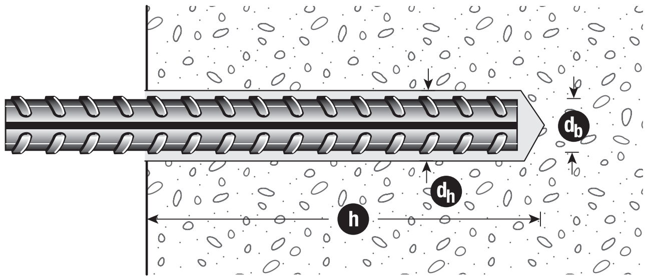
Introduction

CHEMICAL ANCHORING - REINFORCING BAR ANCHORING

The following section applies to reinforcing bar in anchorage applications. For structural post-installed reinforcing bar designs intended to comply with AS3600, please refer to the section titled Chemical Anchoring Reinforcing Bar to AS3600 & AS5216.

- Reinforcing bar complying with the requirements of grade 500 according to current revision of AS/NZS 4671.
- Reidbar™ Continuously threaded reinforcing bar.
- Design requirements for shallow anchorage of reinforcement relating to Safety Critical Applications and AS5216 or EN1992-4.



ChemSet™ Reo 502™ PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN AUSTRALIA ONLY

(New Zealand refer to EPCON™ C6 PLUS range)

GENERAL INFORMATION

Performance Related	Installation Related

Product

ChemSet™ Reo 502™ PLUS is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-18/0675

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

- European Technical Approval 001 Part 5-option 1
- 100 year working Life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes
- Easy dispensing even in cold weather

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes*
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant

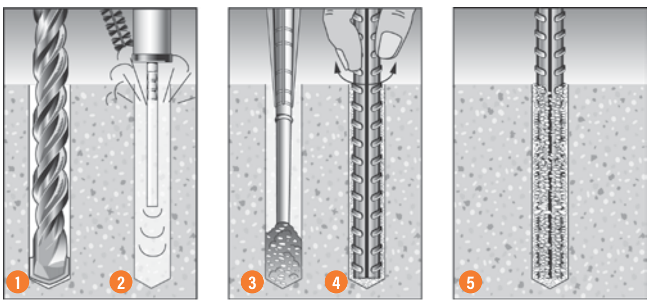
Principal Applications

- 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	10°C	40°C

Installation



1. Drill recommended diameter and depth hole.
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, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense adhesive until colour is uniform light grey (2-3 trigger pulls). Insert mixing nozzle to bottom of hole. Fill hole to 3/4 the hole depth slowly, ensuring no air pockets form.
4. Insert **Ramset**™ ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ PLUS to cure as per setting times.

Service Temperature Limits

-40°C to 70°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	Minimum 10°C	300 min	24 h
10°C	10°C	150 min	18 h
15°C	15°C	40 min	12 h
20°C	20°C	25 min	8 h
25°C	25°C	18 min	6 h
30°C	30°C	12 min	4 h
40°C	40°C	6 min	2 h
Note: Cartridge temperature minimum +10°C			

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

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Installation and performance details: ChemSet™ Reo502™ PLUS 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_{uc} (kN)** — Concrete compressive strength, f'$_c$		
						Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	20 MPa	32 MPa	40 MPa
10	14	90	135	270	115	31.4	21.4	20.4	21.2	21.8
12	16	110	165	330	140	45.2	30.8	29.9	31.1	32.0
16	20	125	187	375	160	80.4	54.8	38.2	43.6	44.8
20	25	150	225	450	190	125.6	85.7	50.2	63.5	67.2
		170	255	510	215			60.5	74.1	76.2
24	32	180	270	540	215	180.8	123.3	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
32	40	240	360	720	320	321.6	219.3	101.5	111.5	114.7
		300	450	900	380			134.0	139.4	143.4

* 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 = 0.56 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.6
***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 +70°C**
All data relevant for Dry, Wet and Flooded Holes
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet Reo 502 PLUS	600ml	REO502P600

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	24	32
Drilled Hole Dia, d_h (mm)	14	16	20	25	32	40
Stress Area, A_s (mm^2)	78.5	113	201	314	491	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	226.0	402.0

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

ChemSet™ Reo 502™ PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

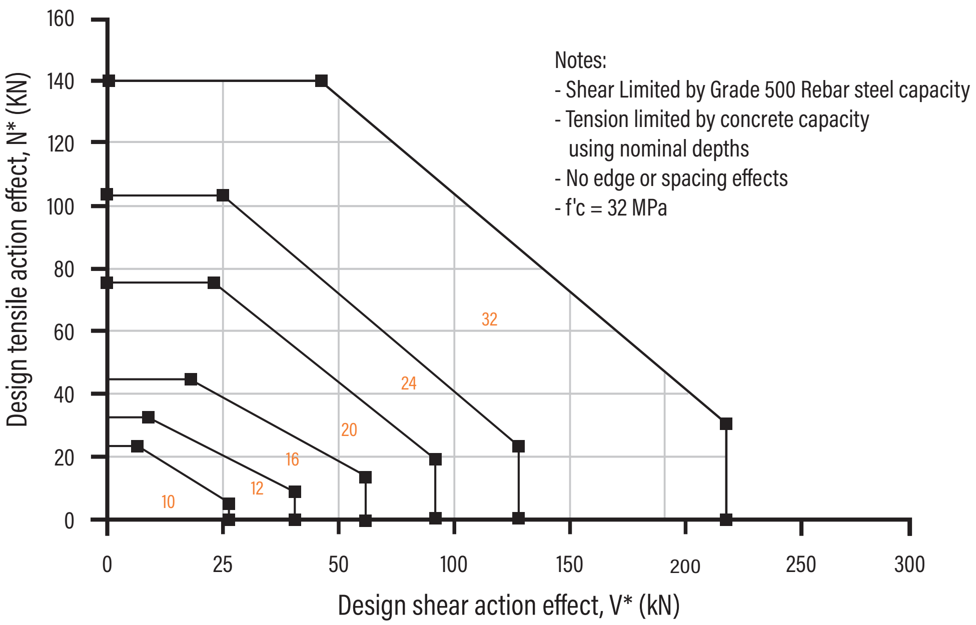

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Rebar size, db	10	12	16	20	24	32
e_m, a_m	40	40	40	50	50	70

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.

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.8 = 0.56, 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	24	32	
Drilled Hole Dia, d_h (mm)	14	16	20	25	32	40	
Effective Depth, h (mm)							
70	16.5						20.2
80	18.9						24.7
90	**21.2**	25.5					29.5
100	23.6	28.3					34.6
110	26.0	**31.1**					39.9
120	28.3	34.0	41.8				45.4
125	29.5	35.4	**43.6**				48.3
140	33.0	39.6	48.8				57.3
150	35.4	42.5	52.3	65.3			63.5
160	37.8	45.3	55.8	69.7			70.0
170	40.1	48.1	59.2	**74.1**			76.6
180	42.5	51.0	62.7	78.4	94.1		83.5
190	44.8	53.8	66.2	82.8	99.3		90.5
200	47.2	56.6	69.7	87.1	104.6		97.8
210		59.5	73.2	91.5	**109.8**		105.2
240		68.0	83.6	104.6	125.5	111.5	128.5
270			94.1	117.6	141.1	125.5	153.4
280			97.6	122.0	146.4	130.1	162.0
300			104.6	130.7	156.8	**139.4**	179.6
320			111.5	139.4	167.3	148.7	197.9
350				152.5	183.0	162.6	226.4
400				174.3	209.1	185.9	276.6
450					235.2	209.1	330.0
500					261.4	232.3	386.5
560						260.2	458.1
640						297.4	559.7

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	24	32	
f'c (MPa)							
20 to 50	0.85	0.77	0.83	0.83	0.71	0.81	0.70

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 (100 years) or ϕN_{uc} x 0.72 (50 years)

All data relevant for Dry, Wet and Flooded Holes

For Non-cracked concrete X_{ncr} = 1.0

Calculate ϕN_{urc} for both ϕN_{ucp} and ϕN_{ucc} then choose the minimum - Refer to Checkpoint 2

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	24	32	
Service temperature (°C)							
-40°C to +70°C	1.00						1.00

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

	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	24	32	
f'c (MPa)							
20	0.96	0.96	0.96	0.96	0.96	0.96	0.79
25	0.98	0.98	0.98	0.98	0.98	0.98	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.03	1.03	1.03	1.12
50	1.05	1.05	1.05	1.05	1.05	1.05	1.25

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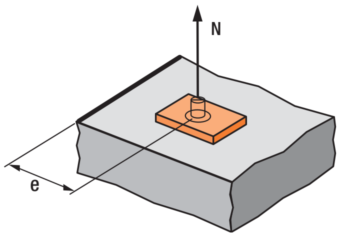


$X_{ne} = 0.25 + 0.5*(e/h)$

Where $e_m \leq e \leq e_c$

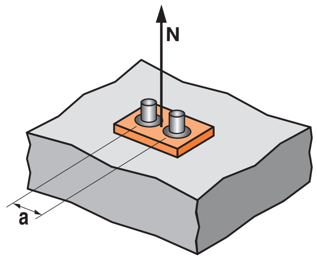
$e_c = 1.5*h$

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	24	32
Edge distance, e (mm)						
40	0.47	0.43	0.41			
45	0.50	0.45	0.43			
50	0.53	0.48	0.45	0.40	0.36	
55	0.56	0.50	0.47	0.41	0.38	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	0.36
80	0.69	0.61	0.57	0.49	0.44	0.38
100	0.81	0.70	0.65	0.54	0.49	0.41
115	0.89	0.77	0.71	0.59	0.52	0.44
135	1	0.86	0.79	0.65	0.57	0.47
165		1	0.91	0.74	0.64	0.52
187			1	0.80	0.70	0.56
255				1	0.86	0.67
315					1	0.77
450						1



$X_{na} = 0.5 + a/(6*h)$

Where $a_m \leq a \leq a_c$

$a_c = 3*h$

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	24	32
Anchor spacing, a (mm)						
40	0.57	0.56	0.55			
45	0.58	0.57	0.56			
50	0.59	0.58	0.57	0.55	0.53	
55	0.60	0.58	0.57	0.55	0.54	
70	0.62	0.60	0.59	0.56	0.55	0.53
85	0.66	0.63	0.61	0.58	0.57	0.54
100	0.69	0.65	0.63	0.60	0.58	0.55
125	0.73	0.69	0.67	0.62	0.60	0.56
150	0.78	0.73	0.70	0.65	0.62	0.58
200	0.87	0.80	0.77	0.70	0.66	0.61
270	1	0.91	0.86	0.76	0.71	0.65
330		1	0.94	0.82	0.76	0.68
375			1	0.87	0.80	0.70
510				1	0.90	0.78
630					1	0.85
900						1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

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

STEP 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	24	32
Gr 500 Rebar	31.4	45.2	80.4	125.6	180.8	321.6

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}

ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{us}

Check $N^*/\phi N_{ur} \leq 1.0$,

if not satisfied return to step 1

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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	24	32
Effective depth, h (mm)	70-200	90-240	120-320	150-400	180-500	240-640
Edge distance, e						
40	4.3	4.7	5.5			
50				8.2	9.2	
70						16.1

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

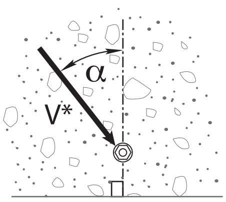
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20	24	32
X_{vcr}	0.70					

For Non-cracked concrete X_{vcr} = 1.0

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

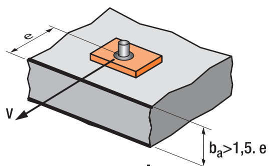
f'c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1	1.11	1.22



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

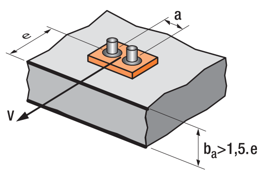


$X_{ve} = e/e_m * \sqrt{e/e_m}$

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

For single anchor fastening X_{ve}

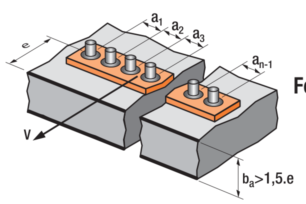
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

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

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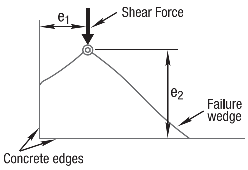
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20	24	32
Effective depth, h (mm)	90	110	125	170	210	300
-40˚C to +70˚C	40.8	59.9	83.8	142.4	211.1	268.1



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 = 0.80

Anchor size, d_b	10	12	16	20	24	32
Gr 500 Rebar	21.4	30.8	54.8	85.7	123.3	219.3

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}

Check $V^*/\phi V_{ur} \leq 1.0$, if not satisfied return to step 1

Ramset™

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

AVAILABLE IN AUSTRALIA ONLY

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™ ChemSet™ Reo 502™ PLUS with (Anchor Size) grade 500 Rebar. Drilled hole depth to be (h) mm.

Example

Ramset™ ChemSet™ Reo 502™ PLUS with 16mm 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.

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related | Installation Related

Product

EPCON™ C8 Xtrem™ is a High Performance Pure Epoxy Anchoring adhesive for use in Cracked and Non-Cracked concrete. For structures subject to external exposure, permanently damp or aggressive conditions.

Compliance

European Technical Assessment (option 1) - ETA-10/0309

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

Greater productivity:

- Anchors in dry, damp, wet or flooded holes
- No weather delays
- Fast, easy dispensing with high flow mixer

Greater security:

- Highest performance in cracked concrete
- Rated for sustained loading

Versatile

- Anchors all stud & bar diameters in all directions
- Oversized holes*
- Anchors in carbide drilled and diamond cored holes*
- For tropical and Cold weather conditions

Greater safety:

- Low odour

Fire Rated : Refer Fire rated anchoring section

Principal Applications

- Anchoring into cracked & non cracked concrete
- Road barrier hold down bolts
- Bridge refurbishment
- Road & Rail tunnel construction
- Reinforcing bar from 10 to 32mm
- Starter Bars
- Threaded studs from M8 to M30
- Threaded Stud material: Zn, A4 316, HCR steels
- Threaded Stud material: 5.8, 8.8, 10.9 grade

Recommended Installation Temperatures

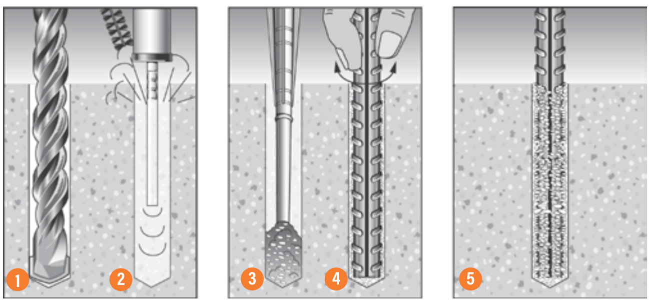
	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	5°C	40°C

Load should not be applied to anchor until the chemical has sufficiently cured as specified.

Service Temperature Limits

-40°C to 80°C

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

Setting Times EPCON™ C8 Xtrem™

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet concrete
5°C - 9°C	20 min	30 h	60 h
10°C - 19°C	14 min	23 h	46 h
20°C - 24°C	11 min	16 h	32 h
25°C - 29°C	8 min	12 h	24 h
30°C - 39°C	5 min	8 h	16 h
40°C	5 min	6 h	12 h

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

Installation and performance details: EPCON™ C8 Xtrem™ 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_{uc} (kN)** — Concrete compressive strength, f'_c		
						Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	20 MPa	32 MPa	40 MPa
10	12	90	135	270	115	31.4	21.4	22.0	23.3	24.6
12	15	110	165	330	140	45.2	30.8	32.0	34.2	36.1
16	20	125	187.5	375	160	80.4	54.8	38.2	48.3	53.6
20	25	150	225	450	190	125.6	85.7	50.2	63.5	70.5
		170	255	510	215			60.5	76.6	85.1
24	30	180	270	540	215	180.8	123.3	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
25	30	180	270	540	215	196.4	133.9	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
28	35	210	315	630	280	246.4	168.0	83.1	105.2	116.8
		270	405	810	340			121.2	153.4	170.2
32	40	240	360	720	320	321.6	219.3	101.5	128.5	142.7
		300	450	900	380			141.9	179.6	199.4

* 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 = 0.56 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.6
***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 ϕN_{uc} x 0.65
For optimised performance data, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
EPCON™ C8 Xtrem™	450ml	C8-450

Drilled hole depth, h_1 (mm)
h_1 = h
h = Effective depth

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	24	25	28	32
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	30	35	40
Stress Area, A_s (mm^2)	78.5	113	201	314	452	491	616	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0

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

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

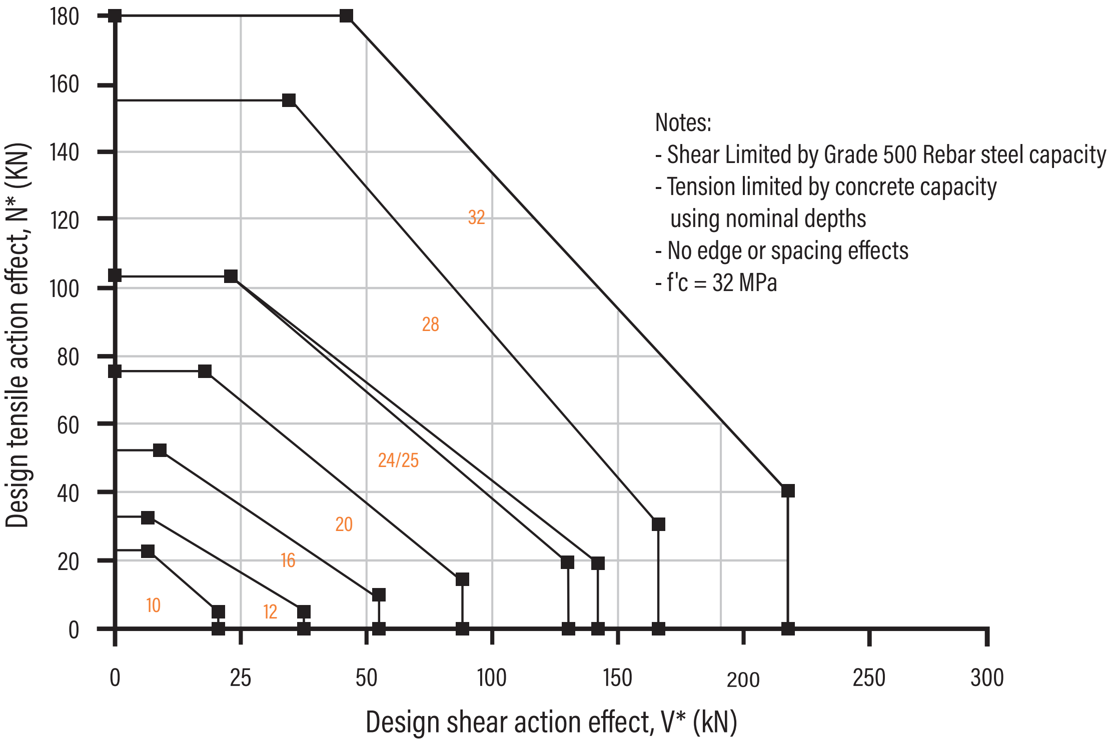


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for cracked concrete

Rebar size, d_b	10	12	16	20	24	25	28	32
Min. Anchor spacing - a_m	50	60	80	100	125	125	140	160
Min. Edge Distance - e_m	50	60	80	100	125	125	140	160

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)		
Rebar Size (mm)		
10	12	16 to 32
h + 30mm ≥ 100mm		h + (2 x d_h)

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

EPCON™ C8 Xtrem™

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 = 1/1.8 = 0.56, 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	24	25	28	32	
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	30	35	40	
Effective Depth, h (mm)									
70	18.1								20.2
80	20.7								24.7
90	**23.3**	28.2							29.5
100	25.9	31.4							34.6
110	28.5	**34.5**							39.9
120	31.1	37.6	51.1						45.4
125	32.4	39.2	**53.3**						48.3
140	36.3	43.9	59.7						57.3
150	38.9	47.1	63.9	75.6					63.5
160	41.4	50.2	68.2	80.6					70.0
170	44.0	53.3	72.4	**85.6**					76.6
180	46.6	56.5	76.7	90.7	111.7	116.4			83.5
190	49.2	59.6	81.0	95.7	117.9	122.9			90.5
200	51.8	62.7	85.2	100.7	124.2	129.3			97.8
210		65.9	89.5	105.8	**130.4**	**135.8**	153.4		105.2
240		75.3	102.3	120.9	149.0	155.2	175.3	189.8	128.5
270			115.1	136.0	167.6	174.6	**197.3**	213.5	153.4
280			119.3	141.0	173.8	181.1	204.6	221.4	162.0
300			127.8	151.1	186.2	194.0	219.2	**237.3**	179.6
320			136.4	161.2	198.6	206.9	233.8	253.1	197.9
350				176.3	217.3	226.3	255.7	276.8	226.4
400				201.5	248.3	258.7	292.2	316.3	276.6
450					279.4	291.0	328.8	355.9	330.0
500					310.4	323.3	365.3	395.4	386.5
560							409.1	442.9	458.1
640								506.1	559.7

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	24	25	28	32	
f'c (MPa)									
20 to 50	0.67	0.64	0.60	0.60	0.60	0.60	0.57	0.50	0.70

Bold values are at Chemset Anchor Stud nominal Depths.

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 FLOODED HOLES: Multiply ϕN_{uc} x 0.65 For Non-cracked concrete X_{ncr} = 1.

If Service temperature limit is -40°C to +40°C then Refer to Checkpoint 2	If Service temperature limit is -40°C to +80°C 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	24	25	28	32	
Service temperature (°C)									
-40°C to +40°C	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
-40°C to +80°C	0.57	0.53	0.52	0.52	0.56	0.56	0.53	0.53	1.00

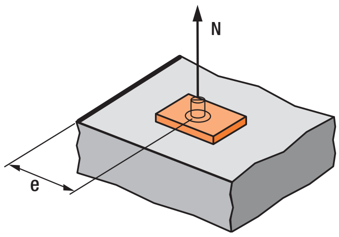
Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

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	24	25	28	32	
f'c (MPa)									
20	0.94	0.93	0.92	0.90	0.88	0.88	0.87	0.85	0.79
25	0.97	0.96	0.95	0.95	0.93	0.93	0.93	0.92	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.06	1.06	1.07	1.09	1.11	1.11	1.12	1.13	1.11
50	1.08	1.09	1.12	1.14	1.18	1.18	1.20	1.22	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	24	25	28	32	
f'c (MPa)									
20	0.95	0.95	0.94	0.93	0.92	0.92	0.91	0.90	0.79
25	0.97	0.97	0.97	0.96	0.95	0.95	0.95	0.95	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.04	1.05	1.07	1.06	1.06	1.07	1.08	1.11
50	1.05	1.07	1.08	1.09	1.11	1.11	1.12	1.14	1.25

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$

Where $e_m \le e \le e_c$

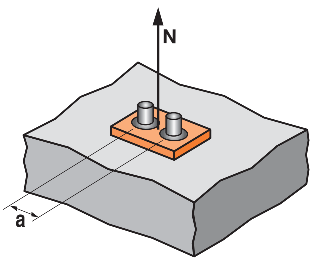
$e_c = 1.5*h$

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}

Rebar size, d_b	10	12	16	20	24/25	28	32
Edge distance, e (mm)							
50	0.53						
60	0.58	0.52					
80	0.69	0.61	0.57				
90	0.75	0.66	0.61				
100	0.81	0.70	0.65	0.54			
125	0.94	0.82	0.75	0.62	0.55		
140	1.03	0.89	0.81	0.66	0.58	0.51	
165		1.00	0.91	0.74	0.64	0.56	0.53
187			1.00	0.80	0.70	0.60	0.56
255				1.00	0.86	0.72	0.68
315					1.00	0.83	0.78
405						1.00	0.93
450							1.00
315						1	0.81
420							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}

Rebar size, d_b	10	12	16	20	24/25	28	32
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			
125	0.73	0.69	0.67	0.62	0.60		
140	0.76	0.71	0.69	0.64	0.61	0.59	
160	0.80	0.74	0.71	0.66	0.63	0.60	0.59
200	0.87	0.80	0.77	0.70	0.66	0.62	0.61
270	1.00	0.91	0.86	0.76	0.71	0.67	0.65
330		1.00	0.94	0.82	0.76	0.70	0.68
375			1.00	0.87	0.80	0.73	0.71
510				1.00	0.90	0.81	0.78
630					1.00	0.89	0.85
810						1.00	0.95
900							1.00

Checkpoint 2

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 Service temperature limit is -40°C to +40°C then

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

STEP 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	24	25	28	32
Gr 500 Rebar	31.4	45.2	80.4	125.6	180.8	196.4	246.4	321.6

Checkpoint 3

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

EPCON™ C8 Xtrem™

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	24	25	28	32
Effective depth, h (mm)	70 - 200	90-240	120-320	150-400	180-500	180-500	210-560	240-640
Edge distance, e_m								
50	5.7							
60		7.9						
80			12.9					
100				18.8				
125					26.9	27.1		
140							33.2	
160								41.7

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

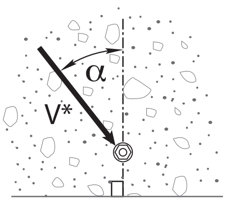
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20	24	25	28	32
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}

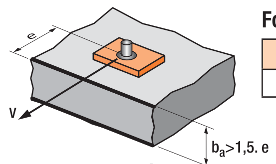
Table 4c - Concrete load direction effect, concrete edge shear, X_{vd}

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}

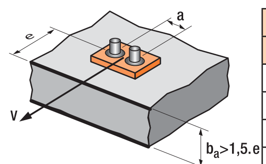
For single anchor fastening X_{ve}

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



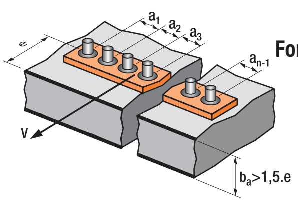
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

For 2 anchors fastening X_{ve}



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

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

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

EPCON™ C8 Xtrem™

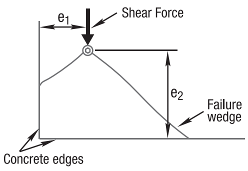
STRENGTH LIMIT STATE DESIGN

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

Rebar size, d_b	10	12	16	20	24	25	28	32
Effective depth, h (mm)	90	110	125	170	210	210	270	300
-40˚C to +40˚C	55.9	79.8	96.6	153.2	210.4	210.4	306.7	359.3
-40˚C to +80˚C	32.0	44.4	68.5	118.6	180.5	188.0	254.9	332.2

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

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



ANCHOR AT A CORNER

Edge distance, e_2 (mm)	50	60	75	125	200	300	400	600	900
Edge distance, e_1 (mm)									
50	0.86	0.77	0.67	0.52	0.44	0.39	0.37	0.35	0.33
60	0.97	0.86	0.75	0.57	0.47	0.41	0.38	0.36	0.34
75	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	0.86	0.65	0.53	0.48	0.42	0.38
200	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	0.86	0.72	0.58	0.49
400	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	0.77	0.61
600	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	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 $\phi v = 0.80$

Anchor size, d_b	10	12	16	20	24	25	28	32
Gr 500 Rebar	21.4	30.8	54.8	85.7	123.3	133.9	168.0	219.3

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

EPCON™ C8 Xtrem™

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™ EPCON™ C8 Xtrem™ with (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ EPCON™ C8 Xtrem™ with 16mm 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.

EPCON™ C6 PLUS

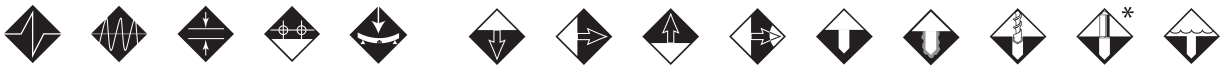
CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN NEW ZEALAND ONLY

(Australia refer to ChemSet™ Reo502™ PLUS range)

GENERAL INFORMATION

Performance Related	Installation Related



Product

EPCON™ C6 PLUS is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-18/0675

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

- 100 year working Life

Greater productivity:

- Easy dispensing even in cold weather
- Anchors in dry, damp, wet or flooded holes

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

- Anchors in carbide drilled and diamond drilled holes*
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant

Principal Applications

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

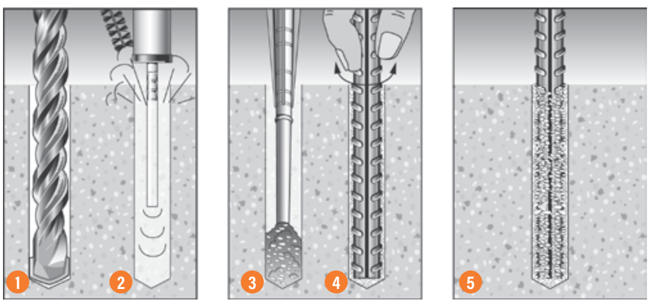
Recommended Installation Temperatures

	Minimum	Maximum
Substrate	5°C	40°C
Adhesive	10°C	40°C

Service Temperature Limits

-40°C to +70°C

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, 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

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	Minimum 10°C	300 min	24 h
10°C	10°C	150 min	18 h
15°C	15°C	40 min	12 h
20°C	20°C	25 min	8 h
25°C	25°C	18 min	6 h
30°C	30°C	12 min	4 h
40°C	40°C	6 min	2 h
Note: Cartridge temperature minimum +10°C			

Note

*Performance of cored & oversized holes was not included in the ETAG test program and therefore is based on testing conducted at Ramset™ Product Engineering Laboratory.

EPCON™ C6 PLUS

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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Installation and performance details: EPCON™ C6 PLUS and Reinforcing Bar

Anchor Size, d_b (mm)	Drilled Hole diam., d_h (mm)	Anchor Effective Depth, h (mm)	Optimum dimensions*			Reduced Characteristic Capacity #				
						Gr 500 Rebar - Steel		Non-Cracked Concrete		
			Edge* distance, e_c (mm)	Anchor spacing, a_c (mm)	Concrete substrate thickness, b_m (mm)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{uc} (kN)** Concrete compressive strength, f'_c 20 MPa	32 MPa	40 MPa
10	14	90	135	270	115	31.4	21.4	20.4	21.2	21.8
12	16	110	165	330	140	45.2	30.8	29.9	31.1	32.0
16	20	125	187	375	160	80.4	54.8	38.2	43.6	44.8
20	25	150	225	450	190	125.6	85.7	50.2	63.5	67.2
		170	255	510	215			60.5	74.1	76.2
25	32	180	270	540	215	196.4	133.9	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
32	40	240	360	720	320	321.6	219.3	101.5	111.5	114.7
		300	450	900	380			134.0	139.4	143.4

* 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 = 0.56 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.6
***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 +70°C**
All data relevant for Dry, Wet and Flooded Holes

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
Epcon C6 PLUS	600ml	EC6P600

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	25	32
Drilled Hole Dia, d_h (mm)	14	16	20	25	32	40
Stress Area, A_s (mm^2)	78.5	113	201	314	491	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	245.5	402.0

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

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

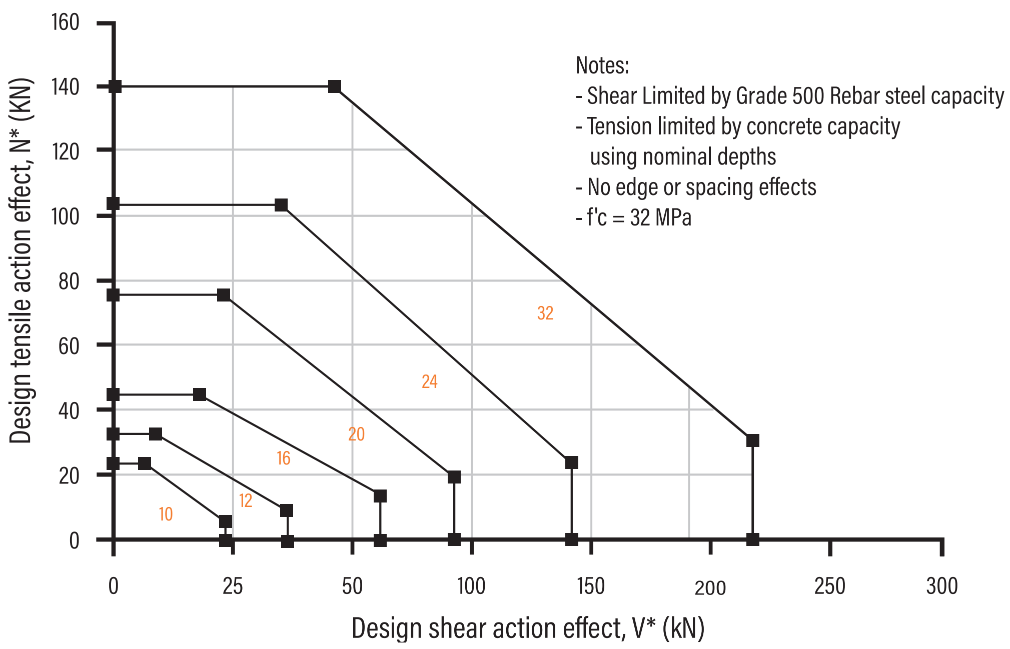

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	10	12	16	20	25	32
Min. Anchor spacing - a_m	40	40	40	50	50	70
Min. Edge Distance - e_m	40	40	40	50	50	70

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 to 32
h + 30mm ≥ 100mm		h + (2 x d_h)

Checkpoint 1

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

Chemical Anchoring - Reinforcing Bar Anchorage

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

AVAILABLE IN NEW ZEALAND ONLY

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.8 = 0.56, 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	25	32	
Drilled Hole Dia, d_h (mm)	14	16	20	25	32	40	
Effective Depth, h (mm)							
70	16.5						20.2
80	18.9						24.7
90	**21.2**	25.5					29.5
100	23.6	28.3					34.6
110	26.0	**31.1**					39.9
120	28.3	34.0	41.8				45.4
125	29.5	35.4	**43.6**				48.3
140	33.0	39.6	48.8				57.3
150	35.4	42.5	52.3	65.3			63.5
160	37.8	45.3	55.8	69.7			70.0
170	40.1	48.1	59.2	**74.1**			76.6
180	42.5	51.0	62.7	78.4	98.0		83.5
190	44.8	53.8	66.2	82.8	103.5		90.5
200	47.2	56.6	69.7	87.1	108.9		97.8
210		59.5	73.2	91.5	**114.4**		105.2
240		68.0	83.6	104.6	130.7	111.5	128.5
270			94.1	117.6	147.0	125.5	153.4
280			97.6	122.0	152.5	130.1	162.0
300			104.6	130.7	163.4	**139.4**	179.6
320			111.5	139.4	174.3	148.7	197.9
350				152.5	190.6	162.6	226.4
400				174.3	217.8	185.9	276.6
450					245.0	209.1	330.0
500					272.3	232.3	386.5
560						260.2	458.1
640						297.4	559.7

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	25	32	
f'c (MPa)							
20 to 50	0.85	0.77	0.83	0.83	0.71	0.81	0.70

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY ϕN_{uc} x 0.6 (100 years) or ϕN_{uc} x 0.72 (50 years)

All data relevant for Dry, Wet and Flooded Holes

For Non-cracked concrete X_{ncr} = 1

Calculate ϕN_{urc} for both ϕN_{ucp} and ψN_{ucc} then choose the minimum - Refer to Checkpoint 2

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	25	32	
Service temperature (˚C)							
-40˚C to +70˚C	1.00						1.00

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

	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	25	32	
f'c (MPa)							
20	0.96	0.96	0.96	0.96	0.96	0.96	0.79
25	0.98	0.98	0.98	0.98	0.98	0.98	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.03	1.03	1.03	1.12
50	1.05	1.05	1.05	1.05	1.05	1.05	1.25

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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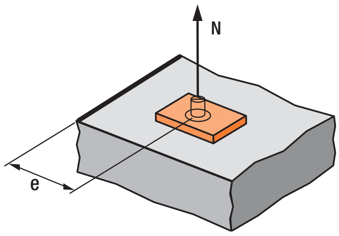
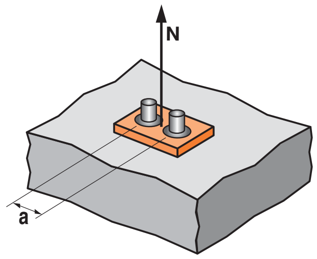


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	10	12	16	20	25	32
Edge distance, e (mm)						
40	0.47	0.43	0.41			
45	0.50	0.45	0.43			
50	0.53	0.48	0.45	0.40	0.36	
55	0.56	0.50	0.47	0.41	0.38	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	0.36
80	0.69	0.61	0.57	0.49	0.44	0.38
100	0.81	0.70	0.65	0.54	0.49	0.41
115	0.89	0.77	0.71	0.59	0.52	0.44
135	1	0.86	0.79	0.65	0.57	0.47
165		1	0.91	0.74	0.64	0.52
187			1	0.80	0.70	0.56
255				1	0.86	0.67
315					1	0.77
450						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	25	32
Anchor spacing, a (mm)						
40	0.57	0.56	0.55			
45	0.58	0.57	0.56			
50	0.59	0.58	0.57	0.55	0.53	
55	0.60	0.58	0.57	0.55	0.54	
70	0.62	0.60	0.59	0.56	0.55	0.53
85	0.66	0.63	0.61	0.58	0.57	0.54
100	0.69	0.65	0.63	0.60	0.58	0.55
125	0.73	0.69	0.67	0.62	0.60	0.56
150	0.78	0.73	0.70	0.65	0.62	0.58
200	0.87	0.80	0.77	0.70	0.66	0.61
270	1	0.91	0.86	0.76	0.71	0.65
330		1	0.94	0.82	0.76	0.68
375			1	0.87	0.80	0.70
510				1	0.90	0.78
630					1	0.85
900						1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

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

STEP 3

Verify anchor tensile capacity - per anchor

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

Anchor size, d_b	10	12	16	20	24	32
Gr 500 Rebar	31.4	45.2	80.4	125.6	196.4	321.6

Checkpoint 3

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

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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STEP 4

Step 4 - Verify Concrete Edge Shear Resistance - 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	25	32
Effective depth, h (mm)	70 - 200	90 - 240	120 - 320	150 - 400	180 - 500	240 - 640
Edge distance, e						
40	4.3	4.7	5.5			
50				8.2	9.2	
70						16.1

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

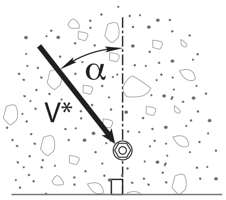
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20	25	32
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	1.11	1.22



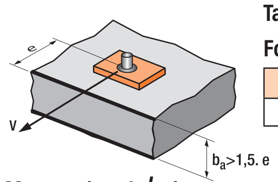
Load direction effect, conc. edge shear, X_{vd}

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}

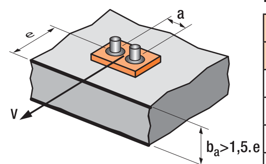
For single anchor fastening X_{ve}



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

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

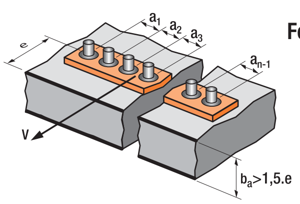
For 2 anchors fastening X_{ve}



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

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



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

EPCON™ C6 PLUS

STRENGTH LIMIT STATE DESIGN

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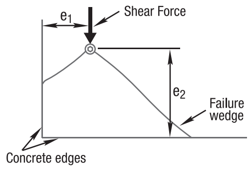
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20	25	32
Effective depth, h (mm)	90	110	125	170	210	300
-40˚C to +70˚C	40.8	59.9	83.8	142.4	219.9	268.1



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 = 0.67

Anchor size, d_b	10	12	16	20	25	32
Gr 500 Rebar	21.4	30.8	54.8	85.7	133.9	219.3

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}

Check $V^*/\phi V_{ur} \leq 1.0$,

if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

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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™ EPCON™ C6 PLUS Injection
(Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

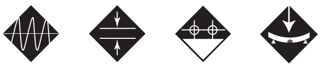
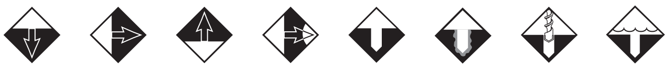
Ramset™ EPCON™ C6 PLUS Injection with
16mm grade 500 Rebar
Drilled hole depth to be 125 mm.
To be installed in accordance with
Ramset™ Installation Instructions.

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

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

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

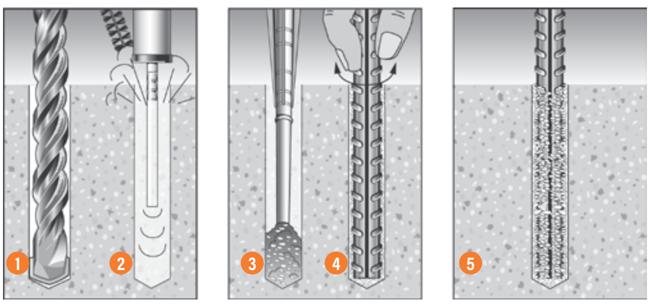
Service Temperature Limits

-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			

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

ChemSet™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

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 (mm²)	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

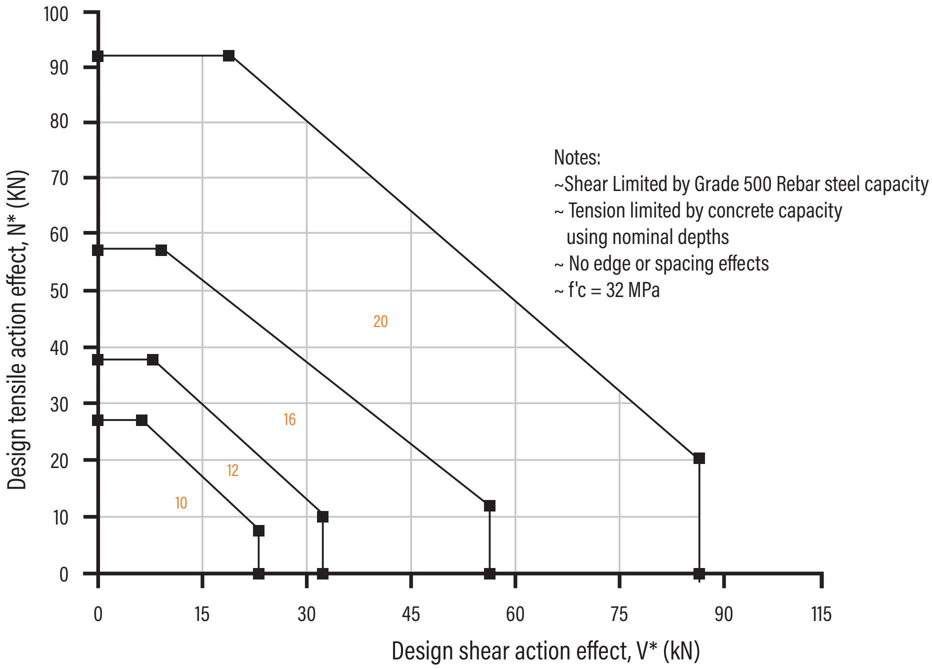


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

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.

ChemSet™ 801 Xtrem™ XC²

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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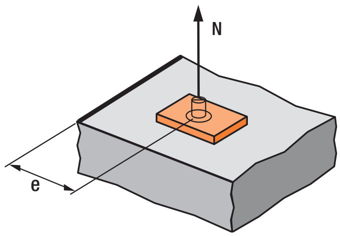
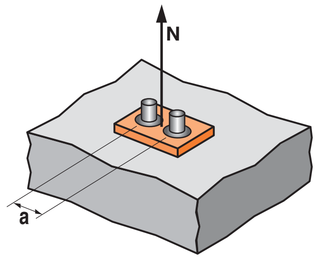
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \leq e \leq e_c$
$e_c = 1.5*h$
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 $a_m \leq a \leq a_c$
$a_c = 3*h$
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

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 $\phi N_{ucc} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na}$

STEP 3

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 $N^*/\phi N_{ur} \leq 1.0$,
if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

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.

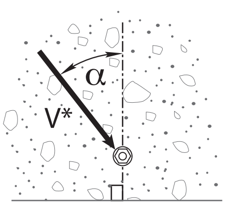
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

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

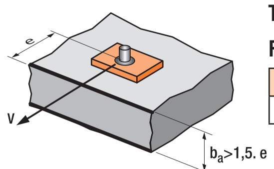


Load direction effect, conc. edge shear, X_{vd}

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

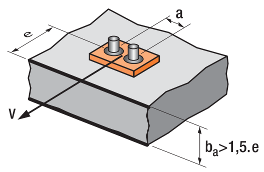
Table 4d - Concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}



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

For single anchor fastening X_{ve}

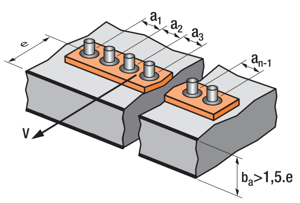
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

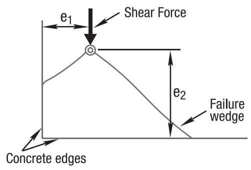
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

ChemSet™ 801 Xtrem™ XC²

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

ChemSet™ 801 Xtrem™ XC²

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

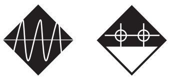
Ramset™ 801 Xtrem™ XC² Injection with 20mm grade 500 Rebar
Drilled hole depth to be 125 mm.
To be installed in accordance with Ramset™ Installation Instructions.

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

ChemSet™ 101 PLUS

CHEMICAL INJECTION - NON-CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Installation Related
	

Product

ChemSet™ Injection 101 PLUS is a marine grade polyester adhesive anchor.

Benefits, Advantages and Features

- Certified Performance European Technical Assessment EAD 330499 - Option 7

Fast installation:

- Load in 50 minutes (at 20°C)
- Easy cold weather dispensing

Versatile:

- Suitable for anchoring into a wide variety of substrates
- Solid concrete, hollow block and brick
- Flooded holes
- Styrene Free
- Cold and temperate climates
- VOC Compliant

Ramset Design Method:

- Uses technical data validated from testing in ANZ concrete

Australian Made

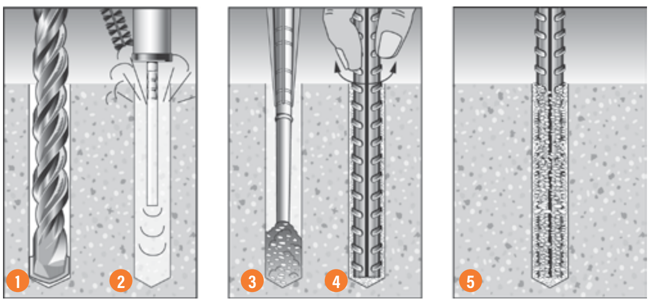
Principal Applications

- **Hollow brick and block**
- **Stadium seating**
- **Starter Bars**
- **Balustrades**

Recommended Installation Temperatures

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

Installation



1. Drill recommended diameter and depth hole.
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 4, brush x 3, blow x 4, brush x 3, blow x 4.
3. Dispense adhesive to waste until colour is uniform light grey (2-3 trigger pulls). Insert mixing nozzle to bottom of hole. Fill hole to 3/4 the hole depth slowly, ensuring no air pockets form.
4. Insert rebar to bottom of hole while turning.
5. ChemSet™ Injection to cure as per setting times.

Service Temperature Limits

-40°C to 80°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	5°C	18 min	145 min
10°C	10°C	10 min	85 min
20°C	20°C	6 min	50 min
25°C	25°C	5 min	40 min
+30°C	+30°C	5 min	35 min
Note: Cartridge temperature minimum +5°C			

ChemSet™ 101 PLUS

CHEMICAL INJECTION - NON-CRACKED CONCRETE

Installation and performance details: ChemSet™ Injection 101 PLUS 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	14	90	40	60	115	31.4	21.4	7.8	9.8	11.0
12	16	110	50	70	140	45.2	30.8	11.5	14.5	16.2
16	20	125	65	100	160	80.4	54.8	17.3	21.9	24.5
20	25	150	80	120	190	125.6	85.7	26.0	32.9	36.8
		170			215			29.5	37.3	41.7
24	30	180	100	145	240	180.8	123.3	37.5	47.4	53.0
		210			270			43.7	55.3	61.9
25	30	180	100	150	240	196.4	133.9	39.1	49.4	55.3
		210			270			45.6	57.7	64.5
28	35	225	115	170	295	246.4	168.0	54.7	69.2	77.4
		270			340			65.6	83.0	92.8
32	40	240	130	195	320	321.6	219.3	66.7	84.3	94.3
		300			380			83.4	105.4	117.9
36	45	290	145	220	380	408.0	278.3	90.6	114.7	128.2
		330			420			103.2	130.5	145.9
40	50	320	160	240	420	504.0	343.7	111.1	140.6	157.2
		360			460			125.0	158.2	176.8

* 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 = 0.6 and N_{UC} = Characteristic ultimate concrete tensile capacity. **For conversion to Working Load Limit MULTIPLY ϕN_{UC} x 0.55

***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}

WET HOLES: Multiply ϕN_{UC} x 1 All data relevant for Non-Cracked Concrete

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

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ 101 PLUS Cartridge	380 ml	C101C
ChemSet™ 101 PLUS Jumbo Cartridge	750 ml	C101J
ChemSet™ 101 PLUS Kit	2 x 380 ml	ISKP
Mixer Nozzle for 101 PLUS	-	ISNP

Substrate thickness, b_m (mm)

b_m = greater of: 1.25 x h,
h + (2 x d_h)

Drilled hole depth, h_1 (mm)
h_1 = h
h = Effective depth

TYPICAL ENGINEERING PROPERTIES OF GRADE 500 REINFORCING BAR

Rebar Size	10	12	16	20	24	25	28	32	36	40
Drilled Hole Dia, d_h (mm)	14	16	20	25	30	30	35	40	45	50
Stress Area, A_s (mm^2)	78.5	113	201	314	452	491	616	804	1020	1260
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500	500	500	500	500
Tensile Steel Yield Capacity N_{sy}, (KN)	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0	510.0	630.0

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

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

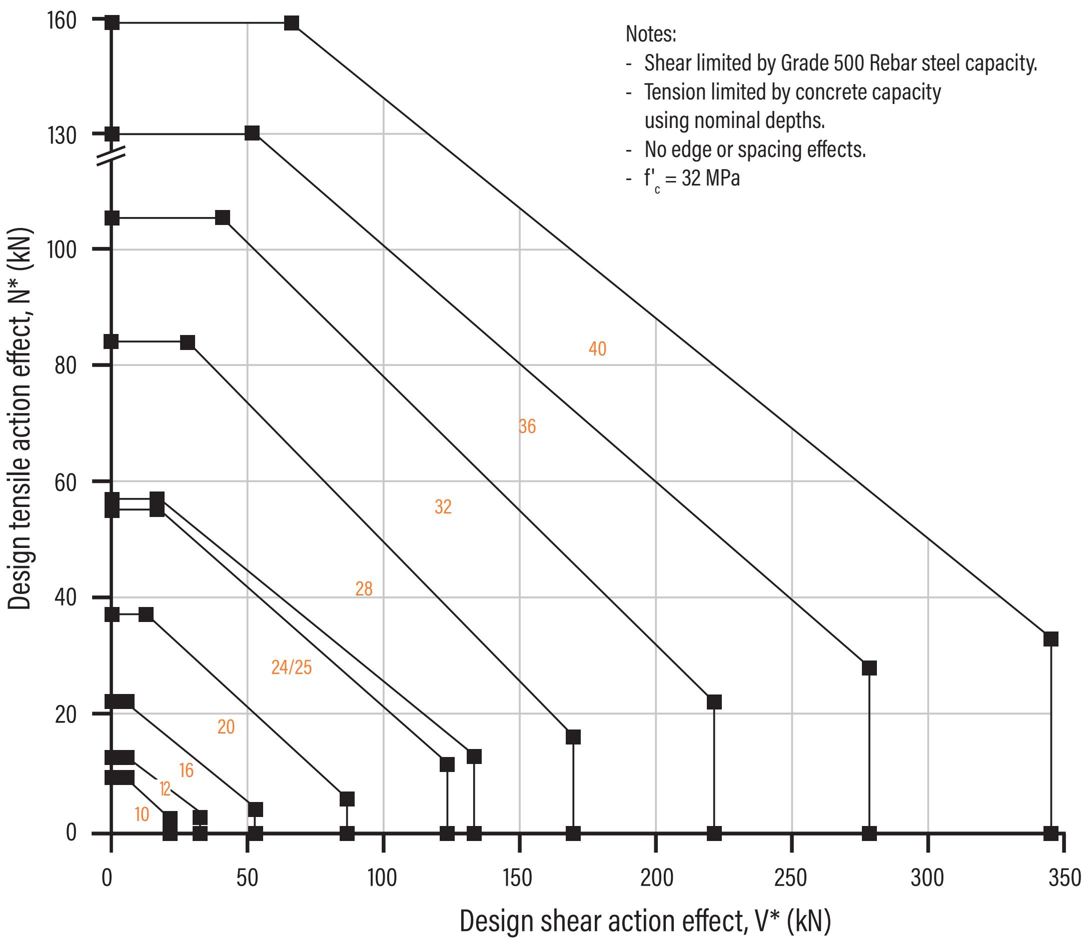


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
e_m, a_m	30	36	48	60	72	75	84	96	108	120

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 fixed

Substrate thickness, b_m (mm)

b_m = greater of: $1.25 \times h$, $h + (2 \times d_h)$

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

ChemSet™ 101 PLUS

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 = 0.6, f'$_c$ = 32 MPa

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Drilled Hole Dia, d_h (mm)	14	16	20	25	30	30	35	40	45	50
Effective Depth, h (mm)										
85	9.3									
90	**9.8**									
95	10.4									
100	10.9	13.1								
105	11.5	13.8								
110	12.0	**14.5**								
115	12.6	15.1								
125	13.7	16.4	**21.9**							
140	15.3	18.4	24.6							
150	16.4	19.7	26.3	32.9						
170		22.4	29.8	**37.3**						
180		23.7	31.6	39.5	47.4	49.4				
210			36.9	46.1	**55.3**	**57.7**	64.5			
240			42.2	52.7	63.3	65.9	73.8	84.3		
270				59.3	71.1	74.1	**83.0**	94.8	106.7	
300				65.9	79.0	82.4	92.2	**105.4**	118.6	131.7
320				70.2	84.3	87.9	98.4	112.4	126.5	140.5
330					86.9	90.6	101.4	115.9	**130.4**	144.9
360					94.8	98.8	110.7	126.5	142.3	**158.1**
420						115.3	129.1	147.6	166.0	184.5
460								161.7	181.8	202.0
500								175.7	197.6	219.6
550									217.4	241.6
600										263.5
625										274.5

Bold values are at ChemSet™ Anchor Stud nominal depths.

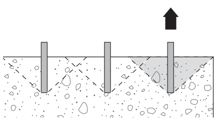
WET HOLES: Multiply ϕN_{uc} x 1

All data relevant for Non-Cracked Concrete. For optimised performance data, please use Ramset iExpert Anchoring Software.

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

f'$_c$ (MPa)	20	25	32	40	50
X_{nc}	0.79	0.88	1.00	1.12	1.25

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



Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Edge Distance, e (mm)										
30	0.83									
35	0.91	0.81								
40	1.00	0.88								
50		1.00	0.85							
65			1.00	0.87						
80				1.00	0.88	0.86				
95					1.00	0.97	0.89	0.82		
100						1.00	0.93	0.85		
110							1.00	0.90	0.83	
130								1.00	0.93	0.87
145									1.00	0.93
160										1.00

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

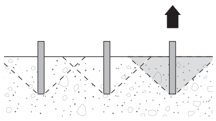


Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

For single anchor design, X_{nae} = 1.0

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Anchor Spacing, a (mm)										
30	0.75									
35	0.79	0.74								
40	0.83	0.78								
50	0.92	0.85	0.76							
60	1.00	0.92	0.81	0.75						
75		1.00	0.89	0.81	0.76	0.75				
95			1.00	0.90	0.83	0.82	0.78			
120				1.00	0.92	0.90	0.86	0.81	0.78	0.75
140					1.00	0.97	0.92	0.86	0.82	0.79
150						1.00	0.95	0.89	0.85	0.81
170							1.00	0.94	0.89	0.85
195								1.00	0.95	0.91
220									1.00	0.96
240										1.00

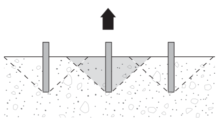


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

For single anchor design, X_{nai} = 1.0

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Anchor Spacing, a (mm)										
30	0.50									
35	0.58	0.49								
40	0.67	0.56								
50	0.83	0.69	0.52							
60	1.00	0.83	0.63	0.50						
75		1.00	0.78	0.63	0.52	0.50				
95			1.00	0.79	0.66	0.63	0.57	0.49		
120				1.00	0.83	0.80	0.71	0.63	0.56	0.50
150					1.00	1.00	0.89	0.78	0.69	0.63
170							1.00	0.89	0.79	0.71
195								1.00	0.90	0.81
215									1.00	0.90
240										1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$$\phi N_{urc} = \phi N_{uc} * X_{nc} * X_{ne} * (X_{nae} \text{ or } X_{nai})$$

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN), ϕ_n = 0.8

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
e_m, a_m	31.4	45.2	80.4	125.6	180.8	196.4	246.4	321.6	408.8	504.0

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$$\phi N_{ur} = \text{minimum of } \phi N_{urc}, \phi N_{us}$$

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

Tensile performance conversion table

Performance Required	Concrete Tensile Performance		Steel Tensile Performance	
	Notation	Concrete Tension Capacity	Notation	Carbon Steel Tension Capacity
Strength Limit State	ϕN_{urc}	MULTIPLY $ØN_{urc}$ x 1.00	ϕN_{us}	MULTIPLY ϕN_{us} x 1.00
Working Load Limit	N_{ac}	MULTIPLY $ØN_{urc}$ x 0.55	N_{as}	MULTIPLY ϕN_{us} x 0.56
Cyclic Loading	N_{yc}	Refer to page 40 for suitable anchor	N_{ys}	Refer to page 40 for suitable anchor
Fire Resistance	$N_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$N_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$N^0_{Rd,p,sis}$	Refer to Seismic Anchors	$N_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

STEP 4 Verify concrete shear capacity - per anchor

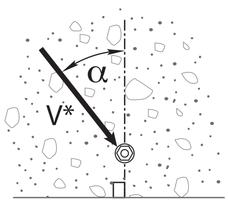
Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), $\phi_q = 0.6$, $f'_c = 32$ MPa

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Edge Distance, e (mm)										
30	2.5									
35	3.2									
40	3.9	4.2								
50	5.5	5.9	6.5							
60	7.2	7.7	8.6	9.6						
75	10.1	10.8	12.0	13.4	14.7	14.7				
95	14.3	15.3	17.1	19.2	21.0	21.0	22.7			
120	20.4	21.8	24.3	27.2	29.8	29.8	32.2	34.4	36.5	38.5
200	43.8	46.8	52.4	58.6	64.1	64.1	69.3	74.1	78.6	82.8
300	80.5	86.1	96.2	107.6	117.8	117.8	127.3	136.1	144.3	152.1
400	123.9	132.5	148.1	165.6	181.4	181.4	196.0	209.5	222.2	234.2
500	173.2	185.2	207.0	231.5	253.6	253.6	273.9	292.8	310.6	327.4
600	227.7	243.4	272.2	304.3	333.3	333.3	360.0	384.9	408.2	430.3

Note: Effective depth, h must be ≥ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.88	1.00	1.12	1.25



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

Note: For single anchor designs, $X_{va} = 1.0$

Edge distance, e (mm)	25	30	35	50	60	75	125	200	300	400	500	600
Anchor spacing, a (mm)												
25	0.70	0.67	0.64	0.60	0.58	0.57	0.54					
30	0.74	0.70	0.67	0.62	0.60	0.58	0.55	0.53				
35	0.78	0.73	0.70	0.64	0.62	0.59	0.56	0.54	0.52			
50	0.90	0.83	0.79	0.70	0.67	0.63	0.58	0.55	0.53	0.53		
60	0.98	0.90	0.84	0.74	0.70	0.66	0.60	0.56	0.54	0.53	0.52	
75	1.00	1.00	0.93	0.80	0.75	0.70	0.62	0.58	0.55	0.54	0.53	0.53
150			1.00	1.00	1.00	0.90	0.74	0.65	0.60	0.58	0.56	0.55
200						1.00	0.82	0.70	0.63	0.60	0.58	0.57
300							0.98	0.80	0.70	0.65	0.62	0.60
400							1.00	0.90	0.77	0.70	0.66	0.63
500								1.00	0.83	0.75	0.70	0.67
625									0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
875										0.94	0.85	0.79
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

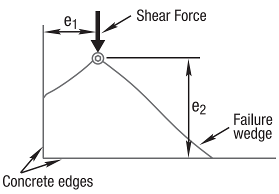
Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, $X_{vn} = 1.0$

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

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

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



ANCHOR AT A CORNER

Edge distance, e_2 (mm)	25	30	35	50	60	75	125	200	300	400	600	900
Edge dustance, 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

Ramset™

ChemSet™ 101 PLUS

STRENGTH LIMIT STATE DESIGN

Checkpoint 4

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

$$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$$

STEP 5 Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us} (kN), $\phi_v = 0.8$

Anchor size, d_b	10	12	16	20	24	25	28	32	36	40
Grade 500 Rebar	21.4	30.8	54.8	85.7	123.3	133.9	168.0	219.3	278.3	343.7

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{us}

Check $V^* / \phi V_{ur} \leq 1$,

if not satisfied return to step 1

Shear performance conversion table

Performance Required	Concrete Shear Performance		Steel Shear Performance	
	Notation	Concrete Shear Capacity	Notation	Carbon Steel Shear Capacity
Strength Limit State	ϕV_{uc}	MULTIPLY ϕV_{uc} x 1.00	ϕV_{us}	MULTIPLY ϕV_{us} x 1.00
Working Load Limit	V_{ac}	MULTIPLY ϕV_{uc} x 0.55	V_{as}	MULTIPLY ϕV_{us} x 0.45
Cyclic Loading	V_{yc}	Refer to page 40 for suitable anchor	V_{ys}	Refer to page 40 for suitable anchor
Fire Resistance	$V_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$V_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$V^0_{Rd,c,sis}$	Refer to Seismic Anchors	$V^0_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Shear Capacity is the minimum of Concrete Shear and Steel Shear Capacities

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™ ChemSet™ 101 PLUS with (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ ChemSet™ 101 PLUS with N20 grade 500 Rebar
Drilled hole depth to be 160 mm.
To be installed in accordance with Ramset™ Installation Instructions.

Notes

CHEMICAL ANCHORING - REINFORCING BAR ANCHORAGE