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European Technical Assessment





General Part

Technical Assessment Body issuing the European Technical Assessment	Instytut Techniki Budowlanej
Trade name of the construction product	R-KEX-II
Product family to which the construction product belongs	Bonded fasteners with threaded rod, rod with inner thread and rebar for use in concrete
Manufacturer	RAWLPLUG S.A. ul. Kwidzyńska 6 51-416 Wrocław Poland
Manufacturing plant	Manufacturing Plant no. 3
This European Technical Assessment contains	38 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	European Assessment Document (EAD) 330499-01-0601 "Bonded fasteners for use in concrete"
This version replaces	ETA-21/0244 issued on 30/12/2021



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Specific Part

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1 Technical description of the product

The R-KEX-II are bonded anchors (injection type) consisting of a injection mortar cartridge using an applicator gun equipped with a special mixer nozzle and steel element. The steel element consists of:

- threaded anchor rod sizes M8 to M30 made of:
- galvanized carbon steel,
- carbon steel with zinc flake coating,
- stainless steel,
- high corrosion resistant stainless steel,

with hexagon nut and washer,

- rod with inner thread sizes M6/Ø10 to M16/Ø24 made of:
 - galvanized carbon steel,
 - stainless steel,
 - high corrosion resistant stainless steel,
- rebar sizes Ø8 to Ø32.

The steel element is placed into a drilled hole previously injected (using an applicator gun) with a mortar with a slow and slight twisting motion. The rod or rebar is anchored by the bond between steel element and concrete.

The product description is given in Annex A.

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

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

The provisions given in this European Technical Assessment are based on an assumed working life of the anchor of 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, 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 Performance of the product

3.1.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to static and quasi-static loading, displacements	See Annexes C1 to C13
Characteristic resistance to seismic performance category C1, displacements	See Annexes C14 to C16
Characteristic resistance to seismic performance category C2, displacements	See Annex C17

3.1.2 Hygiene, health and the environment (BWR 3)

No performance assessed.



3.2 Methods used for the assessment

The assessment has been made in accordance with EAD 330499-01-0601.

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

According to Decision 96/582/EC of the European Commission the system 1 of assessment and verification of constancy of performance applies (see Annex V to regulation (EU) No 305/2011).

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited in Instytut Techniki Budowlanej.

For type testing the results of the tests performed as part of the assessment for the European Technical Assessment shall be used unless there are changes in the production line or plant. In such cases the necessary type testing has to be agreed between Instytut Techniki Budowlanej and the notified body.

Issued in Warsaw on 27/09/2023 by Instytut Techniki Budowlanej

Anna Panek, MSc Deputy Director of ITB











Designation			Mater	ial	
Steel, zinc plated					
electroplated ≥ 5 μm accordir	ng to EN ISO	4042			
hot-dip galvanized ≥ 40 μm a	cording to E	N ISO 1461			
non-electrolytically applied z	inc flake coat	ing ≥ 8 µm accordin	g to EN ISO 10683		
Threaded rod	Property class	Characteristic steel ultimate strength	Characteristic steel yield strength	Fracture elongation	
	5.8	f _{uk} ≥ 500 N/mm²	f _{yk} ≥ 400 N/mm²	A ₅ > 8%	
	6.8	f _{uk} ≥ 600 N/mm²	f _{yk} ≥ 480 N/mm ²	A ₅ > 8%	EN ISO 898-1
	8.8	f _{uk} ≥ 800 N/mm²	f _{yk} ≥ 640 N/mm ²	A₅ ≥ 12%	
	9.8	f _{uk} ≥ 900 N/mm ²	$f_{yk} \ge 640 \text{ N/mm}^2$	A₅ ≥ 10%	
	10.9	f _{uk} ≥ 1000 N/mm²	$f_{yk} \ge 900 \text{ N/mm}^2$	A ₅ > 9%	
	12.9	f _{uk} ≥ 1200 N/mm ²	$f_{yk} \ge 1800 \text{ N/mm}^2$	A ₅ > 8%	
Hexagon nut	5		for class 5.8 rods		
	6		for class 6.8 rods		
	8		for class 8.8 rods		
	9		for class 9.8 rods		EN 130 696-2
	10		for class 10.9 rods		
	12		for class 12.9 rods		
Vasher	0	Steel according to EN	ISO 7089; correspon	ding to anchor rod	material
Stainless steel A4 High corrosion resistance sta	ainless steel ((Materials) (HCR) (Materials)) 1.4401, 1.4404, 1.4) 1.4529, 1.4565, 1.4	571 547	
Threaded rod	Property class	Characteristic steel ultimate strength	Characteristic steel yield strength	Fracture elongation	EN 10088
	70	f _{uk} ≥ 700 N/mm²	f _{yk} ≥ 450 N/mm²	A₅ ≥ 12%	EN ISO 3506
	80	f _{uk} ≥ 800 N/mm²	f _{yk} ≥ 600 N/mm ²	A₅ ≥ 12%	
Hexagon nut	70		for class 70 rods		EN 10088
	80		for class 80 rods		EN ISO 3506
Vasher		Steel, according to E	N 10088; correspond	ing to anchor rod n	naterial
For anchorages under seisn potion b): $A_5 \ge 12\%$ and $f_{ijk} \le 12\%$	nic actions w	hich are designed i	n accordance with	EN 1992-4:2018	Section 9.2 (

material and mechanical properties according to Table A1,

 confirmation of material and mechanical properties by inspection certificate 3.1 according to EN-10204:2004; the documents shall be stored,

marking of the threaded rod with the embedment depth.

Note: Commercial standard threaded rods made of galvanized steel with property class above 8.8 are not permitted in some Member States.

R-KEX-II

Product description Materials (1) Annex A3



Table A2: Rods with inner th	read				
Designation			Mater	rial	
Steel, zinc plated					
electroplated ≥ 5 μm according	to EN ISO	4042			
hot-dip galvanized ≥ 40 μm acc	ording to E	N ISO 1461			
Rod with inner thread	Property class	Characteristic steel ultimate strength	Characteristic steel yield strength	Fracture elongation	
	5.8	f _{uk} ≥ 500 N/mm²	$f_{yk} \ge 400 \text{ N/mm}^2$	A ₅ > 8%	EN ISO 898-1
	6.8	f _{uk} ≥ 600 N/mm²	f _{yk} ≥ 480 N/mm²	A ₅ > 8%	
	8.8	f _{uk} ≥ 800 N/mm²	$f_{yk} \ge 640 \text{ N/mm}^2$	A₅ ≥ 12%	
Stainless steel A4		(Materials)	1.4401, 1.4404, 1.4	571	
High corrosion resistance stain	nless steel (HCR) (Materials)	1.4529, 1.4565, 1.4	547	
Rod with inner thread	Property class	Characteristic steel ultimate strength	Characteristic steel yield strength	Fracture elongation	EN 10088
	70	f _{uk} ≥ 700 N/mm²	f _{yk} ≥ 450 N/mm²	A ₅ ≥ 12%	EN ISO 3506
	80	f _{uk} ≥ 800 N/mm²	f _{yk} ≥ 600 N/mm ²	A₅ ≥ 12%	

Table A3: Reinforcing bars (rebar) according to EN 1992-1-1, Annex C

Product form		Bars and de	-coiled rods
Class		В	С
Characteristic yield strength fyk or f0,2k [N/mm ²]		400 t	o 600
Minimum value of $\mathbf{k} = (f_t / f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ϵ_{uk} [%]		≥ 5,0	≥ 7,5
Bendability		Bend / Re	ebend test
Maximum deviation from nominal mass (individual bar) [%]	Nominal bar size [mm] ≤ 8 > 8	± (± 4	6,0 4,5
Bond: minimum relative rib area, $f_{R,min}$	Nominal bar size [mm] 8 to 12 > 12	0,0 0,0)40)56

Rib height: The maximum rib height is: $h_{rib} \le 0.07 \cdot \emptyset$

Table A4: Injection mortar

Product	Composition	
R-KEX-II (two component injection mortar)	Epoxy system with fillers	
R-KEX-II		Annex A4
Product description Materials (2)	n	of European Technical Assessment ETA-21/0244







Specification of intended use

Anchors subject to:

- Static and quasi-static loads: threaded rod size M8 to M30, rod with inner thread size M6/Ø10 to M16/Ø24 and rebar Ø8 to Ø32.
- Seismic performance category C1: threaded rod size M8 to M30 and rebar Ø8 to Ø32.
- Seismic performance category C2: threaded rod size M12 to M24.

Base material:

- Reinforced or unreinforced normal weight concrete of strength class C20/25 to C50/60 according to EN 206.
- Cracked and uncracked concrete threaded rod size M8 to M30 and rebar Ø8 to Ø32.
- Uncracked concrete only rod with inner thread size M6/Ø10 to M16/Ø24.

Temperature ranges:

Installation temperature (temperature of substrate):

• +5°C to +30°C.

In-service temperature:

The anchors may be used in the following temperature range:

- -40°C to +40°C (max. short term temperature +40°C and max. long term temperature +24°C).
- -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).

Use conditions (environmental conditions):

- Structures subject to dry internal conditions: all materials.
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class (CRC):
 - stainless steel A4 according to Annex A, Table A3: CRC III,
 - high corrosion resistance steel (HCR) according to Annex A, Table A3: CRC V.

Design methods:

- Anchorages are designed in accordance with EN 1992-4:2018 and EOTA Technical Report TR 055.
- Anchorages under seismic actions have to be designed in accordance with EN 1992-4:2018.
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- 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.).

Installation:

- Dry or wet concrete (use category I1).
- Flooded holes (use category I2).
- Installation direction D3 (downward, horizontal and upwards installation).
- The anchors are suitable for hammer drilled holes or diamond core drilled holes.

R-KEX-II

Intended use Specification Annex B1





Table B1: Installation parameters – threaded rods

Size		M8	M10	M12	M16	M20	M24	M30
Nominal drilling diameter	d ₀ [mm]	10	12	14	18	22 or 24	28	35
Maximum diameter hole in the fixture	d _f [mm]	9	12	14	18	22	26	33
Effective embedment	h _{ef,min} [mm]	60	70	80	100	120	140	165
depth	h _{ef,max} [mm]	160	200	240	320	400	480	600
Depth of the drilling hole	h ₀ [mm]				n _{ef} + 5 mm	1		
Minimum thickness of the concrete slab	h _{min} [mm]	h _{ef} + 3	30 mm; ≥ 1	00 mm		h _{ef} ⋅	+ 2d ₀	
Maximum installation torque	T _{inst,max} [Nm]	10	20	40	80	120	180	200
Minimum spacing	s _{min} [mm]	40	40	40	50	60	70	85
Minimum edge distance	c _{min} [mm]	40	40	40	50	60	70	85

R-KEX-II

Intended use Installation parameters (1) Annex B2





Table B2: Installation parameters – rods with inner thread

Size		M6/ Ø10/ 75	M8/ Ø12/ 75	M8/ Ø12/ 90	M10/ Ø16/ 75	M10/ Ø16/ 100	M12/ Ø16/ 100	M16/ Ø24/ 125
Nominal drilling diameter	d₀ [mm]	12	14	14	20	20	20	28
Maximum diameter hole in the fixture	d _f [mm]	7	9	9	12	12	14	18
Effective embedment depth	h _{ef} = h _{nom} [mm]	75	75	90	75	100	100	125
Thread length, min	l _s [mm]	24	25	25	30	30	35	50
Depth of the drilling hole	h₀[mm]				h _{ef} + 5 mm	1		
Minimum thickness of the concrete slab	h _{min} [mm]	h _{ef} + 3	0 mm; ≥ 1	00 mm		h _{ef} +	- 2d ₀	
Maximum installation torque	T _{inst,max} [Nm]	3	5	5	10	10	20	40
Minimum spacing	s _{min} [mm]	40	40	50	40	50	50	70
Minimum edge distance	c _{min} [mm]	40	40	50	40	50	50	70

R-KEX-II

Intended use Installation parameters (2) Annex B3



Błąd! Nie można tworzyć obiektów przez edycję kodów pól.

Table B3: Installation parameters – rebar

Size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Nominal drilling diameter	d ₀ [mm]	10 or 12	12 or 14	14 or 18	18	22	26	32	40
Effective embedment	h _{ef,min} [mm]	60	70	80	80	100	120	140	165
depth	h _{ef,max} [mm]	160	200	240	280	320	400	500	640
Depth of the drilling hole	h ₀ [mm]				h _{ef} +	5 mm			
Minimum thickness of the concrete slab	h _{min} [mm]	h _{ef}	+ 30 mm	ı; ≥ 100 n	nm		h _{ef} ⊦	- 2d ₀	
Minimum spacing	s _{min} [mm]	40	40	40	40	50	60	70	85
Minimum edge distance	c _{min} [mm]	40	40	40	40	50	60	70	85

R-KEX-II

Intended use Installation parameters (3) Annex B4



	R-K	EX-II	
Nortar temperature [°C]	Concrete (substrate) temperature [°C]	Maximum processing time [min.]	Minimum curing time ¹⁾ [min.]
+5	+5	150	2880
+10	+10	120	1080
+20	+20	35	480
+25	+30	12	300
(whichever is longer). Mi installation +25°C. For w	nimum mortar temperature for et condition and flooded holes	r installation +5°C; maximum s the curing time must be doul	mortar temperature for bled.
	R-KEX-II		Annoy PE
	R-KEX-II		Annex B5
	R-KEX-II		Annex B5 of European
	R-KEX-II		Annex B5 of European Technical Assess







Dispenser	Cartridge size
Manual gun for side by side cartridges R-GUN-385-P	385 ml
Manual gun for side by side cartridges R-GUN-600-P	385, 600 ml
Błąd! Nie można tworzyć obiektów przez edycję kodów pól. Cordless dispenser gun	
ETT	385, 600 ml
Pneumatic dispenser gun	
	385, 600 ml
Manual gun for side by side cartridges R-GUN-MULTI	
R-KEX-II	Anney R7
	of European
later de duise	Technical Assessr



Image: Threaded rod diameterM8M10M12M16M20M24M33d_bBrush diameter[mm]12141620263037able B6: Brush diameter for rod diameterd_bBrush diameter[mm]16M8/Ø12M10/Ø16M12/Ø16M12/Ø16M16/Ø20d_bBrush diameter[mm]161620222230able B7: Brush diameter for rebarM8/Ø10Ø12Ø14Ø16Ø20Ø25Ød_bBrush diameter[mm]141620202428374able B8: Dosing plug diameterPosing plug R-NQ2-P21222425262830323540
db Brush diameter [mm] 12 14 16 20 26 30 37 able B6: Brush diameter for rod with inner thread Threaded rod diameter M6/Ø10 M8/Ø12 M10/Ø16 M12/ Ø16 M16/Ø20 Ø db Brush diameter [mm] 16 16 22 22 22 30 able B7: Brush diameter for rebar Ø8 Ø10 Ø12 Ø14 Ø16 Ø20 Ø25 Ø db Brush diameter [mm] 14 16 20 20 24 28 37 4 able B8: Dosing plug diameter Hole diameter [mm] 16 18 20 22 24 25 26 28 30 32 35 40
able B6: Brush diameter for rod with inner threadThreaded rod diameterM6/Ø10M8/Ø12M10/Ø16M12/ Ø16M16/Ø2d_bBrush diameter[mm]161612 22 22 22 30 able B7: Brush diameter for rebarRebar diameter for rebarM8/Ø10Ø12Ø14Ø16Ø20Ø25ØdbBrush diameter[mm]1416 20 20 24 28 37 4 Able B8: Dosing plug diameterHole diameter [mm]1618 20 22 24 25 26 28 30 32 35 40
Image: Image
d_b Brush diameter [mm] 16 16 22 22 30 able B7: Brush diameter for rebar Rebar diameter for rebar d_b Brush diameter 088 010 012 014 016 020 025 0025
able B7: Brush diameter for rebar Rebar diameter for rebar db Brush diameter Ø8 Ø10 Ø12 Ø14 Ø16 Ø20 Ø25 Ø db Brush diameter [mm] 14 16 20 20 24 28 37 4 able B8: Dosing plug diameter Hole diameter [mm] 16 18 20 22 24 25 26 28 30 32 35 40
Rebar diameter Ø8 Ø10 Ø12 Ø14 Ø16 Ø20 Ø25 Ø d_b Brush diameter [mm] 14 16 20 20 24 28 37 4 able B8: Dosing plug diameter Mole diameter [mm] 16 18 20 22 24 25 26 28 30 32 35 40
db Brush diameter [mm] 14 16 20 20 24 28 37 4 able B8: Dosing plug diameter Hole diameter [mm] 16 18 20 22 24 25 26 28 30 32 35 40 Dosing plug B-NQZ-P Grad of the g
able B8: Dosing plug diameter Hole diameter [mm] 16 18 20 22 24 25 26 28 30 32 35 40 Dosing plug R-NQZ-P 340 340 340 340 340 340 340
diameter Ø16 Ø18 Ø20 do Ø22 Ø24 do Ø26 Ø28 Ø30 do 32 Ø35 Ø40

R-KEX-II

Intended use Tools (3) Annex B8



1.	 Hole drilling. a. Hammer drilling. 	
	Drill hole to the required dia rotary hammer drilling mach b. Diamond core drilling. Drill hole to the required dia diamond core drilling	meter and depth using a ine. meter and depth using a machine and the
	corresponding core bit are u	sed.
2. a. b. x^{*} x^{*} $x^{$	 2. Hole cleaning. a. Manual cleaning with brushammer drilled hole: starting from the drill hole least 4 times using the hale using the specified brush the hole at least 4 times, starting from the drill hole 4 times with the hand pure b. Cleaning hole, diamond dair: flush the hole from the box 2 times, using the specified brush the hole at least 3 times, starting from the drill hole 2 times, 	sh and hand pump for e bottom blow the hole at nd pump, , mechanically brush out le bottom, blow at least np. rilling, with compressed ottom with water at least , mechanically brush out le bottom, blow at least
1.001	2 times with compressed	dll.
3.	Dispense to waste until even co 10 cm).	lour is obtained (min.
4.	 Insert the mixer nozzle to the fa inject mortar, slowly withdrawing is filled to 2/3 of its depth. 	r end of the hole and g the nozzle as the hole
5.	 Immediately insert the threaded slight twisting motion. Remove a around the hole before it sets. 	rod, slowly and with any excess mortar
6.	6. Leave the fixing undisturbed unt elapses.	til the curing time
7. ✓ –	7. Attach fixture and tighten the nu The installation torque cannot e	ut to the required torque. xceed T _{inst,max} .
R-KEX-II		Annex B9
Intended use Installation instruction – thr	eaded rod	Technical Assessment ETA-21/0244



1. a. b.	 Hole drilling. Hammer drilling. Drill hole to the required diameter and depth using a rotary hammer drilling machine. Diamond core drilling. Drill hole to the required diameter and depth using a diamond core drilling machine and the corresponding core bit are used.
2. a. b.	 2. Hole cleaning. a. Manual cleaning with brush and hand pump for hammer drilled hole: starting from the drill hole bottom blow the hole at least 4 times using the hand pump, using the specified brush, mechanically brush out the hole at least 4 times, starting from the drill hole bottom, blow at least 4 times with the hand pump. b. Cleaning hole, diamond drilling, with compressed air: flush the hole from the bottom with water at least 2 times, using the specified brush, mechanically brush out the hole at least 3 times,
3.	 Insert cartridge into dispenser and attach nozzle. Dispense to waste until even colour is obtained (min. 10 cm).
4. 5.	 4. Insert the mixer nozzle to the far end of the hole and inject mortar, slowly withdrawing the nozzle as the hole is filled to 2/3 of its depth. 5. Immediately insert the rod with inner thread, slowly and with slight twisting motion. Remove any excess motion are not being being it each of the hole is the set of the hole is the set.
6. 0	6. Leave the fixing undisturbed until the curing time elapses.
7.	 Attach fixture and tighten the bolt to the required torque. The installation torque cannot exceed T_{inst,max}.
R-KEX-II	Annex B10
Intended use Installation instruction – rod with in	ner thread of European Technical Assessment ETA-21/0244



1. a. b. c. b. b. c.	 Hole drilling. Hammer drilling. Drill hole to the requires using a rotary hammer Diamond core drilling. Drill hole to the requires using a diamond correct the corresponding correct the corresponding correct the corresponding. Hole cleaning. Manual cleaning with for hammer drilled hole at least 4 times – using the specified brush out the hole at least 4 times – using the specified brush out the hole – starting from the direct drives with the hole of the starting from the direct driv	red diameter and depth er drilling machine. g. red diameter and depth e drilling machine and ore bit are used. h brush and hand pump ble: rill hole bottom blow the es using the hand pump, I brush, mechanically at least 4 times, rill hole bottom, blow at he bed bottom, blow at
3.	least 4 times with t b. Cleaning hole, diamo compressed air: - flush the hole from least 2 times, - using the specified brush out the hole - starting from the du least 2 times with o 3. Insert cartridge into disp Dispense to waste until 6 (min. 10 cm).	he hand pump. ond drilling, with the bottom with water at I brush, mechanically at least 3 times, rill hole bottom, blow at compressed air. enser and attach nozzle. even colour is obtained
X AN		
4.	 Insert the mixer nozzle and inject mortar, slowl as the hole is filled to 2/3 	to the far end of the hole y withdrawing the nozzle 3 of its depth.
5.	 Immediately insert the slight twisting motion. Re around the hole before it 	rebar, slowly and with emove any excess mortar sets.
6.	 Leave the fixing undistuelapses. 	rbed until the curing time
R-KEX-II		Annex B11
Intended use Installation instruction – reb	par	of European Technical Assessment ETA-21/0244



	1.	Inject from the bot the mortar about 2 For best performa appropriately size on the mixer.	tom of the hole. Inject 2/3 of the hole depth. nce use extension and d piston plug assembled
	2.	Drive the rebar im Use temporary int wedges.	mediately into the hole. erlocking element e.g
	3.	Leave the fixing u time elapses. To a rebar during the o (due to the rebar o temporary interloo	ndisturbed until the curing avoid the slipping of the pen time of the product own weight) use a sking element.
	1		
R-KEX-II			Annex B12
Intended use Installation instruction – rebar – overhead i	instal	lation	Technical Assessment ETA-21/0244



Size			M8	M10	M12	M16	M20	M24	M30
Steel failure				1					-
Steel, property class 5.8									
Characteristic resistance	N _{Rk,s}	[kN]	18	29	42	78	122	176	280
Partial safety factor 1)	Ϋ́Ms	[-]				1,50			
Steel, property class 8.8									
Characteristic resistance	N _{Rk,s}	[kN]	29	46	67	126	196	282	449
Partial safety factor 1)	γ _{Ms}	[-]				1,50			
Steel, property class 10.9				•	•				
Characteristic resistance	N _{Rk,s}	[kN]	37	58	84	157	245	353	561
Partial safety factor 1)	γ́Ms	[-]				1,40			
Steel, property class 12.9	1	-	n		ir	n		Ť.	T
Characteristic resistance	N _{Rk,s}	[kN]	44	70	101	188	294	424	673
Partial safety factor 1)	γMs	[-]				1,40			
Stainless steel, property class A4-7	0								
Characteristic resistance	N _{Rk,s}	[kN]	26	41	59	110	171	247	393
Partial safety factor 1)	γMs	[-]				1,87			
Stainless steel, property class A4-8	0								1
Characteristic resistance	N _{Rk,s}	[kN]	29	46	67	126	196	282	448
Partial safety factor 1)	Ϋ́Ms	[-]				1,60			
High corrosion resistant stainless st	eel, property class 70		~-						
Characteristic resistance	N _{Rk,s}	[kN]	25	40	59	110	1/1	247	393
Partial safety factor 1	Ϋ́Ms					1,87			
Combined pull-out and concrete	cone failure in uncra	cked concrete	C20/25 -	- hamme	r drilling,	working	lite 50 y	ears	1
Temperature range I: 40°C/24°C	τ _{Rk,ucr,50}	[N/mm ²]	17,0	16,0	17,0	15,0	15,0	13,0	12,0
Temperature range II: 80°C/50°C	$\tau_{\rm Rk,ucr,50}$	[N/mm ²]	15,0	14,0	15,0	13,0	13,0	12,0	10,0
Combined pull-out and concrete	cone failure in uncra	cked concrete	C20/25 -	 diamon 	d core di	rilling, wo	orking life	e 50 year	s
Temperature range I: 40°C/24°C	$\tau_{\rm Rk,ucr,50}$	[N/mm ²]	14,0	15,0	16,0	14,0	14,0	12,0	11,0
Temperature range II: 80ºC/50ºC	$\tau_{\rm Rk,ucr,50}$	[N/mm ²]	12,0	14,0	14,0	13,0	13,0	11,0	10,0
Factors – working life 50 years									
		C30/37				1,04			
Increasing factor	ψc	C40/50				1,07			
		C50/60				1,09			
Sustained load factor for $\tau_{Rk,ucr,50}$) W ⁰ = =	40°C/24°C				0,75			
in uncracked concrete	Ψ sus,50	80°C/50°C				0,72			
Combined pull-out and concrete	cone failure in uncra	cked concrete	C20/25 -	– hamme	r drilling,	working	life 100	years	
Temperature range I: 40°C/24°C	TRk,ucr,100	[N/mm ²]	17,0	16,0	17,0	15,0	15,0	13,0	12,0
Temperature range II: 80°C/50°C	T DI	[N/mm ²]	15.0	14 0	15.0	13.0	13.0	12.0	10 (
	♥RK,UCF,100	[]	10,0	11,0	10,0	10,0	10,0	12,0	10,0
Combined pull-out and concrete	cone failure in uncra	cked concrete	C20/25 -	 diamon 	d core di	rilling, wo	orking life	e 100 yea	rs
Temperature range I: 40°C/24°C	T _{Rk,ucr,100}	[N/mm ²]	14,0	15,0	16,0	14,0	14,0	12,0	11,(
Temperature range II: 80°C/50°C	₹Rk,ucr,100	[N/mm ²]	12,0	14,0	14,0	13,0	13,0	11,0	10,0
Factors – working life 100 years									
		C30/37				1,04			
Increasing factor	Ψc	C40/50				1,07			
		C50/60				1,09			
In the absence of other national rec	gulation								
	R-KEX-II						An	nex C1	
	Performance	s				т	of E echnica	uropear I Asses	า smer
Characte in uncra	Performance ristic resistance to acked concrete – 1	s tension load threaded rod	ds I			Т	echnica ETA	1 As -21/	sess 024



Size			M8	M10	M12	M16	M20	M24	M30
Concrete cone failure in uncrack	ed concrete								
Factor for uncracked concrete	k _{ucr,N}	[-]				11,0			
Edge distance	C _{cr,N}	[mm]				1,5 · h _{ef}			
Spacing	S _{cr,N}	[mm]				$3,0 \cdot h_{ef}$			
Splitting failure									
	c _{cr,sp} for h _{min}				2,0 · h _{ef}			1,5	· h _{ef}
	c _{cr,sp} for				-				
Edge distance	$h_{min} < h^{-1} < 2 \cdot h_{ef}$	[mm]			280				
	(c _{cr,sp} from linear interpolation)	[IIIII]			hnin		dinap.		
	$c_{cr,sp}$ for $h^{(1)} \ge 2 \cdot h_{ef}$					C _{cr,N}			
Spacing	S _{cr,sp}	[mm]				2,0 · c _{cr,s}	p		
Installation safety factors for con	nbined pull-out, concrete	cone and	splitting	failure					
Installation safety factor for in use category I1						1,0			
Installation safety factor for in use category I2	Ύinst	[-]				1,2			

¹⁾ h – concrete member thickness

R-KEX-II

Performances Characteristic resistance to tension loads in uncracked concrete – threaded rod Annex C2



loaus									
Size			M8	M10	M12	M16	M20	M24	M30
Steel failure									
Steel, property class 5.8	П								
Characteristic resistance	N _{Rk,s}	[kN]	18	29	42	78	122	176	280
Partial safety factor ¹⁾	γMs	[-]				1,50			
Steel, property class 8.8	Ne	[kNI]	20	46	67	125	106	282	118
Partial safety factor ¹⁾	VM-	[-]	29	40	07	1.50	190	202	440
Steel, property class 10.9	7 MIS	LJ				1,00			
Characteristic resistance	N _{Rk,s}	[kN]	36	58	84	157	245	353	561
Partial safety factor ¹⁾	γMs	[-]				1,40			
Steel, property class 12.9									
Characteristic resistance	N _{Rk,s}	[kN]	43	69	101	188	294	423	673
Partial safety factor '/ Staipless steel, property class A4 70	γMs	[-]				1,40			
Characteristic resistance	NpLa	[kN]	25	40	59	109	171	247	392
Partial safety factor ¹⁾	YMo	[-]	20	-10	55	1.87	171	271	002
Stainless steel, property class A4-80	11/15	LJ				.,0.			
Characteristic resistance	N _{Rk,s}	[kN]	29	46	67	125	196	282	448
Partial safety factor ¹⁾	γMs	[-]				1,60			
High corrosion resistant stainless steel,	property class 70								
Characteristic resistance	N _{Rk,s}	[kN]	25	40	59	109	171	247	392
Partial safety factor '	γ _{Ms}	[-]	20/25		بر ممالاته	1,8/	fa E0 vaa		
Combined pull-out and concrete con	e failure in crack		,20/25 – 1	nammer C	arnning, w	orking in	re ou yea	rs	
Temperature range I: 40°C/24°C	τ _{Rk,cr,50}	[N/mm ²]	8,0	8,0	7,0	7,0	7,0	6,0	5,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,50}$	[N/mm ²]	7,0	7,0	6,0	6,0	6,0	5,0	4,0
Combined pull-out and concrete con	e failure in crack	ed concrete C	20/25 – 0	diamond	core drill	ing, worl	king life 5	50 years	
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm ²]	5,5	7,0	8,0	7,0	8,0	7,0	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,50}$	[N/mm ²]	5,0	6,5	7,5	6,5	7,0	6,5	3,5
Factors – working life 50 years									
		C30/37				1,04			
Increasing factor	Ψc	C40/50				1,07			
Quate in a d la a d fa stan fan		050/60				1,09			
Sustained load factor for $\tau_{Rk,ucr,50}$	Ψ^0 sus,50	40°C/24°C				0,75			
Combined pull-out and concrete con	e failure in crack	ed concrete C	20/25 – 1	hammer o	trilling, w	orking li	fe 100 ve	ars	
							7.0		5.0
Temperature range I: 40°C/24°C	τ _{Rk,cr} ,100	[N/mm²]	8,0	8,0	6,5	7,0	7,0	6,0	5,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,100}$	[N/mm ²]	6,5	7,0	6,0	6,0	6,0	5,0	4,0
Combined pull-out and concrete con	e failure in crack	ed concrete C	20/25 – 0	diamond	core drill	ing, worl	king life 1	00 years	
Temperature range I: 40°C/24°C	τ _{Rk,cr,100}	[N/mm ²]	5,5	7,0	8,0	7,0	7,0	6,0	4,0
Temperature range II: 80°C/50°C	τ _{Rk,cr,100}	[N/mm ²]	5,0	6,5	7,0	6,0	6,5	5,0	3,5
Factors – working life 100 years									
ractoro monang no roo youro		C30/37				1,00			
Increasing factor	Ψc	C40/50				1,00			
	•	C50/60				1,00			
¹⁾ In the absence of other national regulat	ion								
	R-KEX-II						A of	nnex C3 Europea	3 IN
Characteris in cracke	Performance tic resistance to ed concrete – the	e s o tension lo hreaded roc	ads 1				Technic ET/	al Asses A-21/024	ssment 14

Table C3: Characteristic resistance to tension loads for threaded rod in cracked concrete – static and quasi-static



Table C4: Characteristic resistance to tension load for threaded rod in cracked concrete – static and quasi-static loads

Size			M8	M10	M12	M16	M20	M24	M30
Concrete cone failure in cracked c	oncrete								
Factor for cracked concrete	k _{cr,N}	[-]				7,7			
Edge distance	C _{cr,N}	[mm]				1,5 · h _{ef}			
Spacing	S _{cr,N}	[mm]				3,0 · h _{ef}			
Splitting failure									
	c _{cr,sp} for h _{min}				2,0 · h _{ef}			1,5	· h _{ef}
	c _{cr,sp} for								
Educ distance	$h_{min} < h^{-1} < 2 \cdot h_{ef}$	$h_{min} < h^{(1)} < 2 \cdot h_{ef}$							
Edge distance	(c _{cr sp} from linear	[mm]	***W						
	interpolation)				ⁿ cin	Early	Course .		
	$c_{cr,sp}$ for $h^{(1)} \ge 2 \cdot h_{ef}$					C _{cr,N}			
Spacing	S _{cr,sp}	[mm]				2,0 · c _{cr,sp}	•		
Installation safety factors for comb	ined pull-out, concrete	cone and	splitting	failure					
Installation safety factors						1.0			
for in use category I1		r 1	1,0						
Installation safety factors	γinst	[-]				1 2			
for in use category I2						∡, ۱			

¹⁾ h – concrete member thickness

R-KEX-II

Performances Characteristic resistance to tension loads in cracked concrete – threaded rod

Annex C4



Steel figure Nex [NN 10 18 29 42 Characteristic resistance Nex [NN 10 18 29 42 Steel, property class 5.8 1.50 1.50 1.50 1.50 1.50 Steel, property class 8.8 1.50 1.50 1.50 1.50 1.50 Characteristic resistance Nex [kN] 14 25 40 59 Partial sately factor 10 70x [-] 1.87 59 59 Stainless steel, property class A4-30 Nex [kN] 14 25 40 59 Characteristic resistance Nex [kN] 14 25 40 59 Partial sately factor 11 casistance Nex [kN] 14 25 40 59 Partial sately factor 11 casistance Nex [kN] 14 25 40 59 Combined pulsout and concrete cone failure in uncracked concrete C2025 - hammer drilling 1.87 Concrete C2025 - hammer drilling 1.87 Combined pulsout and concrete cone failure in uncracked concrete C2025 - hammer drilli				M6 / Ø10	M8 / Ø12	M10 / Ø16	M12 / Ø16	M16 /Ø24			
Steel, property class 5.8							1				
Characteristic resistance $N_{B_{k,d}}$ [KN] 10 18 29 42 Partial safety factor 11 Yata [-] 1.50 Steel, property class 8.8 Characteristic resistance $N_{B_{k,d}}$ [KN] 16 29 46 67 Partial safety factor 11 Yata [-] 1.50 Stainless steel, property class A4-70 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.60 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.60 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.60 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.60 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.60 Characteristic resistance $N_{B_{k,d}}$ [KN] 14 25 40 59 Partial safety factor 11 Yata [-] 1.67 Combined pull-out and concrete cone failure in uncracked concrete C2025 - hammer drilling Temperature range [: $40^{\circ}C/24^{\circ}C$ $t_{B_{k,df,0}0}$ [N/mm] 8.0 12.0 12.0 11.0 10.0 Increasing factor ψ_{e} C3037 1.04 Increasing factor ψ_{e} C4050 1.07 Solution failure In uncracked concrete C3025 - hammer drilling, working life 100 year Increasing factor ψ_{e} C4050 1.07 Solution failure Increased concrete C3025 - hammer drilling Solution 1.09 Resistance to concrete Concrete $\psi_{e,m}$ [-] 1.0 Installation safety factors for combined pull-out, concrete conce and splitting failure Installation safety factors	class 5.8										
Partial safety factor " $T_{Max} [I] = 1.50$ Telle, property class 8.8 Characteristic resistance Na _{8.4} [KN] 16 29 46 67 Partial safety factor " Par	esistance	N _{Rk,s}	[kN]	10	18	29	42	78			
Steel, property class 8.8	ctor 1)	γ́Ms	[-]			1,50					
Characteristic resistance Nexa [KN] 16 29 46 67 Partial safety factor ¹ 726 [c] 1.50 Stainless steel, property class A4-70 Characteristic resistance Nexa [KN] 14 25 40 59 Partial safety factor ¹ 766 [c] 1.60 Characteristic resistance Nexa [KN] 16 29 46 67 Partial safety factor ¹ 766 [c] 1.60 Characteristic resistance Nexa [KN] 16 29 46 67 Partial safety factor ¹ 766 [c] 1.60 Characteristic resistance Nexa [KN] 14 25 40 59 Characteristic resistance Nexa [KN] 14 20 12.0 11.0 Temperature range I: 40°C/24°C transvisio [N/mr] 8.0 12.0 12.0 11.0 Increasing factor V (C) C30/37 1.04 Increasing factor V (C) C) C (C) (C) (C) (C) (C) (C) (C) (C	class 8.8				-						
Partial safety factor ¹⁰ Yma [-] 1.50 Stainless steel, property class AA-70 Characteristic resistance Nmxa [KN] 14 25 40 59 Stainless steel, property class AA-80	esistance	N _{Rk,s}	[kN]	16	29	46	67	125			
Stainless steel, property class A4-70 Characteristic resistance Nex. [kN] 14 25 40 59 Partial safety factor " The control control of the	ctor 1)	γMs	[-]			1,50					
Characteristic resistance $N_{\text{Nex.s.}}$ $[kN]$ 14 25 40 59 Partial safety factor 11 γ_{Max} [-] 1,87 Stainless steel, property class A4-80 Characteristic resistance NNex.s. $[kN]$ 16 29 46 67 Partial safety factor 11 γ_{Max} [-] 1,60 High corrosion resistant stainless steel, property class 70 Characteristic resistance NNex.s. $[kN]$ 14 25 40 59 Partial safety factor 11 γ_{Max} [-] 1,87 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling Temperature range I: 40°C/24°C $\tau_{\text{Rex.ef.50}}$ $[N'mm^2]$ 7,5 11,0 11,0 10,0 Temperature range II: 80°C/50°C $\tau_{\text{Rex.ef.50}}$ $[N'mm^2]$ 7,5 11,0 11,0 10,0 Increasing factor ψ_c $C30'37$ 1,04 Increasing factor ψ_c $C30'37$ 1,	property class A4-70				T	T		1			
Partial safety factor ¹⁰ Yma [-] 1,87 Stainless steel, property class A4-80 Characteristic resistance Nex. [N] 16 29 46 67 Partial safety factor ¹⁰ Yma [-] 1,80 1,80 1,80 Characteristic resistance Nex. [N] 14 25 40 59 Partial safety factor ¹⁰ Yma [-] 1,87 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling Temperature range I: 40°C/24°C 11,0 10,0 Temperature range I: 80°C/50°C TRUMER.CO. [N/mm ²] 7,5 11,0 11,0 10,0 Increasing factor V.c C30/37 1,04 C30/37 1,04 C0/20/24°C 0,75 Sustained load factor for tracker.oo W ⁰ an.00 80°C/50°C 0,75 0,75 11,0 10,0 10,0 Sustained pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 years 0,75 11,0 10,0 10,0 Temperature range I: 40°C/24°C Tex.or.100	esistance	N _{Rk,s}	[kN]	14	25	40	59	109			
Stainless steel, property class A4-80 NBKs. [kN] 16 29 46 67 Characteristic resistance NBKs. [kN] 16 29 46 67 Characteristic resistance NBKs. [kN] 14 25 40 59 Partial safety factor ¹⁰ Yms. [-] 14 25 40 59 Cambined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling. 1,87 50 11,0 11,0 10,0 Temperature range II: 80°C/50°C TRL.ec.50 [N/mm²] 7,5 11,0 11,0 10,0 Increasing factor Vr. C30/37 1,04 10,0	ctor 1)	γMs	[-]			1,87					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	property class A4-80				T	T					
Partial safety factor " $ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,60 \\ 1,87 \\ 1,97 \\ 1,0 \\ $	esistance	N _{Rk,s}	[kN]	16	29	46	67	125			
High corrosion resistant stainless steel, property class 70 Naxas [kN] 14 25 40 59 Partial safety factor ¹⁰ 7 _{M6} [-] 187 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling Temperature range I: 40°C/24°C $\tau_{Rk,uer,50}$ [N/mm ²] 8.0 12.0 12.0 11.0 10.0 Temperature range II: 80°C/50°C $\tau_{Rk,uer,50}$ [N/mm ²] 7.5 11.0 11.0 10.0 Increasing factor Ψ_c C40/50 1.07 C50/60 1.09 Sustained load factor for $\tau_{Rk,uer,50}$ $\Psi^0_{ex.50}$ 40°C/24°C 0.75 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year Temperature range II: 80°C/50°C $\tau_{Rk,uer,50}$ $\Psi^0_{ex.50}$ 40°C/24°C 0.75 C50/60 1.09 Sustained load factor for $\tau_{Rk,uer,50}$ $\Psi^0_{ex.50}$ 40°C/24°C 0.75 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year Temperature range II: 80°C/50°C $\tau_{Rk,uer,100}$ [N/mm ²] 7.5 11.0 10.0 10.0 Factors - working life 100 years 1.04 Increasing factor Ψ_c C30/37 1.04 Increasing factor Ψ_c C30/37 1.04 Increasing factor Ψ_c C30/37 1.04 Increasing factor Ψ_c C30/37 1.04 Increasing factor Ψ_c C30/50 C $\tau_{Rk,uer,100}$ [N/mm ²] 7.5 11.0 10.0 10.0 Factors - working life 100 years 1.07 Edge distance Concrete cone failure in uncracked concrete - hammer drilling Factor for uncracked concrete $k_{war,M}$ [-] 11.0 Edge distance Concrete $k_{war,M}$ [mm] 3.0 · h _w Spacing Swar,M [mm] 4.5 · h _M Spacing Swar,M [mm] 4.0 · c _{erx,p} for h ⁻² ≥ 2 · h _w [mm] 3.0 · h _w Spacing Swar,M [mm] 4.2 · c _{erx,p} [mather there interpolation) $c_{war,p}$ [mather the set of the	ctor 1)	γMs	[-]			1,60					
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	resistant stainless steel, prop	ty class 70					1				
Partial safety factor ¹) Type [-] 1.87 Combined pull-out and concrete cone failure in uncracked concrete 20/25 - hammer drilling Temperature range 1: 40°C/24°C TRLuer.50 [N/mm ²] 8,0 12,0 11,0 Temperature range 1: 80°C/50°C TRLuer.50 [N/mm ²] 7,5 11,0 11,0 Increasing factor Ψc C40/50 1.07 Combined pull-out and concrete cone failure in uncracked concrete 20/2/24°C 0.75 Combined pull-out and concrete cone failure in uncracked concrete 20/25 - hammer drilling, working life 100 year Combined pull-out and concrete cone failure in uncracked concrete 0.75 Combined pull-out and concrete cone failure in uncracked concrete 0.75 Combined pull-out and concrete cone failure in uncracked concrete 0.75 Combined pull-out and concrete cone failure in uncracked concrete 0.75 Increasing factor 1.04 Temperature range 1: 80°C/50°C TRLUE.100 1.07 Concrete concrete cone failure in uncracked concrete Sa/050 1.07	esistance	N _{Rk,s}	[kN]	14	25	40	59	109			
Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling Temperature range 1: 40°C/24°C $\tau_{Rk,uer,50}$ $[N/mm^2]$ 8.0 12.0 12.0 11.0 Temperature range 1: 80°C/50°C $\tau_{Rk,uer,50}$ $[N/mm^2]$ 7,5 11.0 11.0 10.0 Increasing factor Ψ_c C40/50 1.07 1.09 Sustained load factor for $\tau_{Rk,uer,50}$ $\Psi^0_{exa,50}$ 80°C/24°C 0.75 in uncracked concrete $B0°C/50°C$ 0.75 0.75 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year 0.72 Temperature range 1: $80°C/50°C$ $\tau_{Rk,uer,100}$ $[N/mm^2]$ 7,5 11.0 10.0 10.0 Temperature range 1: $80°C/50°C$ $\tau_{Rk,uer,100}$ $[N/mm^2]$ 7,5 11.0 10.0 10.0 Temperature range 1: $80°C/50°C$ $\tau_{Rk,uer,100}$ $[N/mm^2]$ 7,5 11.0 10.0 10.0 Temperature range 1: $80°C/50°C$ $\tau_{Rk,uer,100}$ $[N/mm^2]$ $7,5$ 11.0 10.0 Resistance to concrete cone failure in uncracked concrete harrow $[N/mm^2]$	ctor 1)	γ́Ms	[-]			1,87					
Temperature range I: $40^{\circ}C/24^{\circ}C$ TRAJECTOR [N/mm ²] 8,0 12,0 12,0 11,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Bkuer,50}$ $[N/mm2]$ 7,5 11,0 11,0 10,0 Increasing factor Ψ_c $C30'37$ 1,04 10,0 Sustained load factor for $\tau_{Bkuer,50}$ Ψ_{0}° $C30'37$ 0,72 0,72 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year 0,72 0,75 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Bkuer,100}$ [N/mm ²] 7,5 11,0 10,0 10,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Bkuer,100}$ [N/mm ²] 8,0 12,0 12,0 11,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Bkuer,100}$ [N/mm ²] 8,0 12,0 10,0 10,0 10,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Bkuer,100}$ [N/mm ²] 7,5 11,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 10,0 1,0	-out and concrete cone fail	re in uncracked	concrete	C20/25 – hai	mmer drilling	9	1	1			
Temperature range II: 80°C/50°C $\frac{1}{\text{TR}_{\text{Kucr,50}}} = \frac{1}{(N/mn)^2} \frac{7.5}{7.5} \frac{11.0}{11.0} \frac{11.0}{10.0} \frac{10.0}{10.0}$ Increasing factor $\psi_c = \frac{C30/37}{C40/50} \frac{1.07}{C50/60} \frac{10.07}{C50/60}$ Sustained load factor for $\tau_{\text{R}_{\text{Kucr,50}}} = \frac{1}{0} \frac{40^{\circ}\text{C}/24^{\circ}\text{C}}{0.75} \frac{11.0}{0.7} \frac{10.0}{0.7} \frac{10.0}{C50/60} \frac{10.07}{C50/60} \frac{10.09}{C50^{\circ}\text{C}} \frac{10.0}{0.72} \frac{10.0}{11.0} \frac{10.0}{10.0} \frac{10.0}{10.0} \frac{10.0}{10.0} \frac{10.0}{10.0} \frac{10.0}{10.0} \frac{10.0}{C50/60} \frac{10.07}{C50/60} 10.0$	nge I: 40°C/24°C	TRk ucr 50	[N/mm ²]	8.0	12.0	12.0	11.0	10.0			
Temperature range II: 80°C/50°C $\tau_{Rkuer,50}$ $[N/mn^2]$ 7,5 11,0 11,0 10,0 Increasing factor ψ_c C30/37 1.04 Sustained load factor for $\tau_{Rkuer,50}$ ψ_c C50/60 1.07 Combined pull-out and concrete cone failure in uncracked concrete $Q^0C/24^{\circ}C$ 0.75 0.72 Combined pull-out and concrete cone failure in uncracked concrete C20/37 11.0 10,0 10,0 Temperature range I: $40^\circ C/24^\circ C$ $\tau_{Rkuer,100}$ $[N/mm^2]$ 8,0 12,0 12,0 11,0 Temperature range II: $80^\circ C/50^\circ C$ $\tau_{Rkuer,100}$ $[N/mm^2]$ 7,5 11,0 10,0 10,0 Temperature range II: $80^\circ C/50^\circ C$ $\tau_{Rkuer,100}$ $[N/mm^2]$ 7,5 11,0 10,0 10,0 Temperature range II: $80^\circ C/50^\circ C$ $\tau_{Rkuer,100}$ $[N/mm^2]$ 7,5 11,0 10,0 10,0 Resistance to concrete cone failure in uncracked concrete - hammer drilling Tacof on uncracked concrete 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0 1,0		VRK,UCI,50	[]	0,0	,0	,0	, e	. 0,0			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	nge II [.] 80°C/50°C	TBk war 50	[N/mm ²]	7.5	11.0	11.0	10.0	9.0			
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$		VRK,UCI,50	[]	1,0	11,0	11,0	10,0	0,0			
Increasing factor ψ_c $C40/50$ 1.07 C50/60 0.109 Sustained load factor for $\tau_{Rk,uer,50}$ in uncracked concrete $C0/25 - harmer drilling, working life 100 year Combined pull-out and concrete cone failure in uncracked concrete C20/25 - harmer drilling, working life 100 year Temperature range I: 40°C/24°C \tau_{Rk,uer,100} [N/mm^2] 8.0 12.0 12.0 11.0Temperature range II: 80°C/50°C \tau_{Rk,uer,100} [N/mm^2] 7.5 11.0 10.0 10.0Factors - working life 100 yearsIncreasing factor \psi_c C30/37 1.04Increasing factor \psi_c C30/37 1.04Resistance to concrete cone failure in uncracked concrete -harmer drillingFactors for uncracked concrete h_{kucN} [-] 11.0Edge distance C_{ucr,80} for h_{min} h^{-2} > 2 \cdot h_{ef} (c_{ucr,80} for h_{min} h^{-2} > 2 \cdot h_{ef} (c_{ucr,80} for h_{min} h^{-2} > 2 \cdot h_{ef} (c_{ucr,80} for h_{min} h^{-2} > 2 \cdot h_{ef} 1.2Spacing s_{ucr,90} (mm] 2.0 \cdot c_{cr,80} Imm]Spacing s_{ucr,90} (mm] 2.0 \cdot c_{er,80} Imm]Factors for use category I1Installation safety factors for use category I2In the absence of other national regulation h = concrete concrete conce and splitting failure 1.2R-KEX-II$		-	C30/37			1,04					
Sustained load factor for $\tau_{Rk,uer,50}$ in uncracked concrete Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year Temperature range I: 40°C/24°C Tenk,uer,100 Temperature range II: 80°C/50°C Tenk,uer,100 Temperature range II: 80°C/50°C Tenk,uer,100 Temperature range II: 80°C/50°C Tenk,uer,100 Tenk,uer,10	or	Ψc	C40/50			1,07					
Sustained load factor for $\tau_{Rk,uer.50}$ $V^{0}_{9u.8.50}$ $\frac{40^{\circ}C/24^{\circ}C}{80^{\circ}C/50^{\circ}C}$ 0,75 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year Temperature range I: $40^{\circ}C/24^{\circ}C$ $\tau_{Rk,uer.100}$ [N/mm ²] 8,0 12,0 12,0 11,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ $\tau_{Rk,uer.100}$ [N/mm ²] 7,5 11,0 10,0 10,0 Factors - working life 100 years Increasing factor V_{c} $\frac{C30/37}{C40/50}$ 1,07 C50/60 1,07 Resistance to concrete cone failure in uncracked concrete - hammer drilling Factor for uncracked concrete k _{ker.N} [-] 11,0 Edge distance $C_{uer.N}$ [mm] 1,5 · h _{eff} Spacing $S_{uer.N}$ [mm] 3,0 · h _{eff} Edge distance $C_{uer.p}$ for h_{min} $C_{0}^{\circ} 2 \cdot h_{eff}$ Interpolation) $C_{uer.gp}$ for h_{min} $2,0 \cdot h_{eff}$ Spacing $S_{uer.N}$ [mm] 2,0 · h _{eff} $C_{uer.gp}$ for h_{min} $1,5 \cdot h_{eff}$ Spacing $S_{uer.N}$ [mm] 2,0 · h _{eff} $C_{uer.gp}$ for h_{min} $1,5 \cdot h_{eff}$ Spacing $C_{uer.gp}$ for h_{min} $1,5 \cdot c_{er,N}$ Edge distance $V_{uer.gp}$ for h_{min} $1,2 \cdot c_{er,N}$ Installation safety factors for use category 11 Installation safety factors for use category 12 In the absence of other national regulation h_{h} V_{inst} [-] $1,2$ In the absence of other national regulation h_{h} h_{h} concrete member thickness			C50/60			1,09					
in uncracked concrete $V^{VBB,SO}$ [80°C/50°C] 0,72 Combined pull-out and concrete cone failure in uncracked concrete C20/25 - hammer drilling, working life 100 year Temperature range I: 40°C/24°C $\tau_{Rk,uer,100}$ [N/mm ²] 8,0 12,0 12,0 11,0 Temperature range II: 80°C/50°C $\tau_{Rk,uer,100}$ [N/mm ²] 7,5 11,0 10,0 10,0 Factors - working life 100 years Increasing factor V_{C} $\frac{C30/37}{C40/50}$ 1,07 Eactor for uncracked concrete cone failure in uncracked concrete - hammer drilling Factor for uncracked concrete kear.N [-] 11,0 Edge distance $C_{uer,N}$ [mm] 1,5 · h _{eff} Spacing $S_{uer,N}$ [mm] 3,0 · h _{eff} Spacing $S_{uer,N}$ [mm] 2,0 · h _{eff} Edge distance $C_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ ($c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ ($c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ for $h_{min} < h^2 < 2 · h_{eff}$ $c_{uer,gp}$ $c_{er,N}$	factor for TRk,ucr,50)// ⁰	40°C/24°C			0,75					
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – harmer drilling, working life 100 year Temperature range I: $40^{\circ}C/24^{\circ}C$ TRKurr,100 [N/mm²] 8,0 12,0 12,0 11,0 Temperature range II: $80^{\circ}C/50^{\circ}C$ TRKurr,100 [N/mm²] 7,5 11,0 10,0 10,0 Factors – working life 100 years Increasing factor Vc C30/37 11,0 10,0 10,0 Resistance to concrete cone failure in uncracked concrete – harmer drilling Factor for uncracked concrete Line 11,0 Edge distance 11,0 Edge distance 11,0 Edge distance Curr, gn for hmin 1,5 · h_d Spacing Suct.N [mm] 3,0 · h_d Spacing Curr, gn for hmin Curr, gn for hmin <t< td=""><td>oncrete</td><td>Ψ sus,50</td><td>80°C/50°C</td><td></td><td></td><td>0,72</td><td></td><td></td></t<>	oncrete	Ψ sus,50	80°C/50°C			0,72					
Temperature range I: 40°C/24°C TRK.uer,100 [N/mm²] 8,0 12,0 12,0 11,0 Temperature range II: 80°C/50°C TRK.uer,100 [N/mm²] 7,5 11,0 10,0 10,0 Factors - working life 100 years C30/37 1,04 10,0 10,0 10,0 Factors - working life 100 years Vc C30/37 1,04 10,0 10,0 Factors - working life 100 years Vc C30/37 1,04 10,0 10,0 Factors - working life 100 years Vc C30/37 1,04 10,0 10,0 Resistance to concrete cone failure in uncracked concrete - hammer drilling 1,07 10,0 10,0 10,0 Resistance for uncracked concrete kuer.N [-] 11,0 10,0 10,0 10,0 Spacing Suer.N [mm] 3,0 \cdot het 10,0 10,0 10,0 10,0 Edge distance Cuer.sp for hmin [mm] 2,0 · het Cuer.sp for hmin 2,0 · het 10,0 10,0 Spacing Suer.sp for h ² 2 2 · het [mm] 2,0 · cor.sp 10,0 1,2 1,2	-out and concrete cone fail	re in uncracked	concrete	C20/25 – hai	mmer drilling	g, working lif	fe 100 years	1			
Temperature range II: 80°C/50°C $\tau_{Rk,uer,100}$ $[N/mm^2]$ 7,5 11,0 10,0 10,0 Factors – working life 100 years Increasing factor V_{c} $C30/37$ 1,04 Increasing factor V_{c} $C30/37$ 1,04 Increasing factor V_{c} $C30/37$ 1,04 Resistance to concrete cone failure in uncracked concrete – hammer drilling Factor for uncracked concrete $k_{ucr.N}$ [-] 11,0 Edge distance $C_{ucr.N}$ [mm] 3,0 · h_{ef} Spacing Sucr.N Edge distance $C_{ucr.sp}$ for hmin $C_{ucr.sp}$ for h ^{min} $C_{ucr.sp}$ for hmin $C_{ucr.sp}$ for h ² > 2 · hei [mm] $2,0 \cdot h_{ef}$ Spacing Sucr.N Edge distance $C_{ucr.sp}$ for h ² > 2 · hei [mm] $C_{ucr.sp}$ for h ² > 2 · hei [mm] $2,0 \cdot c_{cr.N}$ Spacing $S_{ucr.sp}$ [mm] $2,0 \cdot c_{cr.sp}$ Installation safety factors for use category 11 $1,2$ Installation safety factors for use category 12 $1,2$ In the absence of other national regulation h – concrete member thickness	nge I: 40°C/24°C	TRk,ucr,100	[N/mm ²]	8,0	12,0	12,0	11,0	10,0			
Factors – working life 100 years Increasing factor V_c C30/37 1,04 Increasing factor V_c C30/37 1,04 Resistance to concrete cone failure in uncracked concrete – hammer drilling 1,07 1,09 Factor for uncracked concrete $k_{ucr,N}$ [-] 11,0 Edge distance $C_{ucr,N}$ [mm] 1,5 · h_{ef} Spacing $S_{ucr,N}$ [mm] 3,0 · h_{ef} Edge distance $C_{ucr,sp}$ for $h_{min} < h^{2} < 2 · h_{ef}$ [mm] $2,0 · h_{ef}$ Edge distance $S_{ucr,sp}$ for $h_{min} < h^{2} < 2 · h_{ef}$ [mm] $2,0 · c_{cr,N}$ Spacing $S_{ucr,sp}$ for $h^{2} > 2 · h_{ef}$ [mm] $2,0 · c_{cr,N}$ Spacing $S_{ucr,sp}$ [mm] $2,0 · c_{cr,N}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $1,2$ Installation safety factors for use category 11 $1,2$ $1,2$ Installation safety factors for use category 12 Y_{inst} $1,2$ $1,2$ In the absence of other national regulation $h -$ concrete member thickness $1,2$	nge II: 80°C/50°C	TRk,ucr,100	[N/mm ²]	7,5	11,0	10,0 10,0					
Increasing factor ψ_c C30/37 1,04 Increasing factor ψ_c C30/37 1,07 Resistance to concrete cone failure in uncracked concrete - hammer drilling 1,09 Factor for uncracked concrete kuer,N [-] 11,0 Edge distance Cuer,N [mm] 1,5 · h_{ef} Spacing Suer,N [mm] 3,0 · h_{ef} Splitting failure Cuer,sp for hmin Cuer,sp for hmin C,0 · h_{ef} Edge distance Cuer,sp for hmin 2,0 · h_{ef} 2,0 · h_{ef} Spacing Suer,sp for h ² > 2 · h_{ef} Cer.N Cer.N Spacing Suer,sp for h ² > 2 · h_{ef} Cer.N Cer.N Spacing Suer,sp for h ² > 2 · h_{ef} Cer.N Cer.N Spacing Suer,sp [mm] 2,0 · cr.sp Installation safety factors for use category 11 Installation safety factors for use category 12 Yinst [-] 1,2 1,2 In the absence of other national regulation h - concrete member thickness R-KEX-II Intervent thickness Intervent thickness	king life 100 years				1	1	1				
Increasing factor ψ_c $\frac{C40/50}{C50/60}$ 1,07 Resistance to concrete cone failure in uncracked concrete – hammer drilling Factor for uncracked concrete 1,09 Redge distance $k_{ucr,N}$ [-] 11,0 Edge distance $C_{ucr,N}$ [mm] 1,5 \cdot h _{eff} Spacing $s_{ucr,N}$ [mm] 3,0 \cdot h _{eff} Splitting failure $C_{ucr,sp}$ for hmin $2,0 \cdot$ h _{eff} Edge distance $C_{ucr,sp}$ for hmin $2,0 \cdot$ h _{eff} $C_{ucr,sp}$ for hmin $c_{ucr,sp}$ for hmin $2,0 \cdot$ h _{eff} $C_{ucr,sp}$ for hminear interpolation) $c_{ucr,sp}$ $c_{ur,sp}$ $c_{ucr,sp}$ for h ² $\geq 2 \cdot$ h _{eff} $c_{er,N}$ $c_{er,N}$ Spacing $s_{ucr,sp}$ m $2,0 \cdot$ $c_{cr,sp}$ Installation safety factors for use category 11 r_{inst} r_{inst} r_{inst} Installation safety factors for use category 12 r_{inst} r_{inst} r_{inst} i h - concrete member thickness r_{inst} r_{inst} r_{inst} r_{inst}			C30/37			1,04					
Contract of the concrete cone failure in uncracked concrete - hammer drilling Factor for uncracked concrete kuer,N [-] 11,0 Edge distance Cuer,N [mm] 1,5 · het Spacing Sugrithment [mm] 3,0 · het Splitting failure Cuer,sp for hmin 2,0 · het Edge distance Cuer,sp for hmin (mm] 2,0 · het Edge distance Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Spacing Sugrege for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Spacing Sugrege for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Cuer,sp for hmin Spacing Sugrege for hmin Cuer,sp for hmin <td>or</td> <td>Ψc</td> <td>C40/50</td> <td></td> <td></td> <td>1,07</td> <td></td> <td></td>	or	Ψc	C40/50			1,07					
Resistance to concrete cone failure in uncracked concrete – hammer drilling Factor for uncracked concrete kuer.N [-] 11,0 Edge distance $C_{uer.N}$ [mm] $3,0 \cdot h_{ef}$ Spacing Suer.N [mm] $3,0 \cdot h_{ef}$ Splitting failure $C_{uer.sp}$ for h_{min} $2,0 \cdot h_{ef}$ Edge distance $C_{uer.sp}$ for $h_{min} < h^2 < 2 \cdot h_{ef}$ [mm] $2,0 \cdot h_{ef}$ Edge distance $C_{uer.sp}$ for $h^2 > 2 \cdot h_{ef}$ [mm] $2,0 \cdot c_{cr.N}$ Spacing $Suer.N$ [mm] $2,0 \cdot c_{cr.N}$ Spacing $C_{uer.sp}$ for $h^2 > 2 \cdot h_{ef}$ [mm] $2,0 \cdot c_{cr.N}$ Spacing $Suer.sp$ [mm] $2,0 \cdot c_{cr.N}$ Spacing $Suer.sp$ [mm] $1,2$ Installation safety factors for combined pull-out, concrete cone and splitting failure $1,2$ Installation safety factors for use category 12 γ_{inst} [-] $1,2$ P installation safety factors for use category 12 $1,2$ $1,2$ $1,2$ P - concrete member thickness R -KEX-II $1,2$ $1,2$ $1,2$ $1,2$ $1,2$			C50/60			1,09					
Factor for uncracked concrete kucr.N [-] 11,0 Edge distance $C_{ucr,N}$ [mm] $1,5 \cdot h_{ef}$ Spacing $S_{ucr,N}$ [mm] $3,0 \cdot h_{ef}$ Splitting failure $C_{ucr,sp}$ for hmin $C_{ucr,sp}$ for hmin $2,0 \cdot h_{ef}$ Edge distance $C_{ucr,sp}$ for hmin $C_{ucr,sp}$ for hmin $2,0 \cdot h_{ef}$ Edge distance $C_{ucr,sp}$ for h ² < 2 · h_{ef} $[mm]$ $2,0 \cdot h_{ef}$ Spacing $S_{ucr,sp}$ for h ² > 2 · h_{ef} $[mm]$ $2,0 \cdot h_{ef}$ Spacing $S_{ucr,sp}$ for h ² > 2 · h_{ef} $[mm]$ $2,0 \cdot c_{or,sp}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $C_{or,N}$ Installation safety factors for use category 11 $1,2$ $1,2$ Installation safety factors for use category 12 γ_{inst} $[\cdot]$ $1,2$ P in the absence of other national regulation $h - concrete member thickness R-KEX-II R-KEX-II I $	concrete cone failure in une	acked concrete	e – hammei	r drilling							
Edge distance $C_{ucr,N}$ [mm] $1,5 \cdot h_{ef}$ Spacing $S_{ucr,N}$ [mm] $3,0 \cdot h_{ef}$ Splitting failure $C_{ucr,sp}$ for hmin $2,0 \cdot h_{ef}$ Edge distance $\begin{bmatrix} C_{ucr,sp}$ for hmin $2,0 \cdot h_{ef}$ $Edge distance$ $\begin{bmatrix} C_{ucr,sp}$ for hmin $C_{ucr,sp}$ for h ² $\geq 2 \cdot h_{ef}$ $C_{ur,N}$ $C_{ur,N}$ Spacing $S_{ucr,sp}$ for h ² $\geq 2 \cdot h_{ef}$ $C_{ur,N}$ Spacing $S_{ucr,sp}$ for h ² $\geq 2 \cdot h_{ef}$ $C_{ur,N}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $C_{ur,N}$ Installation safety factors for use category 11 $1,2$ $1,2$ Installation safety factors for use category 12 γ_{inst} $[-]$ $1,2$ In the absence of other national regulation $h - concrete member thickness$ R -KEX-II I_{inst} I_{inst}	acked concrete	k _{ucr,N}	[-]			11,0					
Spacing $s_{ucr,N}$ [mm] $3,0 \cdot h_{ef}$ Splitting failure $c_{ucr,sp}$ for h_{min} $2,0 \cdot h_{ef}$ Edge distance $c_{ucr,sp}$ for $h_{min} < h^{-2} < 2 \cdot h_{ef}$ [mm] $2,0 \cdot h_{ef}$ Edge distance $c_{ucr,sp}$ for $h^{-2} < 2 \cdot h_{ef}$ [mm] $2,0 \cdot h_{ef}$ Spacing $c_{ucr,sp}$ for $h^{-2} > 2 \cdot h_{ef}$ [mm] $2,0 \cdot c_{cr,N}$ Spacing $s_{ucr,sp}$ [mm] $2,0 \cdot c_{cr,N}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $1,2$ Installation safety factors for use category 11 γ_{inst} [-] $1,2$ In the absence of other national regulation $h -$ concrete member thickness R -KEX-II R -KEX-II		C _{ucr.N}	[mm]			1,5 · h _{ef}					
Splitting failure $c_{ucr,sp} \text{ for } h_{min}$ $2,0 \cdot h_{ef}$ Edge distance $c_{ucr,sp} \text{ for } h_{min} < h^{2} < 2 \cdot h_{ef}$ $[mm]$ $2,0 \cdot h_{ef}$ Edge distance $c_{ucr,sp} \text{ for } h_{min} < h^{2} < 2 \cdot h_{ef}$ $[mm]$ $2,0 \cdot h_{ef}$ Spacing $c_{ucr,sp} \text{ for } h^{2} > 2 \cdot h_{ef}$ $c_{cr,N}$ Spacing $s_{ucr,sp}$ $[mm]$ $2,0 \cdot c_{cr,N}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $1,2$ Installation safety factors for use category 11 γ_{inst} $[-]$ $1,2$ Installation safety factors for use category 12 γ_{inst} $[-]$ $1,2$ In the absence of other national regulation $h - $ concrete member thickness R -KEX-II R -KEX-II I		S _{ucr,N}	[mm]			3,0 · h _{ef}					
Edge distance $c_{ucr,sp} \text{ for } h_{min}$ $2,0 \cdot h_{ef}$ Edge distance $c_{ucr,sp} \text{ for } h_{min} < h^2 < 2 \cdot h_{ef}$ $[mm]$ $2,0 \cdot h_{ef}$ Spacing $c_{ucr,sp} \text{ for } h^2 > 2 \cdot h_{ef}$ $c_{ur,sp}$ $c_{ur,sp}$ $c_{ur,sp}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $c_{ur,sp}$ $1,2$ Installation safety factors for use category 11 γ_{inst} $[-]$ $1,2$ In the absence of other national regulation $h -$ concrete member thickness r_{inst} $[-]$	8										
Edge distance $c_{ucr,sp}$ for $h_{min} < h^{-2} < 2 \cdot h_{ef}$ ($c_{ucr,sp}$ from linear interpolation) [mm] $x \neq t_{eff}$ Spacing $s_{ucr,sp}$ for $h^{-2} \ge 2 \cdot h_{eff}$ [mm] $c_{cr,N}$ Spacing $s_{ucr,sp}$ [mm] $2,0 \cdot c_{cr,sp}$ Installation safety factors for combined pull-out, concrete cone and splitting failure $1,2$ Installation safety factors for use category 11 γ_{inst} [-] $1,2$ In the absence of other national regulation $h - concrete member thickness$ r_{inst} $[-]$ $1,2$	C	r on for hmin			2.0	• h _{ef}		1.5 · h.			
Edge distance $c_{ucr,sp}$ for $h_{min} < h^{-2} < 2 \cdot h_{ef}$ ($c_{ucr,sp}$ from linear interpolation) [mm] $x + h_{ef}$ Spacing $c_{ucr,sp}$ for $h^{-2} \ge 2 \cdot h_{ef}$ [mm] $c_{cr,N}$ Spacing $s_{ucr,sp}$ [mm] $2,0 \cdot c_{cr,sp}$ Installation safety factors for combined pull-out, concrete cone and splitting failure 1,2 Installation safety factors for use category 11 γ_{inst} [-] Installation safety factors for use category 12 $1,2$ In the absence of other national regulation $h - concrete member thickness$ γ_{inst} [-] R-KEX-II r_{inst} r_{inst} r_{inst}		1,sp . e			_,0			., e _e			
Edge distance		C _{ucr,sp} for									
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	h _{min}	: h ²⁾ < 2 · h _{ef}	[mm]		2×						
interpolation) interpolation) $c_{ucr,sp}$ for h ² ≥ 2 · h _{ef} $c_{cr,N}$ Spacing $s_{ucr,sp}$ [mm] $2,0 \cdot c_{cr,sp}$ Installation safety factors for combined pull-out, concrete cone and splitting failure 1,2 Installation safety factors for use category 11 γ_{inst} [-] 1,2 Installation safety factors for use category 12 γ_{inst} [-] 1,2 In the absence of other national regulation $h -$ concrete member thickness R -KEX-II R -KEX-II	(Cuc	_{sp} from linear	[]								
cucr,sp for h ² $\ge 2 \cdot h_{ef}$ c _{cr,N} Spacing s _{ucr,sp} [mm] 2,0 \cdot c _{cr,sp} Installation safety factors for combined pull-out, concrete cone and splitting failure Installation safety factors for use category 11 1,2 Installation safety factors for use category 12 γ_{inst} [-] 1,2 In the absence of other national regulation b h – concrete member thickness R-KEX-II Installation safety factors for use category II	ir	erpolation)			1.4	nin E _{main} Co	100				
Curr.sp IOI II 1 2 2 1 lief Curr.N Spacing Sucr.sp [mm] 2,0 · C _{cr.sp} Installation safety factors for combined pull-out, concrete cone and splitting failure Installation safety factors for use category 11 1,2 Installation safety factors for use category 12 γinst [-] 1,2 In the absence of other national regulation h – concrete member thickness R-KEX-II		$(ar h^2) > 2$				2					
Spacing sucr.sp [mm] 2,0 · c _{cr.sp} Installation safety factors for combined pull-out, concrete cone and splitting failure Installation safety factors for use category 11 1,2 Installation safety factors for use category 11 γinst [-] 1,2 Installation safety factors for use category 12 1,2 1,2	Cucr,sp	$OI II = 2 \cdot II_{ef}$				C _{cr,N}					
Installation safety factors for combined pull-out, concrete cone and splitting failure Installation safety factors for use category 11 Installation safety factors for use category 12 In the absence of other national regulation In - concrete member thickness R-KEX-II		Sucr,sp	[mm]			∠,U · C _{cr,sp}					
Installation safety factors for use category I1 1,2 Installation safety factors for use category I2 γinst In the absence of other national regulation the concrete member thickness 1,2	ety factors for combined p	I-out, concrete	cone and s	splitting faile	ure						
category I1 γinst [-] Installation safety factors for use category I2 γinst [-] In the absence of other national regulation 1,2 R-KEX-II	ty factors for use					1.2					
Installation safety factors for use 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2		Vinst	[-]			,					
category 12 I In the absence of other national regulation I h – concrete member thickness R-KEX-II	ty factors for use	Tinac				1.2					
In the absence of other national regulation h – concrete member thickness R-KEX-II						,					
R-KEX-II	of other national regulation										
	F	KEX-II									
Annex							Annex C	5			
Berformancos de Constante de Const	Dem	rmancoa					of Europe	an			
Technical As	Peri	mances				Tech	nnical Asse	essment			
Unaracteristic resistance to tension loads	Characteristic res	stance to tens	sion load	5			ETA-21/02	244			



Cine .				an	a 40	G 40	0 44	<i>α</i>	ann	0 07	<i>a</i>
Size				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure		N	[LN]				A 3)	4			
Partial safety factor ¹⁾		YMe	[-]				As ^{-/}	• i _{uk} 40			
Combined pull-out and concrete c	one fa	ailure in uncrack	ed concrete	C20/25	– hamn	ner drilli	ng, wor	king life	50 year	S	
Temperature range I: 40°C/24°C		$\tau_{Rk,ucr,50}$	[N/mm ²]	11,0	12,0	12,0	10,0	12,0	12,0	9,5	8,5
Temperature range II: 80°C/50°C		TRk,ucr,50	[N/mm ²]	10,0	11,0	11,0	9,0	11,0	11,0	8,5	7,5
Combined pull-out and concrete c	one f	ailure in uncrack	ed concrete	C20/25	– diam	ond core	e drilling	, workiı	ng life 50) years	
Temperature range I: 40°C/24°C		$\tau_{Rk,ucr,50}$	[N/mm ²]	9,5	11,0	10,0	10,0	10,5	11,0	9,0	8,0
Temperature range II: 80°C/50°C		$\tau_{\rm Rk,ucr,50}$	[N/mm ²]	8,5	10,0	9,0	9,0	9,0	10,0	8,0	7,0
Factors – working life 50 years			000/07					0.4			
Increasing factor			C30/37				1,	04			
increasing factor		Ψc	C40/50				1,	07			
A A A A A A A			4090/00				1,	75			
Sustained load factor for $\tau_{Rk,ucr,50}$		Ψ^0 sus,50	40°C/24°C				0,	75			
			80°C/50°C	000/05	h e un u		0,	/2	100		
	one i			620/25	- nami		ng, wor	king me			
Temperature range I: 40°C/24°C		TRk,ucr,100	[N/mm ²]	11,0	12,0	12,0	10,0	12,0	12,0	9,5	8,5
Temperature range II: 80°C/50°C		τ _{Rk,ucr,100}	[IN/mm²]	10,0	11,0	11,0	9,0	11,0	11,0	8,5	7,5
Combined pull-out and concrete c	one fa	ailure in uncrack	ed concrete	C20/25	– diam	ond core	e drilling	j, workii	ng life 10	00 years	
Temperature range I: 40°C/24°C		TRk,ucr,100	[N/mm ²]	9,5	11,0	10,0	10,0	10,5	11,0	9,0	8,0
Temperature range II: 80°C/50°C	perature range II: 80°C/50°C τ _{Rk,ucr,100}			8,5	10,0	9,0	9,0	9,0	10,0	8,0	7,0
ractors – working me too years			C30/37				1,	04			
Increasing factor		ψc	C40/50 C50/60	0 1,07 0 1,09							
Concrete cone failure in uncracke	ed con	crete									
Factor for uncracked concrete		k _{ucr,N}	[-]	11,0 15 · b							
Spacing		C _{ucr,N}	[mm]	1,5 · h _{ef}							
Splitting failure	1	Cuci,N	[]				0,0	••••			
		c _{ucr,sp} for h _{min}				2,0	· h _{ef}			1,5	$\cdot h_{\text{ef}}$
		$c_{\text{ucr,sp}}$ for									
Edge distance	h _{mi}	$_{\rm n}$ < h $^{2)}$ < 2 \cdot h _{ef}	[mm]				2 x h _{e1}				
	(Cu	_{Icr,sp} from linear					h _{min}	an Cone			
		for $h^{(2)} > 2 \cdot h$	-				<u>^</u>	- NI			
	✓ucr.sp						20.	Cor on			
Spacing		Sucree	Immi				_,0	- 01,5P			
Spacing Installation safety factors for com	bined	s _{ucr,sp} pull-out, concre	[mm] te cone and	splittin	g failure)				-	
Spacing Installation safety factors for com Installation safety factors for use cat	bined egory	S _{ucr,sp} pull-out, concre 11 Vinst	[mm] te cone and [-]	splittin	g failure)	1	,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat	bined egory egory	S _{ucr,sp} pull-out, concre 11 12 γ _{inst}	[mm] te cone and [-]	splittin	g failure	•	1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cate Installation safety factors for use cate In the absence of other national regul	bined egory egory ation	S _{ucr,sp} pull-out, concre 11 12 γ _{inst}	[mm] te cone and [-]	splittin	g failure)	1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat In the absence of other national regul In the absence of other national regul In the concrete member thickness Stressed cross section of the steel	bined egory egory ation	S _{ucr,sp} pull-out, concre I1 γ _{inst}	[mm] te cone and [-]	splittin	g failure		1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat In the absence of other national regul h – concrete member thickness Stressed cross section of the steel	bined egory egory ation	S _{ucr,sp} pull-out, concre 11 12 γ _{inst}	[mm] te cone and [-]	splittin	g failure		<u>1</u> 1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat) In the absence of other national regul) h – concrete member thickness) Stressed cross section of the steel	bined egory egory ation	S _{ucr,sp} pull-out, concre 11 12 γinst	[mm] te cone and [-]	splittin	g failure		<u>1</u> 1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat Installation safety factors for use cat In the absence of other national regul h – concrete member thickness Stressed cross section of the steel	bined egory egory ation	Sucr.sp pull-out, concre 11 12 Yinst	[mm] te cone and [-]	splittin	g failure	3	1	,2 ,2			
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat In the absence of other national regul h – concrete member thickness Stressed cross section of the steel	bined egory egory lation	Sucr.sp pull-out, concre 11 12 γinst R-KEX-II	[mm] te cone and [-]	splittin	g failure	3	1	,2	Anne	x C6	
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat) In the absence of other national regul) h – concrete member thickness) Stressed cross section of the steel	bined egory egory ation	Sucr.sp pull-out, concre 11 12 Υinst R-KEX-II	[mm] te cone and [-]	splittin	g failure	<u>}</u>		2	Anne	x C6	
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat) In the absence of other national regul) h – concrete member thickness) Stressed cross section of the steel	bined egory egory ation	Sucr.sp pull-out, concre 11 12 Yinst R-KEX-II	[mm] te cone and [-]	splittin	g failure	3 		2 2	Anne: of Eurc	x C6	
Spacing Installation safety factors for com Installation safety factors for use cat Installation safety factors for use cat) In the absence of other national regul) h – concrete member thickness) Stressed cross section of the steel	bined egory egory lation	Sucr.sp pull-out, concre 11 12 γinst R-KEX-II erformances	[mm] te cone and [-]	splittin	g failure	3 		2 2 Tech	Anne of Euro nical A	x C6	nent



Size				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure	1										
Characteristic resistance		N _{Rk,s}	[kN]				A _s ³⁾	• f _{uk}			
Partial safety factor 1)		γMs	[-]				1,	40	_		
Combined pull-out and concrete of	cone fai	lure in cracked	d concrete C	20/25 –	hamme	r drilling	, workir	ng life 50	0 years	[
Temperature range I: 40°C/24°C		$\tau_{\text{Rk,cr,50}}$	[N/mm ²]	5,5	5,0	5,5	5,5	5,0	5,0	5,4	4,0
Temperature range II: 80°C/50°C		τ _{Rk,cr,50}	[N/mm ²]	5,0	4,5	5,0	5,0	4,5	4,5	5,0	3,0
Combined pull-out and concrete of	cone fai	lure in cracked	l concrete C	20/25 –	diamon	d core d	rilling. v	working	life 50 y	ears	[
Temperature range I: 40°C/24°C		$\tau_{Rk,cr,50}$	[N/mm ²]	5,5	5,5	6,0	6,0	5,0	5,5	4,5	4,0
Temperature range II: 80°C/50°C		$\tau_{Rk,cr,50}$	[N/mm ²]	5,0	5,0	5,5	5,5	4,5	5,0	4,0	4,0
Factors – working life 50 years											
			C30/37				1,	04			
Increasing factor		ψ_{c}	C40/50				1,	07			
			C50/60				1,	09			
Sustained load factor for Teking to			40°C/24°C				0,	75			
in cracked concrete		$\psi^0_{\text{sus},50}$	80°C/50°C				۰. ۱	72			
Combined pull-out and concrete (cone fai	lure in cracker		20/25	hamme	drilling	u workir	na life 10)) veare		
				_0/25 -				.9		- •	
i emperature range I: 40°C/24°C		τ _{Rk,cr,100}	[N/mm ²]	5,5	5,0	5,5	5,5	5,0	5,0	5,4	4,
Temperature range II: 80°C/50°C		$\tau_{Rk,cr,100}$	[N/mm ²]	5,0	4,5	5,0	5,0	4,5	4,5	5,0	3,
Combined pull-out and concrete of	cone fai	lure in cracked	d concrete C	20/25 –	diamon	d core d	lrilling, v	working	life 100	years	1
Temperature range I: 40°C/24°C		$\tau_{Rk,cr,100}$	[N/mm ²]	5,5	5,5	6,0	6,0	5,0	5,0	4,5	4,
Temperature range II: 80°C/50°C		τ _{Rk,cr,100}	[N/mm ²]	5,0	5,0	5,5	5,5	4,5	4,5	4,0	4,
Factors – working life 100 years			000/07				4	0.4			
Increasing factor)//	C30/37				1,	04			
		Ψ¢	C50/60	1,09							
Concrete cone failure in cracked	concret	e					· · · ·				
Factor for cracked concrete		k _{cr,N}	[-]				7	,7			
Edge distance		C _{cr,N}	[mm]	-			1,5	· h _{ef}			
Spacing		S _{cr,N}	[mm]				3,0	· h _{ef}			
Splitting failure											
	Cc	_{r,sp} for h _{min}				2,0	· h _{ef}			1,5	$\cdot h_{\text{ef}}$
		c _{cr,sp} for									
Edge distance	h _{min} <	< h ²⁾ < 2 · h _{ef}	[mm]				2×1.				
	(C _{cr.s}	_p from linear	[]				han	1			
	int	erpolation)					17.000	and Gene			
	C _{cr,sp} fo	or h ²) ≥ 2 · h _{ef}					Cc	r,N			
Spacing		S _{cr,sp}	[mm]				2,0 ·	C _{cr,sp}			
Installation safety factors for com Installation safety factors for in use	ibined p	oull-out, concre	ete cone and	splittir	ng failure)	1	2			
category I1 Installation safety factors for in use		γinst	[-]				. 1	2			
category I2	ation							,∠			
 h mile absence of other hational regul h – concrete member thickness Stressed cross section of the steel ele 	ement										
 h – concrete member thickness) Stressed cross section of the steel ele 	ement										
⁽¹⁾ h – concrete member thickness ⁽¹⁾ Stressed cross section of the steel ele		R-KEX-II							Anne	x C7	
) h – concrete member thickness) Stressed cross section of the steel electronic sectronic section o		R-KEX-II							Anne of Euro	x C7 opean	
) h – concrete member thickness) Stressed cross section of the steel ele	ement I Per	R-KEX-II formances						Tech	Anne of Eurc nical A	x C7 opean ssessn	nent
) h – concrete member thickness) Stressed cross section of the steel ele	Per istic re:	R-KEX-II formances	ension loa	ds				Tech	Anne of Euro nical A ETA-21	x C7 opean ssessn /0244	nent



Size			M8	M10	M12	M16	M20	M24	M30
Steel, property class 5.8									
Characteristic resistance	V ⁰ _{Rk.s}	[kN]	11	17	25	47	73	106	168
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor 1)	ΎMs	[-]				1,25			
Steel, property class 8.8									
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	224
Factor considering ductility	k ₇	[-]				1,0			-
Partial safety factor 1)	Ϋ́Ms	[-]				1,25			
Steel, property class 10.9									
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	18	29	42	78	122	176	280
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor 1)	γMs	[-]				1,50			
Steel, property class 12.9									
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	22	35	51	94	147	212	336
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor 1)	γMs	[-]				1,50			
Stainless steel, property class A4-70									
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	13	20	29	55	86	124	196
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor ¹⁾	γ́Ms	[-]				1,56			
Stainless steel, property class A4-80									
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	224
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor ¹⁾	γMs	[-]				1,33			
High corrosion resistant stainless steel,	property class 7	0							
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	13	20	29	55	86	124	196
Factor considering ductility	k ₇	[-]				1,0			
Partial safety factor ¹⁾	γMs	[-]				1,56			

Table C8: Characteristic resistance to shear loads for threaded rod – steel failure without lever arm

¹⁾ In the absence of other national regulation

R-KEX-II

Performances Characteristic resistance to shear loads in cracked and uncracked concrete – threaded rod

Annex C8



Size			M8	M10	M12	M16	M20	M24	M30
Steel, property class 5.8									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	19	37	65	166	324	561	1124
Partial safety factor 1)	γMs	[-]				1,25			
Steel, property class 8.8									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	898	1799
Partial safety factor 1)	γMs	[-]				1,25			
Steel, property class 10.9									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	37	75	131	333	649	1123	2249
Partial safety factor 1)	γMs	[-]				1,50			
Steel, property class 12.9									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	45	90	157	400	779	1347	2698
Partial safety factor 1)	γMs	[-]				1,50			
Stainless steel, property class A4-70									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	26	52	92	233	454	786	1574
Partial safety factor ¹⁾	γMs	[-]				1,56			
Stainless steel, property class A4-80									
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	898	1799
Partial safety factor 1)	γMs	[-]				1,33			
High corrosion resistant stainless steel, prope	erty class 70								
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	26	52	92	233	454	786	1574
Partial safety factor ¹⁾	γMs	[-]				1,56			

Table C9: Characteristic resistance to shear loads for threaded rod - steel failure with lever arm

¹⁾ In the absence of other national regulation

Table C10: Characteristic resistance to shear loads - pry out and concrete edge failure for threaded rod

Size			M8	M10	M12	M16	M20	M24	M30
Pry out failure			1						
Factor	k ₈	[-]				2			
Concrete edge failure									
Outside diameter of anchor	d _{nom}	[mm]	8	10	12	16	20	24	30
Effective length of anchor under shear loading	lf	[mm]			min (h _{ef}	;12d _{nom})			min (h _{ef} ; 8d _{nom})

R-KEX-II

Performances Characteristic resistance to shear loads in cracked and uncracked concrete – threaded rod

Annex C9



			M6/	Mo/	M40/	M40/	M16/
Size			(VIO)	1VIO/	016	016	024
Steel, property class 5.8			210	012	910	210	024
Characteristic resistance	V ⁰ Pk o	[kN]	6.0	11.0	17.0	25.0	47.0
Factor considering ductility	k ₇	[-]	0,0	,e	1.0	20,0	,0
Partial safety factor ¹⁾	VMs	[-]			1.25		
Steel, property class 8.8	11013				- ,		
Characteristic resistance	V ⁰ Rk.s	[kN]	8,0	14,6	23,2	33,7	62,8
Factor considering ductility	k ₇	[-]	,		1,0		,
Partial safety factor 1)	γMs	[-]			1,25		
Stainless steel, property class A4-70							
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	7,0	12,8	20,3	29,5	55,0
Factor considering ductility	k ₇	[-]			1,0		
Partial safety factor ¹⁾	γMs	[-]			1,56		
Stainless steel, property class A4-80							
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	8,0	14,6	23,2	33,7	62,8
Factor considering ductility	k7	[-]			1,0		
Partial safety factor ¹⁾	γMs	[-]			1,33		
High corrosion resistant stainless steel, prope	rty class 70						
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	7,0	12,8	20,3	29,5	55,0
Factor considering ductility	k ₇	[-]			1,0		
Partial safety factor 1)	γMs	[-]			1,56		

Table C11: Characteristic resistance to shear loads for rod with inner thread - steel failure without lever arm

¹⁾ In the absence of other national regulation

Table C12: Characteristic resistance to shear loads for rod with inner thread - steel failure with lever arm

Size			M6/ Ø10	M8/ Ø12	M10/ Ø16	M12/ Ø16	M16/ Ø24
Steel, property class 5.8							
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	7,6	18,7	37,4	65,5	166,5
Partial safety factor ¹⁾	γMs	[-]			1,25		
Steel, property class 8.8							
Characteristic resistance	M⁰ _{Rk,s}	[Nm]	12,2	30,0	59,8	104,8	266,4
Partial safety factor ¹⁾	Ϋ́Ms	[-]			1,25		
Stainless steel, property class A4-70							
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	10,7	26,2	52,3	91,7	233,1
Partial safety factor ¹⁾	γMs	[-]			1,56		
Stainless steel, property class A4-80							
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	12,2	30,0	59,8	104,8	266,4
Partial safety factor 1)	γMs	[-]			1,33		
High corrosion resistant stainless steel, prope	erty class 70						
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	10,7	26,2	52,3	91,7	233,1
Partial safety factor 1)	γMs	[-]			1,56		

¹⁾ In the absence of other national regulation

Table C13: Characteristic resistance to shear loads - pry out and concrete edge failure for rod with inner thread

Size			M6 /Ø10	M8/ Ø12	M10/ Ø16	M12/ Ø16	M16/ Ø24
Pry out failure							
Factor	k ₈	[-]			2		
Concrete edge failure							
Outside diameter of anchor	d _{nom}	[mm]	10	12	16	16	24
Effective length of anchor under shear loading	lf	[mm]		r	nin (h _{ef} ; 12d _{no}	m)	

R-KEX-II

Annex C10

of European Technical Assessment ETA-21/0244

Performances Characteristic resistance to shear loads in cracked and uncracked concrete – rod with inner thread



Table C14: Characteristic resistance to shear loads for rebar - steel failure without lever arm

Size Rebar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Characteristic resistance	V ⁰ _{Rk,s}	[kN]				0,5 · A	s ²⁾ · f _{uk}			
Factor considering ductility	k ₇	[-]				1	,0			
Partial safety factor ¹⁾	γMs	[-]				1	,5			

¹⁾ In the absence of other national regulation

²⁾ Stressed cross section of the steel element

Table C15: Characteristic resistance to shear loads for rebar – steel failure with lever arm

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Rebar										
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]				1,2 · W	/ _{el} ²⁾ · f _{uk}			
Partial safety factor 1)	γ _{Ms}	[-]				1	.5			

¹⁾ In the absence of other national regulation

²⁾ Elastic section modulus calculated from the stressed cross section of steel element

Table C16: Characteristic resistance to shear loads - pry out and concrete edge failure for rebar

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Pry out failure			l		l		l		l	
Factor	k ₈	[-]				:	2			
Concrete edge failure	1		1		I	1	I	1	I	
Outside diameter of anchor	d _{nom}	[mm]	8	10	12	14	16	20	25	32
Effective length of anchor under shear loading	lf	[mm]			min (h _{ef}	;12d _{nom})			min (h _e	_f ;8d _{nom})
		R-KEX-	11					A of	nnex C f Europe	11 an
Charac in cracke	Pe teristic r ed and u	rformar esistanc ncracke	nces ce to she d concre	ear loads ete – reb	ar			Techni E	cal Asse FA-21/02	essment 244



		uou iou							
Size			M8	M10	M12	M16	M20	M24	M30
Characteristic displacement in uncracked	d concrete C20/25	i to C50/6	0 under 1	tension I	oads				
Displacement ¹⁾	δ _{N0}	[mm]	0,33	0,40	0,41	0,47	0,52	0,56	0,70
Displacement	δ _{N∞}	[mm]	0,75	0,75	0,75	0,75	0,75	0,75	0,75
Characteristic displacement in cracked c	oncrete C20/25 to	C50/60 u	nder ten	sion loa	ds				
Dianlocoment ¹	δ _{N0}	[mm]	0,20	0,20	0,24	0,28	0,39	0,44	0,46
	δ _{N∞}	[mm]	3,0	3,0	2,5	2,6	2,5	2,4	3,0
¹⁾ These values are suitable for each tempe	rature range and c	ategories	specified	in Annex	с B1				

Table C17: Displacement under tension loads - threaded rod

Calculation of the displacement: $\delta_{N0} = \delta_{N0}$ -factor · N; $\delta_N = \delta_{N\infty}$ -factor · N; (N – applied tension load)

Table C18: Displacement under shear loads - threaded rod

Size			M8	M10	M12	M16	M20	M24	M30
Characteristic displacement in cracked	I and uncracked o	concrete C2	0/25 to C	C50/60 u	nder she	ar loads			
Displacement 1)	δ _{V0}	[mm]	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Displacement *	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7
¹⁾ These values are suitable for each tem	perature range and	d categories	specified	in Anne	x B1				

Calculation of the displacement: $\delta_{N0} = \delta_{N0}$ -factor · V; $\delta_N = \delta_{N\infty}$ -factor · V; (V – applied shear load)

Table C19: Displacement under tension loads – rod with inner thread

Size			M6/Ø10	M8/Ø12	M10/Ø16	M12/Ø16	M16/Ø24
Characteristic displacement in uncracked	l concrete	e C20/25 to	C50/60 undei	r tension load	ds		
Displacement 1)	δ_{N0}	[mm]	0,25	0,25	0,26	0,32	0,37
Displacement	δ_{N^∞}	[mm]	0,75	0,75	0,75	0,75	0,75
¹⁾ These values are suitable for each temper	rature rang	ge and categ	ories specifie	d in Annex B	1		

Calculation of the displacement: $\delta_{N0} = \delta_{N0}$ -factor $\cdot N$; $\delta_N = \delta_{N\infty}$ -factor $\cdot N$; (N – applied tension load)

Table C20: Displacement under shear loads - rod with inner thread

Size		M6/Ø10	M8/Ø12	M10/Ø16	M12/ Ø16	M16/Ø24
Characteristic displacement in uncrack	ed concrete C20/25	o C50/60 unde	r shear loads	5		
	δ _{v0} [mm]	2,5	2,5	2,5	2,5	2,5
Displacement ?	δ _{V∞} [mm]	3,7	3,7	3,7	3,7	3,7
	R-KEX-II				Anne>	c C12



Table C21: Displacement under tens	ion load	s – rebar								
Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Characteristic displacement in uncracked	concrete	e C20/25 t	o C50/60	under te	ension lo	ads				
Dipplacement 1)	δ_{N0}	[mm]	0,25	0,25	0,32	0,37	0,43	0,45	0,48	0,53
Displacement	δ_{N^∞}	[mm]	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75
Characteristic displacement in cracked co	oncrete C	20/25 to C	50/60 ur	der tens	ion load	s				
Displacement	δ_{N0}	[mm]	0,2	0,2	0,24	0,30	0,31	0,34	0,38	0,40
Displacement	δ_{N^∞}	[mm]	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0
¹⁾ These values are suitable for each temper	ature rang	ge and cat	egories s	pecified i	n Annex	B1.				

Calculation of the displacement: $\delta_{N0} = \delta_{N0}$ -factor $\cdot N$; $\delta_N = \delta_{N\infty}$ -factor $\cdot N$; (N – applied tension load)

Table C22: Displacement under shear loads - rebar

Size	Size			Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Characteristic displacement in cracked and uncracked concrete C20/25 to C50/60 under shear loads										
Displacement ¹⁾	δ_{V0}	[mm]	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
	δ _{V∞}	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7
1) These values are suitable for each terms and				مر مر ک	a D.4					

¹⁾ These values are suitable for each temperature range and categories specified in Annex B1 Calculation of the displacement: $\delta_{N0} = \delta_{N0}$ -factor $\cdot V$; $\delta_N = \delta_{Nc}$ -factor $\cdot V$; (V – applied shear load)

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Annex C13

Performances

Displacement under service loads: tension and shear loads - rebar



						-		•••	
Size			M8	M10	M12	M16	M20	M24	M30
Steel failure			1	1		1	1	1	
Steel, property class 5.8									
Characteristic resistance	N _{Rk,s,C1}	[kN]	18	29	42	78	122	176	280
Partial safety factor 1)	Ϋ́Ms, C1	[-]				1,50			
Steel, property class 8.8									
Characteristic resistance	N _{Rk,s,C1}	[kN]	29	46	67	125	196	282	448
Partial safety factor 1)	Ϋ́Ms, C1	[-]				1,50			
Steel, property class 10.9									
Characteristic resistance	N _{Rk,s,C1}	[kN]	36	58	84	157	245	353	561
Partial safety factor ¹⁾	γMs, C1	[-]				1,4			
Steel, property class 12.9									
Characteristic resistance	N _{Rk,s,C1}	[kN]	43	69	101	188	294	423	673
Partial safety factor ¹⁾	γMs, C1	[-]				1,4			
Stainless steel, property class A4-70									
Characteristic resistance	N _{Rk,s,C1}	[kN]	25	40	59	109	171	247	392
Partial safety factor ¹⁾	γMs, C1	[-]				1,87			
Stainless steel, property class A4-80									
Characteristic resistance	N _{Rk,s,C1}	[kN]	29	46	67	125	196	282	448
Partial safety factor ¹⁾	γMs, C1	[-]				1,60			
High corrosion resistant stainless steel, pr	operty class 70	r							
Characteristic resistance	N _{Rk,s,C1}	[kN]	25	40	59	109	171	247	392
Partial safety factor ¹⁾	γMs, C1	[-]				1,87			
Combined pull-out and concrete cone f	ailure, working li	fe 50 years	1	1		r	r	r	
Temperature range I: 40°C/24°C	TRk,C1	[N/mm ²]	6,0	7,0	6,5	7,0	6,0	5,5	4,0
Temperature range II: 80°C/50°C	τ _{Rk,C1}	[N/mm ²]	5,0	6,5	5,5	6,0	5,5	5,0	3,5
Combined pull-out and concrete cone f	ailure, working li	fe 100 years							
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm ²]	6,0	7,0	6,0	6,5	6,0	5,5	4,0
Temperature range II: 80°C/50°C	τ _{Rk,C1}	[N/mm²]	5,0	6,0	5,5	6,0	5,5	5,0	3,5

Table C23: Characteristic resistance to tension loads - threaded rod under seismic performance category C1

Note: Design method according to EN 1992-4:2008

¹⁾ In the absence of other national regulation

Table C24: Characteristic resistance to tension loads - rebar under seismic performance category C1

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure				Į.			Į.			
Characteristic resistance	N _{Rk,s,C1}	[kN]				A _s ²⁾	$\cdot \mathbf{f}_{uk}$			
Partial safety factor 1)	γMs, C1	[-]				1,4	40			
Combined pull-out and concrete cone fa	ailure, working li	fe 50 years								
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm ²]	4,0	4,5	5,0	5,0	5,0	5,0	5,0	3,0
Temperature range II: 80°C/50°C	τ _{Rk,C1}	[N/mm ²]	3,5	4,0	4,5	4,5	4,5	4,5	4,5	2,5
Combined pull-out and concrete cone fa	ailure, working li	fe 100 years	;	1			1			
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm ²]	3,5	4,5	5,0	5,0	5,0	3,5	5,0	3,0
Temperature range II: 80°C/50°C	τ _{Rk,C1}	[N/mm ²]	3,5	4,0	4,5	4,5	4,5	4,0	4,5	2,5

Note: Design method according to EN 1992-4:2008

¹⁾ In the absence of other national regulation

 $^{\mbox{\tiny 2)}}$ Stressed cross section of the steel element

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Performances

 $\begin{array}{c} \mbox{Characteristic resistance to tension loads for seismic performance category C1-} \\ \mbox{threaded rod and rebar} \end{array}$

Annex C14



Table C25: Characteristic resistance to shear loads – threaded rod under seismic performance category C1 – steel failure without lever arm

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure with threaded rod grade 5.8			11						
Characteristic resistance	V _{Rk,s,C1}	[kN]	7,7	11,9	17,5	32,9	51,1	74,2	117,6
Partial safety factor ¹⁾	γMs, C1	[-]				1,25			
Steel failure with threaded rod grade 8.8									
Characteristic resistance	V _{Rk,s,C1}	[kN]	10,2	16,1	23,5	44,1	68,6	98,7	156,8
Partial safety factor ¹⁾	Ϋ́Ms, C1	[-]				1,25			
Steel failure with threaded rod grade 10.9									
Characteristic resistance	V _{Rk,s,C1}	[kN]	12,6	20,3	29,4	54,6	85,4	123,2	196
Partial safety factor ¹⁾	Ϋ́Ms, C1	[-]				1,5			
Steel failure with threaded rod grade 12.9									
Characteristic resistance	V _{Rk,s,C1}	[kN]	15,4	24,5	35,7	65,8	102,9	148,4	235,2
Partial safety factor ¹⁾	γMs, C1	[-]				1,5			
Steel failure with stainless steel threaded rod A	44-70								
Characteristic resistance	V _{Rk,s,C1}	[kN]	9,1	14,4	20,7	38,5	59,9	86,5	137,4
Partial safety factor ¹⁾	γMs, C1	[-]				1,56			
Steel failure with stainless steel threaded rod A	\4-80								
Characteristic resistance	V _{Rk,s,C1}	[kN]	10,2	16,1	23,5	44,1	68,6	98,7	157,2
Partial safety factor ¹⁾	Ϋ́Ms, C1	[-]				1,33			
Steel failure with high corrosion stainless stee	l grade 70								
Characteristic resistance	V _{Rk,s,C1}	[kN]	9,1	14,4	20,7	38,5	59,9	86,5	137,4
Partial safety factor 1)	γMs, C1	[-]				1,56			

¹⁾ In the absence of other national regulation

Table C26: Characteristic resistance to shear loads – rebar under seismic performance category C1 – steel failure without lever arm

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure with rebar										
Characteristic resistance	V _{Rk,s,C1}	[kN]				0,35 · A	$A_s^{2)} \cdot f_{uk}$			
Partial safety factor 1)	γMs, C1	[-]				1	,5			

¹⁾ In the absence of other national regulation

²⁾ Stressed cross section of the steel element

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Performances

Characteristic resistance to shear loads under seismic performance category C1 – threaded rod and rebar

Annex C15



Table C27: Displacement under tension loads – threaded rod under seismic performance category C1

Size			M8	M10	M12	M16	M20	M24	M30
Displacement	$\delta_{N,C1}$	[mm]	2,8	3,0	3,0	3,2	3,3	4,0	5,5

Table C28: Displacement under shear loads - threaded rod under seismic performance category C1

Size			M8	M10	M12	M16	M20	M24	M30
Displacement	δ _{V,C1}	[mm]	3,4	4,0	5,0	5,3	5,9	6,0	6,5

Table C29: Displacement under tension loads – rebar under seismic performance category C1

Size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32	
Displacement	$\delta_{N,C1}$	[mm]	3,0	3,3	3,5	3,9	4,1	4,5	5,6	6,0

Table C30: Displacement under shear loads - rebar under seismic performance category C1

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Displacement	$\delta_{V,C1}$	[mm]	3,6	3,7	4,0	4,6	4,8	5,5	6,6	7,0

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Performances

Displacement under service loads: tension and shear loads for seismic performance category C1 - threaded rod and rebar

Annex C16



Table C31: Characteristic resistance to tension load (threaded rod) – seismic performance category C2

Size			M12	M16	M20	M24
Steel failure						
Characteristic resistance	N _{Rk,s,C2}	[N/mm ²]	N _{Rk,s}	N _{Rk,s}	N _{Rk,s}	N _{Rk,s}
Combined pull-out and concrete cone failure (uncracked and	d cracked con	crete)				
Temperature range -40°C / +40°C	τ _{Rk,C2}	[N/mm ²]	5,65	3,93	5,18	3,65
Temperature range -40°C / +80°C	τ _{Rk,C2}	[N/mm ²]	5,03	3,50	4,61	3,25

Table C32: Characteristic resistance to shear load (threaded rod) – seismic performance category C2

Size			M12	M16	M20	M24
Steel failure with threaded rod grade 5.8						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	11,6	13,7	26,3	47,0
Steel failure with threaded rod grade 8.8						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	18,5	22,0	42,1	75,1
Steel failure with threaded rod grade 10.9						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	23,2	27,4	52,6	93,9
Steel failure with threaded rod grade 12.9						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	27,8	32,9	63,2	112,6
Stainless steel, property class A4-70						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	15,8	19,2	36,9	66,0
Stainless steel, property class A4-80						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	18,5	22,0	42,1	75,1
High corrosion resistant stainless steel, property class 70						
Characteristic resistance	V _{Rk,s,C2}	[N/mm ²]	15,8	19,2	36,9	66,0

Table C33: Displacements under tensile and shear load (threaded rod) – seismic performance category C2

Size			M12	M16	M20	M24
Displacements for tensile and shear load for seismic performance category C2						
Displacement in tensile at damage limitation states 1)	$\delta_{\text{N,eq,C2}(\text{DLS})}$	[mm]	0,85	1,14	0,77	0,94
Displacement in tensile at ultimate limit state 1)	$\delta_{\text{N,eq,C2}} \text{(ULS)}$	[mm]	1,70	2,01	2,07	1,91
Displacement in shear at damage limitation states ¹⁾	$\delta_{\text{V,eq,C2}} \text{(DLS)}$	[mm]	3,01	2,28	3,60	3,15
Displacement in shear at ultimate limit state 1)	$\delta_{\text{V,eq,C2}} \text{(ULS)}$	[mm]	6,44	8,81	7,57	8,21

¹⁾ All temperature ranges

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Performances

 $Characteristic \ resistance \ to \ tension \ and \ shear \ loads \ and \ displacement \ for \ seismic \\ performance \ category \ C2-threaded \ rod$

Annex C17