rbs P400C+

Description

rbs P400C+ an extra high performance, styrene free, anchoring mortar with Seismic C2 certification. This caters to both cracked and non-cracked concrete under any environmental condition—dry, wet, or flooded—while maintaining consistent bond strengths.

Employing an injection-type anchor system compatible with both galvanized and stainless steel elements like threaded rods or rebars, supports advanced drilling methods such as Hammer Drilling (HD), Diamond Core Drilling (DD), and Dustless Drilling (HDB).

Free of styrene and very low in odour, ideally suited for indoor use and confined spaces, offering superior performance and safety.

Features

- Suitable for both cracked and uncracked concrete.
- Styrene Free - low hazard formula.
- Suitable for use with close edge distance and small anchor spacings.
- Installation in dry, wet or flooded conditions, while maintaining consistent bond and product performance.
- Gel and cure times are not affected by the presence of humidity in the drilled holes.
- Non-sag thixotropic formulation for overhead applications without specific accessories.
- Economical: reduced drilling diameters, 22mm for M20 and 26mm for M24; result in significant material and labour savings.
- Variable installation depths from 4 to 20 times the anchor diameter.
- ETA Approved.
- C2 Seismic category - qualification procedure for more demanding structural and non-structural applications via critical tests with pulsating loads on dynamic cracks. Also beneficial for other types of dynamic forces including vibration, high winds and heavy impacts.
- Low odour for better application indoors or in confined spaces.
- Available in 410ml co-axial cartridges.
- Ratio of 10:1 Resin to Curing Component.
- 100 Years working life.
- Fire Exposure Curve for threaded rods (up to 341°C) and post-installed rebar connections (up to 308°C).

Approvals and Tests

- ETA according to EAD 330499-02-0601 (Formerly TR29).
- ETA according to EAD 330087-01-0601 (TR023: Rebar Connections).

Base Materials

- Cracked concrete
- Uncracked concrete
- Masonry solid
- Masonry hollow
- Solid rock
- Autoclaved Aerated concrete (AAC)
- Hard natural stone
- Voided stone
- Voided rock

Uses and applications

- Canopies
- Racking
- Boilers
- Machinery
- Bicycle racks
- Hand rails
- Safety barriers
- Balcony fences

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.

Health & Safety

When working with rbs P400C+ suitable protective clothing, eye/face protection and gloves should be worn.

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

Working & loading times

Cartridge Temperature	T Work	Base Material Temperature	T Load
5°C	18 Minutes	5°C	145 Minutes
5°C to 10°C	10 Minutes	5°C to 10°C	145 Minutes
10°C to 20°C	6 Minutes	10°C to 20°C	85 Minutes
20°C to 25°C	5 Minutes	20°C to 25°C	50 Minutes
25°C to 30°C	4 Minutes	25°C to 30°C	40 Minutes
30°C		30°C	35 Minutes

Note: The minimum cartridge temperature is +5°C.
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.

Physical properties

Property		Typical value	Unit	Test Standard
Compressive Strength	24 hrs	60	N/mm²	ASTM D695 @ +20°C
	7 days	70		
Tensile Strength	24 hrs	11.5	N/mm²	ASTM D 638 @ +20°C
	7 days	12.2		
Elongation at Break	24 hrs	0.1	%	ASTM D 638 @ +20°C
	7 days	0.1		
Tensile Modulus	24 hrs	3	GN/mm²	ASTM D638 @+20°C
	7 days	4		
Flexural Strength	7 days	28	N/mm²	ASTM D 790 @ +20°C

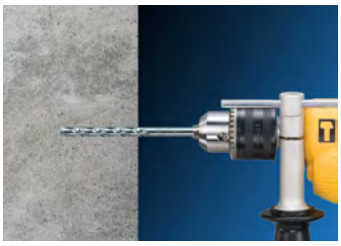
Chemical resistance

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

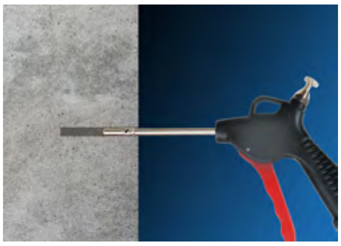
v = Resistant to 75°C with at least 80% of physical properties retained.
c = Contact only to a maximum of 25°C.
x = Not resistant.

rbs P400C+

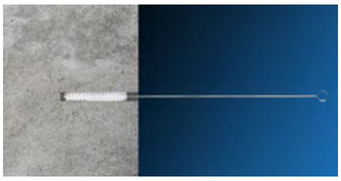
Bonded fasteners for use in concrete based on EAD 330499-02-0601 (anchoring).
Solid substrate installation method



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



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



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

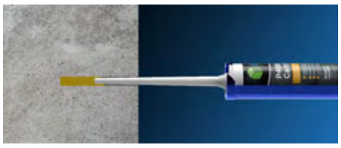
4. Repeat step 2 (blowing operation x2)

5. Repeat step 3 (brushing operation x2)

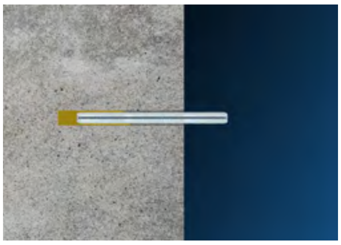
6. Repeat step 2 (blowing operation x2)

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

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



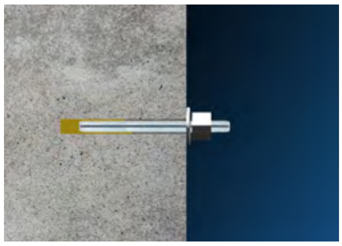
9. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. Ensure no air voids are created as the nozzle is withdrawn. Inject resin until the hole is approximately ¾ full and remove the nozzle from the hole.



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

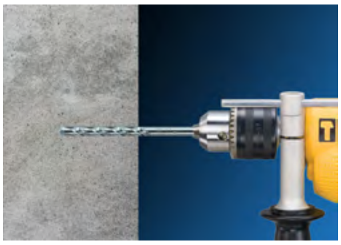
11. Clean any excess resin from around the mouth of the hole.

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



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

Deep embedment & overhead installation method



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

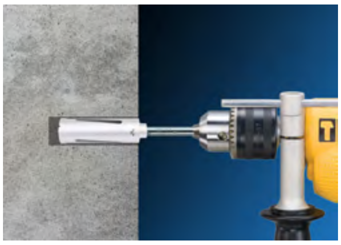
2a. Attach the correct diameter and length extension tube to the nozzle. Where necessary select the correct diameter resin stopper for the application, then push and screw the extension tube into the resin stopper. This is held in place with a coarse internal thread. The resin stopper is a reusable accessory.

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

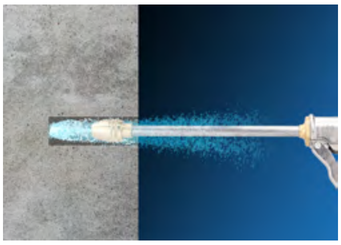
4a. Ensure the extension tube is angled to allow free movement of the resin stopper as the resin is extruded.

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

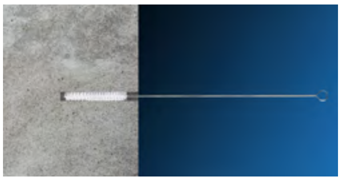
Diamond core drilling



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



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



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

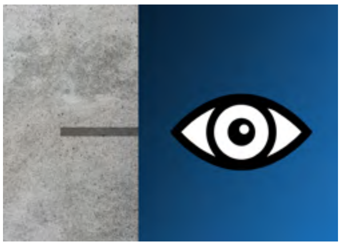
4b. Repeat step 2b (flushing operation x2).

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

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

Dustless drilling

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



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

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

Installation parameters – threaded rods

Size			M8	M10	M12	M16	M20	M24
Nominal Drill Hole Diameter	d_o	mm	10	12	14	18	22	26
Diameter of Cleaning Brush	d_b	mm	14	14	20	20	29	29
Torque Moment	T_{inst}	mm	10	20	40	80	120	160
Minimum Embedment Depth	h_{ef}	mm	60	60	70	80	90	96
Maximum Embedment Depth	h_{ef}	mm	160	200	240	320	400	480
Depth of drill hole	h_0	mm	$h_{ef} + 5$	$h_{ef} + 5$	$h_{ef} + 5$	$h_{ef} + 5$	$h_{ef} + 5$	$h_{ef} + 5$
Minimum Edge Distance	C_{min}	mm	40	40	50	70	80	100
Minimum Spacing	S_{min}	mm	40	40	50	70	80	100
Minimum Member Thickness	h_{min}	mm	h_{ef} +30 mm ≥ 100 mm			$h_{ef} + 2\ d_o$		

Characteristic resistance - combined pullout & concrete cone failure using threaded rods

Size				M8	M10	M12	M16	M20	M24
Characteristic Bond Resistance in Uncracked Concrete Working Life of 50 Years and 100 Years Dry/Wet Concrete and Flooded Holes -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	11.0	10.0	10.0	9.0	7.5	7.0
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	5.0	5.0	4.5	4.0	4.0	4.0
Characteristic Bond Resistance in Cracked Concrete Working Life of 100 Years Dry/Wet Concrete and Flooded Holes -40°C to 80°C		$\tau_{Rk,cr}$	N/mm²	4.0	4.0	3.5	3.5	3.5	3.5
Partial safety factor	Dry/wet concrete	γ_{inst}	[-]	1.2	1.2	1.2	1.2	1.2	1.2
	Flooded holes	γ_{inst}	[-]	1.2	1.2	1.2	1.2	1.2	1.2
Factor for concrete	C25/30	Ψ_c	[-]	1.04					
	C30/37			1.08					
	C35/45			1.12					
	C40/50			1.15					
	C45/55			1.17					
	C50/60			1.19					
Factor for influence of sustained loading for a working life of 50 years (T: 50/80)		Ψ_{sus}	[-]	0.75	0.75	0.75	0.75	0.75	0.75

Splitting failure – threaded rods

Size			M8	M10	M12	M16	M20	M24
Edge distance	$C_{cr,sp}$	mm	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$
Spacing	$S_{cr,sp}$	mm	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$

Resistance values for threaded rod in uncracked concrete - 50 and 100 years working life

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

Size			M8	M10	M12	M16	M20	M24
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90	96
Design Resistance	N_{Rd}	kN	9.0	10.0	14.5	19.5	23.0	25.5
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170	210
Design Resistance	N_{Rd}	kN	12.0	15.5	23.0	32.0	44.5	61.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240	288
Design Resistance	N_{Rd}	kN	14.5	20.5	30.0	48.0	62.5	84.0
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400	480
Design Resistance	N_{Rd}	kN	24.5	34.5	50.0	80.0	104.5	140.5

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/mm^2.
6. Tabulated resistance values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

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

Size			M8	M10	M12	M16	M20	M24
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90	96
Design Resistance	N_{Rd}	kN	9.0	10.0	14.5	19.5	23.0	25.5
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170	210
Design Resistance	N_{Rd}	kN	12.0	15.5	23.0	32.0	44.5	61.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240	288
Design Resistance	N_{Rd}	kN	14.5	20.5	30.0	48.0	62.5	84.0
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400	480
Design Resistance	N_{Rd}	kN	24.5	34.5	50.0	80.0	104.5	140.5

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.

Resistance values for threaded rod in cracked concrete - 100 years working life

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

Size			M8	M10	M12	M16	M20	M24
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90	96
Design Resistance	N_{Rd}	kN	3.0	4.0	5.0	7.5	10.5	14.0
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170	210
Design Resistance	N_{Rd}	kN	4.0	6.0	8.0	12.5	20.5	30.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240	288
Design Resistance	N_{Rd}	kN	5.0	8.0	10.5	18.5	29.0	42.0
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400	480
Design Resistance	N_{Rd}	kN	8.5	13.5	17.5	31.0	48.5	70.0

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.

Threaded rods - characteristic values for steel failure (tension)

Size			Partial Safety Factor γMs	M8	M10	M12	M16	M20	M24
Steel Grade 4.6	$N_{Rk,s}$	kN	2.00	15	23	34	63	98	141
Steel Grade 4.8	$N_{Rk,s}$	kN	1.50	15	23	34	63	98	141
Steel Grade 5.6	$N_{Rk,s}$	kN	2.00	18	29	42	79	123	177
Steel Grade 5.8	$N_{Rk,s}$	kN	1.50	18	29	42	79	123	177
Steel Grade 8.8	$N_{Rk,s}$	kN	1.87	29	46	67	126	196	282
Stainless Steel Grade A4-80	$N_{Rk,s}$	kN	1.60	29	46	67	126	196	282
Stainless Steel Grade 1.4529	$N_{Rk,s}$	kN	1.50	26	41	59	110	172	247

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

Threaded rods - characteristic values for steel failure (shear – without lever arm)

Size			Partial Safety Factor γMs	M8	M10	M12	M16	M20	M24
Steel Grade 4.6	$V_{Rk,s}$	kN	1.67	7	12	17	31	49	71
Steel Grade 4.8	$V_{Rk,s}$	kN	1.25	7	12	17	31	49	71
Steel Grade 5.6	$V_{Rk,s}$	kN	1.68	9	15	21	39	61	88
Steel Grade 5.8	$V_{Rk,s}$	kN	1.25	9	15	21	39	61	88
Steel Grade 8.8	$V_{Rk,s}$	kN	1.56	15	23	34	63	98	141
Stainless Steel Grade A4-80	$V_{Rk,s}$	kN	1.33	15	23	34	63	98	141
Stainless Steel Grade 1.4529	$V_{Rk,s}$	kN	1.25	13	20	30	55	89	124

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

Threaded rods - characteristic values for steel failure (shear – with lever arm)

Size			Partial Safety Factor γMs	M8	M10	M12	M16	M20	M24
Steel Grade 4.6	$M^0_{Rk,s}$	N.m	1.67	15	30	52	133	260	449
Steel Grade 4.8	$M^0_{Rk,s}$	N.m	1.25	15	30	52	133	260	449
Steel Grade 5.6	$M^0_{Rk,s}$	N.m	1.67	19	37	66	166	325	561
Steel Grade 5.8	$M^0_{Rk,s}$	N.m	1.25	19	37	66	166	325	561
Steel Grade 8.8	$M^0_{Rk,s}$	N.m	1.25	30	60	105	266	519	898
Steel Grade 10.9*	$M^0_{Rk,s}$	N.m	1.50	37	75	131	333	649	1123
Stainless Steel Grade A4-70	$M^0_{Rk,s}$	N.m	1.56	26	52	92	233	454	786
Stainless Steel Grade A4-80	$M^0_{Rk,s}$	N.m	1.33	30	60	105	266	519	898
Stainless Steel Grade 1.4529	$M^0_{Rk,s}$	N.m	1.25	26	52	92	233	454	786
Concrete pryout failure									
Factor k **			-				2		
Partial safety factor			γMs				1.50		

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

** K Value from TR029 Design of bonded anchors pt 5.2.3.3

Seismic performance category C2 - hammer drilling, dustless drilling, tension load

For Steel Failure see paragraphs 2.7, 2.8

Size			M12	M16
Characteristic resistance to pull-out for a working life of 50 years				
Dry, wet concrete and flooded hole	$\tau_{Rk,C2}$	N/mm²	0.84	0.56
Characteristic resistance to pull-out for a working life of 100 years				
Dry, wet concrete and flooded hole	$\tau_{Rk,C2}$	N/mm²	0.56	0.37
Installation safety factor				
Dry, wet concrete	γ_{inst}	[-]	1.2	1.2
Hammer drilling - flooded hole	γ_{inst}	[-]	1.2	1.2
Dustless drilling - flooded hole	γ_{inst}	[-]	1.4	1.4

Seismic performance category C2 – steel failure without level arm, shear load

Size			Partial Safety Factor γ_{Ms}	M12	M16
Steel Grade 4.6	$V_{Rk,s,C2}$	kN	1.67	13.6	27.3
Steel Grade 4.8	$V_{Rk,s,C2}$	kN	1.25	13.6	27.3
Steel Grade 5.6	$V_{Rk,s,C2}$	kN	1.67	17.0	34.1
Steel Grade 5.8	$V_{Rk,s,C2}$	kN	1.25	17.0	34.1
Steel Grade 8.8	$V_{Rk,s,C2}$	kN	1.25	27.1	54.6
Stainless Steel Grade A2-70, A4-70	$V_{Rk,s,C2}$	kN	1.56	23.8	47.8
Stainless Steel Grade A4-80	$V_{Rk,s,C2}$	kN	1.33	27.1	54.6
Stainless Steel Grade 1.4529	$V_{Rk,s,C2}$	kN	1.25	25.7	54.4
Stainless Steel Grade 1.4565	$V_{Rk,s,C2}$	kN	1.56	25.7	54.4
Characteristic shear load resistance $V_{Rk,s,eq}$ in the Table C8 shall be multiplied by following reduction factor for hot-dip galvanized commercial standard rods					
Reduction factor for hot-dip galvanized rods	$\alpha_{v,h\text{-}dg,c2}$	[-]		0.46	0.61
Factor for annular gap	α_{gap}	[-]		0.5	0.5

*Steel grade 10.9 is not qualified for seismic performance category C2

Seismic performance category C2 – displacements under tensile and shear load

Size		M12	M16
$\delta_{N,C2(50\%)}$	mm	0.13	0.12
$\delta_{N,C2(100\%)}$	mm	0.24	0.17
$\delta_{V,C2(50\%)}$	mm	4.68	4.07
$\delta_{V,C2(100\%)}$	mm	8.02	6.76

The anchor shall be used with minimum rupture elongation after fracture A5 ≥ 9%.
Note: Rebars are not qualified for seismic design

Installation parameters – rebar

Size			8mm	10mm	12mm	16mm	20mm
Nominal Drill Hole Diameter	d_0	mm	12	14	16	20	25
Diameter of Cleaning Brush	d_b	mm	14	14	19	22	29
Minimum Embedment Depth	h_{ef}	mm	60	60	70	80	90
Maximum Embedment Depth	h_{ef}	mm	160	200	240	320	400
Depth of drill hole	h_0	mm	h_{ef} + 5	h_{ef} + 5	h_{ef} + 5	h_{ef} + 5	h_{ef} + 5
Minimum Edge Distance	C_{min}	mm	40	40	50	70	80
Minimum Spacing	S_{min}	mm	40	40	50	70	80
Minimum Member Thickness	h_{min}	mm	h_{ef} +30 mm ≥ 100 mm			h_{ef} + 2 d_0	

Characteristic resistance - combined pullout & concrete cone failure for rebar

Size				8mm	10mm	12mm	16mm	20mm
Characteristic Bond Resistance in Uncracked Concrete Working Life of 50 Years and 100 Years Dry/Wet Concrete and Flooded Holes -40°C to 80°C		$\tau_{Rk,uncr}$	N/mm²	8.5	8.0	8.0	7.0	7.0
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	4.0	3.5	3.5	3.5	3.5
Characteristic Bond Resistance in Cracked Concrete Working Life of 100 Years Dry/Wet Concrete and Flooded Holes -40°C to 80°C		$\tau_{Rk,cr}$	N/mm²	3.0	3.0	2.5	2.5	2.5
Partial safety factor	Dry/wet concrete	γ_{inst}	[-]	1.2	1.2	1.2	1.2	1.2
	Flooded holes	γ_{inst}	[-]	1.2	1.2	1.2	1.2	1.2
Factor for concrete	C25/30	Ψ_c	[-]	1.04				
	C30/37			1.08				
	C35/45			1.12				
	C40/50			1.15				
	C45/55			1.17				
	C50/60			1.19				
Factor for influence of sustained loading for a working life of 50 years		Ψ_{sus}	[-]	0.75	0.75	0.75	0.75	0.75

Splitting failure - rebar

Size			8mm	10mm	12mm	16mm	20mm
Edge distance	$C_{cr,sp}$	mm	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$	$2h_{ef}$
Spacing	$S_{cr,sp}$	mm	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$	$4h_{ef}$

Resistance values for reinforcing bars in uncracked concrete - 50 and 100 years working life

Combined Pullout & Concrete Cone Failure and Concrete Cone Failure

Temperature Range: -40°C to 80°C

Size			8mm	10mm	12mm	16mm	20mm
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90
Design Resistance	N_{Rd}	kN	7.0	8.0	11.5	15.5	21.5
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170
Design Resistance	N_{Rd}	kN	9.0	12.5	18.0	25.0	41.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240
Design Resistance	N_{Rd}	kN	11.0	16.5	24.0	37.5	58.5
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400
Design Resistance	N_{Rd}	kN	18.5	27.5	40.0	62.5	97.5

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.

Resistance values for reinforcing bars in cracked concrete - 50 years working life

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

Size			8mm	10mm	12mm	16mm	20mm
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90
Design Resistance	N_{Rd}	kN	3	4	5	8	11
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170
Design Resistance	N_{Rd}	kN	4.0	5.0	8.0	12.5	20.5
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240
Design Resistance	N_{Rd}	kN	5.0	7.0	10.5	18.5	29.0
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400
Design Resistance	N_{Rd}	kN	8.5	12.0	17.5	31.0	48.5

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.

Resistance values for reinforcing bars in cracked concrete - 100 years working life

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

Size			8mm	10mm	12mm	16mm	20mm
Effective Embedment Depth = MIN	h_{ef}	mm	60	60	70	80	90
Design Resistance	N_{Rd}	kN	2.50	3.00	3.50	5.50	7.50
Effective Embedment Depth = STD	h_{ef}	mm	80	90	110	128	170
Design Resistance	N_{Rd}	kN	3.00	4.50	5.50	8.50	14.50
Effective Embedment Depth = 12d	h_{ef}	mm	96	120	144	192	240
Design Resistance	N_{Rd}	kN	4.00	6.00	7.50	13.00	20.50
Effective Embedment Depth = 20d	h_{ef}	mm	160	200	240	320	400
Design Resistance	N_{Rd}	kN	6.50	10.00	12.50	22.00	34.50

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.

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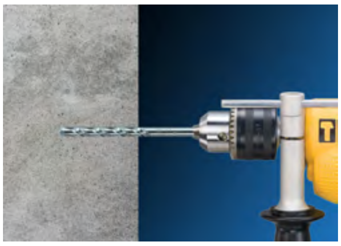
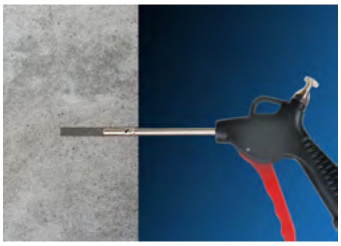
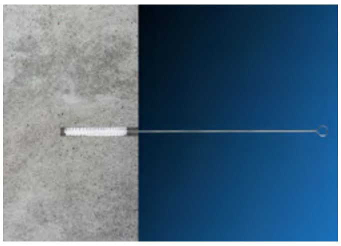
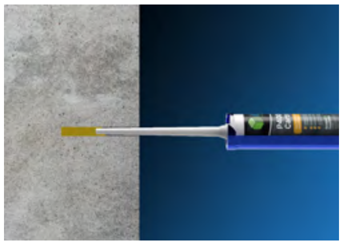
Systems for post-installed rebar connections with mortar according to EAD 330087-01-0601

Installation method

The borehole must be free of dust, debris, water, ice, oil, grease and other contaminants prior to mortar injection.

Hammer drilling (HD) or Compressed air drilling (CA)

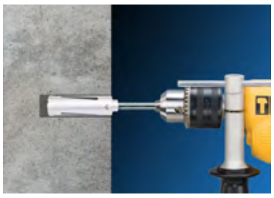
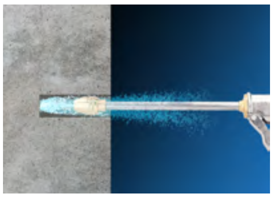
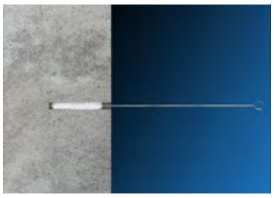
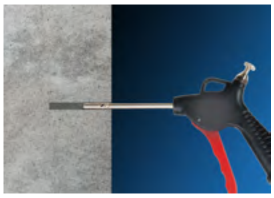
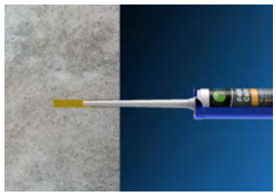
1. After drilling the hole, blow 2 times from the back of the hole with oil-free compressed air (min. 6 bar) until return air stream is free of noticed dust. A manual pump may be used for a drill depth of < 300 mm and for drill holes not larger than 20 mm diameter. Repeat this action twice.

2. Select the appropriate brush and extension, if necessary, insert the brush to the bottom of the hole and firmly withdraw with a twisting motion. There should be positive interaction between the bristles of the brush and the side of the hole otherwise a new brush should be chosen. Repeat this action twice.

3. Repeat operation 1 and 2.

4. Perform the blowing operation 1 more time with compressed air until the return air stream is free from noticeable dust.

Diamond core drilling (DD)

1. After drilling the hole, starting from the back of the hole, flush with pressurised water a minimum of two times and until there is only clean water.

2. Select the appropriate brush and extension, if necessary, insert the brush to the bottom of the hole and firmly withdraw with a twisting motion. There should be positive interaction between the bristles of the brush and the side of the hole otherwise a new brush should be chosen. Perform the brushing operation twice.

3. Repeat operation 1 and 2.

4. Blow 2 times from the back of the hole with oil-free compressed air (min. 6 bar) until the return air stream is free of noticed dust. Repeat this action twice.

Hammer drilling with hollow drill bit (HDB)


1. Use the specified hollow drill bit and follow the manufacturers instruction. Ensure the vacuum system is on.

2. After drilling the hole, perform a visual inspection to ensure the system has worked correctly and that no debris remains.

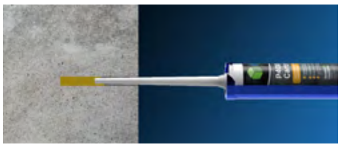
3. No further cleaning process is necessary.

Mortar injection

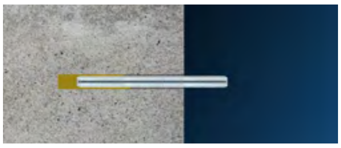
1. Affix the mixer nozzle, open the cartridge and screw onto the mouth of the cartridge. Insert the cartridge into the correct applicator gun.

2. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

3. If necessary, cut extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for rebars 16 mm dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.



4. Insert the mixer nozzle (resin stopper / extension tube if applicable) 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 remove the mixer nozzle completely.



5. Insert the rebar, 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.

6. Any excess resin should 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.

7. Leave the anchor to cure.

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

Installation parameters

Rebar		Drill hole Diameter (mm)	Cleaning Brush	Min. Anchorage Length (mm)	Min. Lap/Splice Length (mm)	Max. Embedment Depth (mm)
Diameter (mm)	f_{yk} (N/mm²)					
8	500	12	Pipe brush 13-14mm	113	200	400
10	500	14	Pipe brush 19-20mm	141	212	500
12	500	16	Pipe brush 19-20mm	170	255	600
14	500	18	Pipe brush 19-20mm	198	297	700
16	500	20	Pipe brush 22-24mm	226	340	800
18	500	22	Pipe brush 22-24mm	255	382	900
20	500	25	Pipe brush 28-29mm	283	425	1000
22	500	28	Pipe brush 28-29mm	311	467	1000
24	500	32	Pipe brush 40-42mm	340	510	1000
25	500	32	Pipe brush 40-42mm	354	531	1000

Note:
Installation parameters are based on C20/25 concrete
Minimum Anchorage Length:
$l_{bPIR} = \alpha_{lb} \cdot \ell_{b,min}$
α_{lb} = amplification factor for minimum anchorage length
$\ell_{b,min}$ = minimum anchorage length of cast-in rebar according to EN 1992-1-1, eq. 8.6

Design Bond Strength for 50 and 100 years working life for hammer drilling or dustless drilling methods for good bond conditions

Rebar Diameter (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8	1.60	2.00	2.30	2.70	3.00	3.00	3.00	3.00	3.00
10	1.60	2.00	2.30	2.70	3.00	3.00	3.00	3.00	3.00
12	1.60	2.00	2.30	2.70	3.00	3.00	3.00	3.00	3.00
14	1.60	2.00	2.30	2.70	2.70	3.00	3.00	3.00	3.00
16	1.60	2.00	2.30	2.70	2.70	3.00	3.00	3.00	3.00
18	1.60	2.00	2.30	2.70	2.70	2.70	2.70	3.00	3.00
20	1.60	2.00	2.30	2.70	2.70	2.70	2.70	2.70	2.70
22	1.60	2.00	2.30	2.70	2.70	2.70	2.70	2.70	2.70
24	1.60	2.00	2.30	2.70	2.70	2.70	2.70	2.70	2.70
25	1.60	2.00	2.30	2.70	2.70	2.70	2.70	2.70	2.70

Reduction factor for 50 and 100 years working life for hammer drilling or dustless drilling methods for good bond conditions

Rebar Diameter (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.76	0.71
10	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.76	0.71
12	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.76	0.71
14	1.00	1.00	1.00	1.00	0.89	0.90	0.82	0.76	0.71
16	1.00	1.00	1.00	1.00	0.89	0.90	0.82	0.76	0.71
18	1.00	1.00	1.00	1.00	0.89	0.80	0.73	0.76	0.71
20	1.00	1.00	1.00	1.00	0.89	0.80	0.73	0.67	0.63
22	1.00	1.00	1.00	1.00	0.89	0.80	0.73	0.67	0.63
24	1.00	1.00	1.00	1.00	0.89	0.80	0.73	0.67	0.63
25	1.00	1.00	1.00	1.00	0.89	0.80	0.73	0.67	0.63

Note:

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.

Values for bond strengths have had reduction factors applied $f_{bd,PIR} = k_b \times f_{bd}$.

Amplification factor for embedment depth

Rebar Diameter (mm)	Amplification Factor	Concrete class								
		C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8	α_{lb}	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0
10	α_{lb}	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0
12	α_{lb}	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.0	1.0
14	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0
16	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.0
18	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
22	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
24	α_{lb}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
25	α_{lb}	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0

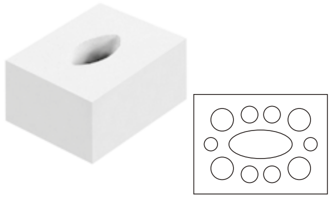
Metal injection anchors for use in masonry according to EAD 330076-01-0604

Types and dimensions of blocks and bricks

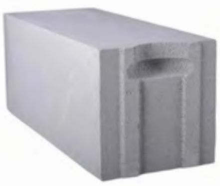
Brick No. 1		Brick No. 2	
	• Solid clay brick Mz 12-2,0-NF according to EN 771-1 • length/width/height = 240 mm/116 mm/71 mm • f_b ≥ 12 N/mm² • ρ_v ≥ 2,0 kg/dm³		• Solid sand lime brick KS 12-2,0-NF according to EN 771-2 • length/width/height = 240 mm/115 mm/70 mm • f_b ≥ 12 N/mm² • ρ ≥ 2,0 kg/dm³

Brick No. 3		Brick No. 4	
	• Hollow clay brick Porotherm 25 P+W KL15 according to EN 771-1 • length/width/height = 373 mm/250 mm/238 mm • f_b ≥ 12 N/mm² • ρ ≥ 0,9 kg/dm³		• Concrete masonry unit Hbn 4-12DF according to EN 771-3 • length/width/height = 370 mm/240 mm/238 mm • f_b ≥ 4 N/mm² • ρ ≥ 1,2 kg/dm³

Brick No. 5		Brick No. 6	
	• Hollow clay brick Hueco Doble according to EN 771-1 • length/width/height = 245 mm/110 mm/88 mm • f_b ≥ 2,5 N/mm² • ρ ≥ 0,74 kg/dm³		• Concrete hollow block Bloque Hormingon according to EN 771-3 • length/width/height = 400 mm/200 mm/200 mm • f_b ≥ 2,5 N/mm² • ρ ≥ 1,7 kg/dm³

Brick No. 7		Brick No. 8	
	• Hollow clay brick HLz 12-1,0-2DF according to EN 771-1 • length/width/height = 235 mm/112 mm/115 mm • f_b ≥ 12 N/mm² • ρ ≥ 1,0 kg/dm³		• Hollow sand lime brick KSL 12-1,4-3DF according to EN 771-2 • length/width/height = 240 mm/175 mm/113 mm • f_b ≥ 12 N/mm² • ρ ≥ 1,4 kg/dm³

Brick No. 9		Brick No. 10	
	• Lightweight concrete hollow block Hbl 4-0,7-8DF according to EN 771-3 • length/width/height = 250 mm/240 mm/248 mm • f_b ≥ 4, 1,0 N/mm² • ρ ≥ 0,7 kg/dm³		• Lightweight concrete hollow block Hbl 2-0,45-10DF according to EN 771-3 • length/width/height = 250 mm/300 mm/248 mm • f_b ≥ 2,0 N/mm² • ρ ≥ 0,45 kg/dm³



Brick No.	Strength class acc. To EN 771-4	L/W/H (mm)	f_b ≥ (N/mm²)	P (kg/dm³)
11	Autoclaved Aerated Concrete AAC2	599/375/249	≥ 2,0	≥ 0,35
12	Autoclaved Aerated Concrete AAC4	599/375/249	≥ 4,0	≥ 0,5
13	Autoclaved Aerated Concrete AA6	499/240/250	≥ 6,0	≥ 0,65

SPECIALITY PRODUCTS

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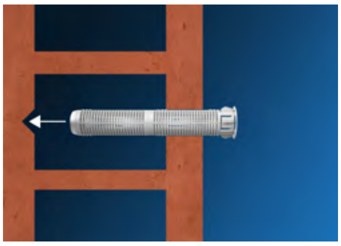
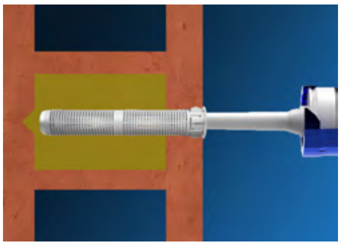
Installation in Hollow Masonry

Follow all instructions as per standard installation except the following:

a) If used in hollow or perforated brick masonry: Plug the centering cap and insert the correct size perforated sleeve flush with the surface of the base material.

b) If used in hollow or perforated brick masonry: Insert mixer nozzle to the end of the perforated sleeve and completely fill the sleeve with resin. Withdraw the mixer nozzle as the sleeve fills.





Installation parameters in solid and hollow masonry

Base Material			Brick No. 1-10						
Anchor Type			Anchor rod with sleeve				Internal threaded socket with sleeve		
Size			M8	M10	M12	M16	M8	M10	M12
Internal threaded socket	$d_{to} x l_t$	mm	-	-	-	-	12 x 80	14 x 80	16 x 80
Sieve Sleeve	l_s	mm	85	85	85	85	85	85	85
Sieve Sleeve	d_s	mm	15/16	15/16	15/16	20	15/16	20	20
Nominal drill hole diameter	d_0	mm	15/16	15/16	15/16	20	15/16	20	20
Diameter of cleaning brush	d_b	mm	$20^{\pm1}$	$20^{\pm1}$	$20^{\pm1}$	$22^{\pm1}$	$20^{\pm1}$	$22^{\pm1}$	$22^{\pm1}$
Depth of drill hole	h_0	mm	90	90	90	90	90	90	90
Effective anchorage depth	h_{ef}	mm	85	85	85	85	80	80	80
Diameter of clearance hole in the fixture	$d_f \leq$	mm	9	12	14	18	9	12	14
Torque moment	$T_{inst} \leq$	mm	2	2	2	2	2	2	2

Installation parameters in solid masonry without sleeve

Base Material			Brick No. 1-2				
Anchor Type			Anchor rod with sleeve				
Size			M6	M8	M10	M12	M16
Nominal drill hole diameter	d_0	mm	6	8	10	12	16
Diameter of cleaning brush	d_b	mm	$9^{\pm1}$	$14^{\pm1}$	$14^{\pm1}$	$14^{\pm1}$	$20^{\pm1}$
depth of drill hole	h_0	mm	80	90	90	90	90
Effective anchorage depth	h_{ef}	mm	80	90	90	90	90
Diameter of clearance hole in the fixture	$d_f \leq$	mm	7	9	12	14	18
Torque moment	$T_{inst} \leq$	mm	2	2	2	2	2

Edge distances and spacing – anchor rod

Brick No.	Anchor rod								
	M8			M10, M12			M16		
	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	Scr⊥ = Smin⊥	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	$S_{cr\perp} = S_{min\perp}$	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	$S_{cr\perp} = S_{min\perp}$
	mm	mm	mm	mm	mm	mm	mm	mm	mm
1	128	255	255	128	255	255	128	255	255
2	128	255	255	128	255	255	128	255	255
3	100	373	238	100	373	238	120	373	238
4	100	370	238	100	370	238	120	370	238
5	100	245	110	100	245	110	120	245	110
6	100	400	200	-	-	-	120	400	200
7	100	235	115	100	240	115	120	235	115
8	100	240	113	100	250	113	120	240	113
9	100	250	248	100	250	248	120	250	248
10	100	250	248	100	255	248	-	-	-

Edge distances and spacing – internal threaded socket

Brick No.	Internal threaded socket								
	M8			M10, M12			M16		
	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	$S_{cr\perp} = S_{min\perp}$	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	$S_{cr\perp} = S_{min\perp}$	C_{cr} = C_{min}	$S_{cr\parallel} = S_{min\parallel}$	$S_{cr\perp} = S_{min\perp}$
	mm	mm	mm	mm	mm	mm	mm	mm	mm
1	128	255	255	128	255	255	128	255	255
2	128	255	255	128	255	255	128	255	255
4	100	370	238	120	370	238	120	370	238
7	100	235	115	120	235	115	120	235	115
8	100	240	113	120	240	113	120	240	113
9	-	-	-	120	250	248	120	250	248
10	100	250	248	120	250	248	120	250	248

Edge distances and spacing in solid masonry without sleeve

Anchor Rod						
Brick No.	M6			M8, M10, M12, M16		
	Ccr = Cmin	Scr || = Smin ||	Scr⊥ = Smin⊥	Ccr = Cmin	Scr || = Smin ||	Scr⊥ = Smin⊥
	mm	mm	mm	mm	mm	mm
1	120	240	240	135	270	270
2	120	240	240	135	270	270

Limitations

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 the resin on the project.

Important Note

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 responsibility of the customer to satisfy themselves that each product is fit for the purpose for which they intend to use it. Ensure 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.

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