x50 M6 I	14x60 M8 I	18x80 M10 I	22x100 M12 I	22x125 M12 I
Steel failure without lever arm FZA I [1]								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	11,9		15,8	20,6	46,3	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Steel failure with lever arm FZA I [1]								
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	19,3		30,1	44,7	150,9	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Steel failure without lever arm FZA I R [1]								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	14,4		17,4	22,7	43,2	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Steel failure with lever arm FZA I R [1]								
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	19,8		28,1	41,7	110,7	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Steel failure without lever arm FZA I HCR [1]								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	12,6		17,4	22,7	55,0	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Steel failure with lever arm FZA I HCR [1]								
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	17,3		28,1	41,7	140,8	
Partial factor	γ_{Ms}	[-]	1,25					
Factor for ductility	k_7		1,0					
Concrete pryout failure FZA I, FZA I R, FZA I HCR								
Factor for pryout failure	k_8	[-]	1,3		3,1			
Concrete edge failure								
Effective length in concrete	l_f	[mm]	40	50	60	80	100	125
Effective diameter of anchor	d_{nom}		12		14	18	22	
Installation factor	γ_{inst}	[-]	1,0					

[1] The characteristic resistances against steel failure for screws or threaded rods must be designed additionally from the construction site - these values often become decisive

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values of resistance under shear loads for internal thread anchor FZA I

Annex C 6

Deutsches Institut für Bautechnik DIBt

Table C7.1: Minimum thickness of concrete members**, minimum spacings** and **minimum edge distances** of **bolt projecting anchor FZA, FZA ST**

Type of fastener			FZA (bolt projecting anchor)							
			10x40 M6	**12x40 12x40 ST M8**	**14x40 14x40 ST M10**	**12x50 M8**	**14x60 14x60 ST M10**	**18x80 M12**	**22x100 M16**	**22x125 M16**
Minimum spacing	s_{min}	[mm]	40		70	50	60	80	100	125
Minimum edge distance	c_{min}		35	40		45	55	70		
Minimum thickness of concrete member	h_{min}		100			110	130	160	200	250

Table C7.2: Minimum thickness of concrete members**, minimum spacings** and **minimum edge distances** of **through bolt anchor FZA D**

Type of fastener			FZA D (through bolt anchor)							
			12x50 M8 D/10	**12x60 M8 D/10**	**12x80 M8 D/30**	**14x80 M10 D/20**	**14x100 M10 D/40**	**18x100 M12 D/20**	**18x130 M12 D/50**	**22x125 M16 D/25**
Minimum spacing	s_{min}	[mm]	40	50		60		80		100
Minimum edge distance	c_{min}		35	45		55		70		
Minimum thickness of concrete member	h_{min}		100	110		130		160		200

Table C7.3: Minimum thickness of concrete members**, minimum spacings** and **minimum edge distances** of **internal thread anchor FZA I**

Type of fastener			FZA (internal thread anchor)					
			12x40 M6 I	**12x50 M6 I**	**14x60 M8 I**	**18x80 M10 I**	**22x100 M12 I**	**22x125 M12 I**
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	125
Minimum edge distance	c_{min}		35	45	55	70		
Minimum thickness of concrete member	h_{min}		100	110	130	160	200	250

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Table C8.1: Characteristic values for **seismic performance category C1** for **bolt projecting anchor FZA**

Type of anchor / size			FZA (bolt projecting anchor) 14x40 M10	14x60 M10	18x80 M12	22x100 M16	22x125 M16
Steel failure FZA							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	46,4		67,4	126	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Steel failure FZA HDG							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,7		60,1	115	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Steel failure FZA R							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,6		59,0	110	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,87				
Steel failure FZA HCR							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,6		59,0	110	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Pullout failure							
Characteristic resistance in cracked concrete	$N_{Rk,p,C1}$	[kN]	6,0		20,0	40,0	
Installation factor	γ_{inst}	[-]	1,2	1,0			
Steel failure without lever arm FZA, FZA HDG							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	20,9		33,8	62,8	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,25				
Steel failure without lever arm FZA R							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	18,3		29,5	55,0	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,56				
Steel failure without lever arm FZA HCR							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	18,3		29,5	55,0	
Partial factor	$\gamma_{Ms,C1}$	[-]	1,25				
Factor for anchorages **with** annular gap	α_{gap}	[-]	0,5				
Factor for anchorages **without** annular gap	α_{gap}	[-]	1,0				

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values for seismic performance category C1
for bolt projecting anchor FZA

Annex C 8

Deutsches Institut für Bautechnik DIBt

Table C9.1: Characteristic values for **seismic performance category C1** for **through bolt anchor FZA D**

Type of anchor / size			FZA D (through bolt anchor)				
			14x80 M10D/20	**14x100 M10D/40**	**18x100 M12D/20**	**18x130 M12D/50**	**22x125 M16D/25**
Steel failure FZA D							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	46,4		67,4		126
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Steel failure FZA D HDG							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,7		60,1		115
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Steel failure FZA D R							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,6		59,0		110
Partial factor	$\gamma_{Ms,C1}$	[-]	1,87				
Steel failure FZA D HCR							
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	40,6		59,0		110
Partial factor	$\gamma_{Ms,C1}$	[-]	1,5				
Pullout failure							
Characteristic resistance in cracked concrete	$N_{Rk,p,C1}$	[kN]	6,0		20,0		40,0
Installation factor	γ_{inst}	[-]	1,0				
Steel failure without lever arm FZA D, FZA D HDG							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	20,9		33,8		62,8
Partial factor	$\gamma_{Ms,C1}$	[-]	1,25				
Steel failure without lever arm FZA D R							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	18,3		29,5		55,0
Partial factor	$\gamma_{Ms,C1}$	[-]	1,56				
Steel failure without lever arm FZA D HCR							
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	18,3		29,5		55,0
Partial factor	$\gamma_{Ms,C1}$	[-]	1,25				
Factor for anchorages **with** annular gap	α_{gap}	[-]	0,5				
Factor for anchorages **without** annular gap	α_{gap}	[-]	1,0				

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Table C10.1: Characteristic values for **seismic performance category C2** for **bolt projecting anchor FZA**

Type of anchor / size			FZA (bolt projecting anchor)				
			14x40 M10 / t_{fix}	**14x60 M10 / t_{fix}**	**18x80 M12 / t_{fix}**	**22x100 M16 / t_{fix}**	**22x125 M16 / t_{fix}**
Steel failure FZA							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	46,4		67,4	126,0	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Steel failure FZA HDG							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,7		60,1	115,0	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Steel failure FZA R							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,6		59,0	110,0	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,87				
Steel failure FZA HCR							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,6		59,0	110,0	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Pullout failure							
Characteristic resistance in cracked concrete	$N_{Rk,p,C2}$	[kN]	6,0	7,5	24,0	25,0	40,0
Installation factor	γ_{inst}	[-]	1,2	1,0			
Steel failure without lever arm FZA, FZA HDG							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	15,6		24,5	47,0	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,25				
Steel failure without lever arm FZA R							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	16,1		25,3	52,3	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,56				
Steel failure without lever arm FZA HCR							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	16,1		25,3	52,3	
Partial factor	$\gamma_{Ms,C2}$	[-]	1,25				
Factor for anchorages **with** annular gap	α_{gap}	[-]	0,5				
Factor for anchorages **without** annular gap	α_{gap}	[-]	1,0				

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Table C11.1: Characteristic values for **seismic performance category C2** for **through bolt anchor FZA D**

Type of anchor / size			FZA D (through bolt anchor)				
			14x80 M10D/20	**14x100 M10D/40**	**18x100 M12D/20**	**18x130 M12D/50**	**22x125 M16D/25**
Steel failure FZA D							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	46,4		67,4		126,0
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Steel failure FZA D, FZA HDG							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,7		60,1		115,0
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Steel failure FZA D R							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,6		59,0		110,0
Partial factor	$\gamma_{Ms,C2}$	[-]	1,87				
Steel failure FZA D HCR							
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	40,6		59,0		110,0
Partial factor	$\gamma_{Ms,C2}$	[-]	1,50				
Pullout failure							
Characteristic resistance in cracked concrete	$N_{Rk,p,C2}$	[kN]	6,0	7,5	24,0	25,0	40,0
Installation factor	γ_{inst}	[-]	1,0				
Steel failure without lever arm FZA D, FZA D HDG							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	15,6		24,5		47,0
Partial factor	$\gamma_{Ms,C2}$	[-]	1,25				
Steel failure without lever arm FZA D R							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	16,1		25,3		52,3
Partial factor	$\gamma_{Ms,C2}$	[-]	1,56				
Steel failure without lever arm FZA D HCR							
Characteristic resistance	$V_{Rk,s,C2}$	[kN]	16,1		25,3		52,3
Partial factor	$\gamma_{Ms,C2}$	[-]	1,25				
Factor for anchorages **with** annular gap	α_{gap}	[-]	0,5				
Factor for anchorages **without** annular gap	α_{gap}	[-]	1,0				

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Table C12.1: Characteristic values for resistance to fire[1)]

FZA, FZA HDG			**10x40 M6 12x40 M6 I 12x50 M6 I**	**12x40 M8 12x40 ST M8 12x50 M8 D/10**	**12x50 M8 12x60 M8 D/10 12x80 M8 D/30 14x60 M8 I 18x80 M10 I**	**14x40 M10 14x40 ST M10**
Steel failure for tension load and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)						
Characteristic resistance	$F_{Rk,s,fi}$ [kN]	R30	1,2	2,2		5,2
		R60	0,7	1,3		2,6
		R90	0,5	1,0		1,8
		R120		0,8		1,3
	$M^0_{Rk,s,fi}$ [Nm]	R30	0,9	2,3		6,7
		R60	0,5	1,3		3,4
		R90	0,4	1,0		2,3
		R120		0,9		1,7
Pullout failure						
Characteristic resistance	$N_{Rk,p,fi}$ [kN]	R30	1,5		2,3	1,5
		R60				
		R90				
		R120	1,2		1,8	1,2
FZA, FZA HDG			**14x60 M10 14x60 ST M10 14x80 M10 D/20 14x100 M10 D/40**	**18x80 M12 18x100 M12 D/20 18x130 M12 D/50 22x100 M12 I 22x125 M12 I**	**22x100 M16 22x125 M16 D/25**	**22x125 M16**
Steel failure for tension load and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)						
Characteristic resistance	$F_{Rk,s,fi}$ [kN]	R30	5,2	7,5	13,9	
		R60	2,6	3,8	7,0	
		R90	1,8	2,5	4,7	
		R120	1,3	1,9	3,6	
	$M^0_{Rk,s,fi}$ [Nm]	R30	6,7	11,6	29,5	
		R60	3,4	5,9	14,9	
		R90	2,3	4,0	10,0	
		R120	1,7	3,0	7,6	
Pullout failure						
Characteristic resistance	$N_{Rk,p,fi}$ [kN]	R30	3,0	5,0	10,0	
		R60				
		R90				
		R120	2,4	4,0	8,0	
Edge distance (for all anchor variants and sizes)						
R30 to R120	$c_{cr,fi}$ [mm]	-	$2 \cdot h_{ef}$			
In case of fire attack from more than one site, the minimum edge distance shall be ≥ 300 mm						
Spacing (for all anchor variants and sizes)						
R30 to R120	$s_{cr,fi}$ [mm]	-	$2 \cdot c_{cr,fi}$			

[1)] The embedment depth has to be increased for wet concrete by at least 30 mm compared to the given value

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values for resistance to fire

Annex C 12

Deutsches Institut für Bautechnik DIBt

Table C13.1: Characteristic values for resistance to fire[1)]

FZA R, FZA HCR			**10x40 M6 12x40 M6 I 12x50 M6 I**	**12x40 M8 12x40 ST M8 12x50 M8 D/10**	**12x50 M8 12x60 M8 D/10 12x80 M8 D/30 14x60 M8 I 18x80 M10 I**	**14x40 M10 14x40 ST M10**
Steel failure for tension load and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)						
Characteristic resistance	$F_{Rk,s,fi}$ [kN]	R30	2,0	3,6		5,7
		R60	1,2	2,3		3,6
		R90	0,9	1,9		3,0
		R120	0,7	1,6		2,6
	$M^0_{Rk,s,fi}$ [Nm]	R30	1,5	3,7		7,4
		R60	0,9	2,4		4,7
		R90	0,7	1,9		3,8
		R120	0,5	1,7		3,4
Pullout failure						
Characteristic resistance	$N_{Rk,p,fi}$ [kN]	R30	1,5		2,3	1,5
		R60				
		R90				
		R120	1,2		1,8	1,2

FZA R, FZA HCR			**14x60 M10 14x60 ST M10 14x80 M10 D/20 14x100 M10 D/40**	**18x80 M12 18x100 M12 D/20 18x130 M12 D/50 22x100 M12 I 22x125 M12 I**	**22x100 M16 22x125 M16 D/25**	**22x125 M16**
Steel failure for tension load and shear load ($F_{Rk,s,fi} = N_{Rk,s,fi} = V_{Rk,s,fi}$)						
Characteristic resistance	$F_{Rk,s,fi}$ [kN]	R30	5,7	11,8	22,0	
		R60	3,6	7,0	13,1	
		R90	3,0	5,5	10,2	
		R120	2,6	4,7	8,7	
	$M^0_{Rk,s,fi}$ [Nm]	R30	7,4	18,3	46,6	
		R60	4,7	10,9	27,9	
		R90	3,8	8,5	21,6	
		R120	3,4	7,3	18,5	
Pullout failure						
Characteristic resistance	$N_{Rk,p,fi}$ [kN]	R30	3,0	5,0	10,0	
		R60				
		R90				
		R120	2,4	4,0	8,0	

Edge distance (for all anchor variants and sizes)				
R30 to R120	$c_{cr,fi}$	[mm]	-	$2 \cdot h_{ef}$
In case of fire attack from more than one side, the minimum edge distance shall be ≥ 300 mm				
Spacing (for all anchor variants and sizes)				
R30 to R120	$s_{cr,fi}$	[mm]	-	$2 \cdot c_{cr,fi}$

[1)] The embedment depth has to be increased for wet concrete by at least 30 mm compared to the given value

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Characteristic values for resistance to fire

Annex C 13

Deutsches Institut für Bautechnik DIBt

Table C14.1: Displacements due to **tension** loads for **bolt projecting anchor FZA**

Type of fastener / size			FZA (bolt projecting anchor)							
			10x40 M6	12x40 M8	14x40 M10	12x50 M8	14x60 M10	18x80 M12	22x100 M16	22x125 M16
Tension load in cracked concrete	N	[kN]	2,0			3,5	5,0	8,0	16,0	
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1							
Tension load in uncracked concrete	N	[kN]	3,3			4,8	7,5	12,7	17,9	
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1							

The displacements do not apply for FZA ST

Table C14.2: Displacements due to **tension** loads for **through bolt anchor FZA D**

Type of fastener / size			FZA D (through bolt anchor)´							
			12x50 M8D/ 10	12x60 M8D/ 10	12x80 M8D/ 30	14x80 M10D/ 20	14x100 M10D/ 40	18x100 M12D/ 20	18x130 M12D/ 50	22x125 M16D/ 25
Tension load in cracked concrete	N	[kN]	2,0	3,5		5,0		8,0		16,0
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1							
Tension load in uncracked concrete	N	[kN]	3,3	4,8		7,5		12,7		17,9
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1							

Table C14.3: Displacements due to **tension** loads for **internal thread anchor FZA I**

Type of fastener / size			FZA I (internal thread anchor FZA I)					
			12x40 M6 I	12x50 M6 I	14x60 M8 I	18x80 M10 I	22x100 M12 I	22x125 M12 I
Tension load in cracked concrete	N	[kN]	2,0	3,5	5,0	8,0	16,0	
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1					
Tension load in uncracked concrete	N	[kN]	3,3	4,8	7,5	12,7	17,9	
Displacement	$\frac{\delta_{N0}}{\delta_{N\infty}}$	[mm]	0,8 / 1,1					

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Displacements due to tension loads

Annex C 14

Deutsches Institut für Bautechnik DIBt

Table C15.1: Displacements due to **shear** loads for **bolt projecting anchor FZA** and **through bolt anchor FZA D**

Type of fastener / size			FZA (bolt projecting anchor) and FZA D (through bolt anchor)							
			10x40 M6	**14x40 M10**	**12x40 M8**	**12x50 M8**	**12x50 M8D/10**	**12x60 M8D/10**	**12x80 M8D/30**	**14x80 M10D/20**
Shear load in cracked and uncracked concrete	V	[kN]	4,0	9,0	5,0					12,5
Displacement	δ_{V0}	[mm]	2,0	1,9	0,7					1,9
	$\delta_{V\infty}$		3,0	2,8	1,0					2,8
			14x60 M10	**14x100 M10D/ 40**	**18x80 M12**	**18x100 M12D/ 20**	**18x130 M12D/ 50**	**22x100 M16**	**22x125 M16**	**22x125 M16D/ 25**
Shear load in cracked and uncracked concrete	V	[kN]	12,5	12,5	19,0			30,0		
Displacement	δ_{V0}	[mm]	1,9		2,1					
	$\delta_{V\infty}$		2,8		3,1					

The displacements do not apply for FZA ST

Table C15.2: Displacements due to **shear** loads for **internal thread anchor FZA I**

Type of fastener / size			FZA I (internal thread anchor)					
			12x40 M6 I	**12x50 M6 I**	**14x60 M8 I**	**18x80 M10 I**	**22x100 M12 I**	**22x125 M12 I**
Shear load in cracked and Uncracked concrete	V	[kN]	5,0		12,5	19,0	30,0	
Displacement	δ_{N0}	[mm]	0,7		1,9	2,1		
	$\delta_{N\infty}$		1,0		2,8	3,1		

Table C15.3: Displacements due to **tension** and **shear** loads for **seismic performance category C2** for **FZA and FZA D**

Type of fastener / size			FZA (bolt projecting anchor) and FZA D (through bolt anchor)				
			14x40 M10	**14x60 M10 14x80 M10 D 14x100 M10 D**	**18x80 M12 18x100 M12 D 18x130 M12 D**	**22x100 M16 22x125 M16 D**	**22x125 M16**
Displacement	$\delta_{N,C2(DLS)}$	[mm]	3,8		4,7	4,9	
	$\delta_{N,C2(ULS)}$		13,5		12,7	13,1	
	$\delta_{V,C2(DLS)}$		4,3		4,6	5,0	
	$\delta_{V,C2(ULS)}$		6,9		7,0	6,9	

fischer-ZYKON-Anchor FZA, FZA D, FZA I, FZA ST

Performances
Displacements due to shear loads
Displacements due to tension and shear loads for seismic performance category C2

Annex C 15