Deutsches Institut für Bautechnik
DIBt

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

Member of EOTA
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European Technical Assessment

ETA-22/0674 of 13 February 2025

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 Strong Undercut Anchor FSU
Product family to which the construction product belongs	Mechanical fastener for use in concrete
Manufacturer	fischerwerke GmbH & Co. KG Klaus-Fischer-Straße 1 72178 Waldachtal DEUTSCHLAND
Manufacturing plant	fischerwerke
This European Technical Assessment contains	20 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 330232-02-0601 Edition 12/2024
This version replaces	ETA-22/0674 issued on 12 April 2024

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Specific part

1 Technical description of the product

The fischer Strong Undercut Anchor is an anchor made of galvanised steel or of stainless steel which is placed in a cylindrical hole and anchored by displacement-controlled, self-undercutted mechanical interlock.

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 anchor 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 anchor of at least 50 years and 100 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 and C3
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C2
Displacements	See Annex C6 and C8
Stiffness	See Annex C8
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C5 and C7

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C4

3.3 Aspects of Durability

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 330232-02-0601 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 EAD

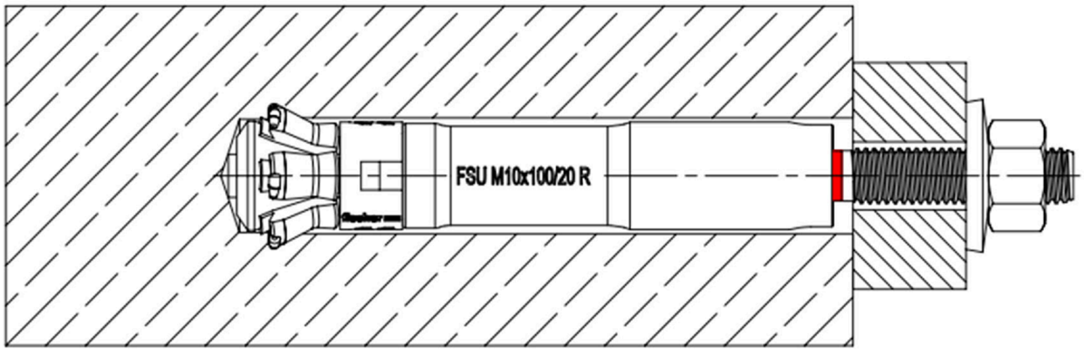
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 13 February 2025 by Deutsches Institut für Bautechnik

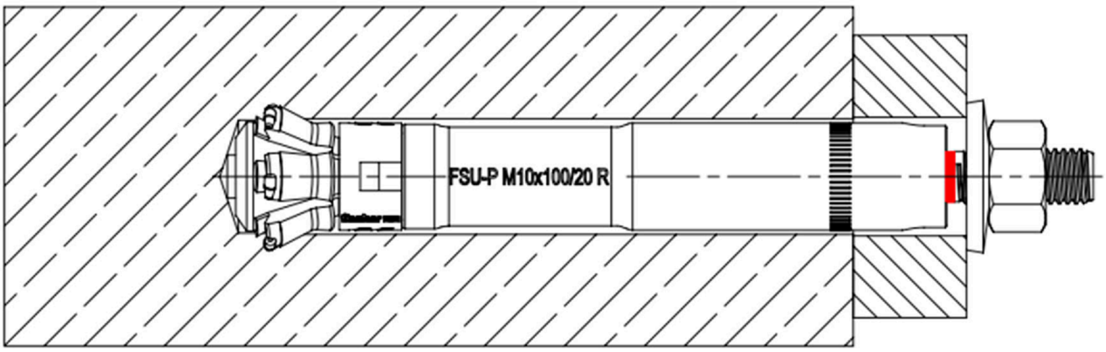
Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Ziegler

Pre-setting anchor FSU / FSU R



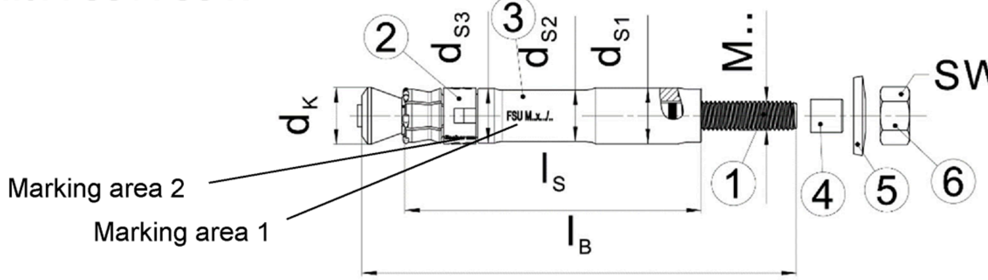
Push-through anchor FSU-P / FSU-P R



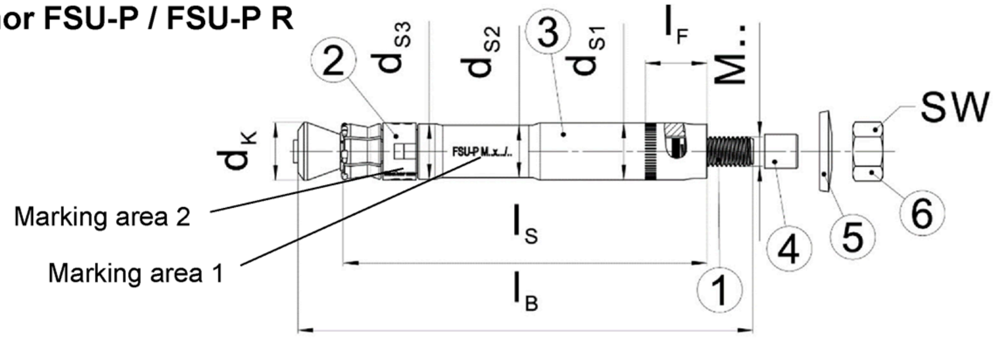
(Figures not to scale)

fischer Strong Undercut Anchor FSU	Annex A1
Product description Installed condition	

Pre-setting anchor FSU / FSU R



Push-through anchor FSU-P / FSU-P R



Product marking, example: FSU-P M10x100/20 R   optional: Brand

Type of fastener — FSU-P

Thread size x effective embedment depth (h_{ef}) / Max. thickness of the fixture (t_{fix}) — M10x100/20

Identification R (stainless steel version) — R

Table A2.1: Dimensions [mm]

Type of anchor	t_{fix}	d_K	d_{S1}	d_{S2}	d_{S3}	M	l_S	l_B	l_F	SW
FSU M10x100/20 (R)	≤ 20	19,3	19	17,5	18,5	10	100	148	-	17
FSU M12x125/30 (R)	≤ 30	21,5	21	19,3	20,5	12	125	188	-	19
FSU M12x125/50 (R)	≤ 50	21,5	21	19,3	20,5	12	125	208	-	19
FSU-P M10x100/20 (R)	≥ 10 ≤ 20	19,3	19	17,5	18,5	10	120	148	20	17
FSU-P M12x125/30 (R)	≥ 12 ≤ 30	21,5	21	19,3	20,5	12	155	188	30	19
FSU-P M12x125/50 (R)	≥ 12 ≤ 50	21,5	21	19,3	20,5	12	175	208	50	19

Table A2.2: Materials FSU

Part	Designation	Material	
		FSU, FSU-P	**FSU R, FSU-P R**
1	Cone bolt	Steel, zinc plated ≥ 5 µm, EN ISO 4042:2022	Stainless steel according to EN 10088:2014
2	Plastic sleeve	Plastic	
3	Sleeve	Steel, zinc plated ≥ 5 µm, EN ISO 4042:2022	Stainless steel according to EN 10088:2014
4	Protective cap	Plastic	
5	Washer	Steel, zinc plated ≥ 5 µm, EN ISO 4042:2022	Stainless steel according to EN 10088:2014
6	Hexagon nut	Steel, zinc plated ≥ 5 µm, EN ISO 4042:2022	Stainless steel A4-80

(Figures not to scale)

fischer Strong Undercut Anchor FSU

Product description
Product marking, dimensions and materials

Annex A2

Stop drill bit FSU-SD

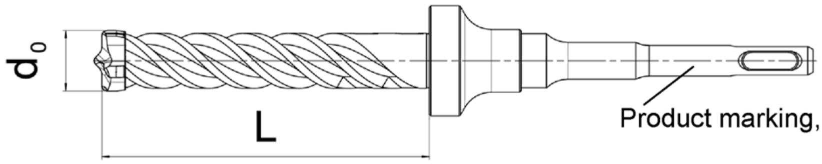


Table A3.1: Required stop drill bits for FSU

Type of anchor	Type of stop drill bit	d_0 [mm]	L [mm]
FSU M10x100/20 (R)	FSU-SD 20x100	20	107
FSU M12x125/30 (R)	FSU-SD 22x125	22	132
FSU M12x125/50 (R)			
FSU-P M10x100/20 (R)	FSU-SD 20x120	20	127
FSU-P M12x125/30 (R)	FSU-SD 22x155	22	162
FSU-P M12x125/50 (R)	FSU-SD 22x175	22	182

Machine setting tool FSU-ST

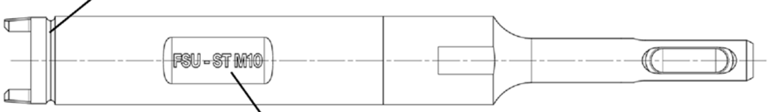


Table A3.2: Required setting tools for FSU

Type of anchor	Type of setting tool
FSU M10x100/20 (R)	FSU-ST M10
FSU M12x125/30 (R)	FSU-ST M12
FSU M12x125/50 (R)	
FSU-P M10x100/20 (R)	FSU-ST M10
FSU-P M12x125/30 (R)	FSU-ST M12
FSU-P M12x125/50 (R)	

Table A3.3: Recommendations for hammer drills used with FSU-ST

Technical feature		Recommendation
Drill chuck	[-]	SDS plus
Hammer drilling RPM	[rpm]	600 - 1800
Hammer impact energy	[J]	2,5 - 6

(Figures not to scale)

fischer Strong Undercut Anchor FSU	Annex A3
Product description Setting tools	

Specifications of intended use with working life 50 and 100 years

Fastenings subject to:

Size		FSU, FSU R			FSU-P, FSU-P R		
		M10x100 /20	**M12x125 /30**	**M12x125 /50**	**M10x100 /20**	**M12x125 /30**	**M12x125 /50**
Static and quasi-static loads		✓					
Cracked and uncracked concrete							
Seismic performance category	C1						
	C2						
Fire exposure							

Base materials:

- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked and uncracked) according to EN 206:2013+A2:2021
- Strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (FSU, FSU-P, FSU R, FSU-P R)
- For all other conditions according to EN 1993-1-4:2006 + A1:2015 corresponding to corrosion resistance class CRC III: FSU R, FSU-P R

Design:

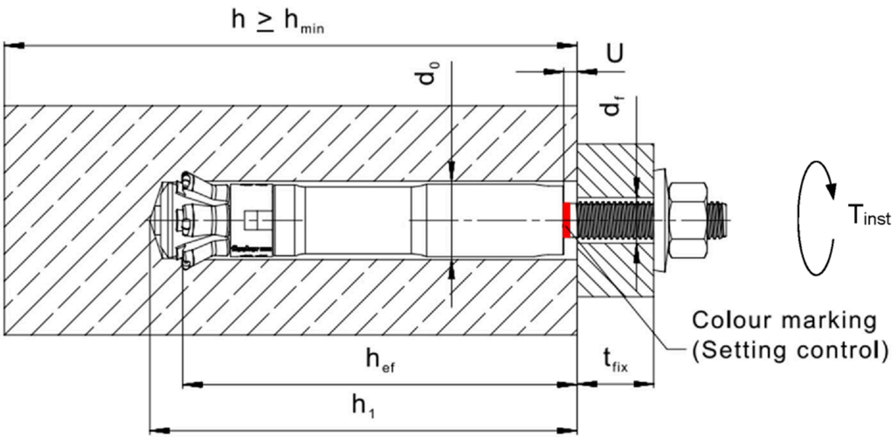
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed in accordance with EN 1992-4:2018.
- For requirements to resistance to fire local spalling of the concrete cover must be avoided.
- The stiffness characteristics k_A-k_D (Annex C8) are intended to be used in finite element calculations, such as linear- and non-linear spring models, for the design of the fastener as a function of fastener displacements and the anchor plate stiffness.

fischer Strong Undercut Anchor FSU	**Annex B1**
Intended Use Specifications	

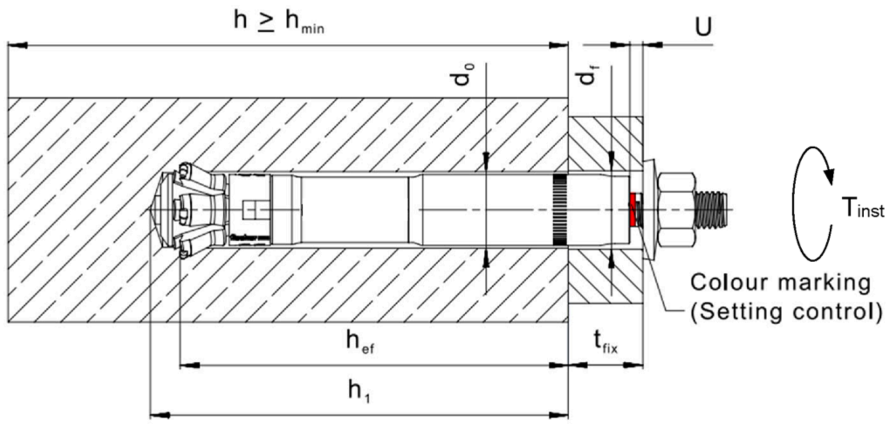
Installation parameters

Table B2.1: Installation parameters

Size			FSU, FSU R M10x100 /20	FSU, FSU R M12x125 /30	FSU, FSU R M12x125 /50	FSU-P, FSU-P R M10x100 /20	FSU-P, FSU-P R M12x125 /30	FSU-P, FSU-P R M12x125 /50
Nominal drill hole diameter	d_0	[mm]	20	22	22	20	22	22
Cutting diameter of drill bits	$d_{cut} \leq$	[mm]	20,5	22,5	22,5	20,5	22,5	22,5
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	107	132	132	127-t_{fix}	162-t_{fix}	182-t_{fix}
Effective embedment depth	$h_{ef} \geq$	[mm]	100	125	125	100	125	125
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12	14	14	21	23	23
Thickness of the fixture	t_{fix}	[mm]	≤ 20	≤ 30	≤ 50	≥ 10 ≤ 20	≥ 12 ≤ 30	≥ 12 ≤ 50
Gap after setting	U	[mm]	2 - 5	3 - 6	3 - 6	2 - 5	3 - 6	3 - 6
Required setting torque	T_{inst}	[Nm]	40	80	80	40	80	80



FSU (R)



FSU-P (R)

(Figures not to scale)

fischer Strong Undercut Anchor FSU

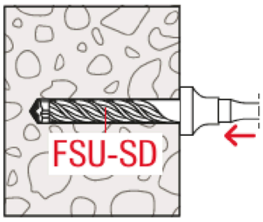
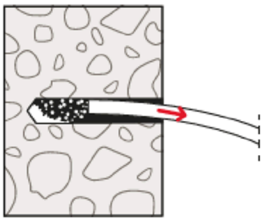
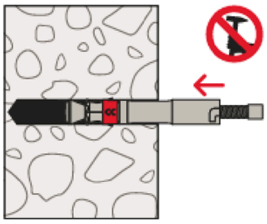
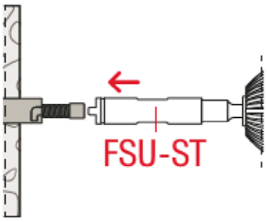
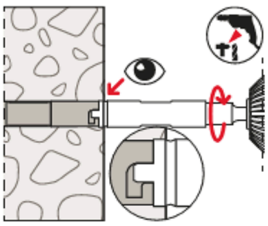
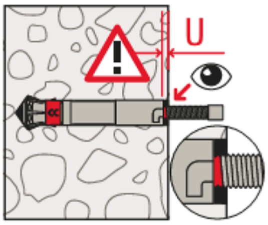
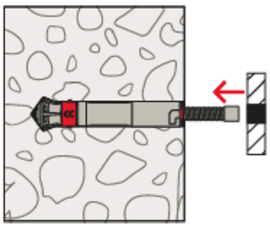
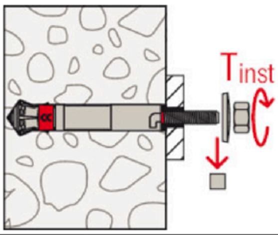
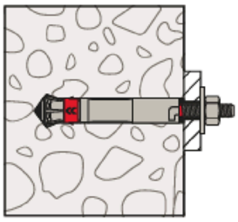
Intended Use
Installation parameters

Annex B2

Installation instructions

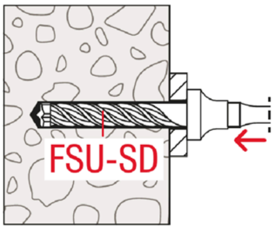
- Fastener installation carried out by appropriately qualified personnel according to the design drawings and under the supervision of the person responsible for technical matters on the site.
- Use of the fastener only as supplied by the manufacturer without exchanging the components of the fastener.
- Fastener installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools (machine setting tool FSU-ST, stop drill bit FSU-SD).
- Drill hole created perpendicular (tolerance +/- 5°) to concrete surface.
- Cleaning the hole of drilling dust.
- Fastener installation ensuring complete expansion of the sleeve with checking that the coloured ring marking on the bolt is visible above the top edge of the anchor sleeve, therefore it is required using the setting tool FSU-ST, that is the appropriate depth ring marking of the setting tool at least flush with the concrete surface (pre-setting) respecting with the fixture surface (Push-through-setting).
- Fastener installation ensuring complete shear load capacity, after setting the gap between the top edge of the sleeve and the concrete surface (pre-setting) or with surface of the fixture (Push-through-setting) has to be in the specified range according to Annex B2, Table B2.1.
- Positioning of the drill holes and the undercut 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.
- Application of the torque moment given in Annex B2, Table B2.1 using a calibrated torque wrench.

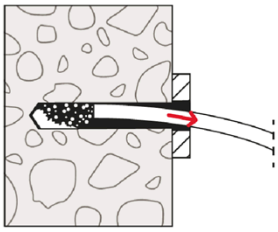
Installation instructions for pre-setting anchor FSU, FSU R

1)  2) 	1) Drill the hole with the designated stop drill bit FSU-SD (see Table A3.1). 2) Clean the hole.
3)  4) 	3) Place the anchor in the hole by hand. Do not use any hammering tools. 4) Use the designated setting tool FSU-ST (see Table A3.2) and follow the recommendations for the hammer drill (see Table A3.3).
5)  6) 	5) Place the setting tool in the grooves provided on the anchor. Carry out the setting process with the rotary-impact mode of the hammer drill. The setting process is completed when the marking ring of the setting tool is flush with the concrete surface. 6) After removing the setting tool, the red coloured ring marking on the bolt must be visible above the top edge of the anchor sleeve. The gap U between the top edge of the sleeve and the concrete surface must be in the specified range according to Table B2.1.
7)  8) 	7) Place the fixture. 8) Remove the protective cap. Place the spring washer and the hexagon nut on the bolt. Take care of the right orientation of the spring washer, in the way, that the outer diameter of the washer in uncompressed condition is in touch with the fixture, only. Apply the installation torque.
9) 	9) Correctly installed fastener.

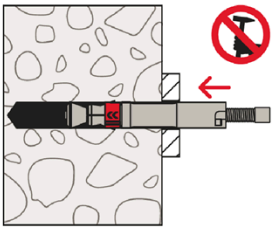
fischer Strong Undercut Anchor FSU	**Annex B4**
Intended Use Installation instructions	

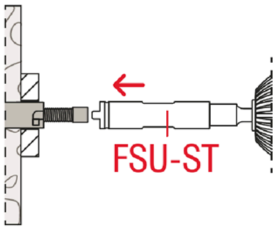
Installation instructions for push-though anchor FSU-P, FSU-P R

1)


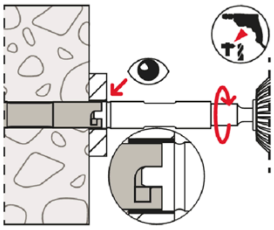
2)


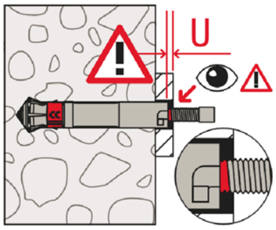
1) Drill the hole with the designated stop drill bit FSU-SD (see table A3.1) in compliance with the specified range of fixture thicknesses (see Table B2.1).
2) Clean the hole.

3)


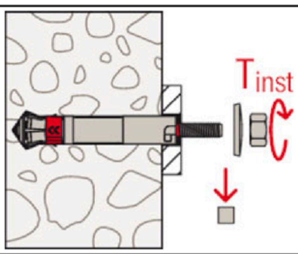
4)


3) Place the anchor in the hole by hand. Do not use any hammering tools.
4) Use the designated setting tool FSU-ST (see Table A3.2) and follow the recommendations for the hammer drill (see Table A3.3).

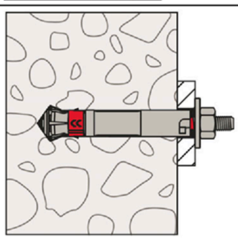
5)


6)


5) Place the setting tool in the grooves provided on the anchor. Carry out the setting process with the rotary-impact mode of the hammer drill. The setting process is completed when the marking ring of the setting tool is flush with the fixture surface.
6) After removing the setting tool, the red coloured ring marking on the bolt must be visible above the top edge of the anchor sleeve. The gap U between the top edge of the sleeve and the fixture surface must be in the specified range according to Table B2.1.

7)


7) Remove the protective cap. Place the spring washer and the hexagon nut on the bolt. Take care of the right orientation of the spring washer, in the way, that the outer diameter of the washer in uncompressed condition is in touch with the fixture, only. Apply the installation torque.

8)


8) Correctly installed fastener.

fischer Strong Undercut Anchor FSU	**Annex B5**
Intended Use Installation instructions	

Table C1.1: Characteristic **tension resistance** under static and quasi-static action for working life 50 and 100 years

Size				FSU, FSU-P, FSU R, FSU-P R	
				M10x100	**M12x125**
Steel failure					
Characteristic resistance		$N_{Rk,s}$ FSU, FSU	[kN]	44,2	65,9
		$N_{Rk,s}$ FSU R, FSU-P R		45,7	67,4
Partial factor for steel failure		γ_{Ms}	[-]	1,5	
Pullout failure					
Characteristic resistance in C20/25	cracked concrete	$N_{Rk,p,cr} = N_{Rk,p,cr,100}$	[kN]	30,0	40,0
	uncracked concrete	$N_{Rk,p,ucr} = N_{Rk,p,ucr,100}$ FSU, FSU-P		44,2	65,9
		$N_{Rk,p,ucr} = N_{Rk,p,ucr,100}$ FSU R, FSU-P R		45,7	69,4
Increasing factor for $N_{Rk,p}$; $N_{Rk,p,100}$ $N_{Rk,p} = \psi_c * N_{Rk,p}$ (C20/25) $N_{Rk,p,100} = \psi_c * N_{Rk,p,100}$ (C20/25)		$\psi_c = \psi_{c,cr} = \psi_{c,ucr}$ [-]	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 sensitivity factor		γ_{inst}	[-]	1,0	
Concrete cone and splitting failure					
Effective embedment depth		h_{ef}	[mm]	100	125
Factor for cracked concrete		$k_{cr,N}$	[-]	8,9	
Factor for uncracked concrete		$k_{ucr,N}$	[-]	12,7	
Characteristic spacing		$s_{cr,N}$	[mm]	3 x h_{ef}	
Characteristic edge distance		$c_{cr,N}$	[mm]	1,5 x h_{ef}	
Characteristic spacing		$s_{cr,sp}$	[mm]	3 x h_{ef}	
Characteristic edge distance		$c_{cr,sp}$	[mm]	1,5 x h_{ef}	
Characteristic resistance to splitting		$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$[1)]	

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

fischer Strong Undercut Anchor FSU

Performances
Characteristic tension resistance under static and quasi-static action for working life 50 and 100 years

Annex C1

Table C2.1: Characteristic **shear resistance** under static and quasi-static action for working life 50 and 100 years **FSU, FSU R**

Size			**FSU, FSU R** M10x100	**FSU, FSU R** M12x125
Steel failure without lever arm				
Characteristic resistance	$V^0_{Rk,s}$ FSU	[kN]	26,8	38,2
	$V^0_{Rk,s}$ FSU R		32,9	49,9
Partial factor for steel failure	γ_{Ms}	[-]	1,25	
Factor for ductility	k_7		1,0	
Steel failure with lever arm				
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	59,8	104,8
Partial factor for steel failure	γ_{Ms}	[-]	1,25	
Concrete pryout failure				
Factor for pryout failure	k_8	[-]	2,4	
Concrete edge failure				
Effective length in concrete	l_f	[mm]	100	125
Effective diameter of fastener	d_{nom}		19	21

Table C2.2: Characteristic **shear resistance** under static and quasi-static action for working life 50 and 100 years **FSU-P, FSU-P R**

Size			**FSU-P, FSU-P R** M10x100		**FSU-P, FSU-P R** M12x125	
Steel failure without lever arm						
Characteristic resistance	for t_{fix}	[mm]	$10 \le t_{fix} < 15$	$15 \le t_{fix} \le 20$	$12 \le t_{fix} < 20$	$20 \le t_{fix} \le 50$
	$V^0_{Rk,s}$ FSU-P	[kN]	66,1	69,6	86,4	96,7
	$V^0_{Rk,s}$ FSU-P R		74,6	80,6	102,9	103,6
Partial factor for steel failure	γ_{Ms}	[-]	1,25			
Factor for ductility	k_7		1,0			
Steel failure with lever arm						
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	59,8		104,8	
Partial factor for steel failure	γ_{Ms}	[-]	1,25			
Concrete pryout failure						
Factor for pryout failure	k_8		2,4			
Concrete edge failure						
Effective length in concrete	l_f	[mm]	100		125	
Effective diameter of fastener	d_{nom}		19		21	

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Performances
Characteristic shear resistance under static and quasi-static action for working life 50 and 100 years

Annex C2

Table C3.1: Minimum thickness of concrete members **FSU, FSU R**

Size			FSU M10x100/20	FSU M12x125/30	FSU M12x125/50
Minimum thickness of concrete member	h_{min}	[mm]	170	215	

Table C3.2: Minimum thickness of concrete members **FSU-P, FSU-P R**

Size			FSU-P M10x100/20	FSU-P M12x125/30	FSU-P M12x125/50
Maximum thickness of the fixture	$t_{fix,max}$	[mm]	20	30	50
Minimum thickness of concrete member	h_{min}	[mm]	190-t_{fix} [1)]	245-t_{fix} [1)]	265-t_{fix} [1)]

[1)] t_{fix} = actual thickness of the fixture

Table C3.3: Minimum spacings and edge distances

Size			FSU, FSU-P, FSU R, FSU-P R M10x100/20	FSU, FSU-P, FSU R, FSU-P R M12x125/30	FSU, FSU-P, FSU R, FSU-P R M12x125/50
Minimum spacing	s_{min}	[mm]	80	90	
Minimum edge distance	c_{min}	[mm]	80	90	

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Performances
Minimum thickness of concrete member, minimum spacings and edge distances

Annex C3

Table C4.1: Characteristic **tension resistance** under **fire exposure** for working life 50 and 100 years

Size				FSU, FSU-P		FSU R, FSU-P R	
				M10x100	M12x125	M10x100	M12x125
Characteristic resistance **steel failure**	$N_{Rk,s,fi}$	R30	[kN]	3,7	4,5	7,2	10,4
		R60		2,2	3,2	5,3	7,7
		R90		1,7	2,8	4,7	6,8
		R120		1,5	2,6	4,4	6,4
Characteristic resistance **Concrete cone failure**	$N_{Rk,c,fi}$	R30-R90		19,9	34,8	19,9	34,8
		R120		15,9	27,7	15,9	27,8
Characteristic resistance **pullout failure**	$N_{Rk,p,fi}$	R30-R90		7,5	10,0	7,5	10,0
		R120		6,0	8,0	6,0	8,0

Table C4.2: Characteristic **shear resistance** under **fire exposure** for working life 50 and 100 years

Size				FSU, FSU-P		FSU R, FSU-P R	
				M10x100	M12x125	M10x100	M12x125
Characteristic resistance **steel failure without lever arm**	$V_{Rk,s,fi}$	R30	[kN]	3,7	4,4	7,2	10,4
		R60		2,2	3,0	5,3	7,7
		R90		1,7	2,6	4,7	6,8
		R120		1,5	2,3	4,4	6,4
Characteristic bending resistance **steel failure with lever arm**	$M^0_{Rk,s,fi}$	R30	[Nm]	4,8	6,9	9,2	16,2
		R60		2,9	5,0	6,9	12,0
		R90		2,2	4,4	6,1	10,6
		R120		1,9	4,0	5,7	9,9
Concrete failure $V^0_{Rk,c,fi}$ and $V_{Rk,cp,fi}$				According to EN 1992-4:2018			

Table C4.3: **Minimum spacings** and **minimum edge distances** under **fire exposure** for **tension** and **shear** load

Size			FSU, FSU-P, FSU R, FSU-P R All sizes
Spacing	$s_{min,fi}$	[mm]	$4 \cdot h_{ef}$
Edge distance	$c_{min,fi}$		$2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min,fi} \geq 300$ mm

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Performances
Characteristic resistance under fire exposure with working life 50 and 100 years

Annex C4

Table C5.1: Characteristic values of **tension** and **shear resistance** under **seismic performance category C1** for working life 50 and 100 years

Size				FSU, FSU-P, FSU R, FSU-P R			
				M10x100		M12x125	
Steel failure							
Characteristic resistance tension load C1		$N_{Rk,s,C1}$ FSU, FSU-P	[kN]	44,2		65,9	
		$N_{Rk,s,C1}$ FSU R, FSU-P R	[kN]	46,2		67,4	
Pullout failure							
Characteristic resistance tension load in cracked concrete C1		$N_{Rk,p,C1}$	[kN]	30,0		40,0	
Steel failure without lever arm							
Characteristic resistance shear load C1		for t_{fix}	[mm]	$10 \le t_{fix} < 15$	$15 \le t_{fix} \le 20$	$12 \le t_{fix} < 20$	$20 \le t_{fix} \le 50$
		$V_{Rk,s,C1}$ FSU	[kN]	18,8		26,8	
		$V_{Rk,s,C1}$ FSU R	[kN]	23,0		34,9	
		$V_{Rk,s,C1}$ FSU-P	[kN]	46,3	48,7	60,5	67,7
		$V_{Rk,s,C1}$ FSU-P R	[kN]	52,2	56,4	72,0	72,5

Table C5.2: Characteristic values of **tension** and **shear resistance** under **seismic performance category C2** with working life 50 and 100 years

Size				FSU, FSU-P, FSU R, FSU-P R			
				M10x100		M12x125	
Steel failure							
Characteristic resistance tension load C2		$N_{Rk,s,C2}$ FSU, FSU-P	[kN]	44,2		65,9	
		$N_{Rk,s,C2}$ FSU R, FSU-P R	[kN]	45,0		67,4	
Pullout failure							
Characteristic resistance tension load in cracked concrete C2		$N_{Rk,p,C2}$	[kN]	30,0		40,0	
Steel failure without lever arm							
Characteristic resistance shear load C2		for t_{fix}	[mm]	$10 \le t_{fix} < 15$	$15 \le t_{fix} \le 20$	$12 \le t_{fix} < 20$	$20 \le t_{fix} \le 50$
		$V_{Rk,s,C2}$ FSU	[kN]	20,1		24,5	
		$V_{Rk,s,C2}$ FSU R	[kN]	22,8		31,9	
		$V_{Rk,s,C2}$ FSU-P	[kN]	39,6	41,8	51,8	62,9
		$V_{Rk,s,C2}$ FSU-P R	[kN]	37,2		56,6	67,3

Table C6.1: Displacements under static and quasi-static tension loads for working life 50 and 100 years

Size			FSU, FSU-P, FSU R, FSU-P R	
			M10x100	M12x125
Tension load in cracked concrete C20/25	N	[kN]	21,8	33,1
Displacements	δ_{N0}	[mm]	1,1	1,3
	$\delta_{N,50years} = \delta_{N,100years}$	[mm]	1,3	1,3
Tension load in uncracked concrete C20/25	N	[kN]	21,8	33,1
Displacements	δ_{N0}	[mm]	1,1	1,7
	$\delta_{N,50years} = \delta_{N,100years}$	[mm]	2,8	2,8

Table C6.2: Displacements under static and quasi-static shear loads for working life 50 and 100 years

Size			FSU, FSU-P, FSU R, FSU-P R	
			M10x100	M12x125
Shear load in cracked and uncracked concrete C20/25	V	[kN]	13,8	21,3
Displacements FSU	δ_{V0}	[mm]	5,4	6,7
	$\delta_{V\infty}$	[mm]	8,0	10,0
Shear load in cracked and uncracked concrete C20/25	V	[kN]	16,9	25,6
Displacements FSU R	δ_{V0}	[mm]	2,4	3,8
	$\delta_{V\infty}$	[mm]	3,6	5,8
Shear load in cracked and uncracked concrete C20/25	V	[kN]	36,3	52,2
Displacements FSU-P	δ_{V0}	[mm]	5,9	7,2
	$\delta_{V\infty}$	[mm]	8,8	10,7
Shear load in cracked and uncracked concrete C20/25	V	[kN]	39,6	55,4
Displacements FSU-P R	δ_{V0}	[mm]	8,91	8,7
	$\delta_{V\infty}$	[mm]	13,4	13,1

Table C7.1: **Displacements** under **tension** loads for **seismic performance category C2** for working life 50 and 100 years

Size			FSU, FSU-P, FSU R, FSU-P R	
			M10x100	**M12x125**
Displacement	$\delta_{N,C2(0,5)}$	[mm]	4,6	4,6
	$\delta_{N,C2(0,8)}$		11,4	10,4

Table C7.2: **Displacements** under **shear** loads for **seismic performance category C2** for working life 50 and 100 years

Size			FSU, FSU-P, FSU R, FSU-P R	
			M10x100	**M12x125**
Displacement FSU	$\delta_{V,C2(0,5)}$	[mm]	5,2	5,0
	$\delta_{V,C2(0,8)}$		7,3	6,7
Displacement FSU R	$\delta_{V,C2(0,5)}$		4,7	4,1
	$\delta_{V,C2(0,8)}$		6,8	5,9
Displacement FSU-P	$\delta_{V,C2(0,5)}$		4,8	5,0
	$\delta_{V,C2(0,8)}$		10,7	18,5
Displacement FSU-P R	$\delta_{V,C2(0,5)}$		3,7	4,2
	$\delta_{V,C2(0,8)}$		7,8	13,2

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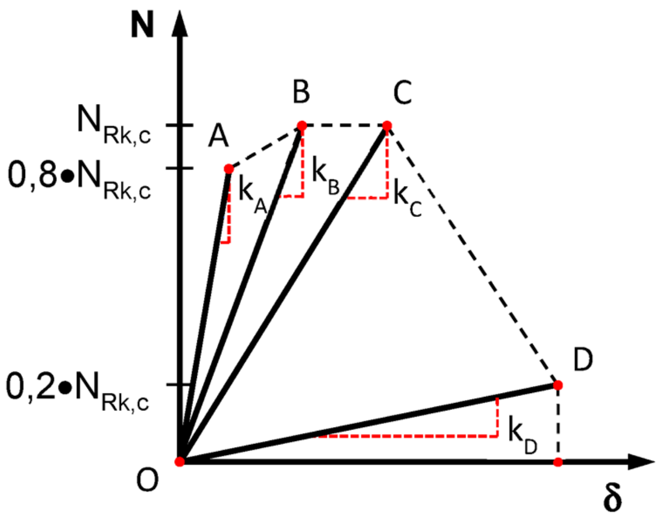
Table C8.1: Stiffness characteristics (mean values) under static and quasi-static **tension** loads for working life 50 and 100 years

Size			FSU, FSU-P, FSU-R, FSU-P R	
			M10x100	**M12x125**
Stiffness characteristics in cracked concrete	$k_{A,cr}$	[kN/mm]	20,1	22,6
	$k_{B,cr}$		13,8	16,0
	$k_{C,cr}$		10,4	12,2
	$k_{D,cr}$		1,8	2,0
Stiffness characteristics in uncracked concrete	$k_{A,ucr}$		33,1	35,0
	$k_{B,ucr}$		25,2	24,5
	$k_{C,ucr}$		20,6	17,3
	$k_{D,ucr}$		3,7	3,4

- The stiffness characteristics k_A-k_D are intended to be used in finite element calculations, such as linear- and non-linear spring models (k_A for linear spring model and k_A-k_D for non-linear spring model), for the design of the fastener group as a function of fastener displacements and the anchor plate stiffness.
- For linear spring model: mean displacement for any load N: $\delta_{mean} = N / k_A$



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Performances
Stiffness characteristics under static and quasi-static loads with working life 50 and 100 years

Annex C8