Ramset™

SpaTec™ Xtrem™

SEISMIC - MECHANICAL ANCHORS

GENERAL INFORMATION

Performance Related	Material	Installation Related

Product

A high security, high performance, through fixing, torque controlled expansion anchor which has approval for use in cracked and non-cracked concrete.

Compliance

European Technical Assessment (option 1) - ETA-10/0276

Design according to:

- AS5216 (formerly TS101)
- AS1170.4 - Earthquake Actions
- EN1992-4 (formerly ETAG001 Annex C, E & TR045)
- NZS3101 (A3) Section 17 - Seismic Design C1 & C2

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

Benefits, Advantages and Features

- CISMA Report Anchors exposed to seismic actions NTC022
- Highest level of European approval for mechanical expansion anchors
- Approved for all directions (floor, wall, overhead)
- Shallow embedment depths
- Highest performance in cracked concrete
- Zinc Plated to 5µm
- Anchor diameters from M10 to M16

Suitable for structural loads:

- Safety critical loads
- High tensile capacity of Grade 8.8 Steel Bolt.
- Heavy duty, heat treated washer.
- Heavy duty, thick expansion sleeve that provides secure grip to concrete.

Improved security:

- Large expansion reserve that ensures retention in concrete if overloaded.
- Torque induced pull down closes gaps and induces preload.

Resistant to cyclic loading:

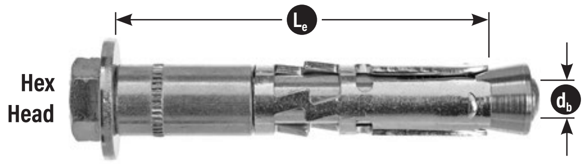
- Heavy duty sleeve with integrated pull-down section works to retain 65% of initial preload.

Fast installation:

- Hex Nut & Hex Bolt versions available
- Countersunk heads available.
- Through fixing eliminates marking out and repositioning of fixtures.

Fire rated: Refer Fire rated mechanical anchor section.

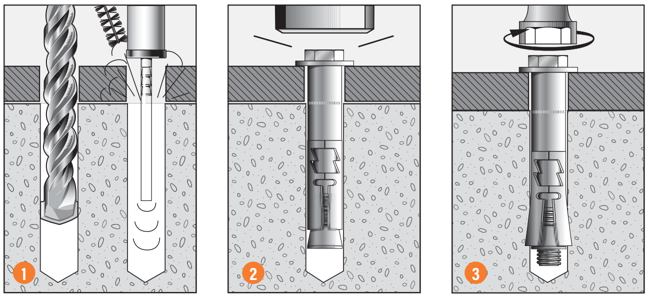
XTREM PREMIUM ANCHORING | FIRE TESTED | SEISMIC | 50 YEAR WORKING LIFE | ETA | CRACKED CONCRETE CERTIFIED



Principal Applications

- Seismic Anchoring to Category C1/C2
- Temporary works/propping/bracing Anchoring into cracked & non cracked concrete
- Safety critical loads
- Steel columns & walkways
- Road barrier hold down
- Bridge refurbishment
- Road & Rail tunnel construction
- Wall Plates
- Safety Rails

Installation



1. Drill or core a hole to the recommended diameter and depth using the fixture as a template. Clean the hole thoroughly with a hole cleaning brush. Remove the debris with a hand pump, compressed air, or vacuum.
2. After ensuring that the anchor is assembled correctly, insert the anchor through the fixture and drive with a hammer until the washer contacts the fixture.
3. Tighten the bolt with a torque wrench to the specified assembly torque.

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SEISMIC - MECHANICAL ANCHORS

Installation and performance details

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Depth of drill hole, h_1 (mm)	Tightening torque, T_r (Nm)	Concrete substrate thickness, b_m (mm)#	C1-Seismic Cracked Concrete reduced characteristic tensile capacity, $N^0_{Rd,c,seis}$ (kN)* Concrete Compressive Strength, f'_c 20 MPa	30 MPa	40 MPa
M10	15	17	70	90	50	140	5.1	6.3	7.2
M12	18	20	80	105	80	160	12.2	15.6	17.3
M16	24	26	100	131	120	200	17.0	21.0	24.2

* Data is based on optimal dimensions, anchor spacing = 3*h, edge distance = 1.5*h
NOTE: For C2 Seismic cracked concrete reduced characteristic tensile capacity:
For M10 Multiply $N^0_{Rd,c,seis}$ * 0.57
For M12 Multiply $N^0_{Rd,c,seis}$ * 0.41
For M16 Multiply $N^0_{Rd,c,seis}$ * 0.52

 # Note: For performance based on smaller concrete substrate thickness, refer to iExpert Anchor Software or Ramset™ Engineer.

For shear loads acting towards an edge or where optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.

DESCRIPTION AND PART NUMBERS

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Effective Length, L_e (mm)	Fixture thickness, t (mm)	ETA Designation Number	Part Number Zinc (Hex Hd)
M10	15	90	20	V10-15/20	SP10105
M12	18	90	10	V12-18/10	SP12105
		105	25	V12-18/25	SP12120
M16	24	125	25	V16-24/25	SP16145

ENGINEERING PROPERTIES

Description	Material	Protection
Cone	1.0765 steel EN 10 087	Galvanised 5µm
Expansion Sleeve	1.5330 steel EN 10 149-2	Galvanised 5µm
Distance sleeve	TS37 a BK or S300Pb NF A 49 341	Galvanised 5µm
Threaded rod	1. Steel Grade 8.8 EN 20 898-1	Galvanised 5µm
Screw	1. Steel Grade 8.8 EN 20 898-1	Galvanised 5µm
Washer	HLE S550MC	Galvanised 5µm
Hexagonal Nut	Grade 8 EN 20 898-2	Galvanised 5µm

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STRENGTH LIMIT STATE DESIGN

STEP 1

Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

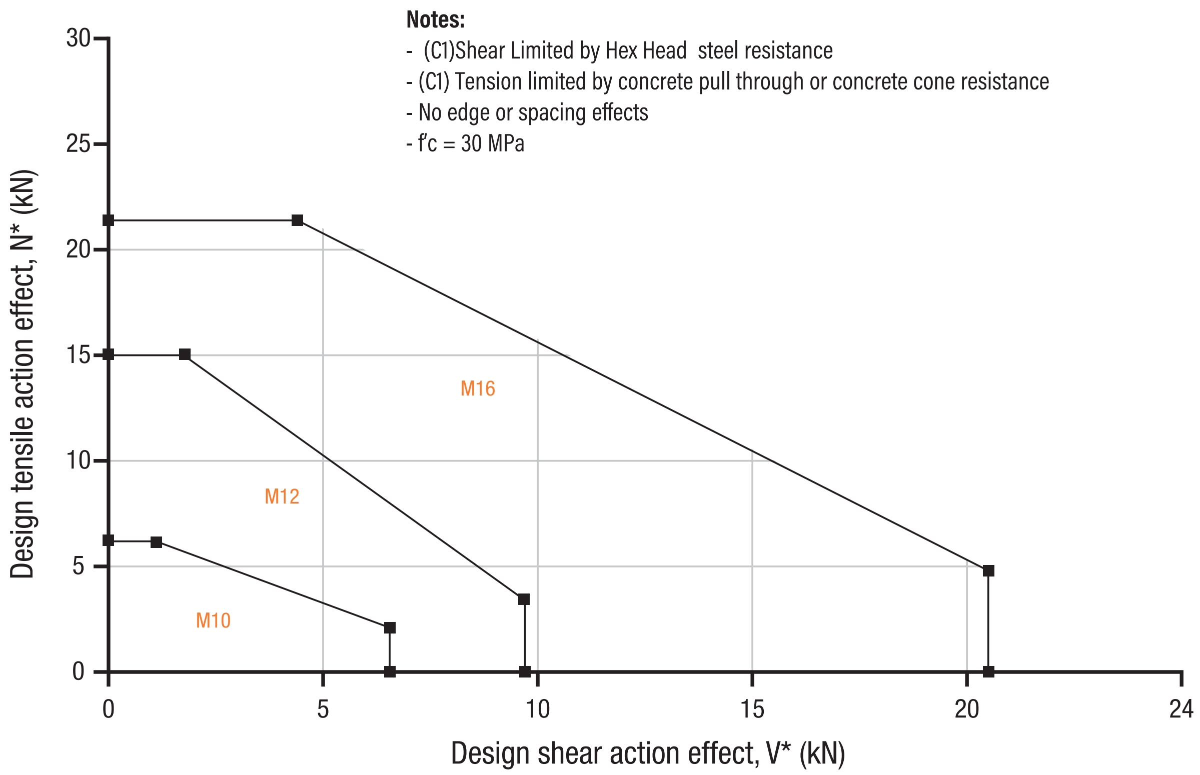

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16
Effective depth, h (mm)	70	80	100
Min. Anchor spacing - a_m	70	80	100
For - e_m	100	160	180
Min. Edge Distance - e_m	70	80	100
For - a_m	160	200	220

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

Refer to "Description and Part Numbers" table in the SARB ANZ on the previous page.

Effective depth, h (mm)

$$h = L_e - t$$

t = total thickness of material(s) being fixed

Checkpoint 1

Anchor size determined, absolute minimum compliance achieved, effective depth (h) calculated.

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STRENGTH LIMIT STATE DESIGN

STEP 2

Verify Seismic C1 or C2 cracked concrete cone tensile resistance - per anchor

Table 2a - Seismic Cracked concrete cone resistance, $N_{Rk,c,seis} = \alpha_{seis} N^0_{Rk,c,seis}/\gamma_{Msp}$ (kN) $\gamma_{Msp} = 1.5$, $f'_c = 30$ MPa, $\alpha_{seis} = 0.75$ where $N^0_{Rk,c} = k_1 * \sqrt{f'_c} * h_{ef}^{1.5}$

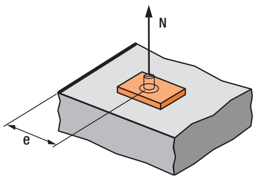
Anchor size, d_b	M10	M12	M16
Drill hole dia, d_h (mm)	15	18	24
Effective depth, h (mm)			
70	12.3		
80		15.0	
100			21.0

For single anchor values: Multiply $N_{Rk,c,seis}$ * 1.13

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

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

f'_c (MPa)	20	30	40	50
X_{nc}	0.81	1.00	1.15	1.27



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

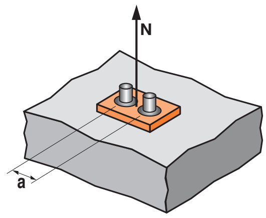
Where $e_m \leq e \leq e_c$

$e_c = 1.5*h$

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	M10	M12	M16
Edge distance, e (mm)			
70	0.75		
80	0.82	0.75	
90	0.89	0.81	
100	0.96	0.88	0.75
120	1	1	0.85
150			1



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

Where $a_m \leq a \leq a_c$

$a_c = 3*h$

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	M10	M12	M16
Anchor spacing, a (mm)			
70	0.67		
80	0.69	0.67	
100	0.74	0.71	0.67
125	0.80	0.76	0.71
150	0.86	0.81	0.75
180	0.93	0.88	0.80
210	1	0.94	0.85
240		1	0.90
300			1

Checkpoint 2

Design Seismic cracked concrete cone resistance, $N_{Rd,c\ seis}$

$$N_{Rd,c,seis} = N_{Rk,c,seis} * X_{nc} * X_{ne} * X_{na}$$

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STRENGTH LIMIT STATE DESIGN

STEP 3

Verify seismic C1 or C2 cracked concrete tensile resistance tension - per anchor

Table 3a - Seismic (C1 & C2) Cracked Concrete steel resistance, tensile, $N_{Rd,s,seis} = \alpha_{seis} N_{Rk,s,seis}/\gamma_{Ms}$ (kN) where $\alpha_{seis} = 1.0$, $\gamma_{Ms} = 1.5$

Anchor size, d_b	M10	M12	M16
Carbon Steel	30.7	44.7	84.0

Table 3b-1 - Seismic (C1) Cracked concrete Pull-out resistance**, $N^0_{Rd,p,seis} = \alpha_{seis} N^0_{Rk,p,seis}/\gamma_{Msp}$ (kN)
$\gamma_{Msp} = 1.5, \alpha_{seis} = 0.85$, f'c = 30 MPa

Anchor size, d_b	M10	M12	M16
Drill hole dia, d_h (mm)	15	18	24
Effective depth, h (mm)			
70	6.3		
80		17.8	
100			24.8

**Cracked concrete Pull-out resistance is not influenced by reduced anchor spacing or edge distance.
For single anchor multiply $N^0_{Rd,p,seis}$ *1.17

Table 3b-2 - Seismic (C2) Cracked concrete Pull-out resistance**, $N^0_{Rd,p,seis} = \alpha_{seis} N^0_{Rk,p,seis}/\gamma_{Msp}$ (kN)
$\gamma_{Msp} = 1.5, \alpha_{seis} = 0.85$, f'c = 30 MPa

Anchor size, d_b	M10	M12	M16
Drill hole dia, d_h (mm)	15	18	24
Effective depth, h (mm)			
70	3.6		
80		6.4	
100			11.4

** Cracked concrete Pull-out resistance is not influenced by reduced anchor spacing or edge distance.
For single anchor multiply $N^0_{Rd,p,seis}$ *1.17

Checkpoint 3a

Design Seismic C1 or C2 cracked concrete pull out resistance, $N_{Rd,p,seis}$

$N_{Rd,p,seis} = N^\circ_{Rd,p,seis} * X_{nc}$

Checkpoint 3b

Design Seismic C1 or C2 cracked concrete tensile resistance, $N_{Rd,seis}$

$N_{Rd,seis}$ = Minimum of $N_{Rd,c,seis}$, $N_{Rd,p,seis}$, $N_{Rd,s,seis}$

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

if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

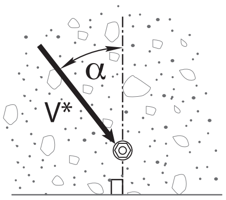
STEP 4

Verify Seismic C1 or C2 cracked concrete edge shear resistance - per anchor

Table 4a - Seismic cracked concrete edge resistance, shear,
$V^0_{Rd,c,seis} = \alpha_{seis} V_{Rk,c} / \gamma_{Mc}$ (kN), $\gamma_{Mc} = 1.5$, $\alpha_{seis} = 0.85$, $f'_c = 30$ MPa

Anchor size, d_b	M10	M12	M16
min. edge distance, e_m	70	80	100
min. anchor spacing, a_m	160	200	220
Effective depth, h (mm)			
70	2.2		
80		3.0	
100			4.5

Note: Data includes annular gap reduction factor of 0.5
For single anchor values: Multiply $V^0_{Rd,c,seis}$*1.17
For optimised performance data, please use Ramset iExpert Anchoring Software.



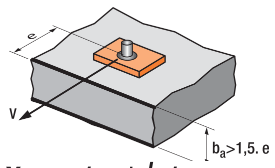
Load direction effect, conc. edge shear, X_{vd}

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

f'_c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.91	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

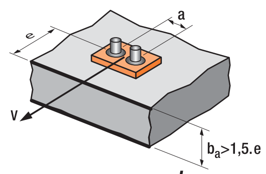


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

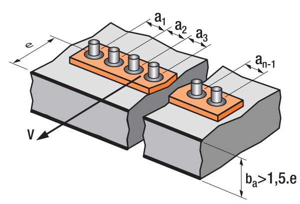
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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}

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

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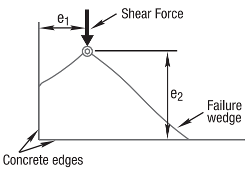
STRENGTH LIMIT STATE DESIGN

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

Anchor size, d_b	M10	M12	M16
Effective depth, h (mm)			
70	12.4		
80		15.1	
100			21.1

Note: Data includes annular gap reduction factor of 0.5
For single anchor values: Multiply $V^0_{Rd,c,seis}$*1.13



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 seismic cracked concrete edge shear resistance, $V_{Rd,c,seis}$
$V_{Rd,c,seis} = V^o_{Rk,c,seis} * X_{vc} * X_{vd} * X_{ve} * X_{vs}$

Checkpoint 4b

Design seismic cracked concrete Pryout failure, $V_{Rd,cp,seis}$
$V_{Rd,cp,seis} = V^o_{Rk,cp,seis} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify seismic C1 or C2 cracked concrete shear resistance - per anchor

Table 5a-1 - Seismic (C1) Cracked Concrete steel shear resistance, $V_{Rk,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN)
where $\alpha_{seis} = 0.85$, $\gamma_{Ms} = 1.25$

Anchor size, d_b	M10	M12	M16
Carbon Steel	5.8	9.7	20.6

Note: Data includes annular gap reduction factor of 0.5. For single anchor multiply $V_{Rd,s,seis}$*1.17

Table 5a-2 - Seismic (C2) Cracked Concrete steel shear resistance, $V_{Rk,s,seis} = \alpha_{seis} V_{Rk,s,seis} / \gamma_{Ms}$ (kN)
where $\alpha_{seis} = 0.85$, $\gamma_{Ms} = 1.25$

Anchor size, d_b	M10	M12	M16
Carbon Steel	4.9	9.7	19.8

Note: Data includes annular gap reduction factor of 0.5. For single anchor multiply $V_{Rd,s,seis}$*1.17

Checkpoint 5

Design Seismic C1 or C2 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 $V^*/V_{Rd,seis} \le 1$
if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

STEP 6 Combined loading and specification

Checkpoint 6

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

Specify	Example
Ramset™ SpaTec™ Xtrem™ Anchor, (Anchor Size) (Part Number) Maximum fixed thickness to be (t) mm.	Ramset™ SpaTec™ Xtrem™ Anchor, M12 (SP12120). Maximum fixed thickness to be 8 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.