

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	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

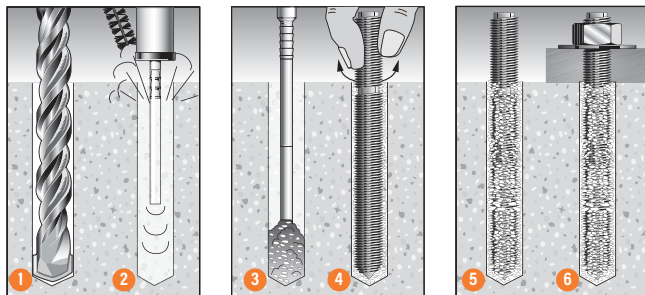
- Anchors all stud & bar diameters in all directions
- Oversized holes*
- Anchors in carbide drilled and diamond cored holes*
- For tropical and Cold weather conditions

Greater safety:

- Low odour

Fire Rated : Refer Fire rated anchoring section

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 x2, brush x2, blow x2, brush x2, blow x2.
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 EPCON™ C8 Xtrem™ to cure as per setting times.
6. Attach fixture.

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

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.

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Installation and performance details: EPCON™ C8 Xtrem™ 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	187.5	375	160
M20	25	22	150	120	225	450	190
			170		255		220
M24	28	26	160	200	240	480	200
			210		315		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		
	Shear, φV _{us} (kN)	Tension, φN _{us} (kN)***	Shear, φV _{us} (kN)	Tension, φN _{us} (kN)***	Shear, φV _{us} (kN)	Tension, φN _{us} (kN)***	Tension, φN _{uc} (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	25.1	26.6	28.1
M12	17.5	28.1	26.0	41.9	21.1	29.5	36.9	39.4	41.7
M16	33.1	53.9	50.9	82.1	41.4	57.7	38.2	48.3	53.6
M20	49.9	81.3	76.8	123.9	62.4	87.1	50.2	63.5	70.5
							60.5	76.6	85.1
M24	72.3	117.8	111.3	179.5	90.4	126.2	55.3	70.0	77.7
							83.1	105.2	116.8
M30	-	-	185.5	299.2	-	-	128.0	162.0	179.8

**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 = 0.67 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 +40°C

FLOODED HOLES: Multiply φN_{uc} x 0.69.

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, h₁ (mm)
h₁ = h
h = Effective depth

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 _t MPa	Shank diameter, d _s (mm)	Stressed Area (mm ²)	Yield Strength f _y MPa	UTS f _t 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.

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STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

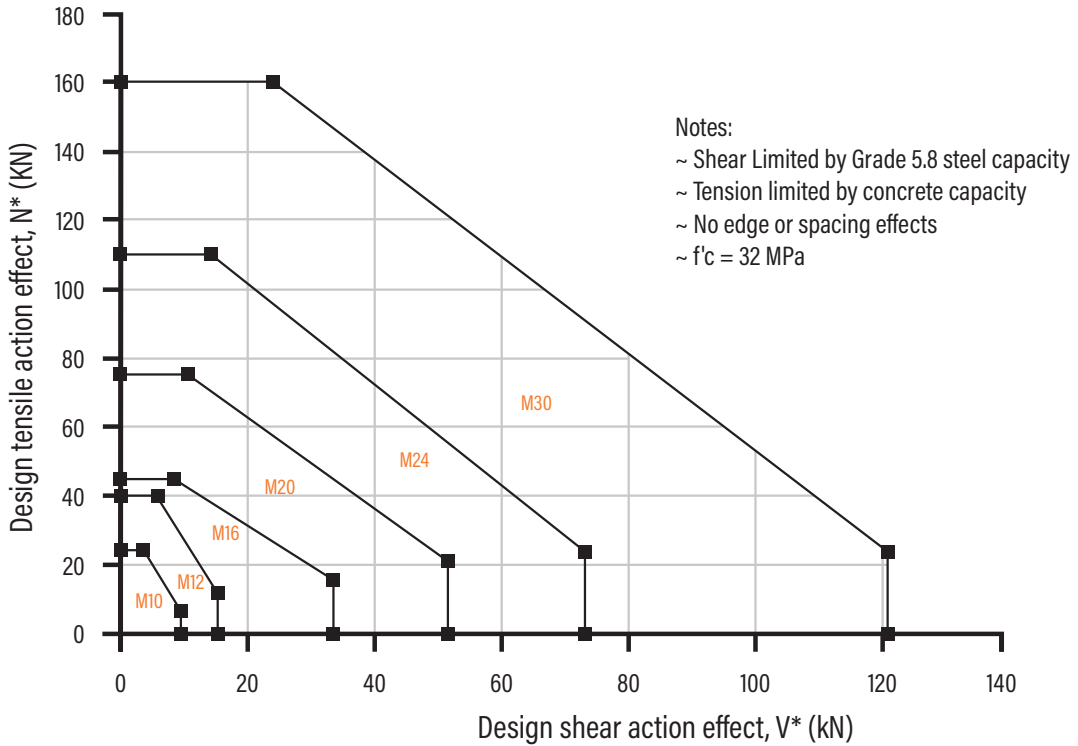


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for cracked concrete

Anchor size, d _b	M10	M12	M16	M20	M24	M30
Min. Anchor spacing - a _m	50	60	80	100	120	150
Min. Edge Distance - e _m	50	60	80	100	120	150

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

Refer to "Description and Part Numbers" table for ChemSet Anchor Studs 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 _b)

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), $\phi_c = 1/1.8 = 0.56$, $f'_c = 32$ MPa

Anchor Size, d_b	Combined pull-out and concrete cone resistance - ϕN_{ucp}						Concrete Cone Resistance - ϕN_{ucc}
	M10	M12	M16	M20	M24	M30	
Drilled Hole Dia, d_h (mm)	12	14	18	25	28	35	
Effective Depth, h (mm)							
70	20.7						20.2
80	23.7						24.7
90	26.6	32.3					29.5
100	29.6	35.9					34.6
110	32.6	39.4	50.2				39.9
120	35.5	43.0	54.8				45.4
125	37.0	44.8	57.1				48.3
140	41.4	50.2	63.9				57.3
150	44.4	53.8	68.5	81.4			63.5
160	47.4	57.4	73.1	86.8	98.5		70.0
170	50.3	61.0	77.6	92.2	104.6		76.6
180	53.3	64.5	82.2	97.6	110.8		83.5
190	56.2	68.1	86.7	103.1	116.9		90.5
200	59.2	71.7	91.3	108.5	123.1		97.8
210		75.3	95.9	113.9	129.2	165.8	105.2
240		86.1	109.6	130.2	147.7	189.5	128.5
280			127.8	151.9	172.3	221.1	162.0
320			146.1	173.6	196.9	252.7	197.9
350				189.9	215.4	276.4	226.4
400				217.0	246.1	315.8	276.6
450					276.9	355.3	330.0
480					295.4	379.0	363.5
550						434.3	445.9
600						473.8	508.1

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

Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

Anchor Size, d_b	Cracked Concrete Effect - X_{ncr}						X_{ncr}
	M10	M12	M16	M20	M24	M30	
f'_c (MPa)	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
20 to 50	0.59	0.55	0.52	0.56	0.60	0.53	0.70

Bold values are at Chemset Anchor Stud nominal Depths

For Sustained Loads MULTIPLY $\phi N_{uc} \times 0.6$ FLOODED HOLES: Multiply $\phi N_{uc} \times 0.69$ 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 $\phi N_{uc} = \phi N_{ucp}$
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Table 2b-1 Concrete service temperature limits effect, tension, X_{ns}

Anchor Size, d_b	Service temperature limits effect, tension, X_{ns}						X_{ns}
	M10	M12	M16	M20	M24	M30	
Service temperature (°C)	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
-40 °C to +40 °C	1.00	1.00	1.00	1.00	1.00	1.00	1.00
-40 °C to +80 °C	0.56	0.55	0.52	0.52	0.52	0.53	1.00

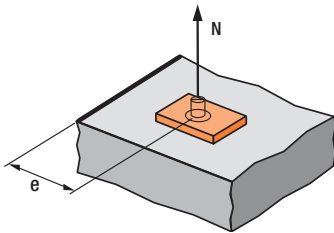
Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

Anchor Size, d_b	Non-Cracked Concrete - X_{nc}						X_{nc}
	M10	M12	M16	M20	M24	M30	
f'_c (MPa)	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
20	0.94	0.93	0.92	0.90	0.88	0.86	0.79
25	0.97	0.96	0.95	0.95	0.94	0.92	0.86
32	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	1.13	1.11
50	1.08	1.09	1.12	1.14	1.17	1.22	1.22

Anchor Size, d_b	Cracked Concrete - X_{nc}						X_{nc}
	M10	M12	M16	M20	M24	M30	
f'_c (MPa)	where $\phi N_{uc} = \phi N_{ucp}$ (from Table 2a)						where $\phi N_{uc} = \phi N_{ucc}$ (from Table 2a)
20	0.95	0.95	0.94	0.93	0.92	0.91	0.79
25	0.97	0.97	0.97	0.96	0.95	0.95	0.86
32	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	1.08	1.11
50	1.05	1.07	1.08	1.09	1.10	1.14	1.22

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

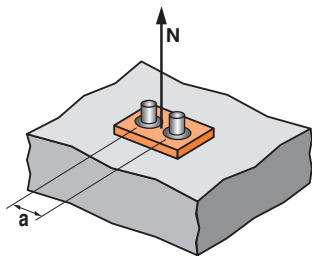
Where $e_m \leq e \leq e_c$

$$e_c = 1.5 \cdot h$$

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)						
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		
120	0.92	0.80	0.73	0.60	0.54	
135	1.00	0.86	0.79	0.65	0.57	
150		0.93	0.85	0.69	0.61	0.52
165		1.00	0.91	0.74	0.64	0.54
187			1.00	0.80	0.70	0.58
255				1.00	0.86	0.71
315					1.00	0.81
420						1.00



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

Where $a_m \leq a \leq a_c$

$$a_c = 3 \cdot h$$

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				
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	0.60	
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	1.00	0.91	0.86	0.76	0.71	0.66
330		1.00	0.94	0.82	0.76	0.70
375			1.00	0.87	0.80	0.72
510				1.00	0.90	0.80
630					1.00	0.88
840						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

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

STEP 3

Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{usr} (kN) where $\phi_n = 0.67$ 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 $\phi_n = 0.58$ for ChemSet™ Anchor Stud A4/316 Stainless Steel

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}

$$\phi N_{ur} = \text{minimum of } \phi N_{urc} \text{ and } \phi N_{usr}$$

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 Reduced characteristic ultimate concrete edge shear capacity, $\phi V_{uc(kN)}, \phi = 1/1.5 = 0.67, f'_c = 32 \text{ MPa}$

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						
50	5.7					
60		7.9				
80			12.6			
100				18.8		
120					24.8	
150						36.6

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

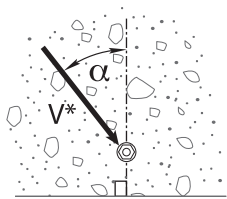
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

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_{vdl}

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

Angle, α°	0-55	60	70	80	90-180
X_{vdl}	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}

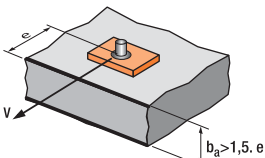
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

For 2 anchors fastening X_{ve}

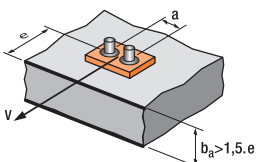
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
a/e_m												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	2.25	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

For 3 anchors fastening and more

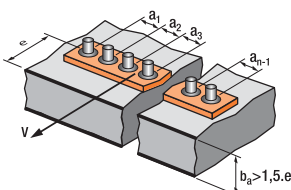
$$X_{ve} = \frac{3 \cdot e + a_1 + a_2 + a_3 + \dots + a_{n-1}}{3 \cdot n \cdot e_m} \cdot \sqrt{e/e_m}$$



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



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



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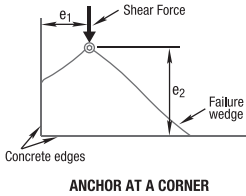
STRENGTH LIMIT STATE DESIGN

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

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	60.3	88.5	125.7	199.4	274.4	457.4
-40 °C to +80 °C	33.9	49.8	71.2	113.9	158.3	246.3

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)	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 concrete shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{usr} (kN) where $\phi_v = 0.67$

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}

$$\phi V_{ur} = \text{minimum of } \phi V_{urc}, \phi V_{urcp}, \phi V_{usr}$$

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

Checkpoint 6

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

Specify - Threaded Stud Anchors
 Ramset™ EPCON™ C8 Xtrem™ with (Anchor Size) grade 5.8 ChemSet™ Anchor Stud (Anchor Stud Part Number) Drilled Hole Depth to be (h) mm.

Example
 Ramset™ EPCON™ C8 Xtrem™ with M16 grade 5.8 ChemSet™ Anchor Stud (CS16I90GH). 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.