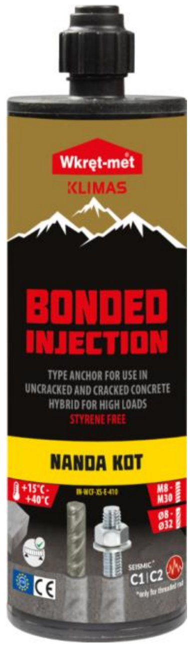
Section 1. PRODUCT DESCRIPTION

Description

WCF-XS is a top-performance ‘new generation hybrid polymer’ anchoring system with very low VOC content offering very high performance in both cracked & uncracked concrete, along with a very good performance under seismic conditions (C1 & C2).

Storage

Cartridges should be stored in their original packaging, the correct way up, in cool conditions (+5°C to +25°C) out of direct sunlight. When stored correctly, the product shelf life will be 12 months from the date of manufacture.



Base materials

-Cracked and uncracked concrete
-Solid rock
-Hard natural stone

Safety

For health and safety information, please refer to the relevant Safety Data Sheet.

Accessories

-Applicators
-Mixing nozzles
-Cleaning blow pump
-Cleaning brushes
-Extension tubes
-Resin stoppers

Approvals & Tests

-ETA Option 1 for cracked and uncracked concrete; EAD 330499-01-0601

-ETA according to EAD 330087-00-0601 (formerly TR023) for post-installed rebar connections

-Approved for seismic action Categories C1 and C2, design according to EN 1992-4

Features

-Suitable for use with close edge distance and small anchor spacings
-Suitable for dry, wet & flooded holes
-Reduced drilling diameters, 22mm for M20 and 26mm for M24; results in significant material and labour savings.
-Variable embedment depths 8d to 20d
-Available in co-axial cartridges (410ml)

Uses/Applications

-Canopies
-Boilers
-Bicycle Racks
-Hand Rails
-Safety Barriers
-Balcony Fences
-Racking
-Machinery
-Satellite Dishes

Section 2. WORKING & LOADING TIMES

WCF-XS - Working & Loading Times

Cartridge Temperature	T Work	Base Material Temperature	T Load
5°C	10 Minutes	5°C to 10°C	145 Minutes
	8 Minutes	10°C to 15°C	85 Minutes
	6 Minutes	15°C to 20°C	75 Minutes
	5 Minutes	20°C to 25°C	50 Minutes
	4 Minutes	25°C to 30°C	40 Minutes

Note: T Work is typical gel time at highest base material temperature in the range. T Load is minimum set time required until load can be applied at the lowest base material temperature in the range.

WCF-XS-C- Working & Loading Times

Cartridge Temperature	T Work	Base Material Temperature	T Load
0°C	10 Minutes	0°C to 5°C	75 Minutes
	5 Minutes	5°C to 20°C	50 Minutes
	100 seconds	+20°C	20 Minutes

Note: T Work is typical gel time at highest base material temperature in the range.
T Load is minimum set time required until load can be applied at the lowest base material temperature in the range.

WCF-XS-E - Working & Loading Times

Cartridge Temperature	T Work	Base Material Temperature	T Load
+15°C	15 Minutes	15°C to 20°C	5 hours
	10 Minutes	20°C to 25°C	145 Minutes
	7.5 Minutes	25°C to 30°C	85 Minutes
	5 Minutes	30°C to 35°C	50 Minutes
	3.5 Minutes	35°C to 40°C	40 Minutes

Note: T Work is typical gel time at highest base material temperature in the range.
T Load is minimum set time required until load can be applied at the lowest base material temperature in the range.

Section 3. PHYSICAL PROPERTIES

Physical Properties

Property		Value	Unit	Test Standard
Compressive Strength	24 hrs	75	N/mm^2	BS6319
	7 days	78		
Tensile Strength	24 hrs	13.5	N/mm^2	ASTM D 638 @ +20°C
	7 days	15.25		
Elongation at Break	24 hrs	6	%	ASTM D 638 @ +20°C
	7 days	6.5		
Tensile Modulus	24 hrs	3.75	GN/m^2	ASTM D 638 @ +20°C
	7 days	4		
Flexural Strength	7 days	30	N/mm^2	ASTM D 790 @ +20°C

Section 4. CHEMICAL RESISTANCE

Chemical Resistance					
Chemical Environment	**Concentration**	**Result**	**Chemical Environment**	**Concentration**	**Result**
Aqueous Solution Acetic Acid	10%	C	Hexane	100%	C
Acetone	100%	×	Hydrochloric Acid	10%	✓
Aqueous Solution Aluminium Chloride	Saturated	✓		15%	✓
Aqueous Solution Aluminium Nitrate	10%	✓		20%	C
Ammonia Solution	5%	×	Hydrogen Sulphide Gas	100%	✓
Jet Fuel	100%	×	Linseed Oil	100%	✓
Benzoic Acid	Saturated	✓	Lubricating Oil	100%	✓
Sodium Hypochlorite Solution	5 - 15%	✓	Mineral Oil	100%	✓
Butyl Alcohol	100%	C	Paraffin / Kerosene (Domestic)	100%	C
Calcium Sulphate Aqueous Solution	Saturated	✓	Phenol Aqueous Solution	1%	×
Carbon Monoxide	Gas	✓	Phosphoric Acid	50%	✓
Carbon Tetrachloride	100%	C	Potassium Hydroxide	10% / pH13	✓
Chlorine Water	Saturated	×	Sea Water	100%	C
Chloro Benzene	100%	C	Sulphur Dioxide Solution	10%	✓
Citric Acid Aqueous Solution	Saturated	✓	Sulphur Dioxide (40°C)	5%	✓
Cyclohexanol	100%	✓	Sulphuric Acid	10%	✓
Diesel Fuel	100%	C		30%	✓
Diethylene Glycol	100%	✓	Turpentine	100%	C
Ethanol	95%	×	White Spirit	100%	✓
Heptane	100%	C	Xylene	100%	×

✓ = Resistant to 75°C with at least 80% of physical properties retained.

C = Contact only to a maximum of 25°C. × = Not resistant.

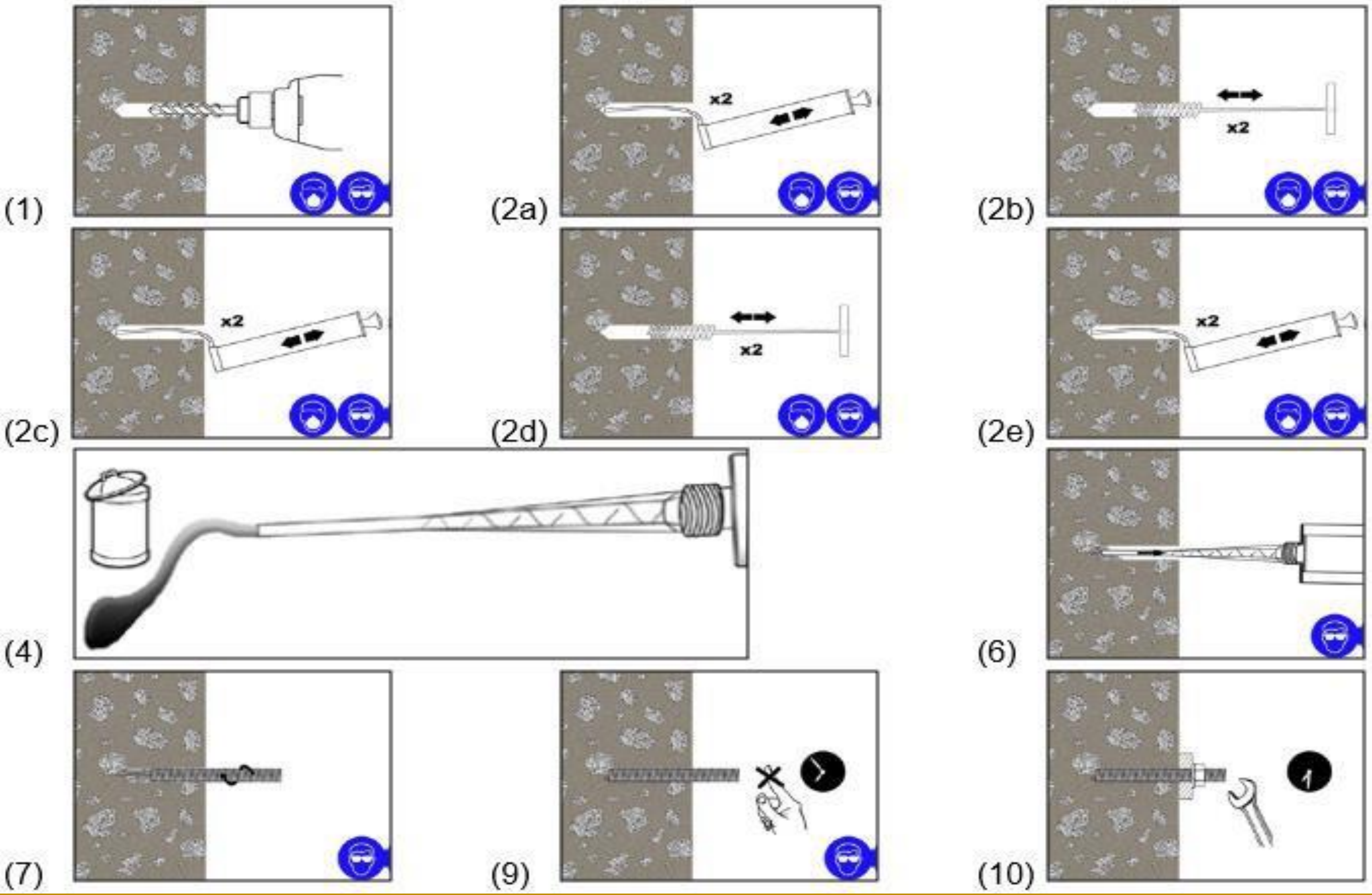
Section 5. SOLID SUBSTRATE INSTALLATION METHOD

Solid Substrate Installation Method

1. Drill the hole to the correct diameter and depth. This can be done with either a rotary percussion or rotaryhammer drilling machine depending upon the substrate.
2. Thoroughly clean the hole in the following sequence using a brush with the required extensions and a sourceof clean compressed air. For holes of 400mm or less deep, a blow pump may be used: Blow Clean x2 → Brush Clean x2 → Blow Clean x2 → Brush Clean x2 → Blow Clean x2.

   If the hole collects water, the current best practice is to remove standing water before cleaning the hole andinjecting the resin. Ideally, the resin should be injected into a properly cleaned, dry hole.
3. Select the appropriate static mixer nozzle for the installation, open the cartridge/foil pack and screw nozzleonto the mouth of the cartridge. Insert the cartridge into a good quality applicator.
4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in theresin.
5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for rebars 16mm dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.
6. Insert the mixer nozzle (resin stopper / extension tube if applicable) to the bottom of the hole. Begin to extrudethe 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 andforth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.
8. Any exces resin will be expelled from the hole evenly around the steel element showing that the hole is full.This excess resin should be removed from around the mouth of the hole before it sets.
9. Leave the anchor to cure. Do not disturb the anchor until the appropriate loading time, has elapsed dependingon the substrate conditions and ambient temperature.
10. Attach the fixture and tighten the nut to the recommended torque. Do not overtighten.



Section 6. INSTALLATION PARAMETERS – THREADED RODS

Installation Parameters - Threaded Rods										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal Drill Hole Diameter	d_o	mm	10	12	14	18	22	26	30	35
Diameter of Cleaning Brush	d_b	mm	14	14	20	20	29	29	40	40
Torque Moment	T_{inst}	Nm	10	20	40	80	150	200	240	275
Minimum Embedment Depth	h_{ef}	mm	64	80	96	128	160	192	216	240
Maximum Embedment Depth	h_{ef}	mm	160	200	240	320	400	480	540	600
Minimum Edge Distance	c_{min}	mm	35	40	50	65	80	96	110	120
Minimum Spacing	s_{min}	mm	35	40	50	65	80	96	110	120
Minimum Member Thickness	h_{min}	mm	h_{ef} + 30 mm ≥ 100mm			$h_{ef} + 2d_o$				

Section 7. CHARACTERISTIC RESISTANCE – COMBINED PULL-OUT & CONCRETE CONE FAILURE USING THREADED RODS

Characteristic Resistance - Combined Pullout & Concrete Cone Failure Using Threaded Rods

Size				M8	M10	M12	M16	M20	M24	M27	M30
Characteristic Bond Resistance in Uncracked Concrete For a Working Life of 50 Years Dry/Wet Concrete -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	11.0	10.0	9.5	9.0	8.5	8.0	6.5	5.5
Characteristic Bond Resistance in Uncracked Concrete Working Life of 50 Years Flooded Holes -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	9.0	8.0	7.5	7.0	7.0	6.0	-	-
Partial Safety Factor	Dry/Saturated Concrete	γ_{inst}	[-]	1.2						1.4	
	Flooded Holes			1.4							
Characteristic Bond Resistance in Cracked Concrete Working Life of 50 Years Dry/Wet Concrete and flooded holes -40°C to 80°C		$\tau_{Rk,cr}$	N/mm²	-	5.5	5.5	5.5	5.0	5.0	-	-
Partial Safety Factor	Dry/Saturated Concrete	γ_{inst}	[-]	1.2						-	-
	Flooded Holes			1.4						-	-
Factor for Concrete		Ψ_c	C30/37	1.12						-	-
			C40/50	1.23						-	-
			C50/60	1.30						-	-

Section 8. SPLITTING FAILURE

Splitting Failure										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Edge Distance	$c_{cr,sp}$	mm	1.5hef							
Spacing	$s_{cr,sp}$	mm	3hef							

Section 9. RESISTANCE VALUES FOR THREADED ROD IN UNCRACKED CONCRETE -50 YEARS WORKING LIFE

Resistance Values for Threaded Rod in Uncracked Concrete - 50 Years Working Life
Combined Pullout & Concrete Cone Failure and Concrete Cone Failure
Temperature Range: -40°C to 80°C

Property	Unit		Anchor Diameter							
			M8	M10	M12	M16	M20	M24	M27	M30
Effective Embedment Depth = MIN = 8d	h_{ef}	mm	64	80	96	128	160	192	216	240
Design Resistance	N_{Rd}	kN	9.5	13.5	19.0	32.0	47.0	64.0	56.5	59.0
Effective Embedment Depth = 8d	h_{ef}	mm	64	80	96	128	160	192	216	240
Design Resistance	N_{Rd}	kN	9.5	13.5	19.0	32.0	47.0	64.0	56.5	59.0
Effective Embedment Depth = 10d	h_{ef}	mm	80	100	120	160	200	240	324	360
Design Resistance	N_{Rd}	kN	12.0	17.0	23.5	40.0	59.0	80.0	85.0	88.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240	288	540	600

Design Resistance	N_{Rd}	kN	14.5	20.5	28.5	48.0	71.0	96.5	141.5	148

1. Resistance values are based on combined pullout & concrete cone failure and concrete cone failure according to EC2-4. Resistance for steel failure must also be considered - the lowest value controls.
2. Resistance values are for single anchors without close edges or eccentric loading considerations.
3. Tabulated values correspond to the above stated temperature range and installation conditions only.
4. Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, e.g.: diurnal cycling.
5. The cylinder compressive strength of the concrete (fck),is assumed to be 20 N/mm2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Section 10. RESISTANCE VALUES FOR THREADED ROD IN CRACKED CONCRETE -50 YEARS WORKING LIFE

Resistance Values for Threaded Rod in Cracked Concrete - 50 Years Working life
Combined Pullout & Concrete Cone Failure and Concrete Cone Failure
Temperature Range: -40°C to 80°C

Property	Unit		Anchor Diameter							
			M8	M10	M12	M16	M20	M24	-	-
Effective Embedment Depth = MIN = 8d	h_{ef}	mm	-	80	96	128	160	192	-	-
Design Resistance	N_{Rd}	kN	-	7.5	11.0	19.5	27.5	40.0	-	-
Effective Embedment Depth = 12d	h_{ef}	mm	-	120	144	192	240	288	-	-
Design Resistance	N_{Rd}	kN	-	11.5	16.5	29.0	41.5	60.0	-	-
Effective Embedment Depth = 20d	h_{ef}	mm	-	200	240	320	400	480	-	-
Design Resistance	N_{Rd}	kN	-	19.0	27.5	49.0	69.5	100.5	-	-

1. Resistance values are based on combined pullout & concrete cone failure and concrete cone failure according to EC2-4. Resistance for steel failure mustalso be considered - the lowest value controls.
2. Resistance values are for single anchors without close edges or eccentric loading considerations.
3. Tabulated values correspond to the above stated temperature range and installation conditions only.
4. Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, e.g.: diurnalcycling.
5. The cylinder compressive strength of the concrete (fck),is assumed to be 20 N/mm2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Section 11. THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (TENSION)

Threaded Rods - Characteristic Values for Steel Failure (Tension)

Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel Grade **4.6**	$N_{Rk,s}$	kN	15	23	34	63	98	141	184	224
Partial Safety Factor	γ_{Ms}	[-]	2							
Steel Grade **5.8**	$N_{Rk,s}$	kN	18	29	42	79	123	177	230	281
Partial Safety Factor	γ_{Ms}	[-]	1.50							
Steel Grade **8.8**	$N_{Rk,s}$	kN	29	46	67	126	196	282	367	449
Partial Safety Factor	γ_{Ms}	[-]	1.50							
Steel Grade **10.9***	$N_{Rk,s}$	kN	37	58	84	157	245	353	459	561
Partial Safety Factor	γ_{Ms}	[-]	1.33							
Stainless Steel Grade **A4-70**	$N_{Rk,s}$	kN	26	41	59	110	172	247	321	393
Partial Safety Factor	γ_{Ms}	[-]	1.87							

Stainless Steel Grade **A4-80**	$N_{Rk,s}$	kN	29	46	67	126	196	282	367	449
Partial Safety Factor	γ_{Ms}	[-]	1.60							
Stainless Steel Grade **1.4529**	$N_{Rk,s}$	kN	26	41	59	110	172	247	321	393
Partial Safety Factor	γ_{Ms}	[-]	1.50							

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

Section 12. THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (SHEAR – WITHOUT LEVER ARM)

Threaded Rods - Characteristic Values for Steel Failure (Shear – without lever arm)										
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	γ_{Ms}	[-]	1.67							
Steel Grade 5.8	$V_{Rk,s}$	kN	9	15	21	39	61	88	115	140
Partial Safety Factor	γ_{Ms}	[-]	1.25							
Steel Grade 8.8	$V_{Rk,s}$	kN	15	23	34	63	98	141	184	224
Partial Safety Factor	γ_{Ms}	[-]	1.25							
Steel Grade 10.9*	$V_{Rk,s}$	kN	18	29	42	79	123	177	230	281
Partial Safety Factor	γ_{Ms}	[-]	1.50							
Stainless Steel Grade A4-70	$V_{Rk,s}$	kN	13	20	30	55	86	124	161	196
Partial Safety Factor	γ_{Ms}	[-]	1.56							
Stainless Steel Grade A4-80	$V_{Rk,s}$	kN	15	23	34	63	98	141	184	224
Partial Safety Factor	γ_{Ms}	[-]	1.33							
Stainless Steel Grade 1.4529	$V_{Rk,s}$	kN	13	20	30	55	86	124	161	196
Partial Safety Factor	γ_{Ms}	[-]	1.25							

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

Section 13. THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (SHEAR – WITH LEVER ARM)

Threaded Rods - Characteristic Values for Steel Failure (Shear – with lever arm)										
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel Grade **4.6**	$M^0_{Rk,s}$	N.m	15	30	52	133	260	449	666	900
Partial Safety Factor	γ_{Ms}	[-]	1.67							
Steel Grade **5.8**	$M^0_{Rk,s}$	N.m	19	37	66	166	325	561	832	1125
Partial Safety Factor	γ_{Ms}	[-]	1.25							
Steel Grade **8.8**	$M^0_{Rk,s}$	N.m	30	60	105	266	519	898	1332	1799
Partial Safety Factor	γ_{Ms}	[-]	1.25							
Steel Grade **10.9***	$M^0_{Rk,s}$	N.m	37	75	131	333	649	1123	1664	2249
Partial Safety Factor	γ_{Ms}	[-]	1.50							
Stainless Steel Grade **A4-70**	$M^0_{Rk,s}$	N.m	26	52	92	233	454	786	1165	1574
Partial Safety Factor	γ_{Ms}	[-]	1.56							
Stainless Steel Grade **A4-80**	$M^0_{Rk,s}$	N.m	30	60	105	266	519	898	1332	1799
Partial Safety Factor	γ_{Ms}	[-]	1.33							
Stainless Steel Grade **1.4529**	$M^0_{Rk,s}$	N.m	26	52	92	233	454	786	1165	1574
Partial Safety Factor	γ_{Ms}	[-]	1.25							
Concrete pryout failure										
Factor k_8	k_8		2							
Partial Safety Factor	γ_{Ms}		1.50							

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

Section 14. INSTALLATION PARAMETERS - REBAR

Installation Parameters - Rebar									
Size			**8**	**10**	**12**	**16**	**20**	**25**	**32**
Nominal Drill Hole Diameter	d_o	mm	12	14	16	20	25	32	40
Diameter of Cleaning Brush	d_b	mm	14	14	19	22	29	40	42
Minimum Embedment Depth	h_{ef}	mm	64	80	96	128	160	200	256
Maximum Embedment Depth	h_{ef}	mm	160	200	240	320	400	500	640
Minimum Edge Distance	c_{min}	mm	35	40	50	65	80	100	130
Minimum Spacing	s_{min}	mm	35	40	50	65	80	100	130
Minimum Member Thickness	h_{min}	mm	h_{ef} + 30 mm ≥ 100mm			$h_{ef} + 2d_o$			

Section 15. CHARACTERISTIC RESISTANCE – COMBINED PULL-OUT & CONCRETE CONE FAILURE FOR REBAR

Characteristic Resistance - Combined Pullout & Concrete Cone Failure for Rebar										
Rebar Diameter (mm)				**8**	**10**	**12**	**16**	**20**	**25**	**32**
Characteristic Bond Resistance in Uncracked Concrete For a Working Life of 50 Years Dry/Wet Concrete and Flooded Holes -40 to 80		$\tau_{Rk,uncr}$	N/mm²	12.0	10.0	10.0	9.0	9.0	9.0	5.5
Installation Factor	Dry/saturated Concrete	γ_{inst}	[-]	1.2						
	Flooded Holes			1.4						
Factor for Concrete		Ψ_c	C50/60	1.00						

Splitting Failure - Rebar									
Size			**8**	**10**	**12**	**16**	**20**	**25**	**32**
Edge Distance	$c_{cr,sp}$	mm	$1{,}5h_{ef}$						
Spacing	$s_{cr,sp}$	mm	$3{,}0h_{ef}$						

Section 16. RESISTANCE VALUES FOR REINFORCING BARS IN UNCRACKED CONCRETE – 50 YEARS WORKING LIFE

Resistance Values for Reinforcing Bars in Uncracked Concrete - 50 years working life
Combined Pullout & Concrete Cone Failure and Concrete Cone Failure
Temperature Range: -40°C to 80°C

Property			Rebar Diameter						
			8mm	10mm	12mm	16mm	20mm	25mm	32mm
Effective Embedment Depth = MIN = 8d	h_{ef}	mm	64	80	96	128	160	200	256
Design Resistance	N_{Rd}	kN	10.5	13.5	20.0	32.0	50.0	77.0	78.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240	300	384
Design Resistance	N_{Rd}	kN	16.0	20.5	30.0	48.0	75.0	117.5	117.5
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400	500	640
Design Resistance	N_{Rd}	kN	26.5	34.5	50.0	80.0	125.5	196.0	196.5

1. Resistance values are based on combined pullout & concrete cone failure and concrete cone failure according to EC2-4 Resistance for steel failure must also be considered - the lowest value controls.
2. Resistance values are for single anchors without close edges or eccentric loading considerations.
3. Tabulated values correspond to the above stated temperature range and installation conditions only.
4. Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals,e.g.: diurnal cycling.
5. The cylinder compressive strength of the concrete (fck),is assumed to be 20 N/mm2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Section 17. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C1 – COMBINED PULL-OUT & CONCRETE CONE FAILURE USING THREADED RODS

Seismic Category C1

Characteristic Resistance - Combined Pullout & Concrete Cone Failure Using Threaded Rods

Size				M10	M12	M16	M20	M24
Characteristic Bond Resistance Category C1 for 50 years working life -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	5.5	5.5	5.5	4.2	5.0
Installation Factor	Dry Concrete	γ_{inst}	[-]	1.2				
	Flooded Holes			1.4				
Factor for Concrete		Ψ_c	C30/37	1.12				
			C40/50	1.23				
			C50/60	1.30				

Section 18. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C1 – THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (TENSION)

Seismic Category C1

Threaded Rods - Characteristic Values for Steel Failure (Tension)

Size			M10	M12	M16	M20	M24
Steel Grade **4.6**	$N_{Rk,s}$	kN	23	34	63	98	141
Partial Safety Factor	γ_{Ms}	[-]	2				
Steel Grade **4.8**	$N_{Rk,s}$	kN	23	34	63	98	141
Partial Safety Factor	γ_{Ms}	[-]	1.5				
Steel Grade **5.6**	$N_{Rk,s}$	kN	29	42	79	123	177
Partial Safety Factor	γ_{Ms}	[-]	2.00				
Steel Grade **5.8**	$N_{Rk,s}$	kN	29	42	79	123	177
Partial Safety Factor	γ_{Ms}	[-]	1.50				
Steel Grade **8.8**	$N_{Rk,s}$	kN	46	67	126	196	282
Partial Safety Factor	γ_{Ms}	[-]	1.50				
Steel Grade **10.9***	$N_{Rk,s}$	kN	58	84	157	245	353
Partial Safety Factor	γ_{Ms}	[-]	1.40				
Stainless Steel Grade **A4-70**	$N_{Rk,s}$	kN	41	59	110	172	247
Partial Safety Factor	γ_{Ms}	[-]	1.90				
Stainless Steel Grade **A4-80**	$N_{Rk,s}$	kN	46	67	126	196	282
Partial Safety Factor	γ_{Ms}	[-]	1.60				
Stainless Steel Grade **1.4529**	$N_{Rk,s}$	kN	41	59	110	172	247
Partial Safety Factor	γ_{Ms}	[-]	1.50				

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

Section 19. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C1 – THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (SHEAR-WITHOUT LEVER ARM)

Threaded Rods - Characteristic Values for Steel Failure (Shear – without lever arm)

Size			**M10**	**M12**	**M16**	**M20**	**M24**
Steel Grade **4.6**	$V_{Rk,s}$	kN	12	17	31	49	71
Partial Safety Factor	γ_{Ms}	[-]	1.67				
Steel Grade **4.8**	$V_{Rk,s}$	kN	12	17	31	49	71
Partial Safety Factor	γ_{Ms}	[-]	1.25				
Steel Grade **5.6**	$V_{Rk,s}$	kN	15	21	39	61	88
Partial Safety Factor	γ_{Ms}	[-]	1.68				
Steel Grade **5.8**	$V_{Rk,s}$	kN	15	21	39	61	88
Partial Safety Factor	γ_{Ms}	[-]	1.25				
Steel Grade **8.8**	$V_{Rk,s}$	kN	23	34	63	98	141
Partial Safety Factor	γ_{Ms}	[-]	1.25				
Steel Grade **10.9***	$V_{Rk,s}$	kN	29	42	79	123	177
Partial Safety Factor	γ_{Ms}	[-]	1.50				
Stainless Steel Grade **A4-70**	$V_{Rk,s}$	kN	20	30	55	86	124
Partial Safety Factor	γ_{Ms}	[-]	1.56				
Stainless Steel Grade **A4-80**	$V_{Rk,s}$	kN	23	34	63	98	141
Partial Safety Factor	γ_{Ms}	[-]	1.33				
Stainless Steel Grade **1.4529**	$V_{Rk,s}$	kN	20	30	55	86	124
Partial Safety Factor	γ_{Ms}	[-]	1.25				

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

Section 20. RESISTANCE VALUES FOR THREADED ROD IN SEISMIC CATEGORY C1 - 50 YEARS WORKING LIFE - Combined Pull-out & Concrete Cone Failure and Concrete Cone Failure

Resistance Values for Threaded Rod in Seismic Category C1 - 50 years working life

Combined Pullout & Concrete Cone Failure and Concrete Cone FailureTemperature Range: -40°C to 80°C

Property	Unit		Anchor Diameter				
			M10	M12	M16	M20	M24
Effective Embedment Depth = MIN = 8d	h_{ef}	mm	80	96	128	160	192
Design Resistance	N_{Rd}	kN	7.5	11.0	19.5	23.0	41.5
Effective Embedment Depth = 12d	h_{ef}	mm	120	144	192	240	288
Design Resistance	N_{Rd}	kN	11.5	16.5	29.0	35.0	60.0
Effective Embedment Depth = STD	h_{ef}	mm	90	110	128	170	210
Design Resistance	N_{Rd}	kN	8.5	12.5	19.5	24.5	43.5
Effective Embedment Depth = MAX = 20d	h_{ef}	mm	200	240	320	400	480
Design Resistance	N_{Rd}	kN	19.0	27.5	49.0	58.5	100.5

1. Resistance values are based on combined pullout & concrete cone failure and concrete cone failure according to EC2-4.Resistance for steel failure must also be considered - the lowest value controls.
2. Resistance values are for single anchors without close edges or eccentric loading considerations.
3. Tabulated values correspond to the above stated temperature range and installation conditions only.
4. Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur overbrief intervals, e.g.: diurnal cycling.
5. The cylinder compressive strength of the concrete (fck),is assumed to be 20 N/mm2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Section 21. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C2 – COMBINED PULL-OUT & CONCRETE CONE FAILURE USING THREADED RODS

Seismic Category C2

Characteristic Resistance - Combined Pullout & Concrete Cone Failure Using Threaded Rods

Size				M12	M16	M20
Characteristic Bond Resistance Category C2 for 50 years working life -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	1.2	1.4	1.6
Installation Factor	Dry/Saturated Concrete	γ_{inst}	[-]	1.2		
	Flooded Holes			1.4		
Factor for Concrete		Ψ_c	C30/37	1.12		
			C40/50	1.23		
			C50/60	1.30		

Section 22. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C2 – THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (TENSION) – 50 YEARS DESIGN LIFE

Seismic category C2 - 50 years design life
Threaded Rods - Characteristic Values for Steel Failure (Tension).

Size			**M12**	**M16**	**M20**
Steel Grade **4.6**	$N_{Rk,s}$	kN	34	63	98
Partial Safety Factor	γ_{Ms}	[-]	2		
Steel Grade **4.8**	$N_{Rk,s}$	kN	34	63	98
Partial Safety Factor	γ_{Ms}	[-]	1.5		
Steel Grade **5.6**	$N_{Rk,s}$	kN	42	79	123
Partial Safety Factor	γ_{Ms}	[-]	2.00		
Steel Grade **5.8**	$N_{Rk,s}$	kN	42	79	123
Partial Safety Factor	γ_{Ms}	[-]	1.50		
Steel Grade **8.8**	$N_{Rk,s}$	kN	67	126	196
Partial Safety Factor	γ_{Ms}	[-]	1.50		
Steel Grade **10.9***	$N_{Rk,s}$	kN	84	157	245
Partial Safety Factor	γ_{Ms}	[-]	1.40		
Stainless Steel Grade **A4-70**	$N_{Rk,s}$	kN	59	110	172
Partial Safety Factor	γ_{Ms}	[-]	1.90		
Stainless Steel Grade **A4-80**	$N_{Rk,s}$	kN	67	126	196
Partial Safety Factor	γ_{Ms}	[-]	1.60		
Stainless Steel Grade **1.4529**	$N_{Rk,s}$	kN	59	110	172
Partial Safety Factor	γ_{Ms}	[-]	1.50		

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

Section 23. CHARACTERISTIC RESISTANCE FOR SEISMIC LOADING CATEGORY C2 – THREADED RODS – CHARACTERISTIC VALUES FOR STEEL FAILURE (SHEAR-WITHOUT LEVER ARM)

Threaded Rods - Characteristic Values for Steel Failure (Shear – without lever arm)

Size			**M12**	**M16**	**M20**
Steel Grade **4.6**	$V_{Rk,s}$	kN	17	31	49
Partial Safety Factor	γ_{Ms}	[-]	1.67		
Steel Grade **4.8**	$V_{Rk,s}$	kN	17	31	49
Partial Safety Factor	γ_{Ms}	[-]	1.25		
Steel Grade **5.6**	$V_{Rk,s}$	kN	21	39	61
Partial Safety Factor	γ_{Ms}	[-]	1.68		
Steel Grade **5.8**	$V_{Rk,s}$	kN	21	39	61
Partial Safety Factor	γ_{Ms}	[-]	1.25		
Steel Grade **8.8**	$V_{Rk,s}$	kN	34	63	98
Partial Safety Factor	γ_{Ms}	[-]	1.25		
Steel Grade 10.9*	$V_{Rk,s}$	kN	42	79	123
Partial Safety Factor	γ_{Ms}	[-]	1.50		
Stainless Steel Grade **A4-70**	$V_{Rk,s}$	kN	30	55	86
Partial Safety Factor	γ_{Ms}	[-]	1.56		
Stainless Steel Grade **A4-80**	$V_{Rk,s}$	kN	34	63	98
Partial Safety Factor	γ_{Ms}	[-]	1.33		
Stainless Steel Grade **1.4529**	$V_{Rk,s}$	kN	30	55	86
Partial Safety Factor	γ_{Ms}	[-]	1.25		

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

Section 24. RESISTANCE VALUES FOR THREADED ROD IN SEISMIC CATEGORY C2 - 50 YEARS WORKING LIFE - Combined Pull-out & Concrete Cone Failure and Concrete Cone Failure

Resistance Values for Threaded Rod in Seismic Category C2 - 50 years working life
Combined Pullout & Concrete Cone Failure and Concrete Cone Failure
Temperature Range: -40°C to 80°C

Property	Unit		Anchor Diameter		
			M12	M16	M20
Effective Embedment Depth = MIN = 8d	h_{ef}	mm	96	128	160
Design Resistance	N_{Rd}	kN	2.0	5.0	8.5
Effective Embedment Depth = 12d	h_{ef}	mm	144	192	240
Design Resistance	N_{Rd}	kN	3.5	7.5	13.0
Effective Embedment Depth = STD	h_{ef}	mm	110	128	170
Design Resistance	N_{Rd}	kN	2.5	5.0	9.0
Effective Embedment Depth = MAX = 20d	h_{ef}	mm	240	320	400
Design Resistance	N_{Rd}	kN	6.0	12.5	22.0

1. Resistance values are based on combined pullout & concrete cone failure and concrete cone failureaccording to EC2-4. Resistance for steel failure must also be considered - the lowest value controls.
2. Resistance values are for single anchors without close edges or eccentric loading considerations.
3. Tabulated values correspond to the above stated temperature range and installation conditions only.
4. Long term temperatures are those that remain roughly constant over prolonged periods. Short termtemperatures occur over brief intervals, e.g.: diurnal cycling.
5. The cylinder compressive strength of the concrete (fck),is assumed to be 20 N/mm2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficientto avoid splitting failure.

Section 25. POST INSTALLED REBAR – INSTALLATION PARAMETERS

Minimum concrete cover c_{min} depending on drilling method

Drilling method	Bar diameter ϕ	Without drilling aid c_{min}	With drilling aid c_{min}
Hammer drilling	< 25 mm	30 mm + 0,06 $\ell_v \geq 2\phi$	30 mm + 0,02 $\ell_v \geq 2\phi$
	≥ 25 mm	40 mm + 0,06 $\ell_v \geq 2\phi$	40 mm + 0,02 $\ell_v \geq 2\phi$
Compressed air drilling	< 25 mm	50 mm + 0,08 ℓ_v	50 mm + 0,02 ℓ_v
	≥ 25 mm	60 mm + 0,08 $\ell_v \geq 2\phi$	60 mm + 0,02 $\ell_v \geq 2\phi$

Minimum anchorage length $\ell_{bd,PIR}$ and minimum anchorage lap length $\ell_{0,PIR}$

Minimum anchorage length

$\ell_{b,PIR} = \alpha_{lb} \bullet \ell_{b,min}$

α_{lb}= amplification factor for minimum anchorage length (see Section 29. DESIGN BOND STRENGTH FOR 50 YEARS WORKING LIFE)

$\ell_{b,min}$= minimum anchorage length of cast-in rebar according to EN 1992-1-1, eq. 8.6

Minimum lap length

$\ell_{0,PIR} = \alpha_{lb} \bullet \ell_{0,min}$

α_{lb}= amplification factor for minimum anchorage length (see Section 29. DESIGN BOND STRENGTH FOR 50 YEARS WORKING LIFE)

$\ell_{0,min}$= minimum lap length of cast-in rebar according to EN 1992-1-1, eq. 8.11

Drilling diameter and maximum embedment depth

Rebar diameter d_{nom} 1)	Nominal drilling diameter d_{cut}	Max permissible embedment depth $\ell_{v,max}$
[mm]	[mm]	[mm]
8	12 (10)	400
10	14 (12)	500
12	16	600
14	18	700
16	20	800
20	25	1000
25	32	1000
28	35	1000
32	40	1000

1) The maximum outer rebar diameter over the ribs shall be: nominal diameter of the bar d_{nom} + 0,20 d_{nom}

Section 26. DESIGN BOND STRENGTH FOR 50 YEARS WORKING LIFE

Design bond strength of post-installed rebar $f_{bd,PIR}$

$f_{bd,PIR} = k_b \bullet f_{bd}$

k_b = reduction factor

f_{bd} = design bond strength of cast-in rebar according to EN 1992-1-1

Values of the design bond strength of post installed rebar $f_{bd,PIR}$ for all drilling methods for good bond conditions

Rebar Ø 8 to 16									
Concrete class	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
k_b [-]	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
$f_{bd,PIR}$ [N/mm²]	**1,6**	**2,0**	**2,3**	**2,7**	**3,0**	**3,4**	**3,7**	**4,0**	**4,3**
Rebar Ø 20									
Concrete class	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
k_b [-]	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,92	0,86
$f_{bd,PIR}$ [N/mm²]	**1,6**	**2,0**	**2,3**	**2,7**	**3,0**	**3,4**	**3,7**		
Rebar Ø 25									
Concrete class	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
k_b [-]	1,0	1,0	1,0	1,0	1,0	0,90	0,82	0,76	0,71
$f_{bd,PIR}$ [N/mm²]	**1,6**	**2,0**	**2,3**	**2,7**	**3,0**				
Rebar Ø 28									
Concrete class	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
k_b [-]	1,0	1,0	1,0	1,0	0,88	0,8	0,73	0,67	0,63
$f_{bd,PIR}$ [N/mm²]	**1,6**	**2,0**	**2,3**	**2,7**					
Rebar Ø 32									
Concrete class	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
k_b [-]	1,0	1,0	1,0	0,86	0,76	0,69	0,63	0,58	0,54
$f_{bd,PIR}$ [N/mm²]	**1,6**	**2,0**	**2,3**						

Tabulated values are valid for good bond conditions according to EN 1992-1-1. For all other bond conditions multiply the values by 0,7.

Amplification factor for minimum anchorage length

Rebar	Amplification factor	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
Ø 8	α_{lb}	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 10		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 12		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 14		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 16		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 20		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 25		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ø 28		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,5
Ø 32		1,0	1,0	1,0	1,0	1,0	1,5	1,5	1,5	1,5

Section 27. IMPORTANT NOTES

Important Notes:

Use in Porous Substrates

This bonded anchor is not intended for use as a cosmetic or decorative product. When anchoring into porous or reconstituted stone it is recommended that technical assistance is sought. Due to the nature of the product, migration of the monomer in the resin may cause staining in certain materials. If you are still uncertain, it is advisable to test the resin by applying it in a small, discrete area and testing before using theresin on the project.

Whilst all reasonable care is taken in compiling technical data on the Company's products, all recommendations or suggestions regarding the use of such products are made without guarantee, since the conditions of use are beyond the control of the Company. It is the customer's responsibility to satisfy himself that each product is fit for the purpose for which he intends to use it, that the actual conditions of use are suitable and that, in the light of our continual research and development programme the information relating to each product has not been superseded.