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-19/0619 of 26 February 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	Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	MKT Metall-Kunststoff-Technik GmbH & Co. KG Auf dem Immel 2 67685 Weilerbach DEUTSCHLAND
Manufacturing plant	MKT Metall-Kunststoff-Technik GmbH & Co. KG Auf dem Immel 2 67685 Weilerbach
This European Technical Assessment contains	21 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

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Specific part

1 Technical description of the product

The Wedge anchor BZ3 / BZ3 A4 / BZ3 HCR is a fastener made of zinc plated steel, stainless steel or high corrosion resistant steel 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
Minimum edge distances and spacing	see Annex B3
Characteristic resistance to tension load (static and quasi-static loading)	see Annex C1, C2
Characteristic resistance to shear load (static and quasi-static loading)	see Annex C3
Characteristic resistance for seismic performance categories C1 and C2	see Annex C4
Displacements	see Annex C6, C7
Durability	see Annex B1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	see Annex C5

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: 1996/582/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 26 February 2020 by Deutsches Institut für Bautechnik

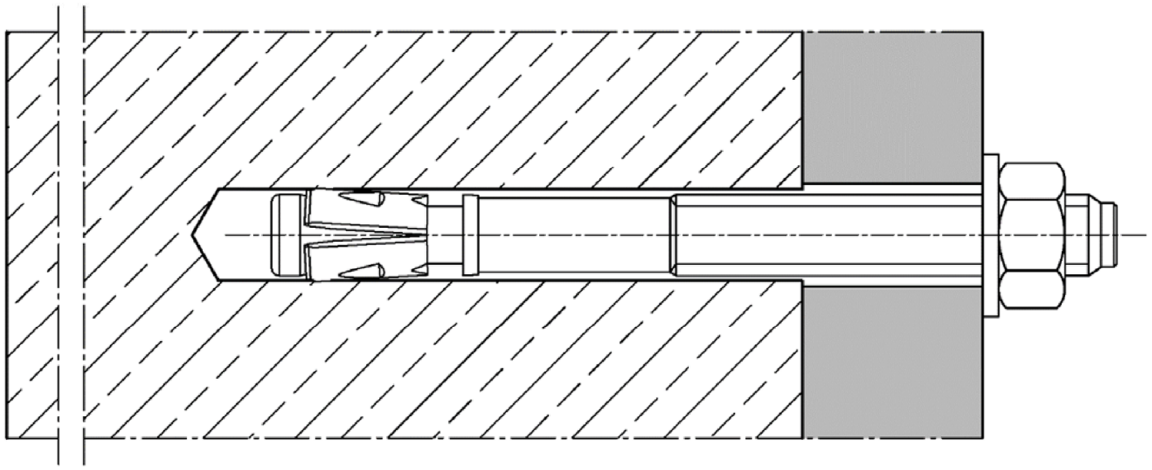
BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Ziegler

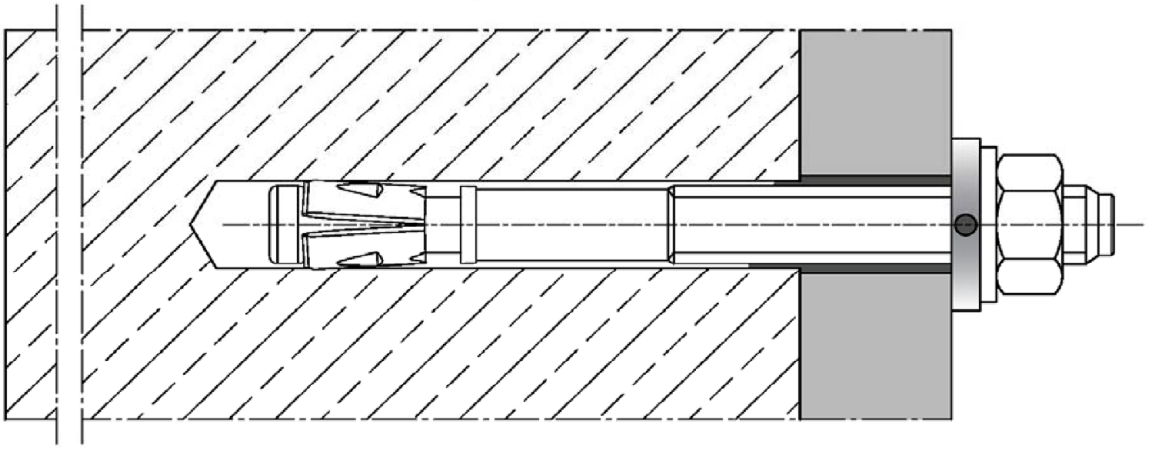
Deutsches Institut für Bautechnik DIBt

Wedge anchor BZ3, BZ3 A4 and BZ3 HCR

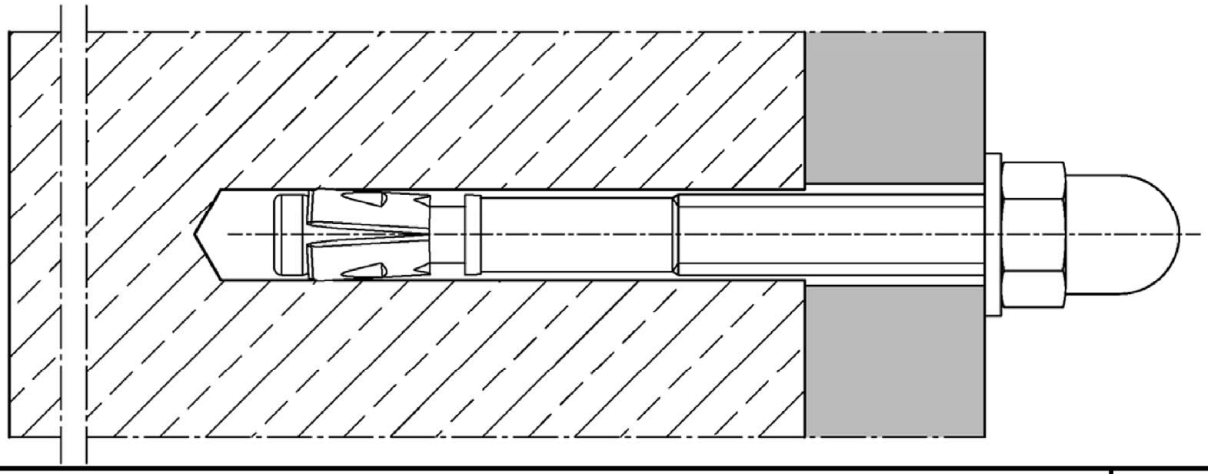
Installation condition



Installation condition with filling washer (optional with cap nut HM)



Installation condition with cap nut HM (optional with filling washer)



Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Product description
Product types and installation conditions

Annex A1

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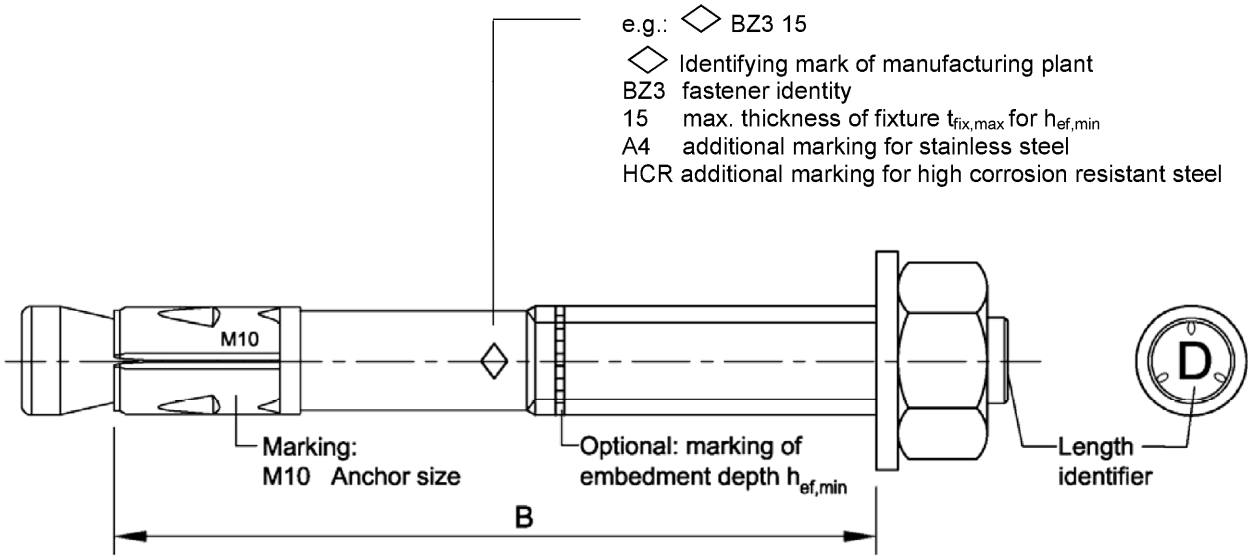
Marking



Usable length: $B = h_{ef} + t_{fix}$

h_{ef}: (existing) effective anchorage depth

t_{fix}: fixture thickness (including e.g. levelling layers or other non-load-bearing layers or additional filling washer)

Table A1: Length identification

Length identifier		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Usable length B	≥	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105

Length identifier		P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD
Usable length B	≥	110	115	120	125	130	135	140	145	150	160	170	180	190	200	210

Length identifier		EE	FF	GG	HH	II	JJ	KK	LL
Usable length B	≥	220	230	240	250	260	270	280	290

Dimensions in mm

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Product description
Marking

Annex A2

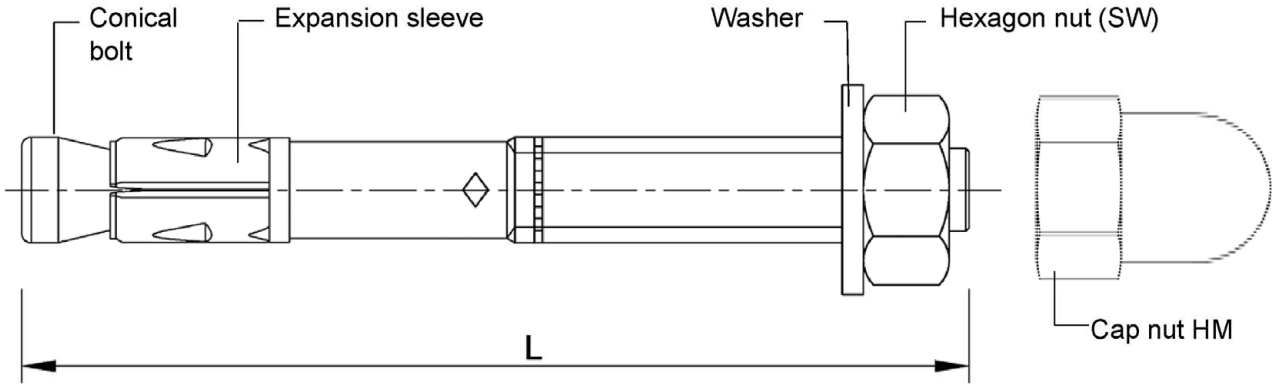
Deutsches Institut für Bautechnik DIBt

Table A2: Material

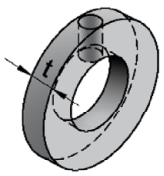
Part	BZ3	BZ3 A4	BZ3 HCR
	Steel, zinc plated	**Stainless steel**	**High corrosion resistant steel**
Conical bolt	Steel, galvanized ≥ 5 µm, fracture elongation A_5 ≥ 8%	Stainless steel, fracture elongation A_5 ≥ 8%	High corrosion resistant steel, fracture elongation A_5 ≥ 8%
Expansion sleeve	Stainless steel	Stainless steel	Stainless steel
Washer	Steel, galvanized ≥ 5 µm	Stainless steel	High corrosion resistant steel
Filling washer			
Hexagon nut			
Cap nut			

Table A3: Fastener dimensions

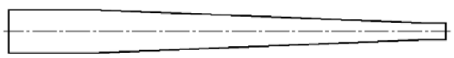
Fastener size			BZ3 / BZ3 A4 / BZ3 HCR			
			M8	**M10**	**M12**	**M16**
Width across hexagon nut / cap nut	SW	[mm]	13	17	19	24
Length of fastener	L	[mm]	$h_{ef} + t_{fix} +$ 18,0	$h_{ef} + t_{fix} +$ 21,5	$h_{ef} + t_{fix} +$ 26,0	$h_{ef} + t_{fix} +$ 33,0
Thickness of filling washer	t	[mm]	5			



Filling washer



Reducing adapter



Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Product description
Material and dimensions

Annex A3

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Wedge Anchor	BZ3 / BZ3 A4 / BZ3 HCR			
	M8	M10	M12	M16
Static or quasi-static action	✓			
Seismic performance categories C1 and C2	✓			
Fire exposure	R30 / R60 / R90 / R120			
Variable, effective anchorage depth	35 mm to 90 mm	40 mm to 100 mm	50 mm to 125 mm	65 mm to 160 mm

Base materials:

- Cracked or uncracked concrete
- Reinforced or unreinforced normal weight concrete according to EN 206: 2013 + A1:2016
- Strength classes C20/25 to C50/60 according to EN 206: 2013 + A1:2016

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions: **BZ3, BZ3 A4, BZ3 HCR**
- For all other conditions according to EN 1993-1-4:2015-10 corresponding to corrosion resistance classes:
  - according to Annex A, Table A.3: CRC I - III **BZ3 A4, BZ3 HCR**
  - according to Annex A, Table A.3: CRC IV, V **BZ3 HCR**

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 fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.)
- Design method EN 1992-4:2018 and Technical Report TR 055

Installation:

- Hole drilling by hammer drill bit or vacuum drill bit
- Use of the fastener only as supplied by the manufacturer without exchanging the components of the fastener (exception: when using the cap nut HM)
- Optionally, the annular gap between fixture and stud of the BZ3 can be filled to reduce the hole clearance. For this purpose, the filling washer (annex A3) must be used in addition to the supplied washer. For filling use high-strength mortar with compressive strength ≥ 40N/mm².

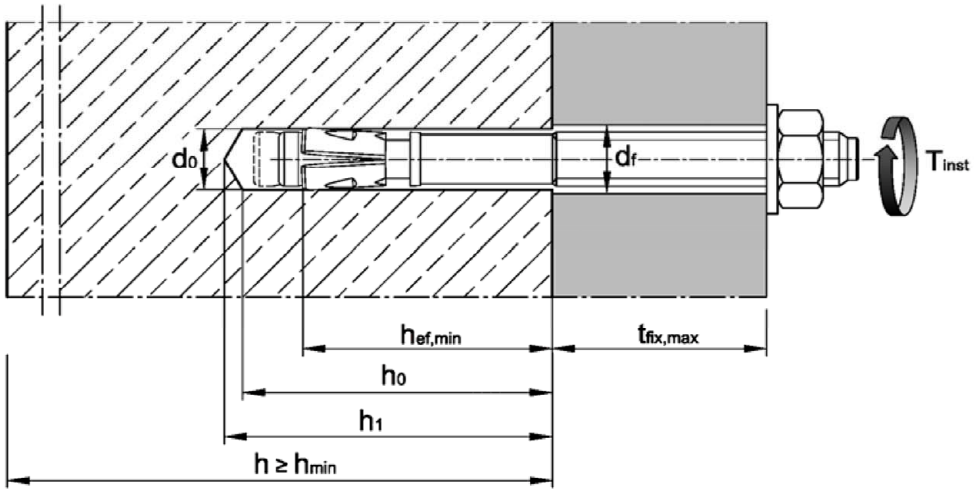
Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR	Annex B1
Intended use Specifications	

Deutsches Institut für Bautechnik DIBt

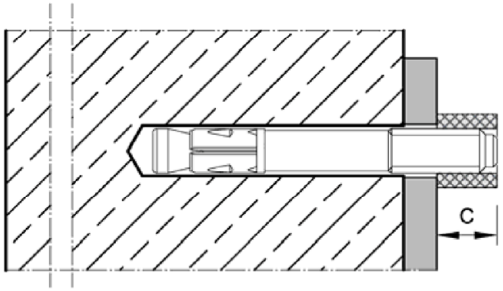
Table B1: Installation parameters

Anchor size				BZ3 / BZ3 A4 / BZ3 HCR			
				M8	M10	M12	M16
Nominal drill hole diameter		d_0	[mm]	8	10	12	16
Cutting diameter of drill bit		$d_{cut} \leq$	[mm]	8,45	10,45	12,5	16,5
Minimum effective anchorage depth		$h_{ef,min}$	[mm]	35	40	50	65
Maximum effective anchorage depth		$h_{ef,max}$	[mm]	90	100	125	160
Depth of drill hole		$h_0 \geq$	[mm]	h_{ef} + 8	h_{ef} + 9	h_{ef} + 10	h_{ef} + 14
		$h_1 \geq$	[mm]	h_{ef} + 10	h_{ef} + 11	h_{ef} + 13	h_{ef} + 17
Diameter of clearance hole in the fixture [1)]		$d_f \leq$	[mm]	9	12	14	18
Projection after anchor has been inserted for installing with cap nut HM (according to Annex B5)		C	[mm]	10,5	12,5	16,0	19,5
Installation torque	BZ3	T_{inst}	[Nm]	15	40	60	110
	BZ3 A4 / HCR	T_{inst}	[Nm]	15	40	55	100

[1)] For larger diameters of clearence hole in the fixture, see EN 1992-4, chapter 6.2.2.2



Setting gauge for installation with cap nut HM



C [mm] :
Projection after anchor has been inserted for installing with cap nut HM or height of setting gauge (see Table B1 and Annex B6).

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Intended use
Installation parameters

Annex B2

Deutsches Institut für Bautechnik DIBt

Table B2: Minimum thickness of concrete member, minimum spacings, edge distances and required area

Anchor size				BZ3 / BZ3 A4 / BZ3 HCR			
				M8	M10	M12	M16
Minimum member thickness depending on h_{ef}		$h_{min} \geq$	[mm]	max (1,5·h_{ef} ; 80)		max (1,5·h_{ef} ;100)	max (1,5·h_{ef} ;120)
Minimum edge distances and spacings							
Minimum edge distance		c_{min}	[mm]	40	45	55	65
Minimum spacings		s_{min}	[mm]	35	40	50	65
Projected required area $A_{pr,req}$							
Projected required area	BZ3	cracked concrete	$A_{pr,req}$ [mm²]	13 900	23 700	31 500	42 300
		uncracked concrete	$A_{pr,req}$ [mm²]	22 500	34 700	41 300	50 200
	BZ3 A4, BZ3 HCR	cracked concrete	$A_{pr,req}$ [mm²]	16 900	25 900	29 800	44 300
		uncracked concrete	$A_{pr,req}$ [mm²]	19 700	35 700	35 300	54 800
The edge distances and spacings shall be selected in steps of 5 mm. In combination with variable anchorage depths and member thicknesses, the following equation must be fulfilled:							
$A_{pr,req} \leq A_{pr,ef}$				$A_{pr,req}$ Projected required area $A_{pr,ef}$ Projected effective area (acc. to Table B4)			

Table B3: Applicable concrete thickness h_{sp} and area A_{sp} to determine characteristic edge distance $c_{cr,sp}$

Anchor size				M8	M10	M12	M16
Applicable concrete thickness	BZ3 BZ3 A4, BZ3 HCR	h_{sp}	[kN]	$\min(h\ ;\ h_{ef} + 1{,}5 \cdot c \cdot \sqrt{2})$			
Area to determine $c_{cr,sp}$ [1)]	BZ3	A_{sp}	[mm²]	$\frac{N^0_{Rk,sp} - 2{,}573}{0{,}000436}$	$\frac{N^0_{Rk,sp} + 2{,}040}{0{,}000693}$	$\frac{N^0_{Rk,sp} + 3{,}685}{0{,}000692}$	$\frac{N^0_{Rk,sp} + 3{,}738}{0{,}000875}$
	BZ3 A4, BZ3 HCR	A_{sp}	[mm²]	$\frac{N^0_{Rk,sp} + 4{,}177}{0{,}000862}$	$\frac{N^0_{Rk,sp} + 7{,}235}{0{,}000967}$	$\frac{N^0_{Rk,sp} + 7{,}847}{0{,}000951}$	$\frac{N^0_{Rk,sp} + 11{,}415}{0{,}000742}$

[1)] with $N^0_{Rk,sp}$ in kN

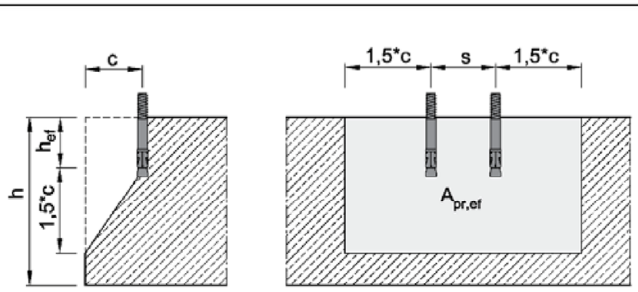
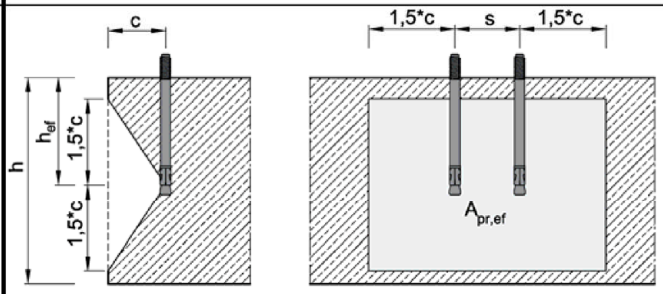
Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

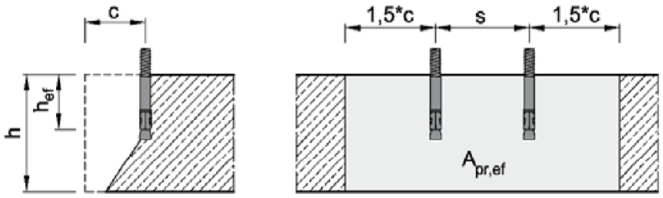
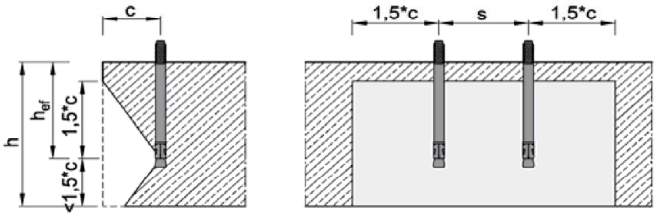
Intended use
Minimum spacings and edge distances
Required area and applicable concrete thickness

Annex B3

Deutsches Institut für Bautechnik DIBt

Table B4: Projected effective area $A_{pr,ef}$ to determine spacings and edge distances

Member thickness: $h > h_{ef} + 1{,}5 \cdot c$	
Effective anchorage depth $h_{ef} < 1{,}5 \cdot c$	Effective anchorage depth $h_{ef} \geq 1{,}5 \cdot c$
anchor group with $s \geq 3 \cdot c$ or single anchor	
$A_{pr,ef} = 2 \cdot (3 \cdot c) \cdot (1{,}5 \cdot c + h_{ef})$ [mm²]	$A_{pr,ef} = 2 \cdot (3 \cdot c) \cdot (3 \cdot c)$ [mm²]
Anchor group $(s < 3 \cdot c)$	
$A_{pr,ef} = (3 \cdot c + s) \cdot (1{,}5 \cdot c + h_{ef})$ [mm²]	$A_{pr,ef} = (3 \cdot c + s) \cdot (3 \cdot c)$ [mm²]
	

Member thickness: $h \leq h_{ef} + 1{,}5 \cdot c$	
Effective anchorage depth $h_{ef} \leq 1{,}5 \cdot c$	Effective anchorage depth $h_{ef} > 1{,}5 \cdot c$
anchor group with $s \geq 3 \cdot c$ or single anchor	
$A_{pr,ef} = 2 \cdot (3 \cdot c) \cdot h$ [mm²]	$A_{pr,ef} = 2 \cdot (3 \cdot c) \cdot (h - h_{ef} + 1{,}5 \cdot c)$ [mm²]
Anchor group $(s < 3 \cdot c)$	
$A_{pr,ef} = (3 \cdot c + s) \cdot h$ [mm²]	$A_{pr,ef} = (3 \cdot c + s) \cdot (h - h_{ef} + 1{,}5 \cdot c)$ [mm²]
	

If the area $A_{pr,ef}$ is trimmed by lateral edges ($c_2 < 1{,}5 \cdot c$), calculate the area actually present.
The spacings and edge distances shall be rounded to 5 mm.

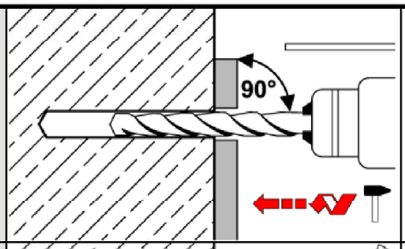
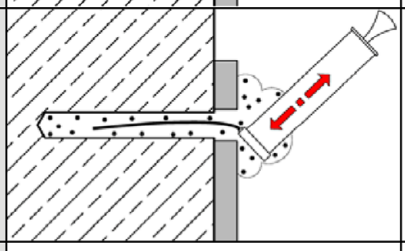
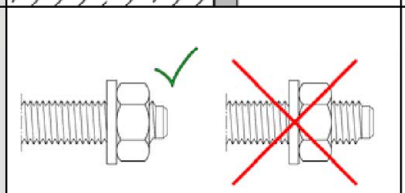
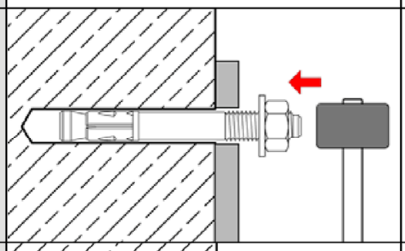
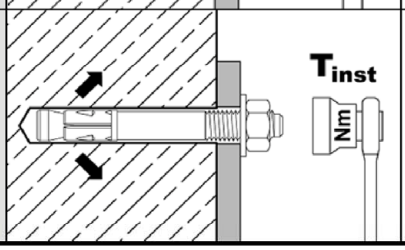
Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Intended use
Projected effective area to determine spacings and edge distances

Annex B4

Deutsches Institut für Bautechnik DIBt

Installation instructions

1		Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3.
2		Blow out dust. Alternatively vacuum clean down to the bottom of the hole.
3		Check position of nut and washer.
4		Drive in fastener.
5		Apply installation torque T_{inst}.

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Intended use
Installation instructions

Annex B5

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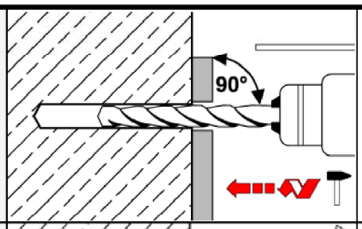
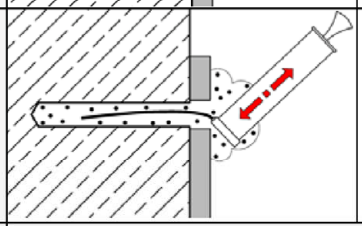
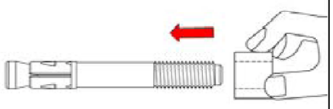
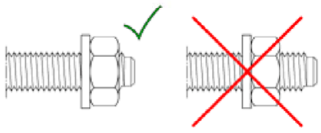
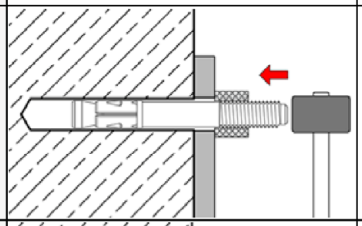
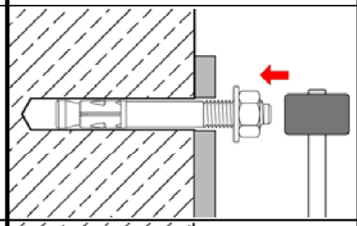
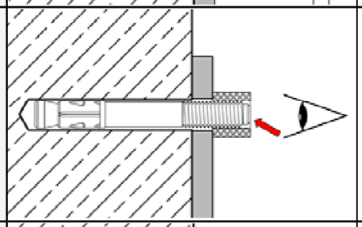
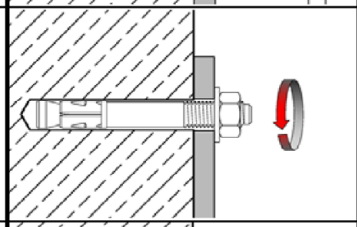
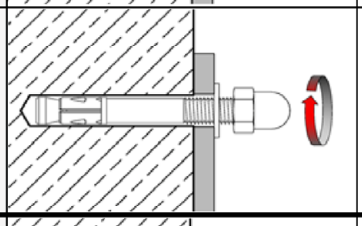
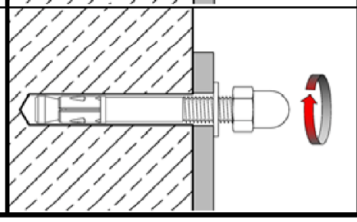
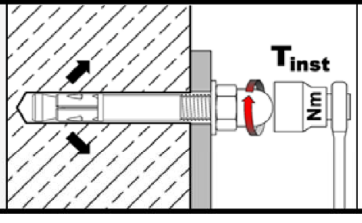
Installation with cap nut HM

1		Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3.		
2		Blow out dust. Alternatively vacuum clean down to the bottom of the hole.		
	Installation <u>with</u> setting gauge		**Installation <u>without</u> setting gauge**	
3		Remove nut and washer. Attach setting gauge.		Check position of nut.
4		Drive in fastener until end of the anchor is level with setting gauge.		Drive in fastener
5		Check excess length of the anchor, remove setting gauge.		Remove nut.
6		Screw on washer and cap nut.		Screw on cap nut
7		Apply installation torque T_{inst}.		

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Intended use
Installation instructions with cap nut

Annex B6

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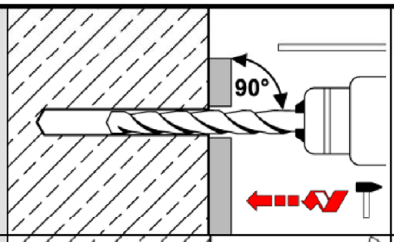
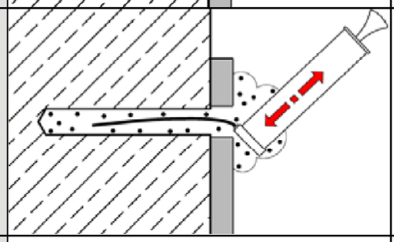
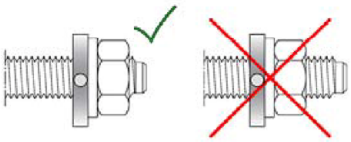
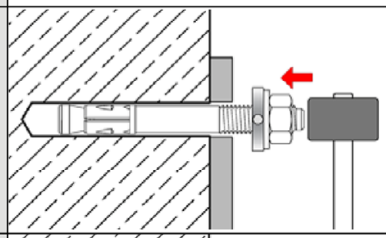
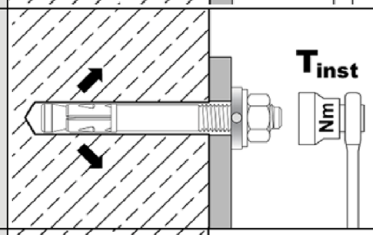
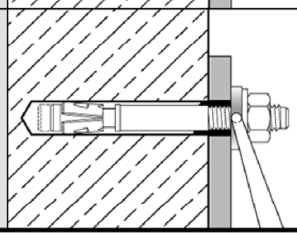
Installation instructions with filling of annular gap

1		Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3.
2		Blow out dust. Alternatively vacuum clean down to the bottom of the hole.
3		Fit the filling washer additionally to the fastener. Check position of nut and washer.
4		Drive in fastener.
5		Apply installation torque T_{inst}.
6		Fill the annular gap between anchor and fixture with mortar (compressive strength ≥ 40 N/mm²). Use enclosed reducing adapter. Observe the processing information of the mortar! The annular gap is completely filled, when excess mortar seeps out.

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Intended use
Installation instructions with filling of annular gap

Annex B7

Deutsches Institut für Bautechnik DIBt

Table C1: Characteristic values for **tension loads** under static and quasi-static action, **BZ3 zinc plated**

Fastener size			**BZ3** (zp)			
			M8	**M10**	**M12**	**M16**
Installation factor	γ_{inst}	[-]	1,0			
Steel failure						
Characteristic resistance	$N_{Rk,s}$	[kN]	19,8	30,4	44,9	79,3
Modulus of elasticity	E_s	[N/mm²]	210.000			
Partial factor	γ_{Ms}	[-]	1,5			
Pull-out						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,cr}$	[kN]	9,5	15	22	30
Increasing factor for $N_{Rk,p,cr}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,439}$	$\left(\frac{f_{ck}}{20}\right)^{0,265}$	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,339}$
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p,ucr}$	[kN]	14	24	30	50
Increasing factor for $N_{Rk,p,ucr}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,489}$	$\left(\frac{f_{ck}}{20}\right)^{0,448}$	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,203}$
Splitting						
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	min ($N_{Rk,p}$; $N^0_{Rk,c}$ [3)])			
Characteristic edge distance [2)]	$c_{cr,sp}$	[mm]	$\frac{A_{sp} + 0{,}8 \cdot (h_{sp} - h_{ef})^2}{(3{,}41 \cdot h_{sp} - 0{,}59 \cdot h_{ef})}$			
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$			
Concrete cone failure						
Minimum, effective anchorage depth	$h_{ef,min}$	[mm]	35 [1)]	40	50	65
Maximum, effective anchorage depth	$h_{ef,max}$	[mm]	90	100	125	160
Characteristic edge distance	$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$			
Characteristic spacing	$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$			
Factor k_1 cracked concrete	$k_{cr,N}$	[-]	7,7			
Factor k_1 uncracked concrete	$k_{ucr,N}$	[-]	11,0			

[1)] Fastenings with anchorage depth h_{ef} < 40mm are restricted to the use of structural components which are statically indeterminate and subject to internal exposure conditions only.
[2)] Applicable concrete thickness h_{sp} and area A_{sp} to determine characteristic edge distance $c_{cr,sp}$ according to Table B3
[3)] $N^0_{Rk,c}$ according to EN 1992-4:2018

Deutsches Institut für Bautechnik DIBt

Table C2: Characteristic values for **tension loads** under static or quasi-static action, **BZ3 A4 and BZ3 HCR**

Fastener size			**BZ3 A4 and BZ3 HCR**			
			M8	**M10**	**M12**	**M16**
Installation factor	γ_{inst}	[-]	1,0			
Steel failure						
Characteristic resistance	$N_{Rk,s}$	[kN]	19,8	30,4	44,9	74,6
Modulus of elasticity - BZ3 A4	E_s	[N/mm²]	200.000			
Modulus of elasticity - BZ3 HCR	E_s	[N/mm²]	195.000			
Partial factor	γ_{Ms}	[-]	1,5			
Pull-out						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p,cr}$	[kN]	9,5	17	22	35
Increasing factor for $N_{Rk,p,cr}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,488}$	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	$\left(\frac{f_{ck}}{20}\right)^{0,435}$	$\left(\frac{f_{ck}}{20}\right)^{0,350}$
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p,ucr}$	[kN]	20	25	42	50
Increasing factor for $N_{Rk,p,ucr}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,240}$	$\left(\frac{f_{ck}}{20}\right)^{0,364}$	$\left(\frac{f_{ck}}{20}\right)^{0,213}$	$\left(\frac{f_{ck}}{20}\right)^{0,196}$
Splitting						
Characteristic resistance	$N^0_{Rk,sp}$	[kN]	min ($N_{Rk,p}$; $N^0_{Rk,c}$ [3])			
Characteristic edge distance [2]	$c_{cr,sp}$	[mm]	$\frac{A_{sp} + 0{,}8 \cdot (h_{sp} - h_{ef})^2}{(3{,}41 \cdot h_{sp} - 0{,}59 \cdot h_{ef})}$			
Characteristic spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$			
Concrete cone failure						
Minimum, effective anchorage depth	$h_{ef,min}$	[mm]	35 [1]	40	50	65
Maximum, effective anchorage depth	$h_{ef,max}$	[mm]	90	100	125	160
Characteristic edge distance	$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$			
Characteristic spacing	$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$			
Factor k_1 cracked concrete	$k_{cr,N}$	[-]	7,7			
Factor k_1 uncracked concrete	$k_{ucr,N}$	[-]	11,0			

[1] Fastenings with anchorage depth h_{ef} < 40 mm are restricted to the use of structural components which are statically indeterminate and subject to internal exposure conditions only

[2] Applicable concrete thickness h_{sp} and area A_{sp} according to Table B3 to determine characteristic edge distance $c_{cr,sp}$

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

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Characteristic values for **tension loads**

Annex C2

Deutsches Institut für Bautechnik DIBt

Table C3: Characteristic values for **shear loads** under static and quasi-static action

Fastener size				**BZ3 / BZ3 A4 / BZ3 HCR**			
				M8	**M10**	**M12**	**M16**
Installation factor		γ_{inst}	[-]	1,0			
Steel failure <u>without</u> lever arm							
Characteristic resistance	BZ3	$V^0_{Rk,s}$	[kN]	15,7	26,8	38,3	60,0
	BZ3 A4 / HCR	$V^0_{Rk,s}$	[kN]	16,8	27,8	39,8	69,5
Partial factor		γ_{Ms}	[-]	1,25			
Ductility factor		k_7	[-]	1,0			
Steel failure <u>with</u> lever arm							
Characteristic bending resistance	BZ3	$M^0_{Rk,s}$	[Nm]	30	60	105	240
	BZ3 A4 / HCR	$M^0_{Rk,s}$	[Nm]	27	55	99	223
Partial factor		γ_{Ms}	[-]	1,25			
Concrete pry-out failure							
Pry-out factor	BZ3	k_8	[-]	2,8	3,1	3,0	3,6
	BZ3 A4 / HCR	k_8	[-]	2,7	2,8	3,3	3,4
Concrete edge failure							
Effective length of fastener in shear loading		l_f	[mm]	h_{ef} [1)]			
Outside diameter of fastener		d_{nom}	[mm]	8	10	12	16

[1)] Fastenings with anchorage depth h_{ef} < 40 mm are restricted to the use of structural components which are statically indeterminate and subject to internal exposure conditions only.

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Characteristic values for **shear loads**

Annex C3

Deutsches Institut für Bautechnik DIBt

Table C4: Characteristic values for **seismic loading,** performance category **C1**

Fastener size				**BZ3 / BZ3 A4 / BZ3 HCR**							
				M8		**M10**		**M12**		**M16**	
Effective anchorage depth		$h_{ef} \geq$	[mm]	40	45	40	60	50	70	65	85
Tension load											
Installation factor		γ_{inst}	[-]	1,0							
Steel failure											
Characteristic resistance	BZ3	$N_{Rk,s,C1}$	[kN]	19,8		30,4		44,9		79,3	
	BZ3 A4 / HCR	$N_{Rk,s,C1}$	[kN]	19,8		30,4		44,9		74,6	
Pull-out											
Characteristic resistance	BZ3	$N_{Rk,s,C1}$	[kN]	9,1		15,0		22,0		30,0	
	BZ3 A4 / HCR	$N_{Rk,s,C1}$	[kN]	9,0		17,0		22,0		35,0	
Shear load											
Steel failure without lever arm											
Characteristic resistance	BZ3	$V_{Rk,s,C1}$	[kN]	11,7	13,4	22,5	24,4	30,0	33,8	48,8	52,3
	BZ3 A4 / HCR	$V_{Rk,s,C1}$	[kN]	11,0	12,7	20,6	22,2	33,2	33,2	61,1	64,3
Factor for anchorages	**with** annular gap	α_{gap}	[-]	0,5							
	without annular gap	α_{gap}	[-]	1,0							

Table C5: Characteristic values for **seismic loading,** performance category **C2**

Fastener size				**BZ3 / BZ3 A4 / BZ3 HCR**							
				M8		**M10**		**M12**		**M16**	
Effective anchorage depth		$h_{ef} \geq$	[mm]	40	45	40	60	50	70	65	85
Tension load											
Installation factor		γ_{inst}	[-]	1,0							
Steel failure											
Characteristic resistance	BZ3	$N_{Rk,s,C2}$	[kN]	19,8		30,4		44,9		79,3	
	BZ3 A4 / HCR	$N_{Rk,s,C2}$	[kN]	19,8		30,4		44,9		74,6	
Pull-out											
Characteristic resistance	BZ3	$N_{Rk,s,C2}$	[kN]	2,8	3,6	7,3	12,5	10,7	19,0	19,8	35,2
	BZ3 A4 / HCR	$N_{Rk,s,C2}$	[kN]	2,3	3,2	5,0	7,7	8,0	13,8	19,0	29,4
Shear load											
Steel failure without lever arm											
Characteristic resistance	BZ3	$V_{Rk,s,C2}$	[kN]	7,3	11,3	15,4	19,0	18,3	28,0	39,4	43,3
	BZ3 A4 / HCR	$V_{Rk,s,C2}$	[kN]	7,5	8,6	12,5	15,9	22,4	25,6	42,7	46,1
Factor for anchorages	**with** annular gap	α_{gap}	[-]	0,5							
	without annular gap	α_{gap}	[-]	1,0							

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Characteristic resistance for **seismic loading**

Annex C4

Deutsches Institut für Bautechnik DIBt

Table C6: Characteristic values **for tension and shear load** under **fire exposure**

Fastener size				**BZ3 / BZ3 A4 / BZ3 HCR**			
				M8	**M10**	**M12**	**M16**
Tension load							
Steel failure							
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	1,2	2,6	4,6	7,7
	R60			1,0	1,9	3,3	5,6
	R90			0,7	1,3	2,1	3,5
	R120			0,6	1,0	1,5	2,5
Shear load							
Steel failure <u>without</u> lever arm							
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	4,0	7,5	12,3	20,7
	R60			2,7	5,1	8,5	14,2
	R90			1,4	2,7	4,6	7,7
	R120			0,8	1,6	2,7	4,5
Steel failure <u>with</u> lever arm							
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	4,1	9,6	19,1	43,8
	R60			2,8	6,6	13,1	30,1
	R90			1,5	3,5	7,2	16,4
	R120			0,8	2,0	4,2	9,6

$N_{Rk,p,fi}$ according to EN 1992-4:2018

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Characteristic values under **fire exposure**

Annex C5

Deutsches Institut für Bautechnik DIBt

Table C7: Displacements under **tension load,** BZ3 zinc plated

Fastener size			**BZ3** (zp)			
			M8	**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ N: acting tension load $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$						
Effective anchorage depth	$h_{ef} \geq$	[mm]	35	40	50	65
Cracked concrete						
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,13	0,05	0,04	0,03
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,29	0,20	0,15	0,11
Uncracked concrete						
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,03	0,01	0,004	0,005
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,03	0,03	0,03	0,03
Displacement under seismic action **C2**						
Effective anchorage depth	$h_{ef} \geq$	[mm]	40 / 45	40 / 60	50 / 70	65 / 85
Displacements for DLS	$\delta_{N, C2(DLS)}$	[mm]	3,9 / 4,9	2,8 / 4,7	2,4 / 4,2	2,5 / 4,5
Displacements for ULS	$\delta_{N, C2(ULS)}$	[mm]	11,3 / 14,3	9,4 / 16,1	7,3 / 12,9	7,2 / 12,8

Table C8: Displacements under **tension load,** BZ3 A4 and BZ3 HCR

Fastener size			**BZ3 A4 / BZ3 HCR**			
			M8	**M10**	**M12**	**M16**
Displacements under static or quasi-static action $\delta_{N0} = \delta_{N0\text{-factor}} \cdot N$ N: acting tension load $\delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot N$						
Effective anchorage depth	$h_{ef} \geq$	[mm]	35	40	50	65
Cracked concrete						
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,11	0,06	0,05	0,02
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,27	0,17	0,16	0,08
Uncracked concrete						
Factor for displacement	$\delta_{N0\text{-factor}}$	[mm/kN]	0,02	0,00	0,001	0,00
	$\delta_{N\infty\text{-factor}}$	[mm/kN]	0,05	0,05	0,05	0,05
Displacement under seismic action **C2**						
Effective anchorage depth	$h_{ef} \geq$	[mm]	40 / 45	40 / 60	50 / 70	65 / 85
Displacements for DLS	$\delta_{N, C2(DLS)}$	[mm]	2,0 / 2,9	2,6 / 4,1	3,3 / 5,7	3,3 / 5,1
Displacements for ULS	$\delta_{N, C2(ULS)}$	[mm]	7,7 / 11,1	10,8 / 16,8	10,4 / 18,0	9,0 / 13,9

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Displacements under tension load

Annex C6

Deutsches Institut für Bautechnik DIBt

Table C9: Displacements under **shear load,** BZ3 zinc plated

Fastener size			**BZ3** (zp)							
			M8		**M10**		**M12**		**M16**	
Displacements under static or quasi-static action $\delta_{V0} = \delta_{V0\text{-factor}} * V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} * V$										
Effective anchorage depth	$h_{ef} \geq$	[mm]	35		40		50		65	
Factor for displacement	$\delta_{V0\text{- factor}}$	[mm/kN]	0,15		0,09		0,09		0,07	
	$\delta_{V\infty\text{- factor}}$	[mm/kN]	0,22		0,13		0,14		0,11	
Displacement under seismic action **C2** [1]										
Effective anchorage depth	$h_{ef} \geq$	[mm]	40	45	40	60	50	70	65	85
Displacements for DLS	$\delta_{V,C2(DLS)}$	[mm]	2,8	2,7	3,0	3,1	3,4	3,7	3,4	3,8
Displacements for ULS	$\delta_{V,C2(ULS)}$	[mm]	5,1	5,0	5,0	5,5	6,3	9,9	6,0	9,6

[1] For anchorages with clearance in the fixture the annular gap must also be taken into account

Table C10: Displacements under **shear load,** BZ3 A4 and BZ3 HCR

Fastener size			**BZ3 A4 / BZ3 HCR**							
			M8		**M10**		**M12**		**M16**	
Displacements under static or quasi-static action $\delta_{V0} = \delta_{V0\text{-factor}} * V$ V: acting shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} * V$										
Effective anchorage depth	$h_{ef} \geq$	[mm]	35		40		50		65	
Factor for displacement	$\delta_{V0\text{- factor}}$	[mm/kN]	0,26		0,14		0,12		0,09	
	$\delta_{V\infty\text{- factor}}$	[mm/kN]	0,39		0,20		0,17		0,14	
Displacement under seismic action **C2** [1]										
Effective anchorage depth	$h_{ef} \geq$	[mm]	40	45	40	60	50	70	65	85
Displacements for DLS	$\delta_{V,C2(DLS)}$	[mm]	2,8	3,0	3,4	3,5	3,5	4,2	3,8	4,4
Displacements for ULS	$\delta_{V,C2(ULS)}$	[mm]	5,2	5,1	7,0	8,4	7,5	11,8	7,8	11,1

[1] For anchorages with clearance in the fixture the annular gap must also be taken into account

Wedge Anchor BZ3 / BZ3 A4 / BZ3 HCR

Performance
Displacements under shear load

Annex C7