ChemSet™ 801 Xtrem™ XC²

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	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
- VOC Compliant
- Suitable for contact with drinking water

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

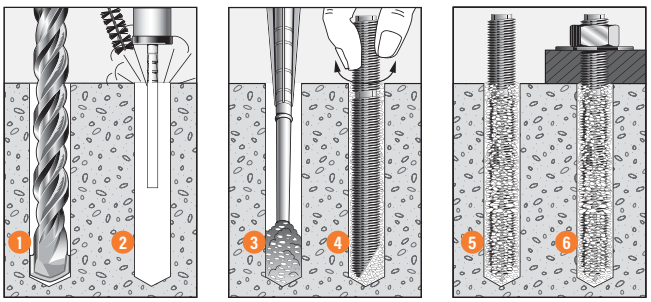
Service Temperature Limits

-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 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.

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Installation and performance details: ChemSet™ 801 Xtrem™ XC² 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	30	165	330	140
M16	18	18	125	60	187	375	160
M20	25	22	150	120	225	450	190
			170		255	510	220
M24	28	26	160	200	240	480	200
			210		315	630	270
M30	35	33	280	400	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)**		
							Concrete Compressive Strength, f'_c		
	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	Shear, ϕV_{us} (kN)	Tension, ϕN_{us} (kN)***	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	56.6	58.3
M20	49.9	81.3	76.8	123.9	62.4	87.1	60.2	76.2	85.0
							72.6	87.7	96.3
M24	72.3	117.8	111.3	179.5	90.4	126.2	66.3	84.0	94.0
							93.4	118.2	129.8
M30	-	-	185.5	299.2	-	-	149.5	175.0	197.4

**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
Flooded Holes: Multiply ϕN_{uc} x 0.75, Max Embedment is limlited to 12d for flooded holes.
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	-	-	-	-	-

Refer to "Engineering Properties" for ChemSet™ Anchor Studs Grade 5.8 and AISI 316 Stainless Steel in the SARB ANZ on page 143

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

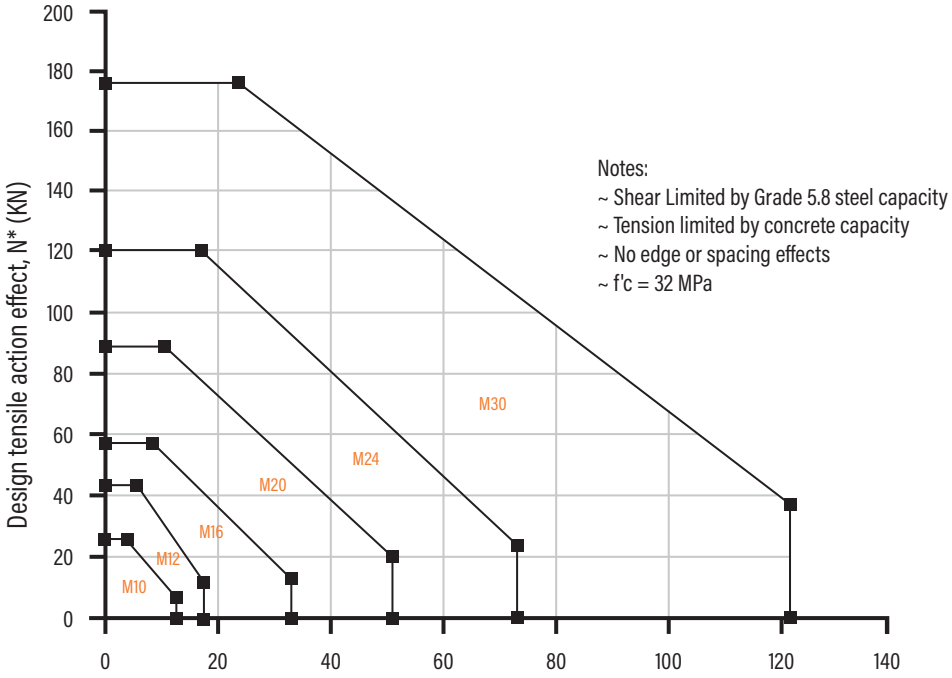

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

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	M20	M24	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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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}
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	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**	49.8				47.9
120	39.2	47.0	54.4				54.5
125	40.8	49.0	**56.6**				58.0
140	45.7	54.9	63.4				68.7
150	49.0	58.8	68.0	77.4			76.2
160	52.3	62.7	72.5	82.6			84.0
170	55.5	66.7	77.0	**87.7**	95.7		91.9
180	58.8	70.6	81.6	92.9	101.3		100.2
190	62.1	74.5	86.1	98.1	107.0		108.6
200	65.3	78.4	90.6	103.2	112.6		117.3
210		82.3	95.1	108.4	**118.2**	131.2	126.2
240		94.1	108.7	123.9	135.1	150.0	154.2
280			126.9	144.5	157.6	**175.0**	194.4
320			145.0	165.1	180.2	200.0	237.5
350				180.6	197.0	218.7	271.6
400				206.4	225.2	249.9	331.9
450					253.3	281.2	396.0
480					270.2	299.9	436.3
550						343.7	535.1
600						374.9	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	0.43	0.43	0.50	0.59	0.65	0.68	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 0.75
For Non-cracked concrete X_{ncr} = 1.
Note:The maximum embedment depth shall be reduced to $12d_b$ for installation in flooded holes

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)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
Service temperature (˚C)							
-40˚C to +40˚C	1.00						1.00
-40˚C to +80˚C	0.90						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)
Anchor Size, d_b	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20	0.96	0.96	0.96	0.89	0.89	0.85	0.79
25	0.96	0.96	0.96	0.89	0.89	0.85	0.88
32	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	1.03	1.03	1.03	1.10	1.10	1.13	1.12
50	1.05	1.05	1.05	1.16	1.16	1.21	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	M10	M12	M16	M20	M24	M30	
f'c (MPa)							
20	0.96	0.96	0.96	0.89	0.89	0.85	0.79
25							0.88
32							1.00
40							1.12
50							1.25

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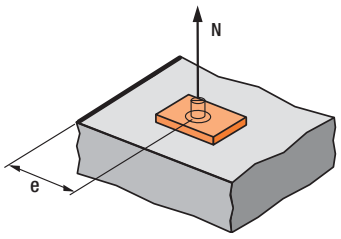
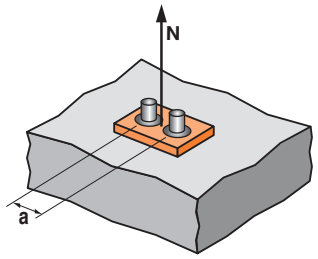


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Edge distance, e (mm)						
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 - 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 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 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 Stud A4/316 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: ϕn = 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 $N^*/\phi N_{ur} \le 1$,
if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

STEP 4

Step 4 - Verify Concrete Shear Capacity - per anchor

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

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	70 - 200	90 - 240	110 - 320	150 - 400	170 - 480	210 - 600
Edge distance, e_m						
45	5.0	5.5				
50			7.0			
55				9.1		
60					11.0	
80						17.4

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

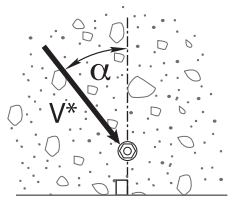
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

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}

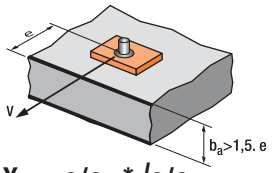
f'_c (MPa)	20	25	32	40	50
X_{vc}	0.79	0.86	1.0	1.11	1.22



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

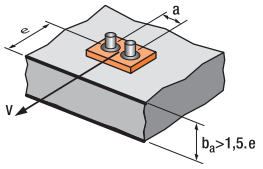


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

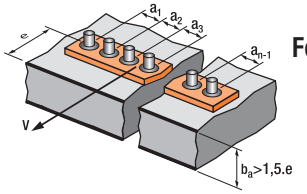
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

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

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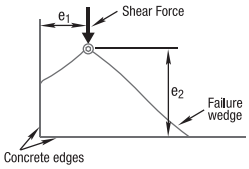
Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20	M24	M30
Effective depth, h (mm)	90	110	125	170	210	280
-40˚C to +40˚C	56.5	82.9	108.9	156.7	211.1	288.4
-40˚C to +80˚C	52.8	77.4	100.5	142.4	190.0	271.4



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 Stud A4/316 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 $V^*/\phi V_{ur} \leq 1$,

if not satisfied return to step 1

ChemSet™ 801 Xtrem™ XC²

STRENGTH LIMIT STATE DESIGN

STEP 6 Combined Loading

Checkpoint 6

Check

$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2,$

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

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