EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related

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

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

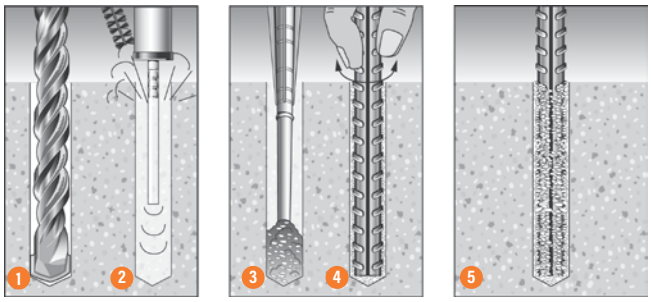
Setting Times EPCON™ C8 Xtrem™

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.

Installation



1. Drill or core hole to specified diameter and depth
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 x 2, brush x 2, blow x 2.
3. Screw mixing nozzle onto cartridge and dispense 2-3 trigger pulls of adhesive to waste until colour is grey with no streaks
4. Insert tip of nozzle to bottom of hole and dispense adhesive
5. Fill hole to about 2/3 full
6. Insert reinforcing bar with rotating motion to release trapped air
7. Wait until adhesive has fully cured before loading (see Working Time / Loading Time chart)
8. Clean up with Acetone

EPCON™ C8 Xtrem™

CHEMICAL INJECTION - NON-CRACKED & CRACKED CONCRETE

Installation and performance details: EPCON™ C8 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	22.0	23.3	24.6
12	15	110	165	330	140	45.2	30.8	32.0	34.2	36.1
16	20	125	187.5	375	160	80.4	54.8	38.2	48.3	53.6
20	25	150	225	450	190	125.6	85.7	50.2	63.5	70.5
		170	255	510	215			60.5	76.6	85.1
24	30	180	270	540	215	180.8	123.3	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
25	30	180	270	540	215	196.4	133.9	66.0	83.5	92.7
		210	315	630	275			83.1	105.2	116.8
28	35	210	315	630	280	246.4	168.0	83.1	105.2	116.8
		270	405	810	340			121.2	153.4	170.2
32	40	240	360	720	320	321.6	219.3	101.5	128.5	142.7
		300	450	900	380			141.9	179.6	199.4

* 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} 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 = 0.8 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
FLOODED HOLES: Multiply ϕN_{uc} x 0.65
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, h_1 (mm)
h_1 = h
h = Effective depth

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	24	25	28	32
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	30	35	40
Stress Area, A_s (mm^2)	78.5	113	201	314	452	491	616	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	226.0	245.5	308.0	402.0

For further information refer to reinforcing bar manufacturer's published information and current revision of **AS/NZS 4671**

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

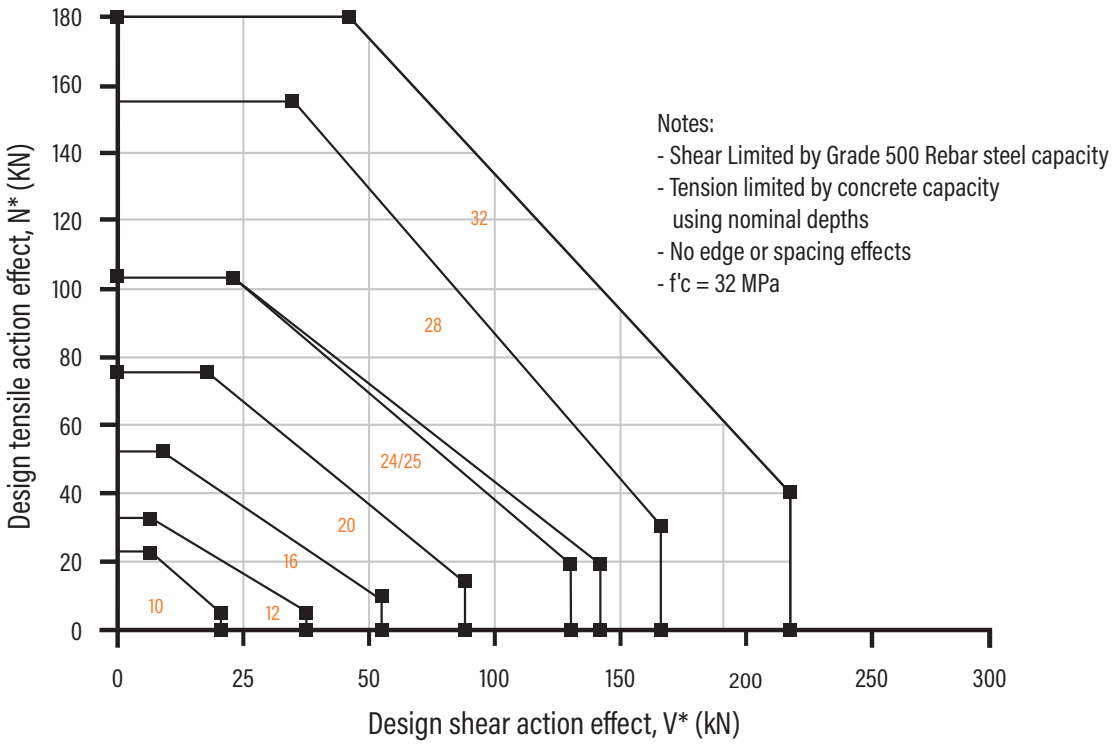


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for cracked concrete

Rebar size, d_b	10	12	16	20	24	25	28	32
Min. Anchor spacing - a_m	50	60	80	100	125	125	140	160
Min. Edge Distance - e_m	50	60	80	100	125	125	140	160

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)		
Rebar 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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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 = 1/1.8 = 0.56, 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	24	25	28	32	
Drilled Hole Dia, d_h (mm)	12	15	20	25	30	30	35	40	
Effective Depth, h (mm)									
70	18.1								20.2
80	20.7								24.7
90	**23.3**	28.2							29.5
100	25.9	31.4							34.6
110	28.5	**34.5**							39.9
120	31.1	37.6	51.1						45.4
125	32.4	39.2	**53.3**						48.3
140	36.3	43.9	59.7						57.3
150	38.9	47.1	63.9	75.6					63.5
160	41.4	50.2	68.2	80.6					70.0
170	44.0	53.3	72.4	**85.6**					76.6
180	46.6	56.5	76.7	90.7	111.7	116.4			83.5
190	49.2	59.6	81.0	95.7	117.9	122.9			90.5
200	51.8	62.7	85.2	100.7	124.2	129.3			97.8
210		65.9	89.5	105.8	**130.4**	**135.8**	153.4		105.2
240		75.3	102.3	120.9	149.0	155.2	175.3	189.8	128.5
270			115.1	136.0	167.6	174.6	**197.3**	213.5	153.4
280			119.3	141.0	173.8	181.1	204.6	221.4	162.0
300			127.8	151.1	186.2	194.0	219.2	**237.3**	179.6
320			136.4	161.2	198.6	206.9	233.8	253.1	197.9
350				176.3	217.3	226.3	255.7	276.8	226.4
400				201.5	248.3	258.7	292.2	316.3	276.6
450					279.4	291.0	328.8	355.9	330.0
500					310.4	323.3	365.3	395.4	386.5
560							409.1	442.9	458.1
640								506.1	559.7

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)
Rebar Size, d_b	10	12	16	20	24	25	28	32	
f'c (MPa)									
20 to 50	0.67	0.64	0.60	0.60	0.60	0.60	0.57	0.50	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 0.65 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 $\phi N_{uc} = \phi N_{ucp}$

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	24	25	28	32	
Service temperature (˚C)									
-40˚C to +40˚C	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
-40˚C to +80˚C	0.57	0.53	0.52	0.52	0.56	0.56	0.53	0.53	1.00

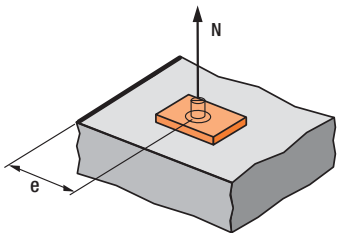
Table 2b-2 Concrete compressive strength effect, tension, X_{nc}

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)
Rebar Size, d_b	10	12	16	20	24	25	28	32	
f'c (MPa)									
20	0.94	0.93	0.92	0.90	0.88	0.88	0.87	0.85	0.79
25	0.97	0.96	0.95	0.95	0.93	0.93	0.93	0.92	0.88
32	1.00	1.00	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	1.11	1.12	1.13	1.11
50	1.08	1.09	1.12	1.14	1.18	1.18	1.20	1.22	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)
Rebar Size, d_b	10	12	16	20	24	25	28	32	
f'c (MPa)									
20	0.95	0.95	0.94	0.93	0.92	0.92	0.91	0.90	0.79
25	0.97	0.97	0.97	0.96	0.95	0.95	0.95	0.95	0.88
32	1.00	1.00	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	1.06	1.07	1.08	1.11
50	1.05	1.07	1.08	1.09	1.11	1.11	1.12	1.14	1.25

EPCON™ C8 Xtrem™

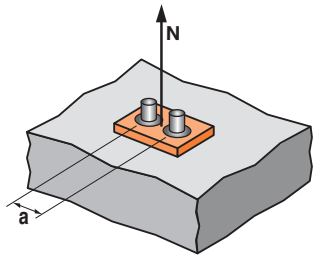
STRENGTH LIMIT STATE DESIGN



$X_{ne} = 0.25 + 0.5*(e/h)$
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 - Concrete Edge distance effect, tension, X_{ne}

Rebar size, d_b	10	12	16	20	24/25	28	32
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			
125	0.94	0.82	0.75	0.62	0.55		
140	1.03	0.89	0.81	0.66	0.58	0.51	
165		1.00	0.91	0.74	0.64	0.56	0.53
187			1.00	0.80	0.70	0.60	0.56
255				1.00	0.86	0.72	0.68
315					1.00	0.83	0.78
405						1.00	0.93
450							1.00
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}

Rebar size, d_b	10	12	16	20	24/25	28	32
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			
125	0.73	0.69	0.67	0.62	0.60		
140	0.76	0.71	0.69	0.64	0.61	0.59	
160	0.80	0.74	0.71	0.66	0.63	0.60	0.59
200	0.87	0.80	0.77	0.70	0.66	0.62	0.61
270	1.00	0.91	0.86	0.76	0.71	0.67	0.65
330		1.00	0.94	0.82	0.76	0.70	0.68
375			1.00	0.87	0.80	0.73	0.71
510				1.00	0.90	0.81	0.78
630					1.00	0.89	0.85
810						1.00	0.95
900							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

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 $\phi = 0.8$

Anchor size, d_b	10	12	16	20	24	25	28	32
Gr 500 Rebar	31.4	45.2	80.4	125.6	180.8	196.4	246.4	321.6

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}
ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{us}
Check $N^*/\phi N_{ur} \le 1.0$,
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

Rebar size, d_b	10	12	16	20	24	25	28	32
Effective depth, h (mm)	70 - 200	90-240	120-320	150-400	180-500	180-500	210-560	240-640
Edge distance, e_m								
50	5.7							
60		7.9						
80			12.9					
100				18.8				
125					26.9	27.1		
140							33.2	
160								41.7

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

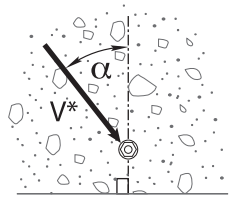
Table 4a-2 Cracked Concrete effect, shear, X_{vcr}

Anchor size, d_b	10	12	16	20	24	25	28	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	1.0	1.11	1.22



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

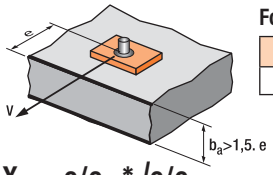
Table 4c - Concrete load direction effect, concrete edge shear, X_{vd}

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1	1.1	1.2	1.5	2

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

For single anchor fastening X_{ve}

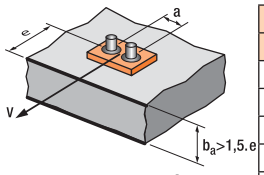
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



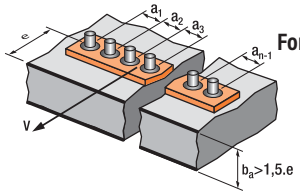
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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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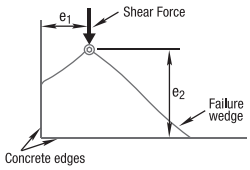
STRENGTH LIMIT STATE DESIGN

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	24	25	28	32
Effective depth, h (mm)	90	110	125	170	210	210	270	300
-40˚C to +40˚C	55.9	79.8	96.6	153.2	210.4	210.4	306.7	359.3
-40˚C to +80˚C	32.0	44.4	68.5	118.6	180.5	188.0	254.9	332.2

Table 4f - Anchor at a corner effect, concrete edge shear, X_{VS}

Note: For $e_1/e_2 > 1.25$, $X_{VS} = 1.0$



ANCHOR AT A CORNER

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 anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us}, (kN) where ϕv = 0.80

Anchor size, d_b	10	12	16	20	24	25	28	32
Gr 500 Rebar	21.4	30.8	54.8	85.7	123.3	133.9	168.0	219.3

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}
ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{urcp}, ϕV_{us}
Check $V^*/\phi V_{ur} \leq 1$,
if not satisfied return to step 1

EPCON™ C8 Xtrem™

STRENGTH LIMIT STATE DESIGN

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™ C8 Xtrem™ with (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ EPCON™ C8 Xtrem™ 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.