Deutsches Institut für Bautechnik

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

# European Technical Assessment ETA-24/0783 of 11 September 2024

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 BZF / BZF A4 / BZF HCR |
| Product family to which the construction product belongs | Mechanical fasteners for use in concrete |
| Manufacturer | FASHIDA (Dalian) Industrial Group Co. Ltd<br>No. 478 Zhongshan Road<br>Shahekou District, DALIAN<br>VOLKSREPUBLIK CHINA |
| Manufacturing plant | Manufacturing plant no. 1 |
| This European Technical Assessment contains | 24 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-v05, Edition 01/2024 |

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## Specific Part

### 1 Technical description of the product

The Wedge anchor BZF / BZF A4 / BZF 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 |
|---|---|
| Characteristic resistance to tension load (static and quasi-static loading) | see Annex B3, 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, C5 |
| Displacements | see Annex C8, C9, C10 |

#### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Class A1 |
| Resistance to fire | see Annex C6, C7 |

#### 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 330232-01-0601-v05 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 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 11 September 2024 by Deutsches Institut für Bautechnik

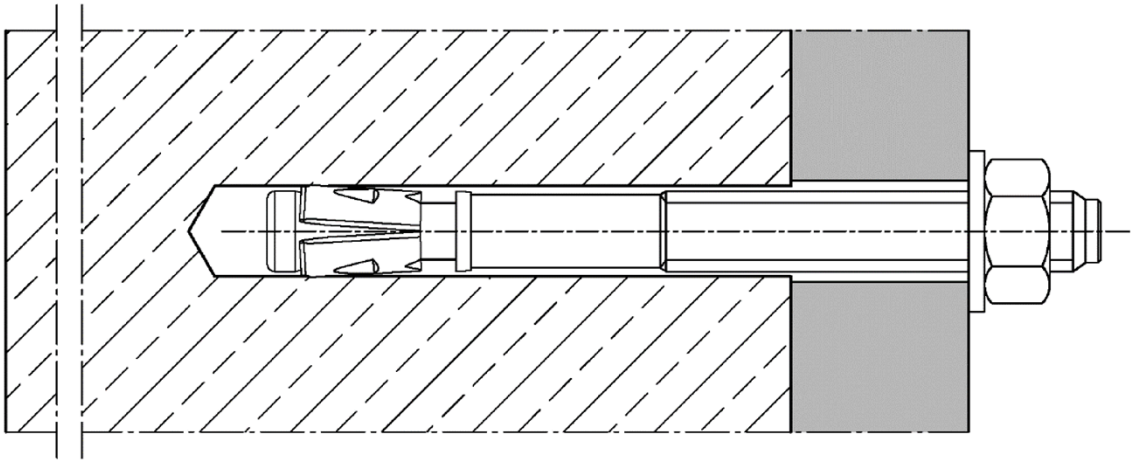
Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Baderschneider

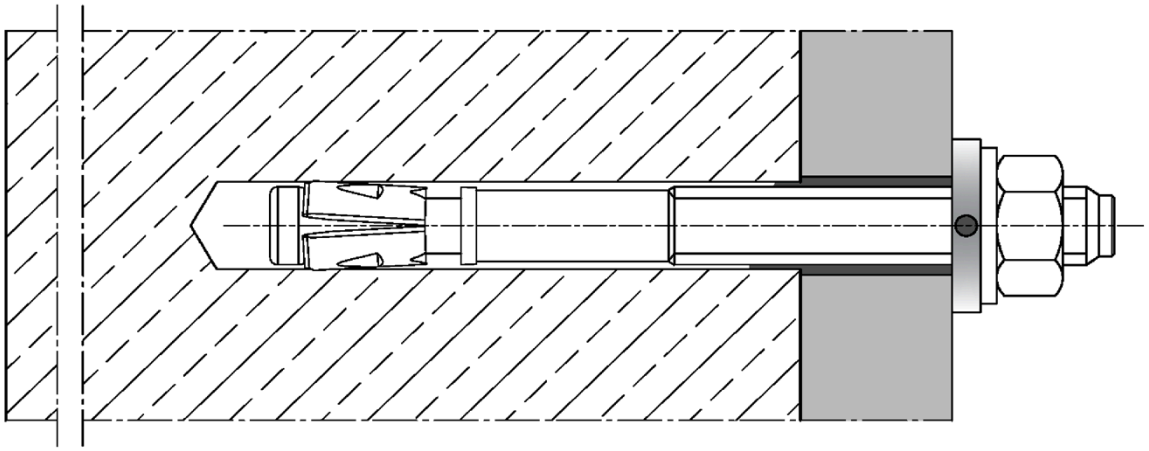
Deutsches Institut für Bautechnik DIBt

## Wedge anchor BZF, BZF A4 and BZF HCR

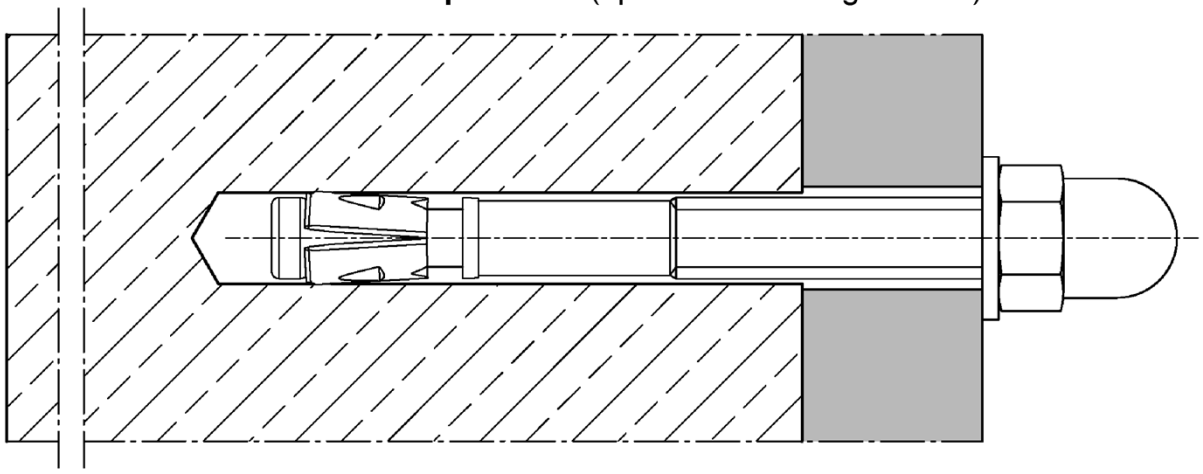
### Installation condition



### **Installation condition with filling washer** (optional with cap nut)

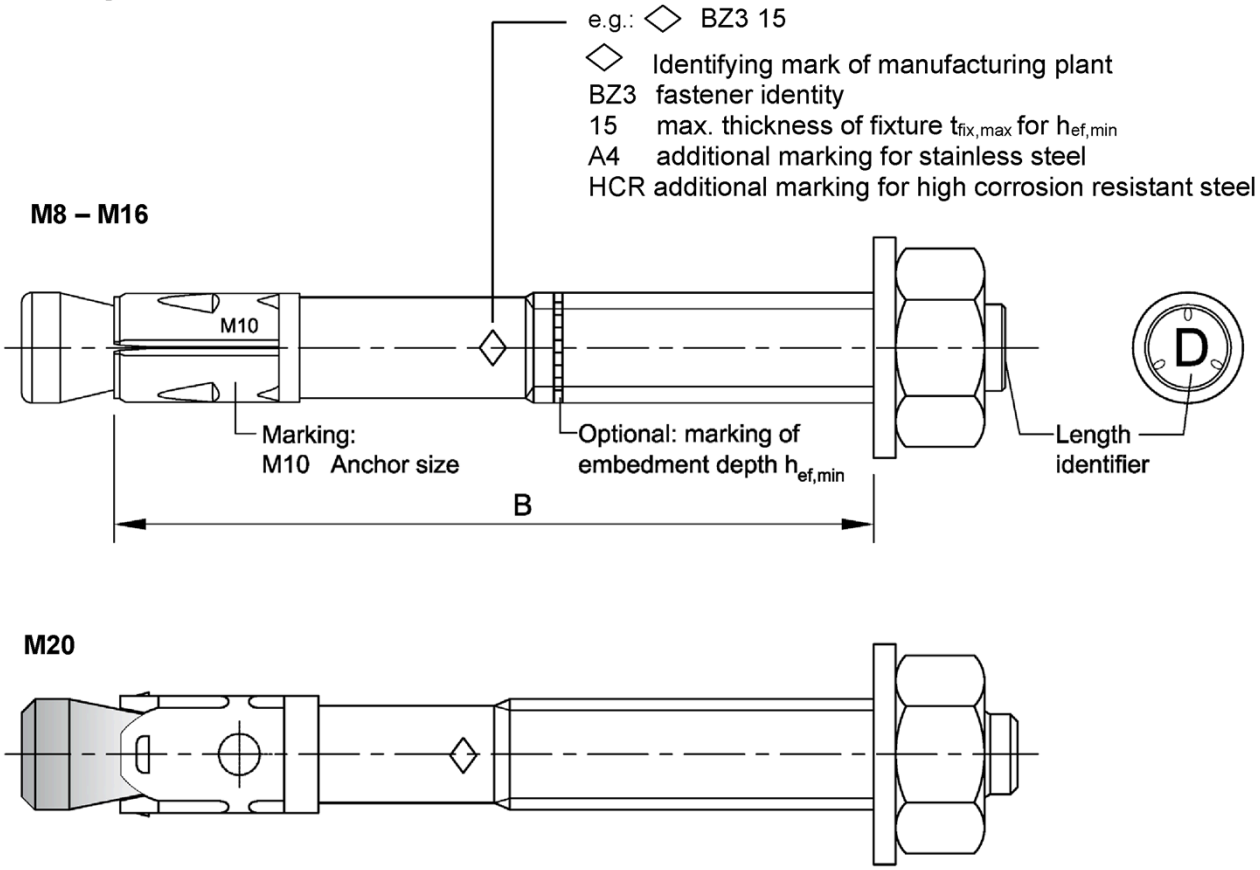


### **Installation condition with cap nut HM** (optional with filling washer)



| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex A1** |
| **Product description**<br>Product types and installation conditions | |

## Marking




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

$h_{ef}$: (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

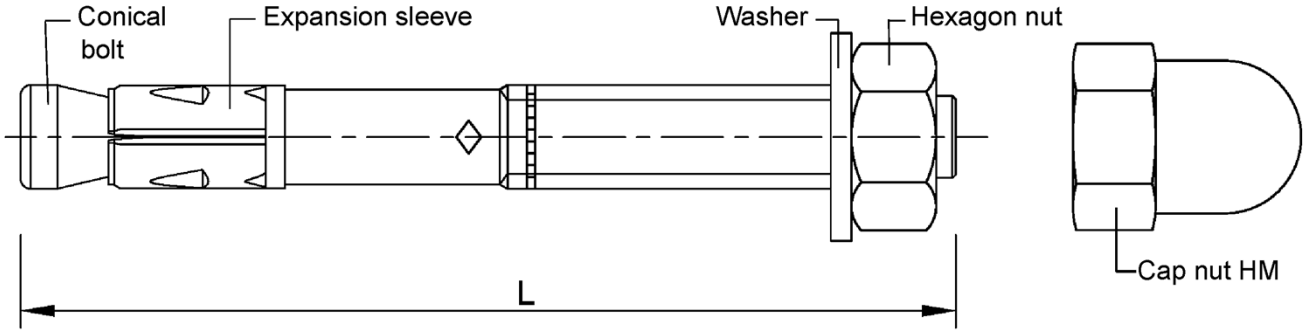
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex A2** |
|---|---|
| **Product description**<br>Marking | |

## Table A2: Material

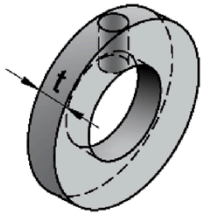
| Part | BZF | BZF A4 | BZF HCR |
|---|---|---|---|
| | **Steel, zinc plated** | **Stainless steel CRC III** | **High corrosion resistant steel CRC V** |
| Conical bolt | Steel, galvanized ≥ 5 µm fracture elongation $A_5$ ≥ 8% | Stainless steel fracture elongation $A_5$ ≥ 8% | High corrosion resistant 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 FS | | | |
| Hexagon nut | | | |
| Cap nut HM | | | |

## Table A3: Fastener dimensions

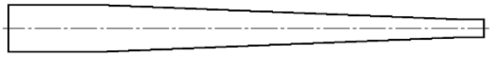
| Fastener size | | | BZF / BZF A4 / BZF HCR | | | | |
|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| Width across hexagon nut / cap nut HM | s | [mm] | 13 | 17 | 19 | 24 | 30 |
| Length of fastener | L | [mm] | $h_{ef}$ + $t_{fix}$ + 18,0 | $h_{ef}$ + $t_{fix}$ + 21,5 | $h_{ef}$ + $t_{fix}$ + 26,0 | $h_{ef}$ + $t_{fix}$ + 33,0 | $h_{ef}$ + $t_{fix}$ + 37,0 |
| Thickness of filling washer FS | t | [mm] | 5 | | | | |




**Filling washer FS**




**Reducing adapter**



| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex A3** |
|---|---|
| **Product description**<br>Material and dimensions | |

## Specifications of intended use

| Wedge Anchor | BZF / BZF A4 / BZF HCR | | | | |
|---|---|---|---|---|---|
| | M8 | M10 | M12 | M16 | M20 |
| 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 | 90 mm to 140 mm |

**Base materials:**

- For all anchor sizes: compacted reinforced or unreinforced normal weight concrete according to EN 206:2013+A2:2021
- For anchor sizes M8 to M10: steel fibre reinforced concrete (SFRC) according to EN 206:2013+A2:2021 including steel fibres according to EN 14889-1:2006, clause 5, group I. The maximum content of steel fibres is 80 kg/m$^3$.
- Cracked or uncracked concrete
- Strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions: all materials
- For all other conditions corresponding to corrosion resistance classes CRC according to EN 1993-1-4:2006 + A1:2015: stainless steel according to Annex A3, Table A2 of this ETA

**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 055:2018

**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)
- The anchor can be set in pre- or through-setting installation.
- Optionally, the annular gap between fixture and stud of 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 Injection Mortar FMZ or FMZ Plus or other high-strength injection mortar with compressive strength ≥ 40N/mm².

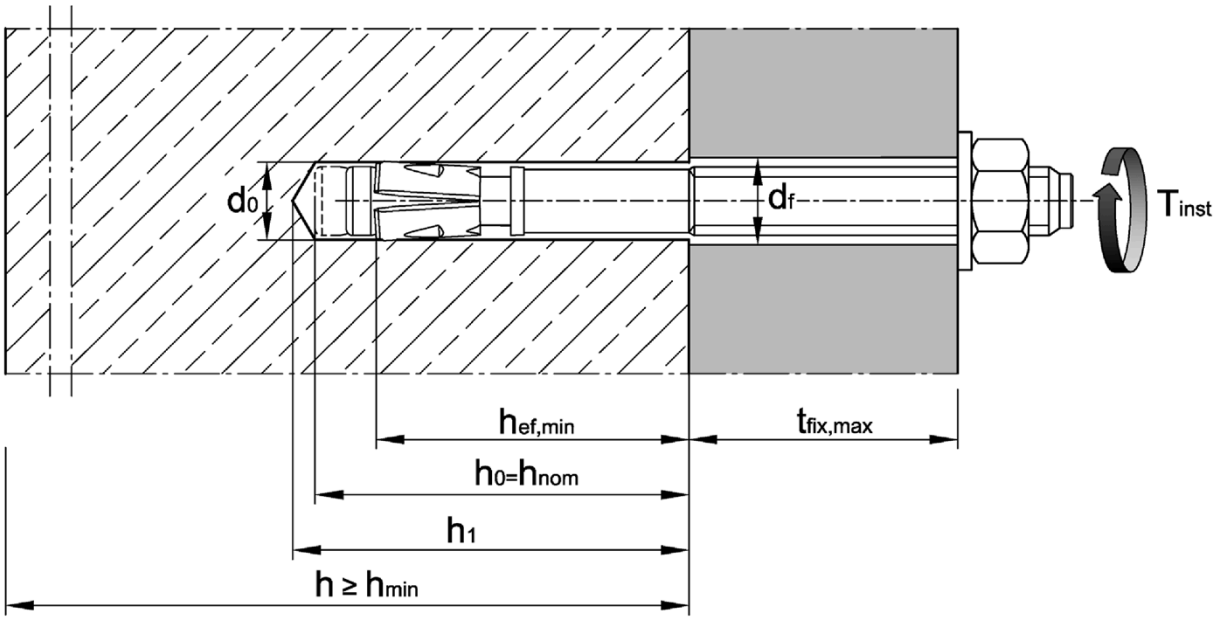
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex B1** |
|---|---|
| **Intended use**<br>Specifications | |

## Table B1: Installation parameters

| Anchor size | | | | BZF / BZF A4 / BZF HCR | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | M8 | M10 | M12 | M16 | M20 |
| Nominal drill hole diameter | | $d_0$ | [mm] | 8 | 10 | 12 | 16 | 20 |
| Cutting diameter of drill bit | | $d_{cut} \leq$ | [mm] | 8,45 | 10,45 | 12,5 | 16,5 | 20,55 |
| Minimum effective anchorage depth | | $h_{ef,min}$ | [mm] | 35 | 40 | 50 | 65 | 90 |
| Maximum effective anchorage depth | | $h_{ef,max}$ | [mm] | 90 | 100 | 125 | 160 | 140 |
| Depth of drill hole | $h_{nom} = h_0 \geq$ | | [mm] | $h_{ef}$ + 8 | $h_{ef}$ + 9 | $h_{ef}$ + 10 | $h_{ef}$ + 14 | $h_{ef}$ + 14 ($h_{ef}$ + 28)[1] |
| | $h_1 \geq$ | | [mm] | $h_{ef}$ + 10 | $h_{ef}$ + 11 | $h_{ef}$ + 13 | $h_{ef}$ + 17 | $h_{ef}$ + 17 ($h_{ef}$ + 31)[1] |
| Diameter of clearance hole in the fixture [2] | | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 |
| Projection after anchor has been inserted for installing with cap nut HM (acc. to Annex B7, Figure 3) | | C | [mm] | 10,5 | 12,5 | 16,0 | 19,5 | 23,0 |
| Installation torque | BZF | $T_{inst}$ | [Nm] | 15 | 40 | 60 | 110 | 160 |
| | BZF A4 / HCR | $T_{inst}$ | [Nm] | 15 | 40 | 55 | 100 | 200 |

[1] Increased drill hole depth for hammer drilling without borehole cleaning.

[2] For larger diameters of clearance hole in the fixture, see EN 1992-4:2018, chapter 6.2.2.2




**Wedge Anchor BZF / BZF A4 / BZF HCR**

**Intended use**
Installation parameters

**Annex B2**

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## Table B2: Minimum thickness of concrete member, minimum spacings, edge distances

| Anchor size | | | BZF / BZF A4 / BZF HCR | | | | |
|---|---|---|---|---|---|---|---|
| | | | M8 | M10 | M12 | M16 | M20 |
| 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) | max (1,5·$h_{ef}$; 150) |
| **Minimum edge distances and spacings** | | | | | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 45 | 55 | 65 | 90 |
| | for s ≥ | [mm] | see Table B4 | | | | |
| Minimum spacings | $s_{min}$ | [mm] | 35 | 40 | 50 | 65 | 95 |
| | for c ≥ | [mm] | see Table B4 | | | | |
| **The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depth and member thickness:** | | | | | | | |
| $A_{sp,rqd} \leq A_{sp,ef}$<br>Required splitting area $A_{sp,rqd}$ and idealized splitting area $A_{sp,ef}$ according to Table B4. | | | | | | | |

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

| Anchor size | | | | BZF / BZF A4 / BZF HCR | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | M8 | M10 | M12 | M16 | M20 |
| Applicable concrete thickness | BZF<br>BZF A4<br>BZF HCR | $h_{sp}$ | [mm] | $\min(h\ ;\ h_{ef} + 1{,}5 \cdot c \cdot \sqrt{2})$ | | | | |
| Area to determine $c_{cr,sp}$ [1)] | BZF | $A_{sp}$ | [mm²] | $\frac{N^0_{Rk,sp} - 2{,}573}{0{,}000436}$ | $\frac{N^0_{Rk,sp} + 2{,}040}{0{,}000693}$ | $\frac{N^0_{Rk,sp} + 3{,}685}{0{,}000692}$ | $\frac{N^0_{Rk,sp} + 3{,}738}{0{,}000875}$ | $\frac{N^0_{Rk,sp} + 2{,}423}{0{,}000453}$ |
| | BZF A4<br>BZF HCR | $A_{sp}$ | [mm²] | $\frac{N^0_{Rk,sp} + 4{,}177}{0{,}000862}$ | $\frac{N^0_{Rk,sp} + 7{,}235}{0{,}000967}$ | $\frac{N^0_{Rk,sp} + 7{,}847}{0{,}000951}$ | $\frac{N^0_{Rk,sp} + 11{,}41}{0{,}000742}$ | $\frac{N^0_{Rk,sp} + 2{,}423}{0{,}000453}$ |

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

| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex B3** |
| **Intended use**<br>Minimum spacings and edge distances<br>Required area and applicable concrete thickness | |

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## Table B4: Areas to determine spacings and edge distances for installation

| **Anchor size** | | | | **BZF / BZF A4 / BZF HCR** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| **The following equation must be fulfilled for the calculation of the minimum spacing and edge distance during installation in combination with variable anchorage depth and member thickness:** $A_{sp,rqd} \leq A_{sp,ef}$ | | | | | | | | |
| **Idealized splitting area $A_{sp,ef}$** The edge distances and spacings shall be selected or rounded in steps of 5 mm. | | | | | | | | |
| **Member thickness: $h > h_{ef} + 1{,}5 \cdot c$** | | | | | | | | |
| Single anchor or anchor group with **$s \geq 3 \cdot c$** | | | | | | | | |
| Idealized splitting area | | $A_{sp,ef}$ | [mm²] | $(6 \cdot c) \cdot (1{,}5 \cdot c + h_{ef})$ | | | | |
| Anchor group ($s < 3 \cdot c$) | | | | | | | | |
| Idealized splitting area | | $A_{sp,ef}$ | [mm²] | $(3 \cdot c + s) \cdot (1{,}5 \cdot c + h_{ef})$ | | | | |
| **Member thickness: $h \leq h_{ef} + 1{,}5 \cdot c$** | | | | | | | | |
| Single anchor or anchor group with **$s \geq 3 \cdot c$** | | | | | | | | |
| Idealized splitting area | | $A_{sp,ef}$ | [mm²] | $(6 \cdot c) \cdot h$ | | | | |
| Anchor group ($s < 3 \cdot c$) | | | | | | | | |
| Idealized splitting area | | $A_{sp,ef}$ | [mm²] | $(3 \cdot c + s) \cdot h$ | | | | |
| **Required splitting area $A_{sp,rqd}$** | | | | | | | | |
| BZF | cracked concrete | $A_{sp,rqd}$ | [mm²] | 13 900 | 23 700 | 31 500 | 42 300 | 91 250 |
| | uncracked concrete | $A_{sp,rqd}$ | [mm²] | 22 500 | 34 700 | 41 300 | 50 200 | 110 000 |
| BZF A4 BZF HCR | cracked concrete | $A_{sp,rqd}$ | [mm²] | 16 900 | 25 900 | 29 800 | 44 300 | 91 250 |
| | uncracked concrete | $A_{sp,rqd}$ | [mm²] | 19 700 | 35 700 | 35 300 | 54 800 | 110 000 |

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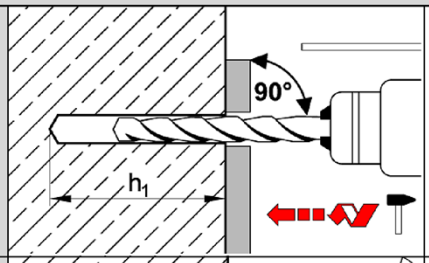
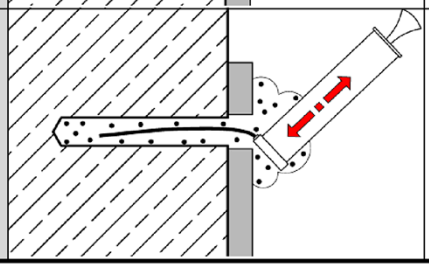
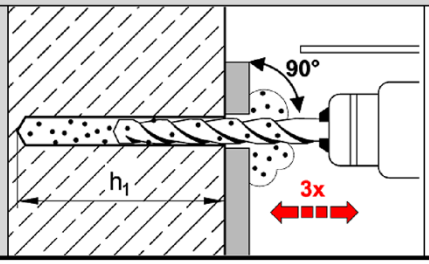
## Installation instructions

### Hole drilling with cleaning

| | | |
|---|---|---|
| 1 |  | **Hammer drilling or vacuum drilling:**<br>Drill hole perpendicular to concrete surface.<br>If using a vacuum drill bit, proceed with step 3. |
| 2 |  | Blow out dust. Alternatively vacuum clean down to the bottom of the hole. |

### Hammer drilling without cleaning (M20)

| | | |
|---|---|---|
| 1 |  | When the drill hole depth ($h_1$= $h_{ef}$ +31mm) is reached, move the drill back and forth at least three times with the machine switched on to remove the dust in the drill hole (venting the drill hole). Continue with step 3. |

| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex B5** |
| **Intended use**<br>Installation instructions – hole drilling and cleaning | |

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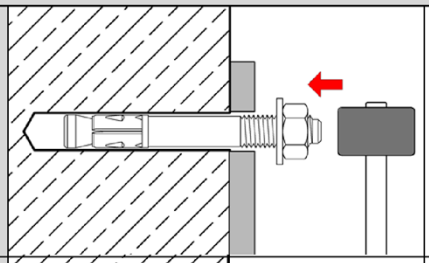
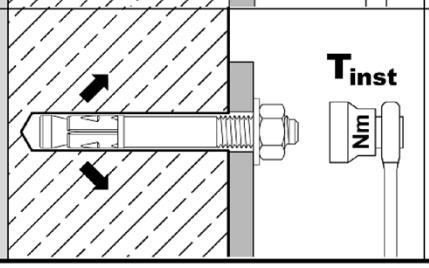
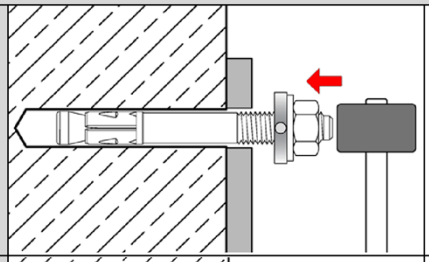
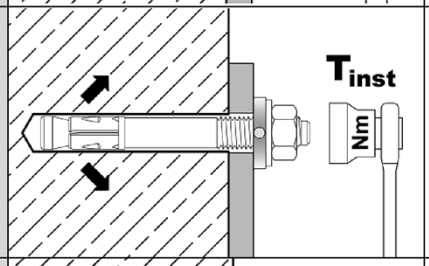
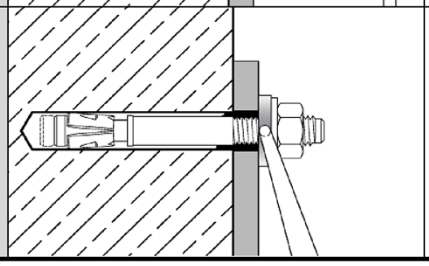
## Installation instructions - continuation

### Insert fastener

| | | |
|---|---|---|
| 3 |  | Drive in fastener. |
| 4 |   | Apply installation torque $T_{inst}$. |

### Insert fastener with filling of annular gap

| | | |
|---|---|---|
| 3 |  | Drive in fastener with additionally mounted filling washer. |
| 4 |   | Apply installation torque $T_{inst}$. |
| 5 |  | Fill the annular gap between anchor and fixture with injection adhesive (see Annex B1).<br>Use enclosed reducing adapter.<br>The annular gap is completely filled, when excess mortar seeps out. |

| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | |
| **Intended Use**<br>Installation instructions - set fastener | **Annex B6** |

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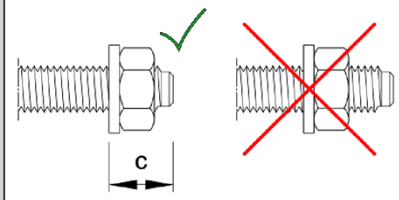
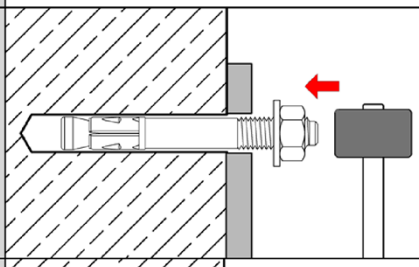
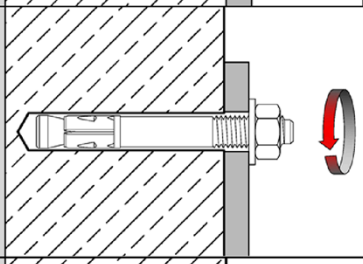
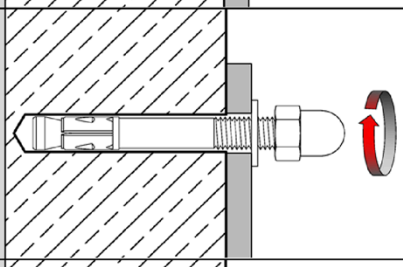
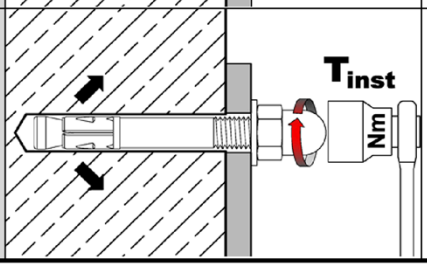
## **Installation instruction** – continuation

| **Install fastener with cap nut HM** | | |
|---|---|---|
| 3 |  | Check position of nut. Projection C after anchor has been inserted see Annex B2, Table B1. |
| 4 |  | Drive in fastener. |
| 5 |  | Remove nut. |
| 6 |  | Screw on cap nut HM. |
| 7 |  | Apply installation torque $T_{inst}$. |

| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex B7** |
| **Product description**<br>Installation instruction – set fastener with cap nut | |

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**Table C1:** Characteristic values for **tension loads** under static and quasi-static action, **BZF** (steel, zinc plated)

| **Fastener size** | | | **BZF** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| **Steel failure** | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 19,8 | 30,4 | 44,9 | 79,3 | 126,2 |
| Partial factor [4] | $\gamma_{Ms}$ | [-] | 1,5 | | | | |
| **Pull-out** | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p,cr}$ | [kN] | 9,5 | 15 | 22 | 30 | 45 |
| Increasing factor $N_{Rk,p,cr} = \psi_C \bullet N_{Rk,p,cr}$ (C20/25) | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,439}$ | $\left(\frac{f_{ck}}{20}\right)^{0,265}$ | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | $\left(\frac{f_{ck}}{20}\right)^{0,339}$ | $\left(\frac{f_{ck}}{20}\right)^{0,338}$ |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p,ucr}$ | [kN] | 14 | 24 | 30 | 50 | 55 |
| Increasing factor $N_{Rk,p,ucr} = \psi_C \bullet N_{Rk,p,ucr}$ (C20/25) | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,489}$ | $\left(\frac{f_{ck}}{20}\right)^{0,448}$ | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | $\left(\frac{f_{ck}}{20}\right)^{0,203}$ | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ |
| **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] | $min\left(\frac{A_{sp}+0,8\cdot(h_{sp}-h_{ef})^2}{(3,41\cdot h_{sp}-0,59\cdot h_{ef})};\frac{A_{sp}}{h_{sp}\cdot\sqrt{8}}\right) \geq 1,5\cdot h_{ef}$ | | | | |
| Characteristic spacing | $s_{cr,sp}$ | [mm] | 2 · $c_{cr,sp}$ | | | | |
| Factor | $\psi_{h,sp}$ | [-] | 1,0 | | | | |
| **Concrete cone failure** | | | | | | | |
| Minimum, effective anchorage depth | $h_{ef,min}$ | [mm] | 35 [1] | 40 | 50 | 65 | 90 |
| Maximum, effective anchorage depth | $h_{ef,max}$ | [mm] | 90 | 100 | 125 | 160 | 140 |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | 1,5 · $h_{ef}$ | | | | |
| Characteristic spacing | $s_{cr,N}$ | [mm] | 2 · $c_{cr,N}$ | | | | |
| Factor — cracked concrete | $k_{cr,N}$ | [-] | 7,7 | | | | |
| Factor — 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

[4] In absence of other national regulations

| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex C1** |
|---|---|
| **Performance**<br>Characteristic values for **tension loads, BZF** (Steel, zinc plated) | |

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

| **Fastener size** | | | **BZF A4 / BZF HCR** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| **Steel failure** | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 19,8 | 30,4 | 44,9 | 74,6 | 126,2 |
| Partial factor [4] | $\gamma_{Ms}$ | [-] | 1,5 | | | | |
| **Pull-out** | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p,cr}$ | [kN] | 9,5 | 17 | 22 | 35 | 45 |
| Increasing factor $N_{Rk,p,cr} = \psi_C \cdot N_{Rk,p,cr}$ (C20/25) | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,488}$ | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | $\left(\frac{f_{ck}}{20}\right)^{0,435}$ | $\left(\frac{f_{ck}}{20}\right)^{0,350}$ | $\left(\frac{f_{ck}}{20}\right)^{0,338}$ |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p,ucr}$ | [kN] | 20 | 25 | 42 | 50 | 55 |
| Increasing factor $N_{Rk,p,ucr} = \psi_C \cdot N_{Rk,p,ucr}$ (C20/25) | $\psi_C$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,240}$ | $\left(\frac{f_{ck}}{20}\right)^{0,364}$ | $\left(\frac{f_{ck}}{20}\right)^{0,213}$ | $\left(\frac{f_{ck}}{20}\right)^{0,196}$ | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ |
| **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] | $min\left(\frac{A_{sp}+0,8\cdot(h_{sp}-h_{ef})^2}{(3,41\cdot h_{sp}-0,59\cdot h_{ef})};\frac{A_{sp}}{h_{sp}\cdot\sqrt{8}}\right) \geq 1,5\cdot h_{ef}$ | | | | |
| Characteristic spacing | $s_{cr,sp}$ | [mm] | $2 \cdot c_{cr,sp}$ | | | | |
| Factor | $\psi_{h,sp}$ | [-] | 1,0 | | | | |
| **Concrete cone failure** | | | | | | | |
| Minimum, effective anchorage depth | $h_{ef,min}$ | [mm] | 35 [1] | 40 | 50 | 65 | 90 |
| Maximum, effective anchorage depth | $h_{ef,max}$ | [mm] | 90 | 100 | 125 | 160 | 140 |
| Characteristic edge distance | $c_{cr,N}$ | [mm] | $1,5 \cdot h_{ef}$ | | | | |
| Characteristic spacing | $s_{cr,N}$ | [mm] | $2 \cdot c_{cr,N}$ | | | | |
| Factor — cracked concrete | $k_{cr,N}$ | [-] | 7,7 | | | | |
| Factor — 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

[4] In absence of other national regulations

| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex C2** |
|---|---|
| **Performance**<br>Characteristic values for **tension loads, BZF A4** and **BZF HCR** | |

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

| **Fastener size** | | | | **BZF / BZF A4 / BZF HCR** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | | | |
| Characteristic resistance – **<u>unfilled</u>** annular gap | BZF | $V^0_{Rk,s}$ | [kN] | 15,7 | 26,8 | 38,3 | 60,0 | 83,8 |
| | BZF A4 / HCR | $V^0_{Rk,s}$ | [kN] | 16,8 | 27,8 | 39,8 | 69,5 | 108,5 |
| Characteristic resistance – **<u>filled</u>** annular gap | BZF | $V^0_{Rk,s}$ | [kN] | 17,3 | 26,7 | 38,6 | 60,6 | 86,1 |
| | BZF A4 / HCR | $V^0_{Rk,s}$ | [kN] | 16,8 | 27,8 | 44,9 | 80,1 | 108,5 |
| Partial factor [2] | | $\gamma_{Ms}$ | [-] | 1,25 | | | | |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | |
| **Steel failure <u>with</u> lever arm** | | | | | | | | |
| Characteristic bending resistance | BZF | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 240 | 412 |
| | BZF A4 / HCR | $M^0_{Rk,s}$ | [Nm] | 27 | 55 | 99 | 223 | 390 |
| Partial factor [2] | | $\gamma_{Ms}$ | [-] | 1,25 | | | | |
| **Concrete pry-out failure** | | | | | | | | |
| Pry-out factor | BZF | $k_8$ | [-] | 2,8 | 3,1 | 3,0 | 3,6 | 3,3 |
| | BZF A4 / HCR | $k_8$ | [-] | 2,7 | 2,8 | 3,3 | 3,4 | 3,3 |
| **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 | 20 |

[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] In absence of other national regulations.

| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex C3** |
|---|---|
| **Performance**<br>Characteristic values for **shear loads** | |

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

| **Fastener size** | | | | **BZF / BZF A4 / BZF HCR** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** | |
| Effective anchorage depth | | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 | 100 |
| **Tension load** | | | | | | | | | | | | | |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| **Steel failure** | | | | | | | | | | | | | |
| Characteristic resistance | BZF | $N_{Rk,s,C1}$ | [kN] | 19,8 | | 30,4 | | 44,9 | | 79,3 | | 126,2 | |
| | BZF A4 / HCR | $N_{Rk,s,C1}$ | [kN] | 19,8 | | 30,4 | | 44,9 | | 74,6 | | 126,2 | |
| **Pull-out** | | | | | | | | | | | | | |
| Characteristic resistance | BZF | $N_{Rk,p,C1}$ | [kN] | 9,1 | | 15,0 | | 22,0 | | 30,0 | | 45,1 | |
| | BZF A4 / HCR | $N_{Rk,p,C1}$ | [kN] | 9,0 | | 17,0 | | 22,0 | | 35,0 | | 45,1 | |
| **Shear load** | | | | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | | | | |
| Characteristic resistance - **unfilled** annular gap | BZF | $V_{Rk,s,C1}$ | [kN] | 11,7 | 13,4 | 22,5 | 24,4 | 30,0 | 33,8 | 48,8 | 52,3 | 83,8 | |
| | BZF A4 / HCR | $V_{Rk,s,C1}$ | [kN] | 11,0 | 12,7 | 20,6 | 22,2 | 33,2 | 33,2 | 61,1 | 64,3 | 108,5 | |
| Characteristic resistance - **filled** annular gap | BZF | $V_{Rk,s,C1}$ | [kN] | 14,0 | 14,7 | 24,1 | 24,4 | 37,0 | 38,6 | 60,2 | 60,2 | 86,1 | |
| | BZF A4 / HCR | $V_{Rk,s,C1}$ | [kN] | 12,6 | 16,8 | 24,5 | 27,5 | 36,7 | 39,8 | 67,7 | 74,2 | 108,5 | |
| Factor for anchorages | **unfilled** annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | | | | | | | |
| | **filled** annular gap | $\alpha_{gap}$ | [-] | 1,0 | | | | | | | | | |

**Wedge Anchor BZF / BZF A4 / BZF HCR**

**Performance**
Characteristic resistance for **seismic loading,** performance category **C1**

**Annex C4**

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

| **Fastener size** | | | | **BZF / BZF A4 / BZF HCR** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** | | |
| Effective anchorage depth | | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 | 100 | 140 |
| **Tension load** | | | | | | | | | | | | | | |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | | | | | |
| Characteristic resistance | BZF | $N_{Rk,s,C2}$ | [kN] | 19,8 | | 30,4 | | 44,9 | | 79,3 | | 126,2 | | |
| | BZF A4 / HCR | $N_{Rk,s,C2}$ | [kN] | 19,8 | | 30,4 | | 44,9 | | 74,6 | | 126,2 | | |
| **Pull-out** | | | | | | | | | | | | | | |
| Characteristic resistance | BZF | $N_{Rk,p,C2}$ | [kN] | 2,8 | 3,6 | 7,3 | 12,5 | 10,7 | 19,0 | 19,8 | 35,2 | 35,1 | 37,6 | 42,9 |
| | BZF A4 / HCR | $N_{Rk,p,C2}$ | [kN] | 2,3 | 3,2 | 5,0 | 7,7 | 8,0 | 13,8 | 19,0 | 29,4 | 35,1 | 37,6 | 42,9 |
| **Shear load** | | | | | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | | | | | |
| Characteristic resistance - **unfilled** annular gap | BZF | $V_{Rk,s,C2}$ | [kN] | 7,3 | 11,3 | 15,4 | 19,0 | 18,3 | 28,0 | 39,4 | 43,3 | 69,0 | | |
| | BZF A4 / HCR | $V_{Rk,s,C2}$ | [kN] | 7,5 | 8,6 | 12,5 | 15,9 | 22,4 | 25,6 | 42,7 | 46,1 | 88,9 | | |
| Characteristic resistance - **filled** annular gap | BZF | $V_{Rk,s,C2}$ | [kN] | 9,7 | 10,8 | 17,7 | 19,9 | 27,6 | 28,9 | 46,0 | 48,8 | 73,3 | | |
| | BZF A4 / HCR | $V_{Rk,s,C2}$ | [kN] | 9,4 | 9,7 | 16,5 | 17,1 | 24,5 | 28,5 | 47,4 | 47,4 | 88,9 | | |
| Factor for anchorages | **unfilled** annular gap | $\alpha_{gap}$ | [-] | 0,5 | | | | | | | | | | |
| | **filled** annular gap | $\alpha_{gap}$ | [-] | 1,0 | | | | | | | | | | |

**Wedge Anchor BZF / BZF A4 / BZF HCR**

**Performance**
Characteristic resistance for **seismic loading,** performance category **C2**

**Annex C5**

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**Table C6:** Characteristic values **for tension and shear load** under **fire exposure, BZF** (steel, zinc plated)

| **Fastener size** | | | | **BZF** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| **Tension load** | | | | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 1,2 | 2,6 | 4,6 | 7,7 | 9,4 |
| | R60 | | | 1,0 | 1,9 | 3,3 | 5,6 | 8,2 |
| | R90 | | | 0,7 | 1,3 | 2,1 | 3,5 | 6,9 |
| | R120 | | | 0,6 | 1,0 | 1,5 | 2,5 | 6,3 |
| **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 | 11,0 |
| | R60 | | | 2,7 | 5,1 | 8,5 | 14,2 | 10,6 |
| | R90 | | | 1,4 | 2,7 | 4,6 | 7,7 | 10,2 |
| | R120 | | | 0,8 | 1,6 | 2,7 | 4,5 | 10,0 |
| **Steel failure <u>with</u> lever arm** | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 4,1 | 9,6 | 19,1 | 43,8 | 29,1 |
| | R60 | | | 2,8 | 6,6 | 13,1 | 30,1 | 28,0 |
| | R90 | | | 1,5 | 3,5 | 7,2 | 16,4 | 26,9 |
| | R120 | | | 0,8 | 2,0 | 4,2 | 9,6 | 26,3 |

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

**Wedge Anchor BZF / BZF A4 / BZF HCR**

**Performance**
Characteristic values under **fire exposure, BZF** (steel, zinc plated)

**Annex C6**

Deutsches Institut für Bautechnik DIBt

**Table C7:** Characteristic values **for tension and shear load** under **fire exposure, BZF A4** and **BZF HCR**

| **Fastener size** | | | | **BZF A4 / BZF HCR** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **M8** | **M10** | **M12** | **M16** | **M20** |
| **Tension load** | | | | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 4,0 | 6,9 | 11,0 | 18,1 | 36,9 |
| | R60 | | | 2,9 | 5,0 | 8,0 | 13,1 | 27,4 |
| | R90 | | | 1,8 | 3,1 | 4,9 | 8,1 | 17,9 |
| | R120 | | | 1,2 | 2,1 | 3,4 | 5,6 | 13,1 |
| **Shear load** | | | | | | | | |
| **Steel failure <u>without</u> lever arm** | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 8,5 | 17,6 | 32,0 | 52,6 | 73,5 |
| | R60 | | | 6,2 | 12,6 | 22,6 | 37,1 | 51,8 |
| | R90 | | | 3,9 | 7,5 | 13,1 | 21,5 | 30,1 |
| | R120 | | | 2,8 | 5,0 | 8,4 | 13,8 | 19,2 |
| **Steel failure <u>with</u> lever arm** | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 8,7 | 22,7 | 49,8 | 111,5 | 194,7 |
| | R60 | | | 6,3 | 16,2 | 35,1 | 78,6 | 137,2 |
| | R90 | | | 4,0 | 9,7 | 20,4 | 45,6 | 79,7 |
| | R120 | | | 2,8 | 6,5 | 13,0 | 29,2 | 50,9 |

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

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## Table C8: Displacements under **tension load, BZF** (steel, zinc plated)

| **Fastener size** | | | **BZF** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** | | |
| **Displacements under static or quasi-static action**<br>$\delta_{N0} = \delta_{N0\text{-factor}} * N$ N: acting tension load<br>$\delta_{N\infty} = \delta_{N\infty\text{-factor}} * N$ | | | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 35 | | 40 | | 50 | | 65 | | 90 | | |
| **Cracked concrete** | | | | | | | | | | | | | |
| Factor for displacement | $\delta_{N0\text{-factor}}$ | [mm/kN] | 0,13 | | 0,05 | | 0,04 | | 0,03 | | 0,04 | | |
| | $\delta_{N\infty\text{-factor}}$ | [mm/kN] | 0,29 | | 0,20 | | 0,15 | | 0,11 | | 0,05 | | |
| **Uncracked concrete** | | | | | | | | | | | | | |
| Factor for displacement | $\delta_{N0\text{- factor}}$ | [mm/kN] | 0,03 | | 0,01 | | 0,004 | | 0,005 | | 0,02 | | |
| | $\delta_{N\infty\text{- factor}}$ | [mm/kN] | 0,03 | | 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 | 90 | 100 | 140 |
| Displacements for DLS | $\delta_{N, C2(DLS)}$ | [mm] | 3,9 | 4,9 | 2,8 | 4,7 | 2,4 | 4,2 | 2,5 | 4,5 | 4,2 | 4,5 | 5,1 |
| Displacements for ULS | $\delta_{N, C2(ULS)}$ | [mm] | 11,3 | 14,3 | 9,4 | 16,1 | 7,3 | 12,9 | 7,2 | 12,8 | 11,7 | 12,5 | 14,3 |

## Table C9: Displacements under **tension load, BZF A4** and **BZF HCR**

| **Fastener size** | | | **BZF A4 / BZF HCR** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** | | |
| **Displacements under static or quasi-static action**<br>$\delta_{N0} = \delta_{N0\text{-factor}} * N$ N: acting tension load<br>$\delta_{N\infty} = \delta_{N\infty\text{-factor}} * N$ | | | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 35 | | 40 | | 50 | | 65 | | 90 | | |
| **Cracked concrete** | | | | | | | | | | | | | |
| Factor for displacement | $\delta_{N0\text{-factor}}$ | [mm/kN] | 0,11 | | 0,06 | | 0,05 | | 0,02 | | 0,04 | | |
| | $\delta_{N\infty\text{-factor}}$ | [mm/kN] | 0,27 | | 0,17 | | 0,16 | | 0,08 | | 0,05 | | |
| **Uncracked concrete** | | | | | | | | | | | | | |
| Factor for displacement | $\delta_{N0\text{- factor}}$ | [mm/kN] | 0,02 | | 0,00 | | 0,001 | | 0,00 | | 0,02 | | |
| | $\delta_{N\infty\text{- factor}}$ | [mm/kN] | 0,05 | | 0,05 | | 0,05 | | 0,05 | | 0,03 | | |
| **Displacement under seismic action C2** | | | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 | 100 | 140 |
| Displacements for DLS | $\delta_{N, C2(DLS)}$ | [mm] | 2,0 | 2,9 | 2,6 | 4,1 | 3,3 | 5,7 | 3,3 | 5,1 | 4,2 | 4,5 | 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 | 11,7 | 12,5 | 14,3 |

**Wedge Anchor BZF / BZF A4 / BZF HCR**

**Performance**
Displacements under tension load

**Annex C8**

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## Table C10: Displacements under **shear load, BZF** (steel, zinc plated)

| **Fastener size** | | | **BZF** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** |
| **Displacements under static or quasi-static action**<br>$\delta_{V0} = \delta_{V0\text{-factor}} * V$ V: acting shear load<br>$\delta_{V\infty} = \delta_{V\infty\text{-factor}} * V$ | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 35 | | 40 | | 50 | | 65 | | 90 |
| Factor for displacement **unfilled** annular gap | $\delta_{V0}$- factor | [mm/kN] | 0,15 | | 0,09 | | 0,09 | | 0,07 | | 0,06 |
| | $\delta_{V\infty}$- factor | [mm/kN] | 0,22 | | 0,13 | | 0,14 | | 0,11 | | 0,10 |
| Factor for displacement **filled** annular gap | $\delta_{V0}$- factor | [mm/kN] | 0,01 | | 0,04 | | 0,06 | | 0,04 | | 0,02 |
| | $\delta_{V\infty}$- factor | [mm/kN] | 0,015 | | 0,06 | | 0,09 | | 0,06 | | 0,03 |
| **Displacement under seismic action C2** [1] **unfilled** annular gap | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | 2,8 | 2,7 | 3,0 | 3,1 | 3,4 | 3,7 | 3,4 | 3,8 | 5,1 |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | 5,1 | 5,0 | 5,0 | 5,5 | 6,3 | 9,9 | 6,0 | 9,6 | 9,4 |
| **Displacement under seismic action C2 filled** annular gap | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | 0,5 | 0,4 | 1,4 | 0,9 | 1,4 | 0,7 | 1,4 | 1,2 | 1,3 |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | 1,7 | 1,9 | 5,8 | 4,5 | 4,5 | 3,1 | 5,0 | 3,9 | 5,2 |

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

| | |
|---|---|
| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex C9** |
| **Performance**<br>Displacements under shear load | |

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## Table C11: Displacements under **shear load, BZF A4** and **BZF HCR**

| **Fastener size** | | | **BZF A4 / BZF HCR** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **M8** | | **M10** | | **M12** | | **M16** | | **M20** |
| **Displacements under static or quasi-static action**<br>$\delta_{V0} = \delta_{V0\text{-factor}} * V$ V: acting shear load<br>$\delta_{V\infty} = \delta_{V\infty\text{-factor}} * V$ | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 35 | | 40 | | 50 | | 65 | | 90 |
| Factor for displacement **unfilled** annular gap | $\delta_{V0}$- factor | [mm/kN] | 0,26 | | 0,14 | | 0,12 | | 0,09 | | 0,09 |
| | $\delta_{V\infty}$- factor | [mm/kN] | 0,39 | | 0,20 | | 0,17 | | 0,14 | | 0,13 |
| Factor for displacement **filled** annular gap | $\delta_{V0}$- factor | [mm/kN] | 0,16 | | 0,05 | | 0,05 | | 0,03 | | 0,09 |
| | $\delta_{V\infty}$- factor | [mm/kN] | 0,23 | | 0,08 | | 0,08 | | 0,05 | | 0,13 |
| **Displacement under seismic action C2** [1] **unfilled** annular gap | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | 2,8 | 3,0 | 3,4 | 3,5 | 3,5 | 4,2 | 3,8 | 4,4 | 5,1 |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | 5,2 | 5,1 | 7,0 | 8,4 | 7,5 | 11,8 | 7,8 | 11,1 | 9,4 |
| **Displacement under seismic action C2 filled** annular gap | | | | | | | | | | | |
| Effective anchorage depth | $h_{ef} \geq$ | [mm] | 40 | 45 | 40 | 60 | 50 | 70 | 65 | 85 | 90 |
| Displacements for DLS | $\delta_{V,C2(DLS)}$ | [mm] | 0,9 | 0,6 | 1,2 | 0,5 | 1,5 | 1,5 | 1,6 | 1,6 | 4,1 |
| Displacements for ULS | $\delta_{V,C2(ULS)}$ | [mm] | 2,5 | 2,6 | 5,4 | 3,6 | 6,0 | 7,1 | 6,2 | 6,2 | 8,4 |

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

| **Wedge Anchor BZF / BZF A4 / BZF HCR** | **Annex C10** |
|---|---|
| **Performance**<br>Displacements under shear load | |