Deutsches Institut für Bautechnik

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

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Mitglied der EOTA

Member of EOTA

European Technical Approval ETA-10/0012

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung Trade name

Zulassungsinhaber Holder of approval

Zulassungsgegenstand und Verwendungszweck

Generic type and use of construction product

Geltungsdauer: vom Validity: from

> bis to

Herstellwerk
Manufacturing plant

fischer Injektionssystem FIS EM fischer injection system FIS EM

fischerwerke GmbH & Co. KG Otto-Hahn-Straße 15

79211 Denzlingen DEUTSCHLAND

Verbunddübel in den Größen Ø 8 mm bis Ø 40 mm zur Verankerung im Beton

Bonded anchor in the size of \emptyset 8 mm to \emptyset 40 mm for use in concrete

26 June 2013

26 June 2018

fischerwerke

Diese Zulassung umfasst This Approval contains 44 Seiten einschließlich 35 Anhänge 44 pages including 35 annexes

Diese Zulassung ersetzt This Approval replaces ETA-10/0012 mit Geltungsdauer vom 22.06.2012 bis 16.02.2015 ETA-10/0012 with validity from 22.06.2012 to 16.02.2015





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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 products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - 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 1998⁴, as amended by Article 2 of the law of 8 November 2011⁵;
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶;
 - Guideline for European technical approval of "Metal anchors for use in concrete Part 5: Bonded anchors", ETAG 001-05.
- 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.
- 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.
- 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.
- 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.
- 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.

Official Journal of the European Communities L 40, 11 February 1989, p. 12

Official Journal of the European Communities L 220, 30 August 1993, p. 1

Official Journal of the European Union L 284, 31 October 2003, p. 25

Bundesgesetzblatt Teil I 1998, p. 812

⁵ Bundesgesetzblatt Teil I 2011, p. 2178

Official Journal of the European Communities L 17, 20 January 1994, p. 34



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II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The fischer injection system FIS EM is a bonded anchor consisting of a cartridge with injection mortar fischer FIS EM and a steel element. The steel elements are either

- fischer anchor rods in the range of M8 to M30 or
- fischer internal threaded anchor RG MI in the range of M8 to M20 or
- Reinforcing bar in the range of Ø 8 to Ø 40 or
- fischer rebar anchor FRA in the range of 12 to 24.

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.

An illustration of the product and intended use is given in Annexes 1 and 2.

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. Safety in case of fire (Essential Requirement 2) is not covered in this European technical approval.

The anchor is to be used only for anchorages subject to static or quasi-static loading 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.

The anchor may be used in cracked or non-cracked concrete.

The anchor with steel elements given in Annex 3 may also be used under seismic action for performance category C1 according to Annex 32.

The anchor may be installed in dry or wet concrete or in flooded holes.

The anchor may be used in the following temperature ranges:

Temperature range I: -40 °C to +60 °C (max long term temperature +35 °C and

max short term temperature +60 °C)

Temperature range II: $-40 \,^{\circ}\text{C}$ to $+72 \,^{\circ}\text{C}$ (max long term temperature $+50 \,^{\circ}\text{C}$ and

max short term temperature +72 °C)

Elements made of zinc coated steel:

The element made of zinc plated or hot dipped galvanised steel may only be used in structures subject to dry internal conditions.

Elements made of stainless steel:

The element made of stainless steel 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 to 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).



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Elements made of high corrosion resistant steel:

The element 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).

Elements made of reinforcing bars:

Post-installed reinforcing bars may be used as anchor designed in accordance with the EOTA Technical Reports TR 029 and TR 045only. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with post-installed reinforcing bars in concrete structures designed in accordance with EN1992-1-1: 2004 are not covered by this European technical approval.

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 indicated in the Annexes shall correspond to the respective values laid down in the technical documentation⁷ of this European technical approval.

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

The two components of the injection mortar fischer FIS EM are delivered in unmixed condition in side-by side-cartridges of sizes 390 ml, 585 ml, 1100 ml or 1500 ml according to Annex 1.

Each cartridge and each steel element is marked in accordance with the specifications given in the Annexes.

Elements made of reinforcing bars shall comply with the specifications given in Annex 7.

The marking of embedment depth may be done on jobsite.

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.



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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", Part 1 "Anchors in general" and Part 5 "Bonded anchors", on the basis of Option 1 and ETAG 001 Annex E "Assessment of Metal Anchors under Seismic Action".

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.

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 Commission⁸ system 2(i) (referred to as System 1) of the 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 control 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.

Official Journal of the European Communities L 254 of 08.10.1996



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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 at Deutsches Institut für Bautechnik.⁹

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.

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 the anchor. 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 manufacture),
- 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, Option 1, in addition: seismic anchor performance category C1 where applicable),
- size.

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.



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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 at 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 approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the 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 in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors" 10 and EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action" under the responsibility of an engineer experienced in anchorages and concrete work.

Anchorages 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 by this European technical approval.

Post-installed reinforcing bars may be used as anchor designed in accordance with the EOTA Technical Report TR 029 only. The basic assumptions for the design according to anchor theory shall be observed. This includes the consideration of tension and shear loads and the corresponding failure modes as well as the assumption that the base material (concrete structural element) remains essentially in the serviceability limit state (either non-cracked or cracked) when the connection is loaded to failure. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with reinforcing bars in concrete structures designed in accordance with EN 1992-1-1:2004 (e.g. connection of a wall loaded with tension forces in one layer of the reinforcement with the foundation) are not covered by this European technical approval.

For the fischer internal threaded anchor RG MI fastening screws or threaded rods made of appropriate steel and strength class acc. to Annex 6 shall be specified. The minimum and maximum thread engagement length I_E of the fastening screw or the threaded rod for installation of the fixture shall be met the requirements according to Annex 5, Table 2. The length of the fastening screw or the threaded rod shall be determined depending on thickness of fixture, admissible tolerances, available thread length and minimum and maximum thread engagement length I_E .

Verifiable calculation notes and drawings are 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.).

The Techncial Report TR 029 "Design of bonded anchors" is published in English on EOTA website www.eota.eu.

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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,
- anchor installation in accordance with the manufacturer's specifications and drawings using the tools indicated in the technical documentation of this European technical approval,
- commercial standard threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled:
 - material, dimensions and mechanical properties of the metal parts according to the specifications given in the Annexes
 - confirmation of material and mechanical properties of the metal parts by inspection certificate 3.1 according to EN 10204:2004, the documents should be stored,
 - marking of the threaded rod with the envisage embedment depth. This may be done
 by the manufacturer of the rod or the person on jobsite.
- reinforcing bars shall comply with specifications given in Annex 7.
- 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,
- marking and keeping the effective anchorage depth,
- edge distance and spacing not less than the specified values without minus tolerances,
- positioning of the drill holes without damaging the reinforcement,
- drilling by hammer-drilling or diamond drilling,
- in case of aborted drill hole: the drill hole shall be filled with mortar,
- cleaning the drill hole and installation in accordance with Annexes 9 to 11,
- during installation and curing of the chemical mortar the anchor component installation temperature shall be at least 5 °C;
- during curing of the chemical mortar the temperature of the concrete must not fall below +5 °C; observing the curing time according to Annex 6, Table 4 until the anchor may be loaded,
- for installation in bore holes $h_0 > 150$ mm extension hoses acc. Annex 1 shall be used,
- for overhead installation or in bore hole depth h₀ > 250 mm injection-funnels acc. to Annex 1 shall be used.
- Fastening screw or threaded rods (including nut and washer) must comply with the appropriate material and strength class of the fischer internal threaded anchor RG MI,
- installation torque moments are not required for functioning of the anchor. However, the torque moments given in the Annexes must not be exceeded.



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5 Indications to the manufacturer

5.1 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 as well as sections 4.2, 4.3 and 5.2 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:

- drill bit diameter,
- hole depth;
- diameter of anchor rod,
- minimum effective anchorage depth;
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration,
- anchor component installation temperature,
- material and property class of metal parts acc. to Annex 6, Table 3,
- ambient temperature of the concrete during installation of the anchor,
- admissible processing time (open time) of the mortar,
- curing time until the anchor may be loaded as a function of the ambient temperature in the concrete during installation,
- torque moment;
- identification of the manufacturing batch,

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

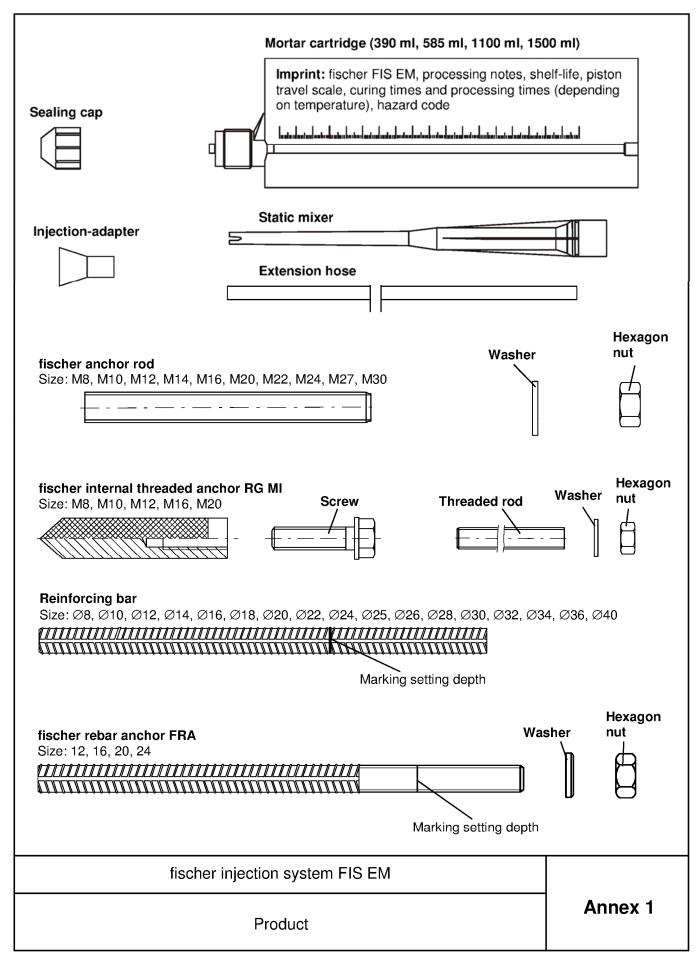
5.2 Packaging, transport and storage

The cartridges shall be protected against sun radiation and shall be stored according to the manufacturer's installation instructions in dry condition at temperatures of at least +5 °C to not more than +30 °C.

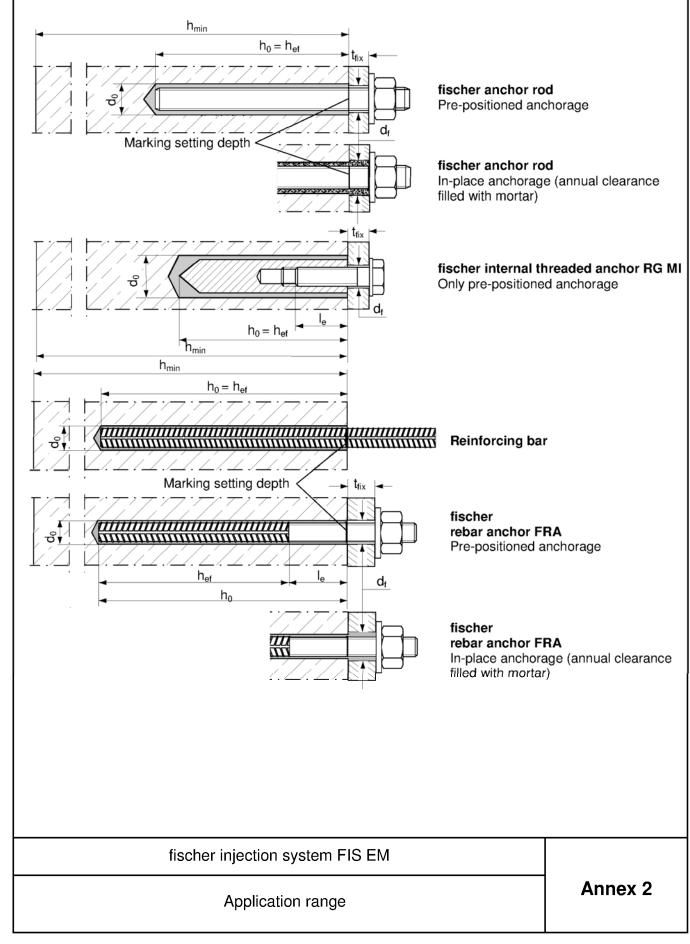
Cartridges with expired shelf life must no longer be used.

Uwe Bender	beglaubigt:
Head of Department	Lange





Electronic copy of the ETA by DIBt: ETA-10/0012





Intended use	fischer Injection system FIS EM							
Installation in hammer drilled holes; cracked or uncracked concrete	Permitted for all a	anchors and sizes						
Installation in diamond drilled holes; cracked or uncracked concrete	Permitted for all a	anchors and sizes						
Installation in in dry or wet concrete	Permitted for all a	anchors and sizes						
Installation in flooded holes	Permitted for all a	anchors and sizes						
Design methods								
;	Static and quasi-static action							
Design according to ETAG 001, TR 029	anchors and sizes							
Design according to CEN/TS 1992-4-5:2009	Permitted for all anchors and sizes							
Seismi	c action / Performance category C	 						
	Permitted for hammer drilled holes	s with:						
Design according to	- fischer anchor rods / Size M10) to M30						
ETAG 001, TR 045	- Standard threaded rods / Size	M10 to M30						
	- Reinforcing bars B500B / Size 10 to 32							
Temperature range								
	max. long term temperature	max. short term temperature						
Temperature range I: -40 °C to +60 °C	+35℃	+60℃						
Temperature range II: -40 ℃ to +72 ℃	+50℃	+72℃						

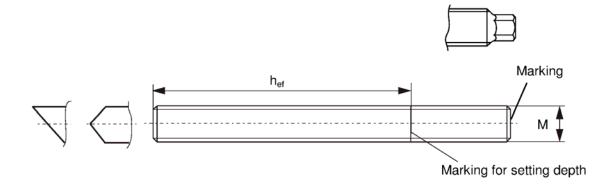
fischer injection system FIS EM	
Intended use, design methods temperature range	Annex 3



Table 1: Installation parameters for fischer anchor rods

Size	[-]	М8	M10	M12	M14	M16	M20	M22	M24	M27	M30			
Nominal drill bit di	[mm]	12	14	14	16	18	24	25	28	30	35			
Depth of drill ho	le	h_0	[mm]		$h_0 = h_{ef}$									
Effective ancho	rage	$h_{\text{ef}, min}$	[mm]	60	60	70	75	80	90	93	96	108	120	
depth		$h_{ef,max}$	[mm]	160	200	240	280	320	400	440	480	540	600	
Minimum spacing and		$c_{min} = \mathbf{c}_{min}$	[mm]	40	45	55	60	65	85	95	105	120	140	
Diameter of clearance hole	pre- positioned anchorage	d _f	[mm]	9	12	14	16	18	22	24	26	30	33	
in the fixture	In-place anchorage	d_{f}	[mm]	14	16	16	18	20	26	28	30	33	40	
Minimum thickn concrete memb	[mm]	h _{ef}	+ 30 ≥1	100	h _{ef} + 2d ₀									
Maximum torque T _{inst,max}		$T_{inst,max}$	[Nm]	10	20	40	50	60	120	135	150	200	300	
Thickness of fixture t _{fix,min}		[mm]					()	·			·		
THICKIIGSS OF IIX	Luie	t _{fix,max}	[mm]					30	00					

fischer anchor rod:



Marking:

Property class 8.8 or high corrosion-resistant steel, property class 80: • Stainless steel A4, property class 50 and high corrosion-resistant steel, property class 50: • •

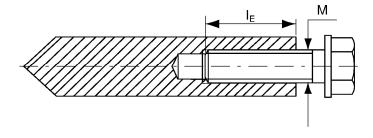
fischer injection system FIS EM	
fischer anchor rod Installation parameters and dimensions	Annex 4

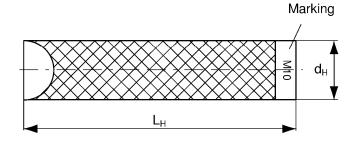


Table 2: Installation parameters fischer internal threaded anchors RG MI

Size			М8	M10	M12	M16	M20
Diameter of anchor	d _H	[mm]	12	16	18	22	28
Nominal drill bit diameter		[mm]	14	18	20	24	32
Length of anchor	L _H	[mm]	90	90	125	160	200
Effective anchorage depth h _{ef} and drill hole depth h ₀	$h_{ef} = h_0$	[mm]	90	90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	55	65	75	95	125
Diameter of clearance hole in the fixture	d _f	[mm]	9	12	14	18	22
Minimum thickness of concrete member	h _{min}	[mm]	120	125	165	205	260
Carou in donth	$I_{E,min}$	[mm]	8	10	12	16	20
Screw-in depth -	$I_{E,max}$	[mm]	18	23	26	35	45
Maximum torque moment	T _{inst,max}	[Nm]	10	20	40	80	120

fischer internal threaded anchor RG MI





Marking: anchor size

e.g.: M10

Stainless steel additional A4

e. g.: M10 A4

High corrosion-resistant steel additional C

e. g.: **M10 C**

fischer injection system FIS EM	
fischer internal threaded anchors RG MI Installation parameters and dimensions	Annex 5



Table 3: Materials: anchor rods, threaded rods, washers, hexagon nuts and screws

		Material	
Designation	Steel, zinc plated	Stainless steel A4	High corrosion- resistant steel C
Anchor rod	Property class 5.8 or 8.8; EN ISO 20898-1 zinc plated ≥ 5μm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	Property class 50 or 70 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 or 1.4062 pr EN 10088:2011	Property class 50 or 80 EN ISO 3506 or property class 70 with $f_{yk} = 560 \text{ N/mm}^2$ 1.4529; 1.4565 EN 10088
Washer EN ISO 7089	Zinc plated ≥ 5μm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	1.4529; 1.4565 EN 10088
Hexagon nut according to EN 24032	Property class 5.8 or 8.8; EN ISO 20898-1 zinc plated ≥ 5μm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	Property class 50 or 70 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	Property class 50, 70 or 80 EN ISO 3506 1.4529; 1.4565 EN 10088
Screw or threaded rod for internal threaded anchor RG MI	Property class 5.8 or 8.8; EN ISO 20898-1 zinc plated ≥ 5μm, EN ISO 4042 A2K or hot-dip galvanised EN ISO 10684	Property class 70 EN ISO 3506 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088	Property class 70 EN ISO 3506 1.4529; 1.4565 EN 10088

Table 4: Maximum permissible processing times and minimum curing times

System temperature	Max. processing time	Minimum curing time ¹⁾
[℃]	[minutes]	[hours]
+5 to +10	120	40
≥ +10 to +20	30	18
≥ +20 to +30	14	10
≥ +30 to +40	7	5

¹⁾ In wet concrete or flooded holes the curing times must be doubled.

fischer injection system FIS EM	
Materials Processing times, curing times	Annex 6



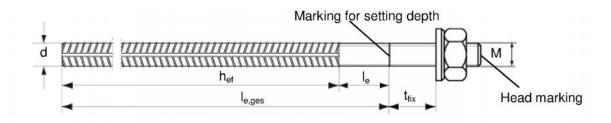
	22 24 25 26 28 30 32 34 36 40	30 30 30 35 35 40 40 40 45 55	$h_0 = h_{ef}$	94 98 100 104 112 120 128 136 144 160	440 480 500 520 560 600 640 680 720 800	95 105 110 120 130 140 160 170 180 200	h _{ef} + 2d ₀			.2N	Non-zinc-plated bars and de-coiled rod	2	400 to 600	1,15	> 1,33	5/,5	Bend / Rebend test	± 6,0 ± 4,5	0,040	0,056
	_			\vdash						ſ		7		_	Т	7				
	56	35		104	520	120					d rod									
	22	30			200	110	ef + 2d ₍				e-coile	٥		1,15	0,1	4,5	,;			
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ars	4	18		75	280	09			rking fe	Annex			MPal			Suk [%]			nm]	
nforcing bars	12	16		20	240	55			Mai	2-1-1			fvk or fozk [MPa]			3		size [r	size [r	≥ 0,07 • d
inforc	우	14		9	200	45	100			N 1992			f _{vk} o					Nominal bar size [mm] ≤ 8 > 8	Nominal bar size [mm] 8 bis 12 > 12	h ≤ 0,0
ers re	∞ _	12		09] 160	1 40	호시			er to E						torce		Nomir s 8 v 8	Nomir 8 bis	VI D •
amete	[mm]	[mm]	[mm]	[mm]	x [mm]	S _{min} = C _{min} [mm]	[mm]			nt: refe			ᆍ	vk)		XIMUL		ar)		0,0
n par	ø	ဗိ	ح	h _{ef,min}	h _{ef,max}	S	rim nim			cemer			streng	= (f _t /f		at ma		from /idual k	ative ril	iust be
Table 5: Installation parameters rei	Nominal bar size	Nominal drill bit diameter	Drill hole depth	Effective	anchorage depth	Minimum spacing and minimum edge distance	Minimum thickness of concrete	member	Reinforcing bar	Properties of reinforcement: refer to EN 1992-1-1 Annex C, Table C.1 and C.2N	Product form	Class	Characteristic yield strength	Minimum value of $k = (f_t/f_{vk})$:	Characteristic strain at maximum force	Bentability	Maximum deviation from nominal mass (individual bar) [%]	Bond: minimum relative rib area, f _{R,min} (determination according to	Rib height h: The rib height h must be d = nominal bar size
<u>. </u>						fisch	er in	jed	tion system	FIS	E	M								
	Reinforcing bars Installation parameters Materials								,	Annex 7										



Table 6: Installation parameters fischer rebar anchor FRA

Threaded diameter			M12	M16	M20	M24			
Nominal bar size	d	[mm]	12	16	20	25			
Nominal drill bit diameter	d_0	[mm]	16	20	25	30			
Depth of drill hole $(h_0 = l_{ges})$	h ₀	[mm]	h _{ef} + l _e						
Effective anaborage depth	$h_{ ext{ef}, ext{min}}$	[mm]	70	80	90	96			
Effective anchorage depth	h _{ef,max}	[mm]	140	220	300	380			
Distance concrete surface to welded join	l _e	[mm]		100					
Minimum spacing and minimum edge distance	s _{min} =c _{min}	[mm]	55	65	85	105			
Diameter of clearance hole in the fixture	pre-positioned anchorage d _f	[mm]	14	18	22	26			
in the lixture	in-place anchorage d _f	[mm]	18	22	26	32			
Minimum thickness of concrete member	h _{min}	[mm]	h ₀ + 30 ≥100	h ₀ + 2d ₀					
Maximum torque moment	T _{inst,max}	[Nm]	40	60	120	150			
Thickness of the fixture	minimum t _{fix}	[mm]	0						
THIOMICSS OF THE HATCHE	maximum t _{fix}	[mm]	3000						

fischer rebar anchor FRA



Head marking e.g.:

FRA (for stainless steel);
FRA C (for high corrosion-resistant steel)

fischer injection system FIS EM	
fischer rebar anchor FRA Installation parameters	Annex 8



Drilling and cleaning the hole (hammer-drilling)

Drill the hole. Drill hole diameter d_0 and drill hole depth h_0 see **Tables 1, 2, 5 or 6**.

2

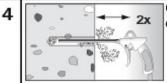
Clean the drill hole: Blow out the drill hole two times, using oil-free compressed air (P > 6bar)



3 2x

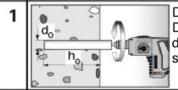
Brush the drill hole two times. For drill hole \geq 30 mm use a power drill. For deep holes use an extension.

dimining q	l ₀ [mm	12	14	16	18	20	24	25	28	30	32	35	40	45	55
d	l _b [mm]	14	16	2	0	25	26	27	30		40		42	47	58

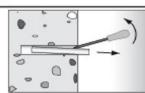


Clean the drill hole: Blow out the drill hole two times, using oil-free compressed air (P > 6bar)

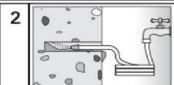
Drilling and cleaning the hole (diamond-drilling)



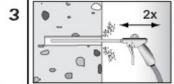
Drill the hole. Drill hole diameter d_0 and drill hole depth h_0 see **Tables 1, 2, 5 or 6**



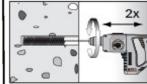
Break the drill core and draw it out.



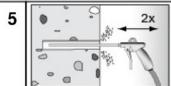
Flush the drill hole until the water comes clear.



Blow out the drill hole two times, using oil-free compressed air (P > 6bar)



Brush the drill hole two times using a power drill. Corresponding brushes see "hammer-drilling"



Blow out the drill hole two times, using oil-free compressed air (P > 6bar)

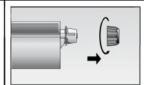
fischer injection system FIS EM

Installation instructions Part 1 Annex 9

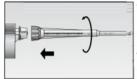


Preparing the cartridge





Twist off the sealing cap



Twist on the static mixer (the spiral in the static mixer must be clearly visible).







Place the cartridge into the applicator gun.



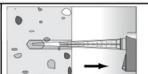




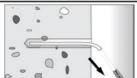
Press approx. 10 cm of material out until the resin is evenly grey in colour. Don't use mortar that is not uniformly grey.

Injection of the mortar

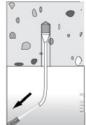
9



Fill approx. 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles.



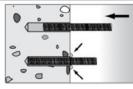
For drill hole depth ≥ 150 mm use an extension hose.

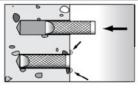


For overhead installation, deep holes $h_0 > 250$ mm or drill hole diameter $d_0 \ge 40$ mm use an injection-adapter.

Installation fischer anchor rods or internal threaded anchors RG MI

10







Only use clean and oil-free anchor elements. Mark the setting depth of the anchor. Press the anchor rod or internal threaded anchor down to the bottom of the hole, turning it slightly while doing so. After inserting the anchor element, excess mortar must emerge from the mouth of the drill hole.

For in-place anchorage fill the annual clearance with mortar.

11



Wait for the specified curing time, t_{cure} see **Table 4**.

Mounting the fixture T_{inst,max} see **Table 1 or 2**

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Installation instructions Part 2 Annex 10

Z58010.13

Installation reinforcing bars and fischer FRA

Setting depth mark

Setting depth mark

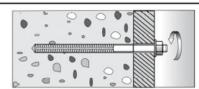
Only use clean and oil-free rebars. Mark the setting depth of the reinforcing bar. Using a turning movement, push the reinforcement bar or the FRA vigorously into the filled hole up to the insertion depth marking.

When reaching the setting depth mark, excess mortar must emerge from the mouth of the drill hole.

11



Wait for the specified curing time t_{cure} see **Table 4**.



Mounting the fixture $T_{inst,max}$ see **Table 6.**

fischer injection system FIS EM

Installation instructions Part 3 Annex 11

Z58010.13

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Table 7: Design of Bonded Anchors acc. to TR 029 Characteristic values to tension load of fischer anchor rods and standard rods

Offai	aciensiic	values to te	1151011	iuau	01 1150	nei ai		ious a	uiu Sla	ailuait	, 10US	
Size			М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Steel failure			ı									
. s	Property	5.8 [kN]	19	29	43	58	79	123	152	177	230	281
is \(\frac{1}{2} \)	class	8.8 [kN]	30	47	68	92	126	196	243	282	368	449
Stainless steel	Property	50 [kN]	19	29	43	58	79	123	152	177	230	281
44 gu 44	class	70 [kN]	26	41	59	81	110	172	212	247	322	393
O Stainless steel At High corrosion resistant steel	Property	50 [kN]	19	29	43	58	79	123	152	177	230	281
ට ගී resistant steel C	class	70 ⁵⁾ [kN]	26	41	59	81	110	172	212	247	322	393
<u> </u>	Droporti	80 [kN] 5.8 [-]	30	47	68	92	126	196 50	243	282	368	449
_	Property class	5.8 [-] 8.8 [-]						50 50				
Stainless steel A4 High corrosion registrant steel	Property	50 [-]						86				
Stainless steel High corrosion	class	70 [-]						87				
TE DE High corrosion		50 [-]						86				
resistant steel	Property	70 ⁵⁾ [-]						50 50				
C	class	80 [-]						60				
Combined pullo	ut and cond		l				.,					
Diameter of calcula		d [mm]	8	10	12	14	16	20	22	24	27	30
Characteristic b							1	1				1 00
hammer-drilling												
Temperature range	e l	ra. 1/ 21	1.0	1.0	4.5	4.4	144	10	10	\top	\top_{10}	T_{40}
(60 ℃/35 ℃)	$ au_{Rk,ucr}$. [N/mm²]	16	16	15	14	14	13	13	13	12	12
Temperature range	e II	. [N/mm²]	15	14	14	13	13	12	12	12	11	11
(72℃/50℃)	τ _{Rk,ucr}						13	12	12	12	11	11
Characteristic b			racked	l concr	ete C2	0/25						
hammer-drilling	•	ole)										
Temperature range	eΙ τ _{Rk,uc}	r [N/mm²]	16	16	15	13	13	11	11	10	10	9
<u>(60°C/35°C)</u>		r [14/11111]	10	10	''	10	10		1 ''			↓ —
Temperature range	e ΙΙ τ _{Rk,uc}	r [N/mm²]	15	14	14	13	12	11	10	10	9	9
(72℃/50℃)												
Characteristic b			racked	concr	ete C2	0/25						
diamond-drilling		et concrete)	T	1							_	т —
Temperature range (60°C/35°C)	∌I τ _{Rk,ucr}	[N/mm²]	16	15	13	12	12	10	10	10	9	9
Temperature range					+		+		+	+	+	
(72°C/50°C)	τ _{Rk,ucr}	. [N/mm²]	15	14	12	11	11	10	9	9	8	8
Characteristic bo	nd resistan	ce in non-cr	acked	concre	te C20	1/25						
diamond-drilling			LUNCU	2011016	020	, 20						
Temperature range	•	•	T	T	T	T	T		T	Τ	Τ	Τ_
(60°C/35°C)	$ au_{Rk,ucr}$	[N/mm ²]	16	15	13	12	12	10	10	10	9	9
Temperature range	e II	rs 2-	1	1	1	1	1	1.5	1_	1_	1_	1_
(72°C/50°C)	$ au_{Rk,ucr}$	[N/mm²]	15	14	12	11	11	10	9	9	8	8
,	Dry and wet			1		-2)	1	_1			2 3)	
Partial safety	concrete	[-]			1	,5 ²⁾			1	1	,8 ³⁾	
factor -		_ []						4 4)	•		-	
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{-1)}$	Flooded hol	e [-]					2	,1 ⁴⁾				
1) If no other nation	onal rogulation	one oviet	•		2) Tho	nartial	cafoty	factor	v = 1 0	ie incli	ıdod	

fischer injection system FIS EM

Design of Bonded Anchors acc. to TR 029 fischer anchor rods Characteristic values to tension load

Annex 12

⁾ If no other national regulations exist. 3) The partial safety factor $\gamma_2 = 1,2$ is included. 5) $f_{uk} = 700 \text{ N/mm}^2$; $f_{yk} = 560 \text{ N/mm}^2$

The partial safety factor $\gamma_2 = 1.0$ is included. The partial safety factor $\gamma_2 = 1.4$ is included.



Table 7.1: Design of Bonded Anchors acc. to TR 029 Characteristic values to tension load of fischer anchor rods and standard rods

Size			М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Characteristic b					20/25							
Hammer and dia		g (dry and w	et con	crete)								
Temperature rang (60 ℃/35 ℃)	τ _{Rk,cr}	[N/mm ²]	7	7	7	7	6	6	7	7	7	7
Temperature range (72°C/50°C)	e II τ _{Rk,cr}	[N/mm²]	7	7	7	7	6	6	7	7	7	7
Characteristic b	ond resistanc	e in cracke	dconc	rete C	20/25	•		•		•		
Hammer and dia		(flooded he	ole)									
Temperature rang (60°C/35°C)	eΙ τ _{Rk,cr}	[N/mm ²]	6	7,5	7,5	7	6	6	7	6	6	6
Temperature range (72°C/50°C)	e II τ _{Rk,cr}	[N/mm ²]	6	7	7	7	6	6	6	6	6	6
		C25/30 [-]					1,	02				
		C30/37 [-]						04				
Increasing factor	Ψ_{c} .	C35/45 [-]						06				
for $ au_{Rk}$	1 C	C40/50 [-]						07				
		C45/55 [-]						08				
		C50/60 [-]					1,	09				
Splitting failure	•											
Edge distance		h / h _{ef} ≥2,0						h _{ef}				
C _{cr,sp} [mm]	2,0	h / h _{ef} ≥ 1,3						– 1,8 h				
		h / h _{ef} ≤ 1,3						3 h _{ef}				
Spacing	D	s _{cr,sp} [mm]					2 c	cr,sp				
Partial safety factor	Dry and wet concrete	[-]			1,	5 ²⁾				1,8	8 ³⁾	
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1}$	Flooded hole	[-]			1,8 ³⁾					2,1 ⁴⁾		

fischer injection system FIS EM Design of Bonded Anchors acc. to TR 029 Annex 13 fischer anchor rods Characteristic values to tension load

¹⁾ If no other national regulations exist.
²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.
³⁾ The partial safety factor $\gamma_2 = 1,2$ is included.
⁴⁾ The partial safety factor $\gamma_2 = 1,4$ is included.



Cina					BAO.	MAAO	M12	B#4.4	M16	MAGO	MAGG	BAO A	1407	M30
Size	el failure witho	out lever au	rm		M8	M10	IVIIZ	M14	OTIVI	M20	M22	M24	M27	M3U
		Property	5.8	[kN]	9	15	21	29	39	61	76	89	115	141
Characteristic esistance V _{Rks}		class	8.8	[kN]	15	23	34	46	63	98	122	141	184	225
eris e V	Stainless	Property	50	[kN]	9	15	21	29	39	61	76	89	115	141
ract	steel A4	class	70	[kN]	13	20	30	40	55	86	107	124	161	197
Characteristic esistance V _{Rks}	High corrosion	Property	50	[kN]	9	15	21	29	39	61	76	89	115	141
Oφ	resistant steel C	class	70 ³⁾	[kN] [kN]	13 15	20 23	30 34	40 46	55 63	86 98	107 122	124 141	161 184	197 225
Stee	el failure with I	ever arm	00	[KIN]	13	23	34	40	03	90	122	141	104	_ 223
		Property	5.8	[Nm]	19	37	65	104	166	324	447	560	833	1123
₽°₹		class	8.8	[Nm]	30	60	105	167	266	519	716	896	1333	1797
Characteristic bending moment $M^{\mathbb{R}_{\kappa}}$	Stainless	Property	_50	[Nm]	19	37	65	104	166	324	447	560	833	1123
Sterii Official	steel A4	class	70	[Nm]	26	52	92	146	232	454	626	784	1167	1573
ara J m	High corrosion resistant	Property	50 70 ³⁾	[Nm]	19	37	65	104	166	324	447	560	833	1123
된 €	steel C	class	80	[Nm] [Nm]	26 30	52 60	92 105	146 167	232 266	454 519	626 716	784 896	1167 1333	1573 1797
Part	tial safety facto	or	00	וואוון	30	60	105	107	200	019	710	090	1333	1/9/
	Jaioty labor	Property	5.8	[-]					1,	25				
		class	8.8	[-]						25				
4)	Stainless	Property	_50	[-]						38				
γ _{Ms,V} 1)	steel A4	class	70	<u>[-]</u>					1,					
	High corrosion resistant	Property	70 ³⁾	[-]						38 05				
	steel C	class	80	[- <u>]</u> [-]						25 33				
Con	crete pryout fa	ailure	- 00	[-]					۱ ,۰	55				
	r k in Equation													
	nical Report TR	029,	k	[-]					2,0	00				
	on 5.2.3.3									-				
			1\											
	l safety factor		γ Mcp 1)	[-]			- .		1,5		<u> </u>			
Coi	ncrete edge fa	ilure	YMcp			Se	e Tech	ınical R	Report 7	R 029	Section	on 5.2.3	3.4	
Co ı Partia	ncrete edge fa I safety factor		ΥΜcp 1) ΥΜς	[-]		Se			Report 1,	TR 029			3.4	
Partia 1) In al	ncrete edge fa Il safety factor bsence of other	national re	γ _{Mcp} ¹⁾ egulation	[-] ons.		Se			Report 7	TR 029			3.4	
Partia 1) In al	ncrete edge fa I safety factor	national re	γ _{Mcp} ¹⁾ egulation	[-] ons.		Se			Report 1,	TR 029			3.4	
Partia 1) In at 2) The	ncrete edge fa Il safety factor bsence of other partial safety fa	national reactor $\gamma_2 = 1$	YMcp YMc ¹⁾ Pgulation, 0 is income	[-] ons. cluded			³⁾ f _{uk} =	700 N /r	Report 1 1,5 mm²; f _y	$\frac{(R \ 029)}{5^{2)}}$ $R_{k} = 560$	N/mm	2	3.4	
Partia 1) In at 2) The Tak	ncrete edge fa Il safety factor bsence of other partial safety fa ble 9: Displace	national reactor $\gamma_2 = 1$	YMcp YMc ¹⁾ Pgulation, 0 is income	[-] ons. cluded	nchor	rods a	³⁾ f _{uk} = and st	700 N/r andar	Report 1,5 1,5 mm ² ; f _y	$\frac{R}{5^{2}} = 560$ s to te	N/mm	load		Mao
Partia Partia In at Tak	ncrete edge fa Il safety factor bsence of other partial safety fa ble 9: Displace	national reactor $\gamma_2 = 1$	YMcp 1) YMc 1) egulation ,0 is incomposed fisc	[-] ons. cluded her a	nchor	rods a	³⁾ f _{uk} = ³ and st	700 N/r andar M14	Report 1 1,5 mm²; f _y	$\frac{(R \ 029)}{5^{2)}}$ $R_{k} = 560$	N/mm	2	3.4 M27	M30
Partia 1) In at 2) The Tat Size	ncrete edge fa I safety factor bsence of other partial safety fa ble 9: Displace e n-cracked and	national reactor $\gamma_2 = 1$ cements coracked cor	γ _{Mcp} ¹⁾ γ _{Mc} ¹⁾ egulation ,0 is incompleted fiscompleted.	[-] ons. cluded her a	nchor M8 peratu	rods a	³⁾ f _{uk} = ³ and st M12 ge I an	700 N/r andar M14	report 1 1,5 mm ² ; f _y rd rods M16	R 029 5 ²⁾ k = 560 s to te M20	N/mmnsion	load		M30
Partia 1) In at 2) The Tat Size No	ncrete edge fa Il safety factor bsence of other partial safety fa ble 9: Displace	national reactor $\gamma_2 = 1$ cements of cracked control δ_{NO} [n	y _{Mcp} y _{Mc} y _{Mc} y _{Mc} y _{Mc} y _{Mc} y y gegulation of fisc concrete nm/(N/r	[-] ons. cluded her a	nchor	rods a	³⁾ f _{uk} = ³ and st	700 N/r andar M14	Report 1,5 1,5 mm ² ; f _y	$\frac{R}{5^{2}} = 560$ s to te	N/mm	load	M27	0,13
Partia 1) In at 2) The Tat Size Noo Displa Displa	ncrete edge fall safety factor beence of other partial safety factor partial safety factor partial safety factor e. e. n-cracked and acement	national reactor $\gamma_2 = 1$ cements of the control	y _{Mcp} y _{Mc} y	[-] ons. cluded. her a te; tem nm²)]	M8 peratu 0,07 0,11	rods a M10 Ire ran 0,08 0,12	³⁾ f _{uk} = and st M12 ge I an 0,09 0,13	700 N/r andar M14 d II 0,09 0,14	1,5 mm ² ; f _y	R 029 $5^{(2)}$ $t_{k} = 560$ S to te M20 $0,11$	N/mm nsion M22 0,11	load M24 0,12	M27	0,13
Partia 1) In at 2) The Tat Siz No Displa Calc	ncrete edge fa Il safety factor bsence of other partial safety fa ble 9: Displace e n-cracked and acement acement culation of chara	r national reactor $\gamma_2=1$ cements of δ_{N0} [n $\delta_{N\infty}$ [n acteristic di	y _{Mcp} y _{Mc} y	[-] ons. cluded. her a le; tem mm²)] mm²)] ment w	nchor M8 peratu 0,07 0,11 with δ_{N} :	rods a M10 ure ran 0,08 0,12 = (δ _{N0} •	$^{3)} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = $	700 N/r andar M14 d II 0,09 0,14	Report 1 1,5 mm ² ; f _y and rods M16 0,10 0,15	FR 029 5^{2} S to te $M20$ $0,11$ $0,16$	N/mm nsion M22 0,11 0,17	load M24 0,12 0,18	M27	0,13
Partia Partia In at Tat Siz No Displa Calc	ncrete edge fa Il safety factor bsence of other partial safety fa ble 9: Displace e n-cracked and acement acement	r national reactor $\gamma_2=1$ cements of δ_{N0} [n $\delta_{N\infty}$ [n acteristic di	y _{Mcp} y _{Mc} y	[-] ons. cluded. her a le; tem mm²)] mm²)] ment w	nchor M8 peratu 0,07 0,11 with δ_{N} :	rods a M10 ure ran 0,08 0,12 = (δ _{N0} •	$^{3)} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = ^{3)} f_{uk} = ^{3} f_{uk} = $	700 N/r andar M14 d II 0,09 0,14	Report 1 1,5 mm ² ; f _y and rods M16 0,10 0,15	FR 029 5^{2} S to te $M20$ $0,11$ $0,16$	N/mm nsion M22 0,11 0,17	load M24 0,12 0,18	M27	0,13
Partia Partia In at Tat Siz No Displa Calc	ncrete edge far all safety factor besence of other partial safety factor partial safety	r national reactor $\gamma_2=1$ cements of δ_{N0} [n $\delta_{N\infty}$ [n acteristic di	y _{Mcp} y _{Mc} y	[-] ons. cluded. her a le; tem mm²)] mm²)] ment w	$\begin{array}{c c} \textbf{M8} \\ \textbf{M8} \\ \textbf{peratu} \\ \textbf{0,07} \\ \textbf{0,11} \\ \textbf{vith } \delta_{N} = \\ \textbf{ancho} \\ \textbf{M8} \\ \end{array}$	rods a M10 ure ran 0,08 0,12 = $(\delta_{N0} \bullet$ or rods M10	$^{3)}$ $f_{uk} = ^{3)}$ and stand stand $^{3)}$ $\frac{M12}{9e \ land \ 0,09}$ $\frac{0,13}{0,13}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ and stand $\frac{1}{3}$	700 N/r andar M14 d II 0,09 0,14	1,5 mm ² ; f _y od rods M16 0,10 0,15	R 029 5 ² s to te M20 0,11 0,16 ds to s M20	N/mm nsion M22 0,11 0,17	load M24 0,12 0,18 load M24	M27	0,13 0,19
Partia Partia In at Tat Size No Displa Calc Tat Size Displa Calc Tat Displa	ncrete edge far la safety factor besence of other partial safety factor below the partial safe	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n acteristic diagram)	$\gamma_{\rm Mcp}$ $\gamma_{\rm Mc}^{(1)}$ egulation, of fisconorein $\gamma_{\rm Mc}$ concrete $\gamma_{\rm Mc}$ especially $\gamma_{\rm Mc}$ e	[-] ons. cluded her a te; tem mm²)] mm²)] ment v scher	mchor M8 nperatu 0.07 0.11 with $\delta_{\rm N}$ = ancho 0.18	rods a M10 are ran 0,08 0,12 = $(\delta_{N0} \bullet r rods)$ M10 0,15	and st $\frac{\mathbf{M12}}{\mathbf{ge \ I \ and}}$ 0.09 0.13 0.73 0.73 0.73	700 N/r andar M14 0,09 0,14 1,4 standa M14 0,10	1,5 mm²; fy rd rods M16 0,10 0,15 ard rod M16 0,09	R 029 5 ² 5 to te M20 0,11 0,16 ds to s M20 0,07	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06	0,12 0,19 M27 0,05	0,13 0,19 M30 0,05
Partia Partia In at Tat Siz No Displa Calc Tat Siz Calc Tat Displa Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor partial safety factor partial safety factor partial safety facement accement pulation of characteristics of the sacement accement accement accement accement accement	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n accements	$\gamma_{\text{Mcp}}^{\text{1}}$ $\gamma_{\text{Mc}}^{\text{1}}$ egulation, of fisconores in $\gamma_{\text{Mc}}^{\text{1}}$ concrete in $\gamma_{\text{Mc}}^{\text{1}}$ especially in	[-] ons. cluded her a te; tem mm²)] mm²)] ment w scher m/kN] m/kN]	mchor M8 nperatu 0.07 0.11 with δ_N ancho M8 0.18 0.27	rods a M10 ure ran 0,08 0,12 = $(\delta_{N0} \bullet 100)$ or rods 0,15 0,22	$^{3)}$ $f_{uk} =$ and st M12 ge I an 0,09 0,13 \circ τ_{Sd}) / \circ and s M12 0,12 0,18	700 N/r andar M14 od II 0,09 0,14 1,4 standa M14 0,10 0,16	1,5 mm ² ; f _y od rods M16 0,10 0,15	R 029 5 ² s to te M20 0,11 0,16 ds to s M20	N/mm nsion M22 0,11 0,17 shear M22	load M24 0,12 0,18 load M24	0,12 0,19	0,13 0,19 M30 0,05
Partia 1) In at 2) The Tat Siz No Displa Calc Tat Siz Calc Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor below the partial safe	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n accements	$\gamma_{\text{Mcp}}^{\text{1}}$ $\gamma_{\text{Mc}}^{\text{1}}$ egulation, of fisconores in $\gamma_{\text{Mc}}^{\text{1}}$ concrete in $\gamma_{\text{Mc}}^{\text{1}}$ especially in	700 N/r andar M14 od II 0,09 0,14 1,4 standa M14 0,10 0,16	1,5 mm²; fy rd rods M16 0,10 0,15 ard rod M16 0,09	R 029 5 ² 5 to te M20 0,11 0,16 ds to s M20 0,07	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06	0,12 0,19 M27 0,05	0,13 0,19 M30 0,05				
Partia 1) In at 2) The Tat Siz No Displa Calc Tat Siz Calc Displa Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor partial safety factor partial safety factor partial safety facement accement pulation of characteristics of the sacement accement accement accement accement accement	r national reactor $\gamma_2=1$ cements δ_{N0} [n $\delta_{N\infty}$ [n acteristic diacteristic	$\gamma_{\text{Mcp}}^{\text{1/Mcp}}$ egulation, 0 is incomplete of fiscomore of fi	[-] ons. cluded. her a le; tem mm²)] ment w scher a le; m/kN] ment v	$\begin{array}{c c} \textbf{M8} \\ \textbf{N9eratu} \\ \textbf{0,07} \\ \textbf{0,11} \\ \textbf{vith } \delta_{\text{N}} = \\ \textbf{ancho} \\ \textbf{M8} \\ \textbf{0,18} \\ \textbf{0,27} \\ \textbf{vith } \delta_{\text{V}} = \\$	rods a M10 ure ran 0,08 0,12 = $(\delta_{N0} \bullet 0,0)$ or rods $(\delta_{N0} \bullet 0,0)$	3) f _{uk} = 3 and st M12 ge I an 0,09 0,13 τ _{Sd}) / τ s and s M12 0,12 0,18 v V _{Sd}) /	700 N/r andar M14 od II 0,09 0,14 1,4 standa M14 0,10 0,16	1,5 mm²; fy rd rods M16 0,10 0,15 ard rod M16 0,09	R 029 5 ² 5 to te M20 0,11 0,16 ds to s M20 0,07	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06	0,12 0,19 M27 0,05	0,13 0,19 M30 0,05
Partia 1) In at 2) The Tat Siz No Displa Calc Tat Siz Calc Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor partial safety far ble 9: Displace n-cracked and accement culation of characteristics of characteristics accement accem	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n acteristic diacements	$\gamma_{\text{Mcp}}^{\text{1/Mcp}}$ egulation,0 is incoording to some entropy of the concrete entropy of the conc	[-] ons. cluded. her a le; ten mm²)] ment was cher a m/kN] ment v	mchor M8 0,11 with $\delta_{\rm N}$ = ancho M8 0,27 with $\delta_{\rm V}$ = system	rods a M10 ure ran 0,08 0,12 = $(\delta_{N0} \bullet 0,15)$ 0,22 = $(\delta_{V0} \bullet 0,15)$ 0,22 m FIS	3) f _{uk} = 3 and st M12 ge I an 0,09 0,13 0 τ _{Sd}) / 3 and s M12 0,12 0,18 0 V _{Sd}) /	700 N/r andar M14 0,09 0,14 1,4 standa M14 0,10 0,16 1,4	mm ² ; f _y d rods M16 0,10 0,15 ard rod M16 0,09 0,14	R 029 5 ² s to te M20 0,11 0,16 ds to s M20 0,07 0,11	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06 0,09	0,12 0,19 M27 0,05 0,08	0,13 0,19 M30 0,05 0,07
Partia Partia In at Tat Siz No Displa Calc Tat Siz Calc Tat Displa Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor partial safety factor partial safety factor partial safety facement accement pulation of characteristics of the sacement accement accement accement accement accement	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n acteristic diacements acteristic diffische onded Ar	γ_{Mcp} γ_{Mc} $\gamma_{$	[-] ons. cluded. her a te; ten mm²)] ment v cher: m/kN] m/kN] ment v ction:	mchor M8 0.07 0.11 with δ_N = ancho 0.18 0.27 with δ_V = system to TF	rods a M10 Jre ran 0,08 0,12 = $(\delta_{N0} \bullet 0,15)$ 0,22 = $(\delta_{V0} \bullet 0,15)$ 0,22 = $(\delta_{V0} \bullet 0,15)$ 0,22 = $(\delta_{V0} \bullet 0,15)$	$^{3)}$ $f_{uk} = ^{3)}$ and stand stand $^{3)}$ $\frac{M12}{0.09}$ $\frac{0.13}{0.13}$ $\frac{0.13}{0.12}$ $\frac{0.12}{0.18}$ $\frac{0.12}{0.18}$ $\frac{0.18}{0.12}$ $\frac{0.18}{0.18}$	700 N/r andar M14 0,09 0,14 1,4 standa M14 0,10 0,16 1,4	mm ² ; f _y d rods M16 0,10 0,15 ard rod M16 0,09 0,14	R 029 5 ² s to te M20 0,11 0,16 ds to s M20 0,07 0,11	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06 0,09	0,12 0,19 M27 0,05	0,13 0,19 M30 0,05 0,07
Partia Partia Partia In at Tat Siz No Displa Calc Tat Siz Calc Displa Displa Displa Displa Displa	ncrete edge far la safety factor besence of other partial safety factor partial safety far ble 9: Displace n-cracked and accement culation of characteristics of characteristics accement accem	r national reactor $\gamma_2=1$ cements δ_{No} [n $\delta_{N\infty}$ [n acteristic diacements	γ_{Mcp} γ_{Mc} $\gamma_{$	[-] ons. cluded her a le; tem mm²)] mm²)] ment w cher a le; tem m/kN] ment v ction a c	mchor M8 0.07 0.11 with δ_N = ancho 0.18 0.27 with δ_V = system to TF	rods a M10 ure ran 0,08 0,12 = $(\delta_{N0} \bullet 0,15)$ 0,22 = $(\delta_{V0} \bullet 0,15)$ m FIS 3 029 shea	$^{3)}$ $f_{uk} = ^{3)}$ and stand stand $^{3)}$ $\frac{M12}{0.09}$ $\frac{0.13}{0.13}$ $\frac{0.13}{0.12}$ $\frac{0.12}{0.18}$ $\frac{0.12}{0.18}$ $\frac{0.18}{0.12}$ $\frac{0.18}{0.18}$	700 N/r andar M14 0,09 0,14 1,4 standa M14 0,10 0,16 1,4	mm ² ; f _y d rods M16 0,10 0,15 ard rod M16 0,09 0,14	R 029 5 ² s to te M20 0,11 0,16 ds to s M20 0,07 0,11	N/mm nsion M22 0,11 0,17 shear M22 0,07	load M24 0,12 0,18 load M24 0,06 0,09	0,12 0,19 M27 0,05 0,08	0,13 0,19 M30 0,05 0,07



Size				М 8	M 10	M 12	M 16	M 20
Steel failure								
	Pro	perty 5.	8 [kN]	19	29	43	79	123
Characteristic	cla			29	47	68	108	179
resistance with	NI	perty A		26	41	59	110	172
screw		ss 70 C		26	41	59	110	172
	Pro	perty 5.	8 [-]			1,50		•
Partial safety	, 1) cla					1,50		
factor	γ _{Ms, N} Pro	perty A	4 [-]			1,87		
	cla	ss 70 C	[-]			1,87		
Combined pullout a	nd concrete	failure						
Diameter of calculation	on	d _H	[mm]	12	16	18	22	28
Effective anchorage		h _{ef}	[mm]	90	90	125	160	200
Characteristic bond		n non-crack		,				
Temperature range I	· · · · · · · · · · · · · · · · · · ·	$ au_{Rk,ucr}$	[N/mm ²]	15	14	14	13	12
Temperature range II		$ au_{Rk,ucr}$		14	13	13	12	11
Characteristic bond		in non-cracl				<u>lrilling (flo</u>		
Temperature range I	·	$ au_{Rk,ucr}$	[N/mm ²]	14	12	12	11	10
Temperature range II		$ au_{Rk,ucr}$	[N/mm ²]	13	12	11	10	9
Characteristic bond		in non-cracl		· · · · · · · · ·		drilling (dr	y and wet	concrete)
Temperature range I	·	$ au_{Rk,ucr}$	[N/mm ²]	13	12	11	10	9
Temperature range II		$ au_{Rk,ucr}$	[N/mm ²]	12	11	10	9	8
Characteristic bond		in non-crack		te C20/25,	diamond-c	drilling (flo	oded hole)	
Temperature range I	· · · · · · · · · · · · · · · · · · ·	$ au_{Rk,ucr}$	[N/mm ²]	13	12	11	10	9
Temperature range II	,	$ au_{Rk,ucr}$	[N/mm ²]	12	11	10	9	8
Characteristic bond re		racked concr		Hammer an	d diamond	drilling (dry	and wet co	ncrete)
Temperature range I		$ au_{Rk,cr}$	[N/mm ²]	7	6	6	7	7
Temperature range II			[N/mm ²]	7	6	6	7	7
Characteristic bond		in cracked c		20/25. Hamr	ner and dia	mond drilli	ng (flooded	hole)
Temperature range I	•	$ au_{Rk,cr}$	[N/mm ²]	7	6,5	6	7	6
Temperature range II	I (72°C/50°C)	$ au_{Rk,cr}$	[N/mm ²]	7	6	6	6	6
		C25/30				1,02		
		C30/37				1,04		
Increasing factors	Ψ_{c}	<u>C35/45</u>				1,06		
for N _{Rk}	- C	C40/50				1,07		
		C45/55				1,08		
0 11111		C50/60) [-]			1,09		
Splitting failure		la /	'h > 0 0			1 O b		
Edge distance	o [mm]		h _{ef} ≥ 2,0		1	1,0 h _{ef}	h	
Euge distance	c _{cr,sp} [mm]		$h_{ef} > 1.3$		4	,6 h _{ef} – 1,8	<u> </u>	
Spacing			h _{ef} ≤ 1,3 r _{rsp} [mm]			2,26 h _{ef} 2 c _{cr,sp}		
эрасту	day and wa		_{r,sp} [mm]			Z C _{cr,sp}	1	
Partial safety	dry and we	L	[-]		1,5 ²⁾		1,	8 ³⁾
factor	concrete							
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{-1}$	flooded hol	e	[-]		1,8 ³⁾		2,	1 ⁴⁾
				3)				
 If no other nation The partial safety 	al regulations γ_1 factor $\gamma_2 = 1$	s exist. ,0 is included	I.				1,2 is inclu 1,4 is includ	
	fischer	injection s	ystem FIS	S EM				
D	esign of Bo	onded Anc	hors acc.	to TR 029	9		Anne	x 15



Table 12: Des	•								
	<u>aracteristi</u>	c values to	<u>shear</u>	load of					
Size					M 8	M 10	M 12	M 16	M 20
Steel failure witho	out lever ar	m							
Characteristic		Property	5.8	[kN]	9,2	14,5	21,1	39,2	62
resistance	W	class	8.8	[kN]	14,6	23,2	33,7	54,0	90
resistance	$V_{Rk,s}$	Property	A4	[kN]	12,8	20,3	29,5	54,8	86
		class 70	С	[kN]	12,8	20,3	29,5	54,8	86
		Property	5.8	[-]			1,25		
Partial safety	1)	class	8.8	[-]			1,25		
factor	γ Ms, $v^{1)}$	Property	A 4	[-]			1,56		
		class 70	C	[-]			1,56		
Steel failure with I	lever arm								
Ol t- wintin		Property	5.8	[Nm]	20	39	68	173	337
Characteristic	$M^0_{Rk,s}$	class	8.8	[Nm]	30	60	105	266	519
bending moment	IVI Rk,s	Property	A 4	[Nm]	26	52	92	232	454
		class 70	C	[Nm]	26	52	92	232	454
		Property	5.8	[-]			1,25		
Partial safety		class	8.8	[-]			1,25		
factor	γ Ms, V	Property	A4	[-]			1,56		
		class 70	C	[-]			1,56		
Concrete pryout	t failure								
Factor k in Equation	n (5.7) of T	echnical	k	r 1			2.0		
Report TR 029, Sec	ction 5.2.3.	3	K	[-]			2,0		
Partial safety factor	r		γωσ	;p ¹⁾ [-]			1,5 ²⁾		
Concrete edge fa	ailure				See T	echnical Re	port TR 02	9, Section 5	5.2.3.4

¹⁾ In absence of other national regulations.

Partial safety factor

Table 13: Displacements of fischer internal threaded anchors RG MI to tension load

Size		M 8	M 10	M 12	M 16	M 20
Non-cracked concrete and o	cracked concrete; temperat	ure range	I and II			
Displacement	δ_{N0} [mm/(N/mm ²)]	0,09	0,10	0,10	0,11	0,13
Displacement	$\delta_{N^{\infty}}[mm/(N/mm^2)]$	0,13	0,15	0,15	0,17	0,19

Calculation of characteristic displacement with $\delta_N = (\delta_{N0} \bullet \tau_{Sd}) / 1,4$

Table 14: Displacements of fischer internal threaded anchors RG MI to shear load

Size		M 8	M 10	M 12	M 16	M 20
Displacement	δ _{V0} [mm/kN]	0,12	0,09	0,08	0,07	0,05
Displacement	δ _{V∞} [mm/kN]	0,18	0,14	0,12	0,10	0,08

Calculation of characteristic displacement with $\delta_V = (\delta_{V0}\, \bullet \, V_{Sd}) \, / \, 1,4$

fischer injection system FIS EM

Design of Bonded Anchors acc. to TR 029 fischer internal threaded anchors RG MI Characteristic values to shear load; Displacements

Annex 16

²⁾ The partial safety factor $\gamma_2 = 1.0$ is included.



	40		691			40			12	10			8	8			7	7		7	7			
ွ	36		260			36			12	11			8	∞			∞	7		ω	7			
g bar	34		499			34			12	11			6	∞			ω	7		ω	7			
orcin	32		443			32			12	11			6	∞			∞	∞		ω	ω			
reinf	30		389			30			12	11			6	တ			တ	∞		တ	∞	1,8 ³⁾		nm².
ad of	28		339			78			13	11			10	თ			ი	∞		ი	∞	<u> </u>	2,14)	= 500 N/mm ²
ol no	56		292			56			5	11			10	თ			თ	∞		ი	∞			,k = 5(
tensi	22		270			52			13	12			10	ი			ი	ი		တ	တ			es for reinforcing bars B500B with f_{uk} = 550 N/mm² and f_{yk} :ulated according to TR 029, Equation (5.1). s. 3) The partial safety factor γ_2 = 1,2 is included uded. $^{(4)}$ The partial safety factor γ_2 = 1,4 is included
es to	24		249	1,4		54			13	12			10	9			10	တ		10	თ			4/mm ² is inclusion in para para para para para para para par
valu	22		209			22			13	12			11	10			10	တ		10	တ			rcing bars B500B with f_{uk} = 550 N/mm ² and rding to TR 029, Equation (5.1). 3) The partial safety factor γ_2 = 1,2 is included 4) The partial safety factor γ_2 = 1,4 is included
	20		173			50			13	12			11	F			10	10		10	10			h f _{uk} = ation (stor γ ₂ stor γ ₂ stor γ ₂ stor γ ₂ stor γ ₃ stor γ ₄ stor γ ₅ stor γ
aracte	18		140			8			4	13			12	72			9	유	-	F	9	: :		B wit Equa ety fac ety fac
); Ch	16		111			16	/25		4	13	/25		12	Ξ	Į,	62/	12	Ξ	/25	7	Ξ			B50(R 029 Ial safalal safalal safalal
3 029	14		85			14	te C20		4	13	te C20		13	12	_ 5	ie CZU	12	Ξ	te C20	12	Ξ	1,52)	1,8 ³⁾	g bars g to T ne part e part
to TF	12		63			12	oncret		15	14	oncret		14	13		oncrei	13	7	oncret	5	12			forcing ording
acc.	10		44			10	ked cc		16	14	cracked concrete C20/25		16	14		cracked concrete CZU/Z5 9)	15	4	cracked concrete C20/25	15	4			r reinf d acc
chors	ω		28		o	∞	-cracl	(e)	16	15			16	15	_		16	15		16	15			culate culate ns.
of Bonded And	ρØ		ıce N _{Rk,s} [kN]	γ _{Ms.N} [-]	d concrete failur	lmm] b uc	resistance in non	and wet concrete	$\tau_{Rk,ucr} [N/mm^2]$	$ au_{Rk,ucr} \left[N/mm^2 ight]$	resistance in non	ded hole)	$ au_{Rk,ucr} \left[N/mm^2 ight]$	τ _{Rk,ucr} [N/mm ²]		resistance in non- / and wet concret	TRK,ucr [N/mm²]	$\tau_{Rk,uor}[N/mm^2]$	resistance in non oded hole)	$\tau_{ m Rk,ucr} [{ m N/mm}^2]$	τ _{Rk,ucr} [N/mm²]	Dry and wet [-]	Flooded [-]	Table 15. are values have to be calonational regulation ctor $\gamma_2 = 1,0$ is incl
Table 15: Design of Bonded Anchors acc. to TR 029; Characteristic values to tension load of reinforcing bars	Size	Steel failure	Characteristic resistance Reinforcing bars	Partial safety factor	Combined pullout and concrete failure	Diameter for calculation	Characteristic bond resistance in non-cracked concrete C20/25	hammer-drilling (dry and wet concrete)	Temperature range I (60°C/35°C)	Temperature range II (72°C/50°C)	Characteristic bond resistance in non-	hammer-drilling (flooded hole)	Temperature range I (60°C/35°C)	Temperature range II	(12 0/30 0)	Characteristic bond resistance in non diamond-drilling (dry and wet concret	Temperature range I (60°C/35°C)	Temperature range II (72°C/50°C)	Characteristic bond resistance in non-diamond-drilling (flooded hole)	Temperature range I (60°C/35°C)	Temperature range II (72°C/50°C)	>	$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1}$	The values given in Table 15. are values for reinforcing bars B500B with f_{uk} = 550 Other reinforcing bars have to be calculated according to TR 029, Equation (5.1). (5.1) In absence of other national regulations. (6.1) The partial safety factor $\gamma_2 = 1$, 0 is included.
						sig	jn d	of		ded einf	An orc	ch in	nors g ba	acc rs	. t	οТ	R 02	9					Anr	nex 17



	T										Г									Τ										_
	40		2	5		5	5	-																						
	36		2	5		5	5																							
bars	34		2	5		5	5																							
rcing	32	(e)	2	5		5	5																							
einfo	30	ncret	7	7		9	9												(2)			7								
d of re	28	and wet concrete)	7	7	(a)	9	9												1,8 ³⁾	;	2,1 ⁴	9	N 000							
ı loac	56	and v	7	2	(flooded hole	9	9															4	<u>¥</u>							
nsior	25	(dry	2	7		9	ဖ									3 h						200	מבום							
to te	24	rilling	7	7	rilling	9	9	1,02	1,04	1,06	1,07	1,08	1,09		1,0 h _{ef}	4,6 h _{ef} – 1,8 h	2,26 h _{ef}	2 C _{cr.sp}				N (N								
Table 15.1: Design of Bonded Anchors acc. to TR 029; Characteric values to tension load of reinforcing bars	22	Characteristic bond resistance in cracked concrete C20/25. Hammer and diamond drilling		2	diamond drilling	7	9	ļ .							-	4,6 h	c,	2				r r	The values given in Table 15.1 are values for removing bars boods with $t_{uk} = 550$ N/min and $t_{yk} = 500$ N/min. Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).							
ric va	20	diam	9	9	diam	9	9															٠ <u>٠</u>	ion ⊊ S							
racte	18	rand	9	9	rand	9	9															2	Equal							
Cha	16	ımme	9	9	ımme	6,5	9															000	6 D 20.							
029;	14	25. Ha		2	Characteristic bond resistance in cracked concrete C20/25. Hammer and	6,5	9												$1,5^{2)}$				g pars to TR							
o TR	12	C20/		2	C50/	6,5													-	i	1,8 ³		rding	ı						
acc. t	10	crete			crete	7,5 6	7															• • • • • • • • • • • • • • • • • • •	acco							
ors a		d con			d con		7															j	es lor lated		jed.	jed.				
Anch	8 Р	racke	2 7	2 2	racke	9 6	9		:::		Ļ	<u> </u>			0	ဗ	က		[-]	+	工	1	calcu	ations.	1,0 is includ	1,2 is includ 1 4 is includ	5			
pəp	Ø	e in c	^{твк} е [N/mm ²]	trk.cr [N/mm ²]	e in c	t _{Rk.gr} [N/mm ²]	TRK.gr [N/mm ²]	C25/30 [C30/37 [C40/50 [-]	C45/55 [-			$h/h_{ef} \ge 2,0$, I< j	$h/h_{ef} \le 1,3$	S _{cr.sp} [mm]		2 5		•	to be	regula			<u>2</u> -			
f Bon		stanc	_		stanc	_	_	3	පි	ප	2	2	S		h/h	2,0 >h / h _{ef} >1,3	h/h	Scr.	Dry and wet		hole	7 2	ole Io have	tional	ır γ ₂ =	= 12/2 = 2/2 = 2/2	- Z			
gn of		resi:		_	resi:		=			Ä	÷					2,0			Dry	,			in rar bars	1) In absence of other national regulations.	$^{2)}$ The partial safety factor γ_2	$^{3/}$ The partial safety factor $\gamma_2 = ^{4/}$ The partial safety factor $\gamma_2 = ^{4/}$				
Desi		bonc	range l	ange l	bonc	ange l	range l			ors				(a)			l						Jiven rcing	of oth	safety	safety	saiciy			
5.1:		ristic		ture r	eristic	ture ra	ture ra			g fact)			failu	2	י פון בי	_		ıfety	5	YMsp	9	einfo	sence	artial	artial	2			
ble 1	a)	aracte	Temperature (60°C/35°C)	Temperature range II (72°C/50°C)	aracte	Temperature range (60°C/35°C)	Temperature (72°C/50°C)			Increasing factors	Ę,			Splitting failure	i	Euge distance	Ccr, sp [111111]	Spacing	Partial safety factor	ا آ ج	YMp=YMc = YMsp	, ,	ther r	In abs	The p	The p	2			
Ta	Size	ວັ	Ter (60	Ter (72	ပ်	Ter (60	Ter (72			<u>n</u>	for the			Sp	'	Ď U	يْ:	Sp	Partia factor	2 2	ďW,	F	- O: 	- 6	ରି ଚି	5 4				
							er inj				_															_				^
				Des	sig	n of	Bond R						s a). t	0 -	TR	0 1	29							F	۱n	nex	k 1	3
				(<u>Ch</u>	arac	<u>teris</u>								sio	n	loa	<u>ad</u>												







Size				M12	M16	M20	M24
Steel failure			·				1
Characteristic resist		$N_{Rk,s}$	[kN]	63	111	173	270
Partial safety factor		$\gamma_{Ms,N}^{1)}$	[-]		1	,4	
	and concrete failu						
Diameter of calculate		d	[mm]	12	16	20	25
	d resistance in no lry and wet concre		concrete C	20/25			
Temperature range		τ _{Rk,ucr}	[N/mm ²]	15	14	13	13
Temperature range		τ _{Rk,ucr}	[N/mm ²]	14	13	12	12
	d resistance in no					<u> </u>	
hammer-drilling (fl							
Temperature range	I (60°C/35°C)	$ au_{Rk,ucr}$	[N/mm ²]	15	13	11	10
Temperature range		$ au_{Rk,ucr}$	[N/mm ²]	14	12	11	10
	d resistance in no		concrete C	20/25			
	dry and wet concre		IN 1 / 21	40	10	10	10
Temperature range		τ _{Rk,ucr}	[N/mm ²]	13 12	12	10	10
Temperature range	il (72°C/50°C) Id resistance in no	τ _{Rk,ucr}	[N/mm²]	• =	11	10	9
Cnaracteristic bon diamond-drilling (1		п-сгаскеа	concrete C	ZU/Z3			
Temperature range		τ _{Rk.ucr}	[N/mm ²]	13	12	10	10
Temperature range	` '	τ _{Rk,ucr}	[N/mm ²]	12	11	10	9
	d resistance in cra	acked con				, , ,	
	ond drilling (dry a						
Temperature range	I (60°C/35°C)	$ au_{Rk,cr}$	[N/mm ²]	7	6	6	7
Temperature range		$ au_{Rk,cr}$	[N/mm ²]	7	6	6	7
Characteristic bon			crete C20/2	5.			
Hammer and diam			[N1/:21				
Temperature range Temperature range	, , , , , , , , , , , , , , , , , , , ,	τ _{Rk,cr}	[N/mm ²] [N/mm ²]	7 7	6	6	6
remperature range	II (72°C/50°C)	$ au_{Rk,cr}$	C25/30 [-]	/		02	0
			C30/37 [-]			04	
Increasing factors		_	C35/45 [-]			06	
for τ_{Rk}			C40/50 [-]			07	
			C45/55 [-]			08	
			C50/60 [-]		1,	09	
Splitting failure							
	- Francis 7		/ h _{ef} ≥ 2,0			h _{ef}	
Edge distance	c _{cr,sp} [mm]		$\frac{/ h_{ef} > 1,3}{/ h_{ef} \le 1,3}$			– 1,8 h 6 h _{ef}	
Spacing	S _{cr,sp}					cr.sp	
Partial safety		wet concre			1,5 ²⁾	cr,sp	1,8 ³⁾
factor	ary aria				*		
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1}$		flooded ho	le [-]		1,8 ³⁾		2,14)
	other national regu	lations					
	fety factor $\gamma_2 = 1.0$ i						
3) The partial sa	fety factor $\gamma_2 = 1,0$ fety factor $\gamma_2 = 1,2$ i	s included.					
4) The partial sa	fety factor $\gamma_2 = 1,4$ is	s included.					
,	•=						
	6'						
	fischer injed	ction syst	em FIS EN	/I			
				·D 000			nex 20
г	Jacian of Panda	4 Vnvpv	'C 200 +0	P U.YO			14:X /!!
Ι	Design of Bonde			R 029		AIII	IEX ZU
[•	ebar ancl	hor FRA			AIII	I C X 20



Table 20: Design of Bonded Anchors acc. to TR 029 Characteristic values to shear load of fischer rebar anchors FRA

Size			M12	M16	M20	M24		
Steel failure		•						
Characteristic	$V_{Rk.s}$	[kN]	30	55	86	124		
resistance	▼ Hk,s	[KIA]		33	00	124		
Partial safety factor	γ _{Ms,V}	[-]		1,	56			
Steel failure with lever arm								
Characteristic bending	$M^0_{Rk,s}$	[Nm]	92	233	454	785		
moment	IVI Rk,s	נואווון	92	200	454	765		
Partial safety factor	γ _{Ms,V}	[-]		1,	56			
Concrete pryout failure								
Factor k in Equation (5.7)								
of Technical Report TR 029,	k	[-]		2	,0			
Section 5.2.3.3								
Partial safety factor	γ _{Mcp} ¹⁾	[-]	1,5 ²⁾					
Concrete edge failure			See Te	chnical Report	ΓR 029, Section	5.2.3.4		
Partial safety factor	γ _{Mc} ¹⁾	[-]		1,	5 ²⁾	-		

Table 21: Displacements of fischer rebar anchors FRA to tension load

Size	Ø	12	16	20	24
Non-cracked and cracked co	ncrete; temperature range	l and II			
Displacement	δ_{N0} [mm/(N/mm ²)]	0,09	0,10	0,11	0,12
Displacement	$\delta_{N\infty}$ [mm/(N/mm ²)]	0,13	0,15	0,16	0,18

Calculation of characteristic displacement with $\delta_N = (\delta_{N0} \, \bullet \, \tau_{Sd}) \, / \, 1,4$

Table 22: Displacements of fischer rebar anchors FRA to shear load

Size	1 12	16	20	24
Displacement δ_{V0} [mm/kN	0,12	0,09	0,07	0,06
Displacement δ _{V∞} [mm/kN	0,18	0,14	0,11	0,09

Calculation of characteristic displacement with $\delta_V = (\delta_{V0} \bullet V_{Sd}) / 1,4$

fischer injection system FIS EM	
Design of Bonded Anchors acc. to TR 029 fischer rebar anchor FRA	Annex 21
Characteristic values to shear load	

 $^{^{1)}}$ In absence of other national regulations. $^{2)}$ The partial safety factor $\gamma_2=1,\!0$ is included.



Table 23: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Characteristic values to tension load of fischer anchor rods and standard rods

Ona	i aciensiic v	alues to te	1151011	luau	JI 115C	nei ai	iciioi i	ious a	iiiu Sid	anuan	ı ious	
Size			М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Steel failure												
	Property	5.8 [kN]	19	29	43	58	79	123	152	177	230	281
Stainless steel A4 High corrosion resistant steel	class	8.8 [kN]	30	47	68	92	126	196	243	282	368	449
Stainless steel	Property _	50 [kN]	19	29	43	58	79	123	152	177	230	281
<u> </u>	class	70 [kN]	26	41	59	81	110	172	212	247	322	393
Stainless steel A4 High corrosion resistant steel	Property -	50 [kN]	19	29	43	58	79	123	152	177	230	281
	class -	70 ⁵⁾ [kN]	26	41	59	81	110	172	212	247	322	393
С		80 [kN]	30	47	68	92	126	196	243	282	368	449
	Property __	5.8 [-]						50				
₹	class	8.8 [-]						50				
Stainless steel	Property _	50 [-]						86				
S S A4 S S S S S S S S S	class	70 [-]						87				
Stainless steel Stainless steel High corrosion	Property -	50 [-]					2,8					
10001011101001	class -	70 ⁵⁾ [-]						50				
С		80 [-]					1,0	60				
Combined pullo				1	1	1			1	T		
Diameter of calcula		d[mm]_	8	10	12	14	16	20	22	24	27	30
Characteristic bo		e in non-crae	cked co	oncrete	C20/25	hamm	<u>ner-drill</u>	ling (dr	y and v	vet cor	<u>icrete)</u>	
Temperature range (60°C/35°C)	eΙ τ _{Rk,ucr}	[N/mm ²]	16	16	15	14	14	13	13	13	12	12
Temperature range (72°C/50°C)	e II τ _{Rk,ucr}	[N/mm²]	15	14	14	13	13	12	12	12	11	11
Characteristic b	ond resistand	e in non-cra	cked c	oncrete	C20/2	5 hamn	ner-dril	ling (flo	oded I	nole)		
Temperature range (60°C/35°C)	τ _{Rk,ucr}	[N/mm ²]	16	16	15	13	13	11	11	10	10	9
Temperature range (72°C/50°C)	e II τ _{Rk,ucr}	[N/mm ²]	15	14	14	13	12	11	10	10	9	9
Characteristic bo	nd resistance	e in non-crac	ked co	ncrete	C20/25	diamo	nd-drill	ing (dr	y and w	vet con	crete)	•
Temperature range (60°C/35°C)	e I τ _{Rk,ucr}	[N/mm ²]	16	15	13	12	12	10	10	10	9	9
Temperature range (72°C/50°C)	e II τ _{Rk,ucr}	[N/mm ²]	15	14	12	11	11	10	9	9	8	8
Characteristic bor	nd resistance	in non-crack	ed cor	ncrete C	20/25	diamor	d-drilli	ng (floc	oded ho	ole)	.1	
Temperature range (60°C/35°C)		[N/mm ²]	16	15	13	12	12	10	10	10	9	9
Temperature range (72°C/50°C)	e II τ _{Rk,ucr}	[N/mm ²]	15	14	12	11	11	10	9	9	8	8
Factor for non-crac	cked concrete	k ₈ =k _{ucr} [-]	1	1	1	1	1	0,1	1	1		
Partial safety	Dry and wet concrete	-	1,5 ²⁾ 1,8 ³⁾									
factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1}$	Flooded hole	e [-]					2	,1 ⁴⁾	•			
1) If no other poti					2) The			£ 1				

fischer injection system FIS EM

Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 fischer anchor rods Characteristic values to tension load

Annex 22

 $^{^{1)}}$ If no other national regulations exist. $^{3)}$ The partial safety factor $\gamma_2=1,2$ is included. $^{5)}$ f_{uk} = 700 N/mm²; f_{yk} = 560 N/mm²

The partial safety factor $\gamma_2 = 1.0$ is included. The partial safety factor $\gamma_2 = 1.4$ is included.



Table 23.1: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Characteristic values to tension load of fischer anchor rods and standard rods

Size			М8	M10	M12	M14	M16	M20	M22	M24	M27	M30	
Characteristic k	ond resistan	ce in cracke	d conc	rete C	20/25								
Hammer and di		g (dry and w	et con	crete)									
Temperature rang (60℃/35℃)	je I τ _{Rk,cr}	[N/mm ²]	7	7	7	7	6	6	7	7	7	7	
Temperature rang (72°C/50°C)	je II τ _{Rk,cr}	[N/mm²]	7	7	7	7	6	6	7	7	7	7	
Characteristic bond resistance in cracked concrete C20/25													
Hammer and diamond drilling (flooded hole)													
Temperature rang (60°C/35°C)	je I τ _{Rk,cr}	[N/mm ²]	6	7,5	7,5	7	6	6	7	6	6	6	
Temperature rang (72°C/50°C)	je II τ _{Rk,cr}	[N/mm ²]	6	7	7	7	6	6	6	6	6	6	
Factor for cracked	concrete k ₈ :	=k _{cr} [-]		•	'		7	,2					
		C25/30 [-]	1,02										
		C30/37 [-]	1,04										
Increasing factor	Ψ_{c}	C35/45 [-]	1,06										
for $ au_{Rk}$	ı c	C40/50 [-]	1,07										
		C45/55 [-]_						08					
		C50/60 [-]	1,09										
Splitting failure)												
Edge distance		h / h _{ef} ≥ 2,0						h _{ef}					
c _{cr,sp} [mm]	2,0	h / h _{ef} ≥ 1,3						– 1,8 h					
		h / h _{ef} ≤ 1,3						3 h _{ef}					
Spacing		s _{cr,sp} [mm]					2 c	cr,sp	I				
Partial safety factor	Dry and wet concrete	[-]	-]										
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1)}$	Flooded hole	[-]			1,8 ³⁾					2,1 ⁴⁾			

Displacements see Annex 14

fischer injection system FIS EM	
Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009	Annex 23
fischer anchor rods	Ailliex 23
Characteristic values to tension load	

¹⁾ If no other national regulations exist.
²⁾ The partial safety factor $\gamma_2 = 1,0$ is included.
³⁾ The partial safety factor $\gamma_2 = 1,2$ is included.
⁴⁾ The partial safety factor $\gamma_2 = 1,4$ is included.



Table 24: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Characteristic values to shear load of fischer anchor rods and standard rods

									1		ı			
Size					М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Steel	failure without	t lever arm												
		Property	5.8	[kN]	9	15	21	29	39	61	76	89	115	141
芳溪		class	8.8	[kN]	15	23	34	46	63	98	122	141	184	225
eris e V	Stainless	Property	_50	[kN]	9	15	21	29	39	61	76	89	115	141
ast I	steel A4	class	70	[kN]	13	20	30	40	55	86	107	124	161	197
Characteristic resistance V _{Rks}	High corrosion	Property	50	[kN]	9	15	21	29	39	61	76	89	115	141
O €	resistant	class	70 ³⁾	[kN]	13	20	30	40	55	86	107	124	161	197
	steel C		80	[kN]	15	23	34	46	63	98	122	141	184	225
Steel failure with lever arm														
⊥ ফু		Property	5.8	[Nm]	19	37	65	104	166	324	447	560	833	1123
કું∘હ્		class	8.8	[Nm]	30	60	105	167	266	519	716	896	1333	1797
를 달	Stainless	Property	50	[Nm]	19	37	65	104	166	324	447	560	833	1123
Teris I	steel A4	class	70	[Nm]	26	52	92	146	232	454	626	784	1167	1573
13 33 12 33	High corrosion	Dropout /	50	[Nm]	19	37	65	104	166	324	447	560	833	1123
Characteristic ben- ding moment M ^R s	resistant	Property class	70 ³⁾	[Nm]	26	52	92	146	232	454	626	784	1167	1573
OB	steel C	Uass	80	[Nm]	30	60	105	167	266	519	716	896	1333	1797
Ductili	ty factor	k_2		[-]					0	,8				
Partia	I safety factor	•												
		Property	5.8	[-]					1,:					
		class	8.8	[-]						25				
	Stainless	Property	50	[-]					2,					
γ _{Ms,V} 1)	steel A4	class	70	[-]						56				
	High corrosion	Property	50	[-]					2,	38				
	resistant	class	70 ³⁾	[-]					1,	25				
	steel C		80	[-]					1,	33				
	rete pryout fai													
	r in Equation (2	27)												
	ΓS 1992-4-5,		k_3	[-]					2,0	00				
	n 6.3.3													
Partial safety factor γ_{Mcp}^{-1} [-] 1,5 ²														
	ncrete edge fa	ilure					See	CEN/T	S 1992	-4-5, S	ection (6.3.4		
Partia	l safety factor		$\gamma_{\rm Mc}^{1)}$	[-]					1,5	5 ²⁾				

Displacements see Annex 14

fischer injection system FIS EM Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Annex 24 fischer anchor rods Characteristic values to shear load

 $^{^{1)}}$ In absence of other national regulations. $^{2)}$ The partial safety factor $\gamma_2 = 1,0$ is included.

 $^{^{3)}\,}f_{uk} = 700\,\,N/mm^2\,;\,f_{yk} = 560\,\,N/mm^2$



Table 25: Des Cha	•							l anchors	RG MI
Size					M 8	M 10	M 12	M 16	M 20
Steel failure					1				•
01		Propert	y 5.8	3 [kN]	19	29	43	79	123
Characteristic	NI	class	8.8	3 [kN]	29	47	68	108	179
resistance with screw	$N_{Rk,s}$	Propert			26	41	59	110	172
SCIEW		class 70		[kN]	26	41	59	110	172
		Propert					1,50		
Partial safety	$\gamma_{Ms, N}$ 1)	class	8.8				1,50		
factor	IIVIS, IN	Propert					1,87		
0		class 70		[-]			1,87		
Combined pull		oncrete i		f	10	10	10	00	
Diameter of calcula			d _H	[mm]	12	16	18	22	28
Effective anchorag		in na	h _{ef}	[mm]	90	90	125	160	200
Characteristic bo							14		12
Temperature range			τ _{Rk,ucr}	[N/mm²] [N/mm²]		14	13	13	11
Temperature range Characteristic b			τ _{Rk,ucr}				_ · -		
				[N/mm ²]		1	12		10
Temperature range Temperature range		•	τ _{Rk,ucr}	[N/mm ²]		12 12	11	11	9
<u> </u>			τ _{Rk,ucr}						
Characteristic bo				N/mm²]		amona-ariii 12	ing (ary and	10	9
Temperature range			τ _{Rk,ucr}	[N/mm ²]		11	10	9	8
Characteristic bo			τ _{Rk,ucr}					_	0
Temperature range				[N/mm ²]		12	11	10	9
Temperature range			τ _{Rk,ucr}	[N/mm ²]	12	11	10	9	8
Factor for non-crack		0 0)	τ _{Rk,ucr}	[111/1111]	12	11	10,1] 9	O
Characteristic bor		o in crac	ked conc	roto (20/2	 5. hammor a	nd diamono		v and wet co	ncrete)
Temperature range				[N/mm ²]		6	6	7	7
Temperature range	•		τ _{Rk,cr}	[N/mm ²]	7	6	6	7	7
Characteristic bo			τ _{Rk,cr}			_	_	•	
Temperature range				[N/mm ²]		6,5	6	7	6
Temperature range			τ _{Rk,cr}	[N/mm ²]	7	6	6	6	6
Factor for cracked		 	$t_{Rk,cr} $ $k_8 = k_{cr}$	[-]	+ '		7,2		
T dotor for cracked	001101010		C25/30	[-]			1,02		
			C30/37	[-]			1,04		
Increasing factors			C35/45				1,06		
for N _{Rk}	Ψ_{c}		C40/50				1,07		
			C45/55				1,08		
			C50/60	[-]			1,09		
Splitting failure									
				/ h _{ef} ≥ 2,0			1,0 h _{ef}		
Edge distance	c _{cr,sp} [m	ոm]		$/ h_{ef} > 1,3$		4	I,6 h _{ef} – 1,8	h	
				/ h _{ef} ≤ 1,3			2,26 h _{ef}		
Spacing				_{cr,sp} [mm]		91	2 c _{cr,sp}	T	-31
Partial safety facto	r <u>dry and</u>	d wet cor	ncrete	<u>[-]</u>		1,5 ²⁾		1,8	3"
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{\prime\prime}$	flooded	d hole		[-]		1,8 ³⁾		2,	
$\gamma_{\text{Mp}} = \gamma_{\text{Mc}} = \gamma_{\text{Msp}}^{1)}$ flooded hole [-] 1,83 2,14 2,15 If no other national regulations exist. 3 The partial safety factor $\gamma_2 = 1,2$ is included.									
The partial safety factor $\gamma_2 = 1,0$ is included. The partial safety factor $\gamma_2 = 1,4$ is included Displacements see Annex 16									
<u> </u>				stem FI	S EM				
Design					/TS 1992-			Anne	x 25
-					ors RG MI ion load			7	-
	Unaid	COLOTION	o values	, 10 10113	iori ioau				



Table 26: Des	•							l	O 1 4 1
	aracterist	c values to	snear	load o					
Size					M 8	M 10	M 12	M 16	M 20
Steel failure wit	hout lever								
Characteristic		Property	5.8	[kN]	9,2	14,5	21,1	39,2	62
resistance	V	class	8.8	[kN]	14,6	23,2	33,7	54,0	90
resistance	$V_{Rk,s}$	Property	_A4	[kN]	12,8	20,3	29,5	54,8	86
		class 70	С	[kN]	12,8	20,3	29,5	54,8	86
		Property	5.8	[-]			1,25		
Partial safety	1)	class	8.8	[-]			1,25		
factor	$\gamma_{ ext{Ms, V}}^{1)}$	Property	A 4	[-]			1,56		
		class 70	С	[-]			1,56		
Steel failure wit	h lever arn	า							
Obawaatawiatia		Property	5.8	[Nm]	20	39	68	173	337
Characteristic	$M^0_{Rk,s}$	class	8.8	[Nm]	30	60	105	266	519
bending moment	IVI Rk,s	Property	A4	[Nm]	26	52	92	232	454
		class 70	С	[Nm]	26	52	92	232	454
		Property	5.8	[-]			1,25		
Partial safety		class	8.8	[-]			1,25		
factor	γ Ms, V	Property	A 4	[-]			1,56		
		class 70	C	[-]			1,56		
Ductility factor			k ₂	[-]			2,0		
Concrete pryor	ut failure		_						
Factor in Equation CEN/TS 1992-4-5,		3.3	k ₃	[-]			2,0		
Partial safety factor			ΥΜ	cp ¹⁾ [-]			1,5 ²⁾		
Concrete edge fail			1 IVI	op L1	S	ee CEN/TS		Section 6.3	.4

Displacements see Annex 16

fischer injection system FIS EM	
Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 fischer internal threaded anchors RG MI	Annex 26
Characteristic values to shear load	

Partial safety factor

1) In absence of other national regulations.
2) The partial safety factor $\gamma_2 = 1,0$ is included.



Table 27: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009; Characteristic values to tension load of reinforcing bars	Size Ød 8 10 12 14 16 18 20 22 24 25 26 28 30 32 34 36 40	Steel failure	Characteristic resistance N _{Rk,s} [kN] 28 44 63 85 111 140 173 209 249 270 292 339 389 443 499 560 691 Reinforcing bars	Partial safety factor $\gamma_{MsN}^{(1)}$ [-1]	Combined pullout and concrete failure	Diameter for calculation d [mm] 8 10 12 14 16 18 20 22 24 25 26 28 30 32 34 36 40	Characteristic bond resistance in non-cracked concrete C20/25; hammer-drilling (dry and wet concrete)	Temperature range I Tek.ucr [N/mm²] 16 16 15 14 14 14 13 13 13 13 13 13 13 12 12 12 12 12 12 12 12 12 12 12 12 12	Temperature range II Tek.ucr [N/mm²] 15 14 14 13 13 13 12 12 12 12 11 11 11 11 11 11 11 10 10 10 (72°C/50°C)	Characteristic bond resistance in non-cracked concrete C20/25; hammer-drilling (flooded hole)	Temperature range I Tek, ucr [N/mm²] 16 16 14 13 12 12 11 11 10 10 10 10 9 9 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	Temperature range II tak, ucr [N/mm²] 15 14 13 12 11 12 11 10 10 9 9 9 9 8 8 8 8 8 8	Characteristic bond resistance in non-cracked concrete C20/25; diamond-drilling (dry and wet concrete)	Temperature range I Tek, ucr [N/mm²] 16 15 13 12 12 10 10 10 9 9 9 9 9 8 8 8 7 (60°C/35°C)	Temperature range II tak, ucr [N/mm²] 15 14 12 11 11 10 10 9 9 9 8 8 8 8 7 7 7 7 7 7 7 7 7 7 7 7 7	Characteristic bond resistance in non-cracked concrete C20/25; diamond-drilling (flooded hole)	Temperature range I Tek, ucr [N/mm²] 16 15 13 12 12 11 10 10 10 9 9 9 9 8 8 8 7 (60°C/35°C)	Temperature range II Tek, ucr [N/mm²] 15 14 12 11 11 10 10 9 9 8 8 8 8 8 7 7 7 7 7 7 7 7 7 7 7 7 7	Factor non-cracked concrete k ₈ =k _{ucr} [-]	Partial safety Dry and wet [-] 1,5 ²⁾ 1,8 ³⁾ 1,8 ³⁾ factor	$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}^{1}$ Flooded [-]	The values given in Table 27. are values for reinforcing bars B500B with f_{uk} = 550 N/mm² and f_{yk} = 500 N/mm². Other reinforcing bars have to be calculated according to TR 029, Equation (5.1). 1) In absence of other national regulations. 2) The partial safety factor γ_2 = 1,0 is included. 4) The partial safety factor γ_2 = 1,4 is included	Displacements see Annex 19
Table 27:	Size	Steel failure	Characteristic Reinforcing ba	Partial safety f	Combined pu	Diameter for c	Characteristic	Temperature r (60°C/35°C)	Temperature r (72°C/50°C)	Characteristic	Temperature r (60°C/35°C)	Temperature r (72°C/50°C)	Characteristic	Temperature r (60°C/35°C)	Temperature r (72°C/50°C)	Characteristic	Temperature r (60°C/35°C)	Temperature r (72°C/50°C)	Factor non-cra	Partial safety factor	$\gamma_{\rm Mp} = \gamma_{\rm Mc} = \gamma_{\rm Msp}^{-1}$	The values gother reinfo	Displacem
	[De:	sign	of		on:	de	d An	chor Rein	s fo	acc.	to C	EI s	IS EI N/TS sion	199	2-4	1 -5:2	:009				Annex 27	



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nors acc. to CEN/TS 1992-4-5:2009; tension load of reinforcing bars	14 16 18 20 22 24 25 26 28 30 32 34 36 40	20/25; hammer and diamond drilling (dry and wet concrete)	7 6 6 6 7 7 7 7 7 5 5 5	5 5 5 7 7 7 7 7 8 5 5	20/25; hammer and diamond drilling (flooded hole)	6,5 6,5 6,5 6 6 6 7 6 6 6 6 6 6 5 5 5 5 5	6 6 6 6 6 6 6 6 5 5 5 5	7,2	1,02	1,04	1,06	1,07	1,08	1,09		1,0 h _{ef}	4,6 h _{ef} – 1,8 h	2,26 h _{ef}	2 C _{Cr,Sp}	1,5 ²⁾	1,8 ³⁾	The values given in Table 15.1 are values for reinforcing bars B500B with $f_{uk} = 550 \text{ N/mm}^2$ and $f_{yk} = 500 \text{ N/mm}^2$. Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).			
Table 27.1: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009; Characteristic values to tension load of reinforcing bars	8 Ø d 8	Characteristic bond resistance in cracked concrete C20/25; hammer and diamond drilling	Temperature range I $ au_{TRk_{SL}}$ 7 (60°C/35°C)	Temperature range II $ au_{FR_{GL}}$ 7 $72^{\circ}C/50^{\circ}C$	Characteristic bond resistance in cracked concrete C20/25; hammer and diamond drilling	Temperature range I $\tau_{RR,gr}$ $[N/mm^2]$ 6 $(60\text{C}/35\text{C})$	Temperature range II $\tau_{RR,gr}$ 6 (72°C/50°C)	Factor for cracked concrete k ₈ =k _{cr} [-]	C25/30 [-]	C30/37 [-]		for t _{Rk} C40/50 [-]	C45/55 [-]	C50/60 [-]	Splitting failure	h / h _{ef} ≥ 2,0	2,0 >	C _{cr,sp} [mm] h / h _{ef} ≤ 1,3	Spacing s _{cr.sp} [mm]	afety Dry and	Ic = 7Msp 1)	The values given in Table 15.1 are values for reinforcing bars B500B with f _{uk} = 55 Other reinforcing bars have to be calculated according to TR 029, Equation (5.1).	In absence of other national regulations. ²⁾ The partial safety factor $\gamma_2=1,0$ is included. ³⁾ The partial safety factor $\gamma_2=1.2$ is included	 Displacements see Annex 19	
Ë			ign c	of Bo	fis	cher	inje inche Rei	ctions	a	cc	yst	ter o (n F CE rs	N/	S E	EM 	99	92-						ex 28	



3: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009; Characteristic values to shear load of reinforcing bars	Ød 8 10 12 14 16 18 20 22 24 25 26 28 30 32 34 36 40	tic V _{HK,S} [kN] 13,8 21,6 31,1 42,4 55,3 70 87 105 125 135 146 170 195 221 250 280 346	ty factor $\gamma_{M_{\mathbb{S},V}}$ [-] 1,5	e with lever arm	tic M _{Ek.s} [Nm] 33 65 112 178 265 378 518 690 896 1012 1139 1422 1749 2123 2547 3023 4147	$\gamma_{\rm Ms, V}^{-1}$ [-]		ryout failure	quation (27) 1992-4-5, k ₃ [-] 2,0	V factor $V_{Mod}^{(1)}$ [-]	OF OLIVING GOOD CONTRACT OF THE CONTRACT OF TH	-	ty factor γ_{Mc} [-]	e values for reinforcing bars with f _{uk} = 550 N/mn be calculated according to TR 029, Equation (5.1 gulations. is included.	Displacements see Annex 19			
Table 28: Design of Bond Characteristic v	Size	Characteristic V _{RK,S} [kN	_	with leve	Characteristic M ⁰ FK,S [Nn bending moment	actor $\gamma_{\text{Ms.v}}^{1)}$	k_2	Concrete pryout failure	بر	factor v Man	INCD	פֿב	Partial safety factor γ ™ ′ [The values given in Table 16 of Other reinforcing bars have to the labsence of other national results. The partial safety factor $\gamma_2=1$	Displacements see An			
	De	sign	of E	301	ndec	ΙA	nc	hc lei	ors acc	: :. t ng	o ba	C ar	EI s	FIS EM N/TS 1992- ear load	4-5:200	09	Annex	29



Table 29: Des	ign of Bonded Ar	nchors a	cc. to CE	N/TS 1992	-4-5:2009		
Cha	aracteristic values	s to tensi	on load o	f fischer re	bar anchors	FRA	
Size				M12	M16	M20	M24
Steel failure				2		20	
Characteristic resis	tance	$N_{Rk,s}$	[kN]	63	111	173	270
Partial safety factor		γ _{Ms,N} 1)	[-]			,4	
	and concrete failu	re	L J		<u> </u>	, .	
Diameter of calcula		d	[mm]	12	16	20	25
	nd resistance in no	n-cracked	concrete		mer-drilling (
Temperature range	I (60°C/35°C)	τ _{Rk.ucr}	[N/mm ²]	15	14	13	13
Temperature range		τ _{Rk,ucr}	[N/mm ²]	14	13	12	12
	nd resistance in no			C20/25; ham	mer-drilling (flooded he	ole)
Temperature range		τ _{Rk,ucr}	[N/mm ²]	15	13	11	10
Temperature range		τ _{Rk.ucr}	[N/mm ²]	14	12	11	10
	nd resistance in no			C20/25; dian	nond-drilling	dry and w	
Temperature range		$ au_{Rk,ucr}$	[N/mm ²]	13	12	10	10
Temperature range		τ _{Rk,ucr}	[N/mm ²]	12	11	10	9
	nd resistance in no	n-cracked		C20/25; dian	nond-drilling	(flooded h	
Temperature range		τ _{Rk.ucr}	[N/mm ²]	13	12	10	10
Temperature range		τ _{Rk,ucr}	[N/mm ²]	12	11	10	9
Factor for non-crac		k _{uçr}	[-]),1	
	I resistance in cracke	ed concrete	e C20/25. ; l	hammer and			wet concrete)
Temperature range	I (60°C/35°C)	$ au_{Rk,cr}$	[N/mm ²]	7	6	6	7
Temperature range	II (72°C/50°C)	$ au_{Rk.cr}$	[N/mm ²]	7	6	6	7
	nd resistance in cra		crete C20/	25; hammer	and diamond	drilling	(flooded hole)
Temperature range	I (60°C/35°C)	$ au_{Rk,cr}$	[N/mm ²]	7	6	6	6
Temperature range	II (72°C/50°C)	$ au_{Rk,cr}$	[N/mm ²]	7	6	6	6
Factor for cracked	concrete	k ₈ =k _{cr}	[-]		7	,2	
			C25/30 [-]		1,	02	
			C30/37 [-]		1,	04	
Increasing factors		м —	C35/45 [-]		1,	06	
for τ_{Rk}		Ψ _c –	C40/50 [-]		1,	07	
			C45/55 [-]		1,	08	
			C50/60 [-]		1,	09	
Splitting failure							
			/ h _{ef} ≥ 2,0			h _{ef}	
Edge distance	c _{cr,sp} [mm]		$/ h_{ef} > 1,3$			– 1,8 h	
		h	/ h _{ef} ≤ 1,3			3 h _{ef}	
Spacing	S _{cr,sp}		[mm]		2 c	cr,sp	
Partial safety	dry and	wet concre	te [-]		1,5 ²⁾		1,8 ³⁾
factor		flooded ho	ole [-]		1,8 ³⁾		2,1 ⁴⁾
$\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$							
1) In absence of o	ther national regulat	ions					

Displacements see Annex 21

fischer injection system FIS EM	
Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Fischer rebar anchors FRA	Annex 30
Characteristic values to tension load	

 $^{^{1)}}$ In absence of other national regulations. $^{2)}$ The partial safety factor $\gamma_2=$ 1,0 is included. $^{3)}$ The partial safety factor $\gamma_2=$ 1,2 is included. $^{4)}$ The partial safety factor $\gamma_2=$ 1,4 is included.



Table 30: Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Characteristic values to shear load of fischer rebar anchors FRA

Size			M12	M16	M20	M24
Steel failure		•				
Characteristic resistance	$V_{Rk,s}$	[kN]	30	55	86	124
Partial safety factor	γ _{Ms.V}	[-]		1,	56	
Steel failure with lever arm						
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	92	233	454	785
Partial safety factor	γMs,V	[-]		1,	56	
Ductility factor	k ₂	[-]		0,	8	
Concrete pryout failure						
Factor in Equation (27) of CEN/TS 1992-4-5, Section 6.3.3	k ₃	[-]		2,		
Partial safety factor	γ _{Mcp} ¹⁾	[-]		1,	5 ²⁾	
Concrete edge failure			Se	e CEN/TS 1992		3.4
Partial safety factor	γ _{Mc} ¹⁾	[-]		1,	5 ²⁾	•

Displacements see Annex 21

fischer injection system FIS EM	
Design of Bonded Anchors acc. to CEN/TS 1992-4-5:2009 Fischer rebar anchors FRA	Annex 31
Characteristic values to shear load	

 $^{^{1)}}$ In absence of other national regulations. $^{2)}$ The partial safety factor $\gamma_2=1,\!0$ is included.



Seismic design according TR045 "Design of metal anchors under seismic action"

The recommended seismic performance categories are given in Table 31. The value of a_a or that of the product a S used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1:2004 and may be different to the values given in Table 31. 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 31: Recommended seismic performance categories for anchors

s	Seismicity level ¹⁾	Importa	ance Class acc	. to EN 1998-1:	2004,4.2.5		
Class	a _g ·S ³⁾	I	II	III	IV		
Very low ²⁾	a _g ·S ≤ 0,05 g		No addition	al requirement			
Low ²⁾	$0,05 \text{ g} < a_g \cdot \text{S} \le 0,1 \text{ g}$	C1	C1 C1 ⁴⁾ or C2 ⁵⁾				
> low	a _g ⋅S > 0,1 g	C1		C2			

¹⁾ The values defining the seismicity levels are may be found in the National Annex of EN 1988-1:2004.

The seismic design resistance R_{d.seis} of a fastening shall be determined as follows:

$$R_{\text{d,seis}} = R_{\text{k,seis}} / \gamma_{\text{M,seis}}$$

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

$$R_{k,seis} = \alpha_{gap} x \alpha_{seis} x R^{0}_{k,seis}$$

The basic characteristic seismic resistance $R^0_{k,seis}$ for "steel failure", "combined pull-out and concrete cone failure" under tension load and "steel failure" under shear load shall be taken from table 33. For all other failure modes R⁰_{k,seis} shall be determined as for static and quasi-static action according to tables 8,12 and

The reduction factors α_{seis} and α_{gap} are given in table 32.

Table 32: Reduction factors α_{seis} and α_{gap}

		0	(_{seis}	0	gap
Loading	Failure mode	Single fastener	Fastener group	Connections with hole clearance ¹⁾	Connections without hole clearance
	Steel failure	1,0	1,0		
Tension	Combined pull-out and concrete failure	1,0	0,85	1,00	
	Concrete cone failur	0,85	0,75		1,00
	Splitting failure	1,0	0,85		1,00
	Steel failure	1,0	0,85		
Shear	Concrete edge failure	1,0	0,85	0,50	
	Concrete pry-out failure	0,85	0,75		

¹⁾ Connections with hole clearance according to CEN/TS 1992-4-4: 2009, table 1

fischer injection system FIS EM	Annov 22
Recommended performance categories and reduction factors for loads under seismic action	Annex 32

²⁾ Definition according to EN 1998-1:2004, 3.2.1.

 $^{^{3)}}$ a_g = design ground acceleration on Type A ground (EN 1998-1:2004, 3.2.1). $^{4)}$ C1 for fixing non-structural elements to structures

⁵⁾ C2 for fixing structural elements to structures



Table 33A: Characteristic values for seismic action valid for performance category C1 of fischer anchor rods with FIS EM in hammer drilled hole

	113011	ei alloll	or rous	/VILII I I	IS LIVI	III IIai	IIIIIEI	urmet	ı iioie				
Size				М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Character	ristic resista	ince tens	ion load	steel	failure	•							
		Property	5.8	-	29	43	58	79	123	152	177	230	281
N _{Rk,s,seis}		class	8.8	-	47	68	92	126	196	243	282	368	449
	Stainless	D	50	-	29	43	58	79	123	152	177	230	281
[kN]	steel A4	Property class	70	-	41	59	81	110	172	212	247	322	393
	and steel C		80	-	47	68	92	126	196	243	282	368	449
		Property						1,	50				
γ _{M,s,seis} 1)		class	8.8					1,	50				
	Stainless	Property	50						86				
[-]	steel A4 and steel C	class							/ 1,87				
			80						,6				
	ristic bond r	esistanc	e, combi	ned pu	llout ar	nd con	crete c	one fail	ure (dr	y and v	vet con	crete)	1
Temperatui (60°C/35°C	5)	$ au_{Rk,seis}$	[N/mm²]	-	7,0	7,0	6,7	5,7	5,7	6,7	6,7	6,7	6,7
Temperatui (72°C/50°C		$ au_{Rk,seis}$	[N/mm²]	-	7,0	7,0	6,7	5,7	5,7	6,7	6,7	6,7	6,7
Character	ristic bond r	esistanc	e, combi	ned pu	llout a	nd con	crete c	one fail	ure (flo	oded h	nole)		
Temperatui (60°C/35°C		$ au_{Rk,seis}$	[N/mm²]	-	7,5	7,5	6,5	5,7	5,7	6,7	5,7	5,7	5,7
Temperatur (72°C/50°C		$\tau_{Rk,seis}$	[N/mm²]	-	6,8	6,8	6,5	5,7	5,7	5,7	5,7	5,7	5,7
1)	d	ry and wet	[-]			1,	5 ³⁾				1,8	8 ⁴⁾	
$\gamma_{M,p,seis}^{1)}$	flo	oded hole	[-]			1,	8 ⁴⁾				2,	1 ⁵⁾	
Character	ristic resista	ince she	ar Ioad, s	teel fa	ilure wi	thout l	ever ar	m					
		Property		-	15	21	29	39	61	76	89	115	141
V _{Rk,s,seis} 6)		class	8.8	-	23	34	46	63	98	122	141	184	225
	Stainless	Property	50	-	15	21	29	39	61	76	89	115	141
[kN]	steel A4	class		-	20	30	40	55	86	107	124	161	197
	and steel C		80	-	23	34	46	63	98	122	141	184	225
		Property							25				
γ _{M,s,seis} 1)		class	8.8						25				
	Stainless	Property	50						38				
[-]	steel A4	class	70						/ 1,56				
	and steel C		80					1,	33				

fischer injection system FIS EM

Hammer-drill

Characteristic values for loads under seismic action categories C1 Fischer anchor rods FIS A und RGM

Annex 33

 $^{^{1)}}$ In absence of other national regulations $^{2)}$ For steel C with $f_{uk}=700\ N/mm^2$ and $f_{yk}=560\ N/mm^2$ $^{3)}$ The partial safety factor $\gamma_2=1,0$ is included $^{4)}$ The partial safety factor $\gamma_2=1,2$ is included $^{5)}$ The partial safety factor $\gamma_2=1,2$

⁵⁾ The partial safety factor $\gamma_2 = 1,4$ is included ⁶⁾ For fischer treaded rods FIS A / RGM the factor for steel ductility is 1,0



Table 33B: Characteristic values for seismic action valid for performance category C1 of standard threaded rods with mortar **FIS EM** in **hammer drilled hole**

Size				М8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Characte	ristic resista	nce tension	on load,	steel f	ailure		<u> </u>	<u> </u>		<u> </u>	I		
Steel failu	ıre							See tal	ole 33A				
	ristic bond r I pullout and							See tal	ole 33A				
Characte	ristic resista	nce shear	load, s	teel fai	lure wi	thout le	ever arı	n					
		Property	5.8	ı	10,5	14,7	20,3	27,3	42,7	53,2	62,3	80,5	98,7
$V_{Rk,s,seis}$		class	8.8	ı	16,1	23,8	32,2	44,1	68,6	85,4	98,7	128,8	157,5
	Stainless	_	50	1	10,5	14,7	20,3	27,3	42,7	53,2	62,3	80,5	98,7
[kN]	steel A4	Property class	70	-	14,0	21,0	28,0	38,5	60,2	74,9	86,8	112,7	137,9
	and steel C	olado .	80	-	16,1	23,8	32,2	44,1	68,6	85,4	98,7	128,8	157,5
		Property	5.8					1,	25				
γ _{M,s,seis} 1)		class	8.8					1,	25				
Tivi,s,seis	Stainless		50					2,	38				
[-]	steel A4	Property class	70					1,	56				
	and steel C	oidoo .	80					1,	33				

¹⁾ In absence of other national regulations

fischer injection system FIS EM

Hammer-drill
Characteristic values for loads under seismic action categories C1
standard threaded rods

Annex 34



8.06.01-319/13

of rei	acteristic value nforcing bars					•			gory C	1	
Rebar B500B		size	8	10	12	14	16	18	20	22	24
Characteristic resista	ance tension lo	ad, steel f	ailure								
N _{Rk,s,seis}		[kN]	-	44	63	85	111	140	173	209	249
YM,s,seis		[-]					1,4				
Characteristic bond Temperature range	resistance, con	nbined pu	llout a	nd con	crete co	one fail	lure (dr	y and v	vet con	crete)	
remperature range r (60 ℃/35 ℃)	$ au_{Rk,s,seis}$	[N/mm ²]	-	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7
Temperature range II (72℃/50℃)	$ au_{Rk,s,seis}$	[N/mm²]	-	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7
Characteristic bond	resistance, con	nbined pu	llout a	nd con	crete c	one fail	ure (flo	oded I	nole)		
Temperature range I (60°C/35°C)	$ au_{Rk,s,seis}$	$[N/mm^2]$	-	7,5	7,0	6,5	5,7	5,7	5,7	6,7	5,7
Temperature range II (72°C/50°C)	$ au_{Rk,s,seis}$	[N/mm²]	1	6,8	6,8	5,8	5,8	5,7	5,7	5,7	5,7
YM,p,seis 1)	dry and wet	-	1,5 ²⁾					1,8 ³⁾			
	flooded hole	[-]	-			1,8 ³⁾				2,1 ⁴⁾	
Characteristic resista	ance shear load	d, steel fai	lure w	ithout l	ever ar	m					
V _{Rk,s,seis}		[kN] [-]	-	15,1	21,8	29,7	38,7	49,0 ,5	60,9	73,5	87,
Rebar B500B Characteristic resista	ance tension lo	size ad, steel f	25 ailure	26	28	30	32	34	36	40	
$N_{Rk,s,seis}$		[kN]	270	292	339	389	443	-	-	-	
YM,s,seis 1)		[-]			1,4			-	-	-	
Characteristic bond	resistance, con	nbined pu	llout a	nd con	crete c	one fail	ure (dr	y and v	wet con	crete)	
	$ au_{Rk,s,seis}$	[N/mm²]	6,7	6,7	6,7	6,7	4,8	-	-	-	
Temperature range I (60 ℃/35 ℃)						6.7	4,8	-	_	-	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C)	$ au_{Rk,s,seis}$	[N/mm ²]	6,7	6,7	6,7	6,7					
Temperature range I (60 ℃/35 ℃) Temperature range II (72 ℃/50 ℃) Characteristic bond		nbined pu	llout a	nd con	crete co	one fail	ure (flo	oded I	nole)		
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond I Temperature range I (60 °C/35 °C)					· ·	· ·		oded I	nole)	-	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond I Temperature range I (60 °C/35 °C) Temperature range II	resistance, con $ au_{ m Rk,s,seis}$ $ au_{ m Rk,s,seis}$	nbined pu [N/mm²] [N/mm²]	llout a	nd con	5,7 5,7	one fail	ure (flo	oded I	nole)	-	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C)	resistance, con $\tau_{\text{Rk,s,seis}}$ $\tau_{\text{Rk,s,seis}}$ dry and wet	nbined pu [N/mm²] [N/mm²]	llout a	5,7	5,7 5,7 1,8 ³⁾	one fail	ure (flo 5,7	- - -	-	-	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) YM,p,seis	resistance, con $\tau_{\rm Rk,s,seis}$ $\tau_{\rm Rk,s,seis}$ dry and wet flooded hole	nbined pu [N/mm²] [N/mm²] [-]	5,7 5,7	5,7 5,7	5,7 5,7 1,8 ³⁾ 2,1 ⁴⁾	5,7 5,7	ure (flo 5,7	-	-	- - -	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) YM,p,seis Characteristic resista	resistance, con $\tau_{\rm Rk,s,seis}$ $\tau_{\rm Rk,s,seis}$ dry and wet flooded hole	nbined pu [N/mm²] [N/mm²] [-] [-]	5,7 5,7 Iure w	5,7 5,7	5,7 5,7 1,8 ³⁾ 2,1 ⁴⁾ ever ar	5,7 5,7 m	5,7 4,8		-		
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) YM,p,seis Characteristic resista V _{Rk,s,seis}	resistance, con $\tau_{\rm Rk,s,seis}$ $\tau_{\rm Rk,s,seis}$ dry and wet flooded hole	nbined pu [N/mm²] [N/mm²] [-] [-] d, steel fai	5,7 5,7	5,7 5,7	5,7 5,7 1,8 ³⁾ 2,1 ⁴⁾ ever ar 119,0	5,7 5,7 m	5,7 4,8	-		- - - -	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) YM,p,seis Characteristic resista V _{Rk,s,seis}	resistance, con $\tau_{\rm Rk,s,seis}$ $\tau_{\rm Rk,s,seis}$ dry and wet flooded hole	nbined pu [N/mm²] [N/mm²] [-] [-]	5,7 5,7 Iure w	5,7 5,7	5,7 5,7 1,8 ³⁾ 2,1 ⁴⁾ ever ar	5,7 5,7 m	5,7 4,8		-	- - - -	
Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) Characteristic bond Temperature range I (60 °C/35 °C) Temperature range II (72 °C/50 °C) yM,p,seis Characteristic resista V _{Rk,s,seis}	resistance, con \(\tau_{Rk,s,seis} \) \(\tau_{Rk,s,seis} \) \(\text{dry and wet } \) flooded hole ance shear load other national reg	nbined pu [N/mm²] [N/mm²] [-] [-] d, steel fai [kN] [-] gulations	5,7 5,7 5,7 lure w	5,7 5,7 5thout le 102,2	5,7 5,7 1,8 ³⁾ 2,1 ⁴⁾ ever ar 119,0 1,5 ²⁾ e partia	5,7 5,7 136,5	154,7	- - - - γ ₂ = 1,0		- - ded	

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reinforcing bars