... eine starke Verbindung

# TOIMIVUSDEKLARATSIOON

DoP nr.: **MKT-114** - ee

- ✧ **Tootetüübi kordumatu identifitseerimiskood:** **Kiil ankur BZ plus ning BZ-IG**
- ✧ **Kavandatud kasutusotstarbe:** Jõu abil juhitav paisumisankur ankrusse sisse betoon vt lisa B
- ✧ **Tootja:** MKT Metall-Kunststoff-Technik GmbH & Co.KG
  Auf dem Immel 2
  67685 Weilerbach
- ✧ **Jõudluse hindamise ja kontrollimise süsteem:** 1
- ✧ **Euroopa hindamisdokument:** **EAD 330232-00-0601**
  Euroopa tehniline hinnang: **ETA-99/0010, 23.07.2018**
  Tehnilise hindamise asutus: DIBt, Berlin
  Teavitatud asutustele: NB 1343 – MPA, Darmstadt
- ✧ **Deklareeritud toimivuse:**

| Põhiomadused | Toimivus |
|---|---|
| **Mehhaaniline vastupidavus ja stabiilsus (BWR1)** | |
| Iseloomulik takistid staatiline ja kvaasstaatiline efektid | BZ plus: Lisa / Annex C1 – C5<br>BZ-IG: Lisa / Annex C11 – C13 |
| Nihked | BZ plus: Lisa / Annex C9 – C10<br>BZ-IG: Lisa / Annex C15 |
| Seismiliste jõudluskategooriate C1 + C2 iseloomulik vastupidavus ja nihked | BZ plus: Lisa / Annex C6 |
| **Tuleohutus (BWR2)** | |
| Tuletundlikkus | Klass A1 |
| Tulekindlus | BZ plus: Lisa / Annex C7 – C8<br>BZ-IG: Lisa / Annex C14 |

Ülaltoodud toote jõudlus on deklareeritud jõudlus / jõudlus. Eespool nimetatud tootja vastutab toimivusdeklaratsiooni koostamise eest vastavalt määrusele (EU) nr 305/2011.

Tootja poolt ja nimel allkirjastanud:

**Stefan Weustenhagen**
(Tegevdirektor)
**Weilerbach, 23.07.2018**

p.p.
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(Tootearenduse juht)

Selle toimivusdeklaratsiooni originaal kirjutati saksa keeles. Tõlke kõrvalekallete korral kasutatakse saksakeelset versiooni.

## Specifications of intended use

| Wedge Anchor BZ plus | | | | | | | |
|---|---|---|---|---|---|---|---|
| Standard anchorage depth | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
| Steel, galvanized | | | | ✓ | | | |
| Steel, sherardized | | | | ✓ | | | |
| Stainless steel A4 and high corrosion resistant steel HCR | | | | ✓ | | | - |
| Static or quasi-static action | | | | ✓ | | | |
| Fire exposure | | | | ✓ | | | |
| Seismic action (C1 and C2) [1)] | | | ✓ | | | - | - |

| Reduced anchorage depth [1)] | M8 | M10 | M12 | M16 |
|---|---|---|---|---|
| Steel, galvanized | | | ✓ | |
| Steel, sherardized | | | ✓ | |
| Stainless steel A4 and high corrosion resistant steel HCR | | | ✓ | |
| Static or quasi-static action | | | ✓ | |
| Fire exposure | | | ✓ | |
| Seismic action (C1 and C2) | | | - | |

[1)] only cold formed anchors acc. to Annex A3

| Wedge Anchor BZ-IG | M6 | M8 | M10 | M12 |
|---|---|---|---|---|
| Steel, galvanized | | | ✓ | |
| Stainless steel A4 and high corrosion resistant steel HCR | | | ✓ | |
| Static or quasi-static action | | | ✓ | |
| Fire exposure | | | ✓ | |
| Seismic action (C1 and C2) | | | - | |

**Base materials:**

- Compacted, reinforced or unreinforced normal weight concrete (without fibers) according to EN 206:2013
- Strength classes C20/25 to C50/60 according to EN 206:2013
- Cracked or uncracked concrete

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions
  (steel zinc plated, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure including industrial and marine environment or exposure to permanently damp internal condition, if no particular aggressive conditions exist
  (stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions
  (high corrosion resistant steel)

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used.)

## Specifications of intended use

**Design:**

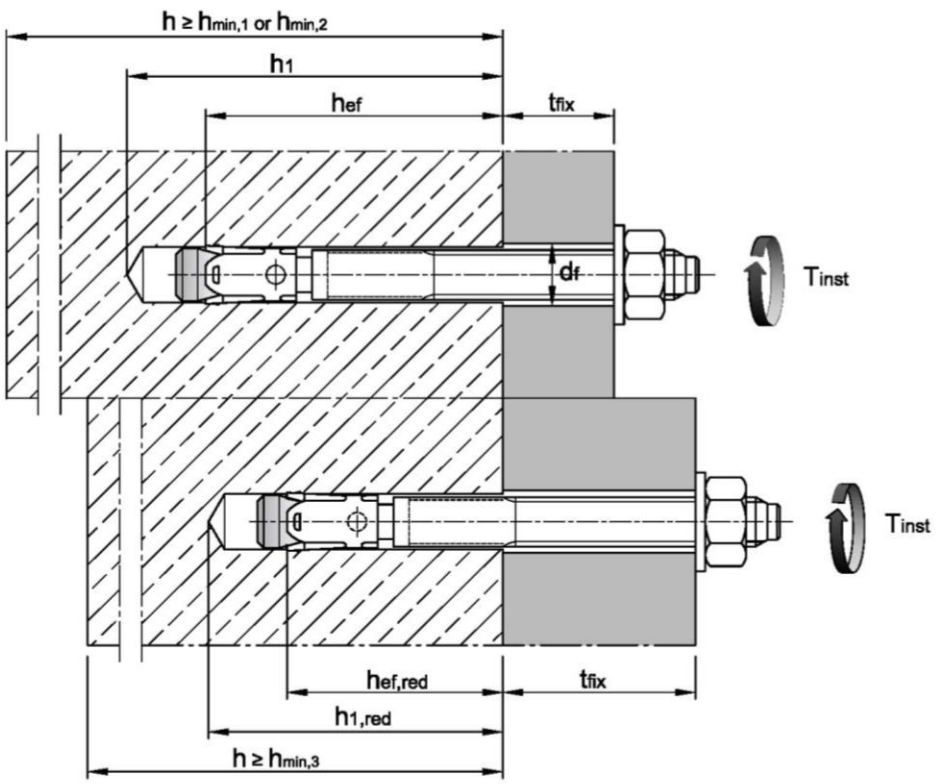
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.).
- Dimensioning of fasteners under static or quasi-static action, seismic action or fire exposure according to FprEN 1992-4: 2016 in conjunction with TR 055

**Installation:**

- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- 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
- Optionally, the annular gap between fixture and stud of the BZ plus can be filled to reduce the hole. For this purpose, the filling washer (3b) must be used in addition to the supplied washer (3a). For filling use high-strength mortar with compressive strength ≥ 50N/mm² (VMZ, VMU plus or VMH)
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted 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

## Table B1: Installation parameters, BZ plus

| Fastener size | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | | $d_0$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 28 |
| Cutting diameter of drill bit | | $d_{cut} \leq$ | [mm] | 8,45 | 10,45 | 12,5 | 16,5 | 20,55 | 24,55 | 28,55 |
| Installation torque | Steel, galvanized | $T_{inst}$ | [Nm] | 20 | 25 | 45 | 90 | 160 | 200 | 300 |
| | Steel, sherardized | $T_{inst}$ | [Nm] | 16 | 22 | 40 | 90 | 160 | 260 | 300 |
| | Stainless steel A4, HCR | $T_{inst}$ | [Nm] | 20 | 35 | 50 | 110 | 200 | 290 | - |
| Diameter of clearance hole in the fixture | | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 | 30 |
| **Standard anchorage depth** | | | | | | | | | | |
| Depth of drill hole | Steel, zinc plated | $h_1 \geq$ | [mm] | 60 | 75 | 90 | 110 | 125 | 145 | 160 |
| | Stainless steel A4, HCR | $h_1 \geq$ | [mm] | 60 | 75 | 90 | 110 | 125 | 155 | - |
| Effective anchorage depth | Steel, zinc plated | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| | Stainless steel A4, HCR | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 | - |
| **Reduced anchorage depth** | | | | | | | | | | |
| Depth of drill hole | | $h_{1,red} \geq$ | [mm] | 49 | 55 | 70 | 90 | - | - | - |
| Reduced effective anchorage depth | | $h_{ef,red}$ | [mm] | 35 | 40 | 50 | 65 | | | |




**Wedge anchor BZ plus**

**Intended use**
Installation parameters

**Annex B3**

**Table B2:** Minimum **spacings** and **edge distances, standard anchorage depth**, BZ plus

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|
| **Standard thickness of concrete member** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Standard thickness of member | $h_{min,1}$ | [mm] | 100 | 120 | 140 | 170 | 200 | 230 | 250 |
| **Cracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 45 | 60 | 60 | 95 | 100 | 125 |
| | für c ≥ | [mm] | 70 | 70 | 100 | 100 | 150 | 180 | 300 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 45 | 60 | 60 | 95 | 100 | 180 |
| | für s ≥ | [mm] | 80 | 90 | 140 | 180 | 200 | 220 | 540 |
| **Uncracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 45 | 60 | 65 | 90 | 100 | 125 |
| | für c ≥ | [mm] | 80 | 70 | 120 | 120 | 180 | 180 | 300 |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | 50 | 75 | 80 | 130 | 100 | 180 |
| | für s ≥ | [mm] | 100 | 100 | 150 | 150 | 240 | 220 | 540 |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Standard thickness of member | $h_{min,1}$ | [mm] | 100 | 120 | 140 | 160 | 200 | 250 | - |
| **Cracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 60 | 95 | 125 | - |
| | für c ≥ | [mm] | 70 | 75 | 100 | 100 | 150 | 125 | |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 55 | 60 | 60 | 95 | 125 | |
| | für s ≥ | [mm] | 80 | 90 | 140 | 180 | 200 | 125 | |
| **Uncracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 65 | 90 | 125 | - |
| | für c ≥ | [mm] | 80 | 75 | 120 | 120 | 180 | 125 | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | 60 | 75 | 80 | 130 | 125 | |
| | für s ≥ | [mm] | 100 | 120 | 150 | 150 | 240 | 125 | |
| **Minimum thickness of concrete member** | | | | | | | | | |
| **Steel zinc plated, stainless steel A4, HCR** | | | | | | | | | |
| Minimum thickness of member | $h_{min,2}$ | [mm] | 80 | 100 | 120 | 140 | - | - | - |
| **Cracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 45 | 60 | 70 | - | - | - |
| | für c ≥ | [mm] | 70 | 90 | 100 | 160 | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 80 | | | |
| | für s ≥ | [mm] | 80 | 115 | 140 | 180 | | | |
| **Uncracked concrete** | | | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 60 | 60 | 80 | - | - | - |
| | für c ≥ | [mm] | 80 | 140 | 120 | 180 | | | |
| Minimum edge distance | $c_{min}$ | [mm] | 50 | 90 | 75 | 90 | | | |
| | für s ≥ | [mm] | 100 | 140 | 150 | 200 | | | |

| | | | |
|---|---|---|---|
| **Fire exposure from one side** | | | |
| Minimum spacing | $s_{min,fi}$ | [mm] | See normal ambient temperature |
| Minimum edge distance | $c_{min,fi}$ | [mm] | See normal ambient temperature |
| **Fire exposure from more than one side** | | | |
| Minimum spacing | $s_{min,fi}$ | [mm] | See normal ambient temperature |
| Minimum edge distance | $c_{min,fi}$ | [mm] | ≥ 300 mm |

Intermediate values by linear interpolation.

**Wedge anchor BZ plus**

**Intended use**
Minimum **spacings** and **edge distances** for **standard anchorage depth**

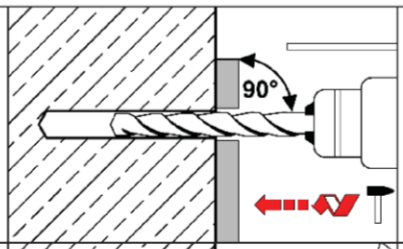
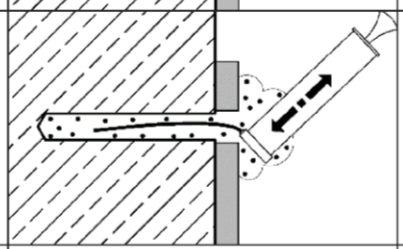
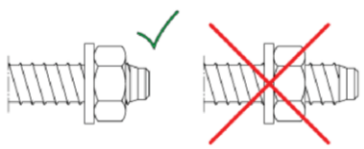
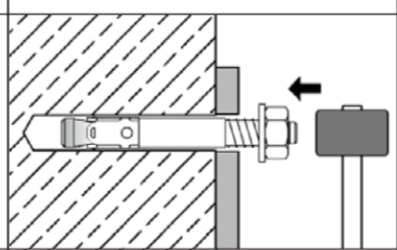
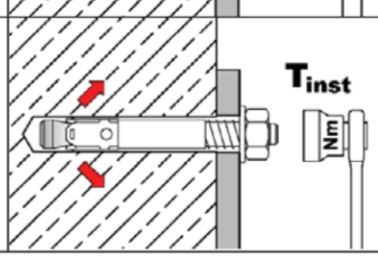
**Annex B4**

**Table B3:** Minimum **spacings** and **edge distances, reduced anchorage depth,** BZ plus

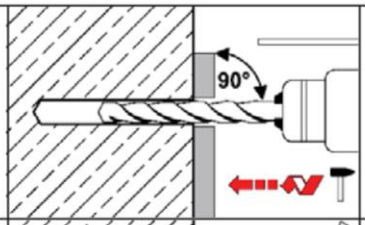
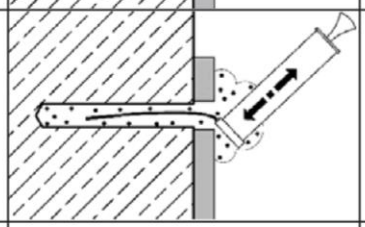
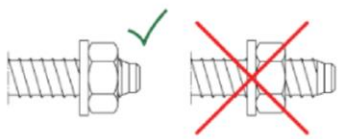
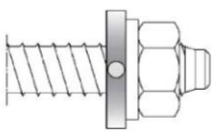
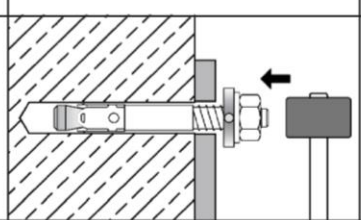
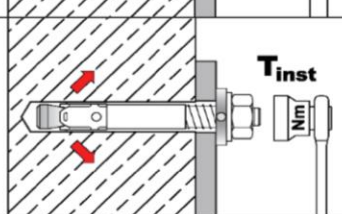
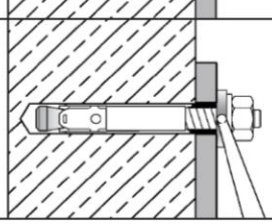
| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** |
|---|---|---|---|---|---|---|
| Minimum thickness of concrete member | $h_{min,3}$ | [mm] | 80 | 80 | 100 | 140 |
| **Cracked concrete** | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | 50 | 50 | 65 |
| | für c ≥ | [mm] | 60 | 100 | 160 | 170 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 65 | 65 | 100 |
| | für s ≥ | [mm] | 185 | 180 | 250 | 250 |
| **Uncracked concrete** | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | 50 | 50 | 65 |
| | für c ≥ | [mm] | 60 | 100 | 160 | 170 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 65 | 100 | 170 |
| | für s ≥ | [mm] | 185 | 180 | 185 | 65 |
| **Fire exposure from one side** | | | | | | |
| Minimum spacing | $s_{min,fi}$ | [mm] | See normal ambient temperature | | | |
| Minimum edge distance | $c_{min,fi}$ | [mm] | See normal ambient temperature | | | |
| **Fire exposure from more than one side** | | | | | | |
| Minimum spacing | $s_{min,fi}$ | [mm] | See normal ambient temperature | | | |
| Minimum edge distance | $c_{min,fi}$ | [mm] | ≥ 300 mm | | | |

Intermediate values by linear interpolation.

## Installation instructions BZ plus

| | | |
|---|---|---|
| 1 |  | 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. |
| 3 |  | Check position of nut. |
| 4 |  | Drive in fastener, such that $h_{ef}$ or $h_{ef,red}$ depth is met. This compliance is ensured, if the thickness of fixture is not greater than the maximum thickness of fixture marked on the fastener in accordance with Annex A3. |
| 5 |  | Installation torque $T_{inst}$ shall be applied by using calibrated torque wrench. |

## Installation instructions BZ plus with filling of annular gap

| | | |
|---|---|---|
| 1 |  | Drill hole perpendicular to concrete surface.<br>If using a vacuum drill bit, proceed with step 3a. |
| 2 |  | Blow out dust. Alternatively vacuum clean down to the bottom of the hole. |
| 3a |  | Check position of nut. |
| 3b |  | Fit the filling washer to the fastener.<br>The thickness of the filling washer must be taken into account with $t_{fix}$. |
| 4 |  | Drive in fastener with filling washer, such that $h_{ef}$ or $h_{ef,red}$ depth is met. This compliance is ensured, if the thickness of fixture is 5mm smaller than the maximum thickness of fixture marked on the fastener in accordance with Annex A3. |
| 5 |  | Installation torque $T_{inst}$ shall be applied by using calibrated torque wrench. |
| 6 |  | Fill the annular gap between stud and fixture with mortar (compressive strength ≥ 50 N/mm² VMH, VMZ or VMU plus).<br>Use enclosed reducing adapter. Observe the processing information of the mortar!<br>The annular gap is completely filled, when excess mortar seeps out. |

## Table B4: Installation parameters BZ-IG

| Fastener size | | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|---|
| Effective anchorage depth | | $h_{ef}$ | [mm] | 45 | 58 | 65 | 80 |
| 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 |
| Depth of drill hole | | $h_1 \geq$ | [mm] | 60 | 75 | 90 | 105 |
| Screwing depth of threaded rod | | $L_{sd}$ [2] $\geq$ | [mm] | 9 | 12 | 15 | 18 |
| Installation torque, steel zinc plated | $T_{inst}$ | S | [Nm] | 10 | 30 | 30 | 55 |
| | | SK | [Nm] | 10 | 25 | 40 | 50 |
| | | B | [Nm] | 8 | 25 | 30 | 45 |
| Installation torque, stainless steel A4, HCR | $T_{inst}$ | S | [Nm] | 15 | 40 | 50 | 100 |
| | | SK | [Nm] | 12 | 25 | 45 | 60 |
| | | B | [Nm] | 8 | 25 | 40 | 80 |
| **Pre-setting installation** | | | | | | | |
| Diameter of clearance hole in the fixture | | $d_f \leq$ | [mm] | 7 | 9 | 12 | 14 |
| Minimum thickness of fixture | $t_{fix} \geq$ | S | [mm] | 1 | 1 | 1 | 1 |
| | | SK | [mm] | 5 | 7 | 8 | 9 |
| | | B | [mm] | 1 | 1 | 1 | 1 |
| **Through-setting installation** | | | | | | | |
| Diameter of clearance hole in the fixture | | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 |
| Minimum thickness of fixture [1] | $t_{fix} \geq$ | S | [mm | 5 | 7 | 8 | 9 |
| | | SK | [mm] | 9 | 12 | 14 | 16 |
| | | B | [mm] | 5 | 7 | 8 | 9 |

[1] The minimum thickness of fixture can be reduced to the value of Pre-setting installation, if the shear load at steel failure is designed with lever arm.
[2] see Annex A5

## Table B5: Minimum spacings and edge distances BZ-IG

| Fastener size | | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|---|
| Minimum thickness of concrete member | | $h_{min}$ | [mm] | 100 | 120 | 130 | 160 |
| **Cracked concrete** | | | | | | | |
| Minimum spacing | | $s_{min}$ | [mm] | 50 | 60 | 70 | 80 |
| | | für c $\geq$ | [mm] | 60 | 80 | 100 | 120 |
| Minimum edge distance | | $c_{min}$ | [mm] | 50 | 60 | 70 | 80 |
| | | für s $\geq$ | [mm] | 75 | 100 | 100 | 120 |
| **Uncracked concrete** | | | | | | | |
| Minimum spacing | | $s_{min}$ | [mm] | 50 | 60 | 65 | 80 |
| | | für c $\geq$ | [mm] | 80 | 100 | 120 | 160 |
| Minimum edge distance | | $c_{min}$ | [mm] | 50 | 60 | 70 | 100 |
| | | für s $\geq$ | [mm] | 115 | 155 | 170 | 210 |
| **Fire exposure from one side** | | | | | | | |
| Minimum spacing | | $s_{min,fi}$ | [mm] | See normal temperature | | | |
| Minimum edge distance | | $c_{min,fi}$ | [mm] | See normal temperature | | | |
| **Fire exposure from more than one side** | | | | | | | |
| Minimum spacing | | $s_{min,fi}$ | [mm] | See normal temperature | | | |
| Minimum edge distance | | $c_{min,fi}$ | [mm] | ≥ 300 mm | | | |

Intermediate values by linear interpolation.

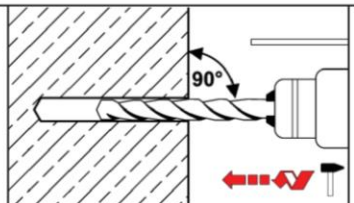
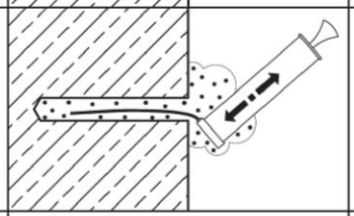
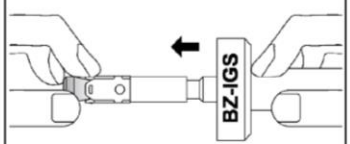
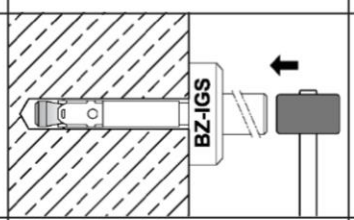
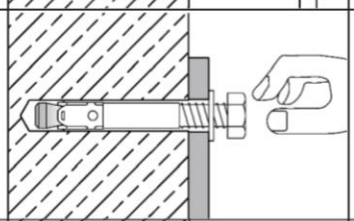
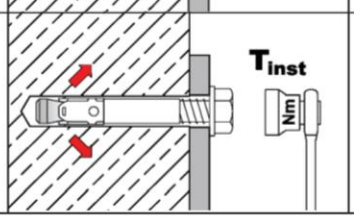
**Wedge anchor BZ-IG**

**Intended use**
Installation parameters, minimum spacings and edge distances BZ-IG

**Annex B8**

## Installation instructions BZ-IG

### Pre-setting installation

| | | |
|---|---|---|
| 1 |  | Drill hole perpendicular to concrete surface.<br>If using vacuum drill bit, proceed with step 3. |
| 2 |  | Blow out dust. Alternatively vacuum clean down to the bottom of the hole. |
| 3 |  | Setting tool for **pre-setting installation** insert in fastener. |
| 4 |  | Drive in fastener with setting tool. |
| 5 |  | Drive in srew. |
| 6 |  | Installation torque $T_{inst}$ may be applied by using calibrated torque wrench. |

## Installation instructions BZ-IG

### Through-setting installation

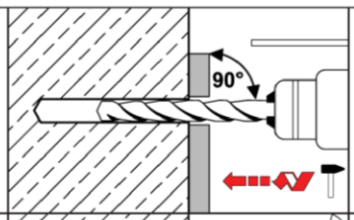
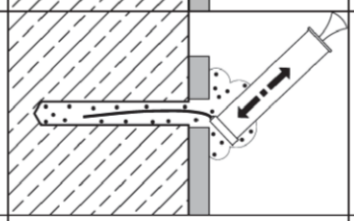
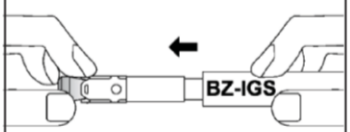
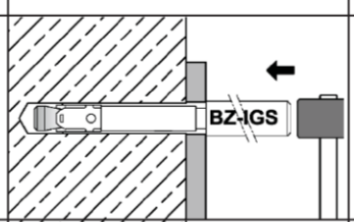
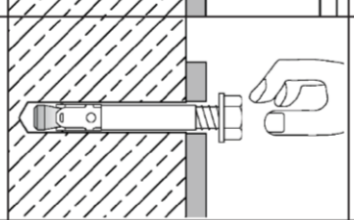
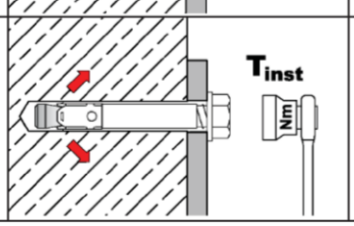
| | | |
|---|---|---|
| 1 |  | Drill hole perpendicular to concrete surface.<br>If using a vacuum drill bit, proceed with step 3. |
| 2 |  | Blow out dust. Alternatively vacuum clean down to the bottom of the hole. |
| 3 |  | Setting tool for **through-setting installation** insert in fastener. |
| 4 |  | Drive in fastener with setting tool. |
| 5 |  | Drive in screw. |
| 6 |  | Installation torque $T_{inst}$ may be applied by using calibrated torque wrench. |

**Table C1:** Characteristic values for **tension loads,** BZ plus **zinc plated, cracked concrete,** static and quasi-static action

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 60 | 86 | 126 | 196 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,53 | | 1,5 | | 1,6 | 1,5 | |
| **Pull-out** | | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 16 | 25 | 1) | 1) | 1) |
| **Reduced anchorage depth** | | | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 7,5 | 1) | 1) | - | - | - |
| Increasing factor for $N_{Rk,p}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | - | - | - |
| Factor for cracked concrete | $k_1 = k_{cr,N}$ | [-] | 7,7 | | | | | | |

1) Pull-out is not decisive
2) Use restricted to anchoring of structural components statically indeterminate

**Wedge anchor BZ plus**

**Performance**
Characteristic values for **tension loads**, BZ plus **zinc plated, cracked concrete**, static and quasi-static action

**Annex C1**

**Table C2:** Characteristic values for **tension loads,** BZ plus **A4** / **HCR,** **cracked concrete,** static and quasi-static action

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 64 | 108 | 110 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,5 | | | | 1,68 | 1,5 |
| **Pull-out** | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 16 | 25 | 1) | 40 |
| **Reduced anchorage depth** | | | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 7,5 | 1) | 1) | - | - |
| Increasing factor for $N_{Rk,p}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | |
| **Concrete cone failure** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | - | - |
| Factor for cracked concrete | $k_1 = k_{cr,N}$ | [-] | 7,7 | | | | | |

1) Pull-out is not decisive
2) Use restricted to anchoring of structural components statically indeterminate

**Table C3:** Characteristic values for **tension loads,** BZ plus **zinc plated, uncracked concrete,** static and quasi-static action

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | |
| **Steel failure** | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 60 | 86 | 126 | 196 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,53 | | 1,5 | | 1,6 | 1,5 | |
| **Pull-out** | | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) | 1) |
| **Reduced anchorage depth** | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 7,5 | 9 | 1) | 1) | - | - | - |
| **Splitting** | | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | | |
| Splitting for **standard thickness of concrete member** (The higher resistance of case 1 and case 2 may be applied; $c_{cr,sp}$ may be linearly interpolated for the member thickness $h_{min,2} < h < h_{min,1}$ (Case 2); $\psi_{h,sp}$= 1,0)) | | | | | | | | | |
| Standard thickness of concrete | $h_{min,1} \geq$ | [mm] | 100 | 120 | 140 | 170 | 200 | 230 | 250 |
| **Case 1** | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 20 | 30 | 40 | 62,3 | 50 |
| Edge distance | $c_{cr,sp}$ | [mm] | 1,5 $h_{ef}$ | | | | | | |
| **Case 2** | | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | 50,5 | 62,3 | 70,6 |
| Edge distance | $c_{cr,sp}$ | [mm] | 2 $h_{ef}$ | | | | 2,2 $h_{ef}$ | 1,5 $h_{ef}$ | 2,5 $h_{ef}$ |
| Splitting for **minimum thickness of concrete member** | | | | | | | | | |
| Minimum thickness of concrete | $h_{min,2} \geq$ | [mm] | 80 | 100 | 120 | 140 | - | - | - |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | | | |
| Edge distance | $c_{cr,sp}$ | [mm] | 2,5 $h_{ef}$ | | | | | | |
| **Reduced anchorage depth** | | | | | | | | | |
| Minimum thickness of concrete | $h_{min,3} \geq$ | [mm] | 80 | 80 | 100 | 140 | - | - | - |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 7,5 | 9 | 17,9 | 26,5 | | | |
| Edge distance | $c_{cr,sp}$ | [mm] | 100 | 100 | 125 | 150 | | | |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | - | - | - |
| Factor for uncracked concrete | $k_1 = k_{ucr,N}$ | [-] | 11,0 | | | | | | |

1) Pull-out is not decisive
2) Use restricted to anchoring of structural components statically indeterminate

**Wedge anchor BZ plus**

**Performance**
Characteristic values for **tension loads,** BZ plus **zinc plated, uncracked concrete,** static and quasi-static action

**Annex C3**

**Table C4:** Characteristic values for **tension loads,** BZ plus **A4** / **HCR,** **uncracked concrete,** static and quasi-static action

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Steel failure** | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 16 | 27 | 40 | 64 | 108 | 110 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,5 | | | | 1,68 | 1,5 |
| **Pull-out** | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 25 | 35 | 1) | 1) |
| **Reduced anchorage depth** | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 7,5 | 9 | 1) | 1) | - | - |
| **Splitting** | | | | | | | | |
| **Standard anchorage depth** | | | | | | | | |
| Splitting for **standard thickness of concrete member** (The higher resistance of case 1 and case 2 may be applied; $c_{cr,sp}$ may be linearly interpolated for the member thickness $h_{min,2} < h < h_{min,1}$ (Case 2); $\psi_{h,sp}$= 1,0) | | | | | | | | |
| Standard thickness of concrete | $h_{min,1} \geq$ | [mm] | 100 | 120 | 140 | 160 | 200 | 250 |
| **Case 1** | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 20 | 30 | 40 | - |
| Edge distance | $c_{cr,sp}$ | [mm] | 1,5 $h_{ef}$ | | | | | |
| **Case 2** | | | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | 50,5 | 70,6 |
| Edge distance | $c_{cr,sp}$ | [mm] | 115 | 125 | 140 | 200 | 220 | 250 |
| Splitting for **minimum thickness of concrete member** | | | | | | | | |
| Minimum thickness of concrete | $h_{min,2} \geq$ | [mm] | 80 | 100 | 120 | 140 | - | - |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 25 | 35 | | |
| Edge distance | $c_{cr,sp}$ | [mm] | 2,5 $h_{ef}$ | | | | | |
| **Reduced anchorage depth** | | | | | | | | |
| Minimum thickness of concrete | $h_{min,3} \geq$ | [mm] | 80 | 80 | 100 | 140 | - | - |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 7,5 | 9 | 17,9 | 26,5 | | |
| Edge distance | $c_{cr,sp}$ | [mm] | 100 | 100 | 125 | 150 | | |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | | | |
| **Concrete cone failure** | | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 |
| Reduced anchorage depth | $h_{ef,red}$ | [mm] | 35 2) | 40 | 50 | 65 | - | - |
| Factor for uncracked concrete | $k_1 = k_{ucr,N}$ | [-] | 11,0 | | | | | |

1) Pull-out is not decisive
2) Use restricted to anchoring of structural components statically indeterminate

**Wedge anchor BZ plus**

**Performance**
Characteristic values for **tension loads,** BZ plus **A4** / **HCR,** **uncracked concrete,** static and quasi-static action

**Annex C4**

**Table C5:** Characteristic values for **shear loads**, BZ plus, **cracked** and **uncracked concrete,** static or quasi static action

| **Fastener size** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|---|
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | |
| **Steel failure without lever arm, Steel zinc plated** | | | | | | | | | | |
| Characteristic resistance | | $V^0_{Rk,s}$ | [kN] | 12,2 | 20,1 | 30 | 55 | 69 | 114 | 169,4 |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | 1,33 | 1,25 | 1,25 |
| **Steel failure without lever arm, Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | | $V^0_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 86 | 123,6 | - |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | | | |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | 1,4 | 1,25 | |
| **Steel failure with lever arm, Steel zinc plated** | | | | | | | | | | |
| Characteristic bending resistance | | $M^0_{Rk,s}$ | [Nm] | 23 | 47 | 82 | 216 | 363 | 898 | 1331,5 |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | 1,33 | 1,25 | 1,25 |
| **Steel failure with lever arm, Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic bending resistance | | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 200 | 454 | 785,4 | - |
| Partial factor | | $\gamma_{Ms}$ | [-] | 1,25 | | | | 1,4 | 1,25 | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Pry-out factor | | $k_8$ | [-] | 2,4 | | | | 2,8 | | |
| **Concrete edge failure** | | | | | | | | | | |
| Effective length of fastener in shear loading with $\mathbf{h_{ef}}$ | Steel zinc plated | $l_f$ | [mm] | 46 | 60 | 70 | 85 | 100 | 115 | 125 |
| | Stainless steel A4, HCR | $l_f$ | [mm] | 46 | 60 | 70 | 85 | 100 | 125 | - |
| Effective length of fastener in shear loading with $\mathbf{h_{ef,red}}$ | Steel zinc plated | $l_{f,red}$ | [mm] | 35[1)] | 40 | 50 | 65 | - | - | - |
| | Stainless steel A4, HCR | $l_{f,red}$ | [mm] | 35[1)] | 40 | 50 | 65 | | | |
| Outside diameter of fastener | | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 |

[1)] Use restricted to anchoring of structural components statically indeterminate

**Table C6:** Characteristic resistance for **seismic loading**, BZ plus, **standard anchorage depth,** performance category **C1** and **C2**

| **Fastener size** | | | **M8** | **M10** | **M12** | **M16** | **M20** |
|---|---|---|---|---|---|---|---|
| **Tension loads** | | | | | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| **Steel failure, Steel zinc plated** | | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,s,eq,C1}$ | [kN] | 16 | 27 | 40 | 60 | 86 |
| Characteristic resistance **C2** | $N_{Rk,s,eq,C2}$ | [kN] | 16 | 27 | 40 | 60 | 86 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,53 | | 1,5 | | 1,6 |
| **Steel failure, Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,s,eq,C1}$ | [kN] | 16 | 27 | 40 | 64 | 108 |
| Characteristic resistance **C2** | $N_{Rk,s,eq,C2}$ | [kN] | 16 | 27 | 40 | 64 | 108 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,5 | | | | 1,68 |
| **Pull-out** (steel zinc plated, stainless steel A4 and HCR) | | | | | | | |
| Characteristic resistance **C1** | $N_{Rk,p,eq,C1}$ | [kN] | 5 | 9 | 16 | 25 | 36 |
| Characteristic resistance **C2** | $N_{Rk,p,eq,C2}$ | [kN] | 2,3 | 3,6 | 10,2 | 13,8 | 24,4 |
| **Shear loads** | | | | | | | |
| **Steel failure without lever arm, Steel zinc plated** | | | | | | | |
| Characteristic resistance **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 9,3 | 20 | 27 | 44 | 69 |
| Characteristic resistance **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 6,7 | 14 | 16,2 | 35,7 | 55,2 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1, 25 | | | | 1,33 |
| **Steel failure without lever arm, Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance **C1** | $V_{Rk,s,eq,C1}$ | [kN] | 9,3 | 20 | 27 | 44 | 69 |
| Characteristic resistance **C2** | $V_{Rk,s,eq,C2}$ | [kN] | 6,7 | 14 | 16,2 | 35,7 | 55,2 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1, 25 | | | | 1,4 |
| Factor for annular gap | **without** filling of annular gap $\alpha_{gap}$ | [-] | 0,5 | | | | |
| | **with** filling of annular gap $\alpha_{gap}$ | [-] | 1,0 | | | | |

**Table C7:** Characteristic values **for tension and shear load** under **fire exposure,** BZ plus, **standard anchorage depth,** cracked and uncracked concrete C20/25 to C50/60

| **Fastener size** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | | | | |
| **Steel failure** | | | | | | | | | | |
| **Steel, zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 1,5 | 2,6 | 4,1 | 7,7 | 9,4 | 13,6 | 17,6 |
| | R60 | | | 1,1 | 1,9 | 3,0 | 5,6 | 8,2 | 11,8 | 15,3 |
| | R90 | | | 0,8 | 1,4 | 2,4 | 4,4 | 6,9 | 10,0 | 13,0 |
| | R120 | | | 0,7 | 1,2 | 2,2 | 4,0 | 6,3 | 9,1 | 11,8 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 3,8 | 6,9 | 12,7 | 23,7 | 33,5 | 48,2 | - |
| | R60 | | | 2,9 | 5,3 | 9,4 | 17,6 | 25,0 | 35,9 | |
| | R90 | | | 2,0 | 3,6 | 6,1 | 11,5 | 16,4 | 23,6 | |
| | R120 | | | 1,6 | 2,8 | 4,5 | 8,4 | 12,1 | 17,4 | |
| **Shear load** | | | | | | | | | | |
| **Steel failure without lever arm** | | | | | | | | | | |
| **Steel, zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 1,6 | 2,6 | 4,1 | 7,7 | 11 | 16 | 20,6 |
| | R60 | | | 1,5 | 2,5 | 3,6 | 6,8 | 11 | 15 | 19,8 |
| | R90 | | | 1,2 | 2,1 | 3,5 | 6,5 | 10 | 15 | 19,0 |
| | R120 | | | 1,0 | 2,0 | 3,4 | 6,4 | 10 | 14 | 18,6 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 3,8 | 6,9 | 12,7 | 23,7 | 33,5 | 48,2 | - |
| | R60 | | | 2,9 | 5,3 | 9,4 | 17,6 | 25,0 | 35,9 | |
| | R90 | | | 2,0 | 3,6 | 6,1 | 11,5 | 16,4 | 23,6 | |
| | R120 | | | 1,6 | 2,8 | 4,5 | 8,4 | 12,1 | 17,4 | |
| **Steel failure with lever arm** | | | | | | | | | | |
| **Steel, zinc plated** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 1,7 | 3,3 | 6,4 | 16,3 | 29 | 50 | 75 |
| | R60 | | | 1,6 | 3,2 | 5,6 | 14 | 28 | 48 | 72 |
| | R90 | | | 1,2 | 2,7 | 5,4 | 14 | 27 | 47 | 69 |
| | R120 | | | 1,1 | 2,5 | 5,3 | 13 | 26 | 46 | 68 |
| **Stainless steel A4, HCR** | | | | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 3,8 | 9,0 | 19,7 | 50,1 | 88,8 | 153,5 | - |
| | R60 | | | 2,9 | 6,8 | 14,6 | 37,2 | 66,1 | 114,3 | |
| | R90 | | | 2,1 | 4,7 | 9,5 | 24,2 | 43,4 | 75,1 | |
| | R120 | | | 1,6 | 3,6 | 7,0 | 17,8 | 32,1 | 55,5 | |

If pull-out is not decisive, $N_{Rk,p}$ must be replaced by $N^0_{Rk,c}$ in equation (D.4) and (D.5), FprEN 1992-4.

**Table C8:** Characteristic values **for tension and shear load** under **fire exposure,** BZ plus, **reduced anchorage depth,** cracked and uncracked concrete C20/25 to C50/60

| **Fastener size** | | | | **M8** | **M10** | **M12** | **M16** |
|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | |
| **Steel failure** | | | | | | | |
| **Steel, zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 1,5 | 2,6 | 4,1 | 7,7 |
| | R60 | | | 1,1 | 1,9 | 3,0 | 5,6 |
| | R90 | | | 0,8 | 1,3 | 1,9 | 3,5 |
| | R120 | | | 0,6 | 1,0 | 1,3 | 2,5 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 3,2 | 6,9 | 12,7 | 23,7 |
| | R60 | | | 2,5 | 5,3 | 9,4 | 17,6 |
| | R90 | | | 1,9 | 3,6 | 6,1 | 11,5 |
| | R120 | | | 1,6 | 2,8 | 4,5 | 8,4 |
| **Shear load** | | | | | | | |
| **Steel failure without lever arm** | | | | | | | |
| **Steel, zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 1,5 | 2,6 | 4,1 | 7,7 |
| | R60 | | | 1,1 | 1,9 | 3,0 | 5,6 |
| | R90 | | | 0,8 | 1,3 | 1,9 | 3,5 |
| | R120 | | | 0,6 | 1,0 | 1,3 | 2,5 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 3,2 | 6,9 | 12,7 | 23,7 |
| | R60 | | | 2,5 | 5,3 | 9,4 | 17,6 |
| | R90 | | | 1,9 | 3,6 | 6,1 | 11,5 |
| | R120 | | | 1,6 | 2,8 | 4,5 | 8,4 |
| **Steel failure with lever arm** | | | | | | | |
| **Steel, zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 1,5 | 3,3 | 6,4 | 16,3 |
| | R60 | | | 1,2 | 2,5 | 4,7 | 11,9 |
| | R90 | | | 0,8 | 1,7 | 3,0 | 7,5 |
| | R120 | | | 0,6 | 1,2 | 2,1 | 5,3 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 3,2 | 8,9 | 19,7 | 50,1 |
| | R60 | | | 2,6 | 6,8 | 14,6 | 37,2 |
| | R90 | | | 2,0 | 4,7 | 9,5 | 24,2 |
| | R120 | | | 1,6 | 3,6 | 7,0 | 17,8 |

If pull-out is not decisive, $N_{Rk,p}$ must be replaced by $N^0_{Rk,c}$ in equation (D.4) and (D.5), FprEN 1992-4.

## Table C9: Displacements under tension load, BZ plus

| Fastener size | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
|---|---|---|---|---|---|---|---|---|---|
| **Standard anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 4,3 | 7,6 | 11,9 | 17,1 | 21,1 | 24 |
| Displacement | $\delta_{N0}$ | [mm] | 0,6 | 1,0 | 0,4 | 1,0 | 0,9 | 0,7 | 0,9 |
| | $\delta_{N\infty}$ | [mm] | 1,4 | 1,2 | 1,4 | 1,3 | 1,0 | 1,2 | 1,4 |
| Tension load in uncracked concrete | N | [kN] | 5,7 | 7,6 | 11,9 | 16,7 | 23,8 | 29,6 | 34 |
| Displacement | $\delta_{N0}$ | [mm] | 0,4 | 0,5 | 0,7 | 0,3 | 0,4 | 0,5 | 0,3 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | | 1,4 | | 0,8 | | 1,4 |
| Displacements under seismic tension loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{N,eq,(DLS)}$ | [mm] | 2,3 | 4,1 | 4,9 | 3,6 | 5,1 | - | - |
| Displacements for ULS | $\delta_{N,eq(ULS)}$ | [mm] | 8,2 | 13,8 | 15,7 | 9,5 | 15,2 | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 4,3 | 7,6 | 11,9 | 17,1 | 19,0 | - |
| Displacement | $\delta_{N0}$ | [mm] | 0,7 | 1,8 | 0,4 | 0,7 | 0,9 | 0,5 | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,4 | 1,4 | 1,4 | 1,0 | 1,8 | |
| Tension load in uncracked concrete | N | [kN] | 5,8 | 7,6 | 11,9 | 16,7 | 23,8 | 33,5 | - |
| Displacement | $\delta_{N0}$ | [mm] | 0,6 | 0,5 | 0,7 | 0,2 | 0,4 | 0,5 | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,0 | 1,4 | 0,4 | 0,8 | 1,1 | |
| Displacements under seismic tension loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{N,eq(DLS)}$ | [mm] | 2,3 | 4,1 | 4,9 | 3,6 | 5,1 | - | - |
| Displacements for ULS | $\delta_{N,eq(ULS)}$ | [mm] | 8,2 | 13,8 | 15,7 | 9,5 | 15,2 | | |
| **Reduced anchorage depth** | | | | | | | | | |
| **Steel zinc plated, stainless steel A4, HCR** | | | | | | | | | |
| Tension load in cracked concrete | N | [kN] | 2,4 | 3,6 | 6,1 | 9,0 | - | - | - |
| Displacement | $\delta_{N0}$ | [mm] | 0,8 | 0,7 | 0,5 | 1,0 | | | |
| | $\delta_{N\infty}$ | [mm] | 1,2 | 1,0 | 0,8 | 1,1 | | | |
| Tension load in uncracked concrete | N | [kN] | 3,7 | 4,3 | 8,5 | 12,6 | - | - | - |
| Displacement | $\delta_{N0}$ | [mm] | 0,1 | 0,2 | 0,2 | 0,2 | | | |
| | $\delta_{N\infty}$ | [mm] | 0,7 | 0,7 | 0,7 | 0,7 | | | |

## Table C10: Displacements under shear load, BZ plus

| Fastener size | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 |
|---|---|---|---|---|---|---|---|---|---|
| **Standard anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 6,9 | 11,4 | 17,1 | 31,4 | 36,8 | 64,9 | 96,8 |
| Displacement | $\delta_{V0}$ | [mm] | 2,0 | 3,2 | 3,6 | 3,5 | 1,8 | 3,5 | 3,6 |
| | $\delta_{V\infty}$ | [mm] | 3,0 | 4,7 | 5,5 | 5,3 | 2,7 | 5,3 | 5,4 |
| Displacements under seismic shear loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{V,eq(DLS)}$ | [mm] | 3,0 | 2,7 | 3,5 | 4,3 | 4,7 | - | - |
| Displacements for ULS | $\delta_{V,eq(ULS)}$ | [mm] | 5,9 | 5,3 | 9,5 | 9,6 | 10,1 | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 7,3 | 11,4 | 17,1 | 31,4 | 43,8 | 70,6 | - |
| Displacement | $\delta_{V0}$ | [mm] | 1,9 | 2,4 | 4,0 | 4,3 | 2,9 | 2,8 | |
| | $\delta_{V\infty}$ | [mm] | 2,9 | 3,6 | 5,9 | 6,4 | 4,3 | 4,2 | |
| Displacements under seismic shear loads **C2** | | | | | | | | | |
| Displacements for DLS | $\delta_{V,eq(DLS)}$ | [mm] | 3,0 | 2,7 | 3,5 | 4,3 | 4,7 | - | - |
| Displacements for ULS | $\delta_{V,eq(ULS)}$ | [mm] | 5,9 | 5,3 | 9,5 | 9,6 | 10,1 | | |
| **Reduced anchorage depth** | | | | | | | | | |
| **Steel zinc plated** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 6,9 | 11,4 | 17,1 | 31,4 | - | - | - |
| Displacement | $\delta_{V0}$ | [mm] | 2,0 | 3,2 | 3,6 | 3,5 | | | |
| | $\delta_{V\infty}$ | [mm] | 3,0 | 4,7 | 5,5 | 5,3 | | | |
| **Stainless steel A4, HCR** | | | | | | | | | |
| Shear load in cracked and uncracked concrete | V | [kN] | 7,3 | 11,4 | 17,1 | 31,4 | - | - | - |
| Displacement | $\delta_{V0}$ | [mm] | 1,9 | 2,4 | 4,0 | 4,3 | | | |
| | $\delta_{V\infty}$ | [mm] | 2,9 | 3,6 | 5,9 | 6,4 | | | |

**Table C11:** Characteristic values for **tension loads, BZ-IG, cracked concrete,** static and quasi-static action

| **Fastener size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,2 | | | |
| **Steel failure** | | | | | | |
| Characteristic resistance, **steel zinc plated** | $N_{Rk,s}$ | [kN] | 16,1 | 22,6 | 26,0 | 56,6 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| Characteristic resistance, **stainless steel A4, HCR** | $N_{Rk,s}$ | [kN] | 14,1 | 25,6 | 35,8 | 59,0 |
| | $\gamma_{Ms}$ | [-] | 1,87 | | | |
| **Pull-out failure** | | | | | | |
| Characteristic resistance in cracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 5 | 9 | 12 | 20 |
| Increasing factor for $N_{Rk,p}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 58 | 65 | 80 |
| Factor for cracked concrete | $k_1 = k_{cr,N}$ | [-] | 7,7 | | | |

**Table C12:** Characteristic values for **tension loads, BZ-IG, uncracked concrete,** static and quasi-static action

| **Fastener size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,2 | | | |
| **Steel failure** | | | | | | |
| Characteristic resistance, **steel zinc plated** | $N_{Rk,s}$ | [kN] | 16,1 | 22,6 | 26,0 | 56,6 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,5 | | | |
| Characteristic resistance, **stainless steel A4, HCR** | $N_{Rk,s}$ | [kN] | 14,1 | 25,6 | 35,8 | 59,0 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,87 | | | |
| **Pull-out** | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N_{Rk,p}$ | [kN] | 12 | 16 | 20 | 30 |
| **Splitting** (the higher resistance of Case 1 and Case 2 may be applied) | | | | | | |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | 100 | 120 | 130 | 160 |
| **Case 1** | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 9 | 12 | 16 | 25 |
| Edge distance | $c_{cr,sp}$ | [mm] | 1,5 $h_{ef}$ | | | |
| **Case 2** | | | | | | |
| Characteristic resistance in uncracked concrete C20/25 | $N^0_{Rk,sp}$ | [kN] | 12 | 16 | 20 | 30 |
| Edge distance | $c_{cr,sp}$ | [mm] | 2,5 $h_{ef}$ | | | |
| Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$ | $\psi c$ | [-] | $\left(\frac{f_{ck}}{20}\right)^{0,5}$ | | | |
| **Concrete cone failure** | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 45 | 58 | 65 | 80 |
| Factor for uncracked concrete | $k_1 = k_{ucr,N}$ | [-] | 11,0 | | | |

**Table C13:** Characteristic values for **shear loads, BZ-IG, cracked and uncracked concrete,** static and quasi-static action

| **Fastener size** | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | |
| **BZ-IG, steel zinc plated** | | | | | | |
| **Steel failure without lever arm, Pre-setting installation** | | | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 5,8 | 6,9 | 10,4 | 25,8 |
| **Steel failure without lever arm, Through-setting installation** | | | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 5,1 | 7,6 | 10,8 | 24,3 |
| **Steel failure with lever arm, Pre-setting installation** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 12,2 | 30,0 | 59,8 | 104,6 |
| **Steel failure with lever arm, Through-setting installation** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 36,0 | 53,2 | 76,0 | 207 |
| Partial factor for $V_{Rk,s}$ and $M^0_{Rk,s}$ | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | |
| **BZ-IG, stainless steel A4, HCR** | | | | | | |
| **Steel failure without lever arm, Pre-setting installation** | | | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 5,7 | 9,2 | 10,6 | 23,6 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| **Steel failure without lever arm, Through-setting installation** | | | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 7,3 | 7,6 | 9,7 | 29,6 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| **Steel failure with lever arm, Pre-setting installation** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 10,7 | 26,2 | 52,3 | 91,6 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,56 | | | |
| **Steel failure with lever arm, Through-setting installation** | | | | | | |
| Characteristic bending resistance | $M^0_{Rk,s}$ | [Nm] | 28,2 | 44,3 | 69,9 | 191,2 |
| Partial factor | $\gamma_{Ms}$ | [-] | 1,25 | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | |
| **Concrete pry-out failure** | | | | | | |
| Pry-out factor | $k_8$ | [-] | 1,5 | 1,5 | 2,0 | 2,0 |
| **Concrete edge failure** | | | | | | |
| Effective length of fastener in shear loading | $l_f$ | [mm] | 45 | 58 | 65 | 80 |
| Effective diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 |

**Table C14:** Characteristic values for **tension** and **shear load** under **fire exposure, BZ-IG,** cracked and uncracked concrete C20/25 to C50/60

| **Fastener size** | | | | **M6** | **M8** | **M10** | **M12** |
|---|---|---|---|---|---|---|---|
| **Tension load** | | | | | | | |
| **Steel failure** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 0,7 | 1,4 | 2,5 | 3,7 |
| | R60 | | | 0,6 | 1,2 | 2,0 | 2,9 |
| | R90 | | | 0,5 | 0,9 | 1,5 | 2,2 |
| | R120 | | | 0,4 | 0,8 | 1,3 | 1,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $N_{Rk,s,fi}$ | [kN] | 2,9 | 5,4 | 8,7 | 12,6 |
| | R60 | | | 1,9 | 3,8 | 6,3 | 9,2 |
| | R90 | | | 1,0 | 2,1 | 3,9 | 5,7 |
| | R120 | | | 0,5 | 1,3 | 2,7 | 4,0 |
| **Shear load** | | | | | | | |
| **Steel failure without lever arm** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 0,7 | 1,4 | 2,5 | 3,7 |
| | R60 | | | 0,6 | 1,2 | 2,0 | 2,9 |
| | R90 | | | 0,5 | 0,9 | 1,5 | 2,2 |
| | R120 | | | 0,4 | 0,8 | 1,3 | 1,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $V_{Rk,s,fi}$ | [kN] | 2,9 | 5,4 | 8,7 | 12,6 |
| | R60 | | | 1,9 | 3,8 | 6,3 | 9,2 |
| | R90 | | | 1,0 | 2,1 | 3,9 | 5,7 |
| | R120 | | | 0,5 | 1,3 | 2,7 | 4,0 |
| **Steel failure with lever arm** | | | | | | | |
| **Steel zinc plated** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 0,5 | 1,4 | 3,3 | 5,7 |
| | R60 | | | 0,4 | 1,2 | 2,6 | 4,6 |
| | R90 | | | 0,4 | 0,9 | 2,0 | 3,4 |
| | R120 | | | 0,3 | 0,8 | 1,6 | 2,8 |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic resistance | R30 | $M^0_{Rk,s,fi}$ | [Nm] | 2,2 | 5,5 | 11,2 | 19,6 |
| | R60 | | | 1,5 | 3,9 | 8,1 | 14,3 |
| | R90 | | | 0,7 | 2,2 | 5,1 | 8,9 |
| | R120 | | | 0,4 | 1,3 | 3,5 | 6,2 |

## Table C15: Displacements under tension load, BZ-IG

| Fastener size | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|
| Tension load in cracked concrete | N | [kN] | 2,0 | 3,6 | 4,8 | 8,0 |
| Displacements | $\delta_{N0}$ | [mm] | 0,6 | 0,6 | 0,8 | 1,0 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | 0,8 | 1,2 | 1,4 |
| Tension load in uncracked concrete | N | [kN] | 4,8 | 6,4 | 8,0 | 12,0 |
| Displacements | $\delta_{N0}$ | [mm] | 0,4 | 0,5 | 0,7 | 0,8 |
| | $\delta_{N\infty}$ | [mm] | 0,8 | 0,8 | 1,2 | 1,4 |

## Table C16: Displacements under shear load, BZ-IG

| Fastener size | | | M6 | M8 | M10 | M12 |
|---|---|---|---|---|---|---|
| Shear load in cracked and uncracked concrete | V | [kN] | 4,2 | 5,3 | 6,2 | 16,9 |
| Displacements | $\delta_{V0}$ | [mm] | 2,8 | 2,9 | 2,5 | 3,6 |
| | $\delta_{V\infty}$ | [mm] | 4,2 | 4,4 | 3,8 | 5,3 |