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European Technical Assessment

**ETA 25/0823
of 01/09/2025**

Technical Assessment Body issuing the ETA: Technical and Test Institute
for Construction Prague

Trade name of the construction product

rbs P400C+

**Product family to which the construction
product belongs**

Product area code: 33
Bonded injection type anchor for use in
cracked and uncracked concrete

Manufacturer

Resapol Ltd
Unit D4, Walter Leigh Way,
Moss Industrial Estate, Leigh,
Lancashire, WN7 3PT
England

Manufacturing plant

Resapol Ltd Plant A

**This European Technical Assessment
contains**

26 pages including 23 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**

EAD 330499-02-0601
Bonded fasteners for use in concrete

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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1. Technical description of the product

The rbs P400C+ with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rods or rebars.

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

The illustration and the description of the product are given in Annex A.

2. Specification of the intended use in accordance with the applicable EAD

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

The provisions made in this European Technical Assessment are based on an assumed working life of the anchor of 50 years and 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 to C 7
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 8 to C 10
Displacements under short-term and long-term loading	See Annex C 11
Characteristic resistance for seismic performance categories C2	See Annex C 12

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Satisfy the requirements for performance class A1
Resistance to fire	See Annex C 13, C 14

3.3 Hygiene, health and environment (BWR 3)

No performance determined.

3.4 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B 1 are kept.

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

According to the Decision 96/582/EC of the European Commission¹ the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	-	1

¹ Official Journal of the European Communities L 254 of 08.10.1996

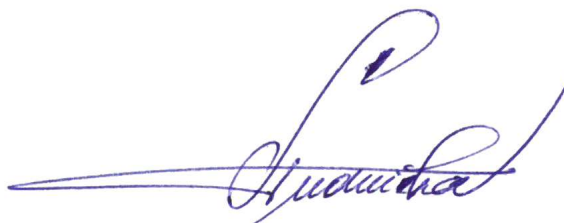
5. Technical details necessary for the implementation of the AVCP system, as provided in the applicable EAD

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technický a zkušební ústav stavební Praha, s.p.² The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

Issued in Prague on 01.09.2025

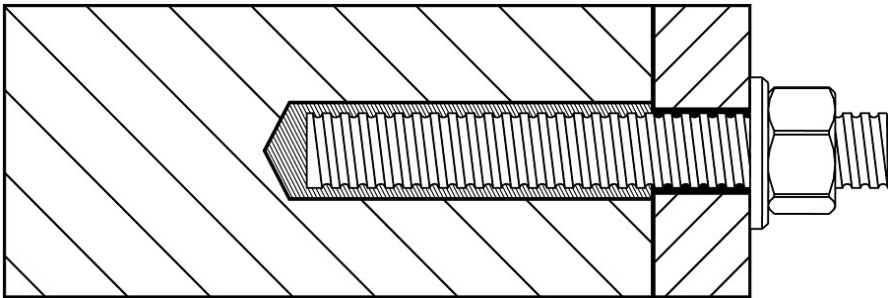
By

Ing. Jiří Studnička, Ph.D.
Head of the Technical Assessment Body

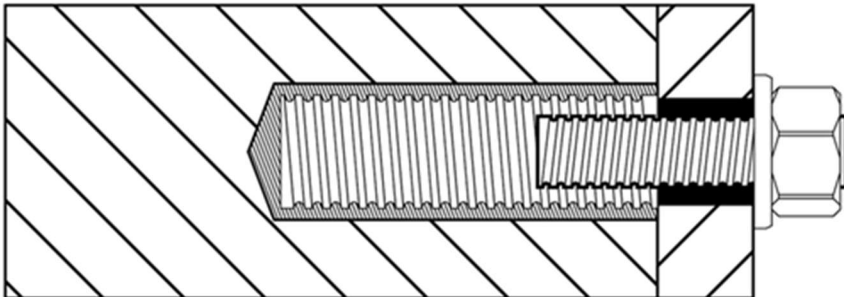


² The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

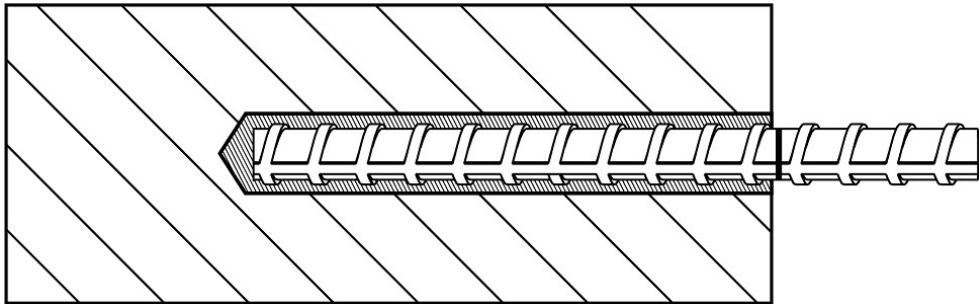
Threaded rod



Threaded socket



Reinforcing bar



rbs P400C+

Product description
Installed conditions

Annex A 1

Coaxial cartridge

rbs P400C+

410 ml



Marking of the mortar cartridges

Identifying mark of the producer, Trade name, Charge code number, Storage life, Curing and processing time

Standard mixing nozzle

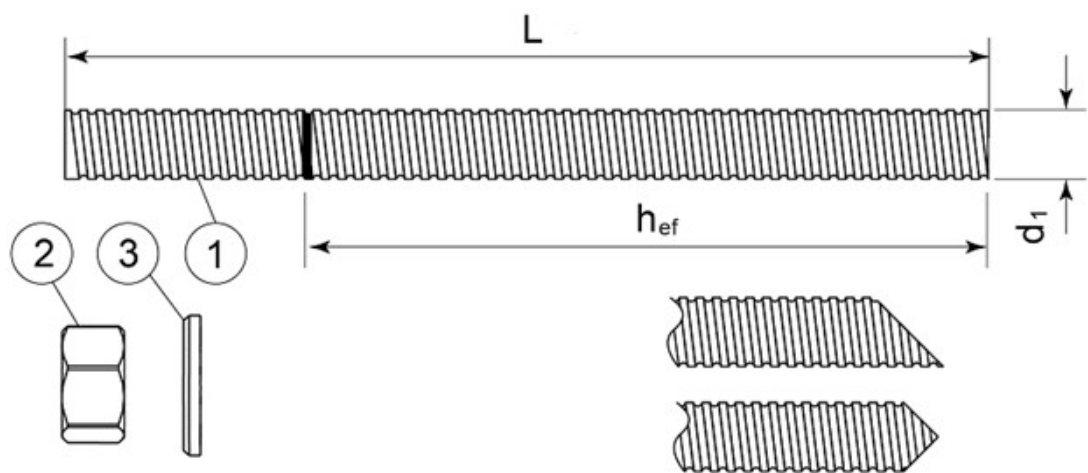


rbs P400C+

Product description
Injection system

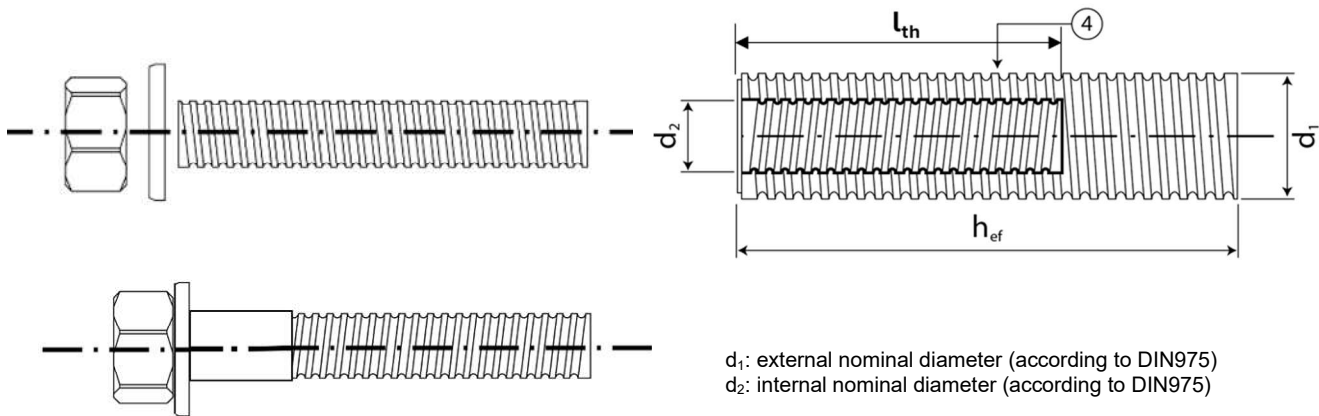
Annex A 2

Threaded rod M8, M10, M12, M16, M20, M24



Standard commercial threaded rod with marked embedment depth.

Threaded socket M6, M8, M10, M12, M16



Standard commercial threaded socket.

rbs P400C+	Annex A 3
Product description Threaded rod Threaded socket	

Part	Designation	Material
Steel, zinc plated $\geq 5 \mu\text{m}$ acc. to EN ISO 4042 or Steel, Hot-dip galvanized $\geq 40 \mu\text{m}$ acc. to EN ISO 1461 and EN ISO 10684 or Steel, zinc diffusion coating $\geq 15 \mu\text{m}$ acc. to EN 13811		
1	Anchor rod	Steel, EN 10087 or EN 10263 Property class 4.6, 4.8, 5.6, 5.8, 8.8, 10.9* EN ISO 898-1
2	Hexagon nut EN ISO 4032	According to threaded rod, EN 20898-2
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
4	Threaded socket	Steel, EN 10087 or EN 10263 Property class 4.6, 4.8, 5.6, 5.8, 8.8, 10.9* EN ISO 898-1
Stainless steel		
1	Anchor rod	Material: A2-70, A4-70, A4-80, EN ISO 3506
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
4	Threaded socket	Material: A2-70, A4-70, A4-80, EN ISO 3506
High corrosion resistant steel		
1	Anchor rod	Material: 1.4529, 1.4565, EN 10088-1
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
4	Threaded socket	Material: 1.4529, 1.4565, EN 10088-1

*Galvanized rod of high strength are sensitive to hydrogen induced brittle failure

rbs P400C+	Annex A 4
Product description Materials	

Rebar Ø8, Ø10, Ø12, Ø16, Ø20, Ø25



Standard commercial reinforcing bar with marked embedment depth

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

rbs P400C+

Product description
Rebars and materials

Annex A 5

Specifications of intended use

Anchorage subject to:

- Static and quasi-static load:
 - threaded rod
 - threaded socket
 - rebar
- Fire exposure
- Seismic actions category C2: threaded rod size M12, M16

Base materials

- Cracked and uncracked concrete
- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according EN 206:2013 + A2:2021.

Temperature range:

- -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 corresponding to corrosion resistance class:
 - Stainless steel A2 according to Annex A 4, Table A1: CRC II
 - Stainless steel A4 according to Annex A 4, Table A1: CRC III
 - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

Concrete conditions:

- I1 – installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete.
- I2 – installation in water-filled (not sea water) and use in service in dry or wet concrete

Design:

- The anchorages are designed in accordance with the EN 1992-4 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.
- Anchorages under seismic actions (cracked concrete) have to be designed in accordance with EN 1992-4.
- For applications with resistance to fire exposure, the fasteners are designed in accordance with EOTA TR 082 "Design of bonded fasteners in concrete under fire conditions"

Installation:

- Hole drilling by hammer drilling, dustless drilling or diamond core drilling mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Installation direction:

- D3 – downward and horizontal and upwards (e.g. overhead) installation

rbs P400C+

Intended use
Specifications

Annex B 1

HDB – Hollow Drill Bit System

Heller Duster Expert hollow drill bit

SDS-Plus $\leq 16\text{mm}$

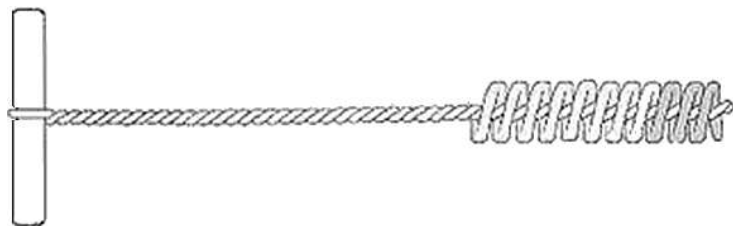
SDS-Max $\geq 16\text{mm}$

Class M vacuum

Minimum flow rate $266\text{ m}^3/\text{h}$ (74 l/s)



Cleaning brush



Applicator gun



rbs P400C+

Intended use

Hollow drill bit system, Cleaning brush

Applicator guns

Annex B 2

SOLID SUBSTRATE INSTALLATION METHOD

1. Using the SDS hammer drill (HD) in rotary hammer mode for drilling, with a carbide tipped drill bit of the appropriate size, drill the hole to the specified hole diameter and depth.



2. Select the correct air lance, insert to the bottom of the hole, and depress the trigger for 2 seconds. The compressed air must be clean and free from water and oil, with a minimum pressure of 90 psi (6 bar). A manual pump may be used for certain diameters and depths; check the approval document. Perform the blowing operation twice.



3. Select the correct size hole cleaning brush. Ensure that the brush is in good condition and of the correct diameter. Insert the brush to the bottom of the hole, using a brush extension if needed to reach the bottom. Withdraw with a twisting motion. There should be a positive interaction between the bristles of the brush and the sides of the drilled hole. Perform the brushing operation twice.

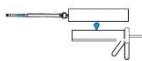


4. Repeat step 2 (blowing operation x2)

5. Repeat step 3 (brushing operation x2)

6. Repeat step 2 (blowing operation x2)

7. Select the most appropriate static mixer nozzle, checking that the mixing elements are present and fit for purpose. Never modify the mixer. Attach the mixer nozzle to the cartridge. Check the dispensing tool is in good working order. Place the cartridge into the dispensing tool.



8. Extrude some resin to waste until an even coloured mixture is achieved. The cartridge is now ready for use.



9. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. Ensure no air voids are created as the nozzle is withdrawn. Inject resin until the hole is approximately ¾ full and remove the nozzle from the hole.



10. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.



11. Clean any excess resin from around the mouth of the hole.

12. Refer to the working and loading times within the tables to determine the appropriate cure time.



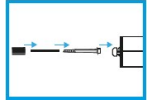
13. Position the fixture and tighten the anchor to the appropriate installation torque. Do not over-torque the anchor, as this could adversely affect its performance.



DEEP EMBEDMENT & OVERHEAD INSTALLATION METHOD

1a. Perform steps 1-8 under "solid substrate installation method".

2a. Attach the correct diameter and length extension tube to the nozzle. Select the correct diameter resin stopper for the application, then push and screw the extension tube into the resin stopper. This is held in place with a coarse internal thread. The resin stopper is a reusable accessory.



3a. Push the resin stopper and extension tube to the back of the drill hole.

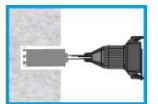
4a. Ensure the extension tube is angled to allow free movement of the resin stopper as the resin is extruded.



5a. Continue from step 10 under "solid substrate installation method".

DIAMOND CORE DRILLING

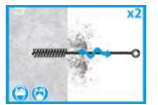
1b. Using a diamond core drill (DD) and following the manufacturer's instructions, drill the specified diameter hole to the correct embedment depth then remove the concrete core.



2b. Starting from the back of the hole, flush with pressurised water a minimum of two times and until there is only clean water.



3b. Select the correct size hole cleaning brush. Ensure that the brush is in good condition and of the correct diameter. Insert the brush to the bottom of the hole, using a brush extension if needed to reach the bottom. Withdraw with a twisting motion. There should be a positive interaction between the bristles of the brush and the sides of the drilled hole. Perform the brushing operation twice.



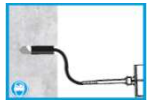
4b. Repeat step 2b (flushing operation x2).

5b. Repeat step 3b (brushing operation x2).

6a. Using the correct air lance and starting from the back of the hole and withdrawing, perform a minimum of two blowing operations and ensure that the hole is clear of debris and excess water.



7a. Continue from step 7 under "solid substrate installation method".



DUSTLESS DRILLING

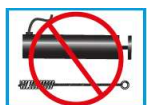
1c. Using the specified hollow drill bit (HDB) and vacuum system and following the manufacturer's instructions, drill the specified diameter hole to the correct embedment depth. Ensure that the minimum vacuum specifications are met and that the vacuum is turned on.



2c. The hole should be inspected to ensure the system has worked correctly. If the hole is clear of dust and debris, no further cleaning is required.



3c. Continue from step 7 under "solid substrate installation method".



rbs P400C+

Intended use
Installation procedure

Annex B 3

Table B1: Installation parameters of threaded rod

Size		M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$\varnothing d_0$ [mm]	10	12	14	18	22	26
Diameter of cleaning brush	d_b [mm]	14	14	20	20	29	29
Manual pump cleaning		$h_{ef} < 300$ mm					
Torque moment	$\max T_{fix}$ [Nm]	10	20	40	80	120	160
Depth of drill hole for $h_{ef,min}$	h_{ef} [mm]	60	60	70	80	90	96
Depth of drill hole for $h_{ef,max}$	h_{ef} [mm]	160	200	240	320	400	480
Depth of drill hole	h_0 [mm]	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$
Minimum edge distance	c_{min} [mm]	40	40	50	70	80	100
Minimum spacing	s_{min} [mm]	40	40	50	70	80	100
Minimum thickness of member	h_{min} [mm]	$h_{ef} + 30$ mm ≥ 100 mm			$h_{ef} + 2d_0$		

Table B2: Installation parameters of threaded socket

Size		M6	M8	M10	M12	M16
Nominal drill hole diameter	$\varnothing d_0$ [mm]	12	14	18	22	26
Cleaning brush		14	20	20	29	29
Nominal Internal diameter of socket	d_2 [mm]	M6	M8	M10	M12	M16
Nominal external diameter of socket	d_1 [mm]	M10	M12	M16	M20	M24
Torque moment	$\max T_{fix}$ [Nm]	10	10	20	40	80
Embedment depth for $h_{ef,min}$	h_{ef} [mm]	60	70	80	90	96
Embedment depth for $h_{ef,max}$	h_{ef} [mm]	200	240	320	400	480
Threaded engagement length min/max	l_{th} [mm]	8/20	8/20	10/25	12/30	16/40
Depth of drill hole	h_0 [mm]	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$
Minimum edge distance	c_{min} [mm]	40	40	40	50	50
Minimum spacing	s_{min} [mm]	40	40	40	50	50
Minimum thickness of member	h_{min} [mm]	$h_{ef} + 30$ mm ≥ 100 mm			$h_{ef} + 2d_0$	

Table B3: Installation parameters of rebar

Size		$\varnothing 8$	$\varnothing 10$	$\varnothing 12$	$\varnothing 16$	$\varnothing 20$	$\varnothing 25$
Nominal drill hole diameter	$\varnothing d_0$ [mm]	12	14	16	20	25	32
Diameter of cleaning brush	d_b [mm]	14	14	19	22	29	40
Manual pump cleaning		$h_{ef} < 300$ mm					
Depth of drill hole for $h_{ef,min}$	h_{ef} [mm]	60	60	70	80	90	100
Depth of drill hole for $h_{ef,max}$	h_{ef} [mm]	160	200	240	320	400	480
Depth of drill hole	h_0 [mm]	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$	$h_{ef}+5$
Minimum edge distance	c_{min} [mm]	40	40	50	70	80	100
Minimum spacing	s_{min} [mm]	40	40	50	70	80	100
Minimum thickness of member	h_{min} [mm]	$h_{ef} + 30$ mm ≥ 100 mm			$h_{ef} + 2d_0$		

Table B4. Minimum curing time

Resin cartridge temperature [°C]	T Work [mins]	Base material Temperature [°C]	T Load [mins]
min +5	18	min +5	145
+5 to +10	10	+5 to +10	
+10 to +20	6	+10 to +20	85
+20 to +25	5	+20 to +25	50
+25 to +30	4	+25 to +30	40
+30		+30	35

T Work is typical gel time at highest base material temperature in the range.

T Load is minimum set time required until load can be applied at the lowest temperature in the range.

rbs P400C+

Intended use
Installation parameters
Curing time

Annex B 4

Table C1: Design method EN 1992-4
Steel failure - Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance				M8	M10	M12	M16	M20	M24
Size									
Steel grade 4.6	$N_{Rk,s}$	[kN]		15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]		2,00					
Steel grade 4.8	$N_{Rk,s}$	[kN]		15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]		1,50					
Steel grade 5.6	$N_{Rk,s}$	[kN]		18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]		2,00					
Steel grade 5.8	$N_{Rk,s}$	[kN]		18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]		1,50					
Steel grade 8.8	$N_{Rk,s}$	[kN]		29	46	67	126	196	282
Partial safety factor	γ_{Ms}	[-]		1,50					
Steel grade 10.9	$N_{Rk,s}$	[kN]		37	58	84	157	245	353
Partial safety factor	γ_{Ms}	[-]		1,40					
Stainless steel grade A2-70, A4-70	$N_{Rk,s}$	[kN]		26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]		1,87					
Stainless steel grade A4-80	$N_{Rk,s}$	[kN]		29	46	67	126	196	282
Partial safety factor	γ_{Ms}	[-]		1,60					
High corrosion resistant steel grade 1.4529	$N_{Rk,s}$	[kN]		26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]		1,50					
High corrosion resistant steel grade 1.4565	$N_{Rk,s}$	[kN]		26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]		1,87					

Table C2: Design method EN 1992-4
Steel failure - Characteristic values of resistance to tension load of threaded socket

Steel failure – Characteristic resistance				M6	M8	M10	M12	M16
Size								
Steel grade 4.6	$N_{Rk,s}$	[kN]		8	15	23	34	63
Partial safety factor	γ_{Ms}	[-]		2,00				
Steel grade 4.8	$N_{Rk,s}$	[kN]		8	15	23	34	63
Partial safety factor	γ_{Ms}	[-]		1,50				
Steel grade 5.6	$N_{Rk,s}$	[kN]		10	18	29	42	79
Partial safety factor	γ_{Ms}	[-]		2,00				
Steel grade 5.8	$N_{Rk,s}$	[kN]		10	18	29	42	79
Partial safety factor	γ_{Ms}	[-]		1,50				
Steel grade 8.8	$N_{Rk,s}$	[kN]		16	29	46	67	126
Partial safety factor	γ_{Ms}	[-]		1,50				
Steel grade 10.9	$N_{Rk,s}$	[kN]		20	37	58	84	157
Partial safety factor	γ_{Ms}	[-]		1,33				
Stainless steel grade A2-70, A4-70	$N_{Rk,s}$	[kN]		14	26	41	59	110
Partial safety factor	γ_{Ms}	[-]		1,87				
Stainless steel grade A4-80	$N_{Rk,s}$	[kN]		16	29	46	67	126
Partial safety factor	γ_{Ms}	[-]		1,60				
High corrosion resistant steel grade 1.4529	$N_{Rk,s}$	[kN]		14	26	41	59	110
Partial safety factor	γ_{Ms}	[-]		1,50				
High corrosion resistant steel grade 1.4565	$N_{Rk,s}$	[kN]		14	26	41	59	110
Partial safety factor	γ_{Ms}	[-]		1,87				

Table C3: Design method EN 1992-4
Steel failure - Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance				Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Size									
Rebar BSt 500 S	$N_{Rk,s}$	[kN]		28	43	62	111	173	270
Partial safety factor	γ_{Ms}	[-]		1,4					

rhs P400C+

Performances
Steel failure characteristic resistance

Annex C 1

Table C4: Design method EN 1992-4

Characteristic values of resistance to tension load of threaded rod

Hammer drilling, Dustless drilling								
Combined pullout and concrete cone failure in concrete C20/25								
Size			M8	M10	M12	M16	M20	M24
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,ucr}$	[N/mm ²]	11,0	10,0	10,0	9,0	7,5	7,0
Installation safety factor								
Dry, wet concrete	γ_{inst}	[-]	1,2					
Hammer drilling - flooded hole	γ_{inst}	[-]	1,2					
Dustless drilling - flooded hole	γ_{inst}	[-]	1,4					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	5,0	5,0	4,5	4,0	4,0	4,0
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	4,0	4,0	3,5	3,5	3,5	3,5
Installation safety factor								
Dry, wet concrete	γ_{inst}	[-]	1,2					
Hammer drilling - flooded hole	γ_{inst}	[-]	1,2					
Dustless drilling - flooded hole	γ_{inst}	[-]	1,4					
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,75					
Factor for concrete	C25/30	ψ_c	[-]	1,04				
	C30/37			1,08				
	C35/45			1,12				
	C40/50			1,15				
	C45/55			1,17				
	C50/60			1,19				
Concrete cone failure								
Factor for concrete cone failure for uncracked concrete	$k_{ucr,N}$	11						
Factor for concrete cone failure for cracked concrete	$k_{cr,N}$	7,7						
Edge distance	$C_{cr,N}$	[mm]	1,5h _{ef}					
Splitting failure								
Size			M8	M10	M12	M16	M20	M24
Edge distance	$C_{cr,sp}$	[mm]	2 • h _{ef}					
Spacing	$S_{cr,sp}$	[mm]	2 • C _{cr,sp}					

rbs P400C+**Performances**

Hammer drilling, Dustless drilling

Characteristic resistance for tension loads - threaded rod

Annex C 2

Table C5: Design method EN 1992-4

Characteristic values of resistance to tension load of threaded socket

Hammer drilling, Dustless drilling								
Combined pullout and concrete cone failure in concrete C20/25								
Size			M6	M8	M10	M12	M16	
Nominal external diameter of socket			M10	M12	M16	M20	M24	
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,ucr}$	[N/mm ²]	10,0	10,0	9,0	7,5	7,0
Installation safety factor								
Dry, wet concrete		γ_{inst}	[-]	1,2				
Hammer drilling - flooded hole		γ_{inst}	[-]	1,2				
Dustless drilling - flooded hole		γ_{inst}	[-]	1,4				
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$	[N/mm ²]	5,0	4,5	4,0	4,0	4,0
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$	[N/mm ²]	4,0	3,5	3,5	3,5	3,5
Installation safety factor								
Dry, wet concrete		γ_{inst}	[-]	1,2				
Hammer drilling - flooded hole		γ_{inst}	[-]	1,2				
Dustless drilling - flooded hole		γ_{inst}	[-]	1,4				
Factor for influence of sustained load for a working life 50 years		ψ^0_{sus}	[-]	0,75				
Factor for concrete	C25/30	ψ_c	[-]	1,04				
	C30/37			1,08				
	C35/45			1,12				
	C40/50			1,15				
	C45/55			1,17				
	C50/60			1,19				
Concrete cone failure								
Factor for concrete cone failure for uncracked concrete		$k_{ucr,N}$	11					
Factor for concrete cone failure for cracked concrete		$k_{cr,N}$	7,7					
Edge distance		$c_{cr,N}$	[mm]	1,5h _{ef}				
Splitting failure								
Size			M6	M8	M10	M12	M16	
Edge distance		$c_{cr,sp}$	[mm]	2 • h _{ef}				
Spacing		$s_{cr,sp}$	[mm]	2 • c _{cr,sp}				

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Performances

Hammer drilling, Dustless drilling

Characteristic resistance for tension loads - threaded socket

Annex C 3

Table C6: Design method EN 1992-4
Characteristic values of resistance to tension load of rebar

Hammer drilling, Dustless drilling								
Combined pullout and concrete cone failure in concrete C20/25								
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,ucr}$ [N/mm²]	8,5	8,0	8,0	7,0	7,0	5,5
Installation safety factor								
Dry, wet concrete		γ_{inst} [-]	1,2					
Hammer drilling - flooded hole		γ_{inst} [-]	1,2					
Dustless drilling - flooded hole		γ_{inst} [-]	1,4					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$ [N/mm²]	4,0	3,5	3,5	3,5	3,5	2,5
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$ [N/mm²]	3,0	3,0	2,5	2,5	2,5	2,0
Installation safety factor								
Dry, wet concrete		γ_{inst} [-]	1,2					
Hammer drilling - flooded hole		γ_{inst} [-]	1,2					
Dustless drilling - flooded hole		γ_{inst} [-]	1,4					
Factor for influence of sustained load for a working life 50 years		ψ^0_{sus} [-]	0,75					
Factor for concrete	C25/30	ψ_c [-]	1,04					
	C30/37		1,08					
	C35/45		1,12					
	C40/50		1,15					
	C45/55		1,17					
	C50/60		1,19					
Concrete cone failure								
Factor for concrete cone failure for uncracked concrete		$k_{ucr,N}$	[-]	11				
Factor for concrete cone failure for cracked concrete		$k_{cr,N}$		7,7				
Edge distance		$C_{cr,N}$ [mm]	1,5h _{ef}					
Splitting failure								
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Edge distance		$C_{cr,sp}$ [mm]	2 • h _{ef}					
Spacing		$S_{cr,sp}$ [mm]	2 • C _{cr,sp}					

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Performances

Hammer drilling, Dustless drilling
Characteristic resistance for tension loads - rebar

Annex C 4

Table C7: Design method EN 1992-4

Characteristic values of resistance to tension load of threaded rod

Diamond core drilling								
Combined pullout and concrete cone failure in concrete C20/25								
Size			M8	M10	M12	M16	M20	M24
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,ucr}$	[N/mm ²]	9,5	9,0	9,0	7,5	6,5	6,0
Installation safety factor								
Dry, wet concrete	γ_{inst}	[-]	1,0					
Flooded hole	γ_{inst}	[-]	1,4					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	5,5	5,5	5,5	4,5	5,0	5,0
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	5,0	4,5	5,0	3,5	3,5	3,5
Installation safety factor								
Dry, wet concrete	γ_{inst}	[-]	1,0					
Flooded hole	γ_{inst}	[-]	1,4					
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,75					
Factor for concrete	C25/30	ψ_c	[-]	1,02				
	C30/37			1,04				
	C35/45			1,06				
	C40/50			1,07				
	C45/55			1,08				
	C50/60			1,09				
Concrete cone failure								
Factor for concrete cone failure for uncracked concrete	$k_{ucr,N}$	11						
Factor for concrete cone failure for cracked concrete	$k_{cr,N}$	7,7						
Edge distance	$c_{Cr,N}$	[mm]	1,5h _{ef}					
Splitting failure								
Size			M8	M10	M12	M16	M20	M24
Edge distance	$c_{Cr,sp}$	[mm]	2 • h _{ef}					
Spacing	$s_{Cr,sp}$	[mm]	2 • c _{Cr,sp}					

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Performances

Diamond core drilling

Characteristic resistance for tension loads - threaded rod

Annex C 5

Table C8: Design method EN 1992-4

Characteristic values of resistance to tension load of threaded socket

Diamond core drilling							
Combined pullout and concrete cone failure in concrete C20/25							
Size		M6	M8	M10	M12	M16	
Nominal external diameter of socket		M10	M12	M16	M20	M24	
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years							
Dry, wet concrete and flooded hole	$\tau_{Rk,ucr}$	[N/mm ²]	9,0	9,0	7,5	6,5	6,0
Installation safety factor							
Dry, wet concrete	γ_{inst}	[-]	1,0				
Flooded hole	γ_{inst}	[-]	1,4				
Characteristic bond resistance in cracked concrete for a working life of 50 years							
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	5,5	5,5	4,5	5,0	5,0
Characteristic bond resistance in cracked concrete for a working life of 100 years							
Dry, wet concrete and flooded hole	$\tau_{Rk,cr}$	[N/mm ²]	4,5	5,0	3,5	3,5	3,5
Installation safety factor							
Dry, wet concrete	γ_{inst}	[-]	1,0				
Flooded hole	γ_{inst}	[-]	1,4				
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,75				
Factor for concrete	C25/30	ψ_c	[-]	1,02			
	C30/37			1,04			
	C35/45			1,06			
	C40/50			1,07			
	C45/55			1,08			
	C50/60			1,09			
Concrete cone failure							
Factor for concrete cone failure for uncracked concrete		$k_{ucr,N}$	11				
Factor for concrete cone failure for cracked concrete		$k_{cr,N}$	7,7				
Edge distance		$c_{cr,N}$	[mm]	1,5h _{ef}			
Splitting failure							
Size							
Edge distance		$c_{cr,sp}$	[mm]	2 • h _{ef}			
Spacing		$s_{cr,sp}$	[mm]	2 • c _{cr,sp}			

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Diamond core drilling

Characteristic resistance for tension loads - threaded rod

Annex C 6

Table C9: Design method EN 1992-4
Characteristic values of resistance to tension load of rebar

Diamond core drilling									
Combined pullout and concrete cone failure in concrete C20/25									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years									
Dry, wet concrete and flooded hole		$\tau_{Rk,ucr}$	[N/mm ²]	8,0	8,0	7,5	7,5	6,5	5,5
Installation safety factor									
Dry, wet concrete		γ_{inst}	[-]	1,0					
Flooded hole		γ_{inst}	[-]	1,4					
Characteristic bond resistance in uncracked concrete for a working life of 50 years									
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$	[N/mm ²]	5,5	6,0	6,0	4,5	4,5	4,5
Characteristic bond resistance in uncracked concrete for a working life of 100 years									
Dry, wet concrete and flooded hole		$\tau_{Rk,cr}$	[N/mm ²]	5,0	5,0	5,5	3,5	3,0	3,5
Installation safety factor									
Dry, wet concrete		γ_{inst}	[-]	1,0					
Flooded hole		γ_{inst}	[-]	1,4					
Factor for influence of sustained load for a working life 50 years		ψ^0_{sus}	[-]	0,87					
Factor for concrete	C25/30	ψ_c	[-]	1,02					
	C30/37			1,04					
	C35/45			1,06					
	C40/50			1,07					
	C45/55			1,08					
	C50/60			1,09					
Concrete cone failure									
Factor for concrete cone failure for uncracked concrete		$k_{ucr,N}$	[-]	11					
Factor for concrete cone failure for cracked concrete		$k_{cr,N}$	[-]	7,7					
Edge distance		$C_{cr,N}$	[mm]	1,5h _{ef}					
Splitting failure									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	
Edge distance		$C_{cr,sp}$	[mm]	2 • h _{ef}					
Spacing		$S_{cr,sp}$	[mm]	2 • C _{cr,sp}					

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Performances

Diamond core drilling
Characteristic resistance for tension loads - rebar

Annex C 7

Table C10: Design method EN 1992-4

Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			M8	M10	M12	M16	M20	M24
Steel grade 4.6	$V_{Rk,s}$	[kN]	9	14	20	38	59	85
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade 4.8	$V_{Rk,s}$	[kN]	9	14	20	38	59	85
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 5.6	$V_{Rk,s}$	[kN]	11	17	25	47	74	106
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade 5.8	$V_{Rk,s}$	[kN]	11	17	25	47	74	106
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 8.8	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 10.9	$V_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]	1,5					
Stainless steel grade A2-70, A4-70	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade A4-80	$V_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	1,33					
High corrosion resistant steel grade 1.4529	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,25					
High corrosion resistant steel grade 1.4565	$V_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,56					
Characteristic resistance of group of fasteners								
Ductility factor $k_7 = 1,0$ for steel with rupture elongation $A_5 > 8\%$								
Steel failure with lever arm								
Size			M8	M10	M12	M16	M20	M24
Steel grade 4.6	$M^o_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade 4.8	$M^o_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 5.6	$M^o_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade 5.8	$M^o_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 8.8	$M^o_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade 10.9	$M^o_{Rk,s}$	[N.m]	37	75	131	333	649	1123
Partial safety factor	γ_{Ms}	[-]	1,50					
Stainless steel grade A2-70, A4-70	$M^o_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade A4-80	$M^o_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms}	[-]	1,33					
High corrosion resistant steel grade 1.4529	$M^o_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,25					
High corrosion resistant steel grade 1.4565	$M^o_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,56					
Concrete pryout failure								
Factor for resistance to pry-out failure		k_8	[-]	2				
Concrete edge failure								
Size			M8	M10	M12	M16	M20	M24
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24
Effective length of fastener	ℓ_f	[mm]	min (h_{ef} , 8 d_{nom})					

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Design according to EN 1992-4

Characteristic resistance for shear loads - threaded rod

Annex C 8

Table C11: Design method EN 1992-4

Characteristic values of resistance to shear load of threaded socket

Steel failure without lever arm							
Size			M6	M8	M10	M12	M16
Nominal external diameter of socket			M10	M12	M16	M20	M24
Steel grade 4.6	$V_{Rk,s}$	[kN]	5	9	14	20	38
Partial safety factor	γ_{Ms}	[-]	1,67				
Steel grade 4.8	$V_{Rk,s}$	[kN]	5	9	14	20	38
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 5.6	$V_{Rk,s}$	[kN]	6	11	17	25	47
Partial safety factor	γ_{Ms}	[-]	1,67				
Steel grade 5.8	$V_{Rk,s}$	[kN]	6	11	17	25	47
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 8.8	$V_{Rk,s}$	[kN]	8	15	23	34	63
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 10.9	$V_{Rk,s}$	[kN]	10	18	29	42	79
Partial safety factor	γ_{Ms}	[-]	1,5				
Stainless steel grade A2-70, A4-70	$V_{Rk,s}$	[kN]	7	13	20	30	55
Partial safety factor	γ_{Ms}	[-]	1,56				
Stainless steel grade A4-80	$V_{Rk,s}$	[kN]	8	15	23	34	63
Partial safety factor	γ_{Ms}	[-]	1,33				
High corrosion resistant steel grade 1.4529	$V_{Rk,s}$	[kN]	7	13	20	30	55
Partial safety factor	γ_{Ms}	[-]	1,25				
High corrosion resistant steel grade 1.4565	$V_{Rk,s}$	[kN]	7	13	20	30	55
Partial safety factor	γ_{Ms}	[-]	1,56				
Characteristic resistance of group of fasteners							
Ductility factor $k_7 = 1,0$ for steel with rupture elongation $A_5 > 8\%$							
Steel failure with lever arm							
Size			M6	M8	M10	M12	M16
Nominal external diameter of socket			M10	M12	M16	M20	M24
Steel grade 4.6	$M^o_{Rk,s}$	[N.m]	6	15	30	52	133
Partial safety factor	γ_{Ms}	[-]	1,67				
Steel grade 4.8	$M^o_{Rk,s}$	[N.m]	6	15	30	52	133
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 5.6	$M^o_{Rk,s}$	[N.m]	8	19	37	66	166
Partial safety factor	γ_{Ms}	[-]	1,67				
Steel grade 5.8	$M^o_{Rk,s}$	[N.m]	8	19	37	66	166
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 8.8	$M^o_{Rk,s}$	[N.m]	12	30	60	105	266
Partial safety factor	γ_{Ms}	[-]	1,25				
Steel grade 10.9	$M^o_{Rk,s}$	[N.m]	15	37	75	131	333
Partial safety factor	γ_{Ms}	[-]	1,50				
Stainless steel grade A2-70, A4-70	$M^o_{Rk,s}$	[N.m]	11	26	52	92	233
Partial safety factor	γ_{Ms}	[-]	1,56				
Stainless steel grade A4-80	$M^o_{Rk,s}$	[N.m]	12	30	60	105	266
Partial safety factor	γ_{Ms}	[-]	1,33				
High corrosion resistant steel grade 1.4529	$M^o_{Rk,s}$	[N.m]	11	26	52	92	233
Partial safety factor	γ_{Ms}	[-]	1,25				
High corrosion resistant steel grade 1.4565	$M^o_{Rk,s}$	[N.m]	11	26	52	92	233
Partial safety factor	γ_{Ms}	[-]	1,56				
Concrete pryout failure							
Factor for resistance to pry-out failure		k_8	[-]	2			
Concrete edge failure							
Size			M6	M8	M10	M12	M16
Nominal external diameter of socket			M10	M12	M16	M20	M24
Outside diameter of fastener	d_{nom}	[mm]	10	12	16	20	24
Effective length of fastener	ℓ_f	[mm]	$\min(h_{ef}, 8 d_{nom})$				

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Design according to EN 1992-4

Characteristic resistance for shear loads - threaded socket

Annex C 9

Table C12: Design method EN 1992-4
Characteristic values of resistance to shear load of rebar

Steel failure without lever arm									
Size				Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Rebar BSt 500 S		$V_{Rk,S}$	[kN]	14	22	31	55	86	135
Partial safety factor		γ_{Ms}	[-]	1,5					
Characteristic resistance of group of fasteners									
Ductility factor		$k_7 = 1,0$ for steel with rupture elongation $A_5 > 8\%$							

Steel failure with lever arm									
Size				Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Rebar BSt 500 S		M° _{Rk,S}	[N.m]	33	65	112	265	518	1013
Partial safety factor		γ _{Ms}	[-]	1,5					
Concrete pryout failure									
Factor for resistance to pry-out failure		k ₈	[-]	2					

Concrete edge failure								
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	25
Effective length of fastener	l_f	[mm]	$\min(h_{ef}, 8 d_{nom})$					

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Performances

Design according to EN 1992-4
Characteristic resistance for shear loads - rebar

Annex C 10

Table C13: Displacement of threaded rod under tension and shear load
Hammer drilling, dustless drilling

Size		M8	M10	M12	M16	M20	M24
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,030	0,024	0,026	0,026	0,022	0,023
$\delta_{N\infty}$	[mm/kN]	0,103	0,083	0,059	0,045	0,038	0,032
Cracked concrete							
δ_{N0}	[mm/kN]	0,056	0,044	0,058	0,063	0,044	0,035
$\delta_{N\infty}$	[mm/kN]	0,694	0,556	0,577	0,469	0,278	0,217
Shear load							
δ_{V0}	[mm/kN]	0,021	0,016	0,013	0,010	0,008	0,007
$\delta_{V\infty}$	[mm/kN]	0,031	0,024	0,020	0,015	0,012	0,010

Table C14: Displacement of threaded rod under tension and shear load
Diamond core drilling

Size		M8	M10	M12	M16	M20	M24
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,035	0,032	0,024	0,026	0,023	0,024
$\delta_{N\infty}$	[mm/kN]	0,106	0,086	0,063	0,048	0,038	0,031
Cracked concrete							
δ_{N0}	[mm/kN]	0,075	0,088	0,057	0,066	0,056	0,060
$\delta_{N\infty}$	[mm/kN]	0,629	0,547	0,348	0,287	0,200	0,159
Shear load							
δ_{V0}	[mm/kN]	0,021	0,016	0,013	0,010	0,008	0,007
$\delta_{V\infty}$	[mm/kN]	0,031	0,024	0,020	0,015	0,012	0,010

Table C15: Displacement of rebar under tension and shear load
Hammer drilling, dustless drilling

Size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,037	0,033	0,036	0,031	0,025	0,023
$\delta_{N\infty}$	[mm/kN]	0,126	0,113	0,081	0,053	0,043	0,031
Cracked concrete							
δ_{N0}	[mm/kN]	0,067	0,054	0,071	0,047	0,044	0,043
$\delta_{N\infty}$	[mm/kN]	0,820	0,630	0,660	0,372	0,272	0,266
Shear load							
δ_{V0}	[mm/kN]	0,020	0,016	0,013	0,010	0,008	0,006
$\delta_{V\infty}$	[mm/kN]	0,030	0,025	0,019	0,015	0,012	0,008

Table C16: Displacement of rebar under tension and shear load
Diamond core drilling

Size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,045	0,037	0,044	0,039	0,037	0,041
$\delta_{N\infty}$	[mm/kN]	0,116	0,091	0,068	0,049	0,038	0,041
Cracked concrete							
δ_{N0}	[mm/kN]	0,107	0,092	0,075	0,075	0,057	0,050
$\delta_{N\infty}$	[mm/kN]	0,609	0,459	0,343	0,287	0,204	0,144
Shear load							
δ_{V0}	[mm/kN]	0,020	0,016	0,013	0,010	0,008	0,006
$\delta_{V\infty}$	[mm/kN]	0,030	0,025	0,019	0,015	0,012	0,008

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Performances

Displacement for threaded rod and rebar

Annex C 11

Table C17: Seismic performance category C2 - Hammer drilling, Dustless drilling

Size		M12	M16
Tension load			
Steel failure			
See Annex C 1			
Characteristic resistance to pull-out for a working life of 50 years			
Dry, wet concrete and flooded hole	$\tau_{Rk,C2}$ [N/mm ²]	0,84	0,56
Characteristic resistance to pull-out for a working life of 100 years			
Dry, wet concrete and flooded hole	$\tau_{Rk,C2}$ [N/mm ²]	0,56	0,37
Installation safety factor			
Dry, wet concrete	γ_{inst}	[-]	1,2
Hammer drilling - flooded hole	γ_{inst}	[-]	1,2
Dustless drilling - flooded hole	γ_{inst}	[-]	1,4

Shear load			
Steel failure without lever arm			
Characteristic resistance grade 4.6	$V_{Rk,s,C2}$	[kN]	13,6
Partial safety factor	γ_{Ms}	[-]	1,67
Characteristic resistance grade 5.8	$V_{Rk,s,C2}$	[kN]	17,0
Partial safety factor	γ_{Ms}	[-]	1,25
Characteristic resistance grade 8.8	$V_{Rk,s,C2}$	[kN]	27,1
Partial safety factor	γ_{Ms}	[-]	1,25
Characteristic resistance grade 10.9	$V_{Rk,s,C2}$	[kN]	Not qualified
Partial safety factor	γ_{Ms}	[-]	
Characteristic resistance A2-70, A4-70	$V_{Rk,s,C2}$	[kN]	23,8
Partial safety factor	γ_{Ms}	[-]	1,56
Characteristic resistance A4-80	$V_{Rk,s,C2}$	[kN]	27,1
Partial safety factor	γ_{Ms}	[-]	1,33
Characteristic resistance 1.4529	$V_{Rk,s,C2}$	[kN]	25,7
Partial safety factor	γ_{Ms}	[-]	1,25
Characteristic resistance 1.4565	$V_{Rk,s,C2}$	[kN]	25,7
Partial safety factor	γ_{Ms}	[-]	1,56
Characteristic shear load resistance $V_{Rk,s,eq}$ in the Table C8 shall be multiplied by following reduction factor for hot-dip galvanized commercial standard rods			
Reduction factor for hot-dip galvanized rods	$\alpha_{v,h-dg,c2}$	[-]	0,46
Factor for annular gap	α_{gap}	[-]	0,5

Table C18: Displacement under tensile and shear load - seismic category C2

Size		M12	M16
$\delta_{N,C2(50\%)}$	[mm]	0,13	0,12
$\delta_{N,C2(100\%)}$	[mm]	0,24	0,17
$\delta_{V,C2(50\%)}$	[mm]	4,68	4,07
$\delta_{V,C2(100\%)}$	[mm]	8,02	6,76

The anchor shall be used with minimum rupture elongation after fracture $A_5 \geq 9\%$.

Note: Threaded sockets and rebars are not qualified for seismic design

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Performances

Hammer drilling, Dustless drilling
Seismic performance category C2

Annex C 12

Characteristic resistance to combined pull-out and concrete failure $\tau_{Rk,fi}(\theta)$ under fire exposure for threaded rods for hammer or dustless drilling

The characteristic resistance to combined pull-out and concrete failure under fire $\tau_{Rk,fi,p}(\theta)$ shall be determined according to following equation:

$$\tau_{Rk,fi,p}(\theta) = k_{fi,p}(\theta) \cdot \tau_{Rk,cr}$$

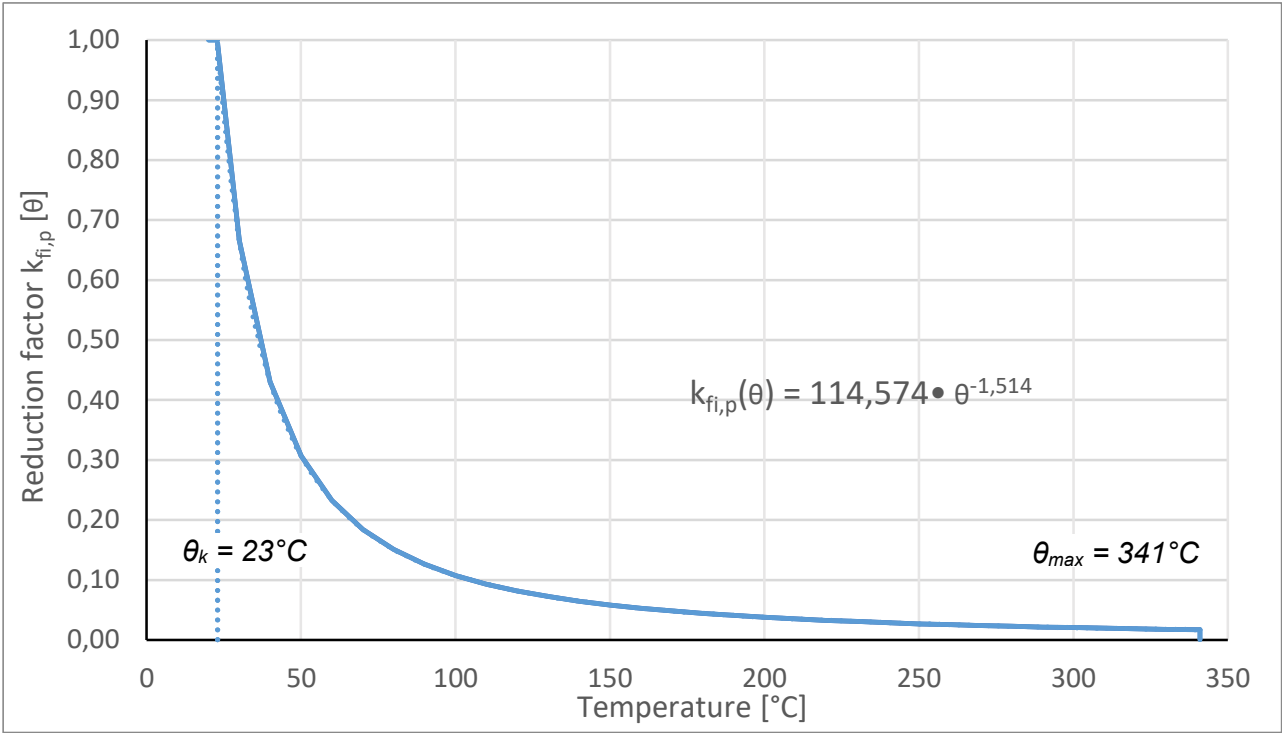
where:

$$\begin{aligned} k_{fi,p}(\theta) &= 1 && \text{for } \theta < \theta_k \\ k_{fi,p}(\theta) &= 114,574 \cdot \theta^{-1,514} \leq 1 && \text{for } \theta \leq \theta_{max} \\ k_{fi,p}(\theta) &= 0 && \text{for } \theta > \theta_{max} \end{aligned}$$

$$\begin{aligned} \theta_k &= 23^{\circ}\text{C} \\ \theta_{max} &= 341^{\circ}\text{C} \end{aligned}$$

- $\tau_{Rk,fi,p}$ = characteristic bond resistance for cracked concrete under fire exposure for given temperature (θ)
- $\tau_{Rk,cr}$ = characteristic bond resistance for cracked concrete for concrete strength class C20/25
- $k_{fi,p}(\theta)$ = reduction factor for bond resistance under fire conditions

Figure C1: Reduction factor $k_{fi,p}(\theta)$



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Performances Bond resistance under fire conditions	

Table C19: Steel failure - Characteristic resistance under tension load under fire conditions for threaded rod

Size			M8	M10	M12	M16	M20	M24
Steel grade: 4.6; 4.8; 5.6; 5.8; 8.8; 10.9	$N_{Rk,s,fi}(30)$	[kN]	0,37	0,87	1,69	3,14	4,90	7,06
	$N_{Rk,s,fi}(60)$	[kN]	0,33	0,75	1,26	2,36	3,68	5,30
	$N_{Rk,s,fi}(90)$	[kN]	0,26	0,58	1,10	2,04	3,19	4,59
	$N_{Rk,s,fi}(120)$	[kN]	0,18	0,46	0,84	1,57	2,45	3,53
Stainless steel grade: A2-70; A4-70; A4-80 High corrosion resistant steel grade: 1.4529; 1.4565	$N_{Rk,s,fi}(30)$	[kN]	0,73	1,45	2,53	4,71	7,35	10,59
	$N_{Rk,s,fi}(60)$	[kN]	0,59	1,16	2,11	3,93	6,13	8,83
	$N_{Rk,s,fi}(90)$	[kN]	0,44	0,93	1,69	3,14	4,90	7,06
	$N_{Rk,s,fi}(120)$	[kN]	0,37	0,81	1,35	2,51	3,92	5,65

Table C23: Steel failure - Characteristic resistance under tension load under fire conditions for rebar

Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Rebar BSt 500 S	$N_{Rk,s,fi}(30)$	[kN]	0,50	1,18	2,26	4,02	6,28	9,82
	$N_{Rk,s,fi}(60)$	[kN]	0,45	1,02	1,70	3,02	4,71	7,36
	$N_{Rk,s,fi}(90)$	[kN]	0,35	0,79	1,47	2,61	4,08	6,38
	$N_{Rk,s,fi}(120)$	[kN]	0,25	0,63	1,13	2,01	3,14	4,91

Table C20: Steel failure - Characteristic resistance under shear load under fire conditions for threaded rod

Size			M8	M10	M12	M16	M20	M24
Steel grade: 4.6; 4.8; 5.6; 5.8; 8.8; 10.9	$V_{Rk,s,fi}(30)$	[kN]	0,37	0,87	1,69	3,14	4,90	7,06
	$V_{Rk,s,fi}(60)$	[kN]	0,33	0,75	1,26	2,36	3,68	5,30
	$V_{Rk,s,fi}(90)$	[kN]	0,26	0,58	1,10	2,04	3,19	4,59
	$V_{Rk,s,fi}(120)$	[kN]	0,18	0,46	0,84	1,57	2,45	3,53
	$M^0_{Rk,s,fi}(30)$	[N.m]	0,4	1,1	2,6	6,7	13,0	22,5
	$M^0_{Rk,s,fi}(60)$	[N.m]	0,3	1,0	2,0	5,0	9,7	16,8
	$M^0_{Rk,s,fi}(90)$	[N.m]	0,3	0,7	1,7	4,3	8,4	14,6
	$M^0_{Rk,s,fi}(120)$	[N.m]	0,2	0,6	1,3	3,3	6,5	11,2
Stainless steel grade: A2-70; A4-70; A4-80 High corrosion resistant steel grade: 1.4529; 1.4565	$V_{Rk,s,fi}(30)$	[kN]	0,73	1,45	2,53	4,71	7,35	10,59
	$V_{Rk,s,fi}(60)$	[kN]	0,59	1,16	2,11	3,93	6,13	8,83
	$V_{Rk,s,fi}(90)$	[kN]	0,44	0,93	1,69	3,14	4,90	7,06
	$V_{Rk,s,fi}(120)$	[kN]	0,37	0,81	1,35	2,51	3,92	5,65
	$M^0_{Rk,s,fi}(30)$	[N.m]	0,7	1,9	3,9	10,0	19,5	33,7
	$M^0_{Rk,s,fi}(60)$	[N.m]	0,6	1,5	3,3	8,3	16,2	28,1
	$M^0_{Rk,s,fi}(90)$	[N.m]	0,4	1,2	2,6	6,7	13,0	22,5
	$M^0_{Rk,s,fi}(120)$	[N.m]	0,4	1,0	2,1	5,3	10,4	18,0

Table C21: Steel failure - Characteristic resistance under shear load under fire conditions for rebar

Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Rebar BSt 500 S	$V_{Rk,s,fi}(30)$	[kN]	0,50	1,18	2,26	4,02	6,28	9,82
	$V_{Rk,s,fi}(60)$	[kN]	0,45	1,02	1,70	3,02	4,71	7,36
	$V_{Rk,s,fi}(90)$	[kN]	0,35	0,79	1,47	2,61	4,08	6,38
	$V_{Rk,s,fi}(120)$	[kN]	0,25	0,63	1,13	2,01	3,14	4,91
	$M^0_{Rk,s,fi}(30)$	[N.m]	0,6	1,8	4,1	9,7	18,9	36,8
	$M^0_{Rk,s,fi}(60)$	[N.m]	0,5	1,5	3,1	7,2	14,1	27,6
	$M^0_{Rk,s,fi}(90)$	[N.m]	0,4	1,2	2,6	6,3	12,3	23,9
	$M^0_{Rk,s,fi}(120)$	[N.m]	0,3	0,9	2,0	4,8	9,4	18,4

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Performances
Bond resistance under fire conditions

Annex C 14