

## European Technical Approval ETA-05/0069

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung  
*Trade name*

fischer Ankerbolzen FAZ II  
*fischer Anchor Bolt FAZ II*

Zulassungsinhaber  
*Holder of approval*

fischerwerke GmbH & Co. KG  
Weinhalde 14-18  
72178 Waldachtal  
DEUTSCHLAND

Zulassungsgegenstand  
und Verwendungszweck  
*Generic type and use  
of construction product*

Kraftkontrolliert spreizender Dübel in den Größen M8, M10, M12, M16, M20 und M24 zur Verankerung im Beton  
*Torque controlled expansion anchor of sizes M8, M10, M12, M16, M20 and M24 for use in concrete*

Geltungsdauer:  
*Validity:* vom  
from  
bis  
to

7 June 2013

7 June 2018

Herstellwerk  
*Manufacturing plant*

fischerwerke

Diese Zulassung umfasst  
*This Approval contains*

26 Seiten einschließlich 18 Anhänge  
*26 pages including 18 annexes*

Diese Zulassung ersetzt  
*This Approval replaces*

ETA-05/0069 mit Geltungsdauer vom 09.12.2008 bis 09.12.2013  
*ETA-05/0069 with validity from 09.12.2008 to 09.12.2013*

## I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
  - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products<sup>1</sup>, modified by Council Directive 93/68/EEC<sup>2</sup> and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council<sup>3</sup>;
  - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998<sup>4</sup>, as amended by Article 2 of the law of 8 November 2011<sup>5</sup>;*
  - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC<sup>6</sup>;
  - Guideline for European technical approval of "Metal anchors for use in concrete - Part 2: Torque controlled expansion anchors", ETAG 001-02.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
- 5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.
- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

<sup>1</sup> Official Journal of the European Communities L 40, 11 February 1989, p. 12  
<sup>2</sup> Official Journal of the European Communities L 220, 30 August 1993, p. 1  
<sup>3</sup> Official Journal of the European Union L 284, 31 October 2003, p. 25  
<sup>4</sup> *Bundesgesetzblatt Teil I* 1998, p. 812  
<sup>5</sup> *Bundesgesetzblatt Teil I* 2011, p. 2178  
<sup>6</sup> Official Journal of the European Communities L 17, 20 January 1994, p. 34

## II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

### 1 Definition of product/ products and intended use

#### 1.1 Definition of the construction product

The fischer Anchor Bolt FAZ II in the range of M8, M10, M12, M16, M20 and M24 is an anchor made of galvanised steel, stainless steel (marking "A4") or high corrosion steel (marking "C") which is placed into a drilled hole and anchored by torque-controlled expansion.

An illustration of the product and intended use is given in Annex 1.

#### 1.2 Intended use

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences.

The anchor is to be used for anchorages subject to static, quasi-static or seismic action (anchor performance categories C1 only for standard anchor depth).

The anchor may be used for anchorages with requirements related to resistance to fire.

It may be used in reinforced or unreinforced normal weight concrete of strength classes C20/25 at minimum and C50/60 at most according to EN 206:2000-12.

It may be anchored in cracked and non-cracked concrete.

##### fischer Anchor Bolt FAZ II made of galvanised steel:

The anchor may only be used in structures subject to dry internal conditions.

##### fischer Anchor Bolt FAZ II A4 made of stainless steel:

The anchor made of stainless steel A4 may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure in permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

##### fischer Anchor Bolt FAZ II C made of high corrosion resistant steel:

The anchor made of high corrosion resistant steel may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

The provisions made in this European technical approval are based on an assumed working life of the anchor of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

## **2 Characteristics of the product and methods of verification**

### **2.1 Characteristics of the product**

The anchor corresponds to the drawings and provisions given in the Annexes. The characteristic material values, dimensions and tolerances of the anchor not given in Annexes shall correspond to the respective values laid down in the technical documentation<sup>7</sup> of this European technical approval.

Regarding the requirements concerning safety in case of fire it is assumed that the anchor meets the requirements of class A1 in relation to reaction to fire in accordance with the stipulations of the Commission decision 96/603/EC, amended by 2000/605/EC.

The characteristic values for the design of anchorages are given in Annexes.

Each anchor is marked with the works symbol, the type of anchor, the thread size and the maximum thickness of fixture for standard effective anchorage depth according to Annex 2. Each anchor made of stainless steel A4 is marked with the letter "A4" and each anchor made of high corrosion resistant steel is marked with the letters "C".

The anchor shall only be packaged and supplied as a complete unit.

### **2.2 Methods of verification**

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for Use in Concrete" ETAG 001, Part 1 "Anchors in general" and Part 2 "Torque-controlled expansion anchors", on the basis of Option 1 and ETAG 001 Annex E "Assessment of Metal Anchors under Seismic Action".

The assessment of the anchor for the intended use in relation to the requirements for resistance to fire has been made in accordance with the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire".

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

<sup>7</sup>

The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

### **3 Evaluation and attestation of conformity and CE marking**

#### **3.1 System of attestation of conformity**

According to the decision 96/582/EG of the European Commission<sup>8</sup> the system 2(i) (referred to as system 1) of attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
  - (1) factory production control;
  - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;
- (b) Tasks for the approved body:
  - (3) initial type-testing of the product;
  - (4) initial inspection of factory and of factory production control;
  - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

#### **3.2 Responsibilities**

##### **3.2.1 Tasks for the manufacturer**

###### **3.2.1.1 Factory production control**

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.<sup>9</sup>

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

###### **3.2.1.2 Other tasks for the manufacturer**

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

<sup>8</sup> Official Journal of the European Communities L 254 of 08.10.1996.

<sup>9</sup> The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.



### **3.2.2 Tasks for the approved bodies**

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control, in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

### **3.3 CE marking**

The CE marking shall be affixed on each packaging of anchors. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacturer),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval,
- use category (ETAG 001-1 Option 1, seismic performance category C1 for standard anchorage depth)
- size.

## **4 Assumptions under which the fitness of the product for the intended use was favourably assessed**

### **4.1 Manufacturing**

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and if so whether further assessment or alterations to the European technical approval shall be necessary.

#### 4.2 Design of anchorages

The fitness of the anchor for the intended use is given under the following conditions:

The anchorages are designed either in accordance with

- ETAG 001 "Guideline for European technical approval of Metal Anchors for use in concrete", Annex C, method A

or in accordance with

- CEN/TS 1992-4:2009, design method A

and Technical Report TR 045 "Design of metal Anchors under Seismic Action" under the responsibility of an engineer experienced in anchorages and concrete work.

Anchorage under seismic action shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings in stand-off installation or with a grout layer under seismic action are not covered.

Verifiable calculation notes and drawings are 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).

The design of anchorages under fire exposure has to consider the conditions given in the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire". The relevant characteristic anchor values are given in Annexes 7 and 8. The design method covers anchors with a fire attack from one side only. If the fire attack is from more than one side, the design method may be taken only, if the edge distance of the anchor is  $c \geq 300$  mm.

#### 4.3 Installation of anchors

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site,
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor,
- Anchor installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools,
- Checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- Check of concrete being well compacted, e.g. without significant voids,
- Edge distances and spacing not less than the specified values without minus tolerances,
- Positioning of the drill holes without damaging the reinforcement,
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application,
- Cleaning of the hole of drilling dust,
- Anchor installation such that the effective anchorage depth is complied with. This compliance is ensured, if the exist thickness of fixture is not greater than the maximum thickness of fixture marked on the anchor,
- Application of the torque moment given in Annex 5 using a calibrated torque wrench.

## **5 Responsibility of the manufacturer**

The manufacturer is responsible to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- Diameter of drill bit,
- Thread diameter,
- Maximum thickness of the fixture,
- Minimum effective anchorage depth,
- Minimum hole depth,
- Torque moment,
- Information on the installation procedure, including cleaning of the hole, preferably by means of an illustration,
- Reference to any special installation equipment needed,
- Identification of the manufacturing batch.

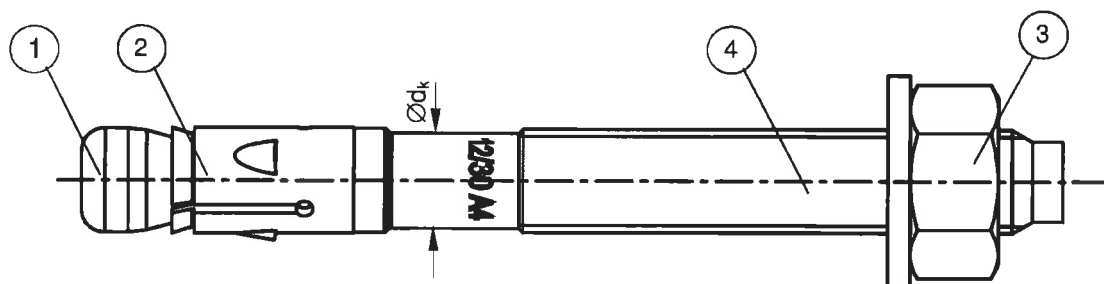
All data shall be presented in a clear and explicit form.

Andreas Kummerow  
p. p. Head of Department

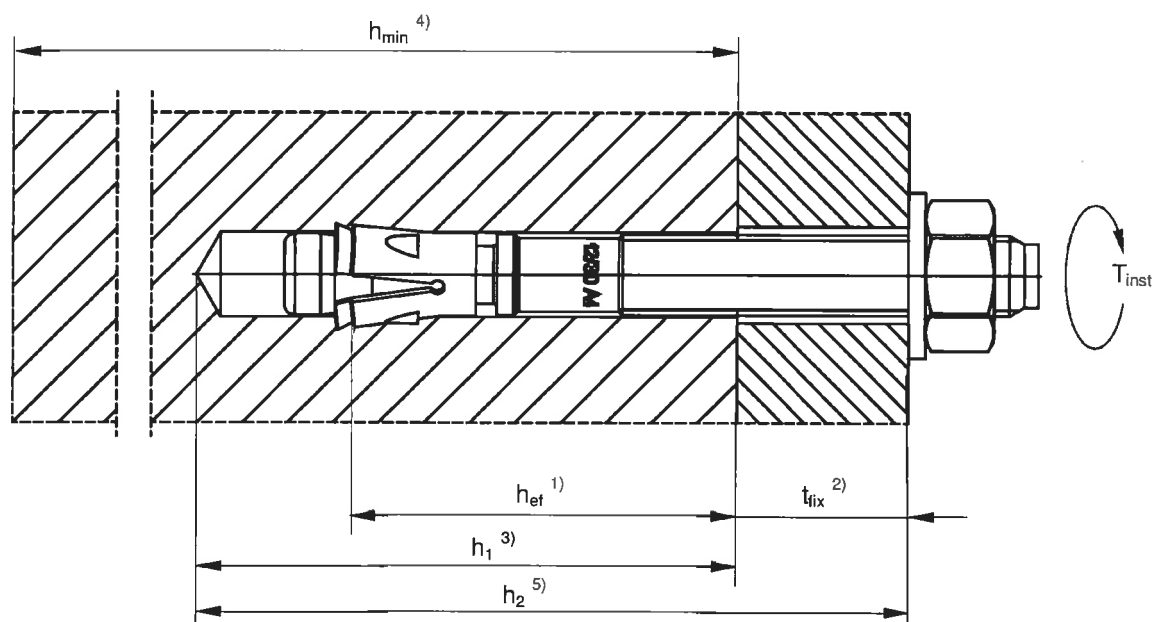
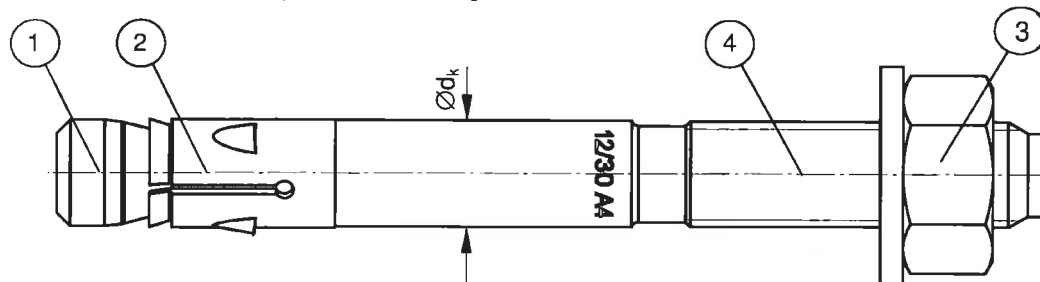
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Cone bolt manufactured by cold – forming:



Cone bolt manufactured by metal – cutting:



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

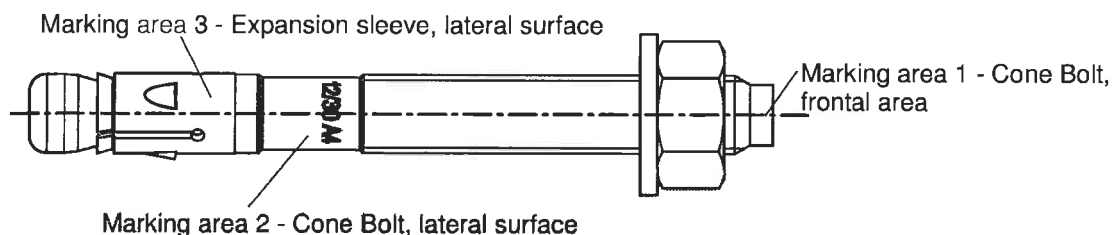
- <sup>1)</sup> effective anchorage depth
- <sup>2)</sup> max. thickness of fixture
- <sup>3)</sup> drill hole depth
- <sup>4)</sup> min. thickness of concrete member
- <sup>5)</sup> min.drill hole depth at push-through installation

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Product and Intended use

Annex 1

FAZ II for use with standard and reduced anchorage depth ( $h_{ef, sta}$  and  $h_{ef, red}$ ):



Product marking, example: FAZ II 12/10 A4

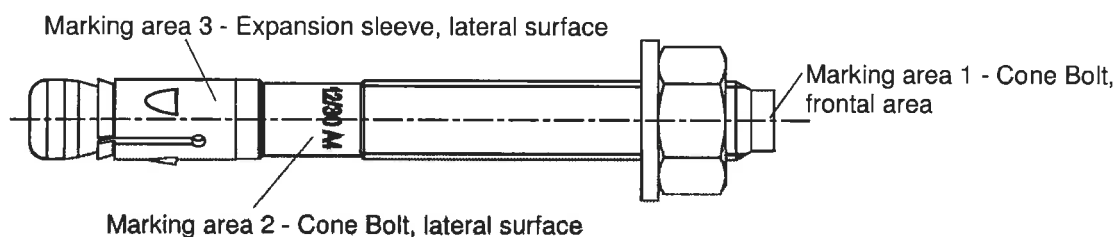
works symbol | type of anchor  
placed on marking area 2 or marking area 3

thread size / max. thickness of fixture ( $t_{fix}$ ) for  $h_{ef, sta}$   
identification A4  
placed on marking area 2

Letter-code on marking area 1 and maximum thickness of fixture  $t_{fix}$ :

marking		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)	(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
max. $t_{fix}$ for $h_{ef, sta}$	M8-M24	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200	250	300	350	400
max. $t_{fix}$ for $h_{ef, red}$	M10-M16	25	30	35	40	45	50	55	60	65	70	80	90	100	110	120	140	160	180	200	220	270	320	370	420

FAZ II K for use with reduced anchorage depth only ( $h_{ef, red}$ ):



Product marking, example: FAZ II 12/10 K A4

works symbol | type of anchor  
placed on marking area 2 or marking area 3

thread size / max. thickness of fixture ( $t_{fix}$ )  
identification K for  $h_{ef, red}$  | identification A4  
placed on marking area 2

Letter-code on marking area 1 and maximum thickness of fixture  $t_{fix}$ :

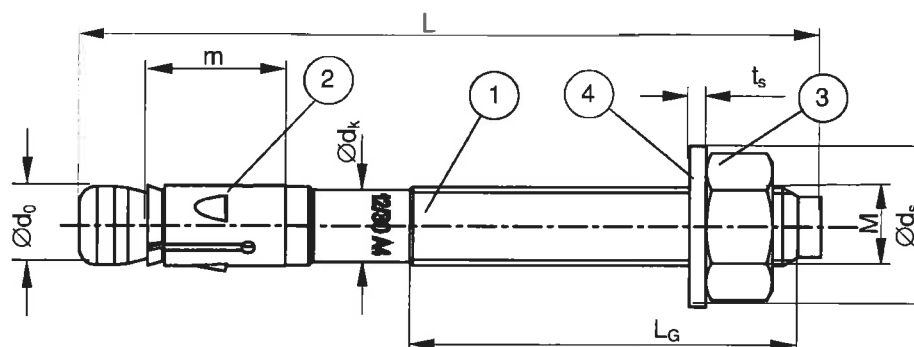
marking		(a)	(b)	(c)	(d)
max. $t_{fix}$ for $h_{ef, red}$	M10-M16	5	10	15	20

Identification for  $h_{ef, red}$  are lower case letters

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Product marking and identification

Annex 2



**Table 1: Anchor dimensions [mm]**

Part	Designation	Deviation	FAZ II, FAZ II A4, FAZ II C					
			M8	M10	M12	M16	M20	M24
1	Cone bolt	thread size	M8	M10	M12	M16	M20	M24
		Ø d <sub>0</sub>	7,8	9,8	11,8	15,7	19,8	23,5
		Ø d <sub>k</sub>	7,1	8,9	10,7	14,5	19,8	23,5
		L <sub>G</sub> ≥	19	26	31	40	50	57
2	Expansion sleeve	m	17,8	20,0	20,6	27,5	33,4	40,2
		sheet thickness	1,3	1,4	1,6	2,4	2,4	3,0
3	Hexagon nut	wrench size	13	17	19	24	30	36
4	Washer	t <sub>s</sub> ≥	1,4	1,8	2,3	2,7	2,7	3,7
		Ø d <sub>s</sub> ≥	15	19	23	29	36	43
Thickness of fixture		t <sub>fix</sub> ≥	0	0	0	0	0	0
		t <sub>fix</sub> ≤	200	250	300	400	500	600
Length of anchor		L <sub>min</sub> =	64,5	64,5	79	102	141	174
		L <sub>max</sub> =	267	336	401	524,5	644	777

The anchor may be produced with different maximum admissible thickness of fixture.

Design methods:

- Annexes 7-9  
→ Design method A according ETAG 001, Annex C
- Annexes 10-11  
→ Design method A according TR 020 and ETAG 001, Annex C
- Annexes 12-16  
→ Design method A according CEN/TS 1992-4: 2009
- Annexes 17-18  
→ Design according TR 045 for seismic performance categories C1  
(only standard anchorage depth)

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Anchor dimensions, Design methods

Annex 3

**Table 2a: Materials FAZ II**

Part	Designation	Material	Treatment
1	Cone bolt	Cold form steel or free cutting steel Nominal steel tensile strength: $f_{u,k} \leq 1000 \text{ N/mm}^2$	Zinc plated $\geq 5 \mu\text{m}$ according to EN ISO 4042, + functional coating
2	Expansion sleeve	Cold strip, EN 10139	Zinc plated $\geq 5 \mu\text{m}$ according to EN ISO 4042
3	Hexagon nut	Steel, property class min. 8, EN ISO 898-2	Zinc plated $\geq 5 \mu\text{m}$ according to EN ISO 4042, + functional coating <sup>1)</sup>
4	Washer	Cold strip, EN 10139	

<sup>1)</sup> Functional coating on hexagon nuts M8 und M10, and on washers for M12, M16 and M24

**Table 2b: Materials FAZ II A4**

Part	Designation	Material	Treatment
1	Cone bolt	stainless steel EN 10 088 Nominal steel tensile strength: $f_{u,k} \leq 1000 \text{ N/mm}^2$	functional coating
2	Expansion sleeve	stainless steel EN 10 088	-
3	Hexagon nut	stainless steel EN 10 088; ISO 3506-2; property class – min. 70	functional coating
4	Washer	stainless steel EN 10 088	-

**Table 2c: Materials FAZ II C**

Part	Designation	Material	Treatment
1	Cone bolt	high corrosion resistant steel EN 10 088 Nominal steel tensile strength: $f_{u,k} \leq 1000 \text{ N/mm}^2$	functional coating
2	Expansion sleeve	high corrosion resistant steel EN 10 088	-
3	Hexagon nut	high corrosion resistant steel EN 10 088; ISO 3506-2; property class – min. 70	functional coating
4	Washer	high corrosion resistant steel EN 10 088	-

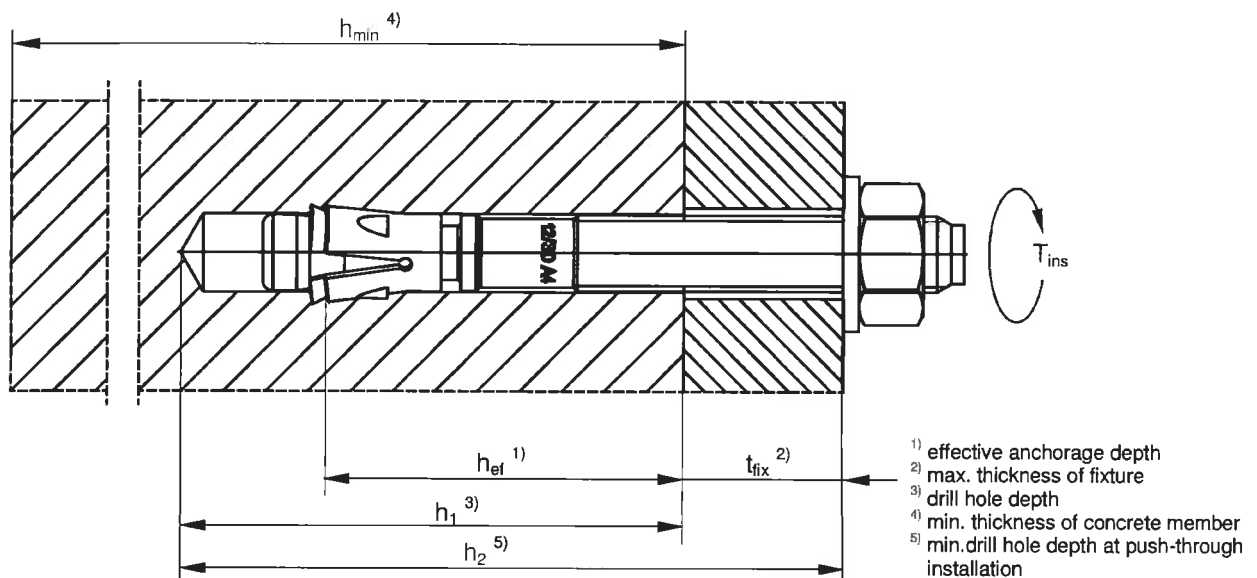
fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Materials

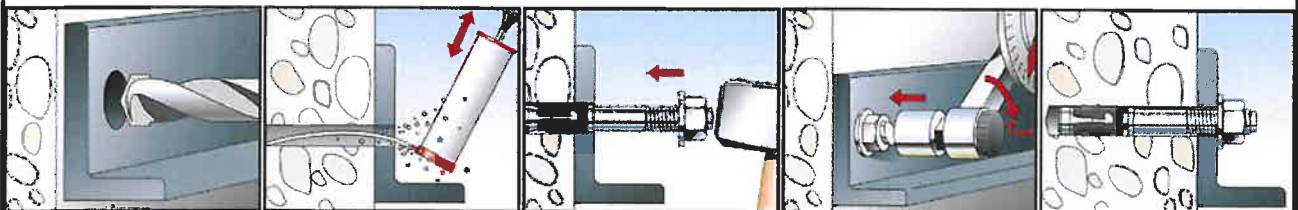
Annex 4

**Table 3:** Installation parameters

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C					
		M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$d_0 = [\text{mm}]$	8	10	12	16	20	24
Cutting diameter of drill bit	$d_{\text{cut}} \leq [\text{mm}]$	8,45	10,45	12,5	16,5	20,55	24,55
Standard anchorage depth	$h_{\text{ef,sta}} \geq [\text{mm}]$	45	60	70	85	100	125
Depth of drill hole in concrete for $h_{\text{ef,sta}}$	$h_{1,\text{sta}} \geq [\text{mm}]$	55	75	90	110	125	155
Reduced anchorage depth	$h_{\text{ef,red}} \geq [\text{mm}]$	-	40	50	65	-	-
Depth of drill hole in concrete for $h_{\text{ef,red}}$	$h_{1,\text{red}} \geq [\text{mm}]$	-	55	70	90	-	-
Diameter of clearance hole in the fixture	$d_f \leq [\text{mm}]$	9	12	14	18	22	26
Required torque moment	$T_{\text{inst}} = [\text{Nm}]$	20	45	60	110	200	270



### Installation instruction



fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Parameters of installation and installation instruction

Annex 5

**Table 4:** Minimum thickness of concrete members, minimum spacing and minimum edge distances of anchors for **standard anchorage depth** ( $h_{ef, sta}$ )

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C						
			M8	M10	M12	M16	M20	M24	
Standard effective anchorage depth			$h_{ef, sta} \geq [mm]$	45	60	70	85	100	125
Applications with concrete members of thickness $\geq 2 \times h_{ef}$	Minimum thickness of concrete member		$h_{min, 1} [mm]$	100	120	140	170	200	250
	Non – cracked concrete								
	Minimum spacing	$s_{min} [mm]$	40	40	50	65	95	100	
		for $c \geq [mm]$	50	60	70	95	180	200	
	Minimum edge distance	$c_{min} [mm]$	40	45	55	65	95	135	
		for $s \geq [mm]$	100	80	110	150	190	235	
	Cracked concrete								
	Minimum spacing	$s_{min} [mm]$	35	40	50	65	95	100	
		for $c \geq [mm]$	50	55	70	95	140	170	
	Minimum edge distance	$c_{min} [mm]$	40	45	55	65	85	100	
		for $s \geq [mm]$	70	80	110	150	190	220	
Applications with concrete members of thickness $< 2 \times h_{ef}$	Minimum thickness of concrete member		$h_{min, 2} [mm]$	80	100	120	140	160	200
	Cracked and non- cracked concrete								
	Minimum spacing	$s_{min} [mm]$	35	40	50	80	125	150	
		for $c \geq [mm]$	70	100	90	130	220	230	
	Minimum edge distance	$c_{min} [mm]$	40	60	60	65	125	135	
		for $s \geq [mm]$	100	90	120	180	230	235	

Intermediate values for  $s_{min}$  and  $c_{min}$  inside of the same thickness of concrete member by linear interpolation.

**Table 5:** Minimum thickness of concrete members, minimum spacing and minimum edge distances of anchors for **reduced anchorage depth** ( $h_{ef, red}$ )

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C			
		M10	M12	M16	
Reduced effective anchorage depth		$h_{ef,red} \geq [mm]$	40	50	65
Applications with concrete members of thickness $\geq 2 \times h_{ef}$	Minimum thickness of concrete member	$h_{min, 3} [mm]$	80	100	140
	Non – cracked concrete				
	Minimum spacing	$s_{min} [mm]$	40	50	65
		for $c \geq [mm]$	100	110	130
	Minimum edge distance	$c_{min} [mm]$	45	55	65
		for $s \geq [mm]$	180	220	250
	Cracked concrete				
	Minimum spacing	$s_{min} [mm]$	40	50	65
		for $c \geq [mm]$	90	110	130
	Minimum edge distance	$c_{min} [mm]$	45	55	65
for $s \geq [mm]$		180	220	250	

Intermediate values for  $s_{min}$  and  $c_{min}$  by linear interpolation.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Minimum edge distances and spacing

Annex 6



**Table 5:** Design method A, according to **ETAG 001, Annex C:** Characteristic values for tension loads, **standard anchorage depth** under static and quasi-static action

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C					
			M8	M10	M12	M16	M20	M24
Steel failure for standard anchorage depth								
Characteristic resistance	$N_{Rk,s}$	[kN]	16,0	27,0	41,5	66,0	111,0	150,0
Partial safety factor	$\gamma_{Ms}^{1)}$		1,5					
Pullout failure for standard anchorage depth								
Effective anchorage depth	$h_{ef,sta} \geq$	[mm]	45	60	70	85	100	125
Characteristic resistance in cracked concrete	$N_{Rk,p}$ [kN]	C20/25	5	9	16	- <sup>2)</sup>		
Characteristic resistance in non - cracked concrete	$N_{Rk,p}$ [kN]	C20/25	9	16	25	- <sup>2)</sup>		
Increasing factors for $N_{Rk,p}$ for cracked and non - cracked concrete	$\Psi_c$	C25/30	1,10					
		C30/37	1,22					
		C35/45	1,34					
		C40/50	1,41					
		C45/55	1,48					
		C50/60	1,55					
Partial safety factor	$\gamma_{Mp}^{1)}$		1,5 <sup>3)</sup>					
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness $\geq 2x h_{ef}$								
Min. thickness of concrete member	$h_{min, 1}$	[mm]	100	120	140	170	200	250
Spacing	$s_{cr,N}$	[mm]	140	180	210	260	300	380
Edge distance	$c_{cr,N}$	[mm]	70	90	105	130	150	190
Spacing (splitting failure) <sup>4)</sup>	$s_{cr,sp}$	[mm]	140	180	210	260	370	430
Edge distance (splitting failure) <sup>4)</sup>	$c_{cr,sp}$	[mm]	70	90	105	130	185	215
Partial safety factor	$\gamma_{Mc}^{1)}$		1,5 <sup>3)</sup>					
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness $< 2x h_{ef}$								
Min. thickness of concrete member	$h_{min, 2}$	[mm]	80	100	120	140	160	200
Spacing	$s_{cr,N}$	[mm]	140	180	210	260	300	380
Edge distance	$c_{cr,N}$	[mm]	70	90	105	130	150	190
Spacing (splitting failure) <sup>4)</sup>	$s_{cr,sp}$	[mm]	180	240	280	340	480	550
Edge distance (splitting failure) <sup>4)</sup>	$c_{cr,sp}$	[mm]	90	120	140	170	240	275
Partial safety factor	$\gamma_{Mc}^{1)}$		1,5 <sup>3)</sup>					

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

<sup>2)</sup> Pullout failure not relevant.

<sup>3)</sup> The partial safety factor  $\gamma_2 = 1,0$  is included.

<sup>4)</sup> Intermediate values for  $s_{cr,sp}$  and  $c_{cr,sp}$  between concrete thickness  $h_{min,2}$  and  $h_{min,1}$  by linear interpolation.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according ETAG 001, Annex C: Characteristic values for tension loads, standard anchorage depth under static and quasi-static action

Annex 7

**Table 6:** Design method A, according to **ETAG 001, Annex C:** Characteristic values for tension loads, **reduced anchorage depth** under static and quasi-static action

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C			
		M10	M12	M16	
Steel failure for reduced anchorage depth					
Characteristic resistance	$N_{Rk,s}$	[kN]	27,0	41,5	66,0
Partial safety factor	$\gamma_{Ms}$ <sup>1)</sup>		1,5		
Pullout failure for reduced anchorage depth					
Effective anchorage depth	$h_{ef,red} \geq$	[mm]	40	50	65
Characteristic resistance in cracked concrete	$N_{Rk,p}$	C20/25	- <sup>2)</sup>		
Characteristic resistance in non - cracked concrete	$N_{Rk,p}$	C20/25	- <sup>2)</sup>		
Increasing factors for $N_{Rk,p}$ for cracked and non - cracked concrete	$\psi_c$	C25/30	1,10		
		C30/37	1,22		
		C35/45	1,34		
		C40/50	1,41		
		C45/55	1,48		
		C50/60	1,55		
Partial safety factor	$\gamma_{Mp}$ <sup>1)</sup>		1,5 <sup>3)</sup>		
Concrete cone and splitting failure for reduced anchorage depth					
Min. thickness of concrete member	$h_{min,3}$	[mm]	80	100	140
Spacing	$s_{cr,N}$	[mm]	120	150	195
Edge distance	$c_{cr,N}$	[mm]	60	75	97,5
Spacing (splitting failure)	$s_{cr,sp}$	[mm]	160	200	260
Edge distance (splitting failure)	$c_{cr,sp}$	[mm]	80	100	130
Partial safety factor	$\gamma_{Mc}$ <sup>1)</sup>		1,5 <sup>3)</sup>		

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

<sup>2)</sup> Pullout failure not relevant.

<sup>3)</sup> The partial safety factor  $\gamma_2 = 1,0$  is included.

**Table 7:** Displacements due to tension loads for **standard and reduced anchorage depth**

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C					
			M8	M10	M12	M16	M20	M24
Values for standard anchorage depth								
Tension load in cracked concrete	N	[kN]	2,3	4,2	7,5	13,2	16,4	22,9
Displacement	$\delta_{N0}$	[mm]	0,5	0,5	0,7	1,0	1,2	1,2
	$\delta_{N\infty}$	[mm]	1,2				1,4	1,5
Tension load in non - cracked concrete	N	[kN]	4,2	7,5	11,7	18,7	23,3	32,5
Displacement	$\delta_{N0}$	[mm]	0,3	0,3	0,5	0,7	1,2	1,2
	$\delta_{N\infty}$	[mm]	1,2				1,4	1,5
Values for reduced anchorage depth								
Tension load in cracked concrete	N	[kN]	-	4,2	6,0	9,0	-	-
Displacement	$\delta_{N0}$	[mm]	-	0,5	0,7	1,0	-	-
	$\delta_{N\infty}$	[mm]	1,2				-	-
Tension load in non - cracked concrete	N	[kN]	-	5,7	8,5	12,6	-	-
Displacement	$\delta_{N0}$	[mm]	-	0,3	0,5	0,7	-	-
	$\delta_{N\infty}$	[mm]	1,2				-	-

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according ETAG 001, Annex C: Characteristic values for tension loads, reduced anchorage depth under static and quasi-static action, displacements for standard and reduced anchorage depth.

Annex 8

**Table 8:** Design method A, according to **ETAG 001, Annex C:** Characteristic values for shear loads, **standard and reduced anchorage depth** under static and quasi-static action.

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C					
		M8	M10	M12	M16	M20	M24
Steel failure without lever arm for <b>standard and reduced anchorage depth</b>							
Characteristic resistance	$V_{Rk,s}$ [kN]	12,0	20,0	29,5	55,0	70	86
Partial safety factor	$\gamma_{Ms}^{1)}$	1,25					
Standard anchorage depth							
Steel failure with lever arm							
Characteristic bending resistance	$M_{Rk,s}^0$ [Nm]	26	52	92	233	487	769
Partial safety factor	$\gamma_{Ms}^{1)}$	1,25					
Concrete pryout failure							
Factor in equation (5.6) of ETAG Annex C, 5.2.3.3	k	2,2		2,4	2,8		
Partial safety factor	$\gamma_{Mc}^{1)}$	1,5 <sup>2)</sup>					
Concrete edge failure							
Effective length of anchor in shear loading	$l_f$ [mm]	45	60	70	85	100	125
Effective diameter of anchor	$d_{nom}$ [mm]	8	10	12	16	20	24
Partial safety factor	$\gamma_{Mc}^{1)}$	1,5 <sup>2)</sup>					
Reduced anchorage depth							
Steel failure with lever arm							
Characteristic bending resistance	$M_{Rk,s}^0$ [Nm]	-	40	89	171	-	-
Partial safety factor	$\gamma_{Ms}^{1)}$	1,25					
Concrete pryout failure							
Factor in equation (5.6) of ETAG Annex C, 5.2.3.3	k	-	2,0	2,3		-	-
Partial safety factor	$\gamma_{Mc}^{1)}$	1,5 <sup>2)</sup>					
Concrete edge failure							
Effective length of anchor in shear loading	$l_f$ [mm]	-	40	50	65	-	-
Effective diameter of anchor	$d_{nom}$ [mm]	-	10	12	16	-	-
Partial safety factor	$\gamma_{Mc}^{1)}$	1,5 <sup>2)</sup>					

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

<sup>2)</sup> The partial safety factor  $\gamma_2 = 1,0$  is included.

**Table 9:** Displacements due to shear loads for **standard and reduced anchorage depth**

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C					
		M8	M10	M12	M16	M20	M24
Shear load in cracked and non-cracked concrete	V [kN]	6,9	11,4	16,9	31,4	39,4	48,5
Displacement	$\delta_{v0}$ [mm]	2,4	4,2	4,5	3,0	3,6	3,6
	$\delta_{v\infty}$ [mm]	3,6	6,3	6,8	4,5	5,4	5,4

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according ETAG 001, Annex C: Characteristic values and displacements for shear loads under static and quasi-static action for standard and reduced anchorage depth.

Annex 9

**Table 10:** Design method A, according to TR 020 and ETAG 001, Annex C: Characteristic values for tension loads under fire exposure.

Type of anchor / size	R30			R60		
	Fire resistance 30 minutes			Fire resistance 60 minutes		
	$N_{Rk,s,fi,30}$ [kN]	$N_{Rk,p,fi,30}$ [kN]	$N_{Rk,c,fi,30}^0$ [kN]	$N_{Rk,s,fi,60}$ [kN]	$N_{Rk,p,fi,60}$ [kN]	$N_{Rk,c,fi,60}^0$ [kN]
<b>Standard anchorage depth</b>						
FAZ II M8 (A4, C)	1,4	1,3	2,4	1,2	1,3	2,4
FAZ II M10 (A4, C)	2,8	2,3	5,0	2,3	2,3	5,0
FAZ II M12 (A4, C)	5,0	4,0	7,4	4,1	4,0	7,4
FAZ II M16 (A4, C)	9,4	7,1	12,0	7,7	7,1	12,0
FAZ II M20 (A4, C)	14,7	9,0	18,0	12,0	9,0	18,0
FAZ II M24 (A4, C)	21,1	12,6	31,4	17,3	12,6	31,4
<b>Reduced anchorage depth</b>						
FAZ II M10 (A4, C)	2,8	2,3	1,8	2,3	2,3	1,8
FAZ II M12 (A4, C)	5,0	3,2	3,2	4,1	3,2	3,2
FAZ II M16 (A4, C)	9,4	4,7	6,1	7,7	4,7	6,1

	R90			R120		
	Fire resistance 90 minutes			Fire resistance 120 minutes		
	$N_{Rk,s,fi,90}$ [kN]	$N_{Rk,p,fi,90}$ [kN]	$N_{Rk,c,fi,90}^0$ [kN]	$N_{Rk,s,fi,120}$ [kN]	$N_{Rk,p,fi,120}$ [kN]	$N_{Rk,c,fi,120}^0$ [kN]
<b>Standard anchorage depth</b>						
FAZ II M8 (A4, C)	0,9	1,3	2,4	0,8	1,0	1,9
FAZ II M10 (A4, C)	1,9	2,3	5,0	1,6	1,8	4,0
FAZ II M12 (A4, C)	3,2	4,0	7,4	2,8	3,2	5,9
FAZ II M16 (A4, C)	6,0	7,1	12,0	5,2	5,6	9,6
FAZ II M20 (A4, C)	9,4	9,0	18,0	8,1	7,2	14,4
FAZ II M24 (A4, C)	13,5	12,6	31,4	11,6	10,1	25,1
<b>Reduced anchorage depth</b>						
FAZ II M10 (A4, C)	1,9	2,3	1,8	1,6	1,8	1,4
FAZ II M12 (A4, C)	3,2	3,2	3,2	2,8	2,5	2,5
FAZ II M16 (A4, C)	6,0	4,7	6,1	5,2	3,8	4,9

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C					
			M8	M10	M12	M16	M20	M24
Spacing	$s_{cr,N}$	[mm]	$4 \times h_{ef}$					
	$s_{min}$	[mm]	35	40	45	60	95	100
Edge distance	$c_{cr,n}$	[mm]	$2 \times h_{ef}$					
	$c_{min}$	[mm]	$c_{min} = 2 \times h_{ef}$ , for fire exposure from more than one side $c_{min} \geq 300$ mm					

In absence of other national regulations the partial safety factor for resistance under fire exposure  $\gamma_{M,fi} = 1,0$  is recommended.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Characteristic tension load resistance under fire exposure  
according to TR 020 and ETAG 001, Annex C

Annex 10

**Table 11:** Design method A, according TR020 and to ETAG 001, Annex C: Characteristic values for shear loads under fire exposure.

Type of anchor / size	R30		R60	
	Fire resistance 30 minutes		Fire resistance 60 minutes	
	$V_{Rk,s,fi,30}$ [kN]	$M_{Rk,s,fi,30}^0$ [Nm]	$V_{Rk,s,fi,60}$ [kN]	$M_{Rk,s,fi,60}^0$ [Nm]
<b>Standard anchorage depth</b>				
FAZ II M8 (A4, C)	1,8	1,4	1,6	1,2
FAZ II M10 (A4, C)	3,6	3,6	2,9	3,0
FAZ II M12 (A4, C)	6,3	7,8	4,9	6,4
FAZ II M16 (A4, C)	11,7	19,9	9,1	16,3
FAZ II M20 (A4, C)	18,2	39,0	14,2	31,8
FAZ II M24 (A4, C)	26,3	67,3	20,5	55,0
<b>Reduced anchorage depth</b>				
FAZ II M10 (A4, C)	3,6	3,6	2,9	3,0
FAZ II M12 (A4, C)	6,3	7,8	4,9	6,4
FAZ II M16 (A4, C)	11,7	20,0	9,1	16,3
	R90		R120	
	Fire resistance 90 minutes		Fire resistance 120 minutes	
	$V_{Rk,s,fi,90}$ [kN]	$M_{Rk,s,fi,90}^0$ [Nm]	$V_{Rk,s,fi,120}$ [kN]	$M_{Rk,s,fi,120}^0$ [Nm]
<b>Standard anchorage depth</b>				
FAZ II M8 (A4, C)	1,3	1,0	1,2	0,8
FAZ II M10 (A4, C)	2,2	2,4	1,9	2,1
FAZ II M12 (A4, C)	3,5	5,0	2,8	4,3
FAZ II M16 (A4, C)	6,6	12,6	5,3	11,0
FAZ II M20 (A4, C)	10,3	24,6	8,3	21,4
FAZ II M24 (A4, C)	14,8	42,6	11,9	37,0
<b>Reduced anchorage depth</b>				
FAZ II M10 (A4, C)	2,2	2,4	1,9	2,1
FAZ II M12 (A4, C)	3,5	5,0	2,8	4,3
FAZ II M16 (A4, C)	6,6	12,6	5,3	11,0

**Concrete pryout failure:** In Equation (5.6) of ETAG 001, Annex C, 5.2.3.3 the k-factor of Table 8 and the relevant values of  $N_{0Rk,c,fi}$  of Table 10 have to be considered.

**Concrete edge failure:** The characteristic resistance  $V_{0Rk,c,fi}$  in concrete C20/25 to C50/60 is determined by:  $V_{0Rk,c,fi} = 0,25 \times V_{0Rk,c}$  (R30, R60, R90),  $V_{0Rk,c,fi} = 0,20 \times V_{0Rk,c}$  (R120) with  $V_{0Rk,c}$  as initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature according to ETAG 001, Annex C, 5.2.3.4.

In absence of other national regulations the partial safety factor for resistance under fire exposure  $\gamma_{M,fi} = 1,0$  is recommended.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Characteristic shear load resistance under fire exposure  
according to TR 020 and ETAG 001, Annex C

Annex 11

**Table 12:** Design method A according CEN/TS 1992-4: 2009: Characteristic values for tension loads, **standard anchorage depth** under static and quasi-static action

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C					
			M8	M10	M12	M16	M20	M24
Steel failure for standard anchorage depth								
Characteristic resistance	$N_{Rk,s}$	[kN]	16,0	27,0	41,5	66,0	111,0	150,0
Partial safety factor	$\gamma_{Ms}$	[-]	1,5					
Pullout failure for standard anchorage depth								
Characteristic resistance in cracked concrete	$N_{Rk,p}^0$	C20/25 [kN]	5	9	16	- <sup>2)</sup>		
Characteristic resistance in non - cracked concrete	$N_{Rk,p}^0$	C20/25 [kN]	9	16	25	- <sup>2)</sup>		
Increasing factors for $N_{Rk,p}$ for cracked and non - cracked concrete	$\psi_c$	C25/30	1,10					
		C30/37	1,22					
		C35/45	1,34					
		C40/50	1,41					
		C45/55	1,48					
		C50/60	1,55					
Partial safety factor	$\gamma_{Mp}$	[-]	1,5 <sup>3)</sup>					
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness $\geq 2x h_{ef}$								
Effective anchorage depth	$h_{ef}$	[mm]	45	60	70	85	100	125
Factor for non-cracked concrete	$k_{ucr}$	[-]	10,1					
Factor for cracked concrete	$k_{cr}$	[-]	7,2					
Min. thickness of concrete member	$h_{min, 1}$	[mm]	100	120	140	170	200	250
Spacing	$s_{cr,N}$	[mm]	140	180	210	260	300	380
Edge distance	$c_{cr,N}$	[mm]	70	90	105	130	150	190
Spacing (splitting failure) <sup>4)</sup>	$s_{cr,sp}$	[mm]	140	180	210	260	370	430
Edge distance (splitting failure) <sup>4)</sup>	$c_{cr,sp}$	[mm]	70	90	105	130	185	215
Partial safety factor	$\gamma_{Mc}$	[-]	1,5 <sup>3)</sup>					
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness $< 2x h_{ef}$								
Effective anchorage depth	$h_{ef}$	[mm]	45	60	70	85	100	125
Factor for non-cracked concrete	$k_{ucr}$	[-]	10,1					
Factor for cracked concrete	$k_{cr}$	[-]	7,2					
Min. thickness of concrete member	$h_{min, 2}$	[mm]	80	100	120	140	160	200
Spacing	$s_{cr,N}$	[mm]	140	180	210	260	300	380
Edge distance	$c_{cr,N}$	[mm]	70	90	105	130	150	190
Spacing (splitting failure) <sup>4)</sup>	$s_{cr,sp}$	[mm]	180	240	280	340	480	550
Edge distance (splitting failure) <sup>4)</sup>	$c_{cr,sp}$	[mm]	90	120	140	170	240	275
Partial safety factor	$\gamma_{Mc}^{1)} = \gamma_{Msd}^{1)}$	[-]	1,5 <sup>3)</sup>					

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

<sup>2)</sup> Pullout failure not relevant.

<sup>3)</sup> The partial safety factor  $\gamma_{inst} = 1,0$  is included.

<sup>4)</sup> Intermediate values for  $s_{cr,sp}$  and  $c_{cr,sp}$  between concrete thickness  $h_{min,2}$  and  $h_{min,1}$  by linear interpolation.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according CEN/TS 1992-4: 2009: Characteristic values for tension loads, standard anchorage depth under static and quasi-static action

Annex 12



**Table 13:** Design method A, according CEN/TS 1992-4: 2009: Characteristic values for tension loads, **reduced anchorage depth** under static and quasi-static action

Type of anchor / size			FAZ II, FAZ II A4, FAZ II C		
			M10	M12	M16
Steel failure for reduced anchorage depth					
Characteristic resistance	$N_{Rk,s}$	[kN]	27,0	41,5	66,0
Partial safety factor	$\gamma_{Ms}^{1)}$	[-]	1,5		
Pullout failure for reduced anchorage depth					
Characteristic resistance in cracked concrete	$N_{Rk,p}^0$	C20/25 [kN]	- <sup>2)</sup>		
Characteristic resistance in non - cracked concrete	$N_{Rk,p}^0$	C20/25 [kN]	- <sup>2)</sup>		
Increasing factors for $N_{Rk,p}$ for cracked and non - cracked concrete	$\psi_c$	C25/30	1,10		
		C30/37	1,22		
		C35/45	1,34		
		C40/50	1,41		
		C45/55	1,48		
		C50/60	1,55		
Partial safety factor	$\gamma_{Mp}^{1)}$	[-]	1,5 <sup>3)</sup>		
Concrete cone and splitting failure for reduced anchorage depth					
Effective anchorage depth	$h_{ef}$	[mm]	40	50	65
Factor for non-cracked concrete	$k_{ucr}$	[-]	10,1		
Factor for cracked concrete	$k_{cr}$	[-]	7,2		
Min. thickness of concrete member	$h_{min, 3}$	[mm]	80	100	140
Spacing	$s_{cr,N}$	[mm]	120	150	195
Edge distance	$c_{cr,N}$	[mm]	60	75	97,5
Spacing (splitting failure) <sup>4)</sup>	$s_{cr,sp}$	[mm]	160	200	260
Edge distance (splitting failure) <sup>4)</sup>	$c_{cr,sp}$	[mm]	80	100	130
Partial safety factor	$\gamma_{Mc}^{1)} = \gamma_{Msp}^{1)}$	[-]	1,5 <sup>3)</sup>		

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

<sup>2)</sup> Pullout failure not relevant.

<sup>3)</sup> The partial safety factor  $\gamma_{inst} = 1,0$  is included.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according CEN/TS 1992-4: 2009: Characteristic values for tension loads, reduced anchorage depth under static and quasi-static action

Annex 13

**Table 14:** Design method A, according CEN/TS 1992-4: 2009: Characteristic values for shear loads, **standard and reduced anchorage depth** under static and quasi-static action.

Type of anchor / size	FAZ II, FAZ II A4, FAZ II C							
	M8	M10	M12	M16	M20	M24		
Steel failure without lever arm for <b>standard and reduced anchorage depth</b>								
Characteristic resistance	$V_{Rk,s}$	[kN]	12,0	20,0	29,5	55,0	70	86
Partial safety factor	$\gamma_{Ms}^{1)}$		1,25					
Standard anchorage depth								
Steel failure with lever arm								
Characteristic bending resistance	$M_{Rk,s}^0$	[Nm]	26	52	92	233	487	769
Partial safety factor	$\gamma_{Ms}^{1)}$		1,25					
Concrete pryout failure								
Factor in equation (16) CEN/TS 1992-4-4:2009, Section 6.2.2.3	$k_3$	[-]	2,2		2,4	2,8		
Partial safety factor	$\gamma_{Mc}^{1)}$	[-]	1,5 <sup>2)</sup>					
Concrete edge failure								
Effective length of anchor in shear loading	$l_f$	[mm]	45	60	70	85	100	125
Effective diameter of anchor	$d_{nom}$	[mm]	8	10	12	16	20	24
Partial safety factor	$\gamma_{Mcp}^{1)}$		1,5 <sup>2)</sup>					
Reduced anchorage depth								
Steel failure with lever arm								
Characteristic bending resistance	$M_{Rk,s}^0$	[Nm]	-	40	89	171	-	-
Partial safety factor	$\gamma_{Ms}^{1)}$		1,25					
Ductility factor	$k_2$	[-]	1,0					
Concrete pryout failure								
Factor in equation (16) CEN/TS 1992-4-4:2009, Section 6.2.2.3	$k_3$	[-]	-	2,0	2,3		-	-
Partial safety factor	$\gamma_{Mc}^{1)}$	[-]	1,5 <sup>2)</sup>					
Concrete edge failure								
Effective length of anchor in shear loading	$l_f$	[mm]	-	40	50	65	-	-
Effective diameter of anchor	$d_{nom}$	[mm]	-	10	12	16	-	-
Partial safety factor	$\gamma_{Mc}^{1)}$	[-]	1,5 <sup>2)</sup>					

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

<sup>2)</sup> The partial safety factor  $\gamma_{inst} = 1,0$  is included.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Design method A according CEN/TS 1992-4: 2009: Characteristic values for shear loads, standard and reduced anchorage depth under static and quasi-static action

Annex 14

**Table 15:** Design method A, according **CEN/TS 1992-4: 2009**: Characteristic values for tension loads under fire exposure.

Type of anchor / size	<b>R30</b> Fire resistance 30 minutes			<b>R60</b> Fire resistance 60 minutes		
	$N_{Rk,s,fi,30}$ [kN]	$N_{Rk,p,fi,30}$ [kN]	$N_{Rk,c,fi,30}^0$ [kN]	$N_{Rk,s,fi,60}$ [kN]	$N_{Rk,p,fi,60}$ [kN]	$N_{Rk,c,fi,60}^0$ [kN]
<b>Standard anchorage depth</b>						
FAZ II M8 (A4, C)	1,4	1,3	2,4	1,2	1,3	2,4
FAZ II M10 (A4, C)	2,8	2,3	5,0	2,3	2,3	5,0
FAZ II M12 (A4, C)	5,0	4,0	7,4	4,1	4,0	7,4
FAZ II M16 (A4, C)	9,4	7,1	12,0	7,7	7,1	12,0
FAZ II M20 (A4, C)	14,7	9,0	18,0	12,0	9,0	18,0
FAZ II M24 (A4, C)	21,1	12,6	31,4	17,3	12,6	31,4
<b>Reduced anchorage depth</b>						
FAZ II M10 (A4, C)	2,8	2,3	1,8	2,3	2,3	1,8
FAZ II M12 (A4, C)	5,0	3,2	3,2	4,1	3,2	3,2
FAZ II M16 (A4, C)	9,4	4,7	6,1	7,7	4,7	6,1

	<b>R90</b> Fire resistance 90 minutes			<b>R120</b> Fire resistance 120 minutes		
	$N_{Rk,s,fi,90}$ [kN]	$N_{Rk,p,fi,90}$ [kN]	$N_{Rk,c,fi,90}^0$ [kN]	$N_{Rk,s,fi,120}$ [kN]	$N_{Rk,p,fi,120}$ [kN]	$N_{Rk,c,fi,120}^0$ [kN]
<b>Standard anchorage depth</b>						
FAZ II M8 (A4, C)	0,9	1,3	2,4	0,8	1,0	1,9
FAZ II M10 (A4, C)	1,9	2,3	5,0	1,6	1,8	4,0
FAZ II M12 (A4, C)	3,2	4,0	7,4	2,8	3,2	5,9
FAZ II M16 (A4, C)	6,0	7,1	12,0	5,2	5,6	9,6
FAZ II M20 (A4, C)	9,4	9,0	18,0	8,1	7,2	14,4
FAZ II M24 (A4, C)	13,5	12,6	31,4	11,6	10,1	25,1
<b>Reduced anchorage depth</b>						
FAZ II M10 (A4, C)	1,9	2,3	1,8	1,6	1,8	1,4
FAZ II M12 (A4, C)	3,2	3,2	3,2	2,8	2,5	2,5
FAZ II M16 (A4, C)	6,0	4,7	6,1	5,2	3,8	4,9

Type of anchor / size			<b>FAZ II, FAZ II A4, FAZ II C</b>					
			<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>
Spacing	$s_{cr,N}$	[mm]	$4 \times h_{ef}$					
	$s_{min}$	[mm]	35	40	45	60	95	100
Edge distance	$c_{cr,n}$	[mm]	$2 \times h_{ef}$					
	$c_{min}$	[mm]	$c_{min} = 2 \times h_{ef}$ , for fire exposure from more than one side $c_{min} \geq 300$ mm					

In absence of other national regulations the partial safety factor for resistance under fire exposure  $\gamma_{M,fi} = 1,0$  is recommended.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Characteristic tension load resistance under fire exposure  
according to TR 020 and CEN/TS 1992-4: 2009

Annex 15

**Table 16:** Design method A, according CEN/TS 1992-4: 2009: Characteristic values for shear loads under fire exposure.

Type of anchor / size	R30		R60	
	Fire resistance 30 minutes		Fire resistance 60 minutes	
	$V_{Rk,s,fi,30}$ [kN]	$M_{Rk,s,fi,30}^0$ [Nm]	$V_{Rk,s,fi,60}$ [kN]	$M_{Rk,s,fi,60}^0$ [Nm]
<b>Standard anchorage depth</b>				
FAZ II M8 (A4, C)	1,8	1,4	1,6	1,2
FAZ II M10 (A4, C)	3,6	3,6	2,9	3,0
FAZ II M12 (A4, C)	6,3	7,8	4,9	6,4
FAZ II M16 (A4, C)	11,7	19,9	9,1	16,3
FAZ II M20 (A4, C)	18,2	39,0	14,2	31,8
FAZ II M24 (A4, C)	26,3	67,3	20,5	55,0
<b>Reduced anchorage depth</b>				
FAZ II M10 (A4, C)	3,6	3,6	2,9	3,0
FAZ II M12 (A4, C)	6,3	7,8	4,9	6,4
FAZ II M16 (A4, C)	11,7	20,0	9,1	16,3
	R90		R120	
	Fire resistance 90 minutes		Fire resistance 120 minutes	
	$V_{Rk,s,fi,90}$ [kN]	$M_{Rk,s,fi,90}^0$ [Nm]	$V_{Rk,s,fi,120}$ [kN]	$M_{Rk,s,fi,120}^0$ [Nm]
<b>Standard anchorage depth</b>				
FAZ II M8 (A4, C)	1,3	1,0	1,2	0,8
FAZ II M10 (A4, C)	2,2	2,4	1,9	2,1
FAZ II M12 (A4, C)	3,5	5,0	2,8	4,3
FAZ II M16 (A4, C)	6,6	12,6	5,3	11,0
FAZ II M20 (A4, C)	10,3	24,6	8,3	21,4
FAZ II M24 (A4, C)	14,8	42,6	11,9	37,0
<b>Reduced anchorage depth</b>				
FAZ II M10 (A4, C)	2,2	2,4	1,9	2,1
FAZ II M12 (A4, C)	3,5	5,0	2,8	4,3
FAZ II M16 (A4, C)	6,6	12,6	5,3	11,0

**Concrete pryout failure:** In Equation (16) CEN/TS 1992-4-4: 2009, section 6.2.2.3 the  $k_3$ -factor of Table 14 and the relevant values of  $N_{Rk,c,fi}^0$  of Table 15 have to be considered.

**Concrete edge failure:** The characteristic resistance  $V_{0Rk,c,fi}$  in concrete C20/25 to C50/60 is determined by:  $V_{0Rk,c,fi} = 0,25 \times V_{0Rk,c}$  (R30, R60, R90),  $V_{0Rk,c,fi} = 0,20 \times V_{0Rk,c}$  (R120) with  $V_{0Rk,c}$  as initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature according to CEN/TS 1992-4-4: 2009, section 5.2.2.4.

In absence of other national regulations the partial safety factor for resistance under fire exposure  $\gamma_{M,fi} = 1,0$  is recommended.

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Characteristic shear load resistance under fire exposure  
according to TR 020 and CEN/TS 1992-4: 2009

Annex 16

### Recommended performance categories and reduction factors for loads under seismic action

The seismic performance of anchor subjected to seismic loading is categorized by performance categories C1 and C2. Table 17 relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product  $a_g \cdot S$ , where  $a_g$  is the design ground acceleration on Type A ground and  $S$  the factor, both in accordance with EN 1998-1:2004. The value of  $a_g$  or that of the product  $a_g \cdot S$  used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1 and may be different to the values given in Table 17. Furthermore, the assignment of the seismic performance categories C1 and C2 to the seismicity level and building importance classes is in the responsibility of each individual Member State.

**Table 17:** Recommended seismic performance categories for anchors

Seismicity level <sup>1)</sup>		Importance Class acc. to EN 1998-1:2004,4.2.5			
Class	$a_g \cdot S$ <sup>3)</sup>	I	II	III	IV
Very low <sup>2)</sup>	$a_g \cdot S \leq 0,05 \text{ g}$	No additional requirement			
Low <sup>2)</sup>	$0,05 \text{ g} < a_g \cdot S \leq 0,1 \text{ g}$	C1	C1 <sup>4)</sup> or C2 <sup>5)</sup>		C2
> low	$a_g \cdot S > 0,1 \text{ g}$	C1	C2		

<sup>1)</sup> The values defining the seismicity levels may be found in the National Annex of EN 1998-1.

<sup>2)</sup> Definition according to EN 1998-1:2004, 3.2.1.

<sup>3)</sup>  $a_g$  = design ground acceleration on Type A ground (EN 1998-1:2004, 3.2.1),  
 $S$  = Soil factor (see e.g. EN 1998-1:2004, 3.2.2).

<sup>4)</sup> C1 for attachments of non-structural elements.

<sup>5)</sup> C2 for structural elements

The characteristic seismic design resistance  $R_{k,seis}$  of a fastening shall be determined as follows:

$$R_{k,seis} = \alpha_{gap} \times \alpha_{seis} \times R_{k,seis}^0$$

The basic characteristic seismic resistance  $R_{k,seis}^0$  shall be taken from table 20 for steel and pull-out failure under tension load and steel failure under shear load. For all other failure modes  $R_{k,seis}^0$  shall be determined as for static and quasi-static action according to tables 12 and 14.

The reduction factors  $\alpha_{seis}$  and  $\alpha_{gap}$  are given in table 18.

**Table 18:** Reduction factors  $\alpha_{seis}$  and  $\alpha_{gap}$

Loading	Failure mode	$\alpha_{seis}$		$\alpha_{gap}$	
		Single fastener	Fastener group	Connections with hole clearance <sup>1)</sup>	Connections without hole clearance
Tension	Steel failure	1,00	1,00	1,00	1,00
	Pull-out failure	1,00	0,85		
	Concrete cone failure	0,85	0,75		
	Splitting failure	1,00	0,85		
Shear	Steel failure	1,00	0,85	0,50	
	Concrete edge failure	1,00	0,85		
	Concrete pry-out failure	0,85	0,75		

<sup>1)</sup> Connections with hole clearance according to CEN/TS 1992-4-4: 2009, table 1 or ETAG001, Annex C, table 4.1

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Recommended performance categories and reduction factors for loads under seismic action

Annex 17

**Table 19:** Valid anchor sizes for seismic design, **performance category C1**,  
**standard anchorage depth**

Type of anchor / size		FAZ II, FAZ II A4, FAZ II C					
		M8	M10	M12	M16	M20	M24
Standard effective anchorage depth	$h_{ef,sta} \geq$ [mm]	45	60	70	85	100	125
Thickness of fixture	$t_{fix,min} =$ [mm]	0	0	0	0	0	0
	$t_{fix,max} =$ [mm]	100	100	120	160	250	300
Length of anchor	$L_{min} =$ [mm]	64,5	84,5	99	122	141	174
	$L_{max} =$ [mm]	167	186	221	284,5	394	477

**Table 20:** Characteristic values for seismic action valid for performance **category C1**,  
**standard anchorage depth**

Type of anchor / size	FAZ II, FAZ II A4, FAZ II C						
	M8	M10	M12	M16	M20	M24	
Characteristic resistance tension load, steel failure							
Anchor type FAZ II, standard anchorage depth	$N_{Rk,s,seis}^0$ [kN]	16	27	41	66	111	150
	$\gamma_{Ms,seis}^{1)}$ [-]	1,5					
Characteristic resistance tension load, pullout failure							
Anchor type FAZ II, standard anchorage depth	$N_{Rk,P,seis}^0$ [kN]	4,6	8,0	16,0	28,2	36,0	50,3
	$\gamma_{Mp,seis}^{1)}$ [-]	1,5					
Characteristic resistance shear load, steel failure without lever arm							
Anchor type FAZ II, standard anchorage depth	$V_{Rk,s,seis}^0$ [kN]	11	17	27	47	56	69
	$\gamma_{Ms,seis}^{1)}$ [-]	1,25					

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

fischer Anchor bolt FAZ II, FAZ II A4, FAZ II C

Valid anchor sizes and characteristic values for loads under seismic action

Annex 18