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European Technical Assessment

ETA 16/0300 of 12/04/2016

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague					
Trade name of the construction product	Essve chemical anchor Seismic Essve chemical anchor ICE Essve chemical anchor Slow steel bonded anchor				
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and non-cracked concrete				
Manufacturer	ESSVE Produkter AB Sidensvansvägen 10 192 55 Sollentuna Sweden				
Manufacturing plant	Essve Produkter AB Plant No. 353				
This European Technical Assessment contains	23 pages including 19 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	ETAG 001-Part 1 and Part 5, edition 2013, used as European Assessment Document (EAD)				

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1. Technical description of the product

The Essve chemical anchor Seismic, ICE (faster curing time) and Slow (extended processing time) with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rod or rebar.

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 anchor is intended to be used with embedment depth from 8 diameters to 20 diameters.

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. 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 for tension loads - threaded rod	See Annex C 1
Characteristic resistance for tension loads - rebar	See Annex C 2
Characteristic resistance for shear loads - threaded rod	See Annex C 3
Characteristic resistance for shear loads - rebar	See Annex C 4
Characteristic resistance for tension loads - threaded rod	See Annex C 5
Characteristic resistance for tension loads - rebar	See Annex C 6
Characteristic resistance for shear loads - threaded rod	See Annex C 7
Characteristic resistance for shear loads - rebar	See Annex C 8
Displacement for threaded rod	See Annex C 9
Displacement for rebar	See Annex C 10
Characteristic resistance for tension and shear loads for seismic design - threaded rod	See Annex C 11

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.3 Hygiene, health and environment (BWR 3)

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

3.4 Safety in use (BWR 4)

For basic requirement safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.5 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.6 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

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

5.1 Tasks of the manufacturer

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European Technical Assessment.

The manufacturer may only use raw materials stated in the technical documentation of this European Technical Assessment.

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 Technical and Test Institute for Construction Prague.² The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

The manufacturer shall, on the basis of a contract, involve a body which is notified for the tasks referred to in section 4 in the field of anchors in order to undertake the actions laid down in section 5.2. For this purpose, the control plan referred to in this section and section 5.2 shall be handed over by the manufacturer to the notified body involved.

The manufacturer shall make a declaration of performance, stating that the construction product is in conformity with the provisions of this European Technical Assessment.

¹ Official Journal of the European Communities L 254 of 08.10.1996

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.

5.2 Tasks of the notified bodies

The notified body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

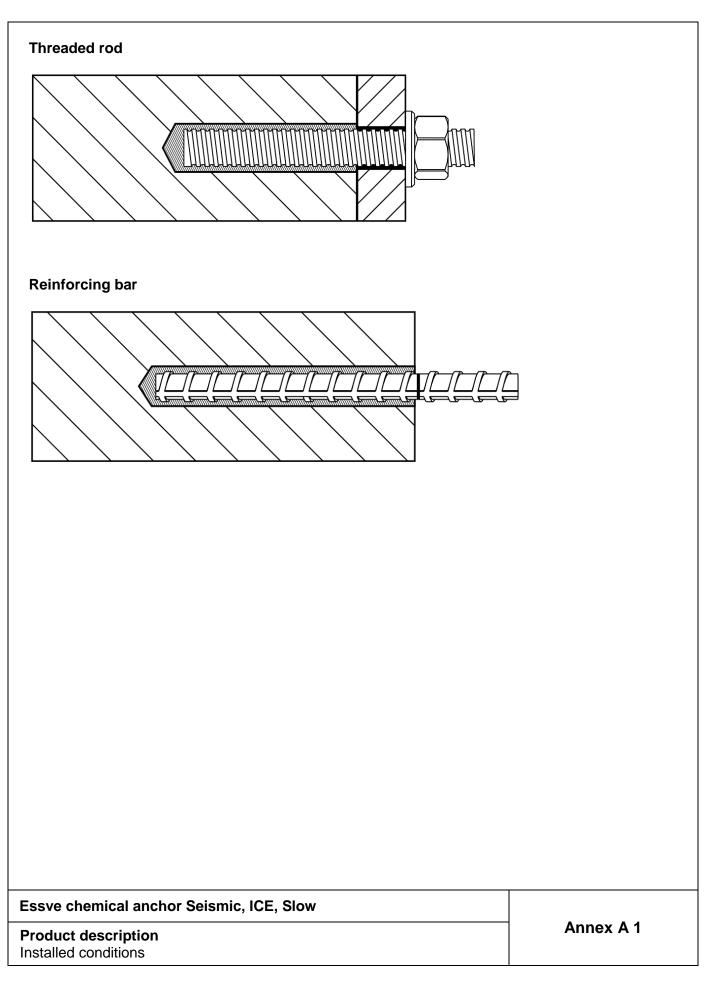
The notified certification body involved by the manufacturer shall issue a certificate of constancy of performance of the product stating the conformity with the provisions of this European Technical Assessment.

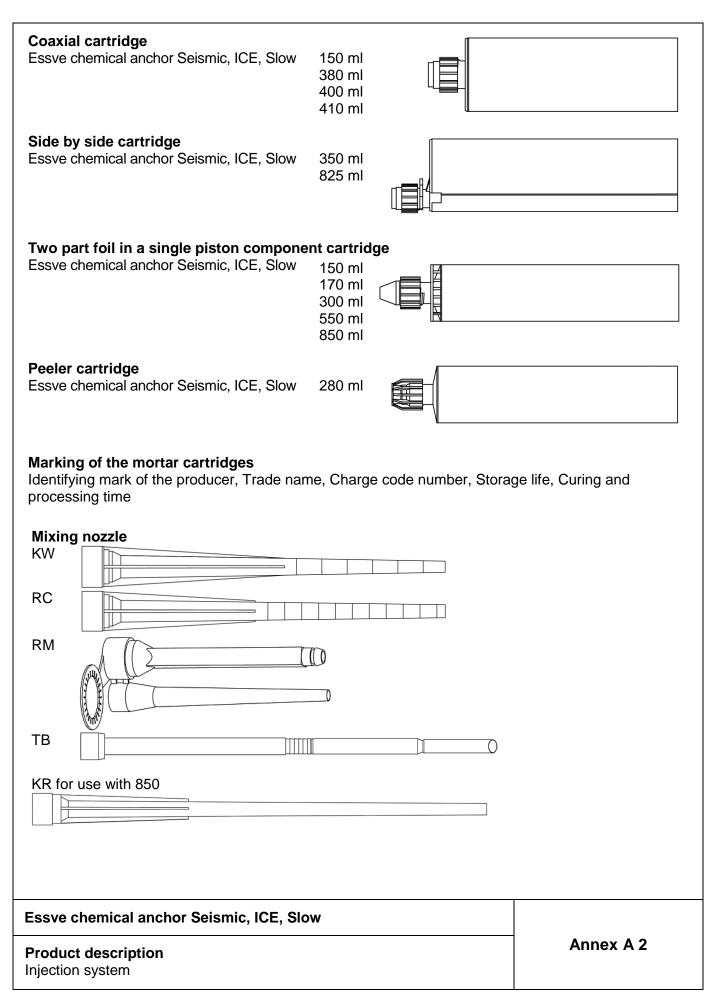
In cases where the provisions of the European Technical Assessment and its control plan are no longer fulfilled the notified body shall withdraw the certificate of constancy of performance and inform Technical and Test Institute for Construction Prague without delay.

Issued in Prague on 12.04.2016

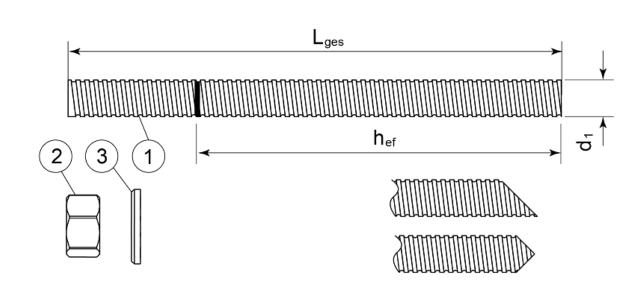
By

Ing. Mária Schaan Head of the Technical Assessment Body





Threaded rod M8, M10, M12, M16, M20, M24, M27, M30



Standard commercial threaded rod with marked embedment depth

Part	Designation	Material				
	, zinc plated ≥ 5 μm acc. to EN ISO					
	, Hot-dip galvanized \geq 40 µm acc. t		0684 or			
Steel,	, zinc diffusion coating ≥ 15 μm ac		262			
1	Anchor rod	Steel, EN 10087 or EN 10. Property class 4.6, 5.8, 8.8				
	Hexagon nut		·			
2	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				
Stain	less steel					
1	Anchor rod	Material: A2-70, A4-70, A4	I-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	According to threaded rod			
High	corrosion resistant steel					
1	Anchor rod	Material: 1.4529, 1.4565, I	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				
*Galva	anized rod of high strength are sensi	tive to hydrogen induced brittle	failure			
sve c	hemical anchor Seismic, ICE, Slov	N				
roduct	d description d rod and materials		Annex A 3			

Rebar Ø8, Ø10, Ø12, Ø16, Ø20, Ø25, Ø32

Standard commercial reinforcing bar with marked embedment depth

Product form	Bars and de	-coiled rods	
Class	Class		
Characteristic yield strength fyk or fo	_{D,2k} (MPa)	400 t	o 600
Minimum value of $k = (f_t/f_y)_k$	≥ 1,08	≥ 1,15 < 1,35	
Characteristic strain at maximum for	≥ 5,0	≥ 7,5	
Bendability		Bend/Re	bend test
Maximum deviation from nominal	Nominal bar size (mm)		
mass (individual bar) (%)	≤ 8	±6,0	
>8		±4,5	
Bond: Minimum relative rib area,	Nominal bar size (mm)		
f _{R,min}	0,0	40	
	> 12	0,0	56

Essve chemical anchor Seismic, ICE, Slow

Product description Rebars and materials Annex A 4

Specifications of intended use

Anchorages subject to:

- Static and quasi-static load.
- Seismic performance category C1: threaded rod size M10, M12, M16, M20, M24

Base materials

- Non-cracked concrete.
- Cracked and non-cracked concrete for threaded rod size M10, M12, M16, M20, M24
- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according EN 206-1:2000-12.

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

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

Use categories:

• Category 2 – installation in dry or wet concrete or in flooded hole.

Design:

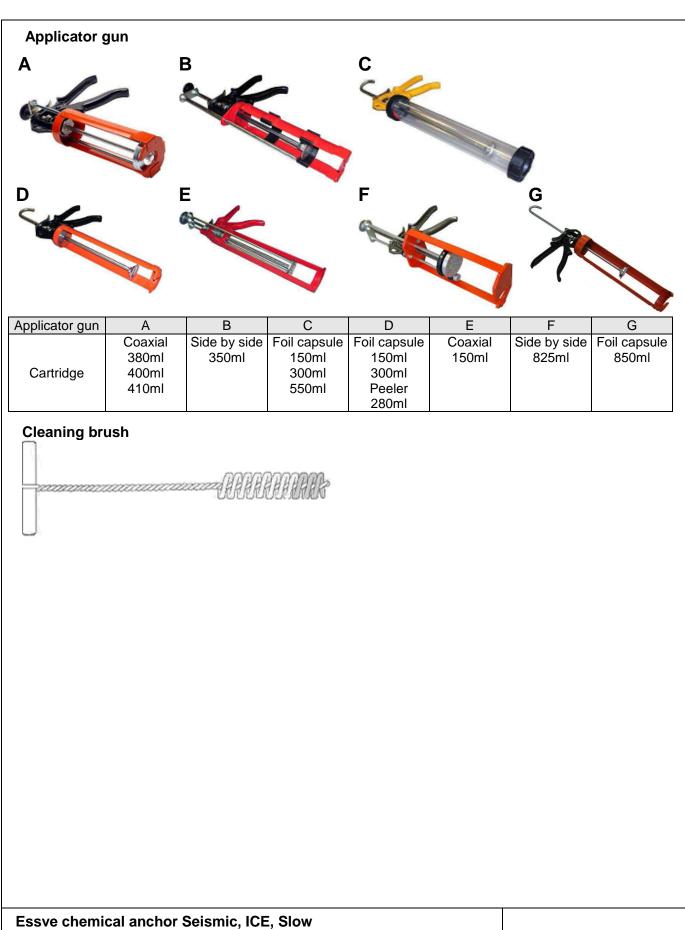
- The anchorages are designed in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors" under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.
- Anchorages under seismic actions (cracked concrete) have to be designed in accordance with EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action".

Installation:

- Dry or wet concrete or flooded hole.
- Hole drilling by hammer drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Essve chemical anchor Seismic, ICE, Slow

Intended use Specifications Annex B 1



Intended use Applicator guns Cleaning brush

Installation instructions

- 1. Drill the hole to the correct diameter and depth using a rotary percussion drilling machine.
- 2. Thoroughly clean the hole in the following sequence using the ESSVE Brush with the required extensions and an ESSVE blow pump:

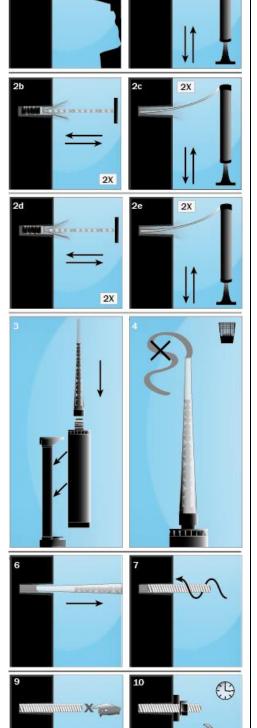
Blow Clean x2. Brush Clean x2. Blow Clean x2. Brush Clean x2. Blow Clean x2.

Remove standing water from the hole prior to cleaning to achieve maximum performance.

- 3. Select the appropriate static mixer nozzle for the installation, open the cartridge/cut foil pack and screw nozzle onto the mouth of the cartridge. Insert the cartridge into a good quality applicator (gun).
- 4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.
- 5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and fit the correct resin stopper to the other end.
- 6. Insert the mixer nozzle (or the extension tube with resin stopper when necessary) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn. Fill the hole to approximately ½ to ¾ full and withdraw the nozzle completely.
- 7. Insert the clean threaded bar, free from oil or other release agents, to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.
- 8. Excess resin will be expelled from the hole evenly around the steel element showing that the hole is full.
- 9. Leave the anchor to cure.

Do not disturb the anchor until the appropriate loading time has elapsed depending on the substrate conditions and ambient temperature.

 The excess resin should be removed from around the mouth of the hole. Attach the fixture and tighten the nut to the recommended torque.
 Do not overtighten.



2X

Essve chemical anchor Seismic, ICE, Slow

Intended use Installation procedure Annex B 3

P

Size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal drill hole diameter	$\operatorname{Ød}_0$	[mm]	10	12	14	18	22	26	30	35
Diameter of cleaning brush	db	[mm]	14	14	20	20	29	29	40	40
Torque moment	Tinst	[Nm]	10	20	40	80	150	200	240	275
h _{ef,min} = 8d										
Depth of drill hole	ho	[mm]	64	80	96	128	160	192	216	240
Minimum edge distance	Cmin	[mm]	35	40	50	65	80	96	110	120
Minimum spacing	Smin	[mm]	35	40	50	65	80	96	110	120
Minimum thickness of member	h _{min}	[mm]	h _{ef} +	+ 30 mn	n ≥ 100	mm		h _{ef} +	- 2d₀	
h _{ef,max} = 20d										
Depth of drill hole	h ₀	[mm]	160	200	240	320	400	480	540	600
Minimum edge distance	Cmin	[mm]	80	100	120	160	200	240	270	300
Minimum spacing	Smin	[mm]	80	100	120	160	200	240	270	300
Minimum thickness of member	h _{min}	[mm]	h _{ef} +	- 30 mn	n ≥ 100	mm		h _{ef} +	- 2d ₀	

Table B2: Installation parameters of rebar

Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Nominal drill hole diameter	Ød ₀	[mm]	12	14	16	20	25	32	40
Diameter of cleaning brush	db	[mm]	14	14	19	22	29	40	42
h _{ef,min} = 8d									
Depth of drill hole	ho	[mm]	64	80	96	128	160	200	256
Minimum edge distance	Cmin	[mm]	35	40	50	65	80	100	130
Minimum spacing	Smin	[mm]	35	40	50	65	80	100	130
Minimum thickness of member	h _{min}	[mm]	h _{ef}	+ 30 mn	n ≥ 100 r	nm	h _{ef} + 2d ₀		
h _{ef,max} = 20d									
Depth of drill hole	ho	[mm]	160	200	240	320	400	500	640
Minimum edge distance	Cmin	[mm]	80	100	120	160	200	250	320
Minimum spacing	Smin	[mm]	80	100	120	160	200	250	320
Minimum thickness of member	h _{min}	[mm]	h _{ef}	+ 30 mn	n ≥ 100 r	nm		hef + 2do	

Table B3: Cleaning

All diameters
- 2 x blowing
- 2 x brushing
- 2 x blowing
- 2 x brushing
- 2 x blowing

Table B4: Minimum curing time

chemical anchor Seismic		
Application temperature	Processing time	Load time
+5 to +10°C	10 mins	145 mins
+10 to +15°C	8 mins	85 mins
+15 to +20°C	6 mins	75 mins
+20 to +25°C	5 mins	50 mins
+25 to +30°C	4 mins	40 mins

Processing time refers to the highest temperature in the range. Load time refers to the lowest temperature in the range. Cartridge must be conditioned to a minimum +5°C.

chemical anchor ICE		
Application temperature	Processing time	Load time
-10 to -5°C	50 mins	12 hours
-5 to 0°C	15 mins	100 mins
0 to +5°C	10 mins	75 mins
+5 to +20°C	5 mins	50 mins
+20°C	100 second	20 mins

Processing time refers to the highest temperature in the range. Load time refers to the lowest temperature in the range. Cartridge must be conditioned to a minimum 0°C.

Essve chemical anchor Seismic, ICE, Slow

Intended use

Installation parameters Curing time

chemical anchor Slow		
Application temperature	Processing time	Load time
+15 to +20°C	15 mins	5 hours
+20 to +25°C	10 mins	145 mins
+25 to +30°C	7.5 mins	85 mins
+30 to +35°C	5 mins	50 mins
+35 to +40°C	3.5 mins	40 mins

Processing time refers to the highest temperature in the range. Load time refers to the lowest temperature in the range. Cartridge must be conditioned to a minimum +15°C.



		Mo	M10	M11) M	16	M20	M2/	M27	M30
No										224
		15	23	54	0.			141	104	224
		18	20	12	7			177	230	281
		10	29	42	1			177	230	201
		29	46	67	12	<u> </u>		282	367	449
		20	40	07	12			202	007	440
		37	58	84	15	<i>,</i>		353	459	561
		•.		• •						
		26	41	59	11			247	321	393
	[-]									
	[kN]	29	46	67	12	26	196	282	367	449
γ _{Ms} ¹⁾	[-]		•							
N _{Rk,s}	[kN]	26	41	59	11	0	172	247	321	393
γMs ¹⁾	[-]		•			1,50)			
N _{Rk,s}	[kN]	26	41	59	11	0	172	247	321	393
γMs ¹⁾	[-]					1,87	7			
one failu	ıro in r	on-c	rackod	cond	roto	C20	/25			
								M2/	M27	M30
non-cra	ckod c	onci								11130
				25	0.5	0	0 5	0	C F	E E
	-	-	10 8	9,5			8,5	8		5,5
•			0	7 -			0.5			1%
			8,5	7,5	1			5,5		
γMc ¹⁾	1					2	,			
Ψc	[-]						1			
one failu	ure in c	crack	ed con	crete	C20/	25				
							116	M20		124
cracked	l conci	rete								
			4.5	4	15	4	15	4		4
	-	-	1,0		1,0				l	•
			4.5	4	15	1		4		4
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			M8 N	/10 I	M12	M16	M20) M24	M27	M30
C cr,sp	[mn	n]	M8 N	/10 I	M12		5h _{ef}) M24	M27	M30
Ccr,sp Scr,sp	[mn [mn	-	M8 N	/10 I	M12	1,) M24	M27	M30
		n]	M8 N	/10 I	M12	1, 3,	5h _{ef}) M24	M27	M30
Scr,sp	[mn	n]	<u>M8</u> N	/10 I	M12	1, 3,	5h _{ef} 0h _{ef}) M24	M27	M30
S cr,sp γMsp ¹⁾	[mn [-]	n]	M8 N	/10 I	M12	1, 3,	5h _{ef} 0h _{ef}	0 M24	M27	M30
Scr,sp γMsp ¹⁾	[mn [-]	n]	<u>M8</u> N	110 I	M12	1, 3,	5h _{ef} 0h _{ef}	0 M24	M27	M30
S _{cr,sp} γ _{Msp} ¹⁾	[mn [-]	n]	<u>M8</u> N	110 I	M12	1, 3,	5h _{ef} 0h _{ef}	0 M24	M27	M30
S _{cr,sp} γ _{Msp} ¹⁾	[mn [-]	n]	M8 N	110	M12	1, 3,	5h _{ef} 0h _{ef}) M24	M27	M30
$\frac{S_{cr,sp}}{\gamma_{Msp}^{1)}}$ included ncluded	[mn [-]	n]	M8 N	110	M12	1, 3,	5h _{ef} 0h _{ef}) M24	M27	M30
S _{cr,sp} γ _{Msp} ¹⁾	[mn [-]	n]	M8 N	110	M12	1, 3,	5h _{ef} 0h _{ef}			
$\frac{S_{cr,sp}}{\gamma_{Msp}^{1)}}$ included ncluded	[mn [-]	n]	M8 N	110	M12	1, 3,	5h _{ef} 0h _{ef}		Anne	
	NRk,s γMs ¹) NR γMc ¹) TRk γMc ¹) Uc One failu	$\begin{array}{c c c c c c c c } \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline N_{Rk,s} & [kN] \\ \hline \gamma_{Ms}^{1)} & [-] \\ \hline \hline ne \ failure \ in \ r \\ \hline \hline non-cracked \ concluster \\ \hline \hline \tau_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline \hline \hline v_{C} & [-] \\ \hline \hline \hline \hline cracked \ concluster \\ \hline \hline \tau_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline v_{C} & [-] \\ \hline \hline \hline \hline v_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline \tau_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline v_{C} & [-] \\ \hline \hline \hline v_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline r_{Rk} & [N/mi \\ \hline \gamma_{Mc}^{1)} & [-] \\ \hline \hline v_{Rk} & [N/mi \\ \hline \hline \gamma_{Rk} & [N/mi \\ \hline \hline \hline v_{Rk} & [N/mi \\ \hline v_{Mc}^{1)} & [-] \\ \hline \hline \hline v_{Rk} & [N/mi \\ \hline v_{Mc}^{1)} & [-] \\ \hline \hline v_{Rk} & [N/mi \\ \hline v_{Mc}^{1)} & [-] \\ \hline \hline v_{Rk} & [N/mi \\ \hline v_{Mc}^{1)} & [-] \\ \hline \hline v_{Rk} & [N/mi \\ v_{Rk} & [N/mi \\$	M8 NRk,s [kN] 15 γMs^{11} [-] NRk,s [kN] 18 γMs^{11} [-] NRk,s [kN] 29 γMs^{11} [-] NRk,s [kN] 29 γMs^{11} [-] NRk,s [kN] 29 γMs^{11} [-] NRk,s [kN] 26 γMs^{11} [-] NRk,s [kN] 29 γMs^{11} [-] NRk,s [kN] 26 γMs^{11} [-] D P P NRk,s [kN] 26 P P γMc^{11} [-] P P P Ome failure in cracked concrete P<	M8 M10 NRk,s [kN] 15 23 γMs^{11} [-]	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	M8 M10 M12 M1 NRk,s [kN] 15 23 34 6 γMs^{1} [-]	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\begin{array}{ c c c c c c c c } \hline M8 & M10 & M12 & M16 & M20 \\ \hline N_{Rk,s} & [kN] & 15 & 23 & 34 & 63 & 98 \\ \hline \gamma_{M5}^{11} & [-] & & & & & & & & & & & & & & & & & & &$	M8 M10 M12 M16 M20 M24 NRk.s [kN] 15 23 34 63 98 141 γMs^{11} [-] 200 123 177 γMs^{11} [-] 200 123 177 γMs^{11} [-] - 1,50 106 282 γMs^{11} [-] - 1,33 172 247 γMs^{11} [-] - 1,87 100 172 247 γMs^{11} [-] - 1,60 110 172 247 γMs^{11} [-] - 1,60 172 247 γMs^{11} [-] - 1,60 172 247 γMs^{11} [-] - 1,50	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$

Table C1: Design method TR 029 Characteristic values of resistance to tension load of threaded rod

Characteristic resistance for tension loads - threaded rod

Table C2: Design method TR 029 Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic res	sistance								
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	N _{Rk,s}	[kN]	28	43	62	111	173	270	442
Partial safety factor	$\gamma Ms^{1)}$	[-]				1,4			

Combined pullout and concrete	cone failu	ire in non-	cracke	d conc	rete C	20/25			
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Characteristic bond resistance	in non-cra	cked cond	crete						
Dry and wet concrete	τRk	[N/mm ²]	11	9,5	9,5	9	8,5	8,5	5,5
Partial safety factor	γMc ¹⁾	[-]				1,8 ²⁾			
Flooded hole	τrk	[N/mm ²]	11	9,5	9,5	9	8,5	8,5	5,5
Partial safety factor	γ _{Mc} ¹⁾	[-]				2,1 ³⁾			
Factor for concrete C50/60	Ψc	[-]				1			

Splitting failure									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Edge distance	C _{cr,sp}	[mm]				1,5h _{ef}			
Spacing	S _{cr,sp}	[mm]				3,0h _{ef}			
Partial safety factor	$\gamma_{Msp}^{1)}$	[-]				1,8			

¹⁾ In absence of national regulations

²⁾ The partial safety factor $\gamma_2=1,2$ is included ³⁾ The partial safety factor $\gamma_2=1,4$ is included

Essve chemical anchor Seismic, ICE, Slow

Performances Design according to TR 029 Characteristic resistance for tension loads - rebar

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	V _{Rk,s}	[kN]	7	12	17	31	49	71	92	112
Partial safety factor	<u>V Rk,s</u> γMs ¹⁾	[KIN] [-]	1	12	17	<u> </u>		11	92	112
Steel grade 5.8	VRk,s	[kN]	9	15	21	39	61	88	115	140
Partial safety factor	<u>V Rk,s</u> γMs ¹⁾	[/inj	9	15	21	<u> </u>		00	115	140
Steel grade 8.8	۲MS / VRk,s	[kN]	15	23	34	63	98	141	184	224
Partial safety factor	γMs ¹⁾	[-]	13	23	54	1,2		141	104	224
Steel grade 10.9	VRk,s	[kN]	18	29	42	79	123	177	230	281
Partial safety factor	γMs ¹⁾	[-]	10	23	72	1,		177	230	201
Stainless steel grade A2-70, A4-70	VRk,s	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	γMs ¹⁾	[-]	10	20	50	1,		124	101	130
Stainless steel grade A4-80	V _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
Partial safety factor	γ _{Ms} ¹⁾	[-]	15	25	54	1,:		141	104	224
Stainless steel grade 1.4529	VRk,s	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	γMs ¹⁾	[-]	15	20	50	1,2		124	101	130
Stainless steel grade 1.4565	V _{Rk,s}	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	<u>ν Rk,s</u> γMs ¹⁾	[-]	10	20	50	1,		124	101	130
	YIVIS '	LJ				1,				
Steel failure with lever arm			MO	M40	M40	MAC	M00	MOA	M07	MOO
Size	Mo	[N m]	M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	M ^o _{Rk,s}	[N.m]	15	30	52	133	260	449	666	900
Partial safety factor	γ _{Ms} ¹⁾	[-]	40	07	00	1,6		504	000	4405
Steel grade 5.8	M ^o Rk,s	[N.m]	19	37	66	166	325	561	832	1125
Partial safety factor	γMs ¹⁾	[-]			10-	1,2			1000	
Steel grade 8.8	M ^o Rk,s	[N.m]	30	60	105	266	519	898	1332	1799
Partial safety factor	γMs ¹⁾	[-]				1,2				
Steel grade 10.9	M ^o Rk,s	[N.m]	37	75	131	333	649	1123	1664	2249
Partial safety factor	γMs ¹⁾	[-]				1,5				
Stainless steel grade A2-70, A4-70	M ^o Rk,s	[N.m]	26	52	92	233	454	786	1165	1574
Partial safety factor	γMs ¹⁾	[-]			1	1,5				
Stainless steel grade A4-80	M ^o Rk,s	[N.m]	30	60	105	266	519	898	1332	1799
Partial safety factor	γMs ¹⁾	[-]			1	1,3		1		
Stainless steel grade 1.4529	$M^{o}_{Rk,s}$		26	52	92	233		786	1165	1574
Partial safety factor	γMs ¹⁾	[-]				1,2		1		
Stainless steel grade 1.4565	$M^{o}_{Rk,s}$	[N.m]	26	52	92	233	454	786	1165	1574
Partial safety factor	γMs ¹⁾	[-]				1,5	56			
Concrete pryout failure										
Factor <i>k</i> from TR 029						2)			
Design of bonded anchors, Part 5.2.3										
Partial safety factor	γMp ¹⁾	[-]				1,	5			
Concrete edge failure					-					
Size			M8	M10	M12	M16	M20	M24	M27	M30
See section 5.2.3.4 of Technical Rep	ort TR 02	29 for th	ne Des	sian of	Bonde	ed Anc	hors			
Partial safety factor	γ _{Mc} ¹⁾	[-]		5		1,				
¹⁾ In absence of national regulations	YIVIC /		1			ι,	<u> </u>			
· in absence of national regulations										
							<u> </u>			
sve chemical anchor Seismic,	ICE, SIC	w								
rformanaac										-
									Anne	ex C
erformances esign according to TR 029 naracteristic resistance for shear I			- al						Anne	ex C

Table C3: Design method TR 029 Characteristic values of resistance to shear load of threaded rod

Table C4: Design method TR 029

Characteristic values of resistance to shear load of rebar

Steel failure without lever arm									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	14	22	31	55	86	135	221
Partial safety factor	$\gamma Ms^{1)}$	[-]				1,5			

Steel failure with lever arm									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	M ^o Rk,s	[N.m]	33	65	112	265	518	1013	2122
Partial safety factor	γ _{Ms} 1)	[-]				1,5			
Concrete pryout failure									
Factor k from TR 029						n			
Design of bonded anchors, Part 5.2.3.3	3					Ζ			
Partial safety factor	γMp ¹⁾	[-]				1,5			

Concrete edge failure									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
See section 5.2.3.4 of Technical	Report TR 029	9 for tl	he Desi	ign of B	onded	Anchor	S		
Partial safety factor	γ _{Mc} 1)	[-]				1,5			
1 and baloty factor	TNIC	[]				1,0			

¹⁾ In absence of national regulations

Essve chemical anchor Seismic, ICE, Slow

Performances Design according to TR 029 Characteristic resistance for shear loads - rebar

	of resist							u -			
Steel failure – Characteristic resis	tance				-	-	-				
Size			M8	M10	M12	M16	6 M20) M2	24	M27	M30
Steel grade 4.6	N _{Rk,s}	[kN]	15	23	34	63	98	14	1	184	224
Partial safety factor	γMs ¹⁾	[-]			1		2,00				
Steel grade 5.8	N _{Rk,s}	[kN]	18	29	42	79	123	17	7	230	281
Partial safety factor	γ _{Ms} 1)	[-]					,50				
Steel grade 8.8	N _{Rk,s}	[kN]	29	46	67	126		28	2	367	449
Partial safety factor	γ _{Ms} 1)	[-]					,50				
Steel grade 10.9	N _{Rk,s}	[kN]	37	58	84	157		35	3	459	561
Partial safety factor	γ _{Ms} 1)	[-]					,33				
Stainless steel grade A2-70, A4-70	N _{Rk,s}	[kN]	26	41	59	110		24	7	321	393
Partial safety factor	γMs ¹⁾	[-]		1			,87		-		
Stainless steel grade A4-80	N _{Rk,s}	[kN]	29	46	67	126		28	2	367	449
Partial safety factor	γMs ¹⁾	[-]					,60		_		
Stainless steel grade 1.4529	N _{Rk,s}	[kN]	26	41	59	110		24	7	321	393
Partial safety factor	γMs ¹⁾	[-]		-	1		1,50				
Stainless steel grade 1.4565	N _{Rk,s}	[kN]	26	41	59	110		24	7	321	393
Partial safety factor	γ _{Ms} 1)	[-]					,87				
Combined pullout and concrete co	one failu	ure in r	<u>10n-c</u>								-
Size					110 M	12 N	116 N	20 N	124	M27	M30
Characteristic bond resistance in	non-cra										
Dry and wet concrete	$ au_{Rk}$	[N/m		10 9	9,5 9	,		3,5	8	6,5	5,5
Partial safety factor	γмс ¹⁾	[-]				1,8 ²				2	,1 ³⁾
Flooded hole	τRk	[N/m		8,5 7	7,5	7		5,5	5,5		
Partial safety factor	γ _{Mc} 1)	[-]					2,1 ³⁾				
Factor for concrete C50/60	Ψc	[-]					1				
Factor according to CEN/TS 1992-4-5			k ₈				10,1				
Combined pullout and concrete co	one failu	ure in o	crack		1	1					
Size	-	_		M10	M 1	12	M16		M20		M24
Characteristic bond resistance in	cracked										
Dry and wet concrete	τrk	[N/m	m²l I	15	4,	5	4,5		4		4
				4,5	- ,						
Partial safety factor	$\gamma Mc^{1)}$	[-]				- 1	1,82)				
Flooded hole	γ _{Mc} 1) τ _{Rk}	[-] [N/m	m²]	4,5	4,	5	4,5		4		4
Flooded hole Partial safety factor	γ _{Mc} ¹⁾ τ _{Rk} γ _{Mc} ¹⁾	[-]	m²]			5	4,5 2,1 ³⁾		4		4
Flooded hole Partial safety factor C30/37	γ _{Mc} ¹⁾ τ _{Rk} γ _{Mc} ¹⁾ 7	[-] [N/m [-]	m²]			5	4,5 2,1 ³⁾ 1,12		4		4
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50	γ _{Mc} ¹⁾ τ _{Rk} γ _{Mc} ¹⁾ 7 Ο ψ _c	[-] [N/m	m²]			5	4,5 2,1 ³⁾ 1,12 1,23		4		4
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\gamma_{Mc}^{1)}}{\gamma_{Mc}}$ 7 0 ψ_{c}	[-] [N/m [-]	m ²]			5	4,5 2,1 ³⁾ 1,12 1,23 1,30		4		4
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\gamma_{Mc}^{1)}}{\gamma_{Mc}}$ 7 0 ψ_{c}	[-] [N/m [-]	m²]			5	4,5 2,1 ³⁾ 1,12 1,23		4		4
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\gamma_{Mc}^{1)}}{\gamma_{Mc}}$ 7 0 ψ_{c}	[-] [N/m [-]	m ²]	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2				
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\gamma_{Mc}^{1)}}{\gamma_{Mc}}$ 7 0 ψ_{c}	[-] [N/m [-]	m ²]	4,5			4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M			M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 0 ψ_c 0 Section	[-] [N/m [-] [-] 6.2.2	m ²] k ₈	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1			M27	
Flooded hole Partial safety factor Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 9 9 Section Section	[-] [N/m [-] 6.2.2 6.2.3	m ²] k ₈ <u>k₀cr k_{cr}</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2	120 N		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 0 0 Constraints Constrain	[-] [N/m [-] 6.2.2 6.2.3 [mr	m ²] k ₈ <u>k₈</u> <u>k_{cr} n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he	120 N		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 9 9 Section Section	[-] [N/m [-] 6.2.2 6.2.3	m ²] k ₈ <u>k₈</u> <u>k_{cr} n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2	120 N		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 0 ψ_c 0 Section Section C _{cr,N} S _{cr,N}	6.2.3 [mr	m ²] k ₈ <u>k_{ucr} k_{cr} n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he	120 N		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 9 9 9 Section 9 Section 0 C _{cr,N} 0 C _{cr,Sp}	6.2.3 [mr [mr	m ²] k ₈ <u>k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 1,5he	1 20 N f f		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing	γ _{Mc} ¹⁾ τ _{Rk} γ _{Mc} ¹⁾ 7 0 Ψc 0 Section Section C _{cr,N} S _{cr,N} C _{cr,sp} S _{cr,sp}	[-] [N/m [-] 6.2.2 6.2.3 [mr [mr [mr	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 7 9 9 9 Section 9 Section 0 C _{cr,N} 0 C _{cr,Sp}	6.2.3 [mr [mr	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 1,5he	1 20 N f f		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹⁾ In absence of national regulations	γMc ¹⁾ τ _{Rk} γMc ¹⁾ 7 0 ψc 0 Section Section Ccr,N Scr,N Ccr,sp Scr,sp γMsp ¹⁾	[-] [N/m [-] 6.2.2 6.2.3 [mr [mr [mr	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹ In absence of national regulations ² The partial safety factor $\gamma_2=1,2$ is inclu	γ _{Mc} ¹⁾ τ _{Rk} γ _{Mc} ¹⁾ 7 0 ψc 0 Section Section Ccr,N Scr,N Ccr,sp γ _{Msp} ¹⁾	[-] [N/m [-] 6.2.2 6.2.3 [mr [mr [mr	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f		M27	
Flooded hole Partial safety factor Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹⁾ In absence of national regulations ²⁾ The partial safety factor $\gamma_2=1,2$ is inclu ³⁾ The partial safety factor $\gamma_2=1,4$ is inclu	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 0 ψ_c 0	6.2.3 [mr [-] 6.2.3	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f		M27	
Flooded hole Partial safety factor C30/37 Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹) In absence of national regulations ²) The partial safety factor $\gamma_2=1,2$ is inclu	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 0 ψ_c 0	6.2.3 [mr [-] 6.2.3	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f		M27	
Flooded hole Partial safety factor Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹⁾ In absence of national regulations ²⁾ The partial safety factor $\gamma_2=1,2$ is inclu ³⁾ The partial safety factor $\gamma_2=1,4$ is inclu	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 0 ψ_c 0	6.2.3 [mr [-] 6.2.3	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f	124		M30
Flooded hole Partial safety factor Factor for cracked concrete C40/50 C50/60 Factor according to CEN/TS 1992-4-5 Concrete cone failure Size Factor according to CEN/TS 1992-4-5 Edge distance Spacing Splitting failure Edge distance Spacing Partial safety factor ¹⁾ In absence of national regulations ²⁾ The partial safety factor $\gamma_2=1,2$ is inclu ³⁾ The partial safety factor $\gamma_2=1,4$ is inclu ssve chemical anchor Seismic,	$\frac{\gamma_{Mc}^{1)}}{\tau_{Rk}}$ $\frac{\tau_{Rk}}{\gamma_{Mc}^{1)}}$ 7 0 ψ_c 0 Section Section Ccr,N Ccr,N Ccr,sp Ccr,sp $\gamma_{Msp}^{1)}$ uded ided	6.2.3 [mr [-] 6.2.3	m ²] k ₈ <u>k_{ucr} k_{cr} n] n] n]</u>	4,5	4,		4,5 2,1 ³⁾ 1,12 1,23 1,30 7,2 116 M 10,1 7,2 1,5he 3,0he 3,0he	1 20 N f f	124		

 Table C5: Design method CEN/TS 1992-4

 Characteristic values of resistance to tension load of threaded rod

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

Steel failure – Characteristic resi	istance								
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	28	43	62	111	173	270	442
Partial safety factor	$\gamma Ms^{1)}$	[-]				1,4			
Combined pullout and concrete	cone failu	re in non-	cracke	ed con	crete C	20/25			
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Characteristic bond resistance in	n non-cra	cked cond	rete						
Dry and wet concrete	$ au_{Rk}$	[N/mm ²]	11	9,5	9,5	9	8,5	8,5	5,5
Partial safety factor	γ _{Mc} 1)	[-]				1,8 ²⁾			
Flooded hole	$ au_{Rk}$	[N/mm ²]	11	9,5	9,5	9	8,5	8,5	5,5
Partial safety factor	γMc ¹⁾	[-]				2,1 ³⁾			
Factor for concrete C50/60	Ψc	[-]				1			
Factor according to CEN/TS 1992-4-	5 Section 6	6.2.2 k ₈				10,1			
Concrete cone failure									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Factor according to CEN/TS 1992-4-	5 Section 6	5.2.3 k _{ucr}				10,1			
Edge distance	Ccr,N	[mm]				1,5h _{ef}			
Spacing	Scr,N	[mm]				3,0h _{ef}			
Splitting failure									
Edge distance	Ccr,sp	[mm]				1,5h _{ef}			
Spacing	Scr,sp	[mm]				3,0h _{ef}			
Partial safety factor	$\gamma Msp^{1)}$	[-]				1,8			

¹⁾ In absence of national regulations ²⁾ The partial safety factor $\gamma_2=1,2$ is included ³⁾ The partial safety factor $\gamma_2=1,4$ is included

Essve chemical anchor Seismic, ICE, Slow

Performances Design according to CEN/TS 1992-4

Characteristic resistance for tension loads - rebar

Steel grade 4.6 $V_{Rk,5}$ [kN] 7 12 17 31 49 71 92 11 Partial safety factor $\gamma_{Ma}^{(1)}$ [-] 1.67 1.67 Steel grade 5.8 $V_{Rk,8}$ [kN] 9 12 13 61 88 115 14 Partial safety factor $\gamma_{Mb}^{(1)}$ [-] 1.25 1.25 123 177 230 28 Partial safety factor $\gamma_{Mb}^{(1)}$ [-] 1.5 23 463 98 141 184 22 Partial safety factor $\gamma_{Mb}^{(1)}$ [-] 1.5 23 34 63 98 141 184 22 Partial safety factor $\gamma_{Mb}^{(1)}$ [-] 1.5 23 46 98 141 184 22 Stainless steel grade 4.4-80 $V_{Rk,8}$ [kN] 13 20 30 55 86 124 161 15 Partial safety factor $\gamma_{Mb}^{(1)}$ [-] 1.33 13 20 30 55 86 124 <	Steel failure without lever arm Size			M8	M10	M12	M16	M20	M24	M27	M30
Partial safety factor $\gamma_{M6}^{(1)}$ [-] 1,67 Steel grade 5.8 V_{Rks} [kN] 9 15 21 39 61 88 115 14 Partial safety factor $\gamma_{M6}^{(1)}$ [-] 1,25 1,56 1,56 1,56 1,56 1,56 1,56 1,56 1,56 1,56 1,56 1,56 1,33 1,33 1,11 1,84 22 1,33 1,33 1,33 1,33 1,33 1,56 1,24 161 1,56 Stainless steel grade 1,4529 V_{Rk,s} [kN] 1,3 20 30 55 86 1,24 161 1,56 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,25 1,56 1,25		Veka	[kN]								112
Steel grade 5.8 $V_{Rk,3}$ (kN) 9 15 21 39 61 88 115 14 Partial safety factor $\gamma_{Rk,3}^{(1)}$ [-] 1,25 1,25 Steel grade 8.8 $V_{Rk,3}$ [kN] 15 23 34 63 98 141 184 22 Partial safety factor $\gamma_{Mk}^{(1)}$ [-] 1,25 177 230 265 Stainless steel grade 42-70, A4-70 $V_{Rk,3}$ [kN] 13 20 30 55 86 124 161 15 Stainless steel grade 44-80 $V_{Rk,3}$ [kN] 15 23 34 63 98 141 184 22 Partial safety factor $\gamma_{Mk}^{(0)}$ [-] 1,33 13 20 30 55 86 124 161 182 Partial safety factor $\gamma_{Mk}^{(0)}$ [-] 1,32 20 30 55 86 124 161 182 Partial safety factor $\gamma_{Mk}^{(0)}$ [-] 1,25 0.8 124 161 <	·	V KK,S VMc ¹)		'	12	17			11	52	112
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Steel grade 10.9 $V_{Rk,s}$ [kN] 18 29 42 79 123 177 230 28 Partial safety factor $\gamma_{Me}^{(1)}$ [-] 1.5 1.5 Stainless steel grade A2-70, A4-70 $V_{Rk,s}$ [kN] 13 20 30 55 86 124 161 15 Partial safety factor $\gamma_{Me}^{(1)}$ [-] 1.32 34 63 98 141 184 22 Partial safety factor $\gamma_{Me}^{(1)}$ [-] 1.33 13 20 30 55 86 124 161 15 Partial safety factor $\gamma_{Me}^{(1)}$ [-] 1.25 1.25 161 161 15 Ductility factor according to k_2 0.8 M10 M12 M16 M20 M24 M27 M3 Steel grade 4.6 $M^{\circ}_{Rk,s}$ [N.m] 15 30 52 133 260 449 66 66 60 92 92 33 260 449 66 66 60 92 92				10	20	04			141	104	227
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Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1 k2 0,8 Steel failure with lever arm 0,8 Size M8 M10 M12 M16 M20 M24 M27 M3 Size M8 M10 M12 M16 M20 M24 M27 M3 Size M8 M10 M12 M16 M20 M24 M27 M3 Size Steel grade 4.6 M° _{Rk,s} [N.m] 15 30 52 133 260 449 666 90 Partial safety factor $\gamma_{M6^{10}}$ [-] 1,67 1,67 1,25 51 51 898 1332 175 Partial safety factor $\gamma_{M6^{10}}$ [-] 1,25 51 12 1,25 51 1333 649 1162 166 125 141 164 22/ 233 454 786 1165 155 14165 155 156 1165 157 1333 1454 786 1165 157 1,33 1454 786 1165 157 <td></td>											
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Steel grade 10.9 M° _{Rk,s} [N.m] 37 75 131 333 649 1123 1664 224 Partial safety factor γ_{Ms}^{11} [-] 1,50 Stainless steel grade A2-70, A4-70 M° _{Rk,s} [N.m] 26 52 92 233 454 786 1165 15 Partial safety factor γ_{Ms}^{11} [-] 1,56 1,56 1332 179 Stainless steel grade A4-80 M° _{Rk,s} [N.m] 30 60 105 266 519 898 1332 179 Partial safety factor γ_{Ms}^{11} [-] 1,33 165 157 Partial safety factor γ_{Ms}^{11} [-] 1,33 454 786 1165 157 Partial safety factor γ_{Ms}^{11} [-] 1,25 166 1165 157 Partial safety factor γ_{Ms}^{11} [-] 1,56 165 157 Partial safety factor γ_{Ms}^{11} [-] 1,56 165 157 Section 6.3.3 2,0 2,0 2,											
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Concrete edge failureSizeM8M10M12M16M20M24M27M3See section 6.3.4 of CEN/TS 1992-4-5Effective length of anchorIf[mm]If = min(hef;8 dnom)Outside diameter of anchordnom[mm]810121620242730Partial safety factor $\gamma_{Mc}^{(1)}$ [-]1,5	Partial safety factor	γ _{Mp} 1)	[-]				1	,5			
See section 6.3.4 of CEN/TS 1992-4-5Effective length of anchorIf[mm]If = min(hef;8 dnom)Outside diameter of anchordnom[mm]810121620242730Partial safety factor $\gamma_{Mc}^{(1)}$ [-]1,5	Concrete edge failure										
Effective length of anchorIf[mm]If = min(hef; 8 dnom)Outside diameter of anchor d_{nom} [mm]810121620242730Partial safety factor γ_{Mc}^{11} [-]1,5	Size			M8	M10	M12	M16	M20	M24	M27	M30
Outside diameter of anchor d_{nom} [mm]810121620242730Partial safety factor $\gamma_{Mc}^{(1)}$ [-]1,5			[.0.1	\ \		
Partial safety factor γ _{Mc¹⁾ [-] 1,5}					40					07	00
Partial safety factor γMc'' [-] 1,5 1) In absence of national regulations 1 1				8	10	12			24	27	30
" in absence of national regulations		γMc''	[-]				1	c,			
	" in absence of national regulations										

Table C7: Design method CEN/TS 1992-4 Characteristic values of resistance to shear load of threaded rod

Design according to CEN/TS 1992-4 Characteristic resistance for shear loads - threaded rod

Performances

Table C8:Design method CEN/TS 1992-4Characteristic values of resistance to shear load of rebar

Steel failure without lever arm									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	14	22	31	55	86	135	221
Partial safety factor	$\gamma Ms^{1)}$	[-]				1,5			
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1		k ₂				0,8			
Steel failure with lever arm									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	$M^{o}_{Rk,s}$	[N.m]	33	65	112	265	518	1013	2122
Partial safety factor	γMs ¹⁾	[-]				1,5			
Concrete pryout failure									
Factor according to CEN/TS 1992-4-5 Section 6.3.3		k ₃				2,0			
Partial safety factor	$\gamma {\rm Mp}^{1)}$	[-]				1,5			
Concrete edge failure									
Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
See section 6.3.4 of CEN/TS 1992-4-	5								
Effective length of anchor	lf	[mm]			$I_f = m$	in(h _{ef} ;8	d _{nom})		
Outside diameter of anchor	dnom	[mm]	8	10	12	16	20	24	30
Partial safety factor	γ _{Mc} 1)	[-]				1,5			

¹⁾ In absence of national regulations

Essve chemical anchor Seismic, ICE, Slow

Performances Design according to CEN/TS 1992-4 Characteristic resistance for shear loads - rebar

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tension load	F	[kN]	6,3	7,9	11,9	15,9	23,8	29,8	37,7	45,6
Displacement	δ _{N0}	[mm]	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,5
	δ _{N∞}	[mm]	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Shear load	F	[kN]	3,1	5,0	7,2	13,5	21,0	30,3	39,4	48,0
Displacement	δνο	[mm]	1,5	1,5	1,5	1,5	2,0	2,5	2,5	2,5
	δ∨∞	[mm]	2,3	2,3	2,3	2,3	3,0	3,8	3,8	3,8
Cracked concrete										
Tension load	F	[kN]		5,1	7,4	13,1	20,5	24,6		
Displacement	δ _{N0}	[mm]		0,4	0,7	0,7	0,7	0,6		

Essve chemical anchor Seismic, ICE, Slow

Performances Displacement for threaded rod

Table C10: Displacement of rebar under tension and shear load										
Rebar size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø32	
Non-cracked concrete										
Tension load	F	[kN]	7,9	9,9	13,9	23,8	29,8	55,6	55,6	
Displacement	δ _{N0}	[mm]	0,3	0,3	0,3	0,4	0,4	0,5	0,5	
	δ_{N^∞}	[mm]	0,5	0,5	0,5	0,5	0,5	0,5	0,5	
Shear load	F	[kN]	5,9	9,3	13,3	23,7	37,0	57,9	94,8	
Displacement	δ _{V0}	[mm]	0,3	0,4	0,4	0,4	0,4	0,5	0,9	
	δ∨∞	[mm]	0,5	0,6	0,6	0,6	0,6	0,8	1,4	

Essve chemical anchor Seismic, ICE, Slow

Performances Displacement for rebar Annex C 10

Size	M10	M12	M16	M20	M24		
Fension load							
Steel failure							
Characteristic resistance grade 4.6	N _{Rk,s,seis}	[kN]	23	34	63	98	141
Partial safety factor	γ _{Ms} 1)	[-]			2,00		•
Characteristic resistance grade 5.8	N _{Rk,s,seis}	[kN]	29	42	79	123	177
Partial safety factor	γ _{Ms} 1)	[-]			1,50		
Characteristic resistance grade 8.8	N _{Rk,s,seis}	[kN]	46	67	126	196	282
Partial safety factor	γMs ¹⁾	[-]			1,50		
Characteristic resistance grade 10.9	N _{Rk,s,seis}	[kN]	58	84	157	245	353
Partial safety factor	γ _{Ms} ¹⁾	[-]			1,33		•
Characteristic resistance A2-70, A4-70	N _{Rk,s,seis}	[kN]	41	59	110	172	247
Partial safety factor	γ _{Ms} ¹⁾	[-]			1,87		•
Characteristic resistance A4-80	N _{Rk,s,seis}	[kN]	46	67	126	196	282
Partial safety factor	γ _{Ms} ¹⁾	[-]			1,60		•
Characteristic resistance 1.4529	N _{Rk,s,seis}	[kN]	41	59	110	172	247
Partial safety factor	γMs ¹⁾	[-]			1,50		
Characteristic resistance 1.4565	N _{Rk,s,seis}	[kN]	41	59	110	172	247
Partial safety factor	γ _{Ms} 1)	[-]			1,87		
Combined pull-out and concrete cone	failure						
Dry and wet concrete	τ _{Rk,seis,C1}	[N/mm ²]	3,5	3,5	3,5	3,5	3,5
Partial safety factor	γ _{Mc} ¹⁾	[-]			1,8 ²⁾	,	
Flooded hole	τRk,seis,C1	[N/mm ²]	3,5	3,5	3,5	3,5	3,5
Partial safety factor	γ _{Mc} 1)	[-]			2,1 ³⁾		
Shear load							
Steel failure without lever arm							
Characteristic resistance grade 4.6	V _{Rk,s,seis}	[kN]	7	10	23	30	40
Partial safety factor	V Rk,s,sels γMs ¹⁾	[-]	/	10	1,67	50	40
Characteristic resistance grade 5.8	VRk,s,seis	[kN]	9	13	28	38	51
Partial safety factor	γMs ¹⁾	[-]	3	15	1,25	50	51
Characteristic resistance grade 8.8	V _{Rk,s,seis}	[kN]	14	21	45	61	81
Partial safety factor	γMs ¹⁾	[-]	17	21	1,25	01	01
Characteristic resistance grade 10.9	V _{Rk,s,seis}	[kN]	18	26	56	76	101
Partial safety factor	γMs ¹⁾	[-]	10	20	1,50	70	101
Characteristic resistance A2-70 , A4-70	V _{Rk,s,seis}	[kN]	12	18	39	53	71
Partial safety factor	γMs ¹⁾	[-]	12	10	1,56	- 55	
Characteristic resistance A4-80	VRk,s,seis	[⁻] [kN]	14	21	45	61	81
Partial safety factor	V Rk,s,seis γMs ¹⁾	[KN] [-]	14	21	1,33	01	01
Characteristic resistance 1.4529	VRk,s,seis	[⁻]	12	18	39	53	71
Partial safety factor	V Rk,s,seis γMs ¹⁾	[-]	14	10	1,25	- 55	11
Characteristic resistance 1.4565		[⁻]	12	18	39	53	71
Partial safety factor	V _{Rk,s,seis} γ _{Ms} ¹⁾	[KIN] [-]	12	10	1,56	55	11

Table C11: Characteristic values of resistance under seismic action category C1 for threaded rods

¹⁾ In absence of national regulations

²⁾ The partial safety factor γ_2 =1,2 is included ³⁾ The partial safety factor γ_2 =1,4 is included

Note: Rebars are not qualified for seismic design

Essve chemical anchor Seismic, ICE, Slow

Performances

Reduction factors for seismic design