BUILDING TRUST

Sika AnchorFix®-3001

DICHIARAZIONE DI PRESTAZIONE
No. 10856840

1	**CODICE DI IDENTIFICAZIONE UNICO DEL PRODOTTO-TIPO:**	10856840
2	**USI PREVISTI**	ETA 14/0157 of 04/09/2014 Sistema di ancoraggio chimico per utilizzo in calcestruzzo fessurato e non
3	**FABBRICANTE:**	Sika Services AG Tüffenwies 16-22 8064 Zürich
4	**MANDATARIO:**	
5	**SISTEMI DI VVCP:**	System 1
6b	**DOCUMENTO DI VALUTAZIONE EUROPEA:**	ETAG 001-Parte 1 e Parte 5, edizione 2013
	Valutazione Tecnica europea:	ETA 14/0157 del 04/09/2014
	Organismodi valutazione tecnica:	TECHNICKY A ZKUSEBNI USTAV STAVEBNI PRAHA s.p.
	Organismi notificati:	1020

7 PRESTAZIONI DICHIARATE

Reaction to fire - Anchorages satisfy requirements for Class A1

Resistance to fire - No performance determined

Anchorages subject to:

- Static and quasi-static load.
- Seismic performance category C1: threaded rod

Base materials

- Cracked and non-cracked concrete.
- 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:

- Ta) -40°C to +40°C (max. short. term temperature +40°C and max. long term temperature+24°C)
- Tb) -40°C to +70°C (max. short. term temperature +70°C and max. long term temperature+40°C)
- Tc) -40°C to +80°C (max. short. term temperature +80°C and max. long term temperature+40°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 1 – installation in dry or wet concrete

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.
- Hole drilling by rotary drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B1: Installation parameters of threaded rod

Size			M10	M12	M16	M20	M24	M30
Nominal drill hole diameter	$Ød_0$	[mm]	12	14	18	22	26	35
Diameter of cleaning brush	d_b	[mm]	S14H/F	S16H/F	S22H/F	S24H/F	S31H/F	S38H/F
Torque moment	T_{inst}	[Nm]	20	40	80	135	200	270
Min. embedment depth								
Depth of drill hole	h_0	[mm]	60	70	80	90	96	120
Effective anchorage depth	h_{ef}	[mm]	60	70	80	90	96	120
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	100	100	115	130	160	200
Max. embedment depth 20d								
Depth of drill hole	h_0	[mm]	200	240	320	400	480	600
Effective anchorage depth	h_{ef}	[mm]	200	240	320	400	480	600
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	224	268	336	444	532	670

Table B2: Installation parameters of rebar

Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Nominal drill hole diameter	$Ød_0$	[mm]	14	16	20	25	32	40
Diameter of cleaning brush	d_b	[mm]	S16H/F	S18H/F	S22H/F	S27H/F	S35H/F	S43H/F
Torque moment	T_{inst}	[Nm]	20	40	80	135	200	270
Min. embedment depth								
Depth of drill hole	h_0	[mm]	60	70	80	90	100	128
Effective anchorage depth	h_{ef}	[mm]	60	70	80	90	100	128
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	100	100	120	140	164	208
Max. embedment depth 20d								
Depth of drill hole	h_0	[mm]	200	240	320	400	500	640
Effective anchorage depth	h_{ef}	[mm]	200	240	320	400	500	640
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	228	272	360	450	564	720

Table B3: Minimum curing time

Concrete temperature [°C]	Gel time [minutes]	Cure time [hours]
+5 to +10	20	24
+10 to +15		12
+15 to +20	15	8
+20 to +25	11	7
+25 to +30	8	6
+30 to +35	6	5
+35 to +40	4	4
+40	3	3
Cartridge must be conditioned to minimum +10°C		

Table C1: Design method TR 029

Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$N_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **10.9***	$N_{Rk,s}$	[kN]	58	84	157	245	353	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					
Stainless steel grade **A4-70**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,9					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,6					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					

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

Pullout failure in concrete C20/25								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	12	12	13	11
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	5,5	5,5	6	5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	4,5	4,5	4,5	5	4,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for non-cracked concrete C30/37			1,12					
Factor for non-cracked concrete C40/50	ψ_c		1,23					
Factor for non-cracked concrete C50/60			1,30					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	9	6	6	6
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	4,5	2,5	2,5	2,5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	3,5	2,5	2,5	2,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for cracked concrete C30/37			1,03					
Factor for cracked concrete C40/50	ψ_c		1,06					
Factor for cracked concrete C50/60			1,07					

Splitting failure								
Size			M10	M12	M16	M20	M24	M30
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0\,h_{ef} \le 2{,}0\,h_{ef}$ $2{,}5\,h_{ef} \le 2{,}4\,h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Msp} [1]	[-]	1,8					

[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

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

Steel failure – Characteristic resistance								
Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	43	62	111	173	270	442
Partial safety factor	γ_{Ms} [1]	[-]	1,4					

Pullout failure in concrete C20/25								
Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	13	13	13	13
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	6	6	6	6
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	5	5	5	5	5
Partial safety factor	γ_{Mc} [1]	[-]	1,8 [2]	2,1 [3]				
Factor for non-cracked concrete C30/37			1,06					
Factor for non-cracked concrete C40/50	ψ_c		1,11					
Factor for non-cracked concrete C50/60			1,14					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	7	7	5	5
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	3	3	2	2
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	2,5	2,5	2	2
Partial safety factor	γ_{Mc} [1]	[-]	1,8 [2]	2,1 [3]				
Factor for cracked concrete C30/37			1,04					
Factor for cracked concrete C40/50	ψ_c		1,07					
Factor for cracked concrete C50/60			1,09					

Splitting failure								
Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0\,h_{ef} \le 2{,}0\,h_{ef}$ $2{,}5\,h_{ef} \le 2{,}4\,h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Msp} [1]	[-]	1,8					

[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

Table C3: Design method TR 029

Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$V^0_{Rk,s}$	[kN]	15	21	39	61	88	140
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V^0_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$V^0_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A4-70**	$V^0_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V^0_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V^0_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					

Steel failure with lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	37	66	166	325	561	1125
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$M^0_{Rk,s}$	[N.m]	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A4-70**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{M} [1)]	[-]	1,5					

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

Concrete edge failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C4: Design method TR 029

Characteristic values of resistance to shear load of rebar

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

Steel failure with lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$M^{o}_{Rk,s}$	[N.m]	65	112	265	518	1013	2122
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{M} [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C5: Design method CEN/TS 1992-4

Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$N_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **10.9***	$N_{Rk,s}$	[kN]	58	84	157	245	353	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					
Stainless steel grade **A4-70**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,9					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,6					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					

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

Pullout failure in concrete C20/25								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm^2]	12	12	12	12	13	11
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm^2]	5,5	5,5	5,5	5,5	6	5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm^2]	5	4,5	4,5	4,5	5	4,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for non-cracked concrete C30/37	ψ_c		1,12					
Factor for non-cracked concrete C40/50	ψ_c		1,23					
Factor for non-cracked concrete C50/60	ψ_c		1,30					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm^2]	9	9	9	6	6	6
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm^2]	4	4	4,5	2,5	2,5	2,5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm^2]	3,5	3,5	3,5	2,5	2,5	2,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for cracked concrete C30/37	ψ_c		1,03					
Factor for cracked concrete C40/50	ψ_c		1,06					
Factor for cracked concrete C50/60	ψ_c		1,07					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		7,2					

Concrete cone failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Factor according to CEN/TS 1992-4-5 Section 6.2.3	k_{ucr}		10,1					
	k_{cr}		7,2					
Edge distance	$c_{cr,N}$	[mm]	$1,5h_{ef}$					
Spacing	$s_{cr,N}$	[mm]	$3,0h_{ef}$					
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]	$1,0 \le h/h_{ef} \le 2,0$: h $h/h_{ef} > 2,5$: $2,4h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$					
Partial safety factor	γ_{Ms} [1)]	[-]	1,8					

[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

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

Steel failure – Characteristic resistance								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	43	62	111	173	270	442
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					

Pullout failure in concrete C20/25								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	13	13	13	13
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	6	6	6	6
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	5	5	5	5	5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for non-cracked concrete C30/37			1,06					
Factor for non-cracked concrete C40/50	ψ_c		1,11					
Factor for non-cracked concrete C50/60			1,14					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	7	7	5	5
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	3	3	2	2
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	2,5	2,5	2	2
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for cracked concrete C30/37			1,04					
Factor for cracked concrete C40/50	ψ_c		1,07					
Factor for cracked concrete C50/60			1,09					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		7,2					

Concrete cone failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Factor according to CEN/TS	k_{ucr}		10,1					
1992-4-5 Section 6.2.3	k_{cr}		7,2					
Edge distance	$c_{cr,N}$	[mm]	$1,5h_{ef}$					
Spacing	$s_{cr,N}$	[mm]	$3,0h_{ef}$					
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]	$1,0 \le \frac{h}{h_{ef}} \le 2,0$: $2,5 h_{ef}$; $\frac{h}{h_{ef}} > 2,0$: $2,4 h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$					
Partial safety factor	γ_{Ms} [1)] p	[-]	1,8					

[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

Table C7: Design method CEN/TS 1992-4

Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$V_{Rk,s}$	[kN]	15	21	39	61	88	140
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$V_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A4-70**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1		k_2	0,8					

Steel failure with lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	37	66	166	325	561	1125
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$M^0_{Rk,s}$	[N.m]	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A4-70**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3			2					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

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

Concrete edge failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\,d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

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

Steel failure without lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	22	31	55	86	135	221
Partial safety factor	γ_{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			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$M^0_{Rk,s}$	[N.m]	65	112	265	518	1013	2122
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3			2,0					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\, d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulation

Table C9: Displacement of threaded rod Tension load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Non-cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
	δ_N	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	δ_N	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	δ_N	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426

Shear load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Non-cracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

Table C10: Displacement of rebar

Tension load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Non-cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
	δ_{N}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	δ_{N}	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	δ_{N}	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
	δ_{N}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	δ_{N}	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	δ_{N}	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426

Shear load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Non-cracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

Table C11: Reduction factors for seismic design category C1 for threaded rods

Size			M10	M12	M16	M20	M24	M30
Tension load								
Steel failure								
Characteristic resistance grade 5.8	$N_{Rk,s,seis}$	[kN]	29,0	42,2	78,5	122,5	176,5	280,5
Characteristic resistance grade 8.8	$N_{Rk,s,seis}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance grade 10.9	$N_{Rk,s,seis}$	[kN]	58,0	84,3	157,0	245,0	353,0	561,0
Characteristic resistance A4-70	$N_{Rk,s,seis}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Characteristic resistance A4-80	$N_{Rk,s,seis}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance 1.4529	$N_{Rk,s,seis}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Combined pull-out and concrete cone failure								
Factor for calculation of $\tau_{Rk,sei}$ [1)]	$\alpha_{N,seis}$	-	1,00	0,96	0,79	0,79	0,68	0,46
Shear load								
Steel failure without lever arm								
Characteristic resistance grade 5.8	$V_{Rk,s,seis}$	[kN]	13,5	19,6	36,5	61,3	86,3	140,3
Characteristic resistance grade 8.8	$V_{Rk,s,seis}$	[kN]	21,6	32,3	58,4	98,0	141,2	224,4
Characteristic resistance grade 10.9	$V_{Rk,s,seis}$	[kN]	27,0	39,2	73,0	122,5	176,5	280,5
Characteristic resistance A4-70	$V_{Rk,s,seis}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4
Characteristic resistance A4-80	$V_{Rk,s,seis}$	[kN]	21,6	31,3	58,4	98,0	141,2	224,4
Characteristic resistance 1.4529	$V_{Rk,s,seis}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4

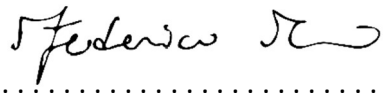
1) $\tau_{Rk,seis} = \alpha_{N,seis} \times \tau_{Rk}$

Note: Rebars are not qualified for seismic design

8 DOCUMENTAZIONE TECNICA APPROPRIATA E/O DOCUMENTAZIONE TECNICA SPECIFICA

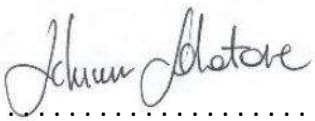
La prestazione del prodotto sopra identificato è conforme all'insieme delle prestazioni dichiarate. La presente dichiarazione di responsabilità viene emessa, in conformità al regolamento (UE) n. 305/2011, sotto la sola responsabilità del fabbricante sopra identificato.
Firmato a nome e per conto del fabbricante da:

Name : Federico Moroni
PE Refurbishment
At Peschiera Borromeo
on 07 September 2021



.....

Name : Salvatore Schirinzi
General Manager
At Peschiera Borromeo
on 07 September 2021



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End of information as required by Regulation (EU) No 305/2011

RELATED DECLARATION OF PERFORMANCE

Product Name	Harmonised technical specification	DoP Number
Sika AnchorFix-3001 For rebar connection	ETA 14/0368	51057369

LABEL CE COMPLETA

CE

14

Sika Services AG, Zurich, Switzerland

DoP No. 10856840

ETAG 001, Part 1 “Anchors in general”, Part 5 “Bonded anchors”

Notified Body 1020

Sistema di ancoraggio chimico per utilizzo in calcestruzzo fessurato e non

Reaction to fire - Anchorages satisfy requirements for Class A1

Anchorages subject to:

- Static and quasi-static load.
- Seismic performance category C1: threaded rod

Base materials

- Cracked and non-cracked concrete.
- 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:

- Ta) -40°C to +40°C (max. short. term temperature +40°C and max. long term temperature+24°C)
- Tb) -40°C to +70°C (max. short. term temperature +70°C and max. long term temperature+40°C)
- Tc) -40°C to +80°C (max. short. term temperature +80°C and max. long term temperature+40°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 1 – installation in dry or wet concrete

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.
- Hole drilling by rotary drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B1: Installation parameters of threaded rod

Size			M10	M12	M16	M20	M24	M30
Nominal drill hole diameter	$Ød_0$	[mm]	12	14	18	22	26	35
Diameter of cleaning brush	d_b	[mm]	S14H/F	S16H/F	S22H/F	S24H/F	S31H/F	S38H/F
Torque moment	T_{inst}	[Nm]	20	40	80	135	200	270
Min. embedment depth								
Depth of drill hole	h_0	[mm]	60	70	80	90	96	120
Effective anchorage depth	h_{ef}	[mm]	60	70	80	90	96	120
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	100	100	115	130	160	200
Max. embedment depth 20d								
Depth of drill hole	h_0	[mm]	200	240	320	400	480	600
Effective anchorage depth	h_{ef}	[mm]	200	240	320	400	480	600
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	224	268	336	444	532	670

Table B2: Installation parameters of rebar

Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Nominal drill hole diameter	$Ød_0$	[mm]	14	16	20	25	32	40
Diameter of cleaning brush	d_b	[mm]	S16H/F	S18H/F	S22H/F	S27H/F	S35H/F	S43H/F
Torque moment	T_{inst}	[Nm]	20	40	80	135	200	270
Min. embedment depth								
Depth of drill hole	h_0	[mm]	60	70	80	90	100	128
Effective anchorage depth	h_{ef}	[mm]	60	70	80	90	100	128
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	100	100	120	140	164	208
Max. embedment depth 20d								
Depth of drill hole	h_0	[mm]	200	240	320	400	500	640
Effective anchorage depth	h_{ef}	[mm]	200	240	320	400	500	640
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	228	272	360	450	564	720

Table B3: Minimum curing time

Concrete temperature [°C]	Gel time [minutes]	Cure time [hours]
+5 to +10	20	24
+10 to +15		12
+15 to +20	15	8
+20 to +25	11	7
+25 to +30	8	6
+30 to +35	6	5
+35 to +40	4	4
+40	3	3
Cartridge must be conditioned to minimum +10°C		

Table C1: Design method TR 029

Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$N_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **10.9***	$N_{Rk,s}$	[kN]	58	84	157	245	353	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					
Stainless steel grade **A4-70**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,9					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,6					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					

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

Pullout failure in concrete C20/25								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	12	12	13	11
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	5,5	5,5	6	5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	4,5	4,5	4,5	5	4,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for non-cracked concrete C30/37			1,12					
Factor for non-cracked concrete C40/50	ψ_c		1,23					
Factor for non-cracked concrete C50/60			1,30					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	9	6	6	6
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	4,5	2,5	2,5	2,5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	3,5	2,5	2,5	2,5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for cracked concrete C30/37			1,03					
Factor for cracked concrete C40/50	ψ_c		1,06					
Factor for cracked concrete C50/60			1,07					

Splitting failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2{,}0 \cdot h_{ef} \cdot \left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Ms} [1)]	[-]	1,8					

[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

Table C2: Design method TR 029

Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	43	62	111	173	270	442
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					

Pullout failure in concrete C20/25								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	13	13	13	13
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	6	6	6	6
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	5	5	5	5	5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for non-cracked concrete C30/37			1,06					
Factor for non-cracked concrete C40/50	ψ_c		1,11					
Factor for non-cracked concrete C50/60			1,14					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	7	7	5	5
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	3	3	2	2
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	2,5	2,5	2	2
Partial safety factor	γ_{Mc} [1)]	[-]	1,8[2)]	2,1[3)]				
Factor for cracked concrete C30/37			1,04					
Factor for cracked concrete C40/50	ψ_c		1,07					
Factor for cracked concrete C50/60			1,09					

Splitting failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2{,}0 \cdot h_{ef} \cdot \left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Msp} [1)]	[-]	1,8					

[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

Table C3: Design method TR 029

Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$V^0_{Rk,s}$	[kN]	15	21	39	61	88	140
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V^0_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$V^0_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A4-70**	$V^0_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V^0_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V^0_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					

Steel failure with lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	37	66	166	325	561	1125
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,S}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$M^0_{Rk,s}$	[N.m]	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A4-70**	$M^0_{Rk,S}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,S}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,S}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

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

Concrete edge failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C4: Design method TR 029

Characteristic values of resistance to shear load of rebar

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

Steel failure with lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$M^{o}_{Rk,S}$	[N.m]	65	112	265	518	1013	2122
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor *k* from TR 029 Design of bonded anchors, Part 5.2.3.3			2					
Partial safety factor	γ_{Mp} [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
See section 5.2.3.4 of Technical Report TR 029 for the Design of Bonded Anchors								
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C5: Design method CEN/TS 1992-4

Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$N_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Steel grade **10.9***	$N_{Rk,s}$	[kN]	58	84	157	245	353	561
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					
Stainless steel grade **A4-70**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,9					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms} [1)]	[-]	1,6					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					

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

Pullout failure in concrete C20/25								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	12	12	13	11
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	5,5	5,5	6	5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	4,5	4,5	4,5	5	4,5
Partial safety factor	γ_{Mc} [1]	[-]	1,8 [2]	2,1 [3]				
Factor for non-cracked concrete C30/37			1,12					
Factor for non-cracked concrete C40/50	ψ_c		1,23					
Factor for non-cracked concrete C50/60			1,30					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	9	6	6	6
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	4,5	2,5	2,5	2,5
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	3,5	2,5	2,5	2,5
Partial safety factor	γ_{Mc} [1]	[-]	1,8 [2]	2,1 [3]				
Factor for cracked concrete C30/37			1,03					
Factor for cracked concrete C40/50	ψ_c		1,06					
Factor for cracked concrete C50/60			1,07					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		7,2					

Concrete cone failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Factor according to CEN/TS	k_{ucr}		10,1					
1992-4-5 Section 6.2.3	k_{cr}		7,2					
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$					
Spacing	$s_{cr,N}$	[mm]	$3{,}0h_{ef}$					
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0\frac{h}{h_{ef}} \geq 2{,}0 \rightarrow 2{,}5\frac{h}{h_{ef}} \geq 2{,}4\frac{h}{h_{ef}}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Msp} [1]	[-]	1,8					

[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

Table C6: Design method CEN/TS 1992-4

Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	43	62	111	173	270	442
Partial safety factor	γ_{Ms} [1)]	[-]	1,4					

Pullout failure in concrete C20/25								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	12	12	13	13	13	13
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	5,5	5,5	6	6	6	6
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	5	5	5	5	5	5
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for non-cracked concrete C30/37			1,06					
Factor for non-cracked concrete C40/50	ψ_c		1,11					
Factor for non-cracked concrete C50/60			1,14					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		10,1					
Characteristic bond resistance in cracked concrete C20/25								
Temperature a) -40°C to +40°C	τ_{Rk}	[N/mm²]	9	9	7	7	5	5
Temperature b) -40°C to +70°C	τ_{Rk}	[N/mm²]	4	4	3	3	2	2
Temperature c) -40°C to +80°C	τ_{Rk}	[N/mm²]	3,5	3,5	2,5	2,5	2	2
Partial safety factor	γ_{Mc} [1)]	[-]	1,8 [2)]	2,1 [3)]				
Factor for cracked concrete C30/37			1,04					
Factor for cracked concrete C40/50	ψ_c		1,07					
Factor for cracked concrete C50/60			1,09					
Factor according to CEN/TS 1992-4-5 Section 6.2.2	k_8		7,2					

Concrete cone failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Factor according to CEN/TS	k_{ucr}		10,1					
1992-4-5 Section 6.2.3	k_{cr}		7,2					
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$					
Spacing	$s_{cr,N}$	[mm]	$3{,}0h_{ef}$					
Splitting failure								
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0\left(\frac{h}{h_{ef}}\right)\cdot 2{,}0\left(\frac{h}{h_{ef}}\right)^{2{,}5}\cdot 2{,}4\cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \bullet C_{cr,sp}$					
Partial safety factor	γ_{Msp} [1)]	[-]	1,8					

[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

Table C7: Design method CEN/TS 1992-4

Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$V_{Rk,s}$	[kN]	15	21	39	61	88	140
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$V_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Stainless steel grade **A4-70**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1		k_2	0,8					

Steel failure with lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	37	66	166	325	561	1125
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Steel grade **10.9***	$M^0_{Rk,s}$	[N.m]	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms} [1)]	[-]	1,50					
Stainless steel grade **A4-70**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms} [1)]	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms} [1)]	[-]	1,25					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3			2					
Partial safety factor	γ_M [1)]	[-]	1,5					

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

Concrete edge failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

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

Steel failure without lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	22	31	55	86	135	221
Partial safety factor	γ_{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			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$M^0_{Rk,S}$	[N.m]	65	112	265	518	1013	2122
Partial safety factor	γ_{Ms} [1)]	[-]	1,5					
Concrete pryout failure								
Factor according to CEN/TS 1992-4-5 Section 6.3.3			2,0					
Partial safety factor	γ_M [1)]	[-]	1,5					

Concrete edge failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
See section 6.3.4 of CEN/TS 1992-4-5								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Partial safety factor	γ_{Mc} [1)]	[-]	1,5					

[1)] In absence of national regulations

Table C9: Displacement of threaded rod Tension load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Non-cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
	δ_N	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	δ_N	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	δ_N	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	δ_N	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426

Shear load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Non-cracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

Table C10: Displacement of rebar

Tension load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Non-cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
	δ_{N}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	δ_{N}	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	δ_{N}	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
	δ_{N}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	δ_{N}	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	δ_{N}	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426

Shear load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Non-cracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

Table C11: Reduction factors for seismic design category C1 for threaded rods

Size			M10	M12	M16	M20	M24	M30
Tension load								
Steel failure								
Characteristic resistance grade 5.8	$N_{Rk,s,seis}$	[kN]	29,0	42,2	78,5	122,5	176,5	280,5
Characteristic resistance grade 8.8	$N_{Rk,s,seis}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance grade 10.9	$N_{Rk,s,seis}$	[kN]	58,0	84,3	157,0	245,0	353,0	561,0
Characteristic resistance A4-70	$N_{Rk,s,seis}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Characteristic resistance A4-80	$N_{Rk,s,seis}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance 1.4529	$N_{Rk,s,seis}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Combined pull-out and concrete cone failure								
Factor for calculation of $\tau_{Rk,sei}$ [1)]	$\alpha_{N,seis}$	-	1,00	0,96	0,79	0,79	0,68	0,46
Shear load								
Steel failure without lever arm								
Characteristic resistance grade 5.8	$V_{Rk,s,seis}$	[kN]	13,5	19,6	36,5	61,3	86,3	140,3
Characteristic resistance grade 8.8	$V_{Rk,s,seis}$	[kN]	21,6	32,3	58,4	98,0	141,2	224,4
Characteristic resistance grade 10.9	$V_{Rk,s,seis}$	[kN]	27,0	39,2	73,0	122,5	176,5	280,5
Characteristic resistance A4-70	$V_{Rk,s,seis}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4
Characteristic resistance A4-80	$V_{Rk,s,seis}$	[kN]	21,6	31,3	58,4	98,0	141,2	224,4
Characteristic resistance 1.4529	$V_{Rk,s,seis}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4

1) $\tau_{Rk,seis} = \alpha_{N,seis} \times \tau_{Rk}$

Note: Rebars are not qualified for seismic design

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