ChemSet™ 801 Xtrem™ XC²

SEISMIC ANCHOR STUDS - CHEMICAL INJECTION

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

ChemSet™ 801 Xtrem™ XC² is a heavy duty Vinylester adhesive 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)
- AS1170.4 - Earthquake Actions
- EN1992-4 (formerly ETAG001 Annex C, E & TR045)
- NZS3101 (A3) Section 17 - Seismic Design C1
- 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:

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

Greater security:

- Strong bond
- Rated for sustained loading

Versatile:

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

Greater safety:

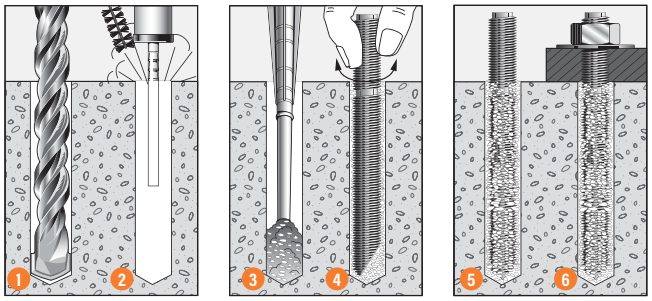
- Low odour
- Suitable for contact with drinking water
- VOC Compliant

Made in Australia

Principal Applications

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

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.
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 **Ramset™** ChemSet™ Anchor Stud/rebar to bottom of hole while turning.
5. Allow Chemset™801 Xtrem™ XC² to cure as per setting times.
6. Attach fixture.

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	Cartridge Temperature	Gel Time	Curing time in dry and 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			

ChemSet™ 801 Xtrem™ XC²

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Installation and performance details: ChemSet 801 Xtrem™ XC² and ChemSet™ Anchor Studs

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Optimum dimensions*		Concrete substrate thickness, b_m (mm)
					Anchor* spacing, a_c (mm)	Edge* distance, e_c (mm)	
M10	12	12	90	20	270	135	120
M12	14	14	110	30	330	165	140
M16	18	18	125	60	375	187	160
M20	25	22	170	120	510	255	220
M24	28	26	210	200	630	315	265
M30	35	33	280	400	840	420	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		Seismic Cracked Concrete C1
	Shear, $V_{Rd,seis}$ (kN)	Tension, $N_{Rd,seis}$ (kN)****	Shear, $V_{Rd,seis}$ (kN)	Tension, $N_{Rd,seis}$ (kN)****	Shear, $V_{Rd,seis}$ (kN)	Tension, $N_{Rd,seis}$ (kN)****	Tension, $N_{Rd,p,Seis}$ (kN)*** Concrete Compressive Strength, f'_c 20 MPa to 50 MPa
M10	2.8	18.9	4.6	30.9	2.9	19.8	9.9
M12	4.2	28.1	6.7	45.0	4.4	29.5	15.3
M16	8.0	53.9	12.5	83.7	8.6	57.7	21.7
M20	12.1	81.3	19.4	130.7	13.0	87.1	37.5
M24	17.5	117.8	28.0	188.3	18.8	126.2	58.3
M30	29.2	196.4	44.5	299.2	-	-	89.7

** Tension values are based on service temperature limits -40˚C to +40˚C only. If service temperature limits is beyond this range please contact Ramset Engineer.

***Note: Seismic Cracked concrete combined pull-out and concrete conce resistance, tension = $N^0_{Rd,p,seis} = \alpha_{Nseis}\, N^0_{Rk,p,seis} / \gamma_{Msp}$ where $\gamma_{Msp} = 1.5$ $\alpha_{Nseis} = 0.85$

****Note: Seismic Cracked Concrete steel resistance, tension = $N_{Rd,s,seis} = \alpha_{Nseis}\, N^0_{Rk,s,seis} / \gamma_{Ms}$ (kN) where $\gamma_{Ms} = 1.5$ (Grade 5.8 & 8.8 steel), $\gamma_{Ms} = 1.73$ (A4 316 SS) and (HCR stainless steel)

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

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
ChemSet™ 801 Xtrem™ XC²	750ml	C801X750 (AU & NZ)
ChemSet™ 801 Xtrem™ XC²	380ml	C801X380 (AU Only)

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	-	-	-	-	-

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

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

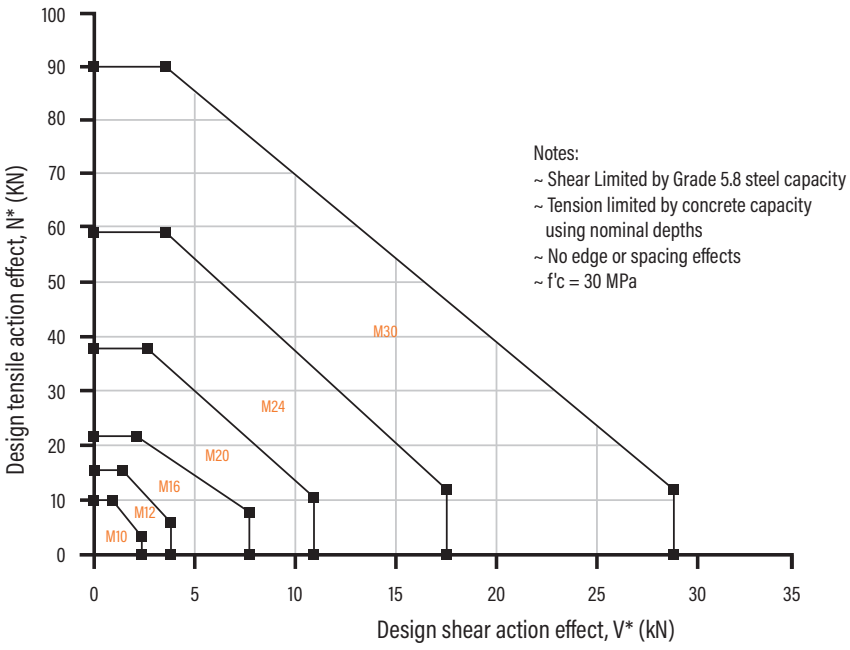

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Min. Anchor Spacing - a_m	50	60	75	90	115	140
Min. Edge Distance - e_m	45	45	50	55	60	80

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.

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 2 Verify Seismic C1 cracked concrete tensile capacity - per anchor

Table 2a - Seismic Cracked concrete combinded Pull-out and concrete cone resistance, tension

$N^0_{Rd,p,seis} = \alpha_{seis} N^0_{Rk,p,seis} / \gamma_{Msp}$ (kN), $\gamma_{Msp} = 1.5$, $\alpha_{N,seis} = 0.85$, f'c = 30 MPa

where $N^0_{Rk,p,seis} = \pi * d_b * h * \tau_{Rk,cr,seis}$

Anchor Size, d_b	M10	M12	M16	M20	M24	M30
Drilled Hole Dia, d_h (mm)	12	14	18	25	28	35
Effective Depth, h (mm)						
70	7.7					
80	8.8					
90	**9.9**	12.5				
100	11.0	13.9				
110	12.1	**15.3**	19.1			
120	13.2	16.7	20.9			
125	13.8	17.4	**21.7**			
140	15.5	19.4	24.3			
150	16.6	20.8	26.1	33.1		
160	17.7	22.2	27.8	35.3		
170	18.8	23.6	29.5	**37.5**	47.2	
180	19.9	25.0	31.3	39.7	50.0	
190	21.0	26.4	33.0	41.9	52.8	
200	22.1	27.8	34.8	44.1	55.5	
210		29.2	36.5	46.4	**58.3**	67.3
240		33.3	41.7	53.0	66.7	76.9
280			48.7	61.8	77.8	**89.7**
320			55.6	70.6	88.9	102.5
350				77.3	97.2	112.2
400				88.3	111.1	128.2
450					125.0	144.2
480					133.3	153.8
550						176.2
600						192.3

Flooded Holes: Multiply $N^0_{Rd,p,seis}$ *0.75

For single anchor values: Multiply $N^0_{Rd,p,seis}$*1.17

Bold values are at ChemSet Anchors Stud nominal depths

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

Note: The maximum embedment depth shall be reduced to $12d_b$ for installation in flooded holes

Table 2b-1 Seismic Cracked concrete service temperature limits effect, tension, X_{ns}

	Service temperature limits effect, tension, X_{ns}					
Anchor size, d_b	M10	M12	M16	M20	M24	M30
Service temperature (˚C)						
-40˚C to +40˚C	1.00	1.00	1.00	1.00	1.00	1.00
-40˚C to +80˚C	1.00	1.00	1.00	0.92	0.92	0.92

Table 2b-2 Seismic Cracked concrete compressive strength effect, tension, X_{nc}

f'c (MPa)	20	25	30	40	50
X_{nc}	1	1	1	1	1

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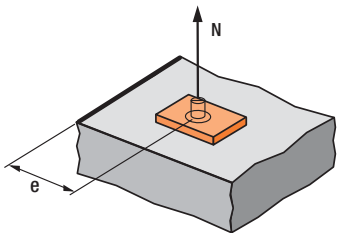
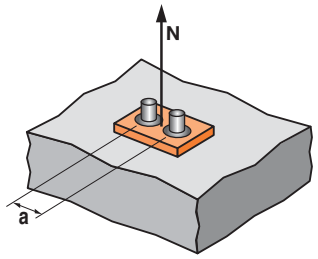
STRENGTH LIMIT STATE DESIGN



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

Table 2c - Seismic cracked concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Edge distance, e (mm)						
45	0.50	0.45				
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	
80	0.69	0.61	0.57	0.49	0.44	0.39
90	0.75	0.66	0.61	0.51	0.46	0.41
100	0.81	0.70	0.65	0.54	0.49	0.43
120	0.92	0.80	0.73	0.60	0.54	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 - Seismic cracked concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Anchor spacing, a (mm)						
50	0.59					
60	0.61	0.59				
75	0.64	0.61	0.60			
90	0.67	0.64	0.62	0.59		
115	0.71	0.67	0.65	0.61	0.59	
130	0.74	0.70	0.67	0.63	0.60	
140	0.76	0.71	0.69	0.64	0.61	0.58
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 seismic cracked concrete combined pull-out and concrete cone resistance, $N_{Rd,p,seis}$

$$N_{Rd,p,seis} = N^0_{Rd,p,seis} * X_{ns} * X_{nc} * X_{ne} * X_{na}$$

STEP 3

Verify seismic C1 cracked concrete tensile resistance - per anchor

Table 3a - Seismic Cracked Concrete steel resistance, tensile, $N_{Rd,s,seis} = \alpha_{seis} N_{Rk,s,seis}/\gamma_{Ms}$ (kN) where $\alpha_{seis} = 1.0$
γ_{Ms} = 1.5 for Grade 5.8 and Grade 8.8 Carbon Steel
γ_{Ms} = 1.73 for A4 316 Stainless Steel & HCR 1.4529 Stainless Steel

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Grade 5.8 Carbon Steel	18.9	28.1	53.9	81.3	117.8	196.4
Grade 8.8 Carbon Steel	30.9	45.0	83.7	130.7	188.3	299.2
A4 316 Stainless Steel	19.8	29.5	57.7	87.1	126.2	-
HCR 1.4529 Stainless Steel	19.8	29.5	57.7	87.1	126.2	-

Checkpoint 3

Design seismic C1 cracked concrete tensile resistance, $N_{Rd,seis}$

$N_{Rd,seis}$ = minimum of $N_{Rd,p,seis}$, $N_{Rd,s,seis}$

Check $N^*/N_{Rd,seis} \le 1$,
if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

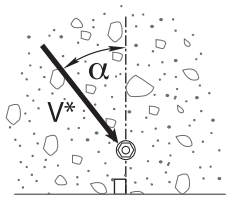
STEP 4

Step 4 - Verify seismic C1 cracked concrete edge shear resistance - per anchor

Table 4a - Seismic cracked concrete edge resistance, $V^0_{Rd,c,seis} = \alpha_{seis} V^0_{Rk,c,seis} / \gamma_{Mc}$ (kN), $\gamma_{Mc} = 1.5$, $\alpha_{seis} = 0.85$, $f'_c = 30$ MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
Edge distance, e_m						
45	1.5	1.7				
50			2.1			
55				2.8		
65					3.5	
70						5.7

Note: Data includes annular gap reduction factor of 0.5
For optimised performance data, please use Ramset iExpert Anchoring Software



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

Table 4b - Seismic cracked concrete compressive strength effect, shear, X_{vc}

f'_c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.90	1	1.16	1.27

Table 4c - Seismic cracked 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

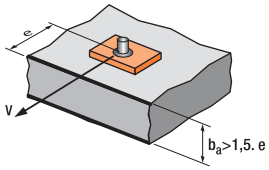
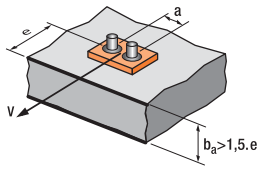


Table 4d - Seismic cracked concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve} For single anchor fastening X_{ve}

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

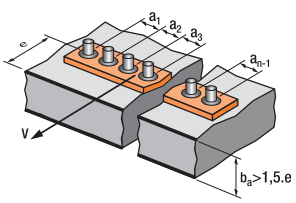
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$



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

For 2 anchors fastening X_{ve}

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



For 3 anchors fastening and more

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

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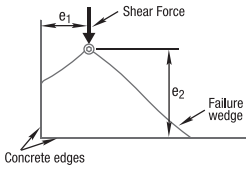
Table 4e - Seismic Cracked concrete Pryout failure, $V^0_{Rd,cp,seis} = \alpha_{seis} V_{Rk,cp,seis} / \gamma_{Mpr}$ (kN), γ_{Mpr} = 1.5, α_{seis} = 0.75, f'_c = 30 MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
-40˚C to +40˚C	8.8	13.5	19.2	33.1	51.5	76.3
-40˚C to +80˚C	8.8	13.5	19.2	30.4	47.5	70.0

Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V^0_{Rd,cp,seis}$*1.13



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 seismic cracked concrete edge shear resistance, $V_{Rd,c,seis}$
$= V^0_{Rd,c,seis} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design seismic cracked concrete Pryout failure,
$V_{Rd,cp,seis} = V^0_{Rd,cp,seis} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify seismic C1 cracked concrete shear resistance - per anchor

Table 5a - Seismic Cracked Concrete steel shear resistance, $V^R_{d,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN)

γ_{Ms} = 1.5 for Grade 5.8 and Grade 8.8 Carbon Steel

γ_{Ms} = 1.73 for A4 316 Stainless Steel & HCR 1.4529 Stainless Steel

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Grade 5.8 Carbon Steel	2.8	4.2	8.0	12.1	17.5	29.2
Grade 8.8 Carbon Steel	4.6	6.7	12.5	19.4	28.0	44.5
A4 316 Stainless Steel	2.9	4.4	8.6	13.0	18.8	-
HCR 1.4529 Stainless Steel	2.9	4.4	8.6	13.0	18.8	-

Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V_{Rd,s,seis}$*1.17

Checkpoint 5

Design seismic C1 cracked concrete shear resistance, $V_{Rd,\ seis}$
$V_{Rd,\ seis}$ = minimum of $V_{Rd,c,\ seis}$, $V_{Rd,cp,\ seis}$, $V_{Rd,s,\ seis}$
Check $V^*/V_{Rd,\ seis} \leq 1$,
if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 6 Combined Loading

Checkpoint 6

Check
$N^*/N_{Rd,seis} + V^*/V_{Rd,seis} \leq 1.0$,
if not satisfied return to step 1

Specifiy - Threaded Stud Anchors
Ramset™ 801 Xtrem™ XC² with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
Ramset™ 801 Xtrem™ XC² Injection with M16 grade 5.8 ChemSet™ Anchor Stud (CS16190GH). Drilled hole depth to be 125mm. To be installed according to Ramset™ Installation Instructions.

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