Deutsches Institut für Bautechnik
DIBt

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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-17/0624 of 28 April 2020

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 Bolt Anchor FBZ, FBZ R
Product family to which the construction product belongs	Mechanical anchor for use in concrete
Manufacturer	fischerwerke GmbH & Co. KG Klaus-Fischer-Straße 1 72178 Waldachtal DEUTSCHLAND
Manufacturing plant	fischerwerke
This European Technical Assessment contains	17 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 330232-00-0601
This version replaces	ETA-17/0624 issued on 8 September 2017

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Specific Part

1 Technical description of the product

The fischer Bolt Anchor FBZ is an anchor made of galvanised steel (FBZ) or made of stainless steel (FBZ R) which is placed into a drilled hole and anchored by torque-controlled expansion.

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)	See Annex B 3, C 1 and C 2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 3
Displacements (static and quasi-static loading)	See Annex C 5
Characteristic resistance and displacements for seismic performance categories C1 and C2	No performance assessed
Durability	See Annex B 1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 4

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 330232-00-0601 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.

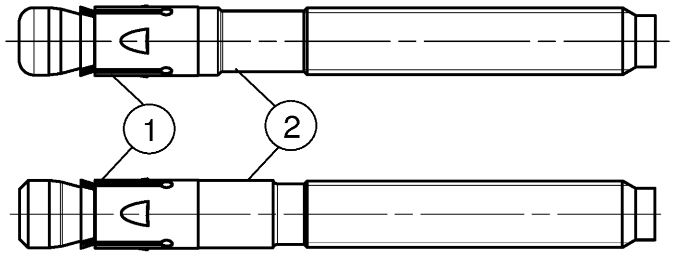
Issued in Berlin on 28 April 2020 by Deutsches Institut für Bautechnik

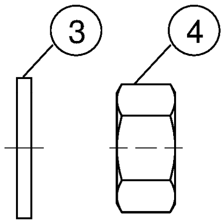
BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Baderschneider

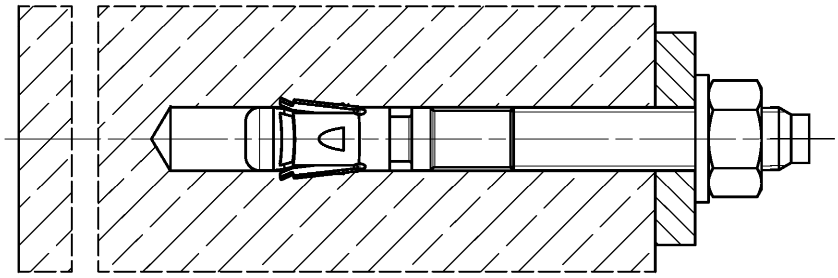
Cone bolt manufactured by cold - forming:

Cone bolt manufactured by turning:





① Expansion sleeve
② Cone bolt (cold – formed or turned)
③ Washer
④ Hexagon nut



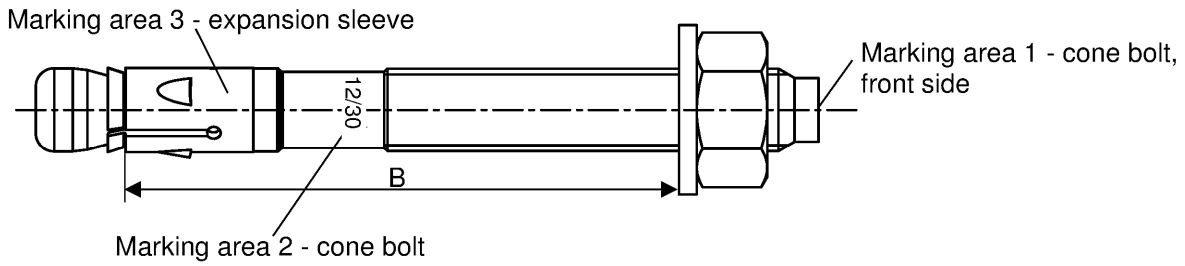
(Fig. not to scale)

fischer Bolt Anchor FBZ, FBZ R

Product description
Installed condition

Annex A 1

Product label and letter-code:



Product label, example: FBZ 12/30 R

Brand | type of fastener placed at marking area 2 or marking area 3

Thread size / max. thickness of the fixture (t_{fix}) identification R placed at marking area 2

FBZ: carbon steel, galvanized
FBZ R: stainless steel

Table A2.1: Letter - code at marking area 1:

Marking		(a)	(b)	(c)	(d)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)
Max. t_{fix}		5	10	15	20	5	10	15	20	25	30	35	40	45	50
B ≥ [mm]	M8	40	45	-		50	55	60	65	70	75	80	85	90	95
	M10	45	50	55	60	65	70	75	80	85	90	95	100	105	110
	M12	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	M16	70	75	80	85	90	95	100	105	110	115	120	125	130	135
	M20	-				105	110	115	120	125	130	135	140	145	150

Marking		(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
Max. t_{fix}		60	70	80	90	100	120	140	160	180	200	250	300	350	400
B ≥ [mm]	M8	105	115	125	135	145	165	185	205	225	245	295	345	395	445
	M10	120	130	140	150	160	180	200	220	240	260	310	360	410	460
	M12	130	140	150	160	170	190	210	230	250	270	320	370	420	470
	M16	145	155	165	175	185	205	225	245	265	285	335	385	435	485
	M20	160	170	180	190	200	220	240	260	280	300	350	400	450	500

Calculation existing h_{ef} for installed fasteners:

existing h_{ef} = $B_{(according\ to\ table\ A2.1)}$ – existing t_{fix}

Thickness of the fixture t_{fix} including thickness of fastener plate t and e.g. thickness of grout layer t_{grout} or other non-structural layers

(Fig. not to scale)

fischer Bolt Anchor FBZ, FBZ R	**Annex A 2**
Product description Product label and letter code	

Product dimensions

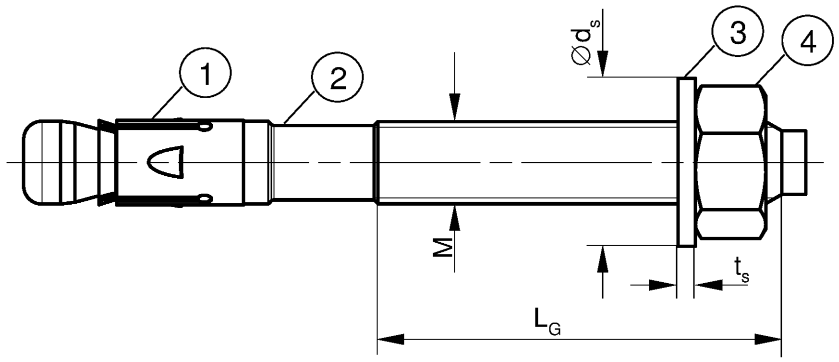


Table A3.1: Dimensions [mm]

Part	Designation			FBZ, FBZ R				
				M8	**M10**	**M12**	**M16**	**M20**
1	Expansion sleeve	Sheet thickness		1,3	1,4	1,6	2,4	
2	Cone bolt	Thread size M		8	10	12	16	20
		L_G	≥	19	26	31	40	50
3	Washer	t_s	≥	1,4	1,8	2,3	2,7	
		∅ d_s	≥	15	19	23	29	36
4	Hexagon nut	Wrench size		13	17	19	24	30

(Fig. not to scale)

fischer Bolt Anchor FBZ, FBZ R

Product description
Dimensions

Annex A 3

Table A4.1: Materials FBZ (ISO 4042:2018/Zn5/An(A2K))

Part	Designation	Material
1	Expansion sleeve	Cold strip, EN 10139:2016 or stainless steel EN 10088:2014
2	Cone bolt	Cold form steel or free cutting steel
3	Washer	Cold strip, EN 10139:2016
4	Hexagon nut	Steel, property class min. 8, EN ISO 898-2:2012

Table A4.2: Materials FBZ R

Part	Designation	Material
1	Expansion sleeve	Stainless steel EN 10088:2014
2	Cone bolt	
3	Washer	
4	Hexagon nut	Stainless steel EN 10088:2014; ISO 3506-2:2018; property class – min. 70

Specifications of intended use

Anchorages subject to:

Size	FBZ, FBZ R				
	M8	**M10**	**M12**	**M16**	**M20**
Static and quasi-static loads	✓				
Cracked and uncracked concrete					
Fire exposure					

Base materials:

- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked and uncracked) according to EN 206-1:2013+A1:2016
- Strength classes C20/25 to C50/60 according to EN 206-1:2013+A1:2016

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (FBZ, FBZ R)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (FBZ R)
  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where deicing materials are used)

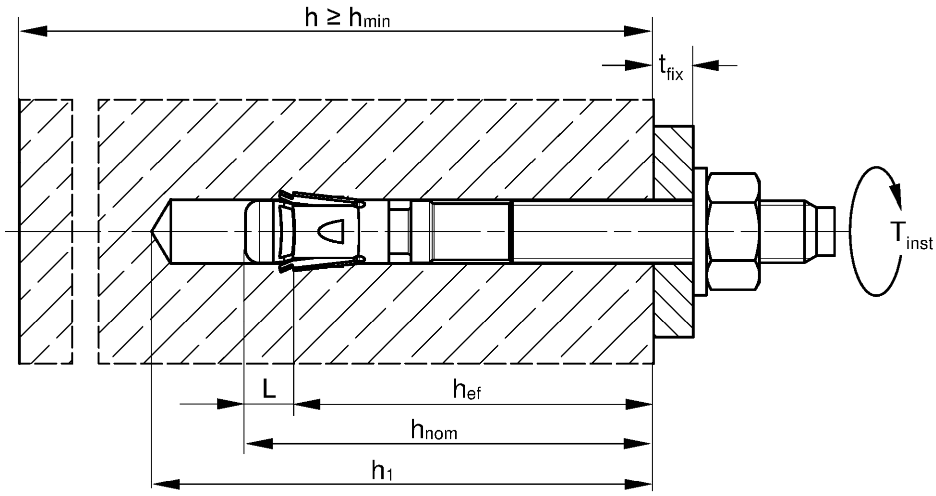
Design:

- Anchorages are to be 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.)
- Design of fastenings according to EN 1992-4:2018 and EOTA Technical Report TR 055
- For effective embedment depth h_{ef} < 40 mm only statically indeterminate fixings (e.g. light-weight suspended ceilings with internal exposure) are covered by the ETA

fischer Bolt Anchor FBZ, FBZ R	**Annex B 1**
Intended Use Specifications	

Table B2.1: Installation parameters

Size			FBZ, FBZ R				
			M8	**M10**	**M12**	**M16**	**M20**
Nominal drill hole diameter	$d_0 =$	[mm]	8	10	12	16	20
Maximum bit diameter with hammer or hollow drilling	$d_{cut,max}$	[mm]	8,45	10,45	12,5	16,5	20,55
Maximum bit diameter with diamond drilling	$d_{cut,max}$	[mm]	8,15	10,45	12,25	16,45	20,50
Overall fastener embedment depth in the concrete	$h_{nom} \geq$ (L)	[mm]	44,5 (9,5)	52,0 (12)	63,5 (13,5)	82,5 (17,5)	120 (20)
			Existing h_{ef} + L = h_{nom}				
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	h_{nom} + 5				h_{nom} + 10
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9	12	14	18	22
Required setting torque	T_{inst} =	[Nm]	20	45	60	110	200



h_{ef} = Effective embedment depth
t_{fix} = Thickness of the fixture
h_1 = Depth of drill hole to deepest point
h = Thickness of the concrete member
h_{min} = Minimum thickness of concrete member
h_{nom} = Overall fastener embedment depth in the concrete
T_{inst} = Required setting torque

(Fig. not to scale)

fischer Bolt Anchor FBZ, FBZ R

Intended Use
Installation parameters

Annex B 2

Table B3.1: Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **standard anchorage depth ($h_{ef,\,sta}$)**

Size				FBZ, FBZ R				
				M8	**M10**	**M12**	**M16**	**M20**
Standard anchorage depth		$h_{ef,sta} \geq$		**45**	**60**	**70**	**85**	**100**
Concrete members with thickness ≥ 2 x $h_{ef,sta}$	Minimum thickness of concrete member	$h_{min,1}$	[mm]	**100**	**120**	**140**	**170**	**200**
	Uncracked concrete							
	Minimum spacing	s_{min}	[mm]	40		50	65	95
		for c ≥		50	60	70	95	180
	Minimum edge distance	c_{min}		40	45	55	65	95
		for s ≥		100	80	110	150	190
	Cracked concrete							
	Minimum spacing	s_{min}	[mm]	35	40	50	65	95
		for c ≥		50	55	70	95	140
	Minimum edge distance	c_{min}		40	45	55	65	85
		for s ≥		70	80	110	150	190
Concrete members with thickness < 2 x $h_{ef,sta}$	Minimum thickness of concrete member	$h_{min,2}$	[mm]	**80**	**100**	**120**	**140**	**160**
	Cracked and uncracked concrete							
	Minimum spacing	s_{min}	[mm]	35	40	50	80	125
		for c ≥		70	100	90	130	220
	Minimum edge distance	c_{min}		40	60		65	125
		for s ≥		100	90	120	180	230

Intermediate values for s_{min} and c_{min} inside of the same thickness of concrete member by linear interpolation

Table B3.2: Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **reduced anchorage depth ($h_{ef,\,red}$)**

Size				FBZ, FBZ R			
				M8	**M10**	**M12**	**M16**
Reduced anchorage depth		$h_{ef,red} \geq$		**35**[1)]	**40**	**50**	**65**
Concrete members with thickness ≥ 2 x $h_{ef,red}$	Minimum thickness of concrete member	$h_{min,3}$	[mm]	**80**		**100**	**140**
	Uncracked concrete						
	Minimum spacing	s_{min}	[mm]	40		50	65
		for c ≥		100		110	130
	Minimum edge distance	c_{min}		45		55	65
		for s ≥		180		220	250
	Cracked concrete						
	Minimum spacing	s_{min}	[mm]	40		50	65
		for c ≥		90		110	130
	Minimum edge distance	c_{min}		45		55	65
		for s ≥		180		220	250

Intermediate values for s_{min} and c_{min} by linear interpolation
1) Only in anchoring structural components which are statically indeterminate

fischer Bolt Anchor FBZ, FBZ R

Intended Use
Minimum thickness of member, minimum spacing and edge distance

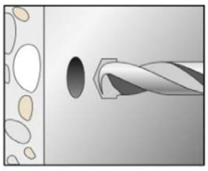
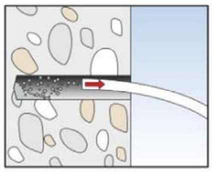
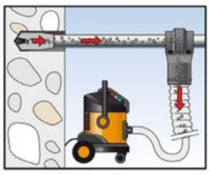
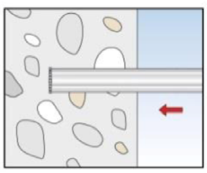
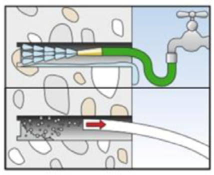
Annex B 3

Installation instructions:

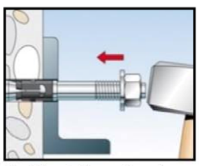
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Use of the anchor only as supplied by the manufacturer without exchanging the components of the anchor
- Checking before placing the anchor to 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
- Hammer, hollow or diamond drilling according to Annex B4
- 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
- It must be ensured that in case of fire local spalling of the concrete cover does not occur
- Fastenings in stand-off installation or with a grout layer under seismic action are not covered
- In case of seismic applications the fastener shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure

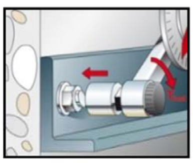
Installation instructions: Drilling and cleaning the hole

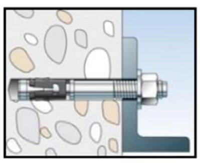
Types of drills and cleaning

Hammer drill		 1: Drill the hole	 2: Clean the hole
Hollow drill		 1: Drill the hole with automatic cleaning	-
Diamond drill, for non seismic applications only and ≥ drill ∅ 8		 1: Drill the hole	 2: Clean the hole

Installation instructions: Installation of the anchor


3: Set the fastener


4: Apply T_{inst}


5: Installed fastener

fischer Bolt Anchor FBZ, FBZ R	**Annex B 4**
Intended Use Installation instructions	

Table C1.1: Characteristic **tension** resistance for **standard anchorage depth**

Size			FBZ, FBZ R				
			M8	**M10**	**M12**	**M16**	**M20**
Steel failure for standard anchorage depth							
Characteristic resistance FBZ	$N_{Rk,s}$	[kN]	16,6	28,3	43,2	67,0	123,3
Characteristic resistance FBZ R	$N_{Rk,s}$	[kN]	17,0	29,0	44,3	70,6	124,9
Partial factor for steel failure	γ_{Ms} 1)	[-]	1,5				
Pullout failure for standard anchorage depth							
Effective embedment depth for calculation	$h_{ef,sta}$	[mm]	45	60	70	85	100
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	6	10	16	26	30
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	11	16	17	34	42
Increasing factors for $N_{Rk,p}$ for cracked and uncracked 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}	[-]	1,0				
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness ≥ 2x $h_{ef,sta}$							
Effective embedment depth	$h_{ef,sta}$	[mm]	45	60	70	85	100
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0 2)				
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7 2)				
Minimum thickness of concrete member	$h_{min,1}$	[mm]	100	120	140	170	200
Characteristic spacing	$s_{cr,N}$	[mm]	$3 \cdot h_{ef}$				
Characteristic edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$				
Spacing (splitting failure) 4)	$s_{cr,sp}$	[mm]	140	180	210	260	370
Edge distance (splitting failure) 4)	$c_{cr,sp}$	[mm]	70	90	105	130	185
Characteristic resistance to splitting	$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ 3)				
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness ≥ 2x $h_{ef,sta}$							
Effective embedment depth	$h_{ef,sta}$	[mm]	45	60	70	85	100
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0 2)				
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7 2)				
Minimum thickness of concrete member	$h_{min,2}$	[mm]	80	100	120	140	160
Characteristic spacing	$s_{cr,N}$	[mm]	$3 \cdot h_{ef}$				
Characteristic edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$				
Spacing (splitting failure) 4)	$s_{cr,sp}$	[mm]	180	240	280	340	480
Edge distance (splitting failure) 4)	$c_{cr,sp}$	[mm]	90	120	140	170	240
Characteristic resistance to splitting	$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ 3)				

1) In absence of other national regulations
2) Based on concrete strength as cylinder strength
3) $N^0_{Rk,c}$ according to EN 1992-4:2018
4) Intermediate values for $s_{cr,sp}$ and $c_{cr,sp}$ between concrete thickness $h_{min,2}$ and $h_{min,1}$ by linear interpolation

fischer Bolt Anchor FBZ, FBZ R	**Annex C 1**
Performances Characteristic values of resistance under tension loads	

Table C2.1: Characteristic **tension** resistance for **reduced anchorage depth**

Size				FBZ, FBZ R			
				M8	M10	M12	M16
Steel failure for reduced anchorage depth							
Characteristic resistance	FBZ	$N_{Rk,s}$	[kN]	16,6	28,3	43,2	67,0
	FBZ R	$N_{Rk,s}$	[kN]	17,0	29,0	44,3	70,6
Partial factor for steel failure		γ_{Ms} 3)	[-]	1,5			
Pullout failure for reduced anchorage depth							
Effective anchorage depth for calculation		$h_{ef,red} \geq$	[mm]	35 1)	40	50	65
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	4	7	10	15
Characteristic resistance in uncracked concrete 20/25		$N_{Rk,p}$	[kN]	8	10	15	22
Increasing factors for $N_{Rk,p}$ for cracked and uncracked 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}	[-]	1,0			
Concrete cone and splitting failure for reduced anchorage depth							
Effective anchorage depth		$h_{ef,red}$	[mm]	35 1)	40	50	65
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11 2)			
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7 2)			
Min. thickness of concrete member		$h_{min,3}$	[mm]	80		100	140
Characteristic spacing		$s_{cr,N}$	[mm]	3 h_{ef}			
Characteristic edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}			
Spacing (splitting failure)		$s_{cr,sp}$	[mm]	140	160	200	260
Edge distance (splitting failure)		$c_{cr,sp}$	[mm]	70	80	100	130
Characteristic resistance to splitting		$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ 4)			

1) Use restricted to anchoring of structural components which are statically indeterminate
2) Based on concrete strength as cylinder strength
3) In absence of other national regulations
4) $N^0_{Rk,c}$ according to EN 1992-4:2018

fischer Bolt Anchor FBZ, FBZ R

Performances
Characteristic values of resistance under tension loads

Annex C 2

Deutsches Institut für Bautechnik DIBt

Table C3.1: Characteristic values of **shear** resistance for **standard and reduced anchorage depth**

Size				FBZ, FBZ R M8	M10	M12	M16	M20
Steel failure without lever arm for standard and reduced anchorage depth								
Characteristic resistance	FBZ	$V^0_{Rk,s}$	[kN]	12,0	21,4	30,6	55,0	70,0
	FBZ R	$V^0_{Rk,s}$	[kN]	16,1	26,5	37,4	57,2	70,0
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,25				
Factor for ductility		k_7	[-]	1,0				
Standard anchorage depth								
Steel failure with lever arm								
Characteristic bending resistance	FBZ	$M^0_{Rk,s}$	[Nm]	26	52	92	233	513
	FBZ R	$M^0_{Rk,s}$	[Nm]	29	59	100	256	519
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,25				
Factor for ductility		k_7	[-]	1,0				
Concrete pryout failure								
Factor for pryout failure		k_8	[-]	2,8	3,2		3,0	2,6
Concrete edge failure								
Effective embedment depth for calculation		l_f	[mm]	45	60	70	85	100
Outside diameter of a fastener		d_{nom}	[mm]	8	10	12	16	20
Reduced anchorage depth								
Steel failure with lever arm								
Characteristic bending resistance	FBZ	$M^0_{Rk,s}$	[Nm]	20	44	92	184	-
	FBZ R	$M^0_{Rk,s}$	[Nm]	21	45	100	193	-
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,25				
Factor for ductility		k_7	[-]	1,0				
Concrete pryout failure								
Factor for pryout failure		k_8	[-]	2,5	2,6	3,1	3,2	-
Concrete edge failure								
Effective embedment depth for calculation		l_f	[mm]	35	40	50	65	-
Outside diameter of a fastener		d_{nom}	[mm]	8	10	12	16	-

1) In absence of other national regulations

fischer Bolt Anchor FBZ, FBZ R

Performances
Characteristic values of resistance under shear loads

Annex C 3

Table C4.1: Characteristic values of **tension** resistance under **fire exposure**

Size				M8	M10	M12	M16	M20
				FBZ, FBZ R				
		$h_{ef} \geq$	[mm]	35 / 45	40 / 60	50 / 70	65 / 85	100
Characteristic resistance **steel failure**	$N_{Rk,s,fi}$	R30	[kN]	1,4	2,8	5,0	9,4	14,7
		R60		1,2	2,3	4,1	7,7	12,0
		R90		0,9	1,9	3,2	6,0	9,4
		R120		0,8	1,6	2,8	5,2	8,1
Characteristic resistance **Concrete cone failure**	$N_{Rk,c,fi}$	R30 - R90		$7{,}7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000$				
		R120		$7{,}7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000 \cdot 0{,}8$				
Characteristic resistance **pullout failure**	$N_{Rk,p,fi}$	R30		0,9 / 2,0	2,2 / 3,3	3,0 / 5,0	4,5 / 6,8	8,6
		R60		0,8 / 2,0				
		R90		0,5 / 2,0				
		R120		0,3 / 1,6	1,7 / 2,6	2,4 / 4,0	3,6 / 5,4	6,9

Table C4.2: Characteristic values of **shear** resistance under **fire exposure**

Size FBZ, FBZ R			R30		R60	
			$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	$h_{ef} \geq$	35	1,8	1,4	1,6	1,2
M10		40	3,6		2,9	3,0
M12		50	6,3	7,8	4,9	6,4
M16		65	11,7	19,9	9,1	16,3
M20		100	18,2	39,0	14,2	31,8

Size FBZ, FBZ R			R90		R120	
			$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	$h_{ef} \geq$	35	1,3	1,0	1,2	0,8
M10		40	2,2	2,4	1,9	2,1
M12		50	3,5	5,0	2,8	4,3
M16		65	6,6	12,6	5,3	11,0
M20		100	10,3	24,6	8,3	21,4

Concrete pryout failure according to EN 1992-4:2018

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

Size			M8	M10	M12	M16	M20
			FBZ, FBZ R				
Spacing	s_{min}	[mm]	Annex B3				
Edge distance	c_{min}		$c_{min} = 2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min} \geq 300$ mm				

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Performances
Characteristic values of resistance under fire exposure

Annex C 4

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Table C5.1: Displacements under static and quasi static **tension** loads

Size			FBZ, FBZ R				
			M8	**M10**	**M12**	**M16**	**M20**
Displacement – factor for tensile load[1)]							
δ_{N0} - factor	in cracked concrete	[mm/kN]	0,22	0,12	0,09	0,08	0,07
$\delta_{N\infty}$ - factor	in cracked concrete	[mm/kN]	0,78	0,40	0,19	0,09	
δ_{N0} - factor	in uncracked concrete	[mm/kN]	0,07	0,05	0,06		0,05
$\delta_{N\infty}$ - factor	in uncracked concrete	[mm/kN]	0,29	0,21	0,14	0,10	0,06

Table C5.2: Displacements under static and quasi static **shear** loads

Size			FBZ				
			M8	**M10**	**M12**	**M16**	**M20**
Displacement – factor for shear load[2)]							
δ_{V0} – factor	in cracked and uncracked concrete	[mm/kN]	0,35	0,37	0,27	0,10	0,09
$\delta_{V\infty}$ - factor	in cracked and uncracked concrete	[mm/kN]	0,52	0,55	0,40	0,14	0,15
			FBZ R				
δ_{V0} - factor	in cracked and uncracked concrete	[mm/kN]	0,23	0,19	0,18	0,10	0,11
$\delta_{V\infty}$ - factor	in cracked and uncracked concrete	[mm/kN]	0,27	0,22	0,16	0,11	0,05

[1)] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0-factor} \cdot N_{ED}$
$\delta_{N\infty} = \delta_{N\infty-factor} \cdot N_{ED}$
(N_{ED}: Design value of the applied tension force)

[2)] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0-factor} \cdot V_{ED}$
$\delta_{V\infty} = \delta_{V\infty-factor} \cdot V_{ED}$
(V_{ED}: Design value of the applied shear force)

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Performances
Displacements under tension and shear loads

Annex C 5