



## DECLARATION OF PERFORMANCE

### DoP 0218

for fischer injection system FIS EM Plus (Bonded fastener for use in concrete)

EN

- |   |   |
|---|---|
| 1. <u>Unique identification code of the product-type:</u> | <b>DoP 0218</b>   |
| 2. <u>Intended use/es:</u>                                | <b>Post-installed fastening in cracked or uncracked concrete, See appendix, especially annexes B1- B13.</b> |
| 3. <u>Manufacturer:</u>                                   | <b>fischerwerke GmbH &amp; Co. KG, Otto-Hahn-Straße 15, 79211 Denzlingen, Germany</b>                       |
| 4. <u>Authorised representative:</u>                      | –   |
| 5. <u>System/s of AVCP:</u>                               | <b>1</b>  |
| 6. <u>European Assessment Document:</u>                   | <b>EAD 330499-01-0601</b>   |
| European Technical Assessment:                            | <b>ETA-17/0979; 2020-06-17</b>  |
| Technical Assessment Body:                                | <b>DIBt- Deutsches Institut für Bautechnik</b>  |
| Notified body/ies:  | <b>2873 TU Darmstadt</b>  |

7. Declared performance/s:

**Mechanical resistance and stability (BWR 1)**

**Characteristic resistance to tension load (static and quasi-static loading):**

- Resistance to steel failure: Annexes C1- C3
- Resistance to combined pull- out and concrete cone failure: Annexes C5- C12
- Resistance to concrete cone failure: Annex C4
- Edge distance to prevent splitting under load: Annex C4
- Robustness: Annex C4
- Maximum installation torque: Annexes B6- B8
- Minimum edge distance and spacing: Annexes B4, B5

$E_s = 210\,000\text{ MPa}$   
 $\psi_{sus} = \text{NPD}$

**Characteristic resistance to shear load (static and quasi-static loading):**

- Resistance to steel failure: Annexes C1- C3
- Resistance to pry-out failure: Annex C4
- Resistance to concrete edge failure: Annex C4

**Displacements under short-term and long-term loading:**

- Displacements under short-term and long-term loading: Annexes C13, C14

**Characteristic resistance and displacements for seismic performance categories C1 and C2:**

- Resistance to tension load, displacements, category C1: Annexes C15- C17
- Resistance to tension load, displacements, category C2: Annexes C15, C16, C18
- Resistance to shear load, displacements, category C1: Annexes C15- C17
- Resistance to shear load, displacements, category C2: Annexes C15, C16, C18
- Factor annular gap: Annex C15

**Hygiene, health and the environment (BWR 3)**

- Content, emission and/or release of dangerous substances: NPD

8. Appropriate Technical Documentation and/or Specific Technical Documentation: –

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Dr.-Ing. Oliver Geibig, Managing Director Business Units & Engineering  
Tumlingen, 2021-04-05

Jürgen Grün, Managing Director Chemistry & Quality

This DoP has been prepared in different languages. In case there is a dispute on the interpretation the English version shall always prevail.

The Appendix includes voluntary and complementary information in English language exceeding the (language-neutrally specified) legal requirements.

## Specific Part

### 1 Technical description of the product

The "fischer injection system FIS EM Plus" is a bonded fastener consisting of a cartridge with injection mortar fischer FIS EM Plus and a steel element according to Annex A5.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

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 anchor 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 anchor of at least 50 or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

### 3 Performance of the product and references to the methods used for its assessment

#### 3.1 Mechanical resistance and stability (BWR 1)

| Essential characteristic   | Performance                       |
|--|-----------------------------------|
| Characteristic resistance to tension load (static and quasi-static loading)              | See Annex B 3 to B 8, C 1 to C 12 |
| Characteristic resistance to shear load (static and quasi-static loading)                | See Annex C 1 to C 4              |
| Displacements under short-term and long-term loading                                     | See Annex C 13 and C 14           |
| Characteristic resistance and displacements for seismic performance categories C1 and C2 | See Annex C 15 to C 18            |

#### 3.2 Hygiene, health and the environment (BWR 3)

| Essential characteristic                                 | Performance             |
|--|-------------------------|
| Content, emission and/or release of dangerous substances | No performance assessed |

**4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base**

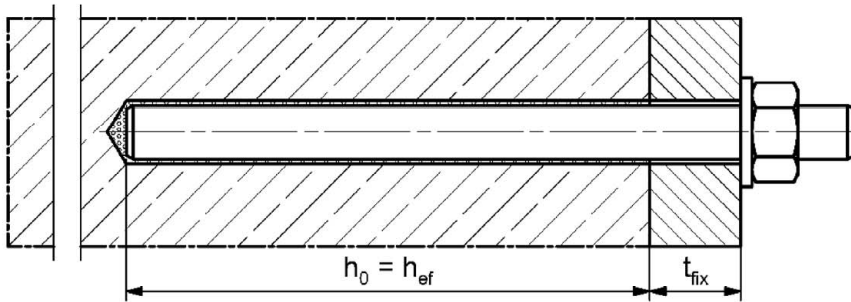
In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

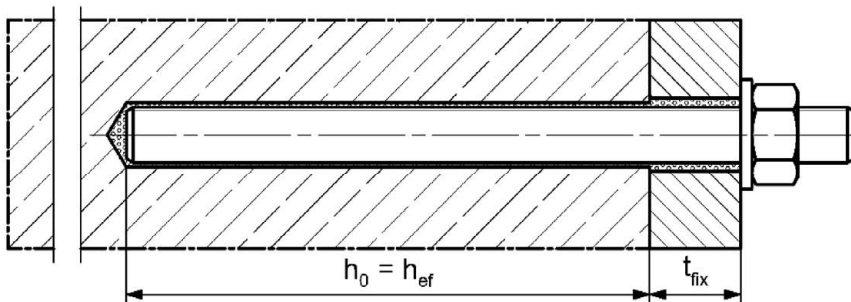
# Installation conditions part 1

## fischer anchor rod

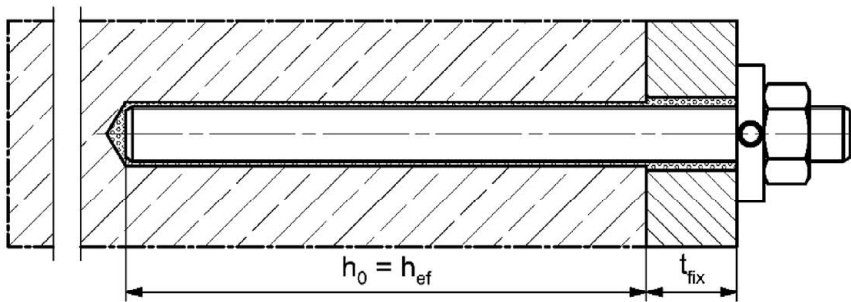
### Pre-positioned installation



### Push through installation (annular gap filled with mortar)



### Pre-positioned or push through installation with subsequently injected fischer filling disc (annular gap filled with mortar)



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

fischer injection system FIS EM Plus

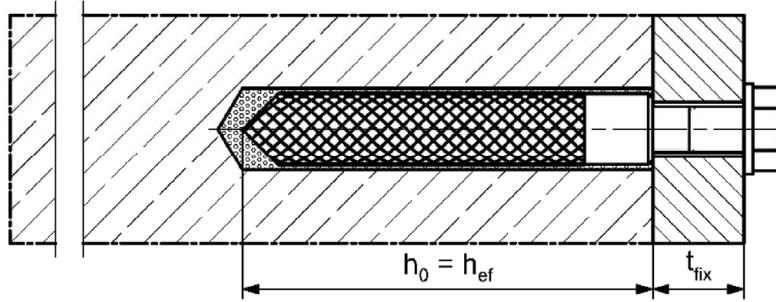
**Product description**  
Installation conditions part 1

**Annex A 1**  
Appendix 3/ 39

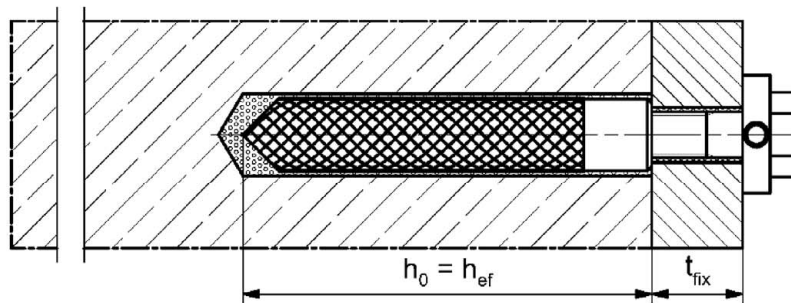
## Installation conditions part 2

### fischer internal threaded anchor RG MI

#### Pre-positioned installation



#### Pre-positioned installation with subsequently injected fischer filling disc (annular gap filled with mortar)



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

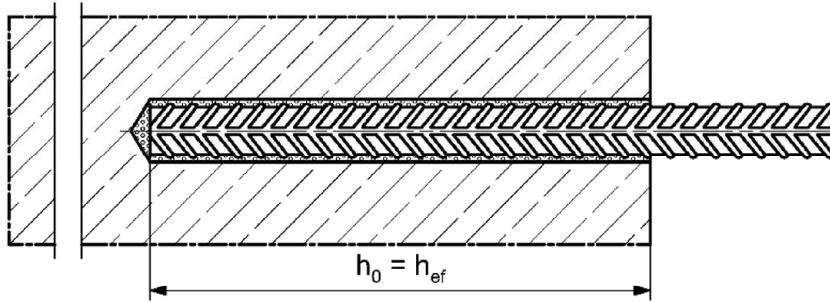
fischer injection system FIS EM Plus

**Product description**  
Installation conditions part 2

**Annex A 2**  
Appendix 4/ 39

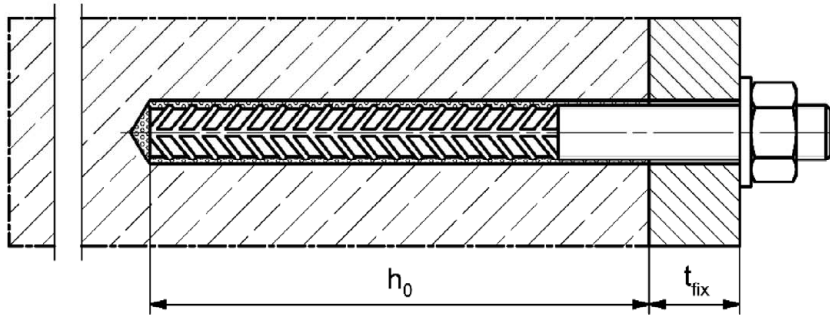
# Installation conditions part 3

## Reinforcing bar

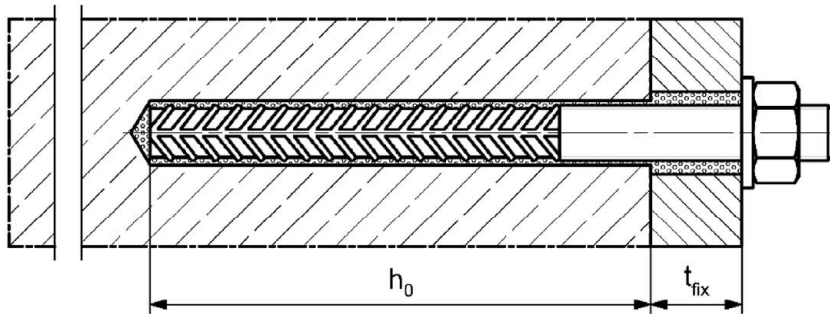


## fischer rebar anchor FRA

### Pre-positioned installation



### Push through installation (annular gap filled with mortar)



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

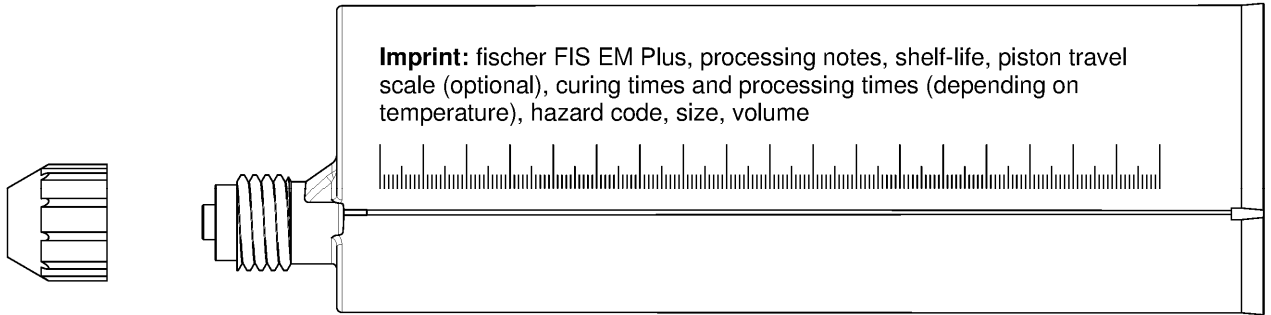
fischer injection system FIS EM Plus

**Product description**  
Installation conditions part 3

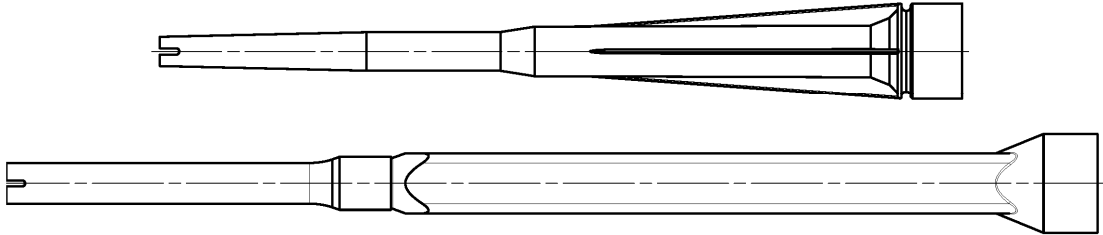
**Annex A 3**  
Appendix 5/ 39

## Overview system components part 1

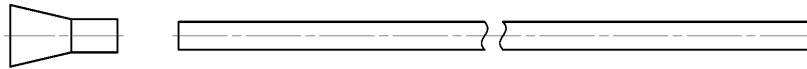
Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1100 ml, 1500 ml



Static mixer FIS MR Plus or UMR



Injection adapter and Extension tube for static mixer



Cleaning brush BS / BSB



Blow-out pump ABP



Figures not to scale

fischer injection system FIS EM Plus

### Product description

Overview system components part 1;  
cartridges / static mixer / accessories

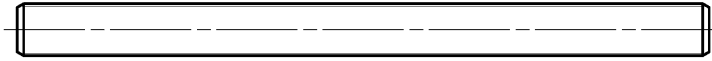
**Annex A 4**

Appendix 6/ 39

## Overview system components part 2

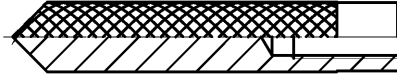
### fischer anchor rod

Size: M8, M10, M12, M14, M16, M20, M22, M24, M27, M30

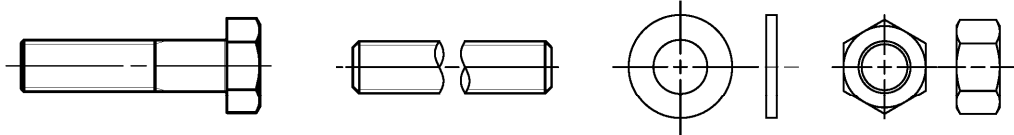


### fischer internal threaded anchor RG MI

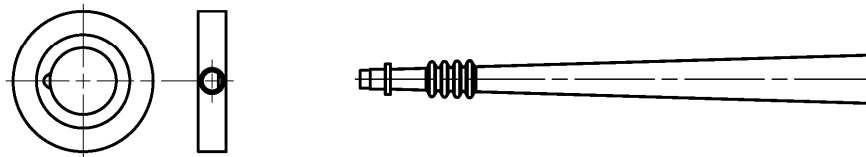
Size: M8, M10, M12, M16, M20



### Screw / threaded rod / washer / hexagon nut



### fischer filling disc with injection adapter



### Reinforcing bar

Nominal diameter:  $\phi 8$ ,  $\phi 10$ ,  $\phi 12$ ,  $\phi 14$ ,  $\phi 16$ ,  $\phi 18$ ,  $\phi 20$ ,  $\phi 22$ ,  $\phi 24$ ,  $\phi 25$ ,  $\phi 26$ ,  $\phi 28$ ,  $\phi 30$ ,  $\phi 32$ ,  $\phi 34$ ,  $\phi 36$ ,  $\phi 40$



### fischer rebar anchor FRA

Size: M12, M16, M20, M24



Figures not to scale

fischer injection system FIS EM Plus

#### Product description

Overview system components part 2;  
steel components

**Annex A 5**

Appendix 7/ 39



**Table A6.1: Materials**

| Part | Designation  | Material  |   |   |
|------|--|---|---|---|
| 1    | Injection cartridge  | Mortar, hardener, filler  |   |   |
|      | Steel grade  | Steel   | Stainless steel R   | High corrosion resistant steel HCR  |
|      |  | zinc plated   | acc. to EN 10088-1:2014<br>Corrosion resistance class<br>CRC III<br>acc. to EN 1993-1-4:2015  | acc. to EN 10088-1:2014<br>Corrosion resistance class<br>CRC V<br>acc. to EN 1993-1-4:2015  |
| 2    | Anchor rod   | Property class 4.8, 5.8 or 8.8;<br>EN ISO 898-1:2013<br>zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)<br>or hot dip galvanised $\geq 40 \mu\text{m}$<br>EN ISO 10684:2004<br>$f_{uk} \leq 1000 \text{ N/mm}^2$<br>$A_5 > 12\%$<br>fracture elongation | Property class 50, 70 or 80<br>EN ISO 3506-1:2009<br>1.4401; 1.4404; 1.4578;<br>1.4571; 1.4439; 1.4362;<br>1.4062, 1.4662, 1.4462;<br>EN 10088-1:2014<br>$f_{uk} \leq 1000 \text{ N/mm}^2$<br>$A_5 > 12\%$<br>fracture elongation   | Property class 50 or 80<br>EN ISO 3506-1:2009<br>or property class 70 with<br>$f_{yk} = 560 \text{ N/mm}^2$<br>1.4565; 1.4529;<br>EN 10088-1:2014<br>$f_{uk} \leq 1000 \text{ N/mm}^2$<br>$A_5 > 12\%$<br>fracture elongation |
|      |  | Fracture elongation $A_5 > 8 \%$ , for applications without requirements<br>for seismic performance category C2   |   |   |
| 3    | Washer<br>ISO 7089:2000  | zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)<br>or hot dip galvanised $\geq 40 \mu\text{m}$<br>EN ISO 10684:2004   | 1.4401; 1.4404;<br>1.4578; 1.4571;<br>1.4439; 1.4362;<br>EN 10088-1:2014  | 1.4565; 1.4529;<br>EN 10088-1:2014  |
| 4    | Hexagon nut  | Property class 4, 5 or 8;<br>EN ISO 898-2:2012<br>zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)<br>or hot dip galvanised $\geq 40 \mu\text{m}$<br>EN ISO 10684:2004   | Property class<br>50, 70 or 80<br>EN ISO 3506-1:2009<br>1.4401; 1.4404; 1.4578;<br>1.4571; 1.4439; 1.4362;<br>EN 10088-1:2014   | Property class<br>50, 70 or 80<br>EN ISO 3506-1:2009<br>1.4565; 1.4529<br>EN 10088-1:2014   |
| 5    | fischer<br>internal threaded anchor<br>RG MI   | Property class 5.8<br>ISO 898-1:2013<br>zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)   | Property class 70<br>EN ISO 3506-1:2009<br>1.4401; 1.4404; 1.4578;<br>1.4571; 1.4439; 1.4362;<br>EN 10088-1:2014  | Property class 70<br>EN ISO 3506-1:2009<br>1.4565; 1.4529;<br>EN 10088-1:2014   |
| 6    | Commercial standard<br>screw or threaded rod<br>for fischer internal<br>threaded anchor<br>RG MI | Property class 5.8 or 8.8;<br>EN ISO 898-1:2013<br>zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)<br>$A_5 > 8 \%$<br>fracture elongation   | Property class 70<br>EN ISO 3506-1:2009<br>1.4401; 1.4404; 1.4578;<br>1.4571; 1.4439; 1.4362;<br>EN 10088-1:2014<br>$A_5 > 8 \%$ fracture elongation  | Property class 70<br>EN ISO 3506-1:2009<br>1.4565; 1.4529;<br>EN 10088-1:2014<br>$A_5 > 8 \%$<br>fracture elongation  |
| 7    | fischer filling disc<br>similar to DIN 6319-G  | zinc plated $\geq 5 \mu\text{m}$ ,<br>ISO 4042:2018/Zn5/An(A2K)<br>or hot dip galvanised $\geq 40 \mu\text{m}$<br>EN ISO 10684:2004   | 1.4401; 1.4404; 1.4578;<br>1.4571; 1.4439; 1.4362;<br>EN 10088-1:2014   | 1.4565; 1.4529;<br>EN 10088-1:2014  |
| 8    | Reinforcing bar<br>EN 1992-1-1:2004 and<br>AC:2010, Annex C                                      | Bars and de-coiled rods, class B or C with<br>$f_{yk}$ and $k$ according to NDP or NCL according to EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$  |   |   |
| 9    | fischer<br>rebar anchor FRA  | Rebar part:<br>Bars and de-coiled rods class B or C with $f_{yk}$<br>and $k$ according to NDP or NCL of EN<br>1992-1-1:2004+AC:2010<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$   | Threaded part: Property class 70 or 80<br>EN ISO 3506-1:2009<br>1.4401, 1.4404, 1.4571, 1.4578, 1.4439,<br>1.4362, 1.4062 acc. to EN 10088-1:2014<br>Corrosion resistance class CRC III<br>acc. to EN 1993-1-4:2015<br>1.4565; 1.4529 acc. to EN 10088-1:2014<br>Corrosion resistance class CRC V<br>acc. to EN 1993-1-4:2015 |   |

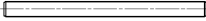






fischer injection system FIS EM Plus

**Product description**  
Materials

**Annex A 6**  
Appendix 8/ 39

# Specifications of intended use (part 1)

**Table B1.1:** Overview use and performance categories

| Anchorages subject to  |   | FIS EM Plus with ...  |  |   |  |                                    |   |           |  |
|--|---|---|--|---|--|------------------------------------|---|-----------|--|
|  |   | Anchor rod<br> | fischer internal threaded anchor<br>RG MI<br> | Reinforcing bar<br> | fischer rebar anchor<br>FRA<br> |                                    |   |           |  |
| Hammer drilling with standard drill bit<br>   |   | all sizes   |  |   |  |                                    |   |           |  |
| Hammer drilling with hollow drill bit (fischer "FHD", Heller "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD", DreBo „D-Plus“, DreBo „D-Max“)<br> |   | Nominal drill bit diameter ( $d_0$ )<br>12 mm to 35 mm  |  |   |  |                                    |   |           |  |
| Diamond drilling<br>  |   | all sizes   |  |   |  |                                    |   |           |  |
| Static and quasi static load, in   | uncracked concrete  | all sizes   | Tables:<br>C1.1<br>C4.1<br>C5.1<br>C6.1<br>C13.1   | all sizes   | Tables:<br>C2.1<br>C4.1<br>C7.1<br>C8.1<br>C13.2   | all sizes                          | Tables:<br>C3.1<br>C4.1<br>C9.1<br>C10.1<br>C14.1 | all sizes | Tables:<br>C3.2<br>C4.1<br>C11.1<br>C12.1<br>C14.2 |
|  | cracked concrete  |   |  |   |  |                                    |   |           |  |
| Seismic performance category (only hammer drilling with standard / hollow drill bits)  | C1  | M10 to M30  | Tables:<br>C15.1<br>C16.2<br>C17.1   | -1)   | $\phi 10$ to $\phi 32$   | Tables:<br>C16.1<br>C16.2<br>C17.2 | -1)   |           |  |
|  | C2  | M12<br>M16<br>M20<br>M24  | Tables:<br>C15.1<br>C16.2<br>C18.1   |   | -1)  |                                    |   |           |  |
| Use category   | I1  | dry or wet concrete   | all sizes  |   |  |                                    |   |           |  |
|  | I2  | water filled hole   | all sizes (not permitted in combined with working life 100 years)  |   |  |                                    |   |           |  |
| Installation direction   | D3 (downward and horizontal and upwards (e.g. overhead) installation) |   |  |   |  |                                    |   |           |  |
| Installation temperature   | $T_{i,min} = -5 \text{ °C}$ to $T_{i,max} = +40 \text{ °C}$           |   |  |   |  |                                    |   |           |  |
| In-service temperature   | Temperature range I   | -40 °C to +60 °C  |  | (max. short term temperature +60 °C;<br>max. long term temperature +35 °C)                            |  |                                    |   |           |  |
|  | Temperature range II  | -40 °C to +72 °C  |  | (max. short term temperature +72 °C;<br>max. long term temperature +50 °C)                            |  |                                    |   |           |  |

<sup>1)</sup> no performance assessed

fischer injection system FIS EM Plus

**Intended use**  
Specifications (part 1)

**Annex B 1**  
Appendix 9/ 39

## Specifications of intended use (part 2)

### Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres of strength classes C20/25 to C50/60 according to EN 206:2013+A1:2016

### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel, stainless steel or high corrosion resistant steel).
- For all other conditions according to EN1993-1-4:2015 corresponding to corrosion resistance classes to Annex A 6 table A6.1.

### Design:

- Anchorages have to be designed by a responsible engineer with experience of concrete anchor design.
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed in accordance with:  
EN 1992-4:2018 and EOTA Technical Report TR 055, Edition February 2018

### Installation:

- Anchor installation is to be carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- In case of aborted hole: The hole shall be filled with mortar
- Anchorage depth should be marked and adhered to on installation
- Overhead installation is allowed

fischer injection system FIS EM Plus

**Intended use**  
Specifications (part 2)

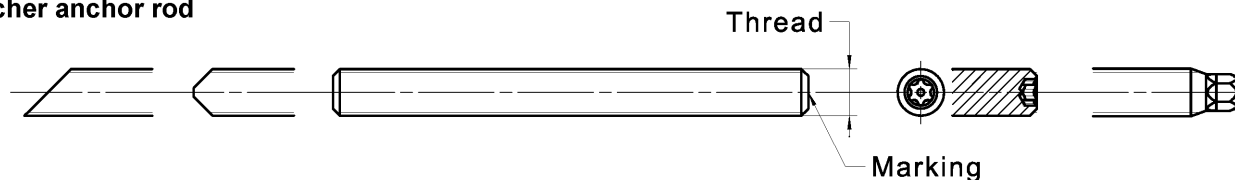
**Annex B 2**  
Appendix 10/ 39

**Table B3.1: Installation parameters for anchor rods**

| Anchor rods                                   |                                      | Thread                          | M8             | M10 | M12 | M14             | M16 | M20                    | M22 | M24 | M27 | M30 |
|---|--------------------------------------|---------------------------------|----------------|-----|-----|-----------------|-----|------------------------|-----|-----|-----|-----|
| Width across flats                            | SW                                   | [mm]                            | 13             | 17  | 19  | 22              | 24  | 30                     | 32  | 36  | 41  | 46  |
| Nominal drill hole diameter                   | $d_0$                                |                                 | 10             | 12  | 14  | 16              | 18  | 22<br>24 <sup>1)</sup> | 25  | 28  | 30  | 35  |
| Drill hole depth                              | $h_0$                                |                                 | $h_0 = h_{ef}$ |     |     |                 |     |                        |     |     |     |     |
| Effective embedment depth                     | $h_{ef, min}$                        |                                 | 60             | 60  | 70  | 75              | 80  | 90                     | 93  | 96  | 108 | 120 |
|   | $h_{ef, max}$                        |                                 | 160            | 200 | 240 | 280             | 320 | 400                    | 440 | 480 | 540 | 600 |
| Diameter of the clearance hole of the fixture | pre-positioned installation<br>$d_f$ |                                 | 9              | 12  | 14  | 16              | 18  | 22                     | 24  | 26  | 30  | 33  |
|   | push through installation<br>$d_f$   |                                 | 12             | 14  | 16  | 18              | 20  | 26                     | 28  | 30  | 33  | 40  |
| Minimum thickness of concrete member          | $h_{min}$                            | $h_{ef} + 30$<br>( $\geq 100$ ) |                |     |     | $h_{ef} + 2d_0$ |     |                        |     |     |     |     |
| Maximum installation torque                   | $\max T_{inst}$                      | [Nm]                            | 10             | 20  | 40  | 50              | 60  | 120                    | 135 | 150 | 200 | 300 |

<sup>1)</sup> Both drill hole diameters can be used

**fischer anchor rod**



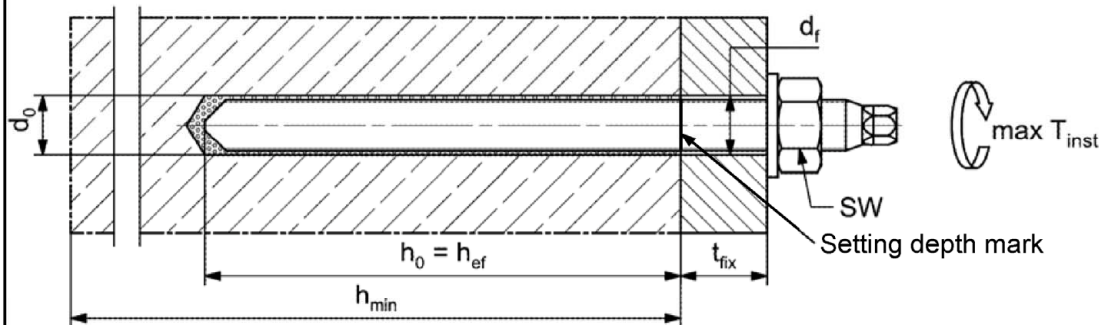
**Marking (on random place) fischer anchor rod:**

|  |        |  |   |
|--|--------|--|---|
| Steel zinc plated PC <sup>1)</sup> 8.8                 | • or + | Steel hot-dip PC <sup>1)</sup> 8.8                     | • |
| High corrosion resistant steel HCR PC <sup>1)</sup> 50 | •      | High corrosion resistant steel HCR PC <sup>1)</sup> 70 | - |
| High corrosion resistant steel HCR PC <sup>1)</sup> 80 | (      | Stainless steel R property class 50                    | ~ |
| Stainless steel R property class 80                    | *      |  |   |

Alternatively: Colour coding according to DIN 976-1:2016

<sup>1)</sup> PC = property class

**Installation conditions:**



**Commercial standard threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled**

- Materials, dimensions and mechanical properties according to Annex A 6, Table A6.1
- Inspection certificate 3.1 according to EN 10204:2004, the documents have to be stored
- Setting depth is marked

Figures not to scale

fischer injection system FIS EM Plus

**Intended use**

Installation parameters anchor rods

**Annex B 3**

Appendix 11/ 39

**Table B4.1:** Minimum spacing and minimum edge distance for **anchor rods** and **reinforcing bars**

| Anchor rods  |              | M8                      | M10                   | M12      | M14       | M16       | -         | M20       | M22       | M24       |
|--|--------------|-------------------------|-----------------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Reinforcing bars (nominal diameter) $\phi$                   |              | 8                       | 10                    | 12       | 14        | 16        | 18        | 20        | 22        | 24        |
| <b>Minimum edge distance</b>                                 |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked / cracked concrete                                 | $c_{min}$    | [mm]                    | 40                    | 45       | 45        | 45        | 50        | 55        | 55        | 60        |
| Minimum spacing  | $s_{min}$    |                         | according to Annex B5 |          |           |           |           |           |           |           |
| <b>Minimum spacing</b>                                       |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked / cracked concrete                                 | $s_{min}$    | [mm]                    | 40                    | 45       | 55        | 60        | 65        | 85        | 85        | 105       |
| Minimum edge distance  | $c_{min}$    |                         | according to Annex B5 |          |           |           |           |           |           |           |
| <b>Required projecting area</b>                              |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked concrete   | $A_{sp,req}$ | [1000 mm <sup>2</sup> ] | 8                     | 13       | 22        | 23        | 24        | 38,5      | 38,5      | 40        |
| Cracked concrete   |              |                         | 6,5                   | 10       | 16,5      | 17,5      | 18,5      | 29,5      | 29,5      | 30,5      |
| <b>Anchor rods</b>   |              |                         |                       |          |           |           |           |           |           |           |
|  |              | -                       | -                     | M27      | -         | M30       | -         | -         | -         | -         |
| <b>Reinforcing bars (nominal diameter) <math>\phi</math></b> |              | <b>25</b>               | <b>26</b>             | <b>-</b> | <b>28</b> | <b>30</b> | <b>32</b> | <b>34</b> | <b>36</b> | <b>40</b> |
| <b>Minimum edge distance</b>                                 |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked / cracked concrete                                 | $c_{min}$    | [mm]                    | 75                    | 75       | 75        | 80        | 80        | 120       | 120       | 175       |
| Minimum spacing  | $s_{min}$    |                         | according to Annex B5 |          |           |           |           |           |           |           |
| <b>Minimum spacing</b>                                       |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked / cracked concrete                                 | $s_{min}$    | [mm]                    | 120                   | 120      | 120       | 140       | 140       | 160       | 160       | 160       |
| Minimum edge distance  | $c_{min}$    |                         | according to Annex B5 |          |           |           |           |           |           |           |
| <b>Required projecting area</b>                              |              |                         |                       |          |           |           |           |           |           |           |
| Uncracked concrete   | $A_{sp,req}$ | [1000 mm <sup>2</sup> ] | 47,5                  | 47,5     | 47,5      | 64        | 64        | 64        | 64        | 64        |
| Cracked concrete   |              |                         | 36,5                  | 36,5     | 36,5      | 49        | 49        | 49        | 49        | 49        |

**Splitting failure** for minimum edge distance and spacing in dependence of the effective embedment depth  $h_{ef}$ .

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

$$A_{sp,req} < A_{sp,t}$$

$A_{sp,req}$  = required projecting area

$A_{sp,t} = A_{sp,ef}$  = effective projecting area (according to Annex B5)

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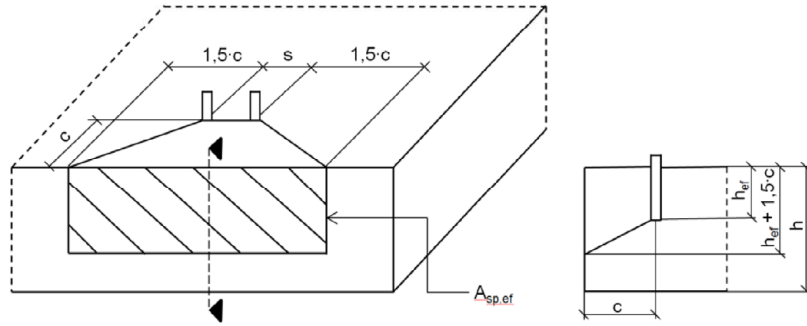
**Intended use**

Minimum spacing and edge distance for anchor rods and reinforcing bars

**Annex B 4**

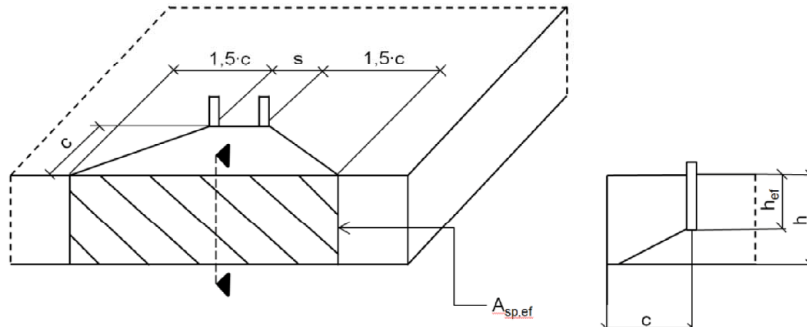
Appendix 12/ 39

**Table B5.1:** Effective projecting area  $A_{sp,t}$  with concrete member thickness  $h > h_{ef} + 1,5 \cdot c$  and  $h \geq h_{min}$



|  |   |                    |  |
|--|---|--------------------|--|
| Single anchor                            | $A_{sp,t} = (3 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$     | [mm <sup>2</sup> ] | with $c \geq c_{min}$                      |
| Group of anchors with $s > 3 \cdot c$    | $A_{sp,t} = (6 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$     | [mm <sup>2</sup> ] |  |
| Group of anchors with $s \leq 3 \cdot c$ | $A_{sp,t} = (3 \cdot c + s) \cdot (h_{ef} + 1,5 \cdot c)$ | [mm <sup>2</sup> ] | with $c \geq c_{min}$ and $s \geq s_{min}$ |

**Table B5.2:** Effektive projecting area  $A_{sp,t}$  with concrete member thickness  $h \leq h_{ef} + 1,5 \cdot c$  and  $h \geq h_{min}$



|  |   |                    |  |
|--|---|--------------------|--|
| Single anchor                            | $A_{sp,t} = 3 \cdot c \cdot \text{existing } h$       | [mm <sup>2</sup> ] | with $c \geq c_{min}$                      |
| Group of anchors with $s > 3 \cdot c$    | $A_{sp,t} = 6 \cdot c \cdot \text{existing } h$       | [mm <sup>2</sup> ] |  |
| Group of anchors with $s \leq 3 \cdot c$ | $A_{sp,t} = (3 \cdot c + s) \cdot \text{existing } h$ | [mm <sup>2</sup> ] | with $c \geq c_{min}$ and $s \geq s_{min}$ |

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

Figures not to scale

fischer injection system FIS EM Plus

**Intended use**

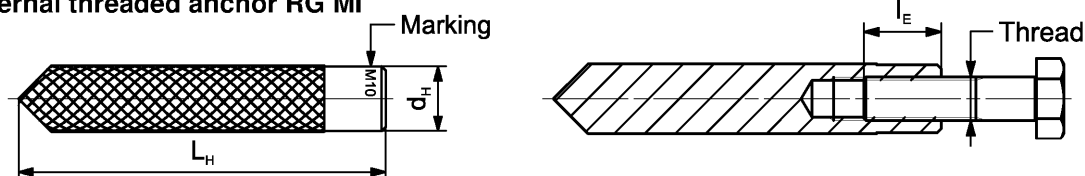
Minimum thickness of concrete member for anchor rods,  
minimum spacing and edge distance

**Annex B 5**  
Appendix 13/ 39

**Table B6.1:** Installation parameters for **fischer internal threaded anchors RG MI**

| Internal threaded anchors RG MI              |                     | Thread | M8                   | M10 | M12 | M16 | M20 |
|--|---------------------|--------|----------------------|-----|-----|-----|-----|
| Diameter of anchor                           | $d_{nom} = d_H$     | [mm]   | 12                   | 16  | 18  | 22  | 28  |
| Nominal drill hole diameter                  | $d_0$               |        | 14                   | 18  | 20  | 24  | 32  |
| Drill hole depth                             | $h_0$               |        | $h_0 = h_{ef} = L_H$ |     |     |     |     |
| Effective embedment depth ( $h_{ef} = L_H$ ) | $h_{ef}$            |        | 90                   | 90  | 125 | 160 | 200 |
| Minimum spacing and minimum edge distance    | $S_{min} = C_{min}$ |        | 55                   | 65  | 75  | 95  | 125 |
| Diameter of clearance hole in the fixture    | $d_f$               |        | 9                    | 12  | 14  | 18  | 22  |
| Minimum thickness of concrete member         | $h_{min}$           |        | 120                  | 125 | 165 | 205 | 260 |
| Maximum screw-in depth                       | $l_{E,max}$         |        | 18                   | 23  | 26  | 35  | 45  |
| Minimum screw-in depth                       | $l_{E,min}$         |        | 8                    | 10  | 12  | 16  | 20  |
| Maximum installation torque                  | $\max T_{inst}$     |        | [Nm]                 | 10  | 20  | 40  | 80  |

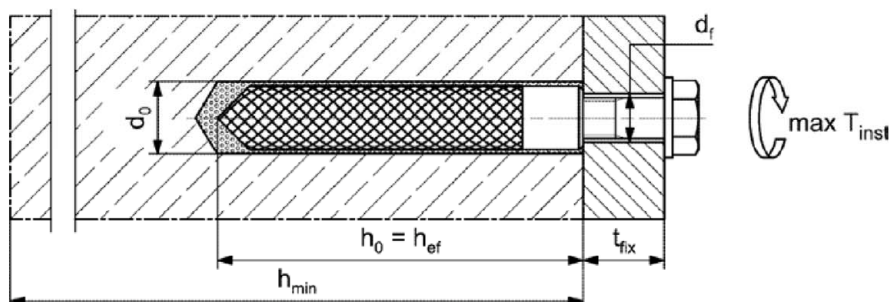
**fischer internal threaded anchor RG MI**



**Marking:** Anchor size e. g.: **M10**  
 Stainless steel → additional **R**; e.g.: **M10 R**  
 High corrosion resistant steel → additional **HCR**; e.g.: **M10 HCR**

Retaining bolt or threaded rods (including nut and washer) must comply with the appropriate material and strength class of Annex A 6, Table A6.1

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**

Installation parameters internal threaded anchors RG MI

**Annex B 6**

Appendix 14/ 39

**Table B7.1:** Installation parameters for reinforcing bars <sup>1)</sup>

| Nominal diameter of the bar          |              | $\phi$ | 8 <sup>2)</sup>                 | 10 <sup>2)</sup> | 12 <sup>2)</sup> | 14  | 16              | 18  | 20  | 22  | 24  |    |    |    |  |
|--------------------------------------|--------------|--------|---------------------------------|------------------|------------------|-----|-----------------|-----|-----|-----|-----|----|----|----|--|
| Nominal drill hole diameter          | $d_0$        | [mm]   | 10                              | 12               | 12               | 14  | 14              | 16  | 18  | 20  | 25  | 25 | 30 | 30 |  |
| Drill hole depth                     | $h_0$        |        | $h_0 = h_{ef}$                  |                  |                  |     |                 |     |     |     |     |    |    |    |  |
| Effective embedment depth            | $h_{ef,min}$ |        | 60                              | 60               | 70               | 75  | 80              | 85  | 90  | 94  | 98  |    |    |    |  |
|                                      | $h_{ef,max}$ |        | 160                             | 200              | 240              | 280 | 320             | 360 | 400 | 440 | 480 |    |    |    |  |
| Minimum thickness of concrete member | $h_{min}$    |        | $h_{ef} + 30$<br>( $\geq 100$ ) |                  |                  |     | $h_{ef} + 2d_0$ |     |     |     |     |    |    |    |  |

| Nominal diameter of the bar          |              | $\phi$ | 25              | 26  | 28  | 30  | 32  | 34  | 36  | 40  | - |  |
|--------------------------------------|--------------|--------|-----------------|-----|-----|-----|-----|-----|-----|-----|---|--|
| Nominal drill hole diameter          | $d_0$        | [mm]   | 30              | 35  | 35  | 40  | 40  | 40  | 45  | 55  | - |  |
| Drill hole depth                     | $h_0$        |        | $h_0 = h_{ef}$  |     |     |     |     |     |     |     |   |  |
| Effective embedment depth            | $h_{ef,min}$ |        | 100             | 104 | 112 | 120 | 128 | 136 | 144 | 160 | - |  |
|                                      | $h_{ef,max}$ |        | 500             | 520 | 560 | 600 | 640 | 680 | 720 | 800 | - |  |
| Minimum thickness of concrete member | $h_{min}$    |        | $h_{ef} + 2d_0$ |     |     |     |     |     |     |     |   |  |

<sup>1)</sup> minimum spacing and minimum edge distance see Annex B 4

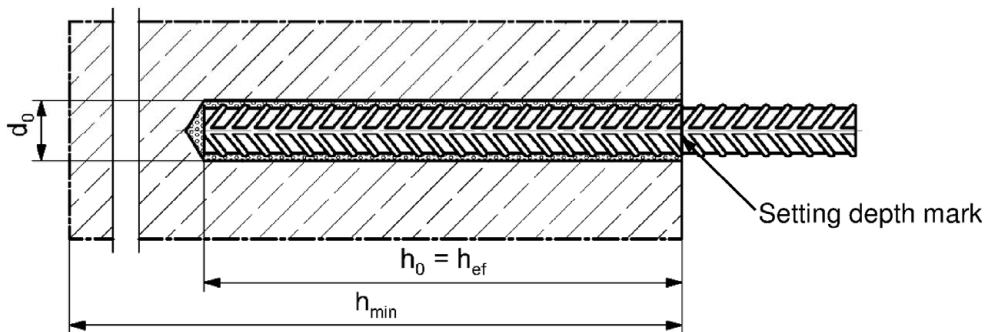
<sup>2)</sup> Both drill hole diameters can be used

**Reinforcing bar**



- The minimum value of related rib area  $f_{R,min}$  must fulfil the requirements of EN 1992-1-1:2004+AC:2010
- The rib height must be within the range:  $0,05 \cdot \phi \leq h_{rib} \leq 0,07 \cdot \phi$   
( $\phi$  = Nominal diameter of the bar,  $h_{rib}$  = rib height)

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters reinforcing bars

**Annex B 7**  
Appendix 15/ 39

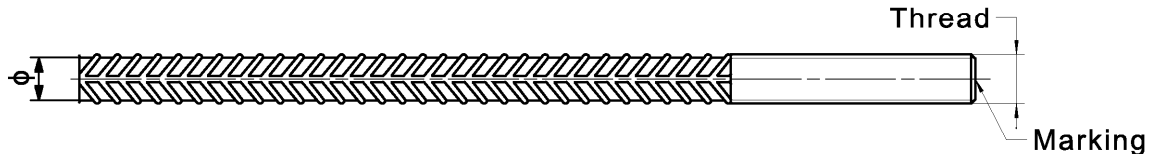




**Table B8.1:** Installation parameters for **fischer rebar anchor FRA**

| Rebar anchor FRA                          |                                      | Thread     | M12 <sup>1)</sup> | M16 | M20 | M24 |
|---|--------------------------------------|------------|-------------------|-----|-----|-----|
| Nominal diameter of the bar               | $\phi$                               | [mm]       | 12                | 16  | 20  | 25  |
| Width across flats                        | SW                                   |            | 19                | 24  | 30  | 36  |
| Nominal drill hole diameter               | $d_0$                                |            | 14                | 16  | 20  | 30  |
| Drill hole depth                          | $h_0$                                |            | $h_{ef} + l_e$    |     |     |     |
| Effective embedment depth                 | $h_{ef,min}$                         |            | 70                | 80  | 90  | 96  |
|   | $h_{ef,max}$                         |            | 140               | 220 | 300 | 380 |
| Distance concrete surface to welded joint | $l_e$                                |            | 100               |     |     |     |
| Minimum spacing and minimum edge distance | $s_{min}$<br>=<br>$c_{min}$          |            | 55                | 65  | 85  | 105 |
|   | Diameter of pre-positioned anchorage |            | $\leq d_f$        | 14  | 18  | 22  |
| Diameter of clearance hole in the fixture | push through anchorage               |            | $\leq d_f$        | 18  | 22  | 26  |
| Minimum thickness of concrete member      | $h_{min}$                            | $h_0 + 30$ | $h_0 + 2d_0$      |     |     |     |
| Maximum installation torque               | $\max T_{inst}$                      | [Nm]       | 40                | 60  | 120 | 150 |

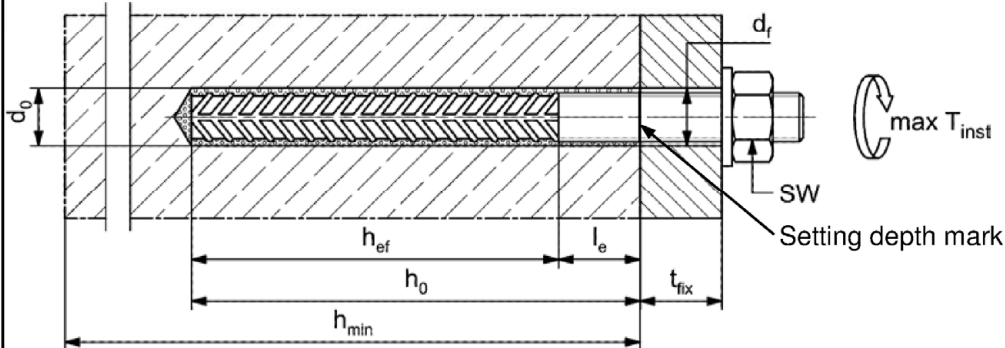
<sup>1)</sup> Both drill hole diameters can be used

**fischer rebar anchor FRA**



Marking frontal e. g:  FRA (for stainless steel);  
 FRA HCR (for high corrosion resistant steel)

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**

Installation parameters rebar anchor FRA

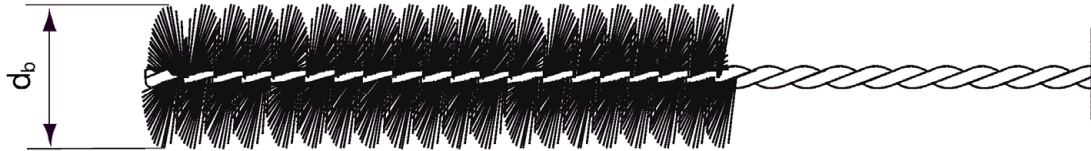
**Annex B 8**

Appendix 16/ 39

**Table B9.1: Parameters of the cleaning brush BS / BSB (steel brush with steel bristles)**

The size of the cleaning brush refers to the drill hole diameter

|                             |       |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-----------------------------|-------|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Nominal drill hole diameter | $d_0$ |      | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 25 | 28 | 30 | 32 | 35 | 40 | 45 | 55 |
| Steel brush diameter BS     | $d_b$ | [mm] | 11 | 14 | 16 | 20 |    | 25 | 26 | 27 | 30 | 40 |    |    | -  | -  | -  |
| Steel brush diameter BSB    | $d_b$ |      | -  | -  | -  | -  |    | -  | -  | -  | -  | -  |    |    | 42 | 47 | 58 |



**Table B9.2 Maximum processing time of the mortar and minimum curing time**  
(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

| Temperature at anchoring base [°C] | Maximum processing time $t_{work}$ | Minimum curing time <sup>1)</sup> $t_{cure}$ |
|------------------------------------|------------------------------------|--|
| -5 to 0 <sup>2)</sup>              | 240 min                            | 200 h  |
| > 0 to 5 <sup>2)</sup>             | 150 min                            | 90 h   |
| > 5 to 10                          | 120 min                            | 40 h   |
| > 10 to 20                         | 30 min                             | 18 h   |
| > 20 to 30                         | 14 min                             | 10 h   |
| > 30 to 40                         | 7 min                              | 5 h  |

<sup>1)</sup> In wet concrete or water filled holes the curing times must be doubled

<sup>2)</sup> Minimal cartridge temperature +5°C

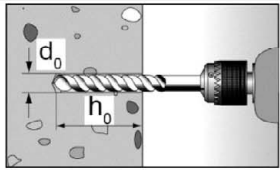
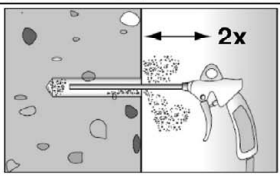

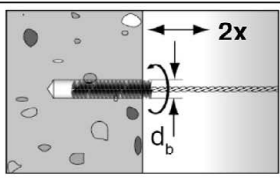
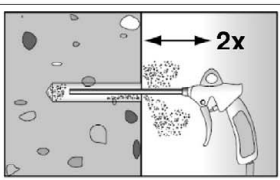

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**Intended use**

Cleaning brush (steel brush)  
Processing time and curing time


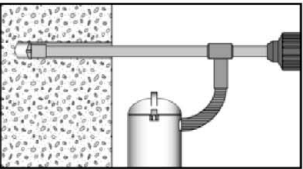
## Installation instructions part 1

### Drilling and cleaning the hole (hammer drilling with standard drill bit)

|   |   |   |
|---|---|---|
| 1 |  | <p>Drill the hole.<br/>Nominal drill hole diameter <math>d_0</math> and drill hole depth <math>h_0</math><br/>see <b>tables B3.1, B6.1, B7.1, B8.1</b></p>  |
| 2 |  | <p>Cleaning the drill hole:<br/>Blow out the drill hole twice, with oil free compressed air (<math>p \geq 6</math> bar)</p>  |
| 3 |  | <p>Brush the drill hole twice. For drill hole diameter <math>\geq 30</math> mm use a power drill.<br/>For deep holes use an extension. Corresponding brushes see <b>table B9.1</b></p>                          |
| 4 |  | <p>Cleaning the drill hole:<br/>Blow out the drill hole twice, with oil free compressed air (<math>p \geq 6</math> bar)</p>  |

Go to step 6

### Drilling and cleaning the hole (hammer drilling with hollow drill bit)

|   |   |   |
|---|---|---|
| 1 |  | <p>Check a suitable hollow drill (see <b>table B1.1</b>)<br/>for correct operation of the dust extraction</p>   |
| 2 |  | <p>Use a suitable dust extraction system, e. g. fischer FVC 35 M or a comparable dust extraction system with equivalent performance data</p> <p>Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Nominal drill hole diameter <math>d_0</math> and drill hole depth <math>h_0</math><br/>see <b>tables B3.1, B6.1, B7.1, B8.1</b></p> |

Go to step 6

fischer injection system FIS EM Plus

**Intended use**  
Installation instructions part 1

**Annex B 10**  
Appendix 18/ 39

## Installation instructions part 2

### Drilling and cleaning the hole (wet drilling with diamond drill bit)

|   |  |   |  |   |
|---|--|---|--|---|
| 1 |  | <p>Drill the hole.<br/>Drill hole diameter <math>d_0</math> and nominal drill hole depth <math>h_0</math> see tables <b>B3.1</b>, <b>B6.1</b>, <b>B7.1</b>, <b>B8.1</b></p> |  | <p>Break the drill core and remove it</p> |
| 2 |  | <p>Flush the drill hole with clean water until it flows clear</p>   |  |   |
| 3 |  | <p>Blow out the drill hole twice, using oil-free compressed air (<math>p &gt; 6</math> bar)</p>   |  |   |
| 4 |  | <p>Brush the drill hole twice using a power drill.<br/>Corresponding brushes see table <b>B9.1</b></p>  |  |   |
| 5 |  | <p>Blow out the drill hole twice, using oil-free compressed air (<math>p &gt; 6</math> bar)</p>   |  |   |

### Preparing the cartridge

|   |  |  |   |  |
|---|--|--|---|--|
| 6 |  | <p>Remove the sealing cap<br/>Screw on the static mixer<br/>(the spiral in the static mixer must be clearly visible)</p> |   |  |
| 7 |  |  | <p>Place the cartridge into the dispenser</p>   |  |
| 8 |  |  | <p>Extrude approximately 10 cm of material out until the resin is evenly grey in colour. Do not use mortar that is not uniformly grey</p> |  |

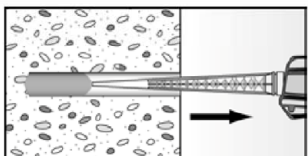
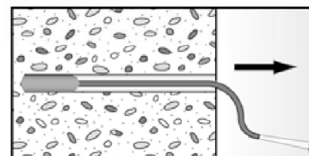
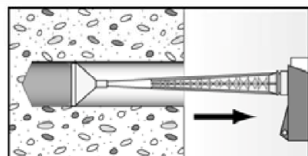
fischer injection system FIS EM Plus

**Intended use**  
Installation instructions part 2

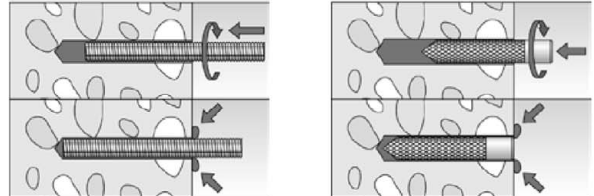
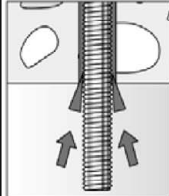
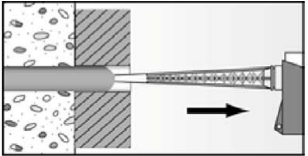

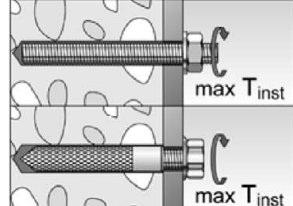
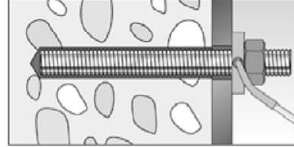
**Annex B 11**  
Appendix 19/ 39

### Installation instructions part 3

#### Injection of the mortar

|          |   |  |   |
|----------|---|--|---|
| <p>9</p> |  <p>Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles</p> |  <p>For drill hole depth <math>\geq 150</math> mm use an extension tube</p> |  <p>For overhead installation, deep holes (<math>h_0 &gt; 250</math> mm) or drill hole diameter (<math>d_0 \geq 40</math> mm) use an injection-adapter</p> |
|----------|---|--|---|

#### Installation of anchor rods or fischer internal threaded anchors RG MI

|               |   |   |
|---------------|---|---|
| <p>10</p>     |    | <p>Only use clean and oil-free metal parts. Mark the setting depth of the metal parts. Push the anchor rod or fischer internal threaded RG MI anchor down to the bottom of the hole, turning it slightly while doing so. After inserting the metal part, excess mortar must be emerged around the anchor element.</p>   |
|               |  <p>For overhead installations support the metal part with wedges (e. g. fischer centering wedges) or fischer overhead clips.</p> |  <p>For push through installation fill the annular gap with mortar</p>  |
| <p>11</p>     |  <p>Wait for the specified curing time <math>t_{cure}</math> see <b>table B9.2</b></p>   | <p>12</p>  <p>Mounting the fixture <math>\max T_{inst}</math> see <b>tables B3.1 and B6.1</b></p>   |
| <p>Option</p> |    | <p>After the minimum curing time is reached, the gap between metal part and fixture (annular clearance) may be filled with mortar via the fischer filling disc. Compressive strength <math>\geq 50</math> N/mm<sup>2</sup> (e.g. fischer injection mortars FIS HB, FIS SB, FIS V, FIS EM Plus)<br/> <b>ATTENTION:</b> Using fischer filling disc reduces <math>t_{fix}</math> (usable length of the anchor)</p> |

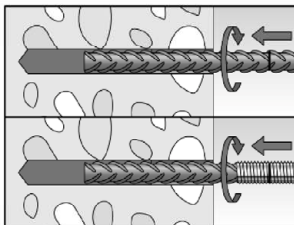
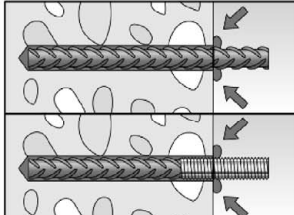

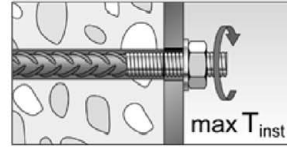
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**Intended use**  
Installation instructions part 3

**Annex B 12**  
Appendix 20/ 39

## Installation instructions part 4

### Installation reinforcing bars and fischer rebar anchor FRA

|    |   |  |   |   |
|----|---|--|---|---|
| 10 |    | Only use clean and oil-free reinforcing bars or fischer FRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the fischer FRA into the filled hole up to the setting depth mark |   |   |
| 10 |    | When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole.  |   |   |
| 11 |  <p>Wait for the specified curing time <math>t_{cure}</math> see <b>table B9.2</b></p> | 12   |  <p>max <math>T_{inst}</math></p> | Mounting the fixture<br>max $T_{inst}$<br>see <b>table B8.1</b> |

fischer injection system FIS EM Plus

**Intended use**  
Installation instructions part 4

**Annex B 13**  
Appendix 21/ 39

**Table C1.1:** Characteristic values for **steel failure** under tension / shear load of **fischer anchor rods** and **standard threaded rods**

| Anchor rod / standard threaded rod                                     |  | M8                 | M10  | M12                       | M14    | M16 | M20 | M22 | M24 | M27 | M30 |      |      |
|--|--|--------------------|------|---------------------------|--------|-----|-----|-----|-----|-----|-----|------|------|
| <b>Bearing capacity under tension load, steel failure<sup>3)</sup></b> |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| Characteristic resistance $N_{Rk,s}$                                   | Steel zinc plated  | Property class 4.8 | [kN] | 15(13)                    | 23(21) | 33  | 46  | 63  | 98  | 121 | 141 | 184  | 224  |
|  |  | 5.8                |      | 19(17)                    | 29(27) | 43  | 58  | 79  | 123 | 152 | 177 | 230  | 281  |
|  |  | 8.8                |      | 29(27)                    | 47(43) | 68  | 92  | 126 | 196 | 243 | 282 | 368  | 449  |
|  | Stainless steel R and high corrosion resistant steel HCR | 50                 |      | 19                        | 29     | 43  | 58  | 79  | 123 | 152 | 177 | 230  | 281  |
|  |  | 70                 |      | 26                        | 41     | 59  | 81  | 110 | 172 | 212 | 247 | 322  | 393  |
|  |  | 80                 |      | 30                        | 47     | 68  | 92  | 126 | 196 | 243 | 282 | 368  | 449  |
| <b>Partial factors <sup>1)</sup></b>                                   |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| Partial factor $\gamma_{Ms,N}$   | Steel zinc plated  | Property class 4.8 | [-]  | 1,50                      |        |     |     |     |     |     |     |      |      |
|  |  | 5.8                |      | 1,50                      |        |     |     |     |     |     |     |      |      |
|  |  | 8.8                |      | 1,50                      |        |     |     |     |     |     |     |      |      |
|  | Stainless steel R and high corrosion resistant steel HCR | 50                 |      | 2,86                      |        |     |     |     |     |     |     |      |      |
|  |  | 70                 |      | 1,50 <sup>2)</sup> / 1,87 |        |     |     |     |     |     |     |      |      |
|  |  | 80                 |      | 1,60                      |        |     |     |     |     |     |     |      |      |
| <b>Bearing capacity under shear load, steel failure<sup>3)</sup></b>   |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| <b>without lever arm</b>   |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| Characteristic resistance $V_{Rk,s}^0$                                 | Steel zinc plated  | Property class 4.8 | [kN] | 9(8)                      | 14(13) | 20  | 28  | 38  | 59  | 73  | 85  | 110  | 135  |
|  |  | 5.8                |      | 11(10)                    | 17(16) | 25  | 34  | 47  | 74  | 91  | 106 | 138  | 168  |
|  |  | 8.8                |      | 15(13)                    | 23(21) | 34  | 46  | 63  | 98  | 122 | 141 | 184  | 225  |
|  | Stainless steel R and high corrosion resistant steel HCR | 50                 |      | 9                         | 15     | 21  | 29  | 39  | 61  | 76  | 89  | 115  | 141  |
|  |  | 70                 |      | 13                        | 20     | 30  | 40  | 55  | 86  | 107 | 124 | 161  | 197  |
|  |  | 80                 |      | 15                        | 23     | 34  | 46  | 63  | 98  | 122 | 141 | 184  | 225  |
| Ductility factor   | k <sub>7</sub>   | [-]                | 1,0  |                           |        |     |     |     |     |     |     |      |      |
| <b>with lever arm</b>  |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| Charact. resistance $M_{Rk,s}^0$                                       | Steel zinc plated  | Property class 4.8 | [Nm] | 15(13)                    | 30(27) | 52  | 83  | 133 | 259 | 357 | 448 | 665  | 899  |
|  |  | 5.8                |      | 19(16)                    | 37(33) | 65  | 104 | 166 | 324 | 447 | 560 | 833  | 1123 |
|  |  | 8.8                |      | 30(26)                    | 60(53) | 105 | 167 | 266 | 519 | 716 | 896 | 1333 | 1797 |
|  | Stainless steel R and high corrosion resistant steel HCR | 50                 |      | 19                        | 37     | 65  | 104 | 166 | 324 | 447 | 560 | 833  | 1123 |
|  |  | 70                 |      | 26                        | 52     | 92  | 146 | 232 | 454 | 626 | 784 | 1167 | 1573 |
|  |  | 80                 |      | 30                        | 60     | 105 | 167 | 266 | 519 | 716 | 896 | 1333 | 1797 |
| <b>Partial factors <sup>1)</sup></b>                                   |  |                    |      |                           |        |     |     |     |     |     |     |      |      |
| Partial factor $\gamma_{Ms,V}$   | Steel zinc plated  | Property class 4.8 | [-]  | 1,25                      |        |     |     |     |     |     |     |      |      |
|  |  | 5.8                |      | 1,25                      |        |     |     |     |     |     |     |      |      |
|  |  | 8.8                |      | 1,25                      |        |     |     |     |     |     |     |      |      |
|  | Stainless steel R and high corrosion resistant steel HCR | 50                 |      | 2,38                      |        |     |     |     |     |     |     |      |      |
|  |  | 70                 |      | 1,25 <sup>2)</sup> / 1,56 |        |     |     |     |     |     |     |      |      |
|  |  | 80                 |      | 1,33                      |        |     |     |     |     |     |     |      |      |

<sup>1)</sup> In absence of other national regulations

<sup>2)</sup> Only admissible for high corrosion resist. steel HCR, with  $f_{yk}/f_{uk} \geq 0,8$  and  $A_5 > 12\%$  (e.g. fischer anchor rods)

<sup>3)</sup> Values in brackets are valid for undersized threaded rods with smaller stress area  $A_s$  for hot dip galvanised standard threaded rods according to EN ISO 10684:2004+AC:2009

fischer injection system FIS EM Plus

**Performances**

Characteristic values for steel failure under tension / shear load of fischer anchor rods and standard threaded rods

**Annex C 1**

Appendix 22/ 39

**Table C2.1:** Characteristic values for **steel failure** under tension / shear load of **fischer internal threaded anchors RG MI**

| fischer internal threaded anchors RG MI   |                 |       |      | M8   | M10  | M12  | M16                                 | M20  |
|---|-----------------|-------|------|------|------|------|-------------------------------------|------|
| <b>Bearing capacity under tension load, steel failure</b>   |                 |       |      |      |      |      |                                     |      |
| Charact. resistance with screw  | Property class  | 5.8   | [kN] | 19   | 29   | 43   | 79                                  | 123  |
|   |                 | 8.8   |      | 29   | 47   | 68   | 108                                 | 179  |
|   |                 | R     |      | 26   | 41   | 59   | 110                                 | 172  |
|   |                 | HCR   |      | 26   | 41   | 59   | 110                                 | 172  |
| <b>Partial factors<sup>1)</sup></b>   |                 |       |      |      |      |      |                                     |      |
| Partial factors   | $\gamma_{Ms,N}$ | 5.8   | [-]  | 1,50 |      |      |                                     |      |
|   |                 | 8.8   |      | 1,50 |      |      |                                     |      |
|   |                 | R     |      | 1,87 |      |      |                                     |      |
|   |                 | HCR   |      | 1,87 |      |      |                                     |      |
| <b>Bearing capacity under shear load, steel failure</b>   |                 |       |      |      |      |      |                                     |      |
| <b>Without lever arm</b>  |                 |       |      |      |      |      |                                     |      |
| Charact. resistance with screw  | Property class  | 5.8   | [kN] | 9,2  | 14,5 | 21,1 | 39,2                                | 62,0 |
|   |                 | 8.8   |      | 14,6 | 23,2 | 33,7 | 54,0                                | 90,0 |
|   |                 | R     |      | 12,8 | 20,3 | 29,5 | 54,8                                | 86,0 |
|   |                 | HCR   |      | 12,8 | 20,3 | 29,5 | 54,8                                | 86,0 |
| Ductility factor  |                 | $k_7$ | [-]  | 1,0  |      |      |                                     |      |
| <b>With lever arm</b>   |                 |       |      |      |      |      |                                     |      |
| Charact. resistance with screw  | Property class  | 5.8   | [Nm] | 20   | 39   | 68   | 173                                 | 337  |
|   |                 | 8.8   |      | 30   | 60   | 105  | 266                                 | 519  |
|   |                 | R     |      | 26   | 52   | 92   | 232                                 | 454  |
|   |                 | HCR   |      | 26   | 52   | 92   | 232                                 | 454  |
| <b>Partial factors<sup>1)</sup></b>   |                 |       |      |      |      |      |                                     |      |
| Partial factors   | $\gamma_{Ms,V}$ | 5.8   | [-]  | 1,25 |      |      |                                     |      |
|   |                 | 8.8   |      | 1,25 |      |      |                                     |      |
|   |                 | R     |      | 1,56 |      |      |                                     |      |
|   |                 | HCR   |      | 1,56 |      |      |                                     |      |
| <sup>1)</sup> In absence of other national regulations  |                 |       |      |      |      |      |                                     |      |
| fischer injection system FIS EM Plus  |                 |       |      |      |      |      | <b>Annex C 2</b><br>Appendix 23/ 39 |      |
| <b>Performances</b><br>Characteristic values for steel failure under tension / shear load of fischer internal threaded anchor RG MI |                 |       |      |      |      |      |                                     |      |



**Table C3.1:** Characteristic values for **steel failure** under tension / shear load of **reinforcing bars**

| Nominal diameter of the bar                               | $\phi$       | 8    | 10                                   | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |  |
|---|--------------|------|--------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| <b>Bearing capacity under tension load, steel failure</b> |              |      |                                      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| Characteristic resistance                                 | $N_{Rk,s}$   | [kN] | $A_s \cdot f_{uk}^{1)}$              |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| <b>Bearing capacity under shear load, steel failure</b>   |              |      |                                      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| <b>Without lever arm</b>                                  |              |      |                                      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| Characteristic resistance                                 | $V^0_{Rk,s}$ | [kN] | $0,5 \cdot A_s \cdot f_{uk}^{1)}$    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| Ductility factor  | $k_7$        | [-]  | 1,0                                  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| <b>With lever arm</b>                                     |              |      |                                      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |
| Characteristic resistance                                 | $M^0_{Rk,s}$ | [Nm] | $1,2 \cdot W_{el} \cdot f_{uk}^{1)}$ |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |

<sup>1)</sup>  $f_{uk}$  or  $f_{yk}$  respectively must be taken from the specifications of the reinforcing bar

**Table C3.2:** Characteristic values for **steel failure** under tension / shear load of **fischer rebar anchors FRA**

| fischer rebar anchor FRA                                  |                 | M12  | M16  | M20 | M24 |     |
|---|-----------------|------|------|-----|-----|-----|
| <b>Bearing capacity under tension load, steel failure</b> |                 |      |      |     |     |     |
| Characteristic resistance                                 | $N_{Rk,s}$      | [kN] | 63   | 111 | 173 | 270 |
| <b>Partial factor<sup>1)</sup></b>                        |                 |      |      |     |     |     |
| Partial factor  | $\gamma_{Ms,N}$ | [-]  | 1,4  |     |     |     |
| <b>Bearing capacity under shear load, steel failure</b>   |                 |      |      |     |     |     |
| <b>Without lever arm</b>                                  |                 |      |      |     |     |     |
| Characteristic resistance                                 | $V^0_{Rk,s}$    | [kN] | 30   | 55  | 86  | 124 |
| Ductility factor  | $k_7$           | [-]  | 1,0  |     |     |     |
| <b>With lever arm</b>                                     |                 |      |      |     |     |     |
| Characteristic resistance                                 | $M^0_{Rk,s}$    | [Nm] | 92   | 233 | 454 | 785 |
| <b>Partial factor<sup>1)</sup></b>                        |                 |      |      |     |     |     |
| Partial factor  | $\gamma_{Ms,V}$ | [-]  | 1,56 |     |     |     |

<sup>1)</sup> In absence of other national regulations

|   |                                     |
|---|-------------------------------------|
| fischer injection system FIS EM Plus  | <b>Annex C 3</b><br>Appendix 24/ 39 |
| <b>Performances</b><br>Characteristic values for steel failure under tension / shear load of reinforcing bars and fischer rebar anchors FRA |                                     |

| <b>Table C4.1: Characteristic values for concrete failure under tension / shear load</b>     |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|--|--------------------------|-----------------|---------------|--|----------------------|-----|-----|-----|-----|-----|-----|-------------------------------------|-----|----|----|----|----|----|----|----|----|
| <b>Size</b>  |                          |                 |               | <b>All sizes</b>   |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Tension load</b>  |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Installation factor  |                          | $\gamma_{inst}$ | [-]           | See annex C 5 to C 12 and C 17 to C 18   |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Factors for the compressive strength of concrete &gt; C20/25</b>                          |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Increasing factor for $\tau_{RK}$  | C25/30                   |                 | $\Psi_c$      | [-]  | 1,02                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | C30/37                   |                 |               |  | 1,04                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | C35/45                   |                 |               |  | 1,06                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | C40/50                   |                 |               |  | 1,07                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | C45/55                   |                 |               |  | 1,08                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | C50/60                   |                 |               |  | 1,09                 |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Splitting failure</b>   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Edge distance  | $h / h_{ef} \geq 2,0$    |                 | $C_{cr,sp}$   | [mm]   | 1,0 $h_{ef}$         |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | $2,0 > h / h_{ef} > 1,3$ |                 |               |  | 4,6 $h_{ef} - 1,8 h$ |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
|  | $h / h_{ef} \leq 1,3$    |                 |               |  | 2,26 $h_{ef}$        |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Spacing  |                          | $S_{cr,sp}$     | 2 $C_{cr,sp}$ |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Concrete cone failure</b>   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Uncracked concrete   |                          | $k_{ucr,N}$     | [-]           | 11,0   |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Cracked concrete   |                          | $k_{cr,N}$      |               | 7,7  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Edge distance  |                          | $C_{cr,N}$      | [mm]          | 1,5 $h_{ef}$   |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Spacing  |                          | $S_{cr,N}$      |               | 2 $C_{cr,N}$   |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Factors for sustained tension load</b>  |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Factor   |                          | $\Psi_{sus}^0$  | [-]           | -1)  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Shear load</b>  |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Installation factor  |                          | $\gamma_{inst}$ | [-]           | 1,0  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Concrete pry-out failure</b>  |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Factor for pry-out failure   |                          | $k_8$           | [-]           | 2,0  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Concrete edge failure</b>   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Effective length of fastener in shear loading  |                          | $l_f$           | [mm]          | for $d_{nom} \leq 24$ mm: min ( $h_{ef}$ , 12 $d_{nom}$ )<br>for $d_{nom} > 24$ mm: min ( $h_{ef}$ , 8 $d_{nom}$ ; 300 mm) |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| <b>Calculation diameters</b>   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| Size   |                          |                 | M8            | M10  | M12                  | M14 | M16 | M20 | M22 | M24 | M27 | M30                                 |     |    |    |    |    |    |    |    |    |
| fischer anchor rods and standard threaded rods   |                          | $d_{nom}$       | [mm]          | 8  | 10                   | 12  | 14  | 16  | 20  | 22  | 24  | 27                                  | 30  |    |    |    |    |    |    |    |    |
| fischer internal threaded anchors RG MI  |                          | $d_{nom}$       |               | 12   | 16                   | 18  | -2) | 22  | 28  | -2) | -2) | -2)                                 | -2) |    |    |    |    |    |    |    |    |
| fischer rebar anchor FRA   |                          | $d_{nom}$       |               | -2)  | -2)                  | 12  | -2) | 16  | 20  | -2) | 25  | -2)                                 | -2) |    |    |    |    |    |    |    |    |
| Size (nominal diameter of the bar)   |                          |                 | $\phi$        | 8  | 10                   | 12  | 14  | 16  | 18  | 20  | 22  | 24                                  | 25  | 26 | 28 | 30 | 32 | 34 | 36 | 40 |    |
| Reinforcing bar  |                          |                 | $d_{nom}$     | [mm]   | 8                    | 10  | 12  | 14  | 16  | 18  | 20  | 22                                  | 24  | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
| 1) No performance assessed   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| 2) Anchor type not part of the ETA   |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |
| fischer injection system FIS EM Plus   |                          |                 |               |  |                      |     |     |     |     |     |     | <b>Annex C 4</b><br>Appendix 25/ 39 |     |    |    |    |    |    |    |    |    |
| <b>Performances</b><br>Characteristic values for concrete failure under tension / shear load |                          |                 |               |  |                      |     |     |     |     |     |     |                                     |     |    |    |    |    |    |    |    |    |

**Table C5.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| Anchor rod / standard threaded rod   |                   | M8   | M10                                  | M12 | M14 | M16 | M20 | M22 | M24 | M27                                 | M30 |     |     |
|--|-------------------|------|--------------------------------------|-----|-----|-----|-----|-----|-----|-------------------------------------|-----|-----|-----|
| <b>Combined pullout and concrete cone failure</b>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Calculation diameter   | d                 | [mm] | 8                                    | 10  | 12  | 14  | 16  | 20  | 22  | 24                                  | 27  | 30  |     |
| <b>Uncracked concrete</b>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ] | 18  | 18  | 18  | 17  | 17  | 16  | 15                                  | 15  | 15  | 14  |
|  | II: 50 °C / 72 °C |      |                                      | 18  | 17  | 17  | 16  | 16  | 15  | 14                                  | 14  | 14  | 14  |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ] | 16  | 16  | 15  | 13  | 13  | 11  | 11                                  | 10  | 10  | 9   |
|  | II: 50 °C / 72 °C |      |                                      | 15  | 14  | 14  | 13  | 12  | 11  | 10                                  | 10  | 9   | 9   |
| <u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ] | 16  | 15  | 13  | 12  | 12  | 10  | 10                                  | 10  | 9   | 9   |
|  | II: 50 °C / 72 °C |      |                                      | 15  | 14  | 12  | 11  | 11  | 10  | 9                                   | 9   | 8   | 8   |
| <b>Installation factors</b>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]  | 1,0                                  |     |     |     |     |     |     |                                     |     |     |     |
| Water filled hole  |                   |      | 1,4                                  |     |     |     |     |     |     |                                     |     |     |     |
| <b>Cracked concrete</b>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]  | 7,5 | 7,5 | 9   | 8,5 | 8,5 | 8,5 | 8,5                                 | 8,5 | 8,5 | 8,5 |
|  | II: 50 °C / 72 °C |      |                                      | 7,5 | 7,5 | 9   | 8,5 | 8,5 | 8,5 | 8,5                                 | 8,5 | 8,5 | 8,5 |
| <u>Diamond - drilling (dry or wet concrete)</u>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]  | 7   | 7   | 7   | 7   | 6   | 6   | 7                                   | 7   | 7   | 7   |
|  | II: 50 °C / 72 °C |      |                                      | 7   | 7   | 7   | 7   | 6   | 6   | 7                                   | 7   | 7   | 7   |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  |      | $\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]  | 6   | 7,5 | 7,5 | 7   | 6   | 6   | 6                                   | 6   | 6   | 6   |
|  | II: 50 °C / 72 °C |      |                                      | 6   | 7   | 7   | 7   | 6   | 6   | 6                                   | 6   | 6   | 6   |
| <b>Installation factors</b>  |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]  | 1,0                                  |     |     |     |     |     |     |                                     |     |     |     |
| Water filled hole  |                   |      | 1,2                                  |     |     |     | 1,4 |     |     |                                     |     |     |     |
| fischer injection system FIS EM Plus   |                   |      |                                      |     |     |     |     |     |     |                                     |     |     |     |
| <b>Performances</b><br>Characteristic values for combined pull-out and concrete failure for fischer anchor rod and standard threaded rods; working life 50 years |                   |      |                                      |     |     |     |     |     |     | <b>Annex C 5</b><br>Appendix 26/ 39 |     |     |     |

**Table C6.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| Anchor rod / standard threaded rod  |                   | M8                    | M10                  | M12  | M14  | M16  | M20  | M22  | M24  | M27  | M30  |      |      |
|---|-------------------|-----------------------|----------------------|------|------|------|------|------|------|------|------|------|------|
| <b>Combined pullout and concrete cone failure</b>                                 |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Calculation diameter  | d                 | [mm]                  | 8                    | 10   | 12   | 14   | 16   | 20   | 22   | 24   | 27   | 30   |      |
| <b>Uncracked concrete</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>                |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 18   | 18   | 18   | 17   | 17   | 16   | 15   | 15   | 15   | 14   |
|   | II: 50 °C / 72 °C |                       |                      | 18   | 17   | 17   | 16   | 16   | 15   | 14   | 14   | 14   | 14   |
| Diamond-drilling (dry or wet concrete)  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 16   | 15   | 13   | 12   | 12   | 10   | 10   | 10   | 9    | 9    |
|   | II: 50 °C / 72 °C |                       |                      | 15   | 14   | 12   | 11   | 11   | 10   | 9    | 9    | 8    | 8    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Dry or wet concrete   | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |      |      |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
|   | II: 50 °C / 72 °C |                       |                      | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| <b>Cracked concrete</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>                  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 7,5  | 7,5  | 9    | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  |
|   | II: 50 °C / 72 °C |                       |                      | 7,5  | 7,5  | 9    | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  | 8,5  |
| Diamond - drilling (dry or wet concrete)  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 7    | 7    | 7    | 7    | 6    | 6    | 7    | 7    | 7    | 7    |
|   | II: 50 °C / 72 °C |                       |                      | 7    | 7    | 7    | 7    | 6    | 6    | 7    | 7    | 7    | 7    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |
| Dry or wet concrete   | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |      |      |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
|   | II: 50 °C / 72 °C |                       |                      | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |

1) **Calculation of characteristic bond resistance in uncracked concrete  $\tau_{Rk,100, ucr}$ :**

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) **Calculation of characteristic bond resistance in cracked concrete  $\tau_{Rk,100, cr}$ :**

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

**Performances**

Characteristic values for combined pull-out and concrete failure for fischer anchor rod and standard threaded rods; working life 100 years

**Annex C 6**

Appendix 27/ 39

**Table C7.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer internal threaded anchors RG MI** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| Internal threaded anchor RG MI   |                   |                 | M8                   | M10 | M12 | M16 | M20                                 |    |
|--|-------------------|-----------------|----------------------|-----|-----|-----|-------------------------------------|----|
| <b>Combined pullout and concrete cone failure</b>  |                   |                 |                      |     |     |     |                                     |    |
| Calculation diameter   | d                 | [mm]            | 12                   | 16  | 18  | 22  | 28                                  |    |
| <b>Uncracked concrete</b>  |                   |                 |                      |     |     |     |                                     |    |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>   |                   |                 |                      |     |     |     |                                     |    |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>   |                   |                 |                      |     |     |     |                                     |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 15  | 14  | 14  | 13                                  | 12 |
|  | II: 50 °C / 72 °C |                 |                      | 14  | 13  | 13  | 12                                  | 11 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>   |                   |                 |                      |     |     |     |                                     |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 14  | 12  | 12  | 11                                  | 10 |
|  | II: 50 °C / 72 °C |                 |                      | 13  | 12  | 11  | 10                                  | 9  |
| <u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>   |                   |                 |                      |     |     |     |                                     |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 13  | 12  | 11  | 10                                  | 9  |
|  | II: 50 °C / 72 °C |                 |                      | 12  | 11  | 10  | 9                                   | 8  |
| <b>Installation factors</b>  |                   |                 |                      |     |     |     |                                     |    |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]             | 1,0                  |     |     |     |                                     |    |
| Water filled hole  |                   |                 | 1,4                  |     |     |     |                                     |    |
| <b>Cracked concrete</b>  |                   |                 |                      |     |     |     |                                     |    |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>   |                   |                 |                      |     |     |     |                                     |    |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u>  |                   |                 |                      |     |     |     |                                     |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$  | [N/mm <sup>2</sup> ] | 7   | 6   | 6   | 7                                   | 7  |
|  | II: 50 °C / 72 °C |                 |                      | 7   | 6   | 6   | 7                                   | 7  |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u>  |                   |                 |                      |     |     |     |                                     |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$  | [N/mm <sup>2</sup> ] | 7   | 6,5 | 6   | 6                                   | 6  |
|  | II: 50 °C / 72 °C |                 |                      | 7   | 6   | 6   | 6                                   | 6  |
| <b>Installation factors</b>  |                   |                 |                      |     |     |     |                                     |    |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]             | 1,0                  |     |     |     |                                     |    |
| Water filled hole  |                   |                 | 1,2                  |     |     | 1,4 |                                     |    |
| fischer injection system FIS EM Plus   |                   |                 |                      |     |     |     |                                     |    |
| <b>Performances</b><br>Characteristic values for combined pull-out and concrete failure for fischer internal threaded anchors RG MI; working life 50 years |                   |                 |                      |     |     |     | <b>Annex C 7</b><br>Appendix 28/ 39 |    |

**Table C8.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer internal threaded anchors RG MI** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| Internal threaded anchor RG MI   |                   |                       | M8                   | M10  | M12  | M16  | M20  |      |
|--|-------------------|-----------------------|----------------------|------|------|------|------|------|
| <b>Combined pullout and concrete cone failure</b>  |                   |                       |                      |      |      |      |      |      |
| Calculation diameter   | d                 | [mm]                  | 12                   | 16   | 18   | 22   | 28   |      |
| <b>Uncracked concrete</b>  |                   |                       |                      |      |      |      |      |      |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>                                     |                   |                       |                      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)                      |                   |                       |                      |      |      |      |      |      |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 15   | 14   | 14   | 13   | 12   |
|  | II: 50 °C / 72 °C |                       |                      | 14   | 13   | 13   | 12   | 11   |
| Diamond-drilling (dry or wet concrete)   |                   |                       |                      |      |      |      |      |      |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 13   | 12   | 11   | 10   | 9    |
|  | II: 50 °C / 72 °C |                       |                      | 12   | 11   | 10   | 9    | 8    |
| <b>Installation factors</b>  |                   |                       |                      |      |      |      |      |      |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |      |
| Working life 100 years   | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
|  | II: 50 °C / 72 °C |                       |                      | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 |
| <b>Cracked concrete</b>  |                   |                       |                      |      |      |      |      |      |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>                                       |                   |                       |                      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete) |                   |                       |                      |      |      |      |      |      |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 7    | 6    | 6    | 7    | 7    |
|  | II: 50 °C / 72 °C |                       |                      | 7    | 6    | 6    | 7    | 7    |
| <b>Installation factors</b>  |                   |                       |                      |      |      |      |      |      |
| Dry or wet concrete  | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |      |
| Working life 100 years   | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 |
|  | II: 50 °C / 72 °C |                       |                      | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 |

1) Calculation of characteristic bond resistance in uncracked concrete  $\tau_{Rk,100, ucr}$  :

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) Calculation of characteristic bond resistance in cracked concrete  $\tau_{Rk,100, cr}$  :

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

**Performances**

Characteristic values for combined pull-out and concrete failure for fischer internal threaded anchors RG MI; working life 100 years

**Table C9.1:** Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| Nominal diameter of the bar $\phi$   |                   | 8  | 10                   | 12  | 14  | 16  | 18  | 20  | 22 | 24 | 25 | 26  | 28 | 30 | 32 | 34 | 36 | 40                                  |    |     |
|--|-------------------|--|----------------------|-----|-----|-----|-----|-----|----|----|----|-----|----|----|----|----|----|-------------------------------------|----|-----|
| <b>Combined pullout and concrete cone failure</b>  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Calculation diameter d   |                   | [mm]   | 8                    | 10  | 12  | 14  | 16  | 18  | 20 | 22 | 24 | 25  | 26 | 28 | 30 | 32 | 34 | 36                                  | 40 |     |
| <b>Uncracked concrete</b>  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>                                   |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)                    |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$  | [N/mm <sup>2</sup> ] | 16  | 15  | 15  | 14  | 14  | 13 | 13 | 13 | 12  | 12 | 12 | 12 | 12 | 11 | 11                                  | 11 |     |
|  | II: 50 °C / 72 °C |  |                      | 15  | 14  | 14  | 13  | 13  | 12 | 12 | 12 | 12  | 11 | 11 | 11 | 11 | 11 | 11                                  | 11 | 10  |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)                      |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$  | [N/mm <sup>2</sup> ] | 16  | 16  | 14  | 13  | 12  | 12 | 11 | 11 | 10  | 10 | 10 | 10 | 9  | 9  | 9                                   | 8  | 8   |
|  | II: 50 °C / 72 °C |  |                      | 15  | 14  | 13  | 12  | 12  | 11 | 11 | 10 | 10  | 9  | 9  | 9  | 9  | 9  | 8                                   | 8  | 8   |
| Diamond-drilling (dry or wet concrete as well as water filled hole)                                  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$  | [N/mm <sup>2</sup> ] | 16  | 15  | 13  | 12  | 12  | 11 | 10 | 10 | 10  | 9  | 9  | 9  | 9  | 8  | 8                                   | 8  | 7   |
|  | II: 50 °C / 72 °C |  |                      | 15  | 14  | 12  | 11  | 11  | 10 | 10 | 9  | 9   | 9  | 8  | 8  | 8  | 8  | 8                                   | 7  | 7   |
| <b>Installation factors</b>  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Dry or wet concrete  |                   | $\gamma_{inst}$  | [-]                  |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    | 1,0 |
| Water filled hole  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    | 1,4 |
| <b>Cracked concrete</b>  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>                                     |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)                    |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$   | [N/mm <sup>2</sup> ] | 7   | 7   | 8   | 8   | 8   | 8  | 8  | 8  | 8   | 8  | 8  | 8  | 8  | 8  | 8                                   | 8  |     |
|  | II: 50 °C / 72 °C |  |                      | 7   | 7   | 8   | 8   | 8   | 8  | 8  | 8  | 8   | 8  | 8  | 8  | 8  | 8  | 8                                   | 8  | 8   |
| Diamond-drilling (dry or wet concrete)   |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$   | [N/mm <sup>2</sup> ] | 7   | 7   | 7   | 7   | 6   | 6  | 6  | 7  | 7   | 7  | 7  | 7  | 5  | 5  | 5                                   | 5  |     |
|  | II: 50 °C / 72 °C |  |                      | 7   | 7   | 7   | 7   | 6   | 6  | 6  | 7  | 7   | 7  | 7  | 7  | 7  | 5  | 5                                   | 5  | 5   |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole) |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$   | [N/mm <sup>2</sup> ] | 6   | 7,5 | 6,5 | 6,5 | 6,5 | 6  | 6  | 6  | 6   | 6  | 6  | 6  | 6  | 5  | 5                                   | 5  |     |
|  | II: 50 °C / 72 °C |  |                      | 6   | 6,5 | 6,5 | 6   | 6   | 6  | 6  | 6  | 6   | 6  | 6  | 6  | 6  | 6  | 5                                   | 5  | 5   |
| <b>Installation factors</b>  |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |
| Dry or wet concrete  |                   | $\gamma_{inst}$  | [-]                  |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    | 1,0 |
| Water filled hole  |                   |  |                      | 1,2 |     |     |     |     |    |    |    | 1,4 |    |    |    |    |    |                                     |    |     |
| fischer injection system FIS EM Plus   |                   |  |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    | <b>Annex C 9</b><br>Appendix 30/ 39 |    |     |
| <b>Performances</b>  |                   | Characteristic values for combined pull-out and concrete failure for reinforcing bars; working life 50 years |                      |     |     |     |     |     |    |    |    |     |    |    |    |    |    |                                     |    |     |

**Table C10.1:** Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| Nominal diameter of the bar $\phi$  |                   | 8                     | 10                   | 12   | 14   | 16   | 18   | 20   | 22   | 24   | 25   | 26   | 28   | 30   | 32   | 34   | 36   | 40   |      |
|---|-------------------|-----------------------|----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>Combined pullout and concrete cone failure</b>                                 |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Calculation diameter d  |                   | [mm]                  | 8                    | 10   | 12   | 14   | 16   | 18   | 20   | 22   | 24   | 25   | 26   | 28   | 30   | 32   | 34   | 36   | 40   |
| <b>Uncracked concrete</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>                |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 16   | 15   | 15   | 14   | 14   | 13   | 13   | 13   | 12   | 12   | 12   | 12   | 12   | 11   | 11   | 11   |
|   | II: 50 °C / 72 °C |                       |                      | 15   | 14   | 14   | 13   | 13   | 12   | 12   | 12   | 12   | 11   | 11   | 11   | 11   | 11   | 11   | 10   |
| Diamond-drilling (dry or wet concrete)  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 16   | 15   | 13   | 12   | 12   | 11   | 10   | 10   | 10   | 9    | 9    | 9    | 8    | 8    | 8    | 7    |
|   | II: 50 °C / 72 °C |                       |                      | 15   | 14   | 12   | 11   | 11   | 10   | 10   | 9    | 9    | 9    | 8    | 8    | 8    | 8    | 7    | 7    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Dry or wet concrete   |                   | $\gamma_{inst}$       | [-]                  | 1,0  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
|   | II: 50 °C / 72 °C |                       |                      | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| <b>Cracked concrete</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>                  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 7    | 7    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    |
|   | II: 50 °C / 72 °C |                       |                      | 7    | 7    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    | 8    |
| Diamond-drilling (dry or wet concrete)  |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 7    | 7    | 7    | 7    | 6    | 6    | 6    | 7    | 7    | 7    | 7    | 7    | 5    | 5    | 5    | 5    |
|   | II: 50 °C / 72 °C |                       |                      | 7    | 7    | 7    | 7    | 6    | 6    | 6    | 7    | 7    | 7    | 7    | 7    | 7    | 5    | 5    | 5    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Dry or wet concrete   |                   | $\gamma_{inst}$       | [-]                  | 1,0  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
|   | II: 50 °C / 72 °C |                       |                      | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |

1) Calculation of characteristic bond resistance in uncracked concrete  $\tau_{Rk,100, ucr}$ :

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) Calculation of characteristic bond resistance in cracked concrete  $\tau_{Rk,100, cr}$ :

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

**Performances**

Characteristic values for combined pull-out and concrete failure for reinforcing bars; working life 100 years

**Annex C 10**

Appendix 31/ 39



**Table C11.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer rebar anchors FRA** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| fischer rebar anchor FRA   |                   |                 | M12                  | M16 | M20 | M24                                  |    |
|--|-------------------|-----------------|----------------------|-----|-----|--------------------------------------|----|
| <b>Combined pullout and concrete cone failure</b>  |                   |                 |                      |     |     |                                      |    |
| Calculation diameter   | d                 | [mm]            | 12                   | 16  | 20  | 25                                   |    |
| <b>Uncracked concrete</b>  |                   |                 |                      |     |     |                                      |    |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>   |                   |                 |                      |     |     |                                      |    |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>   |                   |                 |                      |     |     |                                      |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 15  | 14  | 13                                   | 12 |
|  | II: 50 °C / 72 °C |                 |                      | 14  | 13  | 12                                   | 12 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>   |                   |                 |                      |     |     |                                      |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 14  | 12  | 11                                   | 10 |
|  | II: 50 °C / 72 °C |                 |                      | 13  | 12  | 11                                   | 9  |
| <u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>   |                   |                 |                      |     |     |                                      |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$ | [N/mm <sup>2</sup> ] | 13  | 12  | 10                                   | 9  |
|  | II: 50 °C / 72 °C |                 |                      | 12  | 11  | 10                                   | 9  |
| <b>Installation factors</b>  |                   |                 |                      |     |     |                                      |    |
| Dry or wet concrete  |                   | $\gamma_{inst}$ | [-]                  | 1,0 |     |                                      |    |
| Water filled hole  |                   |                 |                      | 1,4 |     |                                      |    |
| <b>Cracked concrete</b>  |                   |                 |                      |     |     |                                      |    |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>   |                   |                 |                      |     |     |                                      |    |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u>                                |                   |                 |                      |     |     |                                      |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$  | [N/mm <sup>2</sup> ] | 8   | 8   | 8                                    | 8  |
|  | II: 50 °C / 72 °C |                 |                      | 8   | 8   | 8                                    | 8  |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u>                                  |                   |                 |                      |     |     |                                      |    |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$  | [N/mm <sup>2</sup> ] | 7   | 6   | 6                                    | 6  |
|  | II: 50 °C / 72 °C |                 |                      | 7   | 6   | 6                                    | 6  |
| <b>Installation factors</b>  |                   |                 |                      |     |     |                                      |    |
| Dry or wet concrete  |                   | $\gamma_{inst}$ | [-]                  | 1,0 |     |                                      |    |
| Water filled hole  |                   |                 |                      | 1,2 |     | 1,4                                  |    |
| fischer injection system FIS EM Plus   |                   |                 |                      |     |     |                                      |    |
| <b>Performances</b><br>Characteristic values for combined pull-out and concrete failure for fischer rebar anchors FRA; working life 50 years |                   |                 |                      |     |     | <b>Annex C 11</b><br>Appendix 32/ 39 |    |

**Table C12.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer rebar anchors FRA** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| fischer rebar anchor FRA  |                   |                       | M12                  | M16  | M20  | M24  |      |
|---|-------------------|-----------------------|----------------------|------|------|------|------|
| <b>Combined pullout and concrete cone failure</b>   |                   |                       |                      |      |      |      |      |
| Calculation diameter  | d                 | [mm]                  | 12                   | 16   | 20   | 25   |      |
| <b>Uncracked concrete</b>   |                   |                       |                      |      |      |      |      |
| <b>Characteristic bond resistance in uncracked concrete C20/25</b>  |                   |                       |                      |      |      |      |      |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>                      |                   |                       |                      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 15   | 14   | 13   | 12   |
|   | II: 50 °C / 72 °C |                       |                      | 14   | 13   | 12   | 12   |
| <u>Diamond-drilling (dry or wet concrete)</u>   |                   |                       |                      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,ucr}$       | [N/mm <sup>2</sup> ] | 13   | 12   | 10   | 9    |
|   | II: 50 °C / 72 °C |                       |                      | 12   | 11   | 10   | 9    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |
| Dry or wet concrete   | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [N/mm <sup>2</sup> ] | 0,75 | 0,75 | 0,75 | 0,75 |
|   | II: 50 °C / 72 °C |                       |                      | 0,60 | 0,65 | 0,65 | 0,65 |
| <b>Cracked concrete</b>   |                   |                       |                      |      |      |      |      |
| <b>Characteristic bond resistance in cracked concrete C20/25</b>  |                   |                       |                      |      |      |      |      |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u> |                   |                       |                      |      |      |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,cr}$        | [N/mm <sup>2</sup> ] | 8    | 8    | 8    | 8    |
|   | II: 50 °C / 72 °C |                       |                      | 8    | 8    | 8    | 8    |
| <b>Installation factors</b>   |                   |                       |                      |      |      |      |      |
| Dry or wet concrete   | $\gamma_{inst}$   | [-]                   | 1,0                  |      |      |      |      |
| Working life 100 years  | I: 35 °C / 60 °C  | $\alpha_{100\ years}$ | [-]                  | 0,80 | 0,65 | 0,65 | 0,65 |
|   | II: 50 °C / 72 °C |                       |                      | 0,80 | 0,65 | 0,65 | 0,65 |

1) **Calculation of characteristic bond resistance in uncracked concrete  $\tau_{Rk,100, ucr}$ :**

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) **Calculation of characteristic bond resistance in cracked concrete  $\tau_{Rk,100, cr}$ :**

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

**Performances**

Characteristic values for pull-out and concrete failure for fischer rebar anchors FRA; working life 100 years

**Annex C 12**

Appendix 33/ 39

| <b>Table C13.1: Displacements for anchor rods</b>  |                           |      |      |      |      |  |      |      |      |      |      |
|--|---------------------------|------|------|------|------|--|------|------|------|------|------|
| Anchor rod   |                           | M8   | M10  | M12  | M14  | M16  | M20  | M22  | M24  | M27  | M30  |
| <b>Displacement-Factors for tension load<sup>1)</sup></b>  |                           |      |      |      |      |  |      |      |      |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |      |      |  |      |      |      |      |      |
| $\delta_{N0}$ -Factor  | [mm/(N/mm <sup>2</sup> )] | 0,07 | 0,08 | 0,09 | 0,09 | 0,10   | 0,11 | 0,11 | 0,12 | 0,12 | 0,13 |
| $\delta_{N\infty}$ -Factor   |                           | 0,11 | 0,12 | 0,13 | 0,14 | 0,15   | 0,16 | 0,17 | 0,18 | 0,19 | 0,19 |
| <b>Displacement-Factors for shear load<sup>2)</sup></b>  |                           |      |      |      |      |  |      |      |      |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |      |      |  |      |      |      |      |      |
| $\delta_{V0}$ -Factor  | [mm/kN]                   | 0,18 | 0,15 | 0,12 | 0,10 | 0,09   | 0,07 | 0,07 | 0,06 | 0,05 | 0,05 |
| $\delta_{V\infty}$ -Factor   |                           | 0,27 | 0,22 | 0,18 | 0,16 | 0,14   | 0,11 | 0,10 | 0,09 | 0,08 | 0,07 |
| 1) Calculation of effective displacement:<br>$\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$<br>$\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$<br>( $\tau_{Ed}$ : Design value of the applied tensile stress) |                           |      |      |      |      | 2) Calculation of effective displacement:<br>$\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$<br>$\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$<br>( $V_{Ed}$ : Design value of the applied shear force) |      |      |      |      |      |

**Table C13.2: Displacements for fischer internal threaded anchors RG MI**

| Internal threaded anchor RG MI   |                           | M8   | M10  | M12  | M16  | M20  |
|--|---------------------------|------|------|--|------|------|
| <b>Displacement-Factors for tension load<sup>1)</sup></b>  |                           |      |      |  |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |  |      |      |
| $\delta_{N0}$ -Factor  | [mm/(N/mm <sup>2</sup> )] | 0,09 | 0,10 | 0,10   | 0,11 | 0,13 |
| $\delta_{N\infty}$ -Factor   |                           | 0,13 | 0,15 | 0,16   | 0,17 | 0,19 |
| <b>Displacement-Factors for shear load<sup>2)</sup></b>  |                           |      |      |  |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |  |      |      |
| $\delta_{V0}$ -Factor  | [mm/kN]                   | 0,12 | 0,09 | 0,08   | 0,07 | 0,05 |
| $\delta_{V\infty}$ -Factor   |                           | 0,18 | 0,14 | 0,12   | 0,10 | 0,08 |
| 1) Calculation of effective displacement:<br>$\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$<br>$\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$<br>( $\tau_{Ed}$ : Design value of the applied tensile stress) |                           |      |      | 2) Calculation of effective displacement:<br>$\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$<br>$\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$<br>( $V_{Ed}$ : Design value of the applied shear force) |      |      |

|  |  |                                      |
|--|--|--------------------------------------|
| fischer injection system FIS EM Plus   |  | <b>Annex C 13</b><br>Appendix 34/ 39 |
| <b>Performances</b><br>Displacements for anchor rods and fischer internal threaded anchors RG MI |  |                                      |

**Table C14.1: Displacements for reinforcing bars**

| Nominal diameter of the bar $\phi$   |                           | 8    | 10   | 12   | 14   | 16   | 18   | 20   | 22   | 24   | 25   | 26   | 28   | 30   | 32   | 34   | 36   | 40   |
|--|---------------------------|------|------|------|------|------|------|------|--|------|------|------|------|------|------|------|------|------|
| <b>Displacement-Factors for tension load<sup>1)</sup></b>  |                           |      |      |      |      |      |      |      |  |      |      |      |      |      |      |      |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |      |      |      |      |      |  |      |      |      |      |      |      |      |      |      |
| $\delta_{N0}$ -Factor  | [mm/(N/mm <sup>2</sup> )] | 0,07 | 0,08 | 0,09 | 0,09 | 0,10 | 0,10 | 0,11 | 0,11   | 0,12 | 0,12 | 0,12 | 0,13 | 0,13 | 0,13 | 0,14 | 0,14 | 0,15 |
| $\delta_{N\infty}$ -Factor   |                           | 0,11 | 0,12 | 0,13 | 0,14 | 0,15 | 0,16 | 0,16 | 0,17   | 0,18 | 0,18 | 0,18 | 0,19 | 0,19 | 0,20 | 0,20 | 0,21 | 0,22 |
| <b>Displacement-Factors for shear load<sup>2)</sup></b>  |                           |      |      |      |      |      |      |      |  |      |      |      |      |      |      |      |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |                           |      |      |      |      |      |      |      |  |      |      |      |      |      |      |      |      |      |
| $\delta_{V0}$ -Factor  | [mm/kN]                   | 0,18 | 0,15 | 0,12 | 0,10 | 0,09 | 0,08 | 0,07 | 0,07   | 0,06 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 |
| $\delta_{V\infty}$ -Factor   |                           | 0,27 | 0,22 | 0,18 | 0,16 | 0,14 | 0,12 | 0,11 | 0,10   | 0,09 | 0,09 | 0,08 | 0,08 | 0,07 | 0,07 | 0,06 | 0,06 | 0,05 |
| 1) Calculation of effective displacement:<br>$\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$<br>$\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$<br>( $\tau_{Ed}$ : Design value of the applied tensile stress) |                           |      |      |      |      |      |      |      | 2) Calculation of effective displacement:<br>$\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$<br>$\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$<br>( $V_{Ed}$ : Design value of the applied shear force) |      |      |      |      |      |      |      |      |      |

**Table C14.2: Displacements for fischer rebar anchors FRA**

| fischer rebar anchor FRA   | M12  | M16  | M20  | M24  |
|--|------|--|------|------|
| <b>Displacement-Factors for tension load<sup>1)</sup></b>  |      |  |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |      |  |      |      |
| $\delta_{N0}$ -Factor  | 0,09 |  | 0,10 | 0,12 |
| $\delta_{N\infty}$ -Factor   | 0,13 |  | 0,15 | 0,18 |
| <b>Displacement-Factors for shear load<sup>2)</sup></b>  |      |  |      |      |
| <b>Uncracked or cracked concrete; Temperature range I, II</b>  |      |  |      |      |
| $\delta_{V0}$ -Factor  | 0,12 |  | 0,09 | 0,06 |
| $\delta_{V\infty}$ -Factor   | 0,18 |  | 0,14 | 0,09 |
| 1) Calculation of effective displacement:<br>$\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$<br>$\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$<br>( $\tau_{Ed}$ : Design value of the applied tensile stress) |      | 2) Calculation of effective displacement:<br>$\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$<br>$\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$<br>( $V_{Ed}$ : Design value of the applied shear force) |      |      |

**Table C15.1: Characteristic values for steel failure under tension / shear load of fischer anchor rods and standard threaded rods under seismic action performance category C1 or C2**

| Anchor rod / standard threaded rod  |   | M10               | M12            | M14                     | M16             | M20             | M22             | M24             | M27             | M30             |                 |                 |                 |                 |
|---|---|-------------------|----------------|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Bearing capacity under tension load, steel failure<sup>1)</sup></b>                      |   |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| <b>fischer anchor rods and standard threaded rods, performance category C1<sup>2)</sup></b> |   |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| Characteristic resistance $N_{Rk,s,C1}$   | Steel zinc plated   | Property class    | 5.8            | [kN]                    | 29(27)          | 43              | 58              | 79              | 123             | 152             | 177             | 230             | 281             |                 |
|   |   |                   | 8.8            |                         | 47(43)          | 68              | 92              | 126             | 196             | 243             | 282             | 368             | 449             |                 |
|   | Stainless steel R and high corrosion resistant steel HCR                                    |                   | 50             |                         | 29              | 43              | 58              | 79              | 123             | 152             | 177             | 230             | 281             |                 |
|   |   |                   | 70             |                         | 41              | 59              | 81              | 110             | 172             | 212             | 247             | 322             | 393             |                 |
|   |   | 80                |                | 47                      | 68              | 92              | 126             | 196             | 243             | 282             | 368             | 449             |                 |                 |
|   | <b>fischer anchor rods and standard threaded rods, performance category C2<sup>2)</sup></b> |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
|   | Characteristic resistance $N_{Rk,s,C2}$   | Steel zinc plated | Property class | 5.8                     | [-]             | - <sup>4)</sup> | 39              | - <sup>4)</sup> | 72              | 108             | - <sup>4)</sup> | 177             | - <sup>4)</sup> | - <sup>4)</sup> |
|   |   |                   |                | 8.8                     |                 | - <sup>4)</sup> | 61              | - <sup>4)</sup> | 116             | 173             | - <sup>4)</sup> | 282             | - <sup>4)</sup> | - <sup>4)</sup> |
| Stainless steel R and high corrosion resistant steel HCR                                    |   | 50                |                |                         | - <sup>4)</sup> | 39              | - <sup>4)</sup> | 72              | 108             | - <sup>4)</sup> | 177             | - <sup>4)</sup> | - <sup>4)</sup> |                 |
|   |   | 70                |                |                         | - <sup>4)</sup> | 53              | - <sup>4)</sup> | 101             | 152             | - <sup>4)</sup> | 247             | - <sup>4)</sup> | - <sup>4)</sup> |                 |
|   |   | 80                |                | - <sup>4)</sup>         | 61              | - <sup>4)</sup> | 116             | 173             | - <sup>4)</sup> | 282             | - <sup>4)</sup> | - <sup>4)</sup> |                 |                 |
| <b>Bearing capacity under shear load, steel failure without lever arm<sup>1)</sup></b>      |   |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| <b>fischer anchor rods, performance category C1<sup>2)</sup></b>                            |   |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| Characteristic resistance $V_{Rk,s,C1}$   |   | Steel zinc plated | Property class | 5.8                     | [kN]            | 17(16)          | 25              | 34              | 47              | 74              | 91              | 106             | 138             | 168             |
|   | 8.8   |                   |                |                         | 23(21)          | 34              | 46              | 63              | 98              | 122             | 141             | 184             | 225             |                 |
|   | Stainless steel R and high corrosion resistant steel HCR                                    | 50                |                |                         | 15              | 21              | 29              | 39              | 61              | 76              | 89              | 115             | 141             |                 |
|   |   | 70                |                |                         | 20              | 30              | 40              | 55              | 86              | 107             | 124             | 161             | 197             |                 |
|   |   | 80                |                | 23                      | 34              | 46              | 63              | 98              | 122             | 141             | 184             | 225             |                 |                 |
|   | <b>Standard threaded rods, performance category C1<sup>2)</sup></b>                         |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
|   | Characteristic resistance $V_{Rk,s,C1}$   | Steel zinc plated | Property class | 5.8                     | [kN]            | 12(11)          | 17              | 24              | 33              | 52              | 64              | 74              | 97              | 118             |
|   |   |                   |                | 8.8                     |                 | 16(14)          | 24              | 32              | 44              | 69              | 85              | 99              | 129             | 158             |
| Stainless steel R and high corrosion resistant steel HCR                                    |   | 50                |                |                         | 11              | 15              | 20              | 27              | 43              | 53              | 62              | 81              | 99              |                 |
|   |   | 70                |                |                         | 14              | 21              | 28              | 39              | 60              | 75              | 87              | 113             | 138             |                 |
|   |   | 80                |                | 16                      | 24              | 32              | 44              | 69              | 85              | 99              | 129             | 158             |                 |                 |
| <b>fischer anchor rods and standard threaded rods, performance category C2</b>              |   |                   |                |                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| Characteristic resistance $V_{Rk,s,C2}$   |   | Steel zinc plated | Property class | 5.8                     | [-]             | - <sup>4)</sup> | 14              | - <sup>4)</sup> | 27              | 43              | - <sup>4)</sup> | 62              | - <sup>4)</sup> | - <sup>4)</sup> |
|   |   |                   |                | 8.8                     |                 | - <sup>4)</sup> | 22              | - <sup>4)</sup> | 44              | 69              | - <sup>4)</sup> | 99              | - <sup>4)</sup> | - <sup>4)</sup> |
|   | Stainless steel R and high corrosion resistant steel HCR                                    | 50                |                |                         | - <sup>4)</sup> | 14              | - <sup>4)</sup> | 27              | 43              | - <sup>4)</sup> | 62              | - <sup>4)</sup> | - <sup>4)</sup> |                 |
|   |   | 70                |                |                         | - <sup>4)</sup> | 20              | - <sup>4)</sup> | 39              | 60              | - <sup>4)</sup> | 87              | - <sup>4)</sup> | - <sup>4)</sup> |                 |
|   |   | 80                |                | - <sup>4)</sup>         | 22              | - <sup>4)</sup> | 44              | 69              | - <sup>4)</sup> | 99              | - <sup>4)</sup> | - <sup>4)</sup> |                 |                 |
|   | Factor for the annular gap  | $\alpha_{gap}$    | [-]            | 0,5 (1,0) <sup>3)</sup> |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |

<sup>1)</sup> Partial factors for performance category C1 or C2 see table C1.1;

for fischer anchor rods FIS A / RGM the factor for steel ductility is 1,0

<sup>2)</sup> Values in brackets are valid for undersized threaded rods with smaller stress area  $A_s$  for hot dip galvanised standard threaded rods according to EN ISO 10684:2004+AC:2009.

<sup>3)</sup> Values in brackets are valid for filled annular gaps between the anchor rod and the through-hole in the attachment. It is necessary to use the fischer filling disc according to Annex A 1

<sup>4)</sup> No performance assessed

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**Performances**

Characteristic values for steel failure under tension / shear load for fischer anchor rods and standard threaded rods under seismic action (performance category C1 / C2)

**Annex C 15**

Appendix 36/ 39

**Table C16.1:** Characteristic values for **steel failure** under tension / shear load for **reinforcing bars (B500B)** under seismic action performance category **C1**

| Nominal diameter of the bar  | $\phi$        | 10   | 12 | 14 | 16 | 18  | 20  | 22  | 24  | 25  | 26  | 28  | 30  | 32  |     |
|--|---------------|------|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Bearing capacity under tension load, steel failure<sup>1)</sup></b>                 |               |      |    |    |    |     |     |     |     |     |     |     |     |     |     |
| <b>Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1</b>        |               |      |    |    |    |     |     |     |     |     |     |     |     |     |     |
| Characteristic resistance  | $N_{Rk,s,C1}$ | [kN] | 44 | 63 | 85 | 111 | 140 | 173 | 209 | 249 | 270 | 292 | 339 | 389 | 443 |
| <b>Bearing capacity under shear load, steel failure without lever arm<sup>1)</sup></b> |               |      |    |    |    |     |     |     |     |     |     |     |     |     |     |
| <b>Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1</b>        |               |      |    |    |    |     |     |     |     |     |     |     |     |     |     |
| Characteristic resistance  | $V_{Rk,s,C1}$ | [kN] | 15 | 22 | 30 | 39  | 49  | 61  | 74  | 88  | 95  | 102 | 119 | 137 | 155 |

<sup>1)</sup> Partial factors for performance category C1 see table C16.2

**Table C16.2:** **Partial factors** for **fischer anchor rods, standard threaded rods** and **reinforcing bars (B500B)** under seismic action performance category **C1 or C2**

| Anchor rod / standard threaded rod              |  | M10            | M12                       | M14 | M16  | M20 | M22 | M24 | M27 | M30 | M32 |    |    |    |
|---|--|----------------|---------------------------|-----|------|-----|-----|-----|-----|-----|-----|----|----|----|
| Nominal diameter of the bar                     | $\phi$   | 10             | 12                        | 14  | 16   | 18  | 20  | 22  | 24  | 25  | 26  | 28 | 30 | 32 |
| <b>Tension load, steel failure<sup>1)</sup></b> |  |                |                           |     |      |     |     |     |     |     |     |    |    |    |
| Partial factor $\gamma_{Ms,N}$                  | Steel zinc plated  | Property class | 5.8                       | [-] | 1,50 |     |     |     |     |     |     |    |    |    |
|   |  |                | 8.8                       |     | 1,50 |     |     |     |     |     |     |    |    |    |
|   | Stainless steel R and high corrosion resistant steel HCR | 50             | 2,86                      |     |      |     |     |     |     |     |     |    |    |    |
|   |  | 70             | 1,50 <sup>2)</sup> / 1,87 |     |      |     |     |     |     |     |     |    |    |    |
|   |  | 80             | 1,60                      |     |      |     |     |     |     |     |     |    |    |    |
|   | Reinforcing bar  | B500B          | 1,40                      |     |      |     |     |     |     |     |     |    |    |    |
| <b>Shear load, steel failure<sup>1)</sup></b>   |  |                |                           |     |      |     |     |     |     |     |     |    |    |    |
| Partial factor $\gamma_{Ms,V}$                  | Steel zinc plated  | Property class | 5.8                       | [-] | 1,25 |     |     |     |     |     |     |    |    |    |
|   |  |                | 8.8                       |     | 1,25 |     |     |     |     |     |     |    |    |    |
|   | Stainless steel R and high corrosion resistant steel HCR | 50             | 2,38                      |     |      |     |     |     |     |     |     |    |    |    |
|   |  | 70             | 1,25 <sup>2)</sup> / 1,56 |     |      |     |     |     |     |     |     |    |    |    |
|   |  | 80             | 1,33                      |     |      |     |     |     |     |     |     |    |    |    |
|   | Reinforcing bar  | B500B          | 1,50                      |     |      |     |     |     |     |     |     |    |    |    |

<sup>1)</sup> In absence of other national regulations

<sup>2)</sup> Only admissible for high corrosion resistant steel HCR, with  $f_{yk} / f_{uk} \geq 0,8$  and  $A_5 > 12 \%$  (e.g. fischer anchor rods)

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**Performances**

Characteristic values for steel failure under tension/shear load for reinforcing bars under seismic action (performance category C1); partial factors (perform. category C1 / C2)

**Annex C 16**

Appendix 37/ 39

**Table C17.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C1**; **working life 50 and 100 years**

| Anchor rod / standard threaded rod   |                   | M10                                 | M12 | M14               | M16 | M20 | M22 | M24               | M27 | M30 |
|--|-------------------|-------------------------------------|-----|-------------------|-----|-----|-----|-------------------|-----|-----|
| <b>Characteristic bond resistance, combined pullout and concrete cone failure</b>        |                   |                                     |     |                   |     |     |     |                   |     |     |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b> |                   |                                     |     |                   |     |     |     |                   |     |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{RK,C1}$ [N/mm <sup>2</sup> ] | 7,0 | 7,0               | 6,7 | 6,0 | 5,7 | 6,7               | 6,7 | 6,7 |
|  | II: 50 °C / 72 °C |                                     | 7,0 | 7,0               | 6,7 | 5,7 | 5,7 | 6,7               | 6,7 | 6,7 |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>   |                   |                                     |     |                   |     |     |     |                   |     |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{RK,C1}$ [N/mm <sup>2</sup> ] | 7,5 | 7,5               | 6,5 | 5,7 | 5,7 | 5,7               | 5,7 | 5,7 |
|  | II: 50 °C / 72 °C |                                     | 6,8 | 6,8               | 6,5 | 5,7 | 5,7 | 5,7               | 5,7 | 5,7 |
| <b>Installation factors</b>  |                   |                                     |     |                   |     |     |     |                   |     |     |
| Dry or wet concrete  |                   | $\gamma_{inst}$                     | [-] | 1,0               |     |     |     |                   |     |     |
| Water filled hole  |                   |                                     |     | 1,2 <sup>1)</sup> |     |     |     | 1,4 <sup>1)</sup> |     |     |

<sup>1)</sup> Not permitted in combination with working life 100 years

**Table C17.2:** Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer drilled holes under seismic action performance category **C1**; **working life 50 and 100 years**

| Nominal diameter of the bar $\phi$   |                   | 10                                  | 12  | 14                | 16  | 18  | 20  | 22  | 24                | 25  | 26  | 28  | 30  | 32  |
|--|-------------------|-------------------------------------|-----|-------------------|-----|-----|-----|-----|-------------------|-----|-----|-----|-----|-----|
| <b>Characteristic bond resistance, combined pullout and concrete cone failure</b>        |                   |                                     |     |                   |     |     |     |     |                   |     |     |     |     |     |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b> |                   |                                     |     |                   |     |     |     |     |                   |     |     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{RK,C1}$ [N/mm <sup>2</sup> ] | 7,0 | 7,0               | 6,7 | 5,7 | 5,7 | 5,7 | 6,7               | 6,7 | 6,7 | 6,7 | 6,7 | 4,8 |
|  | II: 50 °C / 72 °C |                                     | 7,0 | 7,0               | 6,7 | 5,7 | 5,7 | 5,7 | 6,7               | 6,7 | 6,7 | 6,7 | 6,7 | 6,7 |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>   |                   |                                     |     |                   |     |     |     |     |                   |     |     |     |     |     |
| Temperature range  | I: 35 °C / 60 °C  | $\tau_{RK,C1}$ [N/mm <sup>2</sup> ] | 7,5 | 6,5               | 6,5 | 5,7 | 5,7 | 5,7 | 5,7               | 5,7 | 5,7 | 5,7 | 5,7 | 4,8 |
|  | II: 50 °C / 72 °C |                                     | 6,5 | 6,5               | 5,8 | 5,8 | 5,7 | 5,7 | 5,7               | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| <b>Installation factors</b>  |                   |                                     |     |                   |     |     |     |     |                   |     |     |     |     |     |
| Dry or wet concrete  |                   | $\gamma_{inst}$                     | [-] | 1,0               |     |     |     |     |                   |     |     |     |     |     |
| Water filled hole  |                   |                                     |     | 1,2 <sup>1)</sup> |     |     |     |     | 1,4 <sup>1)</sup> |     |     |     |     |     |

<sup>1)</sup> Not permitted in combination with working life 100 years

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**Performances**

Characteristic values for combined pull-out and concrete failure under seismic action (C1 for fischer anchor rods, stand. thread. rods and reinf. bars; working life 50 and 100 years)

**Annex C 17**

Appendix 38/ 39

**Table C18.1:** Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C2**; **working life 50 and 100 years**

| Anchor rod / standard threaded rod  |                   | M12                                 | M16   | M20               | M24  |      |
|---|-------------------|-------------------------------------|---|-------------------|------|------|
| <b>Characteristic bond resistance, combined pullout and concrete cone failure</b>   |                   |                                     |   |                   |      |      |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>  |                   |                                     |   |                   |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,C2}$ [N/mm <sup>2</sup> ] | 3,5   | 5,8               | 5,0  | 3,1  |
|   | II: 50 °C / 72 °C |                                     | 3,3   | 5,5               | 4,7  | 2,9  |
| <b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>  |                   |                                     |   |                   |      |      |
| Temperature range   | I: 35 °C / 60 °C  | $\tau_{Rk,C2}$ [N/mm <sup>2</sup> ] | 3,5   | 5,8               | 5,0  | 3,1  |
|   | II: 50 °C / 72 °C |                                     | 3,3   | 5,5               | 4,7  | 2,9  |
| <b>Installation factors</b>   |                   |                                     |   |                   |      |      |
| Dry or wet concrete   |                   | $\gamma_{inst}$ [-]                 | 1,0   |                   |      |      |
| Water filled hole   |                   |                                     | 1,2 <sup>1)</sup>   | 1,4 <sup>1)</sup> |      |      |
| <sup>1)</sup> Not permitted in combination with working life 100 years  |                   |                                     |   |                   |      |      |
| <b>Displacement-Factors for tension load<sup>1)</sup></b>   |                   |                                     |   |                   |      |      |
| $\delta_{N,C2}$ (DLS)-Factor  |                   | [mm/(N/mm <sup>2</sup> )]           | 0,09  | 0,10              | 0,11 | 0,12 |
| $\delta_{N,C2}$ (ULS)-Factor  |                   |                                     | 0,15  | 0,17              | 0,17 | 0,18 |
| <b>Displacement-Factors for shear load<sup>2)</sup></b>   |                   |                                     |   |                   |      |      |
| $\delta_{V,C2}$ (DLS)-Factor  |                   | [mm/kN]                             | 0,18  | 0,10              | 0,07 | 0,06 |
| $\delta_{V,C2}$ (ULS)-Factor  |                   |                                     | 0,25  | 0,14              | 0,11 | 0,09 |
| <sup>1)</sup> Calculation of effective displacement:<br>$\delta_{N,C2}$ (DLS) = $\delta_{N,C2}$ (DLS)-Factor · $\tau_{Ed}$<br>$\delta_{N,C2}$ (ULS) = $\delta_{N,C2}$ (ULS)-Factor · $\tau_{Ed}$<br>( $\tau_{Ed}$ : Design value of the applied tensile stress) |                   |                                     | <sup>2)</sup> Calculation of effective displacement:<br>$\delta_{V,C2}$ (DLS) = $\delta_{V,C2}$ (DLS)-Factor · $V_{Ed}$<br>$\delta_{V,C2}$ (ULS) = $\delta_{V,C2}$ (ULS)-Factor · $V_{Ed}$<br>( $V_{Ed}$ : Design value of the applied shear force) |                   |      |      |

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**Performances**

Characteristic values for combined pull-out and concrete failure under seismic action (C2) for fischer anchor rods and standard threaded rods; working life 50 and 100 years