44.1 GENERAL INFORMATION

PERFORMANCE RELATED	INSTALLATION RELATED

Product

EPCON™ C8 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 chemically aggressive conditions.

Benefits, Advantages and Features

European Technical Approval option1 for use in cracked and non cracked concrete – ETA-10/0309:

- Highest level of European approval for chemical anchors
- 100 year design life
- Approved for flooded holes
- Approved for floor, wall, & overhead applications
- Data for Sustained Loading

Greater productivity:

- Anchors in dry, damp, wet or flooded holes
- No weather delays
- Fast ,easy dispensing with high flow (pneumatic) mixer
- Jumbo dispensing cartridge 900ml

Greater security:

- Highest performance in cracked concrete

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.
- Non-flammable.

Fire Rated: Refer Fire rated anchoring section

100 YEARS DESIGN LIFE

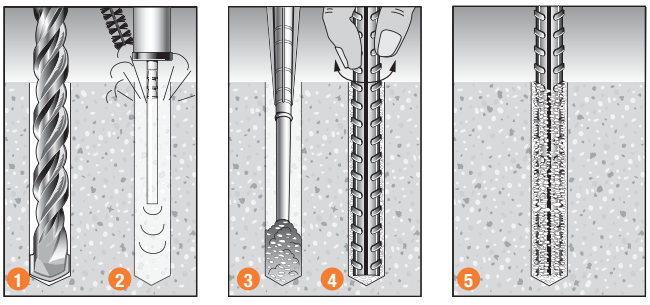
European Technical Approval ETAG 001 Part 5 Option 1 ETA 10/0309 0679-CPD-0549

European Technical Approval ETAG 001 Part 5 TR023 ETA 07/0189 0679-CPD-0276

Principal Applications

- Anchoring into cracked & non cracked concrete
- Road barrier hold down bolts
- Bridge refurbishment
- Road & Rail tunnel construction
- Reinforcing bar from 8 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

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 x 4, brush x 3, blow x 4, brush x 3, blow x 4.
3. Insert mixing nozzle to bottom of hole.
   Fill hole to 3/4 the hole depth slowly, ensuring no air pockets form.
4. Insert rebar to bottom of hole while turning.
5. Allow Ramset EPCON™ C8 to cure as per setting times.

Installation temperature limits:

- Substrate: 5°C to 40°C
- Adhesive: 5°C to 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

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

Installation and performance details:

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Anchor effective depth, h (mm)	Optimum dimensions*			Reduced Characteristic Capacity Cracked Concrete Tension, $N_{Rd,pc}$ (kN) **		
			Anchor spacing, a_c (mm)	Edge distance, e_c (mm)	Concrete substrate thickness, b_m (mm)	Concrete Compressive Strength, f'_c		
						20 MPa	30 MPa	40 MPa
10	12	90	180	90	120	14.9	15.6	16.1
12	15	110	220	110	140	20.7	21.7	22.6
16	20	125	250	125	160	28.5	31.5	33.0
20	25	170	340	170	215	45.2	53.9	57.5
24/25	30	210	420	210	270	62.1	79.9	85.0
28	35	270	540	270	340	90.5	108.9	116.8
32	40	300	600	300	380	106.0	120.9	130.7

* For anchor spacings or edge distances less than the optimum, please refer to the simplified strength limit state design process to verify capacity.

** 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.

WET HOLES in cracked concrete: Multiply $N_{Rd,pc}$ x 0.70

44.2 DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
EPCON™ C8	450 ml	**C8-450**

Drilled hole depth, h_1 (mm)
h_1 = h
h = Effective depth

44.3 ENGINEERING PROPERTIES

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 AS/NZS 4671:2001

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

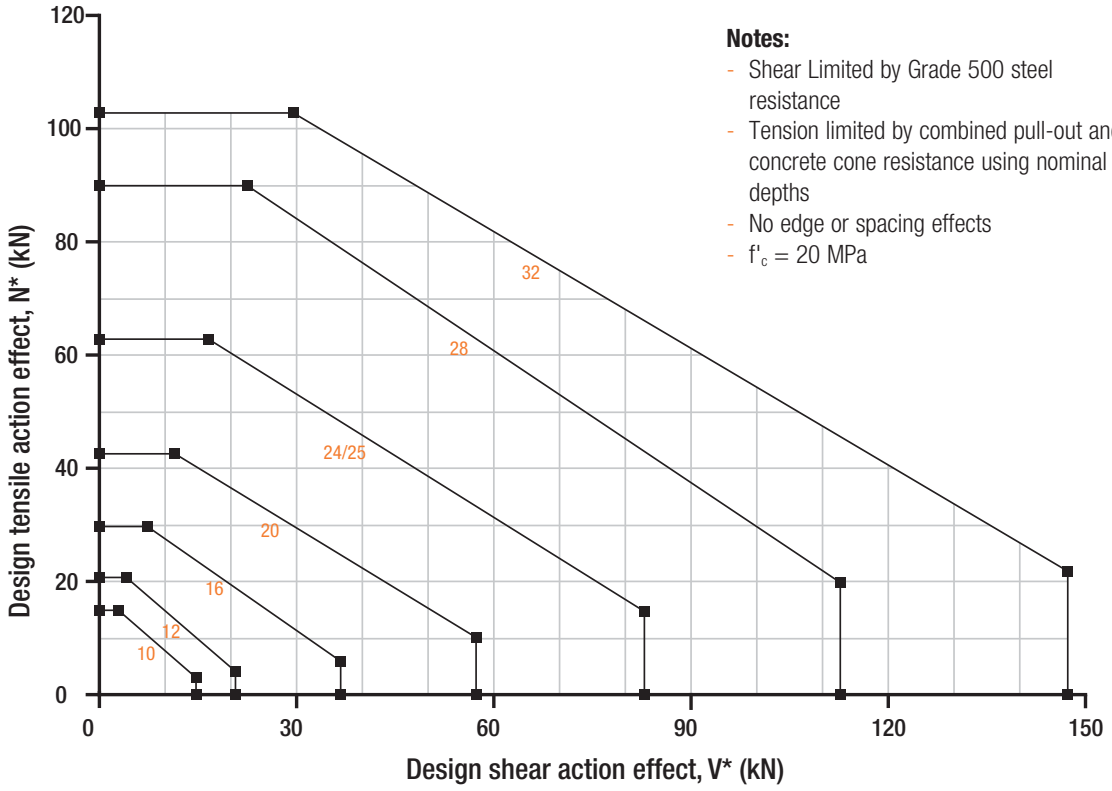


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for cracked concrete

Anchor size, d_b	10	12	16	20	24/25	28	32
Min. Anchor spacing - a_m	50	60	80	100	125	140	160
Min. Edge Distance - e_m	50	60	80	100	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 page 268.

Effective depth, h (mm)

$$h \geq 6 * d_h$$

(To obtain full steel strength in shear)

Checkpoint 1 **Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.**

STEP 2 Verify cracked concrete combined pull-out and concrete cone tensile resistance - per anchor

Table 2a - Cracked Concrete reduced characteristic tensile capacity, $N_{Rd,pc}$ (kN) f'c = 20MPa

Cracked Concrete combined pull-out and concrete cone resistance - $N^0_{Rd,p} = N^0_{Rk,p}/Y_{Msp}$ (kN) Y_{Msp} = 1.8								Cracked Concrete Cone Resistance - $N^0_{Rd,c}$
Anchor size, d_b	10	12	16	20	24/25	28	32	
Drill hole dia, d_h (mm)	12	15	20	25	30	35	40	
Effective depth, h (mm)								
70	11.6							11.9
80	13.3							14.6
90	**14.9**	17.0						**17.4**
100	16.6	18.8						20.4
110	18.2	**20.7**						**23.5**
120	19.9	22.6	28.5					26.8
125	20.7	23.6	**29.7**					**28.5**
140	23.2	26.4	33.2					33.8
150	24.9	28.3	35.6	44.5				37.5
160	26.5	30.2	38.0	47.5				41.3
170	28.2	32.0	40.4	**50.4**				**45.2**
180	29.8	33.9	42.7	53.4	62.8			49.3
190	31.5	35.8	45.1	56.4	66.3			53.4
200	33.2	37.7	47.5	59.3	69.8			57.7
210		39.6	49.8	62.3	**73.3**	77.0		**62.1**
240		45.2	57.0	71.2	83.8	88.0	87.1	75.8
270			64.1	80.1	94.2	**99.0**	98.0	**90.5**
280			66.5	83.1	97.7	102.6	101.6	95.6
300			71.2	89.0	104.7	110.0	**108.9**	**106.0**
320			76.0	94.9	111.7	117.3	116.2	116.8
350				103.8	122.2	128.3	127.1	133.6
400				118.7	139.6	146.6	145.2	163.2
450					157.1	164.9	163.4	194.7
500					174.5	183.3	181.5	228.0
560						205.3	203.3	270.3
640							232.3	330.2

Bold values are at ChemSet™ Reinforcing Bar nominal depths. For capacity in non-cracked concrete refer to pages 119-126.
Note: Effective depth, h must be ≥ 6 x drilled hole diameter,d_h for anchor to achieve tabled shear capacities.

Wet Holes in cracked concrete: Multiply $N_{Rd,pc}$*0.70

$N^0_{Rd,p} = N^0_{Rk,p}/Y_{Msp}$ (kN) Y_{Msp} = 1.8

$N^0_{Rd,c} = N_{Rk,c}/Y_{Mc}$ (kN) Y_{Mc} = 1.8

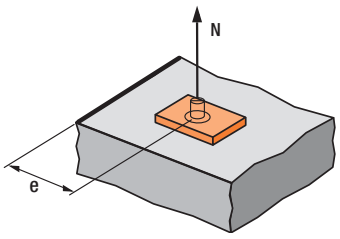
If Service temperature limit is -40°C to +80°C then $N_{Rd,pc} = N^0_{Rd,p}$
If Service temperature limit is -40°C to +40°C then Refer to Checkpoint 2

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

	Service temperature limits effect, tension, X_{ns} where $N_{Rd,pc} = N^0_{Rd,p}$ (from Table 2a)							X_{ns} where $N_{Rd,pc} = N^0_{Rd,c}$ (from Table 2a)
Anchor 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
-40˚C to +80˚C	0.58	0.56	0.53	0.53	0.56	0.53	0.54	1.00

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

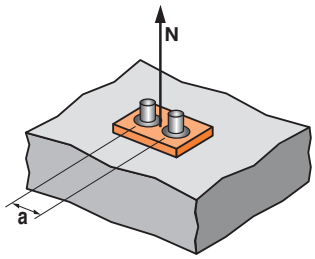
	Concrete compressive strength effect, tension, X_{nc} where $N_{Rd,pc} = N^0_{Rd,p}$ (from Table 2a)							X_{nc} where $N_{Rd,pc} = N^0_{Rd,c}$ (from Table 2a)
Anchor size, d_b	10	12	16	20	24/25	28	32	
f'c (MPa)								
20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	1.02	1.02	1.03	1.03	1.04	1.04	1.05	1.11
30	1.05	1.05	1.06	1.07	1.09	1.10	1.11	1.22
40	1.08	1.09	1.11	1.14	1.16	1.18	1.20	1.41
50	1.10	1.12	1.15	1.17	1.21	1.23	1.26	1.58



$X_{ne} = 0.27 + 0.725*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1*h$
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 - Cracked concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	10	12	16	20	24/25	28	32
Edge distance, e (mm)							
50	0.67						
60	0.75	0.67					
65	0.79	0.70					
80	0.91	0.80	0.73				
90	1.00	0.86	0.79				
100		0.93	0.85	0.70			
110		1.00	0.91	0.74			
120			0.97	0.78			
125			1.00	0.80	0.70		
140				0.87	0.75	0.65	
160				0.95	0.82	0.70	0.66
170				1.00	0.86	0.73	0.68
210					1.00	0.83	0.78
270						1.00	0.92
300							1.00



$X_{na} = 0.5 + a/(4*h)$
Where $a_m \le a \le a_c$
$a_c = 2*h$
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 - Cracked concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	10	12	16	20	24/25	28	32
Anchor spacing, a (mm)							
50	0.64						
60	0.67	0.64					
80	0.72	0.68	0.66				
90	0.75	0.70	0.68				
100	0.78	0.73	0.70	0.65			
125	0.85	0.78	0.75	0.68	0.65		
140	0.89	0.82	0.78	0.71	0.67	0.63	
160	0.94	0.86	0.82	0.74	0.69	0.64	0.63
180	1.00	0.91	0.86	0.76	0.71	0.66	0.64
220		1.00	0.94	0.82	0.76	0.70	0.67
250			1.00	0.87	0.80	0.72	0.70
300				0.94	0.86	0.77	0.73
340				1.00	0.90	0.80	0.77
420					1.00	0.88	0.83
540						0.98	0.92
640							1.00

Checkpoint 2

Design cracked concrete combined pull-out and concrete cone resistance, $N_{Rd,p}$

$N_{Rd,p} = N_{Rd,pc}*X_{ns}*X_{nc}*X_{ne}*X_{na}$

If Service temperature limit is -40°C to +40°C then

$N_{Rd,p}$ = minimum of $N^0_{Rd,p}*X_{ns}*X_{nc}*X_{ne}*X_{na}$ and $N^0_{Rd,c}*X_{ns}*X_{nc}*X_{ne}*X_{na}$

STEP 3

Verify cracked concrete tensile resistance - per anchor

Table 3a - Cracked Concrete steel resistance, tension, $N_{Rd,s} = N_{Rk,s}/\gamma_{Ms}$ (kN) $\gamma_{Ms} = 1.4$

Anchor size, d_b	10	12	16	20	24	25	28	32
Grade 500 Rebar	30.7	44.3	79.3	123.6	177.7	192.5	242.1	315.7

Checkpoint 3

Design cracked concrete tensile resistance, N_{Rd}

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

Check $N^*/N_{Rd} \le 1$,

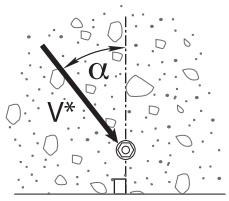
if not satisfied return to step 1

STEP 4 Verify cracked concrete edge shear resistance - per anchor

Table 4a - Cracked concrete edge resistance, shear, $V^{0}_{Rd,c} = V^{0}_{Rk,c} / \gamma_{Mc}$ (kN) $\gamma_{Mc} = 1.5$, $f'_c = 20$ MPa

Anchor size, d_b	10	12	16	20	24/25	28	32
Effective depth, h (mm)	90	110	125	170	210	270	300
Edge distance, e_m							
50	3.8						
60		5.2					
80			8.1				
100				12.2			
125					17.7		
140						22.4	
160							27.9

Note: Effective depth, h must be ≥ 6 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.
NOTE: For capacity in Non-cracked concrete, refer to pages 119-126.



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

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

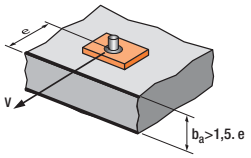
f'_c (MPa)	20	25	30	40	50
X_{vc}	1	1.1	1.26	1.41	1.55

Table 4c - 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 - Cracked concrete anchor spacing and edge distance effect, concrete edge shear, X_{ve}
For single anchor fastening X_{ve}

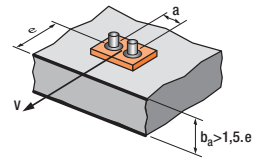
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



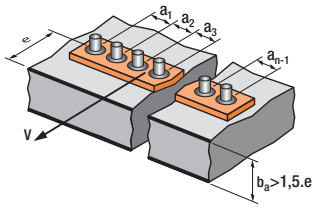
$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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}

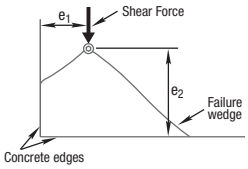
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + \ldots + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

Table 4e - Cracked concrete Pryout failure, $V^0_{Rd,cp} = V_{Rk,cp} / \gamma_{Mpr}$ (kN) $\gamma_{Mpr} = 1.5$, $f'_c = 20$ MPa

Anchor size, d_b	10	12	16	20	24/25	28	32
Effective depth, h (mm)	90	110	125	170	210	270	300
-40˚C to +40˚C	35.8	49.8	71.2	121.1	175.9	237.5	261.4
-40˚C to +80˚C	20.7	27.6	37.7	64.1	99.0	126.7	140.7

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)	25	30	35	50	60	75	125	200	300	400	600	900
Edge dustance, 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 cracked concrete edge shear resistance, $V_{Rd,c}$

$$V_{Rd,c} = V^0_{Rd,c} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$$

Checkpoint 4b

Design cracked concrete Pryout failure, $V_{Rd,cp}$

$$V_{Rd,cp} = V^0_{Rd,cp} * X_{nc} * X_{ne} * X_{na}$$

STEP 4 Verify cracked concrete shear resistance - per anchor

Table 5a - Cracked concrete steel shear resistance, $V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$ (kN), $\gamma_{Ms} = 1.5$

Anchor size, d_b	10	12	16	20	24	25	28	32
Grade 500 Rebar	14.7	20.7	36.7	57.3	82.9	90	112.7	147.3

Checkpoint 5

Design cracked concrete shear resistance, V_{Rd}

V_{Rd} = minimum of $V_{Rd,c}$, $V_{Rd,cp}$, $V_{Rd,s}$

Check $V^*/V_{Rd} \leq 1$,

if not satisfied return to step 1

STEP 6 Combined loading and specification

Checkpoint 6

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

Specify
Ramset EPCON™ C8 Injection (Anchor Size) grade 500 Rebar. Drilled hole depth to be (h) mm.

Example
Ramset EPCON™ C8 Injection with N20 grade 500 Rebar Drilled hole depth to be 170 mm. To be installed in accordance with Ramset Technical Data Sheet

Tension - Sustained Loading - Cracked Concrete

Concrete Strength f'_c = 20 MPa - (-40 ˚C to +40 ˚C)

Anchor Size (d_b)		10	12	16	20	24/25	28	32
Tension load in Cracked Concrete	(kN)	14.9	20.7	29.7	50.4	73.3	99.0	108.9
Displacement	δ_{N0} (mm) (short term)	0.23	0.21	0.24	0.24	0.25	0.24	0.21
	$\delta_{N\infty}$ (mm) (long term)	0.64	0.64	0.64	0.67	0.70	0.68	0.62

Note: Above tables are based on the nominal effective depth, h shown in the installation tables within. For all other values of effective depth, h, please contact your local Ramset Engineer.

Shear - Sustained Loading - Cracked Concrete

Concrete Strength f'_c = 20 MPa

Anchor Size (d_b)		10	12	16	20	24/25	28	32
Displacement	δ_{V0} (mm/kN) (short term)	0.07	0.06	0.06	0.04	0.03	0.02	0.02
	$\delta_{V\infty}$ (mm/kN) (long term)	0.11	0.10	0.09	0.06	0.04	0.03	0.03

Note:
Displacement short term (mm) = $\delta_{V0} \times V_{Sd}$ (Shear Design Load in Cracked Concrete)
Displacement long term (mm) = $\delta_{V\infty} \times V_{Sd}$ (Shear Design Load in Cracked Concrete)