INSTYTUT TECHNIKI BUDOWLANEJ

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

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European Technical Assessment

ETA-21/0244 of 27/09/2023

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

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.

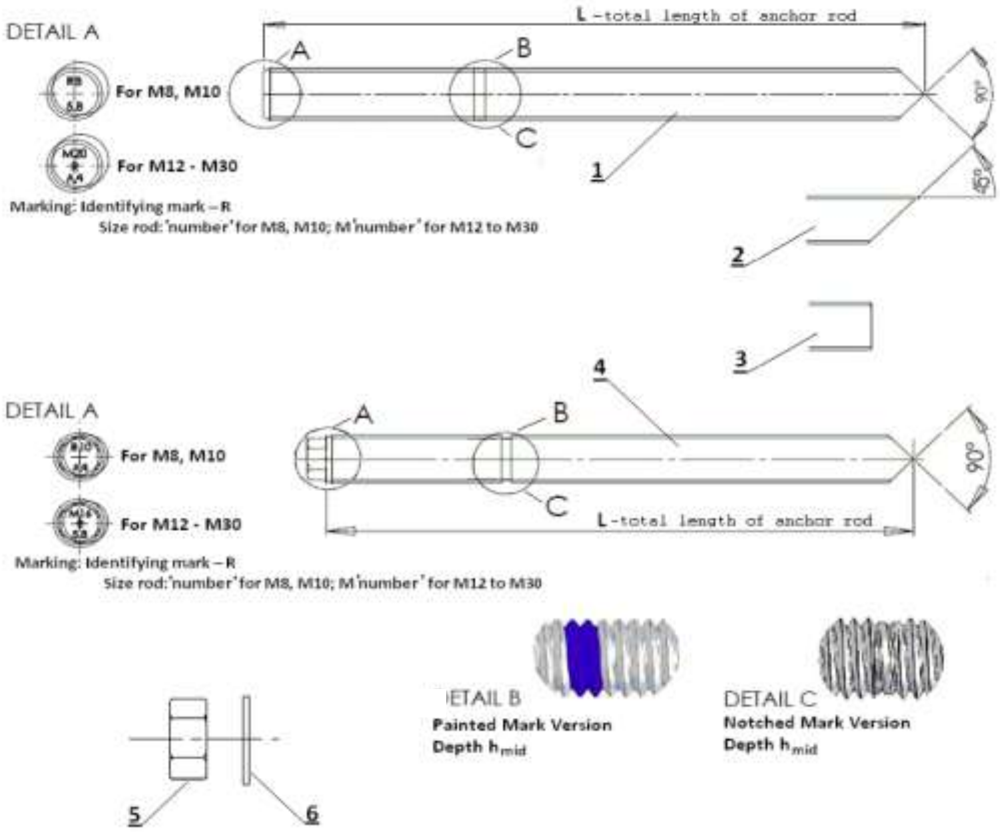
For type testing the results of the tests performed as part of the assessment for the European Technical Assessment shall be used unless there are changes in the production line or plant. In such cases the necessary type testing has to be agreed between Instytut Techniki Budowlanej and the notified body.

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

Anna Panek, MSc

Deputy Director of ITB

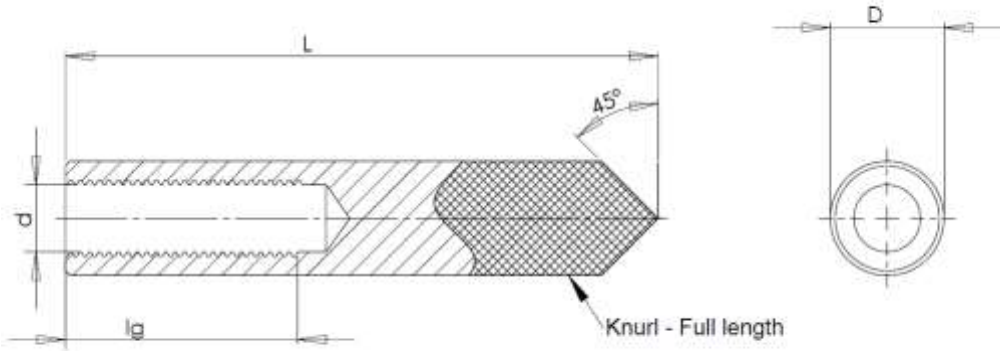
Threaded anchor rods

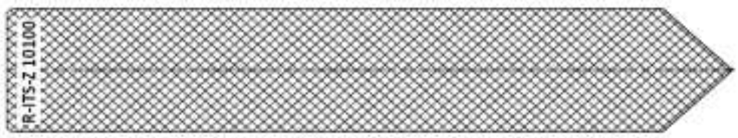


1. Anchor rod R-STUDS
2. 45° shape with anchor rod
3. The flat end of anchor rod
4. Anchor rod R-STUD
5. Hexagonal nut
6. Washer

R-KEX-II	**Annex A1** of European Technical Assessment ETA-21/0244
Product description Threaded anchor rods	

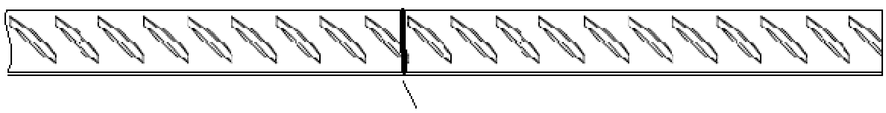
Anchor rods with inner thread





Marking: R - Identifying mark
ITS - product index
Z - carbon steel or A4 - stainless steel
XX - thread size
YYY - length of sleeve

Rebar



embedment depth marking h_{ef}

R-KEX-II	Annex A2 of European Technical Assessment ETA-21/0244
Product description Anchor rods with inner thread and rebar	

Table A1: Threaded rods

Designation	Property class	Characteristic steel ultimate strength	Characteristic steel yield strength	Fracture elongation	Material
Steel, zinc plated electroplated ≥ 5 µm according to EN ISO 4042 hot-dip galvanized ≥ 40 µm according to EN ISO 1461 non-electrolytically applied zinc flake coating ≥ 8 µm according to EN ISO 10683					
Threaded rod	5.8	f_{uk} ≥ 500 N/mm^2	f_{yk} ≥ 400 N/mm^2	A_5 > 8%	EN ISO 898-1
	6.8	f_{uk} ≥ 600 N/mm^2	f_{yk} ≥ 480 N/mm^2	A_5 > 8%	
	8.8	f_{uk} ≥ 800 N/mm^2	f_{yk} ≥ 640 N/mm^2	A_5 ≥ 12%	
	9.8	f_{uk} ≥ 900 N/mm^2	f_{yk} ≥ 640 N/mm^2	A_5 ≥ 10%	
	10.9	f_{uk} ≥ 1000 N/mm^2	f_{yk} ≥ 900 N/mm^2	A_5 > 9%	
	12.9	f_{uk} ≥ 1200 N/mm^2	f_{yk} ≥ 1800 N/mm^2	A_5 > 8%	
Hexagon nut	5	for class 5.8 rods			EN ISO 898-2
	6	for class 6.8 rods			
	8	for class 8.8 rods			
	9	for class 9.8 rods			
	10	for class 10.9 rods			
	12	for class 12.9 rods			
Washer	Steel according to EN ISO 7089; corresponding to anchor rod material				
Stainless steel A4 (Materials) 1.4401, 1.4404, 1.4571 High corrosion resistance stainless steel (HCR) (Materials) 1.4529, 1.4565, 1.4547					
Threaded rod	**Property class**	**Characteristic steel ultimate strength**	**Characteristic steel yield strength**	**Fracture elongation**	EN 10088 EN ISO 3506
	70	f_{uk} ≥ 700 N/mm^2	f_{yk} ≥ 450 N/mm^2	A_5 ≥ 12%	
	80	f_{uk} ≥ 800 N/mm^2	f_{yk} ≥ 600 N/mm^2	A_5 ≥ 12%	
Hexagon nut	70	for class 70 rods			EN 10088 EN ISO 3506
	80	for class 80 rods			
Washer	Steel, according to EN 10088; corresponding to anchor rod material				
For anchorages under seismic actions which are designed in accordance with EN 1992-4:2018, Section 9.2 (3), option b): A_5 ≥ 12% and f_{uk} ≤ 800 N/mm^2.					

Commercial threaded rods (in the case of rods made of galvanized steel – standard rods with property class ≤ 8.8 only), with:

- 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	**Annex A3** of European Technical Assessment ETA-21/0244
Product description Materials (1)	

Table A2: Rods with inner thread

Designation					Material
Steel, zinc plated **electroplated ≥ 5 µm according to EN ISO 4042** **hot-dip galvanized ≥ 40 µm according to EN ISO 1461**					
Rod with inner thread	**Property class**	**Characteristic steel ultimate strength**	**Characteristic steel yield strength**	**Fracture elongation**	EN ISO 898-1
	5.8	$f_{uk} \geq 500$ N/mm²	$f_{yk} \geq 400$ N/mm²	$A_5 > 8\%$	
	6.8	$f_{uk} \geq 600$ N/mm²	$f_{yk} \geq 480$ N/mm²	$A_5 > 8\%$	
	8.8	$f_{uk} \geq 800$ N/mm²	$f_{yk} \geq 640$ N/mm²	$A_5 \geq 12\%$	
Stainless steel A4 (Materials) 1.4401, 1.4404, 1.4571 **High corrosion resistance stainless steel (HCR)** (Materials) 1.4529, 1.4565, 1.4547					
Rod with inner thread	**Property class**	**Characteristic steel ultimate strength**	**Characteristic steel yield strength**	**Fracture elongation**	EN 10088 EN ISO 3506
	70	$f_{uk} \geq 700$ N/mm²	$f_{yk} \geq 450$ N/mm²	$A_5 \geq 12\%$	
	80	$f_{uk} \geq 800$ N/mm²	$f_{yk} \geq 600$ N/mm²	$A_5 \geq 12\%$	

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

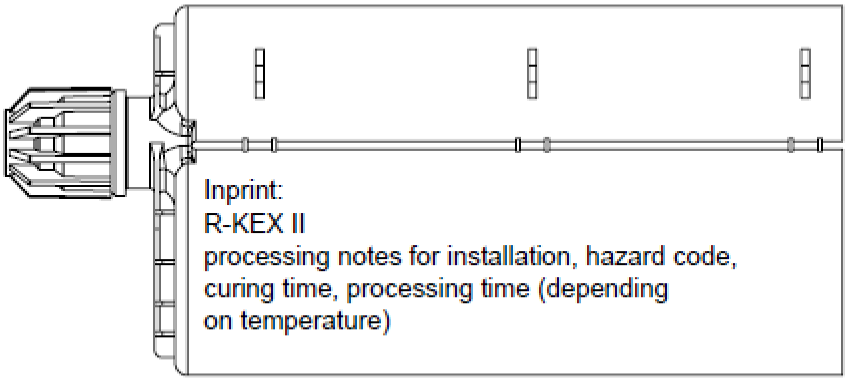
Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ [N/mm²]		400 to 600	
Minimum value of $k = (f_t / f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} [%]		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) [%]	Nominal bar size [mm] ≤ 8 > 8	± 6,0 ± 4,5	
Bond: minimum relative rib area, $f_{R,min}$	Nominal bar size [mm] 8 to 12 > 12	0,040 0,056	

Rib height: The maximum rib height is: $h_{rib} \leq 0{,}07 \cdot Ø$

Table A4: Injection mortar

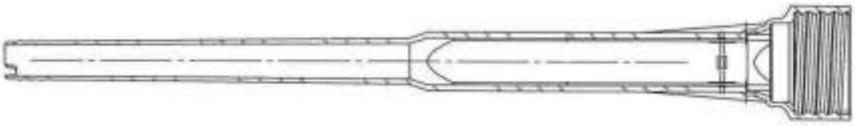
Product	**Composition**
R-KEX-II (two component injection mortar)	Epoxy system with fillers

Side by side cartridge – 385 to 1100 ml

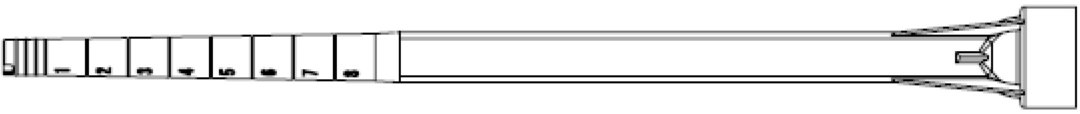


Mixer nozzles

a) STD



b) NEW



R-KEX-II	**Annex A5** of European Technical Assessment ETA-21/0244
Product description Cartridge type and size	

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.

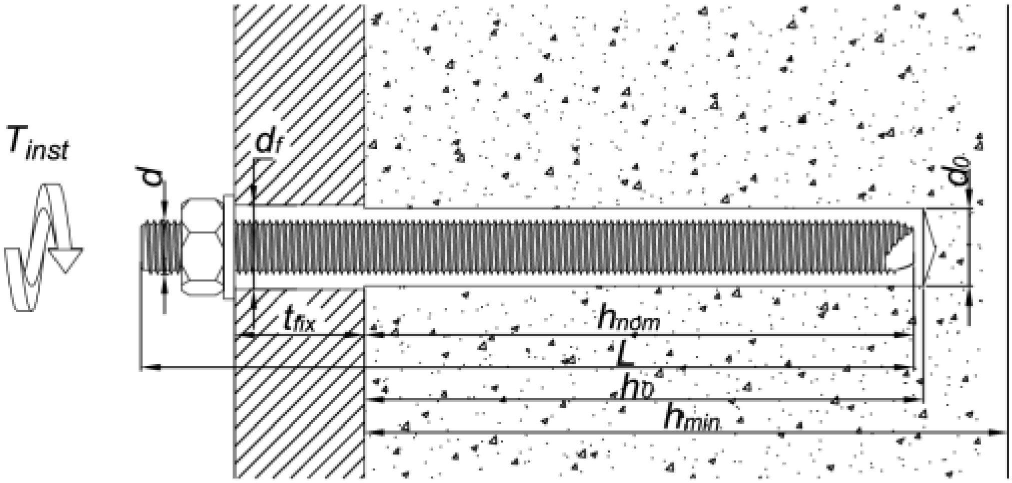


Table B1: Installation parameters – threaded rods

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 depth	$h_{ef,min}$ [mm]	60	70	80	100	120	140	165
	$h_{ef,max}$ [mm]	160	200	240	320	400	480	600
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; ≥ 100 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

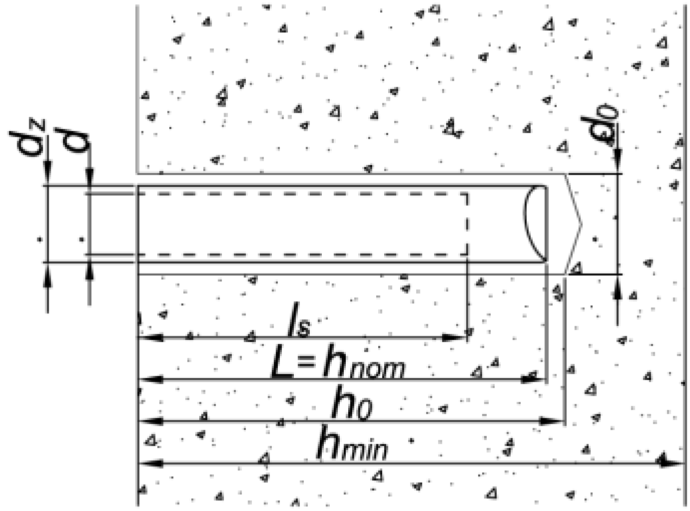


Table B2: Installation parameters – rods with inner thread

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	d_0 [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	h_0 [mm]	h_{ef} + 5 mm						
Minimum thickness of the concrete slab	h_{min} [mm]	h_{ef} + 30 mm; ≥ 100 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

Błąd! Nie można tworzyć obiektów przez edycję kodów pól.

Table B3: Installation parameters – rebar

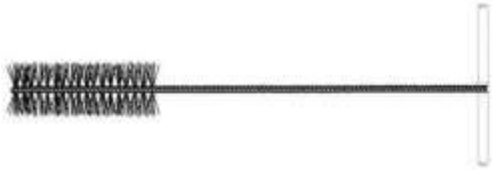
Size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Nominal drilling diameter	d_0 [mm]	10 or 12	12 or 14	14 or 18	18	22	26	32	40
Effective embedment depth	$h_{ef,min}$ [mm]	60	70	80	80	100	120	140	165
	$h_{ef,max}$ [mm]	160	200	240	280	320	400	500	640
Depth of the drilling hole	h_0 [mm]	h_{ef} + 5 mm							
Minimum thickness of the concrete slab	h_{min} [mm]	h_{ef} + 30 mm; ≥ 100 mm				$h_{ef} + 2d_0$			
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

Table B4: Maximum processing time and minimum curing time

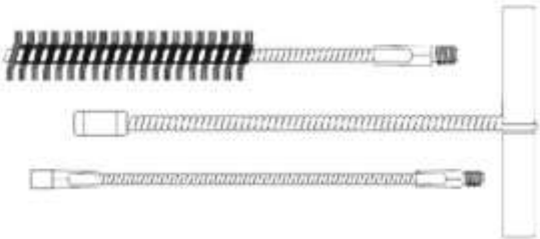
R-KEX-II			
Mortar temperature [ºC]	**Concrete (substrate) temperature [ºC]**	**Maximum processing time [min.]**	**Minimum curing time[1)] [min.]**
+5	+5	150	2880
+10	+10	120	1080
+20	+20	35	480
+25	+30	12	300

[1)] The minimum time from the end of the mixing to the time when the anchor may be torque or loaded (whichever is longer). Minimum mortar temperature for installation +5°C; maximum mortar temperature for installation +25°C. For wet condition and flooded holes the curing time must be doubled.

Manual blower pump R-BLOWPUMP



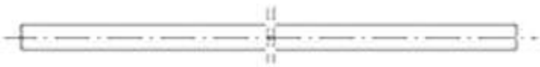
Steel brush R-BRUSH



Steel brush with extension R-BRUSH-T

Dosing plug R-NOZ-P

Temporary positioning wedge



Mixer nozzle extension R-NOZ-EXT

R-KEX-II	**Annex B6** of European Technical Assessment ETA-21/0244
Intended use Tools (1)	

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	385, 600 ml
 Pneumatic dispenser gun	
 Manual gun for side by side cartridges R-GUN-MULTI	385, 600 ml

R-KEX-II

Intended use
Tools (2)

Annex B7

of European Technical Assessment ETA-21/0244

Table B5: Brush diameter for threaded rod

Threaded rod diameter			M8	M10	M12	M16	M20	M24	M30
d_b	Brush diameter	[mm]	12	14	16	20	26	30	37

Table B6: Brush diameter for rod with inner thread

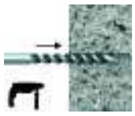
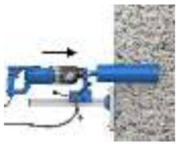
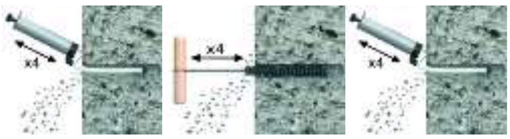
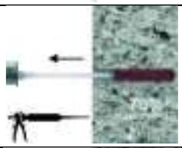
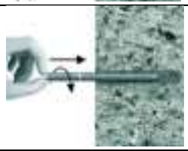
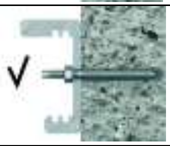
Threaded rod diameter			M6/Ø10	M8/Ø12	M10/Ø16	M12/ Ø16	M16/Ø24
d_b	Brush diameter	[mm]	16	16	22	22	30

Table B7: Brush diameter for rebar

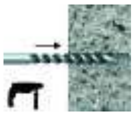
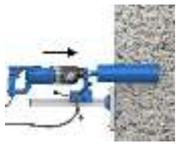
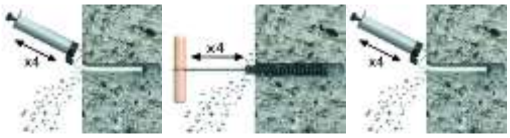
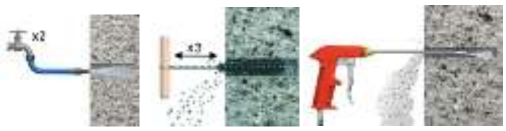
Rebar diameter			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
d_b	Brush diameter	[mm]	14	16	20	20	24	28	37	42

Table B8: Dosing plug diameter

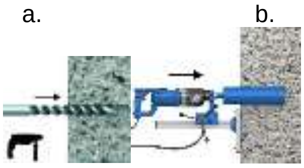
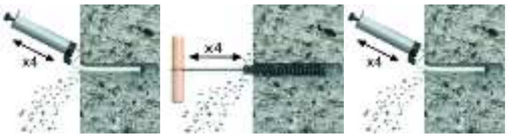
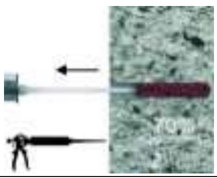
Hole diameter [mm]	16	18	20	22	24	25	26	28	30	32	35	40	50
Dosing plug R-NOZ-P diameter	Ø16	Ø18	Ø20 do Ø22		Ø24 do Ø26			Ø28	Ø30 do 32		Ø35	Ø40	Ø50

1. a.  b. 	1. Hole drilling. a. Hammer drilling. Drill hole to the required diameter and depth using a rotary hammer drilling machine. b. 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, – starting from the drill hole bottom, blow at least 2 times with compressed air.
3. 	3. Insert cartridge into dispenser and attach nozzle. Dispense to waste until even colour is obtained (min. 10 cm).
4. 	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. 	5. Immediately insert the threaded rod, slowly and with slight twisting motion. Remove any excess mortar around the hole before it sets.
6. 	6. Leave the fixing undisturbed until the curing time elapses.
7. 	7. Attach fixture and tighten the nut to the required torque. The installation torque cannot exceed $T_{inst,max}$.

R-KEX-II	**Annex B9** of European Technical Assessment ETA-21/0244
Intended use Installation instruction – threaded rod	

1. a.  b. 	1. Hole drilling. a. Hammer drilling. Drill hole to the required diameter and depth using a rotary hammer drilling machine. b. 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, – starting from the drill hole bottom, blow at least 2 times with compressed air.
3. 	3. Insert cartridge into dispenser and attach nozzle. Dispense to waste until even colour is obtained (min. 10 cm).
4. 	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. 	5. Immediately insert the rod with inner thread, slowly and with slight twisting motion. Remove any excess mortar around the hole before it sets.
6. 	6. Leave the fixing undisturbed until the curing time elapses.
7. 	7. Attach fixture and tighten the bolt to the required torque. The installation torque cannot exceed $T_{inst,max}$.

R-KEX-II	**Annex B10** of European Technical Assessment ETA-21/0244
Intended use Installation instruction – rod with inner thread	

1. a. b. 	1. Hole drilling. a. Hammer drilling. Drill hole to the required diameter and depth using a rotary hammer drilling machine. b. 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.  c. 	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, – starting from the drill hole bottom, blow at least 2 times with compressed air.
3. 	3. Insert cartridge into dispenser and attach nozzle. Dispense to waste until even colour is obtained (min. 10 cm).
4. 	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. 	5. Immediately insert the rebar, slowly and with slight twisting motion. Remove any excess mortar around the hole before it sets.
6. 	6. Leave the fixing undisturbed until the curing time elapses.

R-KEX-II	**Annex B11** of European Technical Assessment ETA-21/0244
Intended use Installation instruction – rebar	

	1. Inject from the bottom of the hole. Inject the mortar about 2/3 of the hole depth. For best performance use extension and appropriately sized piston plug assembled on the mixer.
	2. Drive the rebar immediately into the hole. Use temporary interlocking element e.g wedges.
	3. Leave the fixing undisturbed until the curing time elapses. To avoid the slipping of the rebar during the open time of the product (due to the rebar own weight) use a temporary interlocking element.

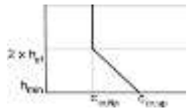
R-KEX-II	**Annex B12** of European Technical Assessment ETA-21/0244
Intended use Installation instruction – rebar – overhead installation	

Table C1: Characteristic resistance to tension load for threaded rod in uncracked concrete – static and quasi-static loads

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure									
Steel, property class 5.8									
Characteristic resistance	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	280
Partial safety factor [1)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	1,40						
Steel, property class 12.9									
Characteristic resistance	$N_{Rk,s}$	[kN]	44	70	101	188	294	424	673
Partial safety factor [1)]	γ_{Ms}	[-]	1,40						
Stainless steel, property class A4-70									
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	393
Partial safety factor [1)]	γ_{Ms}	[-]	1,87						
Stainless steel, property class A4-80									
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	448
Partial safety factor [1)]	γ_{Ms}	[-]	1,60						
High corrosion resistant stainless steel, property class 70									
Characteristic resistance	$N_{Rk,s}$	[kN]	25	40	59	110	171	247	393
Partial safety factor [1)]	γ_{Ms}	[-]	1,87						
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling, working life 50 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	17,0	16,0	17,0	15,0	15,0	13,0	12,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	15,0	14,0	15,0	13,0	13,0	12,0	10,0
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – diamond core drilling, working life 50 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	14,0	15,0	16,0	14,0	14,0	12,0	11,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	12,0	14,0	14,0	13,0	13,0	11,0	10,0
Factors – working life 50 years									
Increasing factor	ψ_c	C30/37	1,04						
		C40/50	1,07						
		C50/60	1,09						
Sustained load factor for $\tau_{Rk,ucr,50}$ in uncracked concrete	$\psi^0_{sus,50}$	40°C/24°C	0,75						
		80°C/50°C	0,72						
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling, working life 100 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,100}$	[N/mm²]	17,0	16,0	17,0	15,0	15,0	13,0	12,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,100}$	[N/mm²]	15,0	14,0	15,0	13,0	13,0	12,0	10,0
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – diamond core drilling, working life 100 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,100}$	[N/mm²]	14,0	15,0	16,0	14,0	14,0	12,0	11,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,100}$	[N/mm²]	12,0	14,0	14,0	13,0	13,0	11,0	10,0
Factors – working life 100 years									
Increasing factor	ψ_c	C30/37	1,04						
		C40/50	1,07						
		C50/60	1,09						

[1)] In the absence of other national regulation

Table C2: Characteristic resistance to tension load for threaded rod in uncracked concrete – static and quasi-static loads

Size			M8	M10	M12	M16	M20	M24	M30
Concrete cone failure in uncracked concrete									
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0						
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$						
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$						
Splitting failure									
Edge distance	$c_{cr,sp}$ for h_{min}	[mm]	$2,0 \cdot h_{ef}$					$1,5 \cdot h_{ef}$	
	$c_{cr,sp}$ for $h_{min} < h$ [1] $< 2 \cdot h_{ef}$ ($c_{cr,sp}$ from linear interpolation)								
	$c_{cr,sp}$ for h [1] $\geq 2 \cdot h_{ef}$		$c_{cr,N}$						
Spacing	$s_{cr,sp}$	[mm]	$2,0 \cdot c_{cr,sp}$						
Installation safety factors for combined pull-out, concrete cone and splitting failure									
Installation safety factor for in use category I1	γ_{inst}	[-]	1,0						
Installation safety factor for in use category I2			1,2						

[1] h – concrete member thickness

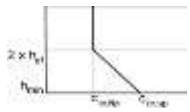
R-KEX-II	Annex C2
Performances Characteristic resistance to tension loads in uncracked concrete – threaded rod	of European Technical Assessment ETA-21/0244

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

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure									
Steel, property class 5.8									
Characteristic resistance	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	280
Partial safety factor [1]	γ_{Ms}	[-]	1,50						
Steel, property class 8.8									
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	125	196	282	448
Partial safety factor [1]	γ_{Ms}	[-]	1,50						
Steel, property class 10.9									
Characteristic resistance	$N_{Rk,s}$	[kN]	36	58	84	157	245	353	561
Partial safety factor [1]	γ_{Ms}	[-]	1,40						
Steel, property class 12.9									
Characteristic resistance	$N_{Rk,s}$	[kN]	43	69	101	188	294	423	673
Partial safety factor [1]	γ_{Ms}	[-]	1,40						
Stainless steel, property class A4-70									
Characteristic resistance	$N_{Rk,s}$	[kN]	25	40	59	109	171	247	392
Partial safety factor [1]	γ_{Ms}	[-]	1,87						
Stainless steel, property class A4-80									
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	125	196	282	448
Partial safety factor [1]	γ_{Ms}	[-]	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 [1]	γ_{Ms}	[-]	1,87						
Combined pull-out and concrete cone failure in cracked concrete C20/25 – hammer drilling, working life 50 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	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/mm²]	7,0	7,0	6,0	6,0	6,0	5,0	4,0
Combined pull-out and concrete cone failure in cracked concrete C20/25 – diamond core drilling, working life 50 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	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/mm²]	5,0	6,5	7,5	6,5	7,0	6,5	3,5
Factors – working life 50 years									
Increasing factor	ψ_c	C30/37	1,04						
		C40/50	1,07						
		C50/60	1,09						
Sustained load factor for $\tau_{Rk,ucr,50}$ in cracked concrete	$\psi^0_{sus,50}$	40°C/24°C	0,75						
		80°C/50°C	0,72						
Combined pull-out and concrete cone failure in cracked concrete C20/25 – hammer drilling, working life 100 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,100}$	[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/mm²]	6,5	7,0	6,0	6,0	6,0	5,0	4,0
Combined pull-out and concrete cone failure in cracked concrete C20/25 – diamond core drilling, working life 100 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,5	7,0	8,0	7,0	7,0	6,0	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,0	6,5	7,0	6,0	6,5	5,0	3,5
Factors – working life 100 years									
Increasing factor	ψ_c	C30/37	1,00						
		C40/50	1,00						
		C50/60	1,00						

[1] In the absence of other national regulation

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 concrete									
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7						
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$						
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$						
Splitting failure									
Edge distance	$c_{cr,sp}$ for h_{min}	[mm]	$2,0 \cdot h_{ef}$					$1,5 \cdot h_{ef}$	
	$c_{cr,sp}$ for $h_{min} < h$ [1] $< 2 \cdot h_{ef}$ ($c_{cr,sp}$ from linear interpolation)								
	$c_{cr,sp}$ for h [1] $\geq 2 \cdot h_{ef}$		$c_{cr,N}$						
Spacing	$s_{cr,sp}$	[mm]	$2,0 \cdot c_{cr,sp}$						
Installation safety factors for combined pull-out, concrete cone and splitting failure									
Installation safety factors for in use category I1	γ_{inst}	[-]	1,0						
Installation safety factors for in use category I2			1,2						

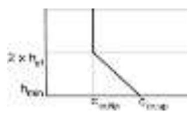
[1] h – concrete member thickness

R-KEX-II

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

Annex C4
of European
Technical Assessment
ETA-21/0244

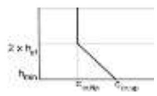
Table C5: Characteristic resistance to tension load for rod with inner thread in uncracked concrete – static and quasi-static loads

Size			**M6 / Ø10**	**M8 / Ø12**	**M10 / Ø16**	**M12 / Ø16**	**M16 /Ø24**
Steel failure							
Steel, property class 5.8							
Characteristic resistance	$N_{Rk,s}$	[kN]	10	18	29	42	78
Partial safety factor [1]	γ_{Ms}	[-]	1,50				
Steel, property class 8.8							
Characteristic resistance	$N_{Rk,s}$	[kN]	16	29	46	67	125
Partial safety factor [1]	γ_{Ms}	[-]	1,50				
Stainless steel, property class A4-70							
Characteristic resistance	$N_{Rk,s}$	[kN]	14	25	40	59	109
Partial safety factor [1]	γ_{Ms}	[-]	1,87				
Stainless steel, property class A4-80							
Characteristic resistance	$N_{Rk,s}$	[kN]	16	29	46	67	125
Partial safety factor [1]	γ_{Ms}	[-]	1,60				
High corrosion resistant stainless steel, property class 70							
Characteristic resistance	$N_{Rk,s}$	[kN]	14	25	40	59	109
Partial safety factor [1]	γ_{Ms}	[-]	1,87				
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling							
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	8,0	12,0	12,0	11,0	10,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	7,5	11,0	11,0	10,0	9,0
Increasing factor	ψ_c	C30/37	1,04				
		C40/50	1,07				
		C50/60	1,09				
Sustained load factor for $\tau_{Rk,ucr,50}$ in uncracked concrete	$\psi^0_{sus,50}$	40°C/24°C	0,75				
		80°C/50°C	0,72				
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling, working life 100 years							
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,100}$	[N/mm²]	8,0	12,0	12,0	11,0	10,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,100}$	[N/mm²]	7,5	11,0	10,0	10,0	9,0
Factors – working life 100 years							
Increasing factor	ψ_c	C30/37	1,04				
		C40/50	1,07				
		C50/60	1,09				
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]	$1,5 \cdot h_{ef}$				
Spacing	$s_{ucr,N}$	[mm]	$3,0 \cdot h_{ef}$				
Splitting failure							
Edge distance	$c_{ucr,sp}$ for h_{min}	[mm]	$2,0 \cdot h_{ef}$				$1,5 \cdot h_{ef}$
	$c_{ucr,sp}$ for $h_{min} < h$ [2] $< 2 \cdot h_{ef}$ ($c_{ucr,sp}$ from linear interpolation)						
	$c_{ucr,sp}$ for h [2] $\geq 2 \cdot h_{ef}$		$c_{cr,N}$				
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 I1	γ_{inst}	[-]	1,2				
Installation safety factors for use category I2			1,2				

[1] In the absence of other national regulation
[2] h – concrete member thickness

R-KEX-II	**Annex C5** of European Technical Assessment ETA-21/0244
Performances Characteristic resistance to tension loads in uncracked concrete – rod with inner thread	

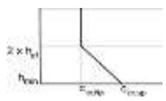
Table C6: Characteristic resistance to tension load for rebar in uncracked concrete – static and quasi-static loads

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	A_s [3] · f_{uk}							
Partial safety factor [1]	γ_{Ms}	[-]	1,40							
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	11,0	12,0	12,0	10,0	12,0	12,0	9,5	8,5
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	10,0	11,0	11,0	9,0	11,0	11,0	8,5	7,5
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – diamond core drilling, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	9,5	11,0	10,0	10,0	10,5	11,0	9,0	8,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	8,5	10,0	9,0	9,0	9,0	10,0	8,0	7,0
Factors – working life 50 years										
Increasing factor	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							
Sustained load factor for $\tau_{Rk,ucr,50}$ in uncracked concrete	$\psi^0_{sus,50}$	40°C/24°C	0,75							
		80°C/50°C	0,72							
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – hammer drilling, working life 100 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,100}$	[N/mm²]	11,0	12,0	12,0	10,0	12,0	12,0	9,5	8,5
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,100}$	[N/mm²]	10,0	11,0	11,0	9,0	11,0	11,0	8,5	7,5
Combined pull-out and concrete cone failure in uncracked concrete C20/25 – diamond core drilling, working life 100 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,100}$	[N/mm²]	9,5	11,0	10,0	10,0	10,5	11,0	9,0	8,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,100}$	[N/mm²]	8,5	10,0	9,0	9,0	9,0	10,0	8,0	7,0
Factors – working life 100 years										
Increasing factor	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							
Concrete cone failure in uncracked concrete										
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}							
Splitting failure										
Edge distance	$c_{ucr,sp}$ for h_{min}	[mm]	2,0 · h_{ef}						1,5 · h_{ef}	
	$c_{ucr,sp}$ for $h_{min} < h$ [2] $< 2 \cdot h_{ef}$ ($c_{ucr,sp}$ from linear interpolation)									
	$c_{ucr,sp}$ for h [2] $\geq 2 \cdot h_{ef}$		$c_{cr,N}$							
Spacing	$s_{ucr,sp}$	[mm]	2,0 · $c_{cr,sp}$							
Installation safety factors for combined pull-out, concrete cone and splitting failure										
Installation safety factors for use category I1	γ_{inst}	[-]	1,2							
Installation safety factors for use category I2			1,2							

[1] In the absence of other national regulation
[2] h – concrete member thickness
[3] Stressed cross section of the steel

R-KEX-II	**Annex C6** of European Technical Assessment ETA-21/0244
Performances Characteristic resistance to tension loads in uncracked concrete – rebar	

Table C7: Characteristic resistance to tension loads for rebar in cracked concrete – static and quasi-static loads

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	A_s 3) · f_{uk}							
Partial safety factor 1)	γ_{Ms}	[-]	1,40							
Combined pull-out and concrete cone failure in cracked concrete C20/25 – hammer drilling, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	5,5	5,0	5,5	5,5	5,0	5,0	5,4	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,50}$	[N/mm²]	5,0	4,5	5,0	5,0	4,5	4,5	5,0	3,0
Combined pull-out and concrete cone failure in cracked concrete C20/25 – diamond core drilling. working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	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/mm²]	5,0	5,0	5,5	5,5	4,5	5,0	4,0	4,0
Factors – working life 50 years										
Increasing factor	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							
Sustained load factor for $\tau_{Rk,ucr,50}$ in cracked concrete	$\psi^0_{sus,50}$	40°C/24°C	0,75							
		80°C/50°C	0,72							
Combined pull-out and concrete cone failure in cracked concrete C20/25 – hammer drilling, working life 100 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,5	5,0	5,5	5,5	5,0	5,0	5,4	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,0	4,5	5,0	5,0	4,5	4,5	5,0	3,0
Combined pull-out and concrete cone failure in cracked concrete C20/25 – diamond core drilling, working life 100 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,5	5,5	6,0	6,0	5,0	5,0	4,5	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,100}$	[N/mm²]	5,0	5,0	5,5	5,5	4,5	4,5	4,0	4,0
Factors – working life 100 years										
Increasing factor	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							
Concrete cone failure in cracked concrete										
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										
Edge distance	$c_{cr,sp}$ for h_{min}	[mm]	2,0 · h_{ef}						1,5 · h_{ef}	
	$c_{cr,sp}$ for h_{min} < h 2) < 2 · h_{ef} ($c_{cr,sp}$ from linear interpolation)									
	$c_{cr,sp}$ for h 2) ≥ 2 · h_{ef}		$c_{cr,N}$							
Spacing	$s_{cr,sp}$	[mm]	2,0 · $c_{cr,sp}$							
Installation safety factors for combined pull-out, concrete cone and splitting failure										
Installation safety factors for in use category I1	γ_{inst}	[-]	1,2							
Installation safety factors for in use category I2			1,2							

1) In the absence of other national regulation
2) h – concrete member thickness
3) Stressed cross section of the steel element

R-KEX-II	**Annex C7** of European Technical Assessment ETA-21/0244
Performances Characteristic resistance to tension loads in cracked concrete – rebar	

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

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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	1,33						
High corrosion resistant stainless steel, property class 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)]	γ_{Ms}	[-]	1,56						

[1)] In the absence of other national regulation

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

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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	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)]	γ_{Ms}	[-]	1,33						
High corrosion resistant stainless steel, property class 70									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454	786	1574
Partial safety factor [1)]	γ_{Ms}	[-]	1,56						

[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									
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	l_f	[mm]	min (h_{ef}; $12d_{nom}$)						min (h_{ef}; $8d_{nom}$)

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

Size			M6/ Ø10	M8/ Ø12	M10/ Ø16	M12/ Ø16	M16/ Ø24
Steel, property class 5.8							
Characteristic resistance	$V^0_{Rk,s}$	[kN]	6,0	11,0	17,0	25,0	47,0
Factor considering ductility	k_7	[-]			1,0		
Partial safety factor [1)]	γ_{Ms}	[-]			1,25		
Steel, property class 8.8							
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)]	γ_{Ms}	[-]			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)]	γ_{Ms}	[-]			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	k_7	[-]			1,0		
Partial safety factor [1)]	γ_{Ms}	[-]			1,33		
High corrosion resistant stainless steel, property 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)]	γ_{Ms}	[-]			1,56		

[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)]	γ_{Ms}	[-]			1,25		
Steel, property class 8.8							
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	12,2	30,0	59,8	104,8	266,4
Partial safety factor [1)]	γ_{Ms}	[-]			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)]	γ_{Ms}	[-]			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)]	γ_{Ms}	[-]			1,33		
High corrosion resistant stainless steel, property class 70							
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	10,7	26,2	52,3	91,7	233,1
Partial safety factor [1)]	γ_{Ms}	[-]			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	l_f	[mm]			min (h_{ef}; $12d_{nom}$)		

R-KEX-II

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

Annex C10
of European
Technical Assessment
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Table C14: Characteristic resistance to shear loads for rebar – steel failure without lever arm

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Rebar										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0,5 \cdot A_s$ [2] $\cdot f_{uk}$							
Factor considering ductility	k_7	[-]	1,0							
Partial safety factor [1]	γ_{Ms}	[-]	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]	$1,2 \cdot W_{el}$ [2] $\cdot f_{uk}$							
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										
Factor	k_8	[-]	2							
Concrete edge failure										
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14	16	20	25	32
Effective length of anchor under shear loading	l_f	[mm]	min (h_{ef}; $12d_{nom}$)						min (h_{ef}; $8d_{nom}$)	

Table C17: Displacement under tension loads – threaded rod

Size			M8	M10	M12	M16	M20	M24	M30
Characteristic displacement in uncracked concrete C20/25 to C50/60 under tension loads									
Displacement [1]	δ_{N0}	[mm]	0,33	0,40	0,41	0,47	0,52	0,56	0,70
	$\delta_{N\infty}$	[mm]	0,75	0,75	0,75	0,75	0,75	0,75	0,75
Characteristic displacement in cracked concrete C20/25 to C50/60 under tension loads									
Displacement [1]	δ_{N0}	[mm]	0,20	0,20	0,24	0,28	0,39	0,44	0,46
	$\delta_{N\infty}$	[mm]	3,0	3,0	2,5	2,6	2,5	2,4	3,0

[1] These values are suitable for each temperature range and categories specified in Annex B1
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 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
	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7

[1] These values are suitable for each temperature range and categories specified in Annex 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 concrete C20/25 to C50/60 under tension loads							
Displacement [1]	δ_{N0}	[mm]	0,25	0,25	0,26	0,32	0,37
	$\delta_{N\infty}$	[mm]	0,75	0,75	0,75	0,75	0,75

[1] These values are suitable for each temperature range and categories specified in Annex B1
Calculation of the displacement: $\delta_{N0} = \delta_{N0}$-factor · N; $\delta_N = \delta_{N\infty}$-factor · 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 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
	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7

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

Table C21: Displacement under tension loads – rebar

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø32
Characteristic displacement in uncracked concrete C20/25 to C50/60 under tension loads										
Displacement [1)]	δ_{N0}	[mm]	0,25	0,25	0,32	0,37	0,43	0,45	0,48	0,53
	$\delta_{N\infty}$	[mm]	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75
Characteristic displacement in cracked concrete C20/25 to C50/60 under tension loads										
Displacement	δ_{N0}	[mm]	0,2	0,2	0,24	0,30	0,31	0,34	0,38	0,40
	$\delta_{N\infty}$	[mm]	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0

[1)] These values are suitable for each temperature range and categories specified in Annex B1.
Calculation of the displacement: $\delta_{N0} = \delta_{N0}$-factor · N; $\delta_N = \delta_{N\infty}$-factor · N; (N – applied tension load)

Table C22: Displacement under shear loads – rebar

Size			Ø8	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
	$\delta_{V\infty}$	[mm]	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7

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

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

Size			M8	M10	M12	M16	M20	M24	M30
Steel failure									
Steel, property class 5.8									
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	18	29	42	78	122	176	280
Partial safety factor [1]	$\gamma_{Ms,C1}$	[-]	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]	$\gamma_{Ms,C1}$	[-]	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]	$\gamma_{Ms,C1}$	[-]	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]	$\gamma_{Ms,C1}$	[-]	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]	$\gamma_{Ms,C1}$	[-]	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]	$\gamma_{Ms,C1}$	[-]	1,60						
High corrosion resistant stainless steel, property class 70									
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	25	40	59	109	171	247	392
Partial safety factor [1]	$\gamma_{Ms,C1}$	[-]	1,87						
Combined pull-out and concrete cone failure, working life 50 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm²]	6,0	7,0	6,5	7,0	6,0	5,5	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,C1}$	[N/mm²]	5,0	6,5	5,5	6,0	5,5	5,0	3,5
Combined pull-out and concrete cone failure, working life 100 years									
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm²]	6,0	7,0	6,0	6,5	6,0	5,5	4,0
Temperature range II: 80°C/50°C	$\tau_{Rk,C1}$	[N/mm²]	5,0	6,0	5,5	6,0	5,5	5,0	3,5

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										
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	A_s [2] $\cdot f_{uk}$							
Partial safety factor [1]	$\gamma_{Ms,C1}$	[-]	1,40							
Combined pull-out and concrete cone failure, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm²]	4,0	4,5	5,0	5,0	5,0	5,0	5,0	3,0
Temperature range II: 80°C/50°C	$\tau_{Rk,C1}$	[N/mm²]	3,5	4,0	4,5	4,5	4,5	4,5	4,5	2,5
Combined pull-out and concrete cone failure, working life 100 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm²]	3,5	4,5	5,0	5,0	5,0	3,5	5,0	3,0
Temperature range II: 80°C/50°C	$\tau_{Rk,C1}$	[N/mm²]	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
[2] Stressed cross section of the steel element

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									
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)]	$\gamma_{Ms, C1}$	[-]	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)]	$\gamma_{Ms, C1}$	[-]	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)]	$\gamma_{Ms, C1}$	[-]	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)]	$\gamma_{Ms, C1}$	[-]	1,5						
Steel failure with stainless steel threaded rod A4-70									
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)]	$\gamma_{Ms, C1}$	[-]	1,56						
Steel failure with stainless steel threaded rod A4-80									
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)]	$\gamma_{Ms, C1}$	[-]	1,33						
Steel failure with high corrosion stainless steel 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)]	$\gamma_{Ms, C1}$	[-]	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]	$0,35 \cdot A_s{}^{2)} \cdot f_{uk}$							
Partial safety factor [1)]	$\gamma_{Ms, C1}$	[-]	1,5							

[1)] In the absence of other national regulation
[2)] Stressed cross section of the steel element

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	$\delta_{V,C1}$	[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

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/mm²]	$N_{Rk,s}$	$N_{Rk,s}$	$N_{Rk,s}$	$N_{Rk,s}$
Combined pull-out and concrete cone failure (uncracked and cracked concrete)						
Temperature range -40°C / +40°C	$\tau_{Rk,C2}$	[N/mm²]	5,65	3,93	5,18	3,65
Temperature range -40°C / +80°C	$\tau_{Rk,C2}$	[N/mm²]	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/mm²]	11,6	13,7	26,3	47,0
Steel failure with threaded rod grade 8.8						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	18,5	22,0	42,1	75,1
Steel failure with threaded rod grade 10.9						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	23,2	27,4	52,6	93,9
Steel failure with threaded rod grade 12.9						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	27,8	32,9	63,2	112,6
Stainless steel, property class A4-70						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	15,8	19,2	36,9	66,0
Stainless steel, property class A4-80						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	18,5	22,0	42,1	75,1
High corrosion resistant stainless steel, property class 70						
Characteristic resistance	$V_{Rk,s,C2}$	[N/mm²]	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)]	$\delta_{N,eq,C2\,(DLS)}$	[mm]	0,85	1,14	0,77	0,94
Displacement in tensile at ultimate limit state [1)]	$\delta_{N,eq,C2\,(ULS)}$	[mm]	1,70	2,01	2,07	1,91
Displacement in shear at damage limitation states [1)]	$\delta_{V,eq,C2\,(DLS)}$	[mm]	3,01	2,28	3,60	3,15
Displacement in shear at ultimate limit state [1)]	$\delta_{V,eq,C2\,(ULS)}$	[mm]	6,44	8,81	7,57	8,21

[1)] All temperature ranges