



Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments



European Technical Assessment

ETA-12/0255 of 9 April 2015

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Walsywa Injection system WQE-500 Plus for concrete
Product family to which the construction product belongs	Bonded anchor for use in concrete
Manufacturer	Walsywa Ind. e Com. De Prod. Met. Ltda Rua Humberto Pela, 198 - Bairro Leitão LOUVEIRA - SÃO PAULO BRASILIEN
Manufacturing plant	Walsywa Ind. e Com. De Prod. Met. Ltda. Plant1 Germany
This European Technical Assessment contains	27 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

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Specific Part

1 Technical description of the product

The "Walsywa Injection System WQE 500 PLUS for concrete" is a bonded anchor consisting of a cartridge with injection mortar WQE 500 PLUS and a steel element. The steel element consist of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30 or a reinforcing bar in the range of diameter 8 to 32 mm.

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

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for design according to TR 029 and TR 045	See Annex C 1 to C6
Characteristic resistance for design according to CEN/TS 1992-4:2009 and TR 045	See Annex C 7 to C 12
Displacements under tension and shear loads	See Annex C 13 / C 14

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance determined (NPD)

3.3 Hygiene, health and the environment (BWR 3)

Not applicable.

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

- 3.5 Protection against noise (BWR 5) Not applicable.
- 3.6 Energy economy and heat retention (BWR 6) Not applicable.



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3.7 Sustainable use of natural resources (BWR 7)

The sustainable use of natural resources was not investigated.

3.8 General aspects

The verification of durability is part of testing the essential characteristics. Durability is only ensured if the specifications of intended use according to Annex B are taken into account.

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

According to Decision of the Commission of 24 June 1996 (96/582/EC) (OJ L 254 of 08.10.96 p. 62-65), the system of assessment and verification of constancy of performance (see Annex V and Article 65 Paragraph 2 to Regulation (EU) No 305/2011) given in the following table applies.

Product	Intended use	Level or class	System
Metal anchors for use in concrete (heavy-duty type)	For fixing and/or supporting concrete structural elements or heavy units such as cladding and suspended ceilings	_	1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

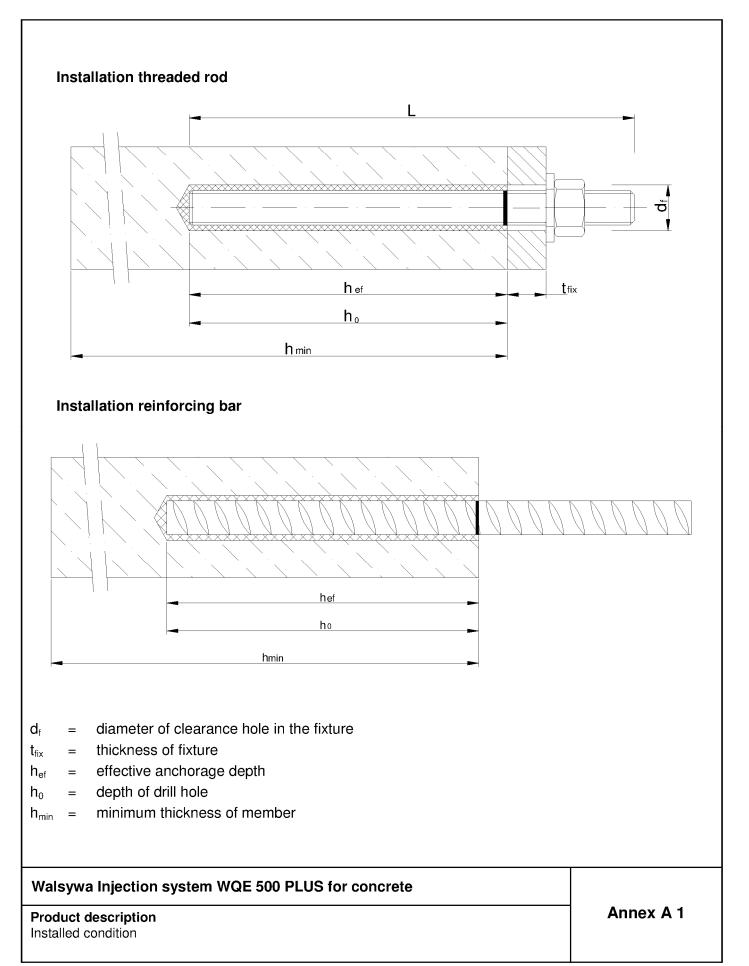
Issued in Berlin on 9 April 2015 by Deutsches Institut für Bautechnik

Uwe Bender Head of Department *beglaubigt:* Baderschneider

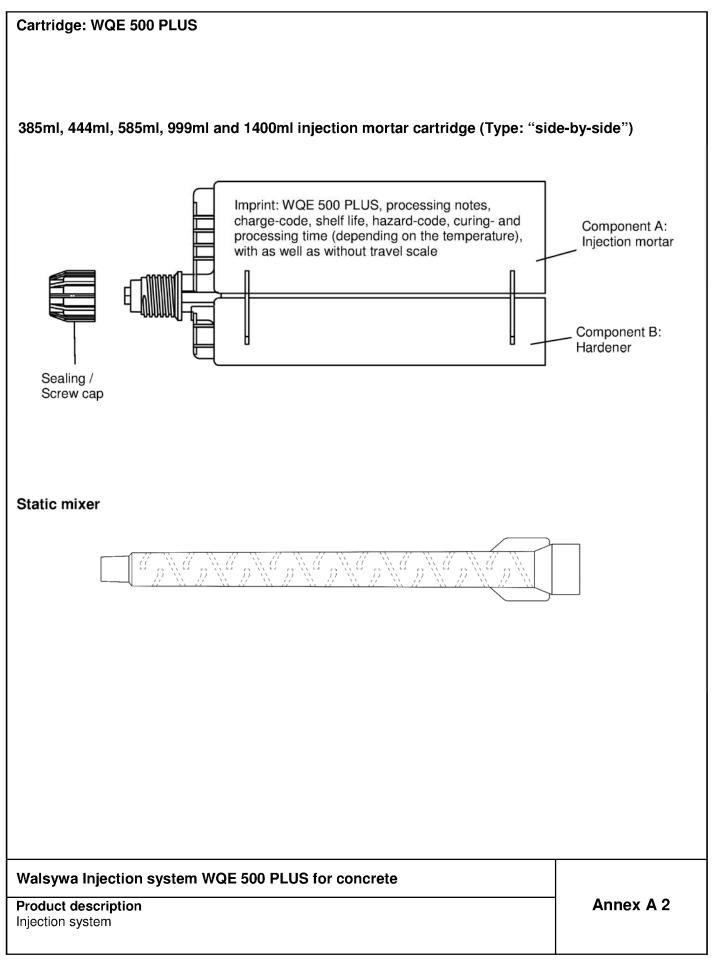
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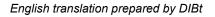
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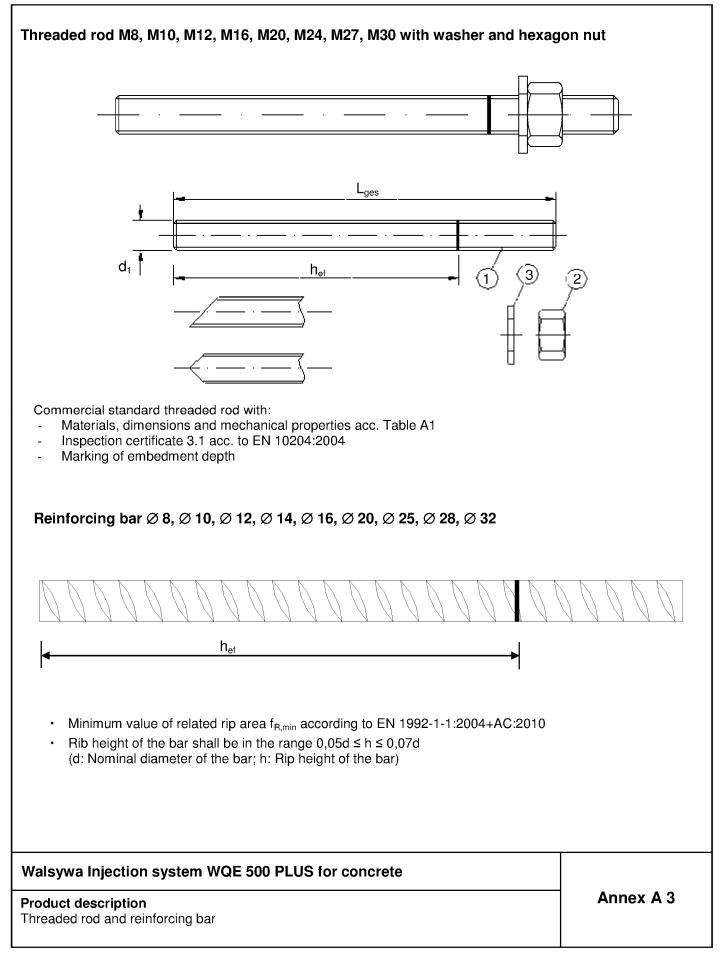




Table A1: Materials

Part	Designation	Material	
	, zinc plated \geq 5 µm acc. to EN ISO 4042:19		
Steel	, hot-dip galvanised ≥ 40 μm acc. to EN IS		
1	Anchor rod	Steel, EN 10087:1998 or EN 10263:200 Property class 4.6, 5.8, 8.8, EN 1993-1-8 $A_5 > 8\%$ fracture elongation	
2	Hexagon nut, EN ISO 4032:2012	Steel acc. to EN 10087:1998 or EN 102 Property class 4 (for class 4.6 rod) EN IS Property class 5 (for class 5.8 rod) EN IS Property class 8 (for class 8.8 rod) EN IS	SO 898-2:2012, SO 898-2:2012,
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated or hot-dip galvanised	
Stain	less steel		
1	Anchor rod	Material 1.4401 / 1.4404 / 1.4571, EN 10 > M24: Property class 50 EN ISO 3506- \leq M24: Property class 70 EN ISO 3506- A ₅ > 8% fracture elongation	1:2009 1:2009
2	Hexagon nut, EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571 EN 100 > M24: Property class 50 (for class 50 ro ≤ M24: Property class 70 (for class 70 ro	d) EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401, 1.4404 or 1.4571, EN 1	
High	corrosion resistance steel		
1	Anchor rod	Material 1.4529 / 1.4565, EN 10088-1:20 > M24: Property class 50 EN ISO $3506^{-1} \le M24$: Property class 70 EN ISO $3506^{-1} A_5 > 8\%$ fracture elongation	1:2009
2	Hexagon nut, EN ISO 4032:2012	Material 1.4529 / 1.4565 EN 10088-1:20 > M24: Property class 50 (for class 50 rc ≤ M24: Property class 70 (for class 70 ro	d) EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565, EN 10088-1:20	
Reinf	orcing bars		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN $f_{uk} = f_{tk} = k \cdot f_{yk}$	1992-1-1/NA:2013
	sywa Injection system WQE 500 PLUS	o for concrete	Annex A 4



Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C1: M12 to M30, Rebar Ø12 to Ø32.
- Seismic action for Performance Category C2: M12 and M16.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000.
- Non-cracked concrete: M8 to M30, Rebar Ø8 to Ø32.
- Cracked concrete: M12 to M30, Rebar Ø12 to Ø32.

Temperature Range:

- I: 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C)
- II: 40 °C to +60 °C (max long term temperature +43 °C and max short term temperature +60 °C)
- III: 40 °C to +72 °C (max long term temperature +43 °C and max short term temperature +72 °C)

Use conditions (Environmental conditions):

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

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

Design:

- 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.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Anchorages under static or quasi-static actions are designed in accordance with:
 - EOTA Technical Report TR 029 "Design of bonded anchors", Edition September 2010 or
 - CEN/TS 1992-4:2009
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
 - EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action", Edition February 2013
 - 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 are not allowed.

Installation:

- Dry or wet concrete: M8 to M30, Rebar Ø8 to Ø32.
- Flooded holes (not sea water): M8 to M30, Rebar Ø8 to Ø32.
- Hole drilling by hammer or compressed air drill mode.
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Walsywa Injection system WQE 500 PLUS for concrete

Intended Use

Specifications

Annex B 1



Table B1: Installation	n parameters fo	or inrea					1		
Anchor size		M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
Nominal drill hole diameter	d ₀ [mm] =	10	12	14	18	24	28	32	35
Effective encharge denth	h _{ef,min} [mm] =	60	60	70	80	90	96	108	120
Effective anchorage depth	h _{ef,max} [mm] =	96	120	144	192	240	288	324	360
Diameter of clearance hole in the fixture	d _f [mm] ≤ 9 12		14	18	22	26	30	33	
Diameter of steel brush	d _b [mm] ≥	12	14	16	20	26	30	34	37
Torque moment	T _{inst} [Nm] ≤	10	20	40	80	120	160	180	200
Thickness of fixture	t _{fix,min} [mm] >	0							
Thickness of fixture	t _{fix,max} [mm] <	1500							
Minimum thickness of member	h _{min} [mm]	h _{ef} + 30 mm ≥ 100 mm			h _{ef} + 2d ₀				
Minimum spacing	s _{min} [mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c _{min} [mm]	40	50	60	80	100	120	135	150

Table B2: Installation parameters for rebar

Rebar size		Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Nominal drill hole diameter	d ₀ [mm] =	12	14	16	18	20	24	32	35	40
Effective encharage depth	h _{ef,min} [mm] =	60	60	70	75	80	90	100	112	128
Effective anchorage depth	h _{ef,max} [mm] =	96	120	144	168	192	240	300	336	384
Diameter of steel brush	d _b [mm] ≥	14	16	18	20	22	26	34	37	41,5
Minimum thickness of member	h _{min} [mm]	h _{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2d_0$						
Minimum spacing	s _{min} [mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	c _{min} [mm]	40	50	60	70	80	100	125	140	160

Walsywa Injection system WQE 500 PLUS for concrete

Intended Use Installation parameters Annex B 2



Steel brush Table B3: Parameter cleaning and setting tools d_{b,min} Threaded Piston d₀ d_{b} Rebar min. Rod Drill bit - Ø Brush - Ø plug Brush - Ø (mm) (mm) (mm)(mm) (mm)(No.) M8 10 12 10.5 M10 8 12 14 12,5 No M12 10 14 16 14,5 piston plug 12 16 18 16,5 required M16 14 18 20 18,5

22

26

30

34

37

41,5

20

24

28

32

35

40



16

20

25

28

32



20,5

24,5

28,5

32,5

35,5

40,5

24

28

32

35

38

Recommended compressed air tool (min 6 bar) Drill bit diameter (d₀): 10 mm to 40 mm

Hand pump (volume 750 ml) Drill bit diameter (d₀): 10 mm to 20 mm



Piston plug for overhead or horizontal installation Drill bit diameter (d₀): 24 mm to 40 mm

Walsywa Injection system WQE 500 PLUS for concrete

Intended Use

M20

M24

M27

M30

Cleaning and setting tools

Annex B 3



Installation inst	ructions	
	1. Drill with hammer drill a hole into the base material to the size a depth required by the selected anchor (Table B1 or Table B2). I drill hole: the drill hole shall be filled with mortar	a presenta de la constructione de la constructione de la construction de la construction de la construction de
	Attention! Standing water in the bore hole must be removed	before cleaning.
2x	2a. Starting from the bottom or back of the bore hole, blow the hole compressed air (min. 6 bar) or a hand pump (Annex B 3) a mini the bore hole ground is not reached an extension shall be used.	mum of two times. If
or	The hand-pump can be used for anchor sizes up to bore hole di	ameter 20 mm.
2x 1	For bore holes larger than 20 mm or deeper 240 mm, compress must be used.	ed air (min. 6 bar)
	 2b. Check brush diameter (Table B3) and attach the brush to a drilli or a battery screwdriver. Brush the hole with an appropriate size > d_{b,min} (Table B3) a minimum of two times. If the bore hole ground is not reached with the brush, a brush example. 	ed wire brush
	shall be used (Table B3).	
or	 2c. Finally blow the hole clean again with compressed air (min. 6 ba (Annex B 3) a minimum of two times. If the bore hole ground is extension shall be used. The hand-pump can be used for anchor sizes up to bore hole di For bore holes larger than 20 mm or deeper 240 mm, compress <u>must</u> be used. 	not reached an ameter 20 mm.
2x	After cleaning, the bore hole has to be protected against re an appropriate way, until dispensing the mortar in the bore the cleaning repeated has to be directly before dispensing In-flowing water must not contaminate the bore hole again.	hole. If necessary,
	3. Attach a supplied static-mixing nozzle to the cartridge and load correct dispensing tool. Cut off the foil tube clip before use. For every working interruption longer than the recommended we (Table B4) as well as for new cartridges, a new static-mixer sha	orking time
her et al.	4. Prior to inserting the anchor rod into the filled bore hole, the posenbedment depth shall be marked on the anchor rods.	ition of the
min. 3 full stroke	5. Prior to dispensing into the anchor hole, squeeze out separately full strokes and discard non-uniformly mixed adhesive componer shows a consistent grey colour. For foil tube cartridges is must b minimum of six full strokes.	nts until the mortar
Walsywa Injection	system WQE 500 PLUS for concrete	
Internal and Line		Annex B 4

Intended Use Installation instructions Annex B 4

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Installation instru	uctions (continuation)
	6. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used. For overhead and horizontal installation a piston plug (Annex B 3) and extension nozzle shall be used. Observe the gel-/ working times given in Table B4.
	7. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.
	The anchor should be free of dirt, grease, oil or other foreign material.
	Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod should be fixed (e.g. wedges).
20°C e.g.	9. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B4).
Tinst.	 After full curing, the add-on part can be installed with the max. torque (Table B2) by using a calibrated torque wrench.

Table B4: Minimum curing time

Concrete temperature	Gelling- working time	Minimum curing time in dry concrete	Minimum curing time in wet concrete
≥ 5 °C	120 min	50 h	100 h
≥ + 10 °C	90 min	30 h	60 h
≥ + 20 °C	30 min	10 h	20 h
≥ + 30 °C	20 min	6 h	12 h
≥ + 40 °C	12 min	4 h	8 h

Walsywa Injection system WQE 500 PLUS for concrete

Intended Use Installation instructions (continuation) Curing time



Steel, property class 3.6 Nex.5 I eval N eval I eval N eval I eval N eval I eval				M 16 N	112	10	\$				Anchor size threaded rod	
Steel, property class 4.6 NR.a [KN] 15 23 34 63 98 141 16 Characteristic tension resistance, Steel, property class 5.8 NR.a [KN] 18 29 42 78 122 176 23 Characteristic tension resistance, Steel, property class 5.8 NR.a [KN] 18 29 42 78 122 176 23 Characteristic tension resistance, Steel, property class 5.8 NR.a [KN] 29 46 67 125 196 282 36 Characteristic tension resistance, Stainless steel A4 and HCR, property class 50 (>M/24) and 70 (< M/24)			I	1	I			I			Steel failure	
Steel, property class 5.8 NFR.8 [KN] 18 29 42 78 122 176 28 Characteristic tension resistance, Steel, property class 8.8 NFR.8 [KN] 29 46 67 125 196 282 36 Characteristic tension resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (< M24) NFR.8 [KN] 26 41 59 110 171 247 25 Combined pull-out and concrete cone failure NFR.8 [KN] 26 41 59 110 171 247 25 Combined pull-out and concrete cone failure NFR.8 [KN] 26 41 59 110 171 247 25 Characteristic bond resistance in non-cracked concrete $\tau_{FK.uer}$ [N/mm²] 15 15 14 13 12 1 40°C/24°C flooded bore hole $\tau_{FK.uer}$ [N/mm²] 9,5 9,0 8,5 8,0 7,5 7,5 7,6 6,6 60°C/43°C flooded bore hole $\tau_{FK.uer}$ [N/mm²] 9,5 9,5 9,0 8,5) 280	141 184	98 141	63	34	3		kN]	Rk,s	, 	Steel, property class 4.6	
Steel, property class 8.8 NRk.8 [KN] 29 46 67 125 196 262 36 Characteristic tension resistance, Stainless steel A4 and HCR, property class 50 (sM24) and 70 (\leq M24) N _{Rk.8} [kN] 26 41 59 110 171 247 23 Combined pull-out and concrete cone failure Characteristic bond resistance in non-cracked concrete C20/25 Temperature range I: 40°C/24°C dry and wet concrete fiooded bore hole $\tau_{Rk.ur}$ [N/mm²] 15 15 14 13 12 1 60°C/43°C dry and wet concrete $\tau_{Rk.ur}$ [N/mm²] 9,5 9,5 9,0 8,5 8,0 7,5 7,0 6,0 60°C/43°C flooded bore hole $\tau_{Rk.ur}$ [N/mm²] 9,5 9,5 9,0 8,5 8,0 7,5 7,0 6,0 72°C/43°C dry and wet concrete $\tau_{Rk.ur}$ [N/mm²] 8,5 8,5 8,0 7,5 7,0 6,0 5, 72°C/43°C dry and wet concrete $\tau_{Rk.ur}$ [N/mm²] 8,5 8,5 8,0		176 230	122 176	78 1	42	9		kN]	Rk,s		Steel, property class 5.8	
Stainless steel A4 and HCR, property class 50 (sM24) and 70 (≤ M24) N _{Rk.s} [kN] 26 41 59 110 171 247 23 Combined pull-out and concrete cone failure Characteristic bond resistance in non-cracked concrete C20/25 Temperature range I: 40°C/24°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 15 15 14 13 12 1 do°C/24°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 15 14 13 10 9,5 8,5 7,7 Temperature range II: 60°C/43°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 9,5 9,5 9,0 8,5 8,0 7,5 7,0 6,0 Temperature range II: 60°C/43°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 9,5 9,0 8,5 7,5 7,0 6,0 5,0 Temperature range III: 72°C/43°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 8,5 8,5 8,0 7,5 7,0 6,0 5,0 Temperature range III: 72°C/43°C dry and wet concrete $\tau_{Fik,uor}$ [N/mm2] 8,5 8,5	3 449	282 368	196 282	125 1	67	6		kN]	Rk,s		Steel, property class 8.8	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	281	247 230	171 247	110 1	59	1		kN]	₹k,s	Characteristic tension resistance, Stainless steel A4 and HCR,		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $										te cone failure	Combined pull-out and co	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $									e C20/25	non-cracked cond	Characteristic bond resistand	
$\frac{110}{100000000000000000000000000000000$	12	12 12	13 12	14	15	5		/mm²]	k,ucr	nd wet concrete	remperature range i:	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	5 7,0	8,5 7,5	9,5 8,5	10 9	13	4		′mm²]	k,ucr	ed bore hole	40°C/24°C	
$\frac{1}{1000 \text{ ded bore hole}} = \frac{1}{r_{\text{Rk,ucr}}} \frac{[\text{N/mm^2}]}{[\text{N/mm^2}]} \frac{9,5}{9,5} \frac{9,0}{9,0} \frac{8,5}{8,5} \frac{7,5}{7,0} \frac{7,0}{6,0} \frac{6,0}{7,5} \frac{7,0}{7,0} \frac{6,0}{7,0} \frac{6,0}{7,0} \frac{7,0}{7,0} \frac{7,0}{7,0} \frac{6,0}{7,0} \frac{7,0}{7,0} \frac{7,0}{7,0} \frac{6,0}{7,0} \frac{7,0}{7,0} \frac{7,0}{7,$	5 7,5	7,5 7,5	8,0 7,5	8,5 8	9,0	5		/mm²]	k,ucr	nd wet concrete		
$\frac{1}{72^{\circ}C/43^{\circ}C} = \frac{1}{10000000000000000000000000000000000$	6,0	7,0 6,5	7,5 7,0	8,5	9,0	5		/mm²]	k,ucr	ed bore hole	60°C/43°C	
100000000000000000000000000000000000	6,5	7,0 6,5	7,0 7,0	7,5	8,0	5		/mm²]	k,ucr	nd wet concrete		
Increasing factors for concrete C40/50 1,08 ψc C50/60 1,10 Splitting failure C C	5,5	6,0 5,5	7,0 6,0	7,5	8,0	5		′mm²]	k,ucr	ed bore hole		
ψ ₀ C40/50 1,08 C50/60 1,10 Splitting failure (1,08)	1,04								30/37			
Splitting failure	1,08								40/50		•	
		1,10						50/60				
Edge distance $c_{\alpha,sp}$ [mm] $1,0 \cdot h_{ef} \le 2 \cdot h_{ef} \left(2,5 - \frac{h}{h}\right) \le 2,4 \cdot h_{ef}$											Splitting failure	
l l l l l l l l l l l l l l l l l l l		2,4 · h _{ef}	$1,0 \cdot h_{ef} \le 2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}}\right) \le 2,4 \cdot h_{ef}$					mm]	r,sp		Edge distance	
Axial distances _{cr,sp} [mm]2 c _{cr,sp}			2 C _{cr,sp}					mm]	r,sp		Axial distance	
Installation safety factor (dry and wet concrete) γ_2 1,2 1,4		1,4	1,2 1,4							wet concrete)	Installation safety factor (dry and wet concrete)	
Installation safety factor (flooded bore hole) γ_2 1,4		1,4							γ ₂		Installation safety factor (flooded bore hole)	
								I				

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for threaded rods under tension loads in non-cracked concrete (Design according to TR 029)



Anchor size threaded r	od			M 12	M 16	M 20	M24	M 27	M 30
Steel failure									1
Characteristic tension resistance, Steel, property class 4.6		N _{Rk,s} =N _{Rk,s,seis}	[kN]	34	63	98	141	184	224
Characteristic tension re Steel, property class 5.8	sistance,	N _{Rk,s} =N _{Rk,s,seis}	[kN]	42	78	122	176	230	280
Characteristic tension re Steel, property class 8.8	sistance,	N _{Rk,s} =N _{Rk,s,seis}	[kN]	67	125	196	282	368	449
Characteristic tension resistance, Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤ M24)		N _{Rk,s} =N _{Rk,s,seis}	[kN]	59	110	171	247	230	281
Combined pull-out and	concrete cone failure								
Characteristic bond resis	stance in cracked concret	e C20/25							
	τ _{Rk,er}	[N/mm ²]	7,5	6,5	6,0	5,5	5,5	5,5	
Temperature range I: 40°C/24°C	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	7,1	6,2	5,7	5,5	5,5	5,5
		τ _{Rk,seis,C2}	[N/mm ²]	2,4	2,2	No Performance Determined (NPD)			
	flooded bore hole	τ _{Rk,cr}	[N/mm ²]	7,5	6,0	5,0	4,5	4,0	4,0
		τ _{Rk,seis,C1}	[N/mm ²]	7,1	5,8	4,8	4,5	4,0	4,0
		τ _{Rk,seis,C2}	[N/mm ²]	2,4	2,1	No Performance Determined (NPD)			
	dry and wet concrete	τ _{Rk,cr}	[N/mm ²]	4,5	4,0	3,5	3,5	3,5	3,5
		τ _{Rk,seis,C1}	[N/mm ²]	4,3	3,8	3,4	3,5	3,5	3,5
emperature range II:		τ _{Rk,seis,C2}	[N/mm ²]	1,4	1,4	No Performance Determined (NPD)			
50°C/43°C	flooded bore hole	τ _{Rk,cr}	[N/mm ²]	4,5	4,0	3,5	3,5	3,5	3,5
		τ _{Rk,seis,C1}	[N/mm ²]	4,3	3,8	3,4	3,5	3,5	3,5
		τ _{Rk,seis,C2}	[N/mm ²]	1,4	1,4	No Performance Determined (NF			(NPD)
		τ _{Rk,cr}	[N/mm ²]	4,0	3,5	3,0	3,0	3,0	3,0
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	3,9	3,4	3,0	3,0	3,0	3,0
Femperature range III:		τ _{Rk,seis,C2}	[N/mm ²]	1,3	1,2	No Performance Determined (NP			
72°C/43°C		τ _{Rk,cr}	[N/mm ²]	4,0	3,5	3,0	3,0	3,0	3,0
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm ²]	3,9	3,4	3,0	3,0	3,0	3,0
		τ _{Rk,seis,C2}	[N/mm ²]	1,3	1,2	No Pe	rformance [Determined	(NPD)
anna faatana far aa	,	C30/37		1,04					
ncreasing factors for co only static or quasi-stati		C40/50			1,08				
Ψ_{c}		C50/60			1,10				
nstallation safety factor	(dry and wet concrete)	γ2		1,2		1,4			
		γ ₂		1,4					

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for threaded rods under tension loads in cracked concrete (Design according to TR 029 and TR 045)



Table C3:Characteristic values of resistance for threaded rods under shear loads in
cracked and non-cracked concrete (Design according to TR 029 and TR
045)

[kN] [kN] [kN] [kN] [kN] [kN] [kN] [kN]	M 8 7 No Perfc Deterr (NF 9 No Perfc Deterr (NF 15 No Perfc Deterr (NF	nined PD) 15 prmance nined PD) 23	M 12 17 14 13 21 18 17	M 16 31 27 25 39 34 31	M 20 49 42 No Perfe 61 53	M24 71 56 ormance I 88 70	M 27 92 72 Determine 115	M 30
[kN] [kN] [kN] [kN] [kN] [kN] [kN] [kN]	No Perfc Deterr (NF 9 No Perfc Deterr (NF 15 No Perfc Deterr	ormance nined PD) 15 ormance nined PD) 23	14 13 21 18	27 25 39 34	42 No Perfe 61	56 ormance I 88	72 Determine 115	88 d (NPD
[kN] [kN] [kN] [kN] [kN] [kN] [kN] [kN]	No Perfc Deterr (NF 9 No Perfc Deterr (NF 15 No Perfc Deterr	ormance nined PD) 15 ormance nined PD) 23	14 13 21 18	27 25 39 34	42 No Perfe 61	56 ormance I 88	72 Determine 115	88 d (NPE
[kN] [kN] [kN] [kN] [kN] [kN] [kN]	Deterr (NF 9 No Perfc Deterr (NF 15 No Perfc Deterr	nined PD) 15 prmance nined PD) 23	13 21 18	25 39 34	No Perfe 61	ormance I 88	Determine	d (NPE
[kN] [kN] [kN] [kN] [kN] [kN]	(NF 9 No Perfc Deterr (NF 15 No Perfc Deterr	PD) 15 prmance nined PD) 23	21 18	39 34	61	88	115	
[kN] [kN] [kN] [kN] [kN] [kN]	No Perfc Deterr (NF 15 No Perfc Deterr	ormance nined PD) 23	18	34				140
[kN] [kN] [kN] [kN] [kN]	Deterr (NF 15 No Perfc Deterr	nined 2D) 23			53	70		
[kN] [kN] [kN] [kN]	(NF 15 No Perfo Deterr	PD) 23	17	31			91	111
[kN] [kN] [kN]	No Perfo Deterr			01	No Perfe	ormance l	Determine	d (NPI
[kN] [kN]	Deterr		34	63	98	141	184	224
[kN]			30	55	85	111	145	177
		PD)	27	50	No Perfe	ormance I	Determine	d (NPE
	13	20	30	55	86	124	115	140
[kN]	No Perfo Deterr		26	48	75	98	91	111
[kN]	(NF		24	44	No Perfe	ormance l	Determine	d (NPE
[Nm]	15	30	52	133	260	449	666	900
[Nm]								
[Nm]			No Perfe	ormance I	Jetermine	a (NPD)		
[Nm]	19	37	65	166	324	560	833	112
[Nm]	ı		No Deví				1	1
[Nm]			No Perfe	ormance i	Jetermine	a (NPD)		
[Nm]	30	60	105	266	519	896	1333	179
[Nm]			No Dout) et e mei n e			
[Nm]			No Perio	ormance i	Jetennine	a (NPD)		
[Nm]	26	52	92	232	454	784	832	112
[Nm]			No Dorf	armanaa (Dotormino			
[Nm]			No Pend	unnance i	Jetennine	u (NPD)		
[-]				2	,0			
				1	,0			
I								
				1	,0			
]]]]]]]]]]]]]]]]]]]	Nm] Nm]	Nm] Nm] Nm] Nm] Nm] Nm] Nm] 30 Nm] 30 Nm] 26 Nm] Nm] Nm]	Nm] 19 37 Nm] 19 37 Nm] 19 37 Nm] 0 0 Nm] 30 60 Nm] 30 60 Nm] 26 52 Nm] Nm] 10	Nm] No Perform Nm] 19 37 65 Nm] 19 37 65 Nm] No Perform No Perform Nm] 30 60 105 Nm] 30 60 105 Nm] No Perform No Perform Nm] 26 52 92 Nm] No Perform No Perform Nm] 26 52 92 Nm] No Perform No Perform	Nm] No Performance I Nm] 19 37 65 166 Nm] No Performance I No Performance I Nm] 30 60 105 266 Nm] 30 60 105 266 Nm] 30 60 105 266 Nm] No Performance I No Performance I Nm] 26 52 92 232 Nm] No Performance I No Performance I Nm] 26 52 92 232 Nm] No Performance I No Performance I Image: State Sta	Nm] No Performance Determine Nm] 19 37 65 166 324 Nm] 19 37 65 166 324 Nm] No Performance Determine Nm] No Performance Determine Nm] 30 60 105 266 519 Nm] 30 60 105 266 519 Nm] No Performance Determine Nm] No Performance Determine Nm] No Performance Determine Nm] No Performance Determine Nm] No Performance Determine	Nm] No Performance Determined (NPD) Nm] 19 37 65 166 324 560 Nm] 19 37 65 166 324 560 Nm] No Performance Determined (NPD) Nm] 30 60 105 266 519 896 Nm] 30 60 105 266 519 896 Nm] No Performance Determined (NPD) Nm] No Performance Determined (NPD) Nm] 26 52 92 232 454 784 Nm] No Performance Determined (NPD) No No Performance Determined (NPD) No [-] 2,0 1,0 1,0 1,0	Nm] No Performance Determined (NPD) Nm] 19 37 65 166 324 560 833 Nm] 19 37 65 166 324 560 833 Nm] 19 37 65 166 324 560 833 Nm] No Performance Determined (NPD) No No 96 1333 Nm] 30 60 105 266 519 896 1333 Nm] 30 60 105 266 519 896 1333 Nm] No Performance Determined (NPD) No No

Characteristic values of resistance for threaded rods under shear loads in cracked and non-cracked concrete, (Design according to TR 029 and TR 045)



	aracteristic va n-cracked cor								on loa	ds in		
Anchor size reinforcing t	bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure			,									
Characteristic tension resis	stance	N _{Rk,s}	[kN]					$A_{s} \boldsymbol{\cdot} f_{uk}$				
Combined pull-out and c	oncrete cone failur	е										
Characteristic bond resista	ince in non-cracked	concrete C	20/25									
Temperature range I:	dry and wet concrete	$\tau_{\rm Rk,ucr}$	[N/mm²]	14	14	13	13	12	12	11	11	11
40°C/24°C	flooded bore hole	τ _{Rk,ucr}	[N/mm²]	14	13	11	10	9,5	8,5	7,5	7,0	6,0
Temperature range II:	dry and wet concrete	τ _{Rk,ucr}	[N/mm ²]	8,5	8,5	8,0	8,0	7,5	7,0	7,0	6,5	6,5
60°C/43°C	flooded bore hole	τ _{Rk,ucr}	[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	6,0	5,5	5,0
Temperature range III:	dry and wet concrete	τ _{Rk,ucr}	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,5	6,0	6,0	6,0
72°C/43°C	flooded bore hole	τ _{Rk,ucr}	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,0	5,5	5,0	4,5
		C30/37			•			1,04			•	
Increasing factors for conc Ψ_c	rete	C40/50						1,08				
		C50/60						1,10				
Splitting failure												
Edge distance		C _{cr,sp}	[mm]			1,0 · h _{ef}	≤2·h _e	_{ef} (2,5 -	$\left(\frac{h}{h_{ef}}\right) \le 2$	2,4 · h _{ef}		
Axial distance		S _{cr,sp}	[mm]					2 c _{cr,sp}				
Installation safety factor (de concrete)	ry and wet	γ2	-			1,2				1	,4	
Installation safety factor (flo	ooded bore hole)	γ2						1,4				

Performances Characteristic values of resistance for rebar under tension loads in non-cracked concrete (Design according to TR 029)



	haracteristic val							ads in	Ì	
Anchor size reinforci	ng bar			Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure						•		•		
Characteristic tension	resistance	N _{Rk,s} =N _{Rk,s,seis,C1}	[kN]				$A_{s} \boldsymbol{\cdot} f_{uk}$			
Combined pull-out ar	nd concrete cone failure	·								
Characteristic bond res	sistance in cracked concret	e C20/25								
	dry and wat concrete	τ _{Rk,cr}	[N/mm²]	7,5	7,0	6,5	6,0	5,5	5,5	5,5
Temperature range I:	dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm²]	6,9	6,4	6,2	5,7	5,5	5,5	5,5
40°C/24°C	flooded bore hole	$ au_{\mathrm{Rk,cr}}$	[N/mm²]	7,5	6,5	6,0	5,0	4,5	4,0	4,0
	hooded bore hole	$\tau_{\rm Rk,seis,C1}$	[N/mm ²]	6,9	6,0	5,7	4,8	4,5	4,0	4,0
		$\tau_{\rm Rk,cr}$	[N/mm²]	4,5	4,0	4,0	3,5	3,5	3,5	3,5
Temperature range II:	dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm²]	4,1	3,7	3,8	3,3	3,5	3,5	3,5
60°Ċ/43°C		$\tau_{\rm Rk,cr}$	[N/mm²]	4,5	4,0	4,0	3,5	3,5	3,5	3,0
	flooded bore hole	$\tau_{Rk,seis,C1}$	[N/mm²]	4,1	3,7	3,8	3,3	3,5	3,5	3,0
		$\tau_{\rm Rk,cr}$	[N/mm ²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0
Temperature range III:	dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm ²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0
72°Ċ/43°C		$\tau_{\rm Rk,cr}$	[N/mm ²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0
	flooded bore hole	$\tau_{\rm Rk,seis,C1}$	[N/mm ²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0
		C30/37					1,04			
Increasing factors for c (only static or quasi-state Ψ_c		C40/50					1,08			
Ψ0		C50/60					1,10			
Installation safety facto	or (dry and wet concrete)	γ2			1,2			1	,4	
Installation safety facto	or (flooded bore hole)	γ2					1,4			

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for rebar under tension loads in cracked concrete (Design according to TR 029 and TR 045)



Table C6:Characteristand non-crace											ł
Anchor size reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure without lever arm			1	1				1			
	V _{Rk,s}	[kN]				0,	50 • A _s •	f _{uk}			
Characteristic shear resistance	V _{Rk,s,seis,C1}	[kN]	Perfor Deter	lo mance mined PD)			0,	44 • A _s •	f _{uk}		
Steel failure with lever arm			·								
Characteristic bending moment	M ⁰ _{Rk,s}	[Nm]				1.	2 ∙ W _{el} ∙	f _{uk}			
	$M^0_{Rk,s,seis,C1}$	[Nm]			No F	Performar	nce Dete	rmined (N	NPD)		
Concrete pry-out failure											
Factor k in equation (5.7) of Technical Report TR 029 for the design of bonded anchors	k	[-]					2,0				
Installation safety factor	γ2						1,0				
Concrete edge failure											
Installation safety factor	γ ₂						1,0				
Walsywa Injection system	WQE 500 PL	US fo	r conc	rete					Ann	ex C 6	6
Characteristic values of resistance f concrete, (Design according to TR (ads in c	racked a	and non-	-crackec	I				



Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Steel failure					•					•	
Characteristic tension resis Steel, property class 4.6	tance,	N _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
Characteristic tension resis	tance,	N _{Rk.s}	[kN]	18	29	42	78	122	176	230	280
Steel, property class 5.8 Characteristic tension resis	tance,	N _{Rk,s}	[kN]	29	46	67	125	196	282	368	449
Steel, property class 8.8 Characteristic tension resis Stainless steel A4 and HCF		N _{Rk.s}	[kN]	26	41	59	110	171	247	230	281
property class 50 (>M24) a	nd 70 (≤ M24)										
Combined pull-out and co	oncrete failure										
Characteristic bond resista	nce in non-cracked concret	e C20/25	1		•			-	-		
Temperature range I:	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm ²]	15	15	15	14	13	12	12	12
40°C/24°C	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	15	14	13	10	9,5	8,5	7,5	7,0
Temperature range II:	dry and wet concrete	$\tau_{\rm Rk,ucr}$	[N/mm ²]	9,5	9,5	9,0	8,5	8,0	7,5	7,5	7,5
60°C/43°C	flooded bore hole	$\tau_{\rm Rk,ucr}$	[N/mm ²]	9,5	9,5	9,0	8,5	7,5	7,0	6,5	6,0
Temperature range III:	dry and wet concrete	$\tau_{\rm Rk,ucr}$	[N/mm ²]	8,5	8,5	8,0	7,5	7,0	7,0	6,5	6,5
72°C/43°C	flooded bore hole	$\tau_{\rm Rk,ucr}$	[N/mm ²]	8,5	8,5	8,0	7,5	7,0	6,0	5,5	5,5
		C30/37					1,	04			
Increasing factors for conci Ψc	ete	C40/50					1,	08			
		C50/60					1,	10			
Factor according to CEN/TS 1992-4-5 Section	6.2.2.3	k ₈	[-]				10),1			
Concrete cone failure											
Factor according to CEN/TS 1992-4-5 Section +	6.2.3.1	k _{ucr}	[-]				10	0,1			
Edge distance		C _{cr,N}	[mm]				1,5	h _{et}			
Axial distance		S _{cr,N}	[mm]				3,0	h _{ef}			
Splitting failure											
Edge distance		C _{cr,sp}	[mm]		1	,0 ⋅ h _{ef} ≤	$2 \cdot h_{ef} (2,$	$5 - \frac{h}{h_{ef}}$	≤ 2,4 · h,	əf	
Axial distance		S _{cr,sp}	[mm]				2 c				
Installation safety factor (dr	y and wet concrete)	γinst			1	,2			1	,4	
	oded bore hole)	γinst					1	,4			

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for threaded rods under tension loads in non-cracked concrete (Design according to CEN/TS 1992-4)



Table C8:Characteristic values of resistance for threaded rods under tension loads in
cracked concrete (Design according to CEN/TS 1992-4 and TR 045)

Anchor size threaded rod	l			M 12	M 16	M 20	M24	M27	M30
Steel failure									
Characteristic tension resis	tance,	N _{Rk,s} =N _{Rk,s,seis}	[kN]	34	63	98	141	184	224
Steel, property class 4.6 Characteristic tension resis	tance,	N _{Rk,s} =N _{Rk,s,seis}	[kN]	42	78	122	176	230	280
Steel, property class 5.8 Characteristic tension resis	tance	TAR,S = TAR,S,SEIS							
Steel, property class 8.8	,	N _{Rk,s} =N _{Rk,s,seis}	[kN]	67	125	196	282	368	449
Characteristic tension resis Stainless steel A4 and HCF property class 50 (>M24) a	٦, `	N _{Rk,s} =N _{Rk,s,seis}	[kN]	59	110	171	247	230	281
Combined pull-out and co	oncrete failure								
Characteristic bond resista	nce in cracked concrete C2	0/25							
		$ au_{Rk,cr}$	[N/mm ²]	7,5	6,5	6,0	5,5	5,5	5,5
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	7,1	6,2	5,7	5,5	5,5	5,5
Temperature range I:		$\tau_{\text{Rk,seis,C2}}$	[N/mm ²]	2,4	2,2	No Perf	ormance [Determine	d (NPD)
40°C/24°C		$\tau_{\text{Rk,cr}}$	[N/mm ²]	7,5	6,0	5,0	4,5	4,0	4,0
	flooded bore hole	$\tau_{\text{Rk,seis,C1}}$	[N/mm ²]	7,1	5,8	4,8	4,5	4,0	4,0
		τ _{Rk,seis,C2}	[N/mm ²]	2,4	2,1	No Perf	ormance [Determine	d (NPD)
		$\tau_{\text{Rk,cr}}$	[N/mm ²]	4,5	4,0	3,5	3,5	3,5	3,5
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	4,3	3,8	3,4	3,5	3,5	3,5
Temperature range II:		$\tau_{\text{Rk,seis,C2}}$	[N/mm²]	1,4	1,4	No Perf	ormance I	Determine	d (NPD)
60°C/43°C		$\tau_{\text{Rk,cr}}$	[N/mm ²]	4,5	4,0	3,5	3,5	3,5	3,5
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm ²]	4,3	3,8	3,4	3,5	3,5	3,5
		$\tau_{\text{Rk,seis,C2}}$	[N/mm ²]	1,4	1,4	No Perf	ormance [Determine	d (NPD)
		$\tau_{Rk,cr}$	[N/mm ²]	4,0	3,5	3,0	3,0	3,0	3,0
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	3,9	3,4	3,0	3,0	3,0	3,0
Temperature range III:		$\tau_{\text{Rk,seis,C2}}$	[N/mm ²]	1,3	1,2	No Perf	ormance [Determine	d (NPD)
72°C/43°C		$\tau_{\rm Rk,cr}$	[N/mm ²]	4,0	3,5	3,0	3,0	3,0	3,0
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm ²]	3,9	3,4	3,0	3,0	3,0	3,0
		$\tau_{\text{Rk,seis,C2}}$	[N/mm ²]	1,3	1,2	No Perf	ormance [Determine	d (NPD)
Increasing factors for conci	rete	C30/37				1,	04		
(only static or quasi-static a		C40/50				1,	08		
Ψc		C50/60				1,	10		
Factor according to CEN/TS 1992-4-5 Section	6.2.2.3	k ₈	[-]			7	,2		
Concrete cone failure									
Factor according to CEN/TS 1992-4-5 Section	6.2.3.1	k _{cr}	[-]				,2		
Edge distance		C _{cr,N}	[mm]			1,5	h _{et}		
Axial distance		S _{cr,N}	[mm]			3,0	h _{ef}		
Installation safety factor (dr	y and wet concrete)	γinst		1	,2		1	,4	
Installation safety factor (flo	oded bore hole)	γinst				1	,4		

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for threaded rods under tension loads in cracked concrete (Design according to CEN/TS 1992-4 and TR 045)

Annex C 8

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Table C9: Characteristic values of resistance for threaded rods under shear loads in cracked and non-cracked concrete (Design according to CEN/TS 1992-4 and TR 045)

/ Fik,s / Fik,s,seis,C1 / Fik,s,seis,C2 / Rik,s,seis,C1 / Rik,s,seis,C1 / Rik,s,seis,C2 / Fik,s,seis,C2 / Fik,s,seis,C1 / Fik,s,seis,C1	[kN] [kN] [kN] [kN] [kN] [kN]	7 No Perfe Determin 9 No Perfe Determin	15	17 14 13 21	31 27 25	49 42 No Per	71 56	92 72	112 88
/ Rk,s,seis,C1 / Rk,s,seis,C2 / Rk,s / Rk,s,seis,C1 / Rk,s,seis,C2 / Rk,s,seis,C2 / Rk,s,seis,C2 / Rk,s,seis,C1 / Rk,s,seis,C2	[kN] [kN] [kN] [kN] [kN]	No Perfo Determin 9 No Perfo	ormance ed (NPD) 15	14 13	27	42	56	72	
/ Fik,s,seis,C2 / Fik,s / Fik,s,seis,C1 / Fik,s,seis,C2 / Fik,s / Fik,s,seis,C1 / Fik,s,seis,C1 / Fik,s,seis,C2	[kN] [kN] [kN] [kN]	Determin 9 No Perfe	ed (NPD) 15	13					88
/ Rk,s / Rk,s,seis,C1 / Rk,s,seis,C2 / Rk,s / Rk,s,seis,C1 / Rk,s,seis,C2	[kN] [kN] [kN]	9 No Perfe	15		25	No Per		-	
/ Rk,s,seis,C1 / Rk,s,seis,C2 / Rk,s / Rk,s,seis,C1 / Rk,s,seis,C2	[kN] [kN]	No Perfe	-	01			formance L	Determined	l (NPD
/ _{Rk,s,seis,C2} / _{Rk,s} / _{Rk,s,seis,C1} / _{Rk,s,seis,C2}	[kN]			۲	39	61	88	115	14(
/ _{Rk,s} / _{Rk,s,seis,C1} / _{Rk,s,seis,C2}		Determin		18	34	53	70	91	11
/ _{Rk,s,seis,C1} / _{Rk,s,seis,C2}	[kN]		ed (NPD)	17	31	No Per	formance [Determined	ל (NPD
/ _{Rk,s,seis,C2}		15	23	34	63	98	141	184	224
	[kN]		ormance	30	55	85	111	145	177
	[kN]	Determin	ed (NPD)	27	50	No Per	formance [Determined	រ (NPD
/ _{Rk,s}	[kN]	13	20	30	55	86	124	115	14
Rk,s,seis,C1	[kN]		ormance	26	48	75	98	91	11
/ _{Rk,s,seis,C2}	[kN]	Determin	ed (NPD)	24	44	No Per	formance [Determined	1 (NPD
K 2					0,	,8			
∕I ⁰ _{Rk,s}	[Nm]	15	30	52	133	260	449	666	90
M ⁰ Rk,s,seis,C1	[Nm]			No Per	formance [Votorminor			
M ⁰ Rk,s,seis,C2	[Nm]								
∕I ⁰ _{Rk,s}	[Nm]	19	37	65	166	324	560	833	112
√ ⁰ Rk,s,seis,C1	[Nm]			No Per	formance [Determiner			
M ⁰ Rk,s,seis,C2	[Nm]						- (=)		
M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	896	1333	179
				No Per	formance [Determinec	J (NPD)		
					·		, , ,		
		26	52	92	232	454	784	832	112
				No Per	formance [Determinec	J (NPD)		
M ⁰ Rk,s,seis,C2	[Nm]								
K ₃					2	,0			
inst					1,	,0			
ŕ	[mm]				l _t = min(h	_{ef} ; 8 d _{nom})			
J _{nom}	[mm]	8	10	12	16	20	24	27	30
inst					1,	,0			
	Λ ⁰ Rk,s Λ ⁰ Rk,s,seis,C1 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C1 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C1 Λ ⁰ Rk,s,seis,C2 In Ris, seis,C2 Λ ⁰ Rk,s,seis,C2 Λ ⁰ Rk,s,seis,C2 In Rick, Right R	Λ ⁰ _{RK,S} [Nm] Λ ⁰ _{RK,S,Seis,C1} [Nm] Λ ⁰ _{RK,S,Seis,C2} [Nm] Λ ⁰ _{RK,S,Seis,C1} [Nm] Λ ⁰ _{RK,S,Seis,C2} [Nm] Λ ⁰ _{RK,S,Seis,C3} [Nm] Λ ⁰ _{RK,S,Seis,C4} [Nm] Λ ⁰ _{RK,S,Seis,C5} [Nm] Λ ⁰ _{RK,S,Seis,C4} [Nm] Λ ⁰ _{RK,S,Seis,C5} [Nm] Λ ⁰ _{RK,S,Seis,C6} [Nm]	Λ ⁰ _{Rk,S} [Nm] 15 Λ ⁰ _{Rk,S,seis,C1} [Nm] Λ ⁰ _{Rk,S,seis,C2} [Nm] Λ ⁰ _{Rk,S,seis,C2} [Nm] Λ ⁰ _{Rk,S,seis,C1} [Nm] Λ ⁰ _{Rk,S,seis,C2} [Nm] 3	Λ ⁰ _{Rk,S} [Nm] 15 30 Λ ⁰ _{Rk,S,Seis,C1} [Nm] 19 37 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 19 37 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 19 37 Λ ⁰ _{Rk,S,Seis,C1} [Nm] 19 37 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 19 37 Λ ⁰ _{Rk,S,Seis,C1} [Nm] 30 60 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 30 60 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 7 7 Λ ⁰ _{Rk,S,Seis,C1} [Nm] 7 7 Λ ⁰ _{Rk,S,Seis,C2} [Nm] 7 7	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$A^{0}_{Rk,s}$ [Nm] 15 30 52 133 $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I $A^{0}_{Rk,s,seis,C2}$ [Nm] 19 37 65 166 $A^{0}_{Rk,s,seis,C2}$ [Nm] 19 37 65 166 $A^{0}_{Rk,s,seis,C1}$ [Nm] 19 37 65 166 $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I No $A^{0}_{Rk,s,seis,C2}$ [Nm] 30 60 105 266 $A^{0}_{Rk,s,seis,C2}$ [Nm] 30 60 105 266 $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I No $A^{0}_{Rk,s,seis,C1}$ [Nm] No Performance I No $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I I $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I I $A^{0}_{Rk,s,seis,C2}$ [Nm] No Performance I I inst 1, I I I I I Inom<	$A_{PK,s}^{0}$ [Nm] 15 30 52 133 260 $A_{PK,s,seis,C1}^{0}$ [Nm] No Performance Determined $A_{PK,s,seis,C2}^{0}$ [Nm] 19 37 65 166 324 $A_{PK,s,seis,C2}^{0}$ [Nm] 19 37 65 166 324 $A_{PK,s,seis,C1}^{0}$ [Nm] 19 37 65 166 324 $A_{PK,s,seis,C2}^{0}$ [Nm] 19 37 65 166 324 $A_{PK,s,seis,C2}^{0}$ [Nm] 30 60 105 266 519 $A_{PK,s,seis,C2}^{0}$ [Nm] 30 60 105 266 519 $A_{PK,s,seis,C2}^{0}$ [Nm] 26 52 92 232 454 $A_{PK,s,seis,C2}^{0}$ [Nm] 26 52 92 232 454 $A_{PK,s,seis,C2}^{0}$ [Nm] No Performance Determined a_{1st} 1,0 1 1,0 1 1 a_{1st} a_{1st} 12 16 20	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

Characteristic values of resistance for threaded rods under shear loads in cracked and non-cracked concrete, (Design according to CEN/TS 1992-4 and TR 045)

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Table C10: Char non-	acteristic value cracked concre									ls in		
Anchor size reinforcing ba	r			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure				I						1	I	
Characteristic tension resista	ince	N _{Rk,s}	[kN]					$A_{s}\boldsymbol{\cdot}f_{uk}$				
Combined pull-out and cor	ncrete failure	1										
Characteristic bond resistance	ce in non-cracked concre	ete C20/25	5									
Temperature range I:	dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	14	14	13	13	12	12	11	11	11
40°C/24°C	flooded bore hole	$\tau_{\text{Rk,ucr}}$	[N/mm²]	14	13	11	10	9,5	8,5	7,5	7,0	6,0
Temperature range II:	dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	7,0	6,5	6,5
60°C/43°C	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	6,0	5,5	5,0
Temperature range III:	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,5	6,0	6,0	6,0
72°C/43°C	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,0	5,5	5,0	4,5
		C30/37						1,04				
Increasing factors for concre Ψ_c	te	C40/50						1,08				
		C50/60						1,10				
Factor according to CEN/TS 1992-4-5 Section 6.	2.2.3	k ₈	[-]					10,1				
Concrete cone failure												
Factor according to CEN/TS 1992-4-5 Section 6.	2.3.1	k _{ucr}	[-]					10,1				
Edge distance		C _{cr,N}	[mm]					1,5 h _{et}				
Axial distance		S _{cr,N}	[mm]					$3,0 \ h_{\text{ef}}$				
Splitting failure				-								
Edge distance		C _{cr,sp}	[mm]			1,0 · h _e	_{ef} ≤2 · h,	ef (2,5	<u>h</u> h _{ef})≤2	,4 ⋅ h _{ef}		
Axial distance		S _{cr,sp}	[mm]					$2 c_{\text{cr,sp}}$				
Installation safety factor (dry	and wet concrete)	γinst				1,2				1	,4	
Installation safety factor (floo	ded bore hole)	γinst						1,4				
Walsywa Injection	system WQE 500) PLUS	for con	crete						Anne	x C 1	0



	aracteristic valu acrete (Design a							ds in	cracke	ed
Anchor size reinforcing	g bar			Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure					1	1		1		
Characteristic tension re	sistance	N _{Rk,s} =N _{Rk,s,seis,C1}	[kN]				$A_{s}\boldsymbol{\cdot}f_{uk}$			
Combined pull-out and	l concrete failure		•							
Characteristic bond resis	stance in cracked concre	te C20/25								
-		$\tau_{Rk,cr}$	[N/mm ²]	7,5	7,0	6,5	6,0	5,5	5,5	5,5
Temperature range I:	dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm ²]	6,9	6,4	6,2	5,7	5,5	5,5	5,5
40°C/24°C		$\tau_{\rm Rk,cr}$	[N/mm ²]	7,5	6,5	6,0	5,0	4,5	4,0	4,0
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm ²]	6,9	6,0	5,7	4,8	4,5	4,0	4,0
	-1	$\tau_{\rm Rk,cr}$	[N/mm ²]	4,5	4,0	4,0	3,5	3,5	3,5	3,5
Temperature range II:	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	4,1	3,7	3,8	3,3	3,5	3,5	3,5
60°C/43°C		$ au_{Rk,cr}$	[N/mm ²]	4,5	4,0	4,0	3,5	3,5	3,5	3,0
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm ²]	4,1	3,7	3,8	3,3	3,5	3,5	3,0
		$ au_{Rk,cr}$	[N/mm ²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0
Temperature range III:	dry and wet concrete	$\tau_{Rk,seis,C1}$	[N/mm ²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0
72°C/43°C		τ _{Rk,cr}	[N/mm ²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0
	flooded bore hole	$\tau_{\rm Rk,seis,C1}$	[N/mm ²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0
Increasing factors for co	ncrete	C30/37					1,04			
(only static or quasi-stati		C40/50					1,08			
Ψc		C50/60	1				1,10			
Factor according to CEN/TS 1992-4-5 Section	on 6.2.2.3	k ₈	[-]				7,2			
Concrete cone failure										
Factor according to CEN/TS 1992-4-5 Section	on 6.2.3.1	k _{cr}	[-]				7,2			
Edge distance		C _{cr,N}	[mm]				1,5 h _{ef}			
Axial distance		S _{cr,N}	[mm]				3,0 h _{et}			
Installation safety factor	(dry and wet concrete)	γinst			1,2			1	,4	
Installation safety factor	(flooded bore hole)	γinst					1,4			

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for rebar under tension loads in cracked concrete (Design according to CEN/TS 1992-4 and TR 045)

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Table C12: Characteristic value and non-cracked co)
Anchor size reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure without lever arm											
	V _{Rk,s}	[kN]				0,	50 • A _s •	f _{uk}			
Characteristic shear resistance	V ⁰ _{Rk,s,seis,C1}	[kN]	Perfor	lo mance mined PD)			0,4	14 • A₅ •	f _{uk}		
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1	k ₂						0,8				
Steel failure with lever arm											
Characteristic bending moment	M ^o _{Rk,s}	[Nm]				1.:	2 ∙ W _{el} ∙	f _{uk}			
Characteristic bending moment	M ⁰ _{Rk,s,seis,C1}	[Nm]			No P€	erformar	nce Dete	rmined ((NPD)		
Concrete pry-out failure			•								
Factor in equation (27) of CEN/TS 1992-4-5 Section 6.3.3	k ₃						2,0				
Installation safety factor	γinst						1,0				
Concrete edge failure											
Effective length of anchor	I _f	[mm]				$I_f = rr$	nin(h _{ef} ; 8	d _{nom})			
Outside diameter of anchor	d _{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation safety factor	γinst						1,0				

Walsywa Injection system WQE 500 PLUS for concrete

Performances

Characteristic values of resistance for rebar under shear loads in cracked and non-cracked concrete, (Design according to CEN/TS 1992-4 and TR 045)



Anchor size thread	ded rod		M 8	M 10	M 12	M 16	M 20	M24	M 27	М 30
Non-cracked conc	rete C20/25	under static and	quasi-statio	c action						
Temperature range I:	δ_{N0} -factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,020	0,024	0,029	0,032	0,03
40°C/24°Cັ	$\delta_{N_{\infty}}$ -factor	[mm/(N/mm ²)]	0,044	0,052	0,061	0,079	0,096	0,114	0,127	0,14
Temperature range II:	δ_{N0} -factor	[mm/(N/mm ²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,04
60°C/43°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,16
Temperature range III:	δ_{N0} -factor	[mm/(N/mm ²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,04
72°C/43°C	$\delta_{N_\infty}\text{-factor}$	[mm/(N/mm ²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,16
Cracked concrete	C20/25 und	er static, quasi-sta	atic and sei	ismic C	1 actior	ì				
Temperature range I:	δ_{N0} -factor	[mm/(N/mm ²)]			0,032	0,037	0,042	0,048	0,053	0,05
40°C/24°C	$\delta_{N_{\infty}}$ -factor	[mm/(N/mm ²)]			0,21	0,21	0,21	0,21	0,21	0,2
Temperature range II:	δ_{N0} -factor	[mm/(N/mm ²)]		ormance	0,037	0,043	0,049	0,055	0,061	0,06
60°C/43°C	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]		mined PD)	0,24	0,24	0,24	0,24	0,24	0,24
Temperature range III:	δ_{N0} -factor	[mm/(N/mm ²)]	, ,	-	0,037	0,043	0,049	0,055	0,061	0,06
72°C/43°C	$\delta_{N_\infty}\text{-factor}$	[mm/(N/mm ²)]			0,24	0,24	0,24	0,24	0,24	0,24
Cracked concrete	C20/25 und	er seismic C2 acti	on							
Temperature range I:	$\delta_{N,seis(DLS)}$	[mm/(N/mm ²)]			0,03	0,05				
40°C/24°C	δ _{N,seis(ULS)}	[mm/(N/mm ²)]			0,06	0,09				
Temperature range II:	$\delta_{N,seis(DLS)}$	[mm/(N/mm ²)]		ormance	0,03	0,05				
60°C/43°C		[mm/(N/mm ²)]		mined	0,06	0.09	No Perf	ormance l	Jetermine	d (NPL
60 C/43 C	ON,seis(ULS)	[[[[]]]]/([w]]]/[[]]/]/]	I (NI	PD)	0,00	0,05				
	$\delta_{N,seis(ULS)}$ $\delta_{N,seis(DLS)}$	[mm/(N/mm ²)]	(NI	PD)	0,03	0,05				
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor	$\begin{array}{c} \delta_{\text{N,seis(DLS)}} \\ \delta_{\text{N,seis(ULS)}} \\ \text{e displaceme} \\ \cdot \tau; \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)]	(NI	PD)		,				
Temperature range III: 72°C/43°C ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor	$\begin{array}{l} \delta_{N,seis(DLS)} \\ \overline{\delta}_{N,seis(ULS)} \end{array}$ e displaceme $\cdot \tau; \\ \cdot \tau; \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)]			0,03	0,05				
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di		[mm/(N/mm ²)] [mm/(N/mm ²)] nt			0,03	0,05	M 20	M24	M 27	M 30
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread	$\begin{array}{c} \overline{\delta_{N,seis(DLS)}}\\ \overline{\delta_{N,seis(ULS)}}\\ e \ displaceme\\ \cdot \ \tau;\\ \cdot \ \tau;\\ \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea	ir load ¹⁾ (1	thread M 10	0,03 0,06 ed rod M 12	0,05 0,09) M 16			M 27	M 30
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread	$\begin{array}{c} \overline{\delta_{N,seis(DLS)}}\\ \overline{\delta_{N,seis(ULS)}}\\ e \ displaceme\\ \cdot \ \tau;\\ \cdot \ \tau;\\ \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea	ir load ¹⁾ (1	thread M 10	0,03 0,06 ed rod M 12	0,05 0,09) M 16			M 27	
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread Non-cracked and o All temperature		[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea	r load ¹⁾ (1 M 8 er static, qu	thread M 10 Jasi-stat	0,03 0,06 ed rod M 12 tic and	0,05 0,09) M 16 seismic	C1 act	ion		0,03
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread Non-cracked and o All temperature ranges	$\begin{array}{c} \overline{\delta}_{N,seis(DLS)}\\ \overline{\delta}_{N,seis(ULS)}\\ e \ displaceme\\ \cdot \ \tau;\\ \cdot \ \tau;\\ splaceme\\ ded \ rod\\ cracked \ cor\\ \overline{\delta}_{Vo}\mbox{-}factor\\ \overline{\delta}_{V\infty}\mbox{-}factor\\ \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea crete C20/25 unde [mm/(kN)] [mm/(kN)]	Ir load ¹⁾ (1 M 8 Pr static, qu 0,06 0,09	thread M 10 Jasi-stat	0,03 0,06 ed rod M 12 tic and 0,05	0,05 0,09) M 16 seismic 0,04	0,04	i on 0,03	0,03	0,03
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread Non-cracked and d All temperature ranges Cracked concrete	$\begin{array}{c} \overline{\delta}_{N,seis(DLS)} \\ \overline{\delta}_{N,seis(ULS)} \\ e \ displaceme \\ \cdot \ \tau; \\ \cdot \ \tau; \\ splaceme \\ ded \ rod \\ cracked \ cor \\ \overline{\delta}_{Vo} \mbox{-}factor \\ \overline{\delta}_{V\infty} \mbox{-}factor \\ cracked \ cor \\ cracked \ cor$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea crete C20/25 unde [mm/(kN)] [mm/(kN)]	er static, qu 0,06 0,09 0n	thread M 10 Jasi-stat	0,03 0,06 ed rod M 12 tic and 0,05 0,08	0,05 0,09) M 16 seismic 0,04 0,06	0,04	i on 0,03	0,03	M 30 0,03 0,05
Temperature range III: 72°C/43°C ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor	$\begin{array}{c} \overline{\delta}_{N,seis(DLS)}\\ \overline{\delta}_{N,seis(ULS)}\\ e \ displaceme\\ \cdot \ \tau;\\ \cdot \ \tau;\\ splaceme\\ ded \ rod\\ cracked \ cor\\ \overline{\delta}_{V0}\text{-}factor\\ \overline{\delta}_{V\infty}\text{-}factor\\ cracked \ cor\\ \overline{\delta}_{V,seis(DLS)}\\ \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea [mm/(kN)] [mm/(kN)] er seismic C2 acti [mm/kN]	Ir load ¹⁾ (1 M 8 Pr static, qu 0,06 0,09 on No Perfu Deter	thread M 10 Jasi-stat 0,06 0,08	0,03 0,06 ed rod M 12 tic and 0,05	0,05 0,09) M 16 seismic 0,04	C1 act 0,04 0,06	i on 0,03	0,03 0,05	0,03
Temperature range III: $72^{\circ}C/43^{\circ}C$ ¹⁾ Calculation of the $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C14: Di Anchor size thread Non-cracked and d All temperature ranges Cracked concrete All temperature	$\begin{array}{c} \overline{\delta}_{N,seis(DLS)} \\ \overline{\delta}_{N,seis(ULS)} \\ e \ displaceme \\ \cdot \ \tau; \\ \cdot \ \tau; \\ splaceme \\ ded \ rod \\ cracked \ cor \\ \overline{\delta}_{Vo}-factor \\ \overline{\delta}_{V_{\infty}}-factor \\ \hline cracked \ cor \\ \overline{\delta}_{V,seis(DLS)} \\ \overline{\delta}_{V,seis(ULS)} \\ e \ displaceme \\ \cdot \ V; \\ \end{array}$	[mm/(N/mm ²)] [mm/(N/mm ²)] nt ents under shea ents under shea [mm/(kN)] [mm/(kN)] er seismic C2 acti [mm/kN] [mm/kN]	Ir load ¹⁾ (1 M 8 Pr static, qu 0,06 0,09 on No Perfu Deter	thread M 10 Jasi-stat 0,06 0,08	0,03 0,06 ed rod M 12 tic and 0,05 0,08	0,05 0,09) M 16 seismic 0,04 0,06	C1 act 0,04 0,06	ion 0,03 0,05	0,03 0,05	0,03



Anchor size reinfo	orcing bar	·	Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Non-cracked cone	crete C20/	25 under static	and qu	asi-stati	ic action	า					
Temperature range I:	δ_{N0} -factor	[mm/(N/mm ²)]	0,011	0,013	0,015	0,018	0,020	0,024	0,030	0,033	0,03
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,044	0,052	0,061	0,070	0,079	0,096	0,118	0,132	0,14
Temperature range II:	δ_{N0} -factor	[mm/(N/mm ²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,04
60°C/43°C	δ_{N_∞} -factor	[mm/(N/mm ²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,17
Temperature range III:	δ_{N0} -factor	[mm/(N/mm ²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,04
72°C/43°C	$\delta_{N_{\infty}}$ -factor	[mm/(N/mm ²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,17
Cracked concrete	e C20/25 ui	nder static, qua	isi-statio	c and se	eismic C	1 actio	n				
Temperature range I:	δ_{N0} -factor	[mm/(N/mm ²)]			0,032	0,035	0,037	0,042	0,049	0,055	0,06
40°C/24°C	$\delta_{N_\infty}\text{-factor}$	[mm/(N/mm²)]		-	0,21	0,21	0,21	0,21	0,21	0,21	0,2
Temperature range II:	δ_{N0} -factor	[mm/(N/mm ²)]			0,037	0,040	0,043	0,049	0,056	0,063	0,07
60°C/43°C	$\delta_{N_{\infty}}$ -factor	[mm/(N/mm ²)]		_	0,24	0,24	0,24	0,24	0,24	0,24	0,24
Temperature range III:	δ_{N0} -factor	[mm/(N/mm ²)]		-	0,037	0,040	0,043	0,049	0,056	0,063	0,07
72°C/43°C	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]			0,24	0,24	0,24	0,24	0,24	0,24	0,24
¹⁾ Calculation of th $\delta_{N0} = \delta_{N0}$ -factor $\delta_{N\infty} = \delta_{N\infty}$ -factor Table C16: D	τ; τ; isplacen	nent under s	1		-			I	I	I	
$\begin{split} \delta_{\text{N0}} &= \delta_{\text{N0}}\text{-factor}\\ \delta_{\text{N\infty}} &= \delta_{\text{N\infty}}\text{-factor} \end{split}$ Table C16: D	τ; τ; isplacen	nent under s	hear lo Ø 8	9 ad¹⁾ (r Ø 10	ebar) Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø3
$\begin{array}{l} \delta_{N0} = \delta_{N0} \text{-factor} \\ \delta_{N\infty} = \delta_{N\infty} \text{-factor} \end{array}$	τ; τ; isplacen orcing bar	nent under s	Ø 8	Ø 10	Ø 12		Ø 16	Ø 20	Ø 25	Ø 28	Ø3
$\begin{split} \delta_{N0} &= \delta_{N0} \text{-factor} \\ \delta_{N\infty} &= \delta_{N\infty} \text{-factor} \end{split}$ Table C16: D Anchor size reinfo For concrete C20/	τ; τ; isplacen orcing bar	nent under s	Ø 8	Ø 10	Ø 12		Ø 16	Ø 20 0,04	Ø 25	Ø 28 0,03	Ø 3 0,0
$\begin{split} \delta_{N0} &= \delta_{N0} \text{-factor} \\ \delta_{N\infty} &= \delta_{N\infty} \text{-factor} \end{split}$ Table C16: D Anchor size reinfo For concrete C20/	τ; τ; isplacen prcing bar 25 under $δ_{V0}$ -factor $δ_{V\infty}$ -factor ne displacen	nent under s static, quasi-sta [mm/(kN)] [mm/(kN)]	Ø 8 atic and	Ø 10 seismie	Ø 12 c C1 act	ion					0,0
$\begin{split} \delta_{N0} &= \delta_{N0} \text{-} \text{factor} \\ \delta_{N\infty} &= \delta_{N\infty} \text{-} \text{factor} \end{split}$ Table C16: D Anchor size reinfo For concrete C20 / All temperature ranges ¹⁾ Calculation of the second sec	τ; τ; isplacen prcing bar 25 under s $δ_{Vo}$ -factor $δ_{V\infty}$ -factor ne displacen V;	nent under s static, quasi-sta [mm/(kN)] [mm/(kN)]	Ø 8 atic and 0,06	Ø 10 seismid 0,05	Ø 12 c C1 act 0,05	i on 0,04	0,04	0,04	0,03	0,03	