



Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments



European Technical Assessment

ETA-15/0275 of 7 August 2015

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:

Trade name of the construction product

Product family to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment contains

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

This version replaces

Deutsches Institut für Bautechnik

Injection system Desa-Chem PEX 3:1 for concrete

Bonded anchor with anchor rod for use in concrete

Desarrollos Especiales de Sistemas de Anclaje S.A. Parque de Negocios de Viladecans Edificio Australia. Manzana B C/Antonio Machado, 78 - 80, 1ª planta 08840 VILADECANS - BARCELONA SPANIEN

Desa Plant 1

anchors", April 2013,

27 pages including 3 annexes which form an integral part of this assessment

Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded

used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

ETA-15/0275 issued on 9 June 2015



European Technical Assessment ETA-15/0275

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Specific Part

1 Technical description of the product

The "Injection System Desa-Chem PEX 3:1 for concrete" is a bonded anchor consisting of a cartridge with injection mortar Desa-Chem PEX 3:1 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 assessed

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply..

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.





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

In accordance with guideline for European technical approval ETAG 001, April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

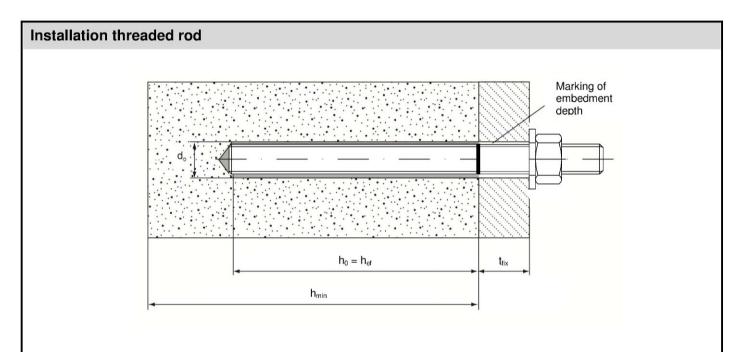
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

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

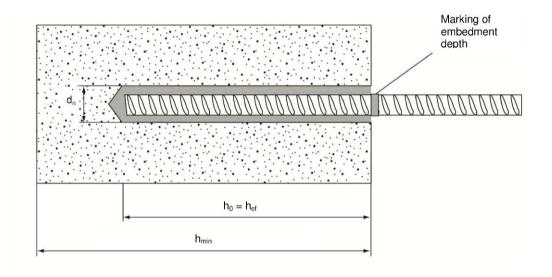
Issued in Berlin on 7 August 2015 by Deutsches Institut für Bautechnik

Uwe Bender Head of Department beglaubigt: Baderschneider





Installation reinforcing bar



 d_0 = diameter of bore hole

 t_{fix} = thickness of fixture

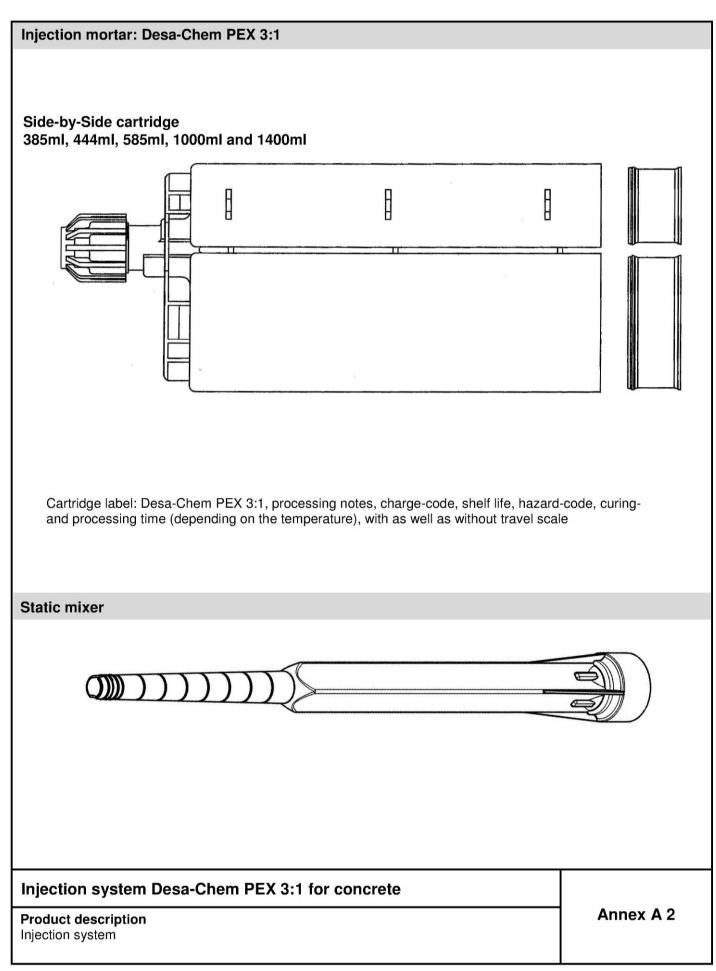
h_{ef} = effective anchorage depth

 h_0 = depth of drill hole

 h_{min} = minimum thickness of member

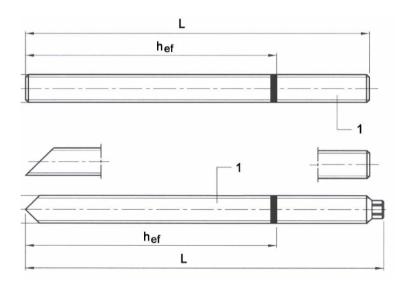
Injection system Desa-Chem PEX 3:1 for concrete	
Product description Installed condition	Annex A 1

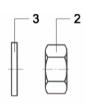






Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut

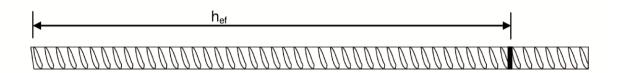




Commercial standard rod with:

- Materials, dimensions and mechanical properties acc. Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

Reinforcing bar \varnothing 8, \varnothing 10, \varnothing 12, \varnothing 14, \varnothing 16, \varnothing 20, \varnothing 25, \varnothing 28, \varnothing 32



Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-12004+AC:2010 Rib hight of the bar shall be in the range $0.05 * d \le h_{rib} \le 0.07 * d$ (d = Nominal diameter of the rebar; h: Rib height of the bar)

Injection system Desa-Chem PEX 3:1 for concrete

Product description
Threaded rod and reinforcing bar

Annex A 3



Table A1: Materials

_							
Part		Material					
	Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042 or Steel, hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009						
1	Anchor rod	Steel, EN 10087:1998 or EN 10263:2001 Property class 4.6, 5.8, 8.8, EN 1993-1-8:2005+AC:2009 A ₅ > 8% fracture elongation					
2	Hexagon nut, EN ISO 4032:2012	Steel acc. to EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 rod) EN ISO 898-2:2012, Property class 5 (for class 5.8 rod) EN ISO 898-2:2012, Property class 8 (for class 8.8 rod) EN ISO 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 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A ₅ > 8% fracture elongation					
2	Hexagon nut, EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571 EN 10088:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) 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 10088-1:2005					
High	corrosion resistance steel						
1	Anchor rod	Material 1.4529 / 1.4565, EN 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A ₅ > 8% fracture elongation					
2	Hexagon nut, EN ISO 4032:2012	Material 1.4529 / 1.4565 EN 10088-1:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) 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 10088-1:2005					
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 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$					

Injection system Desa-Chem PEX 3:1 for concrete	
Product description Materials	Annex A 4



Specifications of intended use

Anchorages subject to:

- Static and guasi-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.

Injection system Desa-Chem PEX 3:1 for concrete	
Intended Use Specifications	Annex B 1



Table B1: Installation parameters for threaded rod

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 anchorage depth	h _{ef,min} [mm] =	60	60	70	80	90	96	108	120
Enective 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 HIXTURE	t _{fix,max} [mm] <				15	00			
Minimum thickness of member	h _{min} [mm]	h _{ef} + 30 mm ≥ 100 mm							
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		Ø8	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 anchorage 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]		30 mm 0 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

Injection system Desa-Chem PEX 3:1 for concrete	
Intended Use Installation parameters	Annex B 2

Installation instructions



1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1 or Table B2).



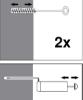
Attention! Standing water in the bore hole must be removed before cleaning.

2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump (Annex B 5) a minimum of two times. If the bore hole ground is not reached an extension shall be used.

The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm.

--2x

For bore holes larger then 20 mm or deeper 240 mm, compressed air (min. 6 bar) must be used.



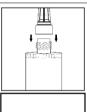
2b. Check brush diameter (Table B4) and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > d_{b,min} (Table B4) a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B4).



2c. Finally blow the hole clean again with compressed air or a hand pump (Annex B 5) a minimum of two times. If the bore hole ground is not reached an extension shall be used. The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm. For bore holes larger then 20 mm or deeper 240 mm, compressed air (min. 6 bar) must be used.

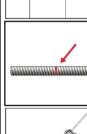


After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.



3. Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.

For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used.



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4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent colour.

Injection system Desa-Chem PEX 3:1 for concrete	
Intended Use Installation instructions	Annex B 3

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Installation instructions (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 in bore holes larger than Ø 20 mm a piston plug and extension nozzle (Annex B 5) shall be used. Observe the gel-/ working times given in Table B3.



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.



8. 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).



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 B3).



10. After full curing, the add-on part can be installed with the max. torque (Table B1) by using a calibrated torque wrench.

Table B3: Minimum curing time

Base material temperature	Gel time (working time)	Minimum curing time in dry concrete	Minimum curing time in wet concrete
+5°C to +9°C	120 min	50 h	100 h
+10°C to +19°C	90 min	30 h	60 h
+20°C to +29°C	30 min	10 h	20 h
+30°C to +39°C	20 min	6 h	12 h
+40 °C	12 min	4 h	8 h

Injection system Desa-Chem PEX 3:1 for concrete	
Intended Use Installation instructions (continuation) Curing time	Annex B 4



Parameter cleaning and setting tools Table B4:

Anchor	Size (mm)	Nominal drill bit diameter	Steel Brush d _b (mm)	Steel Brush (min brush diameter)	Piston plug
		d _o (mm)	will the	d _{b,min} (mm)	
	M8	10,0	12,0	10,5	
	M10	12,0	14,0	12,5	Not wooden.
Threaded	M12	14,0	16,0	14,5	Not necessary
Rod	M16	18,0	20,0	18,5	
	M20	24,0	26,0	24,5	#24
	M24	28,0	30,0	28,5	#28
	M27	32,0	34,0	32,5	#32
	M30	35,0	37,0	35,5	#35
	Ø8	12,0	14,0	12,5	
	Ø10	14,0	16,0	14,5	
	Ø12	16,0	18,0	16,5	Not necessary
Rebar	Ø14	18,0	20,0	18,5	
	Ø16	20,0	22,0	20,5	
7777777777777777777	Ø20	24,0	26,0	24,5	#24
	Ø25	32,0	34,0	32,5	#32
	Ø28	35,0	37,0	35,5	#35
	Ø32	40,0	41,5	38,5	#38

Hand pump (volume 750 ml)

Drill bit diameter (d₀): 10 mm to 20 mm





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

Injection system Desa-Chem PEX 3:1 for concrete	
Intended Use Cleaning and setting tools	Annex B 5



Table C1: Characteristic values of resistance for threaded rods under tension loads in non-cracked concrete (Design according to TR 029)

		(200.g		umg		0_0,				
			М 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
ance,	N _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
ance,	N _{Rk,s}	[kN]	18	29	42	78	122	176	230	280
ance,	N _{Rk,s}	[kN]	29	46	67	125	196	282	368	449
ance, d 70 (≤ M24)	N _{Rk,s}	[kN]	26	41	59	110	171 247 230		281	
ncrete cone failure										
ce in non-cracked co	ncrete C20	/25								
dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	15	15	15	14	13	12	12	12
flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	15	14	13	10	9,5	8,5	7,5	7,0
dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	8,0	7,5	7,5	7,5
flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	7,5	7,0	6,5	6,0
dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	7,0	6,5	6,5
flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	6,0	5,5	5,5
	C30/37					1,	04			
te	C40/50					1,	08			
	C50/60					1,	10			
						_				
	ŀ	n / h _{ef} ≥ 2,0	1	,0 h _{ef}						
_	2,0 > l	n / h _{ef} > 1,3	4,6 h	l _{ef} - 1,8 h						
_	ŀ	n / h _{ef} ≤ 1,3	2,	26 h _{ef}			105	2.0	26.5	c _{cr,sp}
	S _{cr,sp}	[mm]				2 0				
and wet concrete)	γ ₂			1	,2			1,4		
ded bore hole)	γ ₂		1,4							
	nce, nce, nce, nce, nce, nce, nce, nce,	nnce, $N_{Rk,s}$ nnce,	nnce, $N_{Rk,s}$ [kN]	M 8 Ince, N _{Rik,s} [kN] 15 Ince, N _{Rik,s} [kN] 18 Ince, N _{Rik,s} [kN] 29 Ince, N _{Rik,s} [kN] 26 Ince, N _{Rik,s} [kN] 26 Ince, N _{Rik,s} [kN] 26 Ince, N _{Rik,s} [kN] 29 Ince, N _{Rik,s} [kN] 26 Ince, N _{Rik,s} [kN] 29 Ince, N _{Rik,s} [kN] 26 Increte cone failure Increte cone failure Increte concrete Increte concrete	mce, $N_{Rk,s}$ $[kN]$ 15 23 nce, $N_{Rk,s}$ $[kN]$ 18 29 nce, $N_{Rk,s}$ $[kN]$ 29 46 nce, $N_{Rk,s}$ $[kN]$ 26 41 nce, $N_{Rk,s}$ $[kN]$ 26 41 nce, $N_{Rk,s}$ $[kN]$ 26 41 nce to in non-cracked concrete C20/25 dry and wet concrete $T_{Rk,ucr}$ $T_{$	mce, $N_{Rk,s}$ [kN] 15 23 34 nce, $N_{Rk,s}$ [kN] 18 29 42 nce, $N_{Rk,s}$ [kN] 29 46 67 nce, $N_{Rk,s}$ [kN] 29 46 67 nce, $N_{Rk,s}$ [kN] 26 41 59 decrete cone failure is in non-cracked concrete C20/25 dry and wet concrete $\tau_{Rk,ucr}$ [N/mm²] 15 15 15 15 flooded bore hole $\tau_{Rk,ucr}$ [N/mm²] 15 14 13 dry and wet concrete $\tau_{Rk,ucr}$ [N/mm²] 9,5 9,5 9,0 dry and wet concrete $\tau_{Rk,ucr}$ [N/mm²] 9,5 9,5 9,0 flooded bore hole $\tau_{Rk,ucr}$ [N/mm²] 8,5 8,5 8,0 gry and wet concrete $\tau_{Rk,ucr}$ [N/mm²] 8,5 8,5 8,0 $\tau_{Rk,ucr}$ [N/mm²] 8,5 8,5 8,5 8,5 8,5 8,0 $\tau_{Rk,ucr}$ [N/mm²] 8,5 8,5 8,5 8,5 8,5 8,5 8,5 8,5 8,0 $\tau_{Rk,ucr}$ [N/mm²] 8,5 8,5 8,5 8,5 8,5 8,5 8,5 8,5 8,5 8,5	nce, $N_{RK,s}$ $[kN]$ 15 23 34 63 nce, $N_{RK,s}$ $[kN]$ 18 29 42 78 nce, $N_{RK,s}$ $[kN]$ 29 46 67 125 nce, $N_{RK,s}$ $[kN]$ 26 41 59 110 draws and series are in non-cracked concrete C20/25 dry and wet concrete $T_{RK,UCF}$ $[N/mm^2]$ 15 15 15 14 13 10 dry and wet concrete $T_{RK,UCF}$ $[N/mm^2]$ 9,5 9,5 9,0 8,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 9,5 9,5 9,0 8,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,7 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,7 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,6 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,7 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,7 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2]$ 8,5 8,5 8,5 8,0 7,5 flooded bore hole $T_{RK,UCF}$ $[N/mm^2$	M 8 M 10 M 12 M 16 M 20 M 16 M 16 M 20 M 16 M 16 M 16 M 16 M 20 M 16 M 16	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

Injection system Desa-Chem PEX 3:1 for concrete Performances Characteristic values of resistance for threaded rods under tension loads in non-cracked concrete Design according to TR 029 Annex C 1



Table C2: Characteristic values of resistance for threaded rods under tension loads in cracked concrete (Design according to TR 029 and TR 045)

Anchor size threaded	rod			M 12	M 16	M 20	M24	M 27	М 30		
Steel failure											
Characteristic tension re 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		$N_{\text{Rk,s}} = N_{\text{Rk,s,seis}}$	[kN]	42	78	122	176	230	280		
Characteristic tension re Steel, property class 8.8	3	$N_{\text{Rk,s}} = N_{\text{Rk,s,seis}}$	[kN]	67	125	196	282	368	449		
Characteristic tension re Stainless steel A4 and I property class 50 (>M24	HCR,	$N_{\text{Rk,s}} = N_{\text{Rk,s,seis}}$	[kN]	59	110	171	247	230	281		
Combined pull-out and	d concrete cone failure	•									
Characteristic bond resi	stance in cracked concr	ete C20/25									
		τ _{Rk,cr}	[N/mm²]	7,5	6,5	6,0	5,5	5,5	5,5		
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm²]	7,1	6,2	5,7	5,5	5,5	5,5		
Temperature range I:		τ _{Rk,seis,C2}	[N/mm²]	2,4	2,2	No Pe	rformance I	5,5 5,5 5,5 5,5 5,5 5,5 5,5 5,5 5,5 5,5			
40°C/24°C		$ au_{Rk,cr}$	[N/mm²]	7,5	6,0	5,0	4,5	4,0	4,0		
flooded bore	flooded bore hole	τ _{Rk,seis,C1}	[N/mm²]	7,1	5,8	4,8	4,5	4,0	4,0		
		τ _{Rk,seis,C2}	[N/mm²]	2,4	2,1	No Pe	rformance I	Determined	(NPD)		
			[N/mm²]	4,5	4,0	3,5	3,5	3,5	3,5		
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm²]	4,3	3,8	3,4	3,5	3,5	3,5		
Temperature range II:		τ _{Rk,seis,C2}	[N/mm²]	1,4	1,4	No Pe	rformance I	Determined	(NPD)		
60°C/43°C		$ au_{Rk,cr}$	[N/mm²]	4,5	4,0	3,5	3,5	3,5	3,5		
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm²]	4,3	3,8	3,4	3,5	3,5	3,5		
		τ _{Rk,seis,C2}	[N/mm²]	1,4	1,4	No Pe	rformance I	3,5 3,5 3,5 mance Determined (NPD 3,5 3,5 3,5 3,5 3,5 mance Determined (NPD 1,5 1,5 1,5 1,5 1,5 1,5 1,5 1,5 1,5 1,5			
		τ _{Rk,cr}	[N/mm²]	4,0	3,5	3,0	3,0	3,0	3,0		
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm²]	3,9	3,4	3,0	3,0	3,0	3,0		
Temperature range III:		τ _{Rk,seis,C2}	[N/mm²]	1,3	1,2	No Pe	rformance I	Determined	(NPD)		
72°C/43°C		$ au_{Rk,cr}$	[N/mm²]	4,0	3,5	3,0	3,0	3,0	3,0		
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm²]	3,9	3,4	3,0	3,0	3,0	3,0		
		τ _{Rk,seis,C2}	[N/mm²]	1,3	1,2	No Pe	rformance I	Determined	(NPD)		
ncreasing factors for co	oncrete	C30/37				1,0)4				
only static or quasi-stat	tic actions)	C40/50				1,0)8				
Ψc		C50/60				1,1	0				
nstallation safety factor	(dry and wet concrete)	γ2		1,	2		1	,4			
Installation safety factor	(flooded bore hole)	γ2				1,	4				

Injection system Desa-Chem PEX 3:1 for concrete

Performances

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

Annex C 2



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)

045)										
Anchor size threaded rod			М 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Steel failure without lever arm										
	$V_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
Characteristic shear resistance, Steel, property class 4.6	V _{Rk,s,seis,C1}	[kN]	No Perfo	ormance	14	27	42	56	72	88
	$V_{Rk,s,seis,C2}$	[kN]	Determin	ed (NPD)	13	25	No Per	formance [Determined	(NPD)
	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
Characteristic shear resistance, Steel, property class 5.8	$V_{Rk,s,seis,C1}$	[kN]	No Perfo	ormance	18	34	53	70	91	111
71 1 2	$V_{\text{Rk,s,seis,C2}}$	[kN]	Determin	ed (NPD)	17	31	No Performance Determined (NPD)			
	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Characteristic shear resistance, Steel, property class 8.8	$V_{\text{Rk,s,seis,C1}}$	[kN]		ormance	30	55	85	111	145	177
	$V_{\text{Rk,s,seis,C2}}$	[kN]	Determin	ed (NPD)	27	50	No Per	formance [Determined	(NPD)
Characteristic shear resistance,	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	115	140
Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤ M24)	$V_{\text{Rk,s,seis,C1}}$	[kN]		ormance	26	48	75	98	91	111
property class 50 (>IM24) and 70 (\(\sime\) IM24)	$V_{Rk,s,seis,C2}$	[kN]	Determin	ed (NPD)	24	44	No Per	formance [Determined	(NPD)
Steel failure with lever arm										
	M ⁰ _{Rk,s}	[Nm]	15	30	52	133	260	449	666	900
Characteristic bending moment, Steel, property class 4.6	$M^0_{\rm Rk,s,seis,C1}$	[Nm]			No Per	formance [) etermined	I (NPD)		
	$M^0_{Rk,s,seis,C2}$	[Nm]								
	$M^0_{Rk,s}$	[Nm]	19	37	65	166	324	560	833	1123
Characteristic bending moment, Steel, property class 5.8	M ⁰ _{Rk,s,seis,C1}	[Nm]	No Performance Determined (NPD)							
	M ⁰ _{Rk,s,seis,C2}	[Nm]						. (– /		
Characteristic handing mamont	M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	896	1333	1797
Characteristic bending moment, Steel, property class 8.8	M ⁰ _{Rk,s,seis,C1}	[Nm]			No Per	formance [Determined	I (NPD)		
	M ⁰ _{Rk,s,seis,C2}	[Nm]								
Characteristic bending moment,	M ⁰ _{Rk,s}	[Nm]	26	52	92	232	454	784	832	1125
Stainless steel A4 and HCR, property class 50 (>M24) and 70 (≤ M24)	M ⁰ _{Rk,s,seis,C1}				No Per	formance [Determined	(NPD)		
	M ⁰ _{Rk,s,seis,C2}	[Nm]								
Concrete pry-out failure										
Factor k in equation (5.7) of Technical Report TR 029 for the design of Bonded Anchors						2,	,0			
Installation safety factor	γ ₂ 1,0									
Concrete edge failure										
See section 5.2.3.4 of Technical Report TR 02	29 for the design	n of Bond	led Ancho	ors						
			I			1,				

Injection system Desa-Chem PEX 3:1 for concrete

Performances

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

Annex C 3

Installation safety factor (flooded bore hole)



1,4

Anchor size reinforcing base Steel failure Characteristic tension resist	ar			Ø8	Ø 10	Ø 12						
		l failure					Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Characteristic tension resist	aracteristic tension resistance No [kN											
	tance	N _{Rk,s}	[kN]					$A_s \times f_{uk}$				
Combined pull-out and co	oncrete cone failure											
Characteristic bond resistan	nce in non-cracked co	ncrete C20/	25									
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	$ au_{Rk,ucr}$	[N/mm ²]	14	13	11	10	9,5	8,5	7,5	7,0	6,0
Temperature range II:	dry and wet concrete	$ au_{ m 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	$ au_{Rk,ucr}$	[N/mm ²]	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	$ au_{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	$ au_{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 $\psi_{\text{\tiny C}}$	ete	C40/50		1,08								
		C50/60						1,10				
Splitting failure												
		h	ı / h _{ef} ≥ 2,0		1,0 h _{ef}		h/h _{ef}					
Edge distance		2,0 > h	n / h _{ef} > 1,3	4,6	h _{ef} - 1,8	h	1,3 -					
		h	n / h _{ef} ≤ 1,3	2	2,26 h _{ef}		+		1,0·h _{ef}	2,26	·h _{ef}	c _{cr,sp}
Axial distance		S _{cr,sp}	[mm]					2 c _{cr,sp}	· <u>-</u> -		0.	
Installation safety factor (dry	y and wet concrete)	γ ₂				1,2				1,	,4	

Injection system Desa-Chem PEX 3:1 for concrete	
Performances Characteristic values of resistance for rebar under tension loads in non-cracked concrete Design according to TR 029	Annex C 4

γ2

1,10

1,4

1,4

1,2

Table C5: Characteristic values of resistance for rebar under tension loads in cracked concrete (Design according to TR 029 and TR 045) Ø 12 Anchor size reinforcing bar Ø 14 Ø 16 Ø 20 Ø 25 Ø 28 Ø 32 Steel failure $N_{Rk,s} =$ Characteristic tension resistance [kN] $A_s \times f_{uk}$ $N_{\text{Rk},s,\text{seis},\text{C1}}$ Combined pull-out and concrete cone failure Characteristic bond resistance in cracked concrete C20/25 7,5 5,5 5,5 5,5 $[N/mm^2]$ 7,0 6,5 6,0 dry and wet concrete [N/mm²] 6,9 6,4 6,2 5,7 5,5 5,5 5,5 $\tau_{Rk,seis,C1}$ Temperature range I: 40°C/24°C 4,0 $[N/mm^2]$ 7,5 6,5 6,0 5,0 4,5 4,0 $\tau_{\text{Rk,cr}}$ flooded bore hole 4,0 6,9 6,0 5,7 4,5 4,0 [N/mm²] 4.8 τ_{Rk,seis,C1} 3,5 $[N/mm^2]$ 4,5 4,0 4,0 3,5 3,5 3,5 TRk cr dry and wet concrete $[N/mm^2]$ 3.7 3.8 3,3 3.5 3.5 3.5 4.1 τ_{Rk,seis,C1} Temperature range II: 60°C/43°C 3,0 4,5 4,0 4,0 3.5 3,5 3,5 [N/mm²] $au_{\mathsf{Rk},\mathsf{cr}}$ flooded bore hole $[N/mm^2]$ 4,1 3,7 3,8 3,3 3,5 3,5 3,0 τ_{Rk,seis,C1} [N/mm²] 4,0 3,5 3,5 3,0 3,0 3,0 3,0 $au_{\mathsf{Rk},\mathsf{cr}}$ dry and wet concrete 3,7 3,3 2,9 3,0 3,0 3,0 [N/mm²] 3,2 τ_{Rk,seis,C1} Temperature range III: 72°C/43°C [N/mm²]4,0 3,5 3,0 3,0 3,0 3,0 $\tau_{\text{Rk,cr}}$ flooded bore hole 3,0 3,0 [N/mm²] 3,7 3,2 3,3 2,9 3,0 $au_{
m Rk,seis,C1}$ C30/37 1.04 Increasing factors for concrete (only static or quasi-static actions) C40/50 1,08

Injection system Desa-Chem PEX 3:1 for concrete	
Performances Characteristic values of resistance for rebar under tension loads in cracked concrete Design according to TR 029 and TR 045	Annex C 5

C50/60

γ2

γ2

Installation safety factor (dry and wet concrete)

Installation safety factor (flooded bore hole)



Table C6: Characteristic values of resistance for rebar under shear loads in cracked and non-cracked concrete (Design according to TR 029 and TR 045)

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]	$0,50 \times A_s \times f_{uk}$										
Characteristic shear resistance	V _{Rk,s,seis,C1}	[kN]	Perfor Deter	lo mance mined PD)			0,4	$0,44 \times A_s \times f_{uk}$					
Steel failure with lever arm													
Characteristic handing managet	M ⁰ _{Rk,s}	[Nm]	1.2 ⋅W _{el} ⋅ f _{uk}										
Characteristic bending moment	M ⁰ _{Rk,s,seis,C1}	[Nm]	No Performance Determined (NPD)										
Concrete pry-out failure													
Factor k in equation (5.7) of Technical ReTR 029 for the design of bonded anchors	eport						2,0						
Installation safety factor	γ2						1,0						
Concrete edge failure													
See section 5.2.3.4 of Technical Report 1	R 029 for the de	esign of I	of Bonded Anchors										
Installation safety factor	γ2						1,0						

Injection system Desa-Chem PEX 3:1 for concrete	
Performances Characteristic values of resistance for rebar under shear loads in cracked and non-cracked concrete, Design according to TR 029 and TR 045	Annex C 6



Table C7: Characteristic values of resistance for threaded rods under tension loads in non-cracked concrete (Design according to CEN/TS 1992-4)

in no	n-cracked concre	ete (De:	sign acc	cordii	ng to	CEN/	TS 19	992-4)			
Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M 27	М 30
Steel failure											
Characteristic tension resista	ance,	N _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
Steel, property class 4.6 Characteristic tension resista	ance.	-									
Steel, property class 5.8	a. 100,	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	230	280
Characteristic tension resista Steel, property class 8.8	ance,	N _{Rk,s}	[kN]	29	46	67	125	196	282	368	449
Characteristic tension resista Stainless steel A4 and HCR property class 50 (>M24) an	,	N _{Rk,s}	[kN]	26	41	59	110	171	247	230	281
Combined pull-out and co	ncrete failure										
Characteristic bond resistan	ce in non-cracked concrete	C20/25									
Temperature range I:	dry and wet concrete	$ au_{Rk,ucr}$	[N/mm ²]	15	15	15	14	13	12	12	12
40°C/24°C	flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	15	14	13	10	9,5	8,5	7,5	7,0
Temperature range II:	dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	8,0	7,5	7,5	7,5
60°C/43°C	flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	9,5	9,5	9,0	8,5	7,5	7,0	6,5	6,0
Temperature range III:	dry and wet concrete	$ au_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	7,0	6,5	6,5
72°C/43°C	flooded bore hole	$ au_{Rk,ucr}$	[N/mm²]	8,5	8,5	8,0	7,5	7,0	6,0	5,5	5,5
In averaging factors for any array		C30/37					1,	04			
Increasing factors for concre Ψ _c	ete	C40/50					1,	80			
Ψ¢		C50/60		1,10							
Factor according to CEN/TS	1992-4-5 Section 6.2.2.3	k ₈	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	i h _{ef}			
Axial distance		S _{cr,N}	[mm]				3,0) h _{ef}			
Splitting failure											
		h	n / h _{ef} ≥ 2,0	1,0	0 h _{ef}		1/h _{ef} 7				
Edge distance		2,0 > h	ı / h _{ef} > 1,3	4,6 h _e	_f - 1,8 h		1,3				
		h	n / h _{ef} ≤ 1,3	2,2	26 h _{ef}			1,0·h _e	, 2,2€	c _c	r,sp
Axial distance		S _{cr,sp}	[mm]				2 0	cr,sp	,, 2,20	' ''ef	
Installation safety factor (dry	and wet concrete)	γinst		1,2 1,4				,4			
Installation safety factor (floo	oded bore hole)	γinst					1	,4			

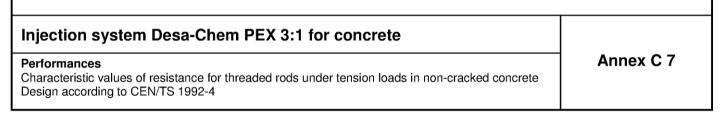




Table C8: Characteristic values of resistance for threaded rods under tension loads in cracked concrete (Design according to CEN/TS 1992-4 or TR 045)

Anchor size threaded rod				M 12	M 16	M 20	M24	M27	M30		
Steel failure											
Characteristic tension resist Steel, property class 4.6	,	$N_{Rk,s} = N_{Rk,seis}$	[kN]	34	63	98	141	184	224		
Characteristic tension resist Steel, property class 5.8	ance,	$N_{Rk,s} = N_{Rk,seis}$	[kN]	42	78	122	176	230	280		
Characteristic tension resist Steel, property class 8.8	ance,	$N_{Rk,s} = N_{Rk,seis}$	[kN]	67	125	196	282	368	449		
Characteristic tension resist Stainless steel A4 and HCR property class 50 (>M24) an	,	$N_{\text{Rk,s}} = N_{\text{Rk,seis}}$	[kN]	59	110	171	247	230	281		
Combined pull-out and co	ncrete failure										
Characteristic bond resistan	ce in cracked concrete Ca	20/25									
		$ au_{ m 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/mm²]	7,1	6,2	5,7	5,5	5,5	5,5		
Temperature range I:		τ _{Rk,seis,C2}	[N/mm²]	2,4	2,2	No Peri	ormance l	Determined	(NPD)		
40°C/24°C		$ au_{Rk,cr}$	[N/mm²]	7,5	6,0	5,0	4,5	4,0	4,0		
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm²]	7,1	5,8	4,8	4,5 4,0		4,0		
		τ _{Rk,seis,C2}	[N/mm²]	2,4	2,1	No Perl	ormance I	Determined	d (NPD)		
			[N/mm²]	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		
Femperature range II:		τ _{Rk,seis,C2}	[N/mm²]	1,4	1,4	No Perl	ormance I	Determined	d (NPD)		
		$ au_{Rk,cr}$	[N/mm ²]	4,5	4,0	3,5	3,5	3,5	3,5		
	flooded bore hole τ	τ _{Rk,seis,C1}	[N/mm ²]	4,3	3,8	3,4	3,5	3,5	3,5		
		T _{Rk,seis,C2}	[N/mm²]	1,4	1,4	No Perf	(NPD)				
		$ au_{ m Rk,cr}$	[N/mm²]	4,0	3,5	3,0	3,0	3,0	3,0		
	dry and wet concrete	τ _{Rk,seis,C1}	[N/mm²]	3,9	3,4	3,0	3,0	3,0	3,0		
Temperature range III:		τ _{Rk,seis,C2}	[N/mm²]	1,3	1,2	No Peri	ormance l	Determined	d (NPD)		
72°C/43°C		τ _{Rk,cr}	[N/mm²]	4,0	3,5	3,0	3,0	3,0	3,0		
	flooded bore hole	T _{Rk,seis,C1}	[N/mm²]	3,9	3,4	3,0	3,0	3,0	3,0		
		T _{Rk,seis,C2}	[N/mm ²]	1,3	1,2	No Peri	ormance I	Determined	d (NPD)		
Increasing factors for concre	nto.	C30/37				1,	04				
Increasing factors for concre (only static or quasi-static ac		C40/50				1,	08				
Ψς		C50/60					10				
Factor according to CEN/TS 6.2.2.3	3 1992-4-5 Section	k ₈	[-]			7	,2				
Concrete cone failure											
Factor according to CEN/TS 6.2.3.1	3 1992-4-5 Section	k _{cr}	[-]	7,2							
Edge distance		C _{cr,N}	[mm]			1,5	h _{ef}				
Axial distance		S _{cr,N}	[mm]			3,0	h _{ef}				
Installation safety factor (dry	and wet concrete)	Yinst		1,	,2		1	,4			
Installation safety factor (floo	oded bore hole)	γinst				1	,4				

Injection system Desa-Chem PEX 3:1 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



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)

9 10 0 11 1				,					
		М 8	M 10	M 12	M 16	M 20	M24	M 27	М 30
		•							
$V_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
V _{Rk,s,seis,C1}	[kN]	No Perfe	ormance	14	27	42	56	72	88
V _{Rk,s,seis,C2}	[kN]	Determin	ed (NPD)	13	25	No Perf	ormance [Determined	(NPD)
$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
$V_{Rk,s,seis,C1}$	[kN]	No Perf	ormance	18	34	53	70	91	111
$V_{Rk,s,seis,C2}$	[kN]	Determin	ed (NPD)	17	31	No Perf	ormance [Determined	(NPD)
$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
$V_{Rk,s,seis,C1}$	[kN]			30	55	85	111	145	177
$V_{Rk,s,seis,C2}$	[kN]	Determin	ed (NPD)	27	50	No Perf	ormance [Determined	(NPD)
$V_{Rk,s}$	[kN]	13	20	30	55	86	124	115	140
$V_{\text{Rk,s,seis,C1}}$	[kN]			26	48	75	98	91	111
V _{Rk,s,seis,C2}	[kN]	Determin	ed (NPD)	24	44	No Perf	ormance [Determined	(NPD)
k ₂					0,	.8			
_		•							
M ⁰ _{Rk,s}	[Nm]	15	30	52	133	260	449	666	900
$M^0_{Rk,s,seis,C1}$	[Nm]			No Perfo	rmanca [) otormina	M (NPD)		
M ⁰ _{Rk,s,seis,C2}	[Nm]								
M ⁰ _{Rk,s}	[Nm]	19	37	65	166	324	560	833	1123
	[Nm]			No Perfo	rmance [Determine	ed (NPD)		
	[Nm]								
	[Nm]	30	60	105	266	519	896	1333	1797
	[Nm]			No Perfo	rmance [Determine	ed (NPD)		
_									ı
		26	52	92	232	454	784	832	1125
				No Perfo	rmance [Determine	ed (NPD)		
M° _{Rk,s,seis,C2}	[Nm]								
k ₃					2,	,0			
γinst					1,	,0			
l _f	[mm]				$l_t = min(h$	ef; 8 d _{nom})			
d _{nom}	[mm]	8	10	12	16	20	24	27	30
	VRk,s,seis,C1 VRk,s,seis,C2 VRk,s VRk,s,seis,C2 VRk,s VRk,s,seis,C2 VRk,s VRk,s,seis,C1 VRk,s,seis,C2 VRk,s VRk,s,seis,C2 VRR,s,seis,C2 VRR,s,seis,C1 VRR,s,seis,C2 VRR,s,seis,C2 VRR,s,seis,C1 VRR,s,seis,C1 VRR,s,seis,C2 VRR,s,seis,C1 VRR,s,seis,C2 VRR,s,seis,C2 VRR,s,seis,C2 VRR,s,seis,C2	VRK,s,seis,C1 [kN] VRK,s,seis,C2 [kN] VRK,s [kN] VRK,s,seis,C1 [kN] VRK,s,seis,C2 [kN] VRK,s [kN] VRK,s,seis,C1 [kN] VRK,s,seis,C2 [kN] VRK,s [kN] VRK,s,seis,C1 [kN] VRK,s,seis,C2 [kN] MORK,s,seis,C2 [kN] MORK,s,seis,C1 [Nm] MORK,s,seis,C1 [Nm] MORK,s,seis,C1 [Nm] MORK,s,seis,C2 [Nm]	VRK,s [KN] 7	V_Rk,s [kN] 7 12	VR.s.s [kN] 7 12 17 VR.s.s.seis,C1 [kN] No Performance Determined (NPD) 13 VR.s.s.seis,C2 [kN] 9 15 21 VR.s.s.seis,C1 [kN] No Performance Determined (NPD) 17 VR.s.s.seis,C2 [kN] No Performance Determined (NPD) 30 VR.s.seis,C1 [kN] No Performance Determined (NPD) 27 VR.s.seis,C2 [kN] No Performance Determined (NPD) 26 VR.s.seis,C2 [kN] No Performance Determined (NPD) 24 K2 [kN] No Performance Determined (NPD) 24 K2 [kN] No Performance Determined (NPD) 26 MR.s.seis,C2 [kN] No Performance Determined (NPD) <td< td=""><td> VRik,s.seis,C1</td><td>VRik,s [kN] 7 12 17 31 49 VRik,s,sois,C1 [kN] No Performance Determined (NPD) 13 25 No Performance Performance Determined (NPD) 13 25 No Performance Performance Petermined (NPD) 13 25 No Performance Petermined (NPD) 13 25 No Performance Petermined (NPD) 18 34 53 53 53 49 44 53 49 53 49 44 53 49 48 53 49 48 53 49 44 45 49 44 43 53 49 44 43 49 44</td><td> VRic.s [KN] 7 12 17 31 49 71 </td><td> VRIK.s. Selfs.C1 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C3 Selfs.Selfs.C3 </td></td<>	VRik,s.seis,C1	VRik,s [kN] 7 12 17 31 49 VRik,s,sois,C1 [kN] No Performance Determined (NPD) 13 25 No Performance Performance Determined (NPD) 13 25 No Performance Performance Petermined (NPD) 13 25 No Performance Petermined (NPD) 13 25 No Performance Petermined (NPD) 18 34 53 53 53 49 44 53 49 53 49 44 53 49 48 53 49 48 53 49 44 45 49 44 43 53 49 44 43 49 44	VRic.s [KN] 7 12 17 31 49 71	VRIK.s. Selfs.C1 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C2 Selfs.Selfs.C3 Selfs.Selfs.C3

Injection system Desa-Chem PEX 3:1 for concrete

Performances

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

Annex C 9



Table C10: Characteristic values of resistance for rebar under tension loads in non cracked concrete (Design according to CEN/TS 1992-4)

								1				
Anchor size reinforcing I	bar			Ø8	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]					$A_s \ x \ f_{uk}$				
Combined pull-out and c	oncrete failure											
Characteristic bond resista	ance in non-cracked concr	ete C20/2	25									
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	$ au_{Rk,ucr}$	[N/mm²]	14	13	11	10	9,5	8,5	7,5	7,0	6,0
Temperature range II:			[N/mm²]	8,5	8,5	8,0	8,0	7,5	7,0	7,0	6,5	6,5
60°C/43°C				8,5	8,5	8,0	8,0	7,5	7,0	6,0	5,5	5,0
Temperature range III:			[N/mm²]	7,5	7,5	7,5	7,0	7,0	6,5	6,0	6,0	6,0
$72^{\circ}\text{C}/43^{\circ}\text{C}$ flooded bore hole $\tau_{\text{Rk,ucr}}$ [N/mm				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				
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 _{ef}								
Axial distance		S _{cr,N}	[mm]					3,0 h _{ef}				
Splitting failure												
		h	/ h _{ef} ≥ 2,0		1,0 h _{ef}		h/h _{ef}					
Edge distance $ 2,0 > h / h_{ef} > 1 $				4,6	h _{ef} - 1,8	h	1,3					
h / h _{ef} ≤ -			/ h _{ef} ≤ 1,3	2	2,26 h _{ef}		+		1,0·h _{ef}	2,26	⊹h _{ef}	C _{cr,sp}
Axial distance $s_{cr,sp}$ [mm]				2 c _{cr,sp}								
Installation safety factor (d	ry and wet concrete)	γinst		1,2 1,4								
Installation safety factor (fl	ooded bore hole)	γinst						1,4				

Injection system Desa-Chem PEX 3:1 for concrete	
Performances Characteristic values of resistance for rebar under tension loads in non-cracked concrete Design according to CEN/TS 1992-4	Annex C 10

English translation prepared by DIBt



Table C11: Characteristic values of resistance for rebar under tension loads in cracked concrete (Design according to CEN/TS 1992-4 and TR 045)

Anchor size reinforcing	bar			Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
Steel failure		<u> </u>	<u> </u>	<u> </u>		<u> </u>					
Characteristic tension res	istance	N _{Rk,s} = N _{Rk,s,seis,C1}	[kN]	$A_s \times f_{uk}$							
Combined pull-out and	concrete failure										
Characteristic bond resist	ance in cracked concre	ete C20/25									
	dry and wet	$ au_{Rk,cr}$	[N/mm²]	7,5	7,0	6,5	6,0	5,5	5,5	5,5	
Temperature range I:	concrete	τ _{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_{ m Rk,cr}$	[N/mm²]	7,5	6,5	6,0	5,0	4,5	4,0	4,0	
nooded bore note		τ _{Rk,seis,C1}	[N/mm²]	6,9	6,0	5,7	4,8	4,5	4,0	4,0	
	dry and wet	τ _{Rk,cr}	[N/mm²]	4,5	4,0	4,0	3,5	3,5	3,5	3,5	
Temperature range II:	τ _{Rk,seis,C1}	[N/mm²]	4,1	3,7	3,8	3,3	3,5	3,5	3,5		
60°C/43°C flooded bore hole		$ au_{ m Rk,cr}$	[N/mm²]	4,5	4,0	4,0	3,5	3,5	3,5	3,0	
		τ _{Rk,seis,C1}	[N/mm²]	4,1	3,7	3,8	3,3	3,5	3,5	3,0	
	dry and wet	$ au_{ m Rk,cr}$	[N/mm²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0	
Temperature range III:	concrete	τ _{Rk,seis,C1}	[N/mm²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0	
72°C/43°C		τ _{Rk,cr}	[N/mm²]	4,0	3,5	3,5	3,0	3,0	3,0	3,0	
	flooded bore hole	τ _{Rk,seis,C1}	[N/mm²]	3,7	3,2	3,3	2,9	3,0	3,0	3,0	
Increasing factors for con	crete	C30/37					1,04			,	
(only static or quasi-static	actions)	C40/50					1,08				
Ψc		C50/60					1,10				
Factor according to CEN/TS 1992-4-5 Section	n 6.2.2.3	k ₈	[-]				7,2				
Concrete cone failure											
Factor according to CEN/TS 1992-4-5 Section	n 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 _{ef}							
Installation safety factor (dry and wet concrete)	γinst		1,2 1,4			1,4				
Installation safety factor (flooded bore hole)	γinst		1,4							

Injection system Desa-Chem PEX 3:1 for concrete	
Performances	Annex C 11
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 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 reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure without lever arm											
Characteristic above resistance	[kN]				0,5	50 x A _s x	f _{uk}				
Characteristic shear resistance	V _{Rk,s,seis,C1}	[kN]	No Performance Determined (NPD) No Performance O,44 x A _s x 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 handing manage	[Nm]				1.	2 ·W _{el} ·	f _{uk}				
Characteristic bending moment	M ⁰ _{Rk,s,seis,C1}	[Nm]			No Pe	erforman	ice 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	γ inst		1,0								
Concrete edge failure											
Effective length of anchor	l _f	[mm]				$I_f = m$	in(h _{ef} ; 8	d _{nom})			
Outside diameter of anchor	d _{nom}	[mm]	8	10	12	14	16	20	24	27	30
Installation safety factor	γinst						1,0				

Injection system Desa-Chem PEX 3:1 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	Annex C 12



Table C13: Displacements under tension load ¹⁾ (threaded rod)											
Anchor size threa	aded rod		М 8	M 10	M 12	M 16	M 20	M24	M 27	M 30	
Non-cracked con	crete C20/25 unde	r static and qua	asi-stati	c actio	n						
40°C/24°C	δ_{N0} – factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,020	0,024	0,029	0,032	0,035	
40 0/24 0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,079	0,096	0,114	0,127	0,140	
60°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,043	
60°0/43°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]	0,050 0,060		0,070	0,091	0,111	0,131	0,146	0,161	
72°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,043	
72°C/43°C	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,161	
Cracked concrete C20/25 under static, quasi-static and seismic C1 action											
40°C/24°C	δ _{N0} – factor	[mm/(N/mm²)]			0,032	0,037	0,042	0,048	0,053	0,058	
40°0/24°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]			0,21	0,21	0,21	0,21	0,21	0,21	
60°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]	No Perfo	ormance mined	0,037	0,043	0,049	0,055	0,061	0,067	
60°0/43°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]		PD)	0,24	0,24	0,24	0,24	0,24	0,24	
72°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]			0,037	0,043	0,049	0,055	0,061	0,067	
72°0/43°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]			0,24	0,24	0,24	0,24	0,24	0,24	
Cracked concrete	e C20/25 under sei	smic C2 action									
40°C/24°C	$\delta_{N,seis(DLS)}-factor$	[mm/(N/mm²)]			0,03	0,05					
40*0/24*0	$\delta_{N,seis(ULS)}-factor$	[mm/(N/mm²)]			0,06	0,09					
60°C/43°C	$\delta_{N,seis(DLS)}-factor$	[mm/(N/mm²)]	No Perfo		0,03	0,05	No Porf	ormanoo l	Determine	rd (NIDD)	
60 0/43 0	$\delta_{N,seis(ULS)}-factor$	[mm/(N/mm²)]	Determined (NPD) 0,06			0,09	No Fell	omance i	Jetennine	ט (וארט)	
72°C/43°C	$\delta_{N,seis(DLS)}-factor$	[mm/(N/mm²)]			0,03	0,05	;				
72-0/43-0	$\delta_{N,seis(ULS)}-factor$	[mm/(N/mm²)]			0,06	0,09					

¹⁾ Calculation of the displacement

 $\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau;$
$$\begin{split} \delta_{\text{N,seis(DLS)}} &= \delta_{\text{N,seis(DLS)}}\text{-factor} \quad \cdot \ \tau; \\ \delta_{\text{N,seis(ULS)}} &= \delta_{\text{N,seis(ULS)}}\text{-factor} \quad \cdot \ \tau; \end{split}$$

 $\delta_{N_{\infty}} = \delta_{N_{\infty}}$ -factor $\cdot \tau$; (τ: action bond strength)

Table C14: Displacements under shear load¹⁾ (threaded rod)

Anchor size threaded rod				M 10	M 12	M 16	M 20	M24	M 27	M 30
Non-cracked and cracked concrete C20/25 under static, quasi-static and seismic C1 action										
All temperatures	δ_{V0} – factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
Air temperatures	$\delta_{V_{\infty}}$ – factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Cracked concrete	C20/25 under seismi	c C2 action								
All temperatures	$\delta_{V,seis(DLS)}$ – factor	[mm/kN]	No Perfo	ormance mined	0,2	0,1	No Porf	ormanco [Determine	4 (VIBD)
Air temperatures	[mm/kN]	(NF		0,2	0,1	NO PERIO	Jilliance L	eterriirie:	d (INFD)	

¹⁾ Calculation of the displacement

 $\delta_{\text{V,seis}(\text{DLS})} = \delta_{\text{V,seis}(\text{DLS})}\text{-factor} \ \cdot \ \text{V}$ $\delta_{V0} = \delta_{V0}$ -factor · V;

 $\delta_{V_{\infty}} = \delta_{V_{\infty}}$ -factor $\cdot V$; $\delta_{\text{V,seis(ULS)}} = \delta_{\text{V,seis(ULS)}}\text{-factor} \quad \text{V}$ (V: action shear load)

Injection system Desa-Chem PEX 3:1 for concrete

Performances

Displacements (threaded rods)

Annex C 13



					-1\						
Table C15:	Displace	ements unde	r tensi	ion loa	d ¹⁾ (reb	oar)					
Anchor size	reinforcing t	ar	Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Non-cracked	concrete C2	20/25 under sta	itic and	quasi-s	tatic act	ion					
40°C/24°C	δ_{N0} – factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,018	0,020	0,024	0,030	0,033	0,037
40°0/24°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,070	0,079	0,096	0,118	0,132	0,149
60°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,043
60°0/43°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,172
72°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,034	0,038	0,043
72.0/43.0	$\delta_{N\infty}$ – factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,136	0,151	0,172
Cracked con	crete C20/25	under static,	quasi-st	atic and	seismi	c C1 act	tion				
40°C/24°C	δ_{N0} – factor	[mm/(N/mm²)]			0,032	0,035	0,037	0,042	0,049	0,055	0,061
40°C/24°C	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]			0,21	0,21	0,21	0,21	0,21	0,21	0,21
60°C/43°C	δ_{N0} – factor	[mm/(N/mm²)]		ormance	0,037	0,040	0,043	0,049	0,056	0,063	0,070
60°0/43°0	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]		mined PD)	0,24	0,24	0,24	0,24	0,24	0,24	0,24
7000/4000	δ_{N0} – factor	[mm/(N/mm²)]		ļ	0,037	0,040	0,043	0,049	0,056	0,063	0,070
72°C/43°C	$\delta_{N_{\infty}}$ – factor	[mm/(N/mm²)]		!	0,24	0,24	0,24	0,24	0,24	0,24	0,24

¹⁾ Calculation of the displacement

 $\delta_{N0} = \delta_{N0} - factor \cdot \tau;$

(τ: action bond strength)

 $\delta_{N\infty} = \delta_{N\infty} - factor \cdot \tau;$

Table C16: Displacement under shear load 1) (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
For concrete C20/25 under static, quasi-static and seismic C1 action											
All temperatures	δ_{V0} – factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
temperatures	$\delta_{V_{\infty}}$ – factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04

^{^1)} Calculation of the displacement $\delta_{V0} = \delta_{V0} - factor \cdot V; \\ \delta_{V\infty} = \delta_{V\infty} - factor \cdot V;$ (

(V: action shear load)

Injection system Desa-Chem PEX 3:1 for concrete	
Performances Displacements (rebar)	Annex C 14