ChemSet™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Installation Related

Product

Chemset™ 801 Xtrem™ XC² is a heavy duty Vinylester for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-18/0045

Design according to:

- AS5216 (formerly TS101)
- EN1992-4 (formerly ETAG001 Annex C, E & TR045)
- Use enclosed data for simplified calculation method

Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

Benefits, Advantages and Features

- 50 year working Life
- Flooded Holes
- Fire rated

Greater productivity:

- Easy dispensing even in cold weather
- Apply torque in 2 hours @ 20ºC

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

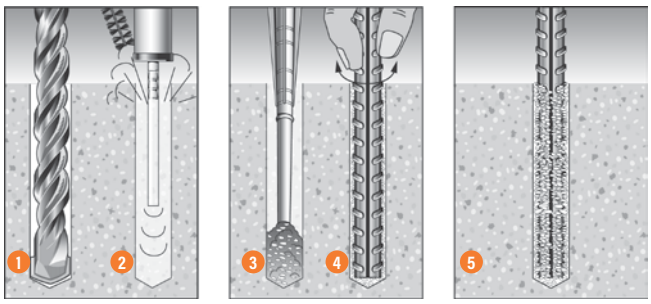
- Earthquake, Fire & Flooded Conditions
- Cold and temperate climates

Greater safety:

- Low odour
- Suitable for contact with drinking water
- VOC Compliant

Made in Australia

Installation



1. Drill or core hole to specified diameter and depth
2. **Important:** Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternatively, clean dust and debris from hole with stiff wire or nylon brush and blower in the following sequence: blow x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense 2-3 trigger pulls of adhesive to waste until colour is grey with no streaks
4. Insert tip of nozzle to bottom of hole and dispense adhesive
5. Fill hole to about 2/3 full
6. Insert reinforcing bar with rotating motion to release trapped air
7. Wait until adhesive has fully cured before loading (see Working Time / Loading Time chart)
8. Clean up with Acetone

Principal Applications

- Threaded Studs
- Starter Bars
- Threaded Inserts
- Over-head installation
- Steel Columns
- Hand Rails
- Road Stitching

Recommended Installation Temperatures

	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	5°C	40°C

Service Temperature Limits

-40°C to 80°C

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet concrete
+5°C	60 min	240 min	480 min
6°C - 10°C	40 min	180 min	360 min
11°C - 20°C	15 min	120 min	240 min
21°C - 30°C	8 min	90 min	180 min
31°C - 40°C	4 min	60 min	120 min
Note: Cartridge temperature minimum +5°C			

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Installation and performance details: ChemSet™ 801 Xtrem™ XC² and Reinforcing Bar

Anchor Size, d_b (mm)	Drilled Hole diam., d_h (mm)	Anchor Effective Depth, h (mm)	Optimum dimensions*			Reduced Characteristic Capacity #				
			Edge* distance, e_c (mm)	Anchor spacing, a_c (mm)	Concrete substrate thickness, b_m (mm)	Gr 500 Rebar - Steel		Non-Cracked Concrete		
						Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{uc} (kN)**		
								Concrete compressive strength, f'_c		
								20 MPa	32 MPa	40 MPa
10	12	90	135	270	115	31.4	21.4	24.5	25.5	26.2
12	15	110	165	330	140	45.2	30.8	35.9	37.4	38.5
16	20	125	187	375	160	80.4	54.8	54.5	56.6	58.3
20	25	150	225	450	190	125.6	85.7	60.2	76.2	85.4
		170	255	510	215			72.6	91.9	99.1

* Note: For shear loads acting towards an edge or where these optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.5
***Note: Reduced characteristic ultimate steel tensile capacity = ϕN_{us} where ϕ = 0.8 and N_{us} = Characteristic ultimate steel tensile capacity .
For conversion to Working Load Limit MULTIPLY ϕN_{us} x 0.56
#Note: Design Tensile Capacity ϕN_{ur} = minimum of ϕN_{uc} and ϕN_{us}
For Cracked Concrete performance, please use the simplified strength limit state design process to verify capacity.
Data is based on a Service temperature limit of -40°C to +40°C
Flooded Holes: Multiply ϕNuc x 0.75
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ 801 Xtrem™	750 ml	C801X750 (AU & NZ)
ChemSet™ 801 Xtrem™	380 ml	C801X380 (AU only)

Drilled hole depth, h1 (mm)
h1 = h
h = Effective depth

Substrate thickness b_m (mm)				
Anchor Stud Size (mm)				
10	12	16	20	24
h + 30mm ≥ 100mm			h + (2 x d_h)	

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20
Drilled Hole Dia, d_h (mm)	12	15	20	25
Stress Area, A_s (mm^2)	78.5	113	201	314
Yield Stress, f_{sy} (MPa)	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0

For further information refer to reinforcing bar manufacturer's published information and current revision of **AS/NZS 4671**

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

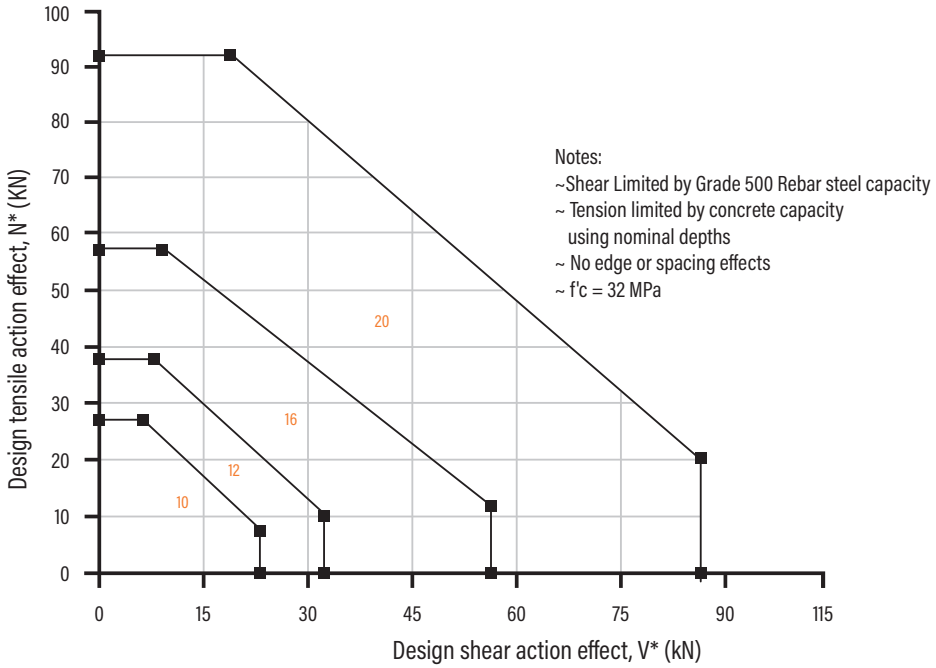

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Rebar size, d_b	10	12	16	20
Min. Anchor Spacing - a_m	50	60	80	100
Min. Edge Distance - e_m	45	45	50	65

Step 1c Calculate anchor effective depth, h (mm)

Refer to nominal recommended effective depths, h, listed in installation and performance details table on previous page.

Effective depth, h (mm)

Preferred h = h_n otherwise,

$$h = L_e - t$$

t = total thickness of material(s) being fastened.

Substrate thickness b_m (mm)			
Anchor Stud Size (mm)			
10	12	16	20
h + 30mm ≥ 100mm		h + (2 x d_h)	

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

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STRENGTH LIMIT STATE DESIGN

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.5 = 0.67, f'_c = 32 MPa

	Combined pull-out and concrete cone resistance - ϕN_{ucp}				Concrete Cone Resistance - ϕN_{ucc}
Rebar Size, d_b	10	12	16	20	
Drilled Hole Dia, d_h (mm)	12	15	20	25	
Effective Depth, h (mm)					
70	19.8				24.3
80	22.7				29.7
90	**25.5**	30.6			35.4
100	28.3	34.0			41.5
110	31.1	**37.4**			47.9
120	34.0	40.8	54.4		54.5
125	35.4	42.5	**56.6**		58.0
140	39.6	47.6	63.4		68.7
150	42.5	51.0	68.0	84.9	76.2
160	45.3	54.4	72.5	90.6	84.0
170	48.1	57.8	77.0	**96.3**	91.9
180	51.0	61.2	81.6	101.9	100.2
190	53.8	64.6	86.1	107.6	108.6
200	56.6	68.0	90.6	113.3	117.3
210		71.4	95.1	118.9	126.2
240		81.6	108.7	135.9	154.2
270			122.3	152.9	184.0
280			126.9	158.6	194.4
300			135.9	169.9	215.6
320			145.0	181.2	237.5
350				198.2	271.6
400				226.5	331.9

For optimised performance data, please use Ramset iExpert Anchoring Software.

Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

	Cracked Concrete Effect - X_{ncr} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)				X_{ncr} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	
f'c (MPa)					
20 to 50	0.38	0.42	0.42	0.46	0.70

Bold values are at Chemset Anchor Stud nominal Depths
Flooded Holes: Multiply ϕN_{uc} x 0.75
For Sustained Loads MULTIPLY ϕN_{uc} x 0.6
For Non-cracked concrete X_{ncr} = 1.
Note:The maximum embedment depth shall be reduced to $12d_b$ for installation in flooded holes

If concrete condition is Non-Cracked then, Refer to Checkpoint 2	If concrete condition is Cracked then, $\phi N_{uc} = \phi N_{ucp}$

Table 2b-1 Concrete service temperature limits effect, tension, X_{ns}

	Service temperature limits effect, tension, X_{ns} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)				X_{ns} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	
Service temperature (˚C)					
-40˚C to +40˚C	1.00				1.00
-40˚C to +80˚C	0.92				1.00

Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

NON- CRACKED	Non-Cracked Concrete - X_{nc} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)				X_{nc} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	
f'c (MPa)					
20	0.96	0.96	0.96	0.96	0.79
25	0.96	0.96	0.96	0.96	0.88
32	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.03	1.12
50	1.05	1.05	1.05	1.05	1.25

CRACKED	Cracked Concrete - X_{nc} where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)				X_{nc} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Rebar Size, d_b	10	12	16	20	
f'c (MPa)					
20 - 50	0.96	0.96	0.96	0.96	0.79

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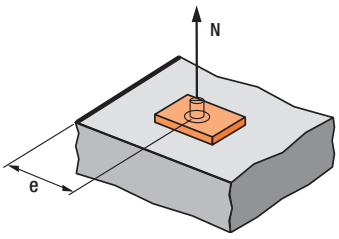
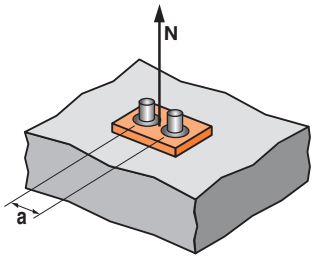
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of X_{ne}, please use equation shown above.

Table 2c - Concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	10	12	16	20
Edge distance, e (mm)				
45	0.50	0.45		
50	0.53	0.48	0.45	
65	0.61	0.55	0.51	0.44
85	0.72	0.64	0.59	0.50
90	0.75	0.66	0.61	0.51
100	0.81	0.70	0.65	0.54
120	0.92	0.80	0.73	0.60
135	1	0.86	0.79	0.65
165		1	0.91	0.74
187			1	0.80
255				1



$X_{na} = 0.5 + a/(6*h)$
Where $a_m \le a \le a_c$
$a_c = 3*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values X_{na}, please use equation shown above.

Table 2d - Concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	10	12	16	20
Anchor spacing, a (mm)				
50	0.59			
60	0.61	0.59		
80	0.65	0.62	0.61	
100	0.69	0.65	0.63	0.60
120	0.72	0.68	0.66	0.62
150	0.78	0.73	0.70	0.65
200	0.87	0.80	0.77	0.70
270	1	0.91	0.86	0.76
330		1	0.94	0.82
375			1	0.87
510				1

Checkpoint 2

STEP 3

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

$\phi N_{urc} = \phi N_{uc} * X_{ncr} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

If concrete condition is Non-Cracked then

ϕN_{urc} = minimum of $\phi N_{ucp} * X_{ncr} * X_{ns} * X_{nc} * X_{ne} * X_{na}$ and $\phi N_{ucc} * X_{ncr} * X_{ns} * X_{nc} * X_{ne} * X_{na}$

Checkpoint 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity. ϕN_{us} (kN), where $\phi = 0.8$

Anchor size, d_b	10	12	16	20
Gr 500 Rebar	31.4	45.2	80.4	125.6

Design reduced ultimate tensile capacity, ϕN_{ur}
ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{us}
Check $N^*/\phi N_{ur} \le 1.0$,
if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

STEP 4

Step 4 - Verify Concrete Shear Capacity - per anchor

Table 4a-1 Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN),ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20
Effective depth, h (mm)	70 - 200	90 - 240	120 - 320	150 - 400
Edge distance, e_m				
45	5.0	5.5		
50			7.2	
65				11.1

For optimised performance data, please use Ramset iExpert Anchoring Software.

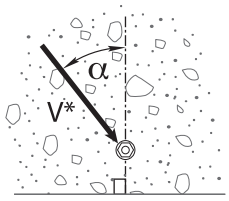
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20
X_{vcr}	0.70			

For Non-cracked concrete X_{vcr} = 1.0

Table 4b - Concrete compressive strength effect, shear, X_{vc}

f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	1.11	1.22



Load direction effect, conc. edge shear, X_{vd}

Table 4c - Concrete load direction effect, concrete edge shear, X_{vd}

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1	1.1	1.2	1.5	2

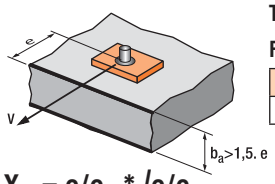
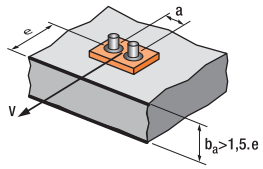


Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}

For single anchor fastening X_{ve}

e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

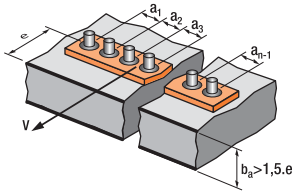
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$



$$X_{ve} = \frac{3*e+a}{6*e_m} * \sqrt{e/e_m}$$

For 2 anchors fastening X_{ve}

e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
a/e_m												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	2.50	2.77	3.04	3.32	3.61
3.0	1.00	1.20	1.42	1.64	1.88	2.12	2.37	2.63	2.90	3.18	3.46	3.76
3.5		1.30	1.52	1.75	1.99	2.24	2.50	2.76	3.04	3.32	3.61	3.91
4.0			1.62	1.86	2.10	2.36	2.62	2.89	3.17	3.46	3.75	4.05
4.5				1.96	2.21	2.47	2.74	3.02	3.31	3.60	3.90	4.20
5.0					2.33	2.59	2.87	3.15	3.44	3.74	4.04	4.35
5.5						2.71	2.99	3.28	3.71	4.02	4.33	4.65
6.0						2.83	3.11	3.41	3.71	4.02	4.33	4.65



For 3 anchors fastening and more

$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

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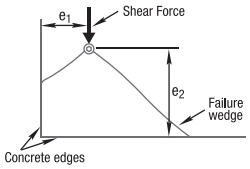
STRENGTH LIMIT STATE DESIGN

Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20
Effective depth, h (mm)	90	110	125	170
-40˚C to +40˚C	51.0	74.8	158.6	192.6
-40˚C to +80˚C	47.0	69.0	104.6	177.7



ANCHOR AT A CORNER

Table 4f Anchor at a corner effect, concrete edge shear, X_{vs}

Note: For $e_1/e_2 > 1.25$, $X_{vs} = 1.0$

Edge distance, e_2 (mm)	25	30	35	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)												
25	0.86	0.77	0.70	0.58	0.53	0.49	0.41	0.37	0.35	0.34	0.32	0.32
30	0.97	0.86	0.78	0.64	0.58	0.52	0.43	0.38	0.36	0.34	0.33	0.32
35	1.00	0.95	0.86	0.69	0.63	0.56	0.46	0.40	0.37	0.35	0.33	0.32
50	1.00	1.00	1.00	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	1.00	1.00	1.00	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	1.00	1.00	1.00	1.00	1.00	0.86	0.64	0.51	0.44	0.41	0.37	0.35
125	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.65	0.53	0.48	0.42	0.38
200	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.58	0.49	0.42
300	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.72	0.58	0.49
400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67	0.55
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.61
600	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.67
900	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86

Checkpoint 4a

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$\phi V_{urc} = \phi V_{uc} * X_{vcr} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

$\phi V_{urcp} = \phi V_{ucp} * X_{ncr} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us}, (kN) where ϕ_v = 0.8

Anchor size, d_b	10	12	16	20
Gr 500 Rebar	21.4	30.8	54.8	85.7

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}
ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}
Check $V^*/\phi V_{ur} \leq 1$,
if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

STEP 6 Combined loading and specification

Checkpoint 6

Check
$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2$,
if not satisfied return to step 1

Specify – Reinforcing Bar Anchorage

Ramset® 801 Xtrem™ XC² Injection (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset® 801 Xtrem™ XC² Injection with 20mm grade 500 Rebar
Drilled hole depth to be 125 mm.
To be installed in accordance with Ramset® Installation Instructions.

Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.