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-22/0725 of 7 February 2023

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	FAKKT Anchor bolt BA, BA R, BA HCR
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	Keller & Kalmbach GmbH Siemensstraße 19 85716 Unterschleißheim DEUTSCHLAND
Manufacturing plant	Herstellwerk 1
This European Technical Assessment contains	18 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

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Specific Part

1 Technical description of the product

The FAKKT Bolt Anchor BA is an anchor made of galvanised steel (BA) or made of stainless steel (BA R) or high corrosion resistant steel (BA HCR) 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 Annexes B 3 and C 1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 2
Displacements (static and quasi-static loading)	See Annex C 4
Characteristic resistance for seismic performance category C1	See Annex C 4
Characteristic resistance and displacements for seismic performance category C2	No performance assessed

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 3

3.2 Aspects of durability

Essential characteristic	Performance
Durability	See Annex B 1

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 7 February 2023 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

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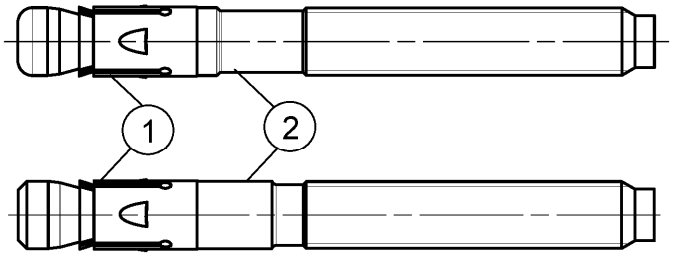
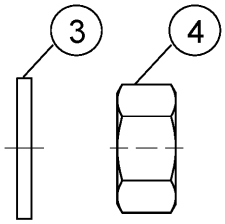
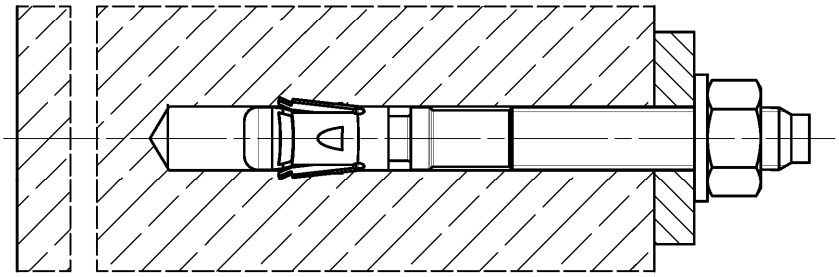
Cone bolt manufactured by cold - forming:

Cone bolt manufactured by turning:





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



(Fig. not to scale)

FAKKT Anchor bolt BA, BA R, BA HCR

Product description
Installed condition

Annex A 1

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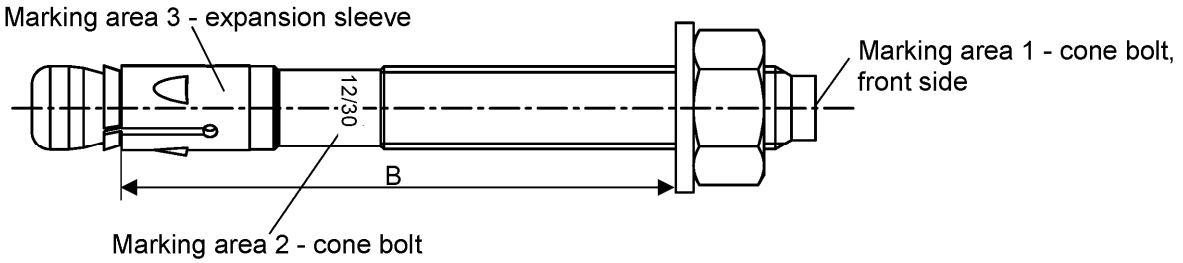
Product label and letter-code:



Product label, example: MAX 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 or HCR placed at marking area 2

Product description	Trade name	Material
MAX	FAKKT Anchor bolt BA	Carbon steel
MAX R	FAKKT Anchor bolt BA R	Stainless steel
MAX HCR	FAKKT Anchor bolt BA HCR	High corrosion resistant 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
	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
	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)

FAKKT Anchor bolt BA, BA R, BA HCR

Product description
Product label and letter code

Annex A 2

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Product dimensions

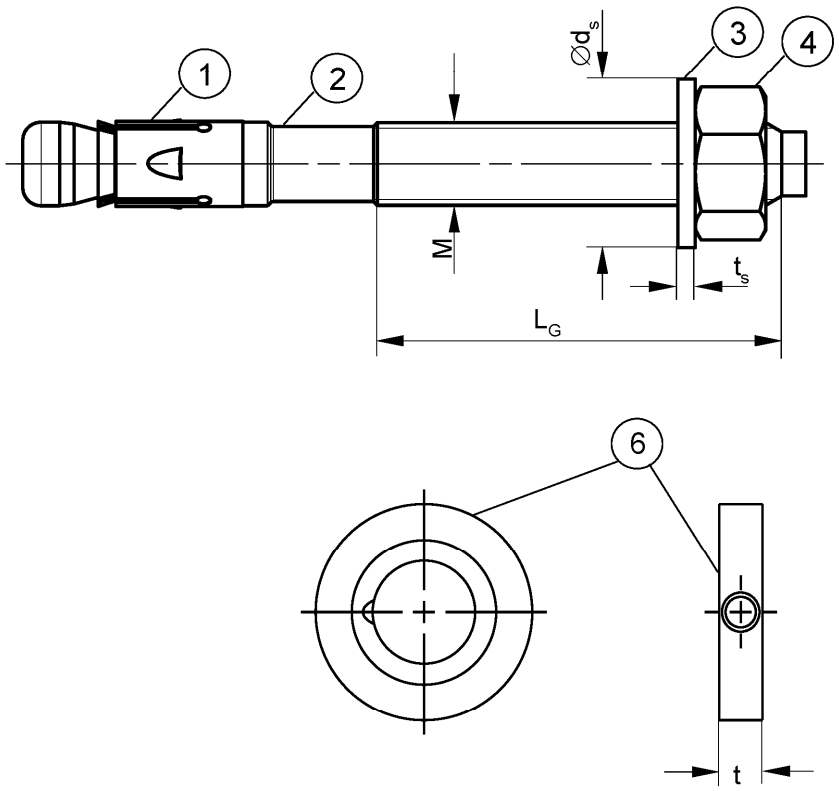

Table A3.1: Dimensions [mm]

Part	Designation			BA, BA R, BA HCR				
				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	
		$\varnothing d_s$	≥	15	19	23	29	36
4	Hexagon nut	Wrench size		13	17	19	24	30
6	Filling disc FFD	t	=	6			7	8

(Fig. not to scale)

FAKKT Anchor bolt BA, BA R, BA HCR

Product description
Dimensions

Annex A 3

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Table A4.1: Materials BA (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 BA R

Part	Designation	Material Stainless steel acc. to EN 10088:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2015
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

Table A4.3: Materials BA HCR

Part	Designation	Material Stainless steel acc. to EN 10088:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4:2015
1	Expansion sleeve	Stainless steel EN 10088:2014
2	Cone bolt	High corrosion resistant steel EN 10088:2014
3	Washer	
4	Hexagon nut	High corrosion resistant steel EN 10088:2014; ISO 3506-2:2018; property class – min. 70

FAKKT Anchor bolt BA, BA R, BA HCR

Product description
Materials

Annex A 4

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Specifications of intended use

Anchorages subject to:

Size	BA, BA R, BA HCR				
	M8	**M10**	**M12**	**M16**	**M20**
Static and quasi-static loads					
Cracked and uncracked concrete			✓		
Fire exposure					
Seismic performance category C1			✓		

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+A1:2021

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions:

  BA, BA R, BA HCR

- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:

  - **CRC III**: **BA R**
  - **CRC V**: **BA HCR**

Design:

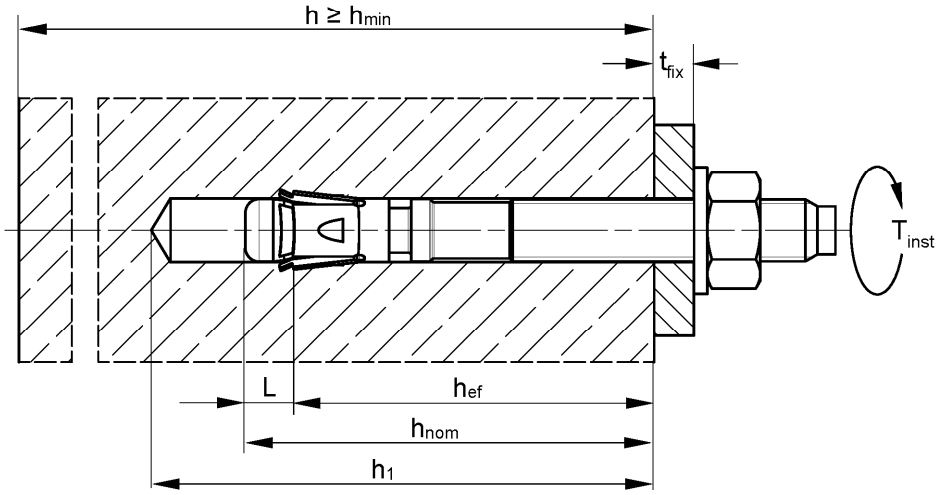
- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position 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, Edition February 2018
- 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

FAKKT Anchor bolt BA, BA R, BA HCR	**Annex B 1**
Intended Use Specifications	

Deutsches Institut für Bautechnik DIBt

Table B2.1: Installation parameters

Size			BA, BA R, BA HCR				
			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
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	$h_1 \geq$		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)

FAKKT Anchor bolt BA, BA R, BA HCR

Intended Use
Installation parameters

Annex B 2

Deutsches Institut für Bautechnik DIBt

Table B3.1: Minimum thickness of concrete members, minimum spacing and minimum edge distance

Size			BA, BA R, BA HCR				
			M8	**M10**	**M12**	**M16**	**M20**
Minimum edge distance							
Uncracked concrete	c_{min}	[mm]	40	45	55	65	95
Cracked concrete							85
Corresponding spacing	s		according to Annex B4				
Minimum thickness of concrete member	h_{min}		80		100	140	160
Thickness of concrete member	h ≥		max. {h_{min}; h_1[1)] + 30}			max. {h_{min}; h_1[1)] + 2 · d_o}	
Minimum spacing							
Uncracked concrete	s_{min}	[mm]	40	40	50	65	95
Cracked concrete			35				
Corresponding edge distance	c		according to Annex B4				
Minimum thickness of concrete member	h_{min}		80	100		140	160
Thickness of concrete member	h ≥		max. {h_{min}; h_1[1)] + 30}			max. {h_{min}; h_1[1)] + 2 · d_o}	
Minimal splitting area							
Uncracked concrete	$A_{sp,req}$	[·1000 mm²]	18	37	54	67	100
Cracked concrete			12	27	40	50	77

[1)] h_1 according to Annex B2

Splitting failure applied for minimum edge distance and spacing in dependence of the h_{ef}

For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

$$\mathbf{A_{sp,req} < A_{sp,ef}}$$

$A_{sp,req}$ = required splitting area
$A_{sp,ef}$ = effective splitting area (according to Annex B4)

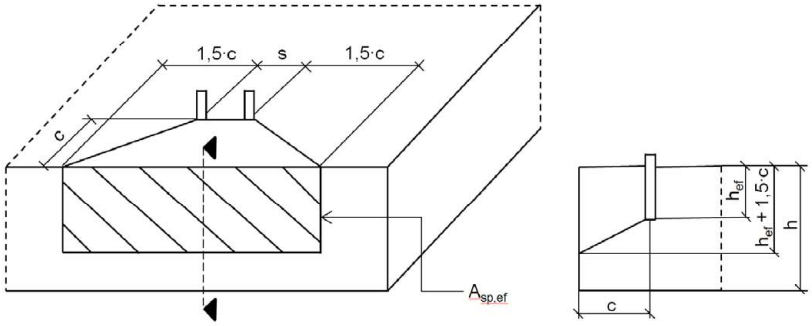
FAKKT Anchor bolt BA, BA R, BA HCR

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

Annex B 3

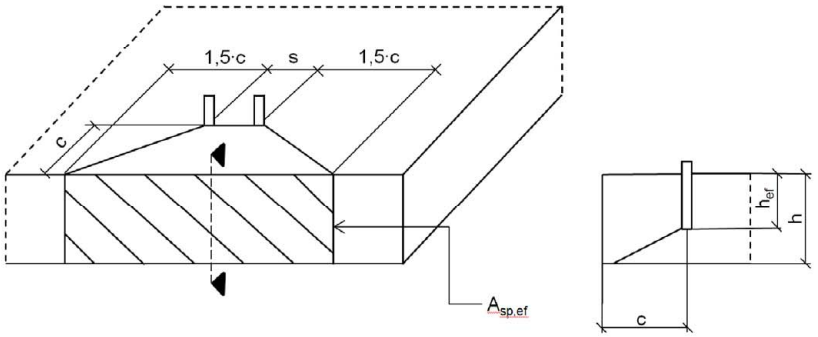
Deutsches Institut für Bautechnik DIBt

Table B4.1: Effective splitting area $A_{sp,ef}$ with member thickness $h > h_{ef} + 1{,}5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = (6 \cdot c) \cdot (h_{ef} + 1{,}5 \cdot c)$ [mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot (h_{ef} + 1{,}5 \cdot c)$ [mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B4.2: Effective splitting area $A_{sp,ef}$ with member thickness $h \leq h_{ef} + 1{,}5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = 6 \cdot c \cdot$ existing h [mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot$ existing h [mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Edge distance and axial spacing shall be rounded to at least 5 mm

(Fig. not to scale)

FAKKT Anchor bolt BA, BA R, BA HCR

Intended Use
Minimum thickness of member, minimum spacings and edge distances

Annex B 4

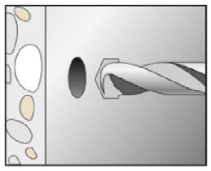
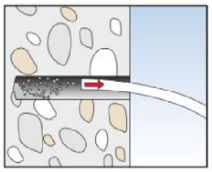
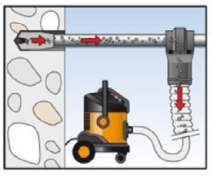
Deutsches Institut für Bautechnik DIBt

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 or hollow drilling according to Annex B5
- 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	-

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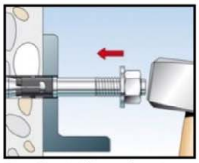
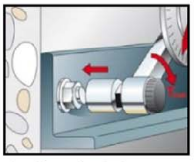
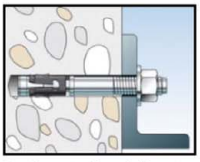
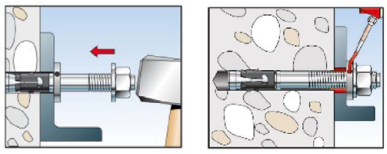
Installation instructions: Installation of the anchor


3: Set the fastener


4: Apply T_{inst}


5: Installed fastener

FILLING DISC FFD optional for seismic C1 application or minimizing the annular gap:

Optional	The gap between bolt and fixture may be filled with mortar (compressive strength ≥ 50 N/mm² e.g. FAKKT IM Z) after step 5 (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.	

FAKKT Anchor bolt BA, BA R, BA HCR

Intended Use
Installation instructions

Annex B 6

Deutsches Institut für Bautechnik DIBt

Table C1.1: Characteristic **tension** resistance under static and quasi-static action

Size				BA, BA R, BA HCR				
				M8	**M10**	**M12**	**M16**	**M20**
Steel failure								
Characteristic resistance	BA	$N_{Rk,s}$	[kN]	16,6	28,3	43,2	67,0	123,3
	BA R/BA HCR			17,0	29,0	44,3	70,6	124,9
Partial factor for steel failure		γ_{Ms}	[-]	1,5				
Modulus of elasticity		E_s	[N/mm²]	210.000				
Pullout failure								
Effective embedment depth for calculation		h_{ef}	[mm]	35 - < 45	45	40 - 60	50 - 70	65 - 85	100
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	5,5	8	13	20	27,0	34,4
Characteristic resistance in uncracked concrete C20/25				14		20	22	38,6	49,2
Increasing factors for $N_{Rk,p}$ $N_{Rk,p} = \psi_c * N_{Rk,p}$ (C20/25)	C25/30	ψ_c		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								
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0				
Factor for cracked concrete		$k_{cr,N}$		7,7				
Characteristic spacing		$s_{cr,N}$	[mm]	$3 \cdot h_{ef}$				
Characteristic edge distance		$c_{cr,N}$		$1,5 \cdot h_{ef}$				
Spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Edge distance for h = 80		$c_{cr,sp}$		$2,4 \cdot h_{ef}$	$2 \cdot h_{ef}$	-[2]	-[2]		
Edge distance for h = 100				$2 \cdot h_{ef}$	$2,4 \cdot h_{ef}$	$2 \cdot h_{ef}$		
Edge distance for h = 120					$1,9 \cdot h_{ef}$	$2,1 \cdot h_{ef}$		
Edge distance for h = 140						$1,5 \cdot h_{ef}$	$2 \cdot h_{ef}$	-[2]
Edge distance for h = 160								$2,4 \cdot h_{ef}$
Edge distance for h = 200								
Characteristic resistance to splitting		$N^0_{Rk,sp}$	[kN]	min ($N^0_{Rk,c}$[1]; $N_{Rk,p}$)				

[1] $N^0_{Rk,c}$ according to EN 1992-4:2018
[2] No performance assessed

FAKKT Anchor bolt BA, BA R, BA HCR

Performances
Characteristic values of resistance under tension loads

Annex C 1

Deutsches Institut für Bautechnik DIBt

Table C2.1: Characteristic values of **shear** resistance under static and quasi-static action

Size				BA, BA R, BA HCR				
				M8	**M10**	**M12**	**M16**	**M20**
Steel failure without lever arm								
Characteristic resistance	BA	$V^0_{Rk,s}$	[kN]	13,6	21,4	30,6	55,0	81,4
	BA R/BA HCR			16,8	26,5	38,3	69,8	106,3
Partial factor for steel failure		γ_{Ms}	[-]	1,25				
Factor for ductility		k_7		1,0				
Steel failure with lever arm and Concrete pryout failure								
Effective embedment depth for calculation		h_{ef}	[mm]	45	60	70	85	100
Characteristic bending resistance	BA	$M^0_{Rk,s}$	[Nm]	26	52	92	233	513
	BA R/BA HCR			29	59	100	256	519
Factor for pryout failure		k_8	[-]	2,8	3,2		3,0	2,6
Effective embedment depth for calculation		h_{ef}	[mm]	35 - < 45	40 - < 60	50 - < 70	65 - < 85	-[1]
Characteristic bending resistance	BA	$M^0_{Rk,s}$	[Nm]	20	44	92	184	
	BA R/BA HCR			21	45	100	193	
Factor for pryout failure		k_8	[-]	2,5	2,6	3,1	3,2	
Partial factor for steel failure		γ_{Ms}	[-]	1,25				
Factor for ductility		k_7		1,0				
Concrete edge failure								
Effective embedment depth for calculation		$l_f =$	[mm]	h_{ef}				
Outside diameter of a fastener		d_{nom}		8	10	12	16	20

[1] No performance assessed

FAKKT Anchor bolt BA, BA R, BA HCR

Performances
Characteristic values of resistance under shear loads

Annex C 2

Deutsches Institut für Bautechnik DIBt

Table C3.1: Characteristic values of **tension** resistance under **fire exposure**

Size				BA, BA R, BA HCR				
				M8	**M10**	**M12**	**M16**	**M20**
		$h_{ef} \geq$	[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 C3.2: Characteristic values of **shear** resistance under **fire exposure**

Size BA, BA R, BA HCR			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 BA, BA R, BA HCR			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 C3.3: Minimum spacings and minimum edge distances of anchors under **fire exposure** for **tension** and **shear** load

Size			BA, BA R, BA HCR				
			M8	**M10**	**M12**	**M16**	**M20**
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				

FAKKT Anchor bolt BA, BA R, BA HCR

Performances
Characteristic values of resistance under fire exposure

Annex C 3

Deutsches Institut für Bautechnik DIBt

Table C4.1: Characteristic values of **tension and shear** resistance under **seismic action category C1**

Size				BA, BA R, BA HCR				
				M8	**M10**	**M12**	**M16**	**M20**
Length of anchor		L_{max}	[mm]	167	186	221	285	394
Effective embedment depth		h_{ef}	[mm]	45	40 - 60	50 - 70	65 - 85	100
Factor for annular gap	Without filling of annular gap	α_{gap}	[-]	0,5				
	With filling of annular gap	α_{gap}	[-]	1,0				
Steel failure								
Characteristic resistance tension load C1		$N_{Rk,s,eq,C1}$	[kN]	16,0	27,0	41,0	66,0	111,0
Partial factor for steel failure		$\gamma_{Ms,eq,C1}$	[-]	1,5				
Pullout failure								
Characteristic resistance tension load in cracked concrete C1		$N_{Rk,p,eq,C1}$	[kN]	4,6	8,0	16,0	28,2	36,0
Installation factor		γ_{inst}	[-]	1,0				
Steel failure without lever arm								
Characteristic resistance shear load C1		$V_{Rk,s,eq,C1}$	[kN]	11	17	27	47	56
Partial factor for steel failure		$\gamma_{Ms,eq,C1}$	[-]	1,25				

Table C4.2: Displacements under static and quasi static **tension** loads

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

Table C4.3: Displacements under static and quasi static **shear** loads

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

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

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

FAKKT Anchor bolt BA, BA R, BA HCR

Performances
Characteristic values under tension and shear loads under seismic action
Displacements under tension and shear loads

Annex C 4