ChemSet™ EPCON™ G5 Xtrem™

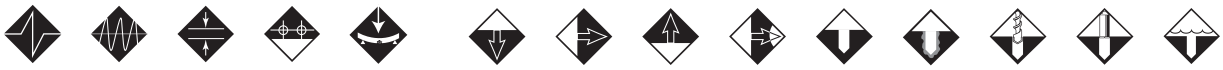
CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

AVAILABLE IN NEW ZEALAND ONLY

(Australia refer to ChemSet™ Reo502™ Xtrem™ range)

GENERAL INFORMATION

Performance Related	Installation Related



Product

ChemSet™ EPCON™ G5 Xtrem™ is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment - ETA-25/0648

Design according to:

- AS 5216 (formerly TS101)
- EN 1992-4 (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.

Principal Applications

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

Benefits, Advantages and Features

- 100 year working Life

Greater productivity:

- 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

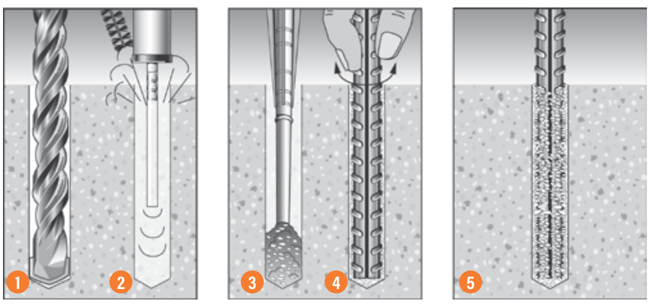
Installation & Substrate Temperature Range

Minimum	Maximum
5°C	40°C

Service Temperature Limits

T1: -40°C to +40°C
T2: -40°C to +60°C
T3: -40°C to +75°C

Installation



1. Drill recommended diameter and depth hole.
2. **Important:** For hammer drilling technique clean dust and debris from hole with stiff wire brush and blower in the following sequence: blow x 2, brush x 2, blow x 2, brush x 2, blow x 2. For diamond drilling technique refer to **ETA-25/0648**
3. Screw mixing nozzle onto cartridge and dispense adhesive to waste until colour is orange. Insert mixing nozzle to bottom of hole.
   Fill hole to 2/3 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™ EPCON™ G5 Xtrem™ to cure as per setting times.

Setting Times

Temperature of base material	Gel Time	Curing time in dry concrete	Curing time in wet and flooded concrete
5°C	75 min	30h	60 h
10°C	45 min	22h	44 h
15°C	35 min	14h	28 h
20°C	22 min	7h	14 h
25°C	14 min	5h	10 h
30°C	8 min	4h	8 h
35°C	6 min	3h	6h
40°C	4 min	2h 45min	5h 30min

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Installation and performance details: ChemSet™ EPCON™ G5 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_{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	27.3	27.3	27.3
12	15	110	165	330	140	45.2	30.8	37.8	41.0	41.5
16	20	125	187	375	160	80.4	54.8	45.8	58.0	62.4
20	25	150	225	450	190	125.6	85.7	60.2	76.2	85.2
		170	255	510	215			72.7	91.9	102.8
25	30	180	270	540	215	196.4	133.9	79.2	100.2	112.0
		210	315	630	275			99.8	126.2	141.1
32	40	240	360	720	320	321.6	219.3	121.9	154.2	172.4
		300	450	900	380			170.4	215.6	241.0

* 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} and N_{uc} = Characteristic ultimate concrete tensile capacity. **For value of ϕ refer to Table 2a
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**
All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.65
For optimised performance data, including performance based on diamond drilling technique, please use Ramset iExpert Anchoring Software.

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ EPCON™ G5 Xtrem™	600ml	CEG5X600

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	25	32
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	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**

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

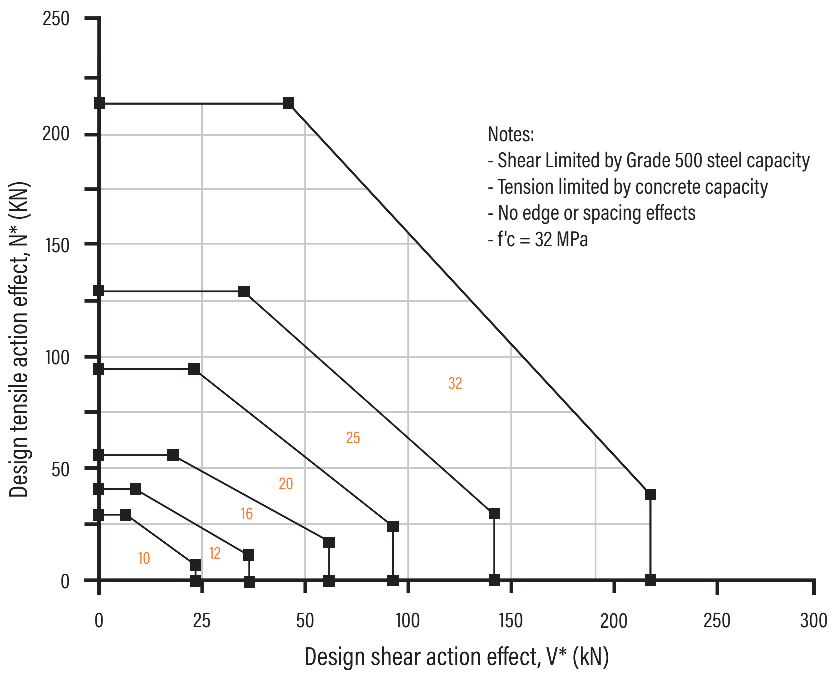

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	10	12	16	20	25	32
Min. Anchor Spacing - a_m	40	50	70	85	90	140
Min. Edge Distance - e_m	40	40	45	55	60	90

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.

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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 = 1/1.5 = 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	25	32	
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	40	
Effective Depth, h (mm)							
70	21.3						24.3
80	24.3						29.7
90	**27.3**	33.6					35.4
100	30.4	37.3					41.5
110	33.4	**41.0**					47.9
120	36.4	44.8	59.3				54.5
125	38.0	46.6	**61.8**				58.0
140	42.5	52.2	69.2				68.7
150	45.6	56.0	74.1	92.6			76.2
160	48.6	59.7	79.0	98.8			84.0
170	51.6	63.4	84.0	**105.0**			91.9
180	54.7	67.2	88.9	111.2	141.3		100.2
190	57.7	70.9	93.9	117.3	149.1		108.6
200	60.7	74.6	98.8	123.5	157.0		117.3
210		78.3	103.7	129.7	**164.8**		126.2
240		89.5	118.6	148.2	188.3	241.1	154.2
270			133.4	166.7	211.9	271.2	184.0
280			138.3	172.9	219.7	281.3	194.4
300			148.2	185.3	235.4	**301.4**	215.6
320			158.1	197.6	251.1	321.4	237.5
350				216.1	274.7	351.6	271.6
400				247.0	313.9	401.8	331.9
450					353.1	452.0	396.0
500					392.4	502.3	463.8
560						562.5	549.7
640						642.9	671.7

For optimised performance data, including performance based on diamond drilling technique, 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	0.74	0.73	0.71	0.70	0.70	0.67	0.70

Bold values are at Chemset Anchor Stud nominal Depths. For Sustained Loads MULTIPLY ϕN_{uc} x 0.72 (100 years) All data relevant for Dry and Wet Holes. For Flooded Holes MULTIPLY ϕN_{uc} x 0.65. 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	25	32	
Service temperature (°C)							
T1: -40°C to +40°C	1.00						1.00
T2: -40°C to +60°C	0.84						
T3: -40°C to +75°C	0.25						

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)
Anchor Size, d_b	10	12	16	20	25	32	
f'c (MPa)							
20	1.00	0.98	0.98	0.98	0.95	0.95	0.79
25	1.00	0.99	0.99	0.99	0.97	0.97	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.00	1.01	1.01	1.01	1.02	1.02	1.12
50	1.00	1.02	1.02	1.02	1.04	1.04	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)
Anchor Size, d_b	10	12	16	20	25	32	
f'c (MPa)							
20	0.95	0.95	0.95	0.91	0.88	0.87	0.79
25	0.97	0.97	0.97	0.95	0.94	0.93	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.02	1.02	1.02	1.04	1.04	1.07	1.12
50	1.04	1.04	1.04	1.09	1.09	1.14	1.25

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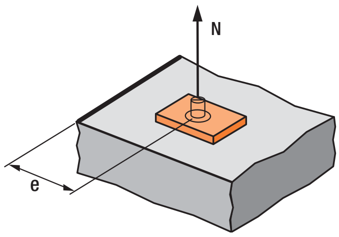
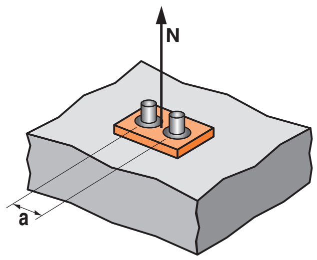


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \leq e \leq e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	10	12	16	20	25	32
Edge distance, e (mm)						
40	0.47	0.43				
45	0.50	0.45	0.43			
50	0.53	0.48	0.45			
55	0.56	0.50	0.47	0.41		
60	0.58	0.52	0.49	0.43	0.39	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	
90	0.75	0.66	0.61	0.51	0.46	0.40
100	0.81	0.70	0.65	0.54	0.49	0.42
115	0.89	0.77	0.71	0.59	0.52	0.44
135	1	0.86	0.79	0.65	0.57	0.48
165		1	0.91	0.74	0.64	0.53
187			1	0.80	0.70	0.56
255				1	0.86	0.68
315					1	0.78
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	25	32
Anchor spacing, a (mm)						
40	0.57					
45	0.58					
50	0.59	0.58				
55	0.60	0.58				
60	0.61	0.59				
70	0.63	0.61	0.59			
85	0.66	0.63	0.61	0.58		
90	0.67	0.64	0.62	0.59	0.57	
140	0.76	0.71	0.69	0.64	0.61	0.58
170	0.81	0.76	0.73	0.67	0.63	0.59
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	0.71
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 $N^*/\phi N_{ur} \leq 1.0$,
if not satisfied return to step 1

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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_m						
40	4.3	4.7				
45			6.3			
55				9.1		
60					11.2	
90						21.3

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

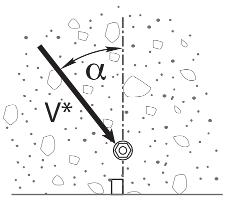
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

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}

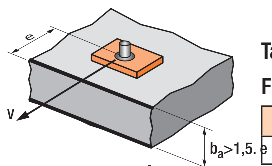
f'c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1	1.11	1.22



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

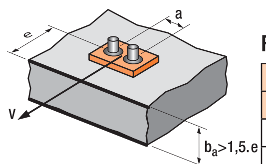


$X_{ve} = e/e_m * \sqrt{e/e_m}$

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

For single anchor fastening X_{ve}

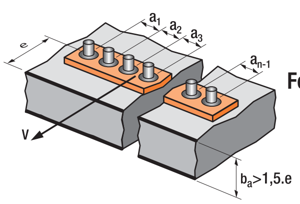
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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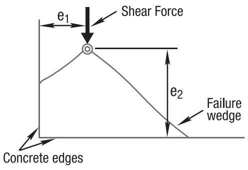
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Rebar size, d_b	10	12	16	20	25	32
Effective depth, h (mm)	90	110	125	170	210	300
T1: -40°C to +40°C	54.7	82.1	116.0	183.9	252.5	431.1
T2: -40°C to +60°C	45.9	68.9	103.7	176.4	252.5	431.1
T3: -40°C to +75°C	13.7	20.5	30.9	52.5	82.4	150.7



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 = 0.67

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

ChemSet™ EPCON™ G5 Xtrem™

STRENGTH LIMIT STATE DESIGN

AVAILABLE IN NEW ZEALAND 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™ EPCON™ G5 Xtrem™ Injection
(Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ EPCON™ G5 Xtrem™ 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.