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	Material Specification	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

- 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
- Suitable for contact with drinking water

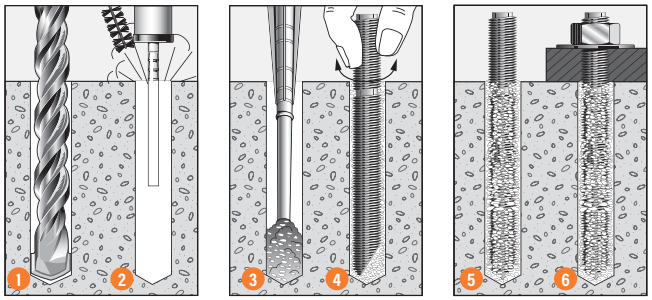
Principal Applications

- 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. Alternativly 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 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 **Ramset™** ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow ChemSet™ Reo 502™ PLUS to cure as per setting times.
6. Attach fixture.

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™ Reo 502™ PLUS and ChemSet™ Anchor Studs

Anchor size, d_b (mm)	Installation Details				Optimum dimensions*		
	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Concrete substrate thickness, b_m (mm)
M10	12	12	90	20	135	270	120
M12	14	14	110	40	165	330	140
M16	18	18	125	80	187.5	375	160
M20	22	22	150	120	225	450	190
			170		255	510	220
M24	26	26	160	160	240	480	200
			210		315	630	270
M30	35	33	280	200	420	840	350

* 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.

Anchor size, d_b (mm)	Reduced Characteristic Capacity#								
	Grade 5.8 Steel Studs		Grade 8.8 Steel Studs		ANSI 316 Stainless Steel Studs		Non-Cracked Concrete		
							Tension, ϕN_{uc} (kN)**		
	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Concrete Compressive Strength, f'_c		
							20 MPa	32 MPa	40 MPa
M10	11.8	18.9	17.5	28.2	14.2	19.8	28.0	29.4	30.3
M12	17.5	28.1	26.0	41.9	21.1	29.5	37.8	43.1	44.4
M16	33.1	53.9	50.9	82.1	41.4	57.7	45.8	52.3	53.8
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	80.7
							72.6	88.9	91.4
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							99.7	126.2	135.5
M30	-	-	185.5	299.2	-	-	153.5	173.8	178.8

**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 = 0.67 and N_{us} = Characteristic ultimate steel tensile capacity .
For conversion to Working Load Limit MULTIPLY ϕN_{us} x 0.67 for Gr 5.8 & Gr 8.8
#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

ENGINEERING PROPERTIES

ChemSet™ Anchor Studs and Threaded Rod

Anchor Size, d_b	Grade 8.8 Threaded Rod				Stainless Steel High Corrosion Resistance HCR Grade 1.4529/1.4565 Threaded Rod				Section modulus Z (mm^3)
	Shank diameter, d_s (mm)	Stressed Area (mm^2)	Yield Strength f_y MPa	UTS f_u MPa	Shank diameter, d_s (mm)	Stressed Area (mm^2)	Yield Strength f_y MPa	UTS f_u MPa	
M10	8.6	58	640	800	8.2	52.8	450	650	62.3
M12	10.4	84.3	640	800	10	78.5	450	650	109.2
M16	14.1	157	640	800	14	153.9	450	650	277.5
M20	17.7	245	640	800	17.2	232.4	450	650	540.9
M24	21.2	353	640	800	20.7	336.5	450	650	935.5
M30	26.7	561	640	800	-	-	-	-	-

Refer to "Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ on page 141.

ChemSet™ Reo 502™ PLUS

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

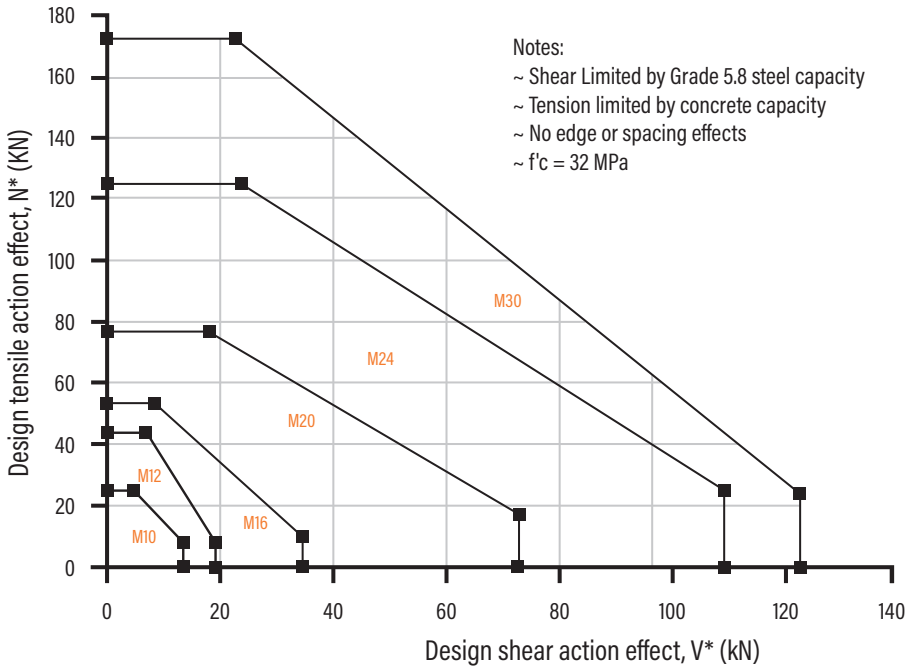

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b M10	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	40	40	40	50	50	60
Min. Edge Distance - e_m	40	40	40	50	50	60

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

Refer to "Description and Part Numbers" table for ChemSet® Anchor Studs page in the SARB ANZ on page 141.

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)		
M10	M12	M16 to M30
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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STEP 2 Verify concrete tensile capacity - per anchor

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

	Combined pull-out and concrete cone resistance - ϕN_{ucp}						Concrete Cone Resistance - ϕN_{ucc}
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
Drilled Hole Dia, d_h (mm)	12	14	18	22	26	35	
Effective Depth, h (mm)							
70	22.9						24.3
80	26.1						29.7
90	**29.4**	35.3					35.4
100	32.7	39.2					41.5
110	35.9	**43.1**	46.0				47.9
120	39.2	47.0	50.2				54.5
125	40.8	49.0	**52.3**				58.0
140	45.7	54.9	58.5				68.7
150	49.0	58.8	62.7	78.4			76.2
160	52.3	62.7	66.9	83.6	100.4		84.0
170	55.5	66.7	71.1	**88.9**	106.6		91.9
180	58.8	70.6	75.3	94.1	112.9		100.2
190	62.1	74.5	79.5	99.3	119.2		108.6
200	65.3	78.4	83.6	104.6	125.5		117.3
210		82.3	87.8	109.8	**131.7**	130.4	126.2
240		94.1	100.4	125.5	150.6	149.0	154.2
280			117.1	146.4	175.6	**173.8**	194.4
320			133.8	167.3	200.7	198.6	237.5
350				183.0	219.6	217.3	271.6
400				209.1	250.9	248.3	331.9
450					282.3	279.4	396.0
480					301.1	298.0	436.3
550						341.4	535.1
600						372.5	609.7

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)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20 to 50	0.67	0.67	0.79	0.75	0.75	0.63	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 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}						X_{ns} where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
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)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
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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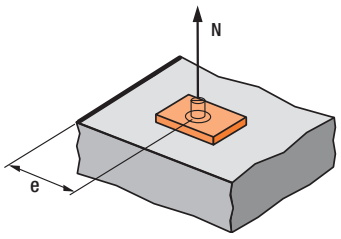
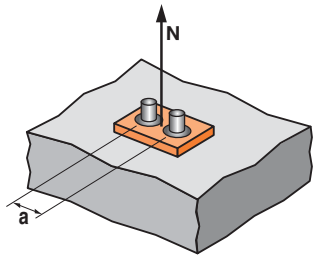


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	M10	M12	M16	M20	M24	M30
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	0.37
70	0.64	0.57	0.53	0.46	0.42	0.38
80	0.69	0.61	0.57	0.49	0.44	0.39
100	0.81	0.70	0.65	0.54	0.49	0.43
115	0.89	0.77	0.71	0.59	0.52	0.46
135	1	0.86	0.79	0.65	0.57	0.49
165		1	0.91	0.74	0.64	0.54
187			1	0.80	0.70	0.58
255				1	0.86	0.71
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}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
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	
65	0.62	0.60	0.59	0.56	0.55	0.54
85	0.66	0.63	0.61	0.58	0.57	0.55
100	0.69	0.65	0.63	0.60	0.58	0.56
125	0.73	0.69	0.67	0.62	0.60	0.57
150	0.78	0.73	0.70	0.65	0.62	0.59
200	0.87	0.80	0.77	0.70	0.66	0.62
270	1	0.91	0.86	0.76	0.71	0.66
330		1	0.94	0.82	0.76	0.70
375			1	0.87	0.80	0.72
510				1	0.90	0.80
630					1	0.88
840						1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}
ϕN_{urc} = minimum of ϕN_{ucp} *X_{ncr} *X_{ns} *X_{nc} *X_{ne} *X_{na} and ϕN_{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_n = 0.67 for Gr 5.8 & Gr 8.8

Anchor size, d_b	M10	M12	M16	M20	M24	M30
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	18.9	28.1	53.9	81.3	117.8	-
ChemSet™ Anchor StudA4/316 Stainless Steel	19.8	29.5	57.7	87.1	126.2	-
ChemSet™ Anchor Stud Grade 8.8 Carbon Steel	28.2	41.9	82.1	123.9	179.5	299.2

Note: ϕ_n = 0.58 for ChemSet™ Anchor Stud A4/316 Stainless Steel

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

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STEP 4

Step 4 - Verify concrete shear capacity - per anchor

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

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	70 - 200	90 - 240	110 - 320	150 - 400	160 - 480	210 - 600
Edge distance, e_m						
40	4.3	4.7	5.4			
50				8.2	8.8	
60						12.7

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

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

Anchor size, d_b	M10	M12	M16	M20	M24	M30
X_{vcr}	0.70					

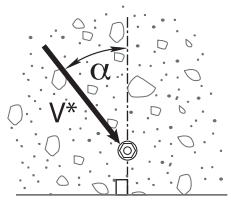
For Non-cracked concrete X_{vcr} = 1.0

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

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

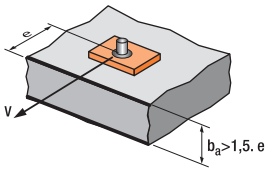


Load direction effect, conc. edge shear, X_{vd}

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

For single anchor fastening X_{ve}

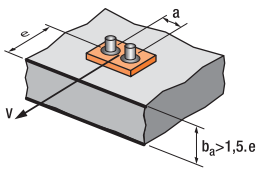
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

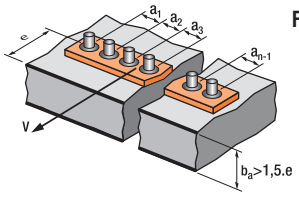
For 2 anchors fastening X_{ve}

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



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

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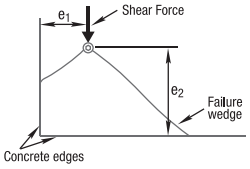
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
-40˚C to +70˚C	58.8	86.3	104.6	177.7	263.5	335.2



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	M10	M12	M16	M20	M24	M30
ChemSet™ Anchor Stud Grade 5.8 Carbon Steel	11.8	17.5	33.1	49.9	72.3	-
ChemSet™ Anchor StudA4/316 Stainless Steel	14.2	21.1	41.4	62.4	90.4	-
ChemSet™ Anchor Stud Grade 8.8 Carbon Steel	17.5	26.0	50.9	76.8	111.3	185.5

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

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

Check $V^*/\phi Vur \leq 1.0$,

if not satisfied return to step 1

ChemSet™ Reo 502™ PLUS

STRENGTH LIMIT STATE DESIGN

AVAILABLE IN AUSTRALIA ONLY

STEP 6 Combined Loading

Checkpoint 6

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

Specifiy - Threaded Stud Anchors
Ramset™ ChemSet™ Reo 502™ PLUS with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ ChemSet™ Reo 502™ PLUS Injection with M16 grade 5.8 ChemSet™ Anchor Stud (CS16190GH). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.

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