EPCON™ C6 PLUS

SEISMIC REINFORCING BAR - CHEMICAL INJECTION

AVAILABLE IN NEW ZEALAND ONLY

(Australia refer to ChemSet™ Reo502™ PLUS range)

GENERAL INFORMATION

Performance Related	Installation Related

Product

EPCON™ C6 PLUS is a heavy duty pure Epoxy for anchoring threaded studs and reinforcing bar into cracked and uncracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-18/0675

Design according to:

- 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

- 100 year working life

Greater productivity:

- Anchors in dry, damp, wet or flooded holes
- Easy dispensing even in cold weather

Greater security:

- Strong bond
- Rated for sustained loading

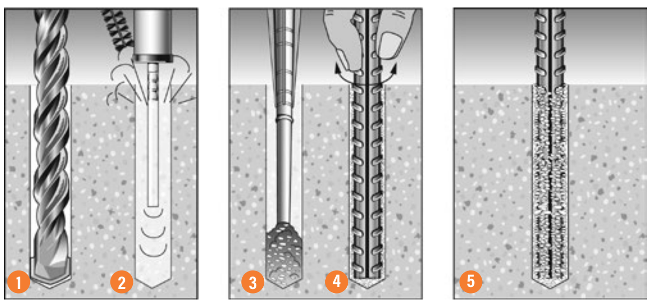
Versatile:

- Anchors in carbide drilled and diamond drilled holes*
- Cold and temperate climates

Greater safety:

- Low odour
- VOC Compliant

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 2, brush x 2, 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 EPCON™ C6 PLUS to cure as per setting times.

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	10°C	40°C

Service Temperature Limits

-40°C to 70°C

Setting Times

Temperature of base material	Cartridge Temperature	Gel Time	Curing time in dry and wet concrete
5°C	Minimum 10°C	300 min	24 h
10°C	10°C	150 min	18 h
15°C	15°C	40 min	12 h
20°C	20°C	25 min	8 h
25°C	25°C	18 min	6 h
30°C	30°C	12 min	4 h
40°C	40°C	6 min	2 h
Note: Cartridge temperature minimum +10°C			

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™ C6 Plus and ChemSet™ Reinforcing Bar

Rebar size, d_b (mm)	Drilled hole diameter, d_h (mm)	Anchor effective depth, h (mm)	Optimum dimensions*		Concrete substrate thickness, b_m (mm)	Gr 500 Rebar - Steel		Seismic (C1) Cracked Concrete reduced characteristic tensile capacity, $N^0_{Rd,p,seis}$ (kN) **		
								Concrete Compressive Strength, f'c		
			Anchor* spacing, a_c (mm)	Edge* distance, e_c (mm)		Tension, $øN_{us}$ (kN)***	Shear, $øV_{us}$ (kN)	20 MPa	30 Mpa	40 Mpa
10	14	90	270	135	120	30.7	10.7	13.6	14.2	14.6
12	16	110	330	165	140	44.3	15.3	17.9	18.6	19.1
16	20	125	375	187.5	165	79.3	27.3	23.5	24.4	25.1
20	25	170	510	255	220	123.6	46.0	40.3	41.9	43.1
25	32	210	630	315	274	192.9	41.2	51.8	53.9	55.4
32	40	300	900	450	380	315.7	74.0	74.6	77.6	79.8

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

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

*** Seismic Cracked concrete steel resistance, tension = $N_{Rd,s,seis} = \alpha_{Nseis} N^0_{Rk,s,seis} / \gamma_{Ms}$ (kN) where $\gamma_{Ms} = 1.4$

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

DESCRIPTION AND PART NUMBERS

Description	Cartridge Size	Part No.
EPCON C6 PLUS	600ml	EC6P600

Drilled hole depth, h1 (mm)
h1 = h
h = Effective depth

Substrate thickness b_m (mm)					
Anchor Stud Size (mm)					
10	12	16	20	25	32
h + 30mm ≥ 100mm		h + (2 x d_h)			

Typical Engineering Properties of Grade 500 Reinforcing Bar

Rebar Size	10	12	16	20	25	32
Drilled Hole Dia, d_h (mm)	14	16	20	25	32	40
Stress Area, A_s (mm^2)	78.5	113	201	314	491	804
Yield Stress, f_{sy} (MPa)	500	500	500	500	500	500
Tensile Steel Yield Capacity, N_{sy} (kN)	39.3	56.5	100.5	157.0	245.5	402.0

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

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STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

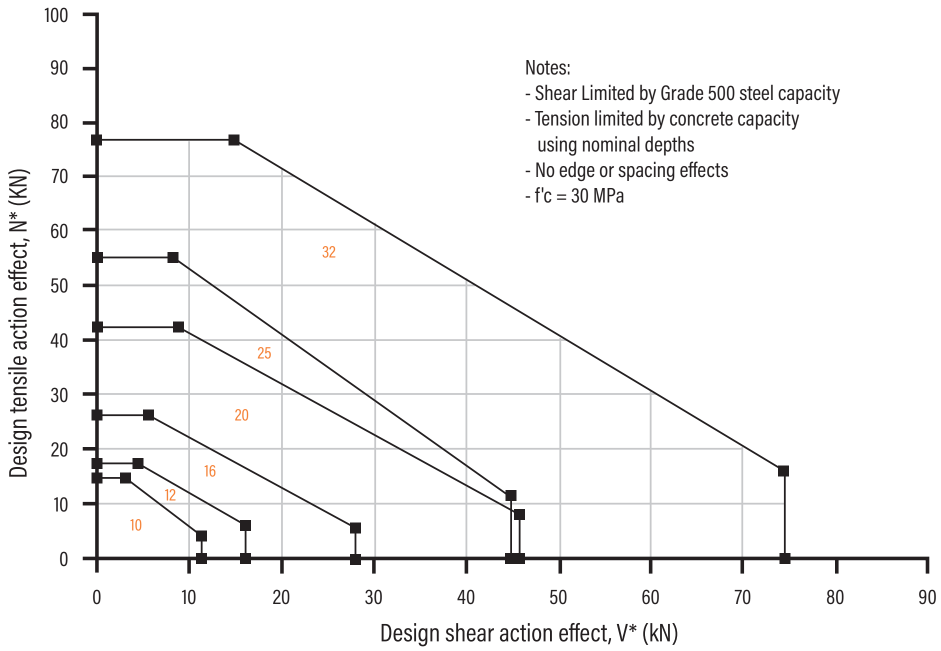

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b M10	10	12	16	20	25	32
Min. Anchor Spacing - a_m	40	40	40	50	50	70
Min. Edge Distance - e_m	40	40	40	50	50	70

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

Refer to nominal recommended effective depths, h listed in installation and performance details in the SARB ANZ on the previous page.

Substrate thickness b_m (mm)					
Anchor Stud Size (mm)					
10	12	16	20	25	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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STEP 2 Verify Seismic C1 cracked concrete tensile capacity - per anchor

Table 2a - Seismic (C1) 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, db	10	12	16	20	25	32
Drilled Hole Dia, dh (mm)	14	16	20	25	32	40
Effective Depth, h (mm)						
70	11.0					
80	12.6					
90	**14.2**	15.2				
100	15.8	16.9				
110	17.3	**18.6**	21.5			
120	18.9	20.3	23.5			
125	19.7	21.1	**24.4**			
140	22.1	23.6	27.4			
150	23.6	25.3	29.3	37.0		
160	25.2	27.0	31.3	39.5		
170	26.8	28.7	33.2	**41.9**	43.6	
180	28.4	30.4	35.2	44.4	46.2	
190	29.9	32.1	37.1	46.9	48.8	
200	31.5	33.8	39.1	49.3	51.3	
210		35.5	41.0	51.8	**53.9**	54.3
240		40.5	46.9	59.2	61.6	62.1
300			58.6	74.0	77.0	**77.6**
320			62.5	78.9	82.1	82.7
350				86.3	89.8	90.5
400				98.7	102.6	103.4
450					115.5	116.3
480					123.2	124.1
550						142.2
600						155.1

Bold values are at ChemSet Rebar Anchor nominal depths

Flooded Holes: Multiply $N^0_{Rd,p,seis}$ * 0.83
For single anchor values: Multiply $N^0_{Rd,p,seis}$ *1.17
For optimised performance data, please use Ramset iExpert Anchoring Software.

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

	Service temperature limits effect, tension, X_{ns}					
Anchor size, db	10	12	16	20	25	32
Service temperature (˚C)						
-40˚C to +70˚C	1.00					

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

f'c (MPa)	20	25	30	40	50
X_{nc}	0.96	0.98	1.00	1.029	1.048

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STRENGTH LIMIT STATE DESIGN

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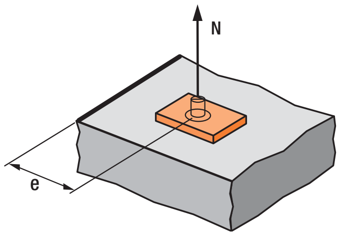
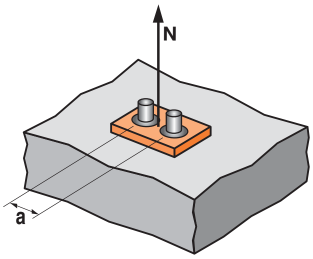


$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
Note: Tabled values are based on the nominal effective depth,
h shown in the installation details.
For other values of X_{ne}, please use equation shown above.

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

Anchor size, d_b	10	12	16	20	25	32
Edge distance, e (mm)						
40	0.47	0.43	0.41			
45	0.50	0.45	0.43			
50	0.53	0.48	0.45	0.40	0.37	
55	0.56	0.50	0.47	0.41	0.38	
60	0.58	0.52	0.49	0.43	0.39	
65	0.61	0.55	0.51	0.44	0.40	
70	0.64	0.57	0.53	0.46	0.42	0.37
80	0.69	0.61	0.57	0.49	0.44	0.38
100	0.81	0.70	0.65	0.54	0.49	0.42
115	0.89	0.77	0.71	0.59	0.52	0.44
135	1	0.86	0.79	0.65	0.57	0.48
165		1	0.91	0.74	0.64	0.53
187			1	0.80	0.70	0.56
255				1	0.86	0.68
315					1	0.78
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	10	12	16	20	25	32
Anchor spacing, a (mm)						
40	0.57	0.56	0.55			
45	0.58	0.57	0.56			
50	0.59	0.58	0.57	0.55	0.54	
55	0.60	0.58	0.57	0.55	0.54	
60	0.61	0.59	0.58	0.56	0.55	
65	0.62	0.60	0.59	0.56	0.55	
70	0.63	0.61	0.59	0.57	0.56	0.54
100	0.69	0.65	0.63	0.60	0.58	0.56
125	0.73	0.69	0.67	0.62	0.60	0.57
150	0.78	0.73	0.70	0.65	0.62	0.58
200	0.87	0.80	0.77	0.70	0.66	0.61
270	1	0.91	0.86	0.76	0.71	0.65
330		1	0.94	0.82	0.76	0.68
375			1	0.87	0.80	0.71
510				1	0.90	0.78
630					1	0.85
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 C1 Cracked Concrete steel resistance, tensile, $N_{Rd,s,seis} = \alpha_{seis} N_{Rk,s,seis}/\gamma_{Ms}$ (kN) where $\alpha_{seis} = 1.0$, $\gamma_{Ms} = 1.4$ for Grade 500 Rebar

Anchor size, d_b	10	12	16	20	25	30
Rebar Gr 500	30.7	44.3	79.3	123.6	192.9	315.7

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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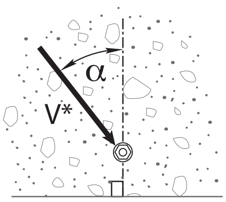
STEP 4

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	10	12	16	20	25	32
Effective depth, h (mm)	90	110	125	170	210	300
Edge distance, e_m						
40	2.7	2.9	3.3			
50				5.0	5.7	
70						10.3

For single anchor values: Multiply $V^0_{Rd,c,seis}$*1.17
For optimised performance data, please use Ramset iExpert Anchoring Software.



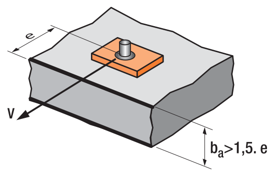
Load direction effect, conc. edge shear, X_{vd}

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

f'c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.9	1	1.15	1.29

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

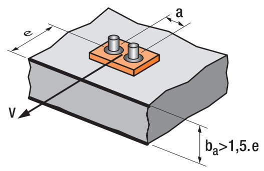


$X_{ve} = e/e_m * \sqrt{e/e_m}$

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

For single anchor fastening X_{ve}

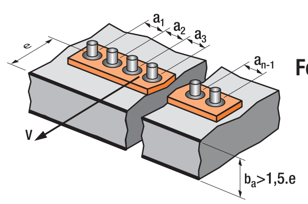
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

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

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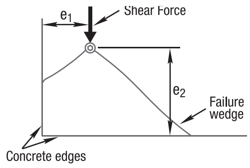
Table 4e - Seismic Cracked concrete Pryout failure,
$V^0_{Rd,cp} = \alpha_{seis} V_{Rk,cp} / \gamma_{Mpr}$ (kN), $\gamma_{Mpr} = 1.5$, $\alpha_{seis} = 0.75$, f'c = 30 Mpa

Anchor size, d_b	10	12	16	20	25	32
Effective depth, h (mm)	90	110	125	170	210	300
-40˚C to +70˚C	25.5	32.8	43.1	74.0	95.1	136.9

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

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 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 (C1) Cracked Concrete steel shear resistance, $V_{Rd,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN)
where $\alpha_{seis} = 1.0$ and $\gamma_{Ms} = 1.5$

Anchor size, d_b	C1 Seismic Data					
	10	20	16	20	25	32
Rebar Gr 500	10.7	15.3	27.3	46.0	44.7	74.0

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

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STEP 6 Combined Loading

Checkpoint 6

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

Specify - Reinforcing Bar Anchorage

Ramset™ EPCON™ C6 PLUS Injection (Anchor Size) grade 500 Rebar.
Drilled hole depth to be (h) mm.

Example

Ramset™ EPCON™ C6 PLUS Injection with 20mm grade 500 Rebar
Drilled hole depth to be 170 mm.
To be installed in accordance with Ramset™ Installation Instructions.

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