AnkaScrew™ Xtrem™

SEISMIC - MECHANICAL SCREW-IN ANCHORS

GENERAL INFORMATION

Performance Related	Material	Installation Related

Product

A seismic certified heavy duty screw-in anchor for permanent anchoring into concrete. Certified for seismic C1 & C2 applications.

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

Compliance

European Technical Assessment (option1) - ETA-20/0731

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

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

Benefits, Advantages and Features

Fire tested to TR020

- Fire rated performance up to 120 minutes
- Highest level of European assessment for mechanical screw-in anchors
- Approved for all directions (floor, wall, overhead)
- Maximum Tensile & Shear capacities in cracked concrete
- Zinc Flake Coating (≥5µm)
- Anchor diameters 6mm to 12mm

Fast and easy to use:

- Install, simply screws into hole.
- Remove leaving an empty hole.

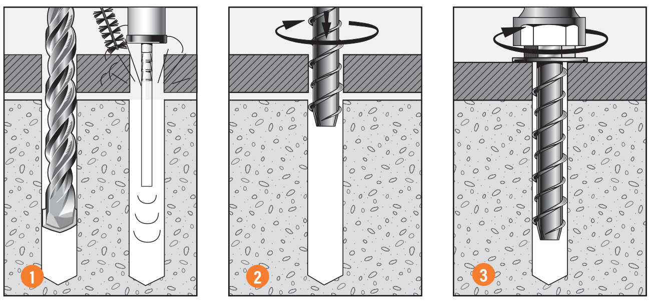
Close to edge and for close anchor spacing:

- Does not expand and burst concrete.

Principal Applications

- **Seismic anchoring to Category C1/C2**
- **Anchoring into cracked & non cracked concrete**
- **Steel framing**
- **Mechanical services**
- **Pallet racking**
- **Safety barriers**
- **Conveyors**
- **Hand rails**
- **Bottom plates**

Installation



1. Drill hole to correct diameter and depth. Important: Use **Ramset™ Dustless Drilling System** to ensure holes are clean. Alternatively, clean thoroughly with brush and remove debris by way of vacuum or hand pump, compressed air etc.
2. Using a socket wrench, screw the AnkaScrew™ Xtrem™ into the hole using slight pressure until the self tapping action starts.
3. Tighten the AnkaScrew™ Xtrem™ until flush with fixture.
   If resistance is experienced when tightening, unscrew anchor one turn and re-tighten. Ensure not to over tighten. Refer to tightening torque for limitations.

AnkaScrew™ Xtrem™

SEISMIC - MECHANICAL SCREW-IN 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 & C2-Seismic Cracked Concrete reduced characteristic tensile capacity*							
							Shear capacity, $V_{Rd,seis}$ (kN)		Tensile capacity, $N^0_{Rd,c,seis}$ or $N^0_{Rd,p,seis}$ (kN) **					
									Concrete Compressive Strength, f'$_c$					
							where f'c ≥ 30 MPa		20 MPa		30 MPa		40 MPa	
							C1	C2	C1	C2	C1	C2	C1	C2
6	6	8	31	45	10	80	1.6	N/A	1.1	N/A	1.4	N/A	1.6	N/A
			44	60		90	1.9	N/A	2.3	N/A	2.8	N/A	3.2	N/A
8	8	12	52	75	20	105	2.9	3.5	6.5	1.31	7.9	1.60	9.1	1.85
10	10	14	43	65	40	90	3.0	N/A	4.8	N/A	5.9	N/A	6.8	N/A
			68	95		136	5.2	7.4	9.6	3.02	11.8	3.70	13.6	4.27
12	12	16	80	110	60	160	7.1	8.3	12.2	4.00	15.0	4.90	17.3	5.66

*Data is based on optimal dimensions, anchor spacing = 3*h, edge distance = 1.5*h

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

**Note: For C1 values concrete cone capacity governs and for C2 values pull-out capacity governs.

 # 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)	Maximum Fixture Thickness, $t_{fix,max}$ (mm)	AnkaScrew™ Xtrem™ Description	Part Number
6	6	41	10	6mmx50mm zinc flake coated	AS06050X
		71	40	6mmx80mm zinc flake coated	AS06080X
8	8	67	15	8mmx80mm zinc flake coated	AS08080X
10	10	48	5	10mmx60mm zinc flake coated	AS10060X
		88	45	10mmx100mm zinc flake coated	AS10100X
12	12	95	15	12mmx110mm zinc flake coated	AS12110X
		135	55	12mmx150mm zinc flake coated	AS12150X

Effective depth, h (mm)

$$h = L_e - t$$

t = total thickness of material(s) being fixed

ENGINEERING PROPERTIES

Anchor size, d_b (mm)	Minimum cross sectional diameter (mm)	Stress area, A_s (mm^2)	Yield strength, f_y (MPa)	UTS, f_u (Mpa)
6	5.1	20.4	560	700
8	7.1	39.6	560	700
10	9.1	65.0	560	700
12	11.1	96.8	560	700

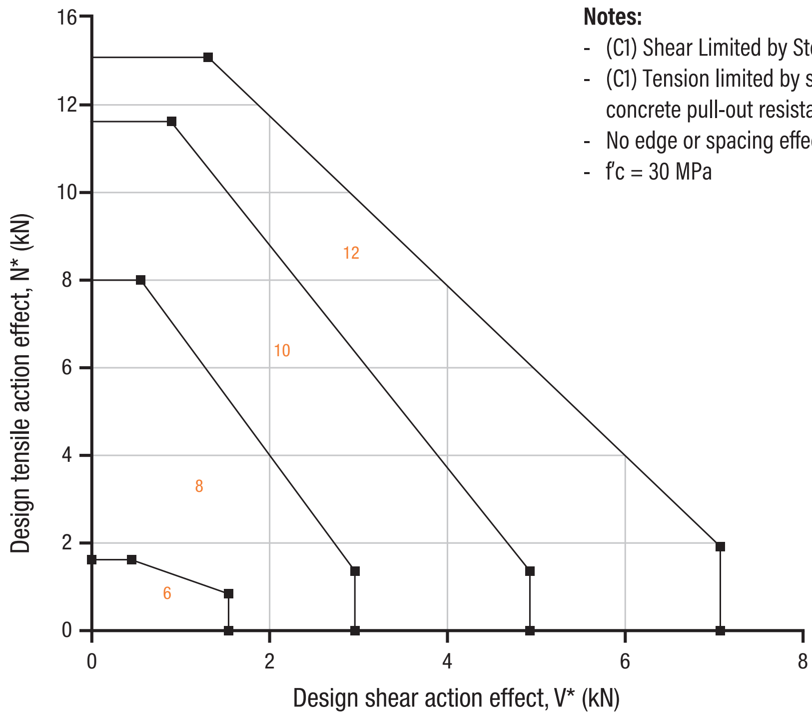
AnkaScrew™ Xtrem™

SEISMIC - MECHANICAL SCREW-IN ANCHORS

STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram



Notes:
- (C1) Shear Limited by Steel Capacity
- (C1) Tension limited by seismic cracked concrete pull-out resistance
- No edge or spacing effects
- f'c = 30 MPa

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

Anchor size, d_b	6		8	10		12
Effective depth, h (mm)	31	44	52	43	68	80
*Min. member thickness (mm)	80	90	105	90	136	160
Min. Anchor spacing - a_m	40	40	50	50	50	70
Min. Edge Distance - e_m	40	40	50	50	50	70

*Note: For calculations based on smaller member thickness, refer to iExpert Anchor Software or Ramset™ Engineer.

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 minima compliance achieved, effective depth (h) calculated.

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 2

Verify seismic 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 $N^0_{Rk,c} = k_1 * \sqrt{f_c} * h_{ef}^{1.5}$

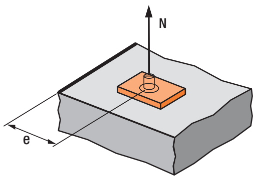
Anchor size, d_b	6	8	10	12
Drill hole dia, d_h (mm)	6	8	10	12
Effective depth, h (mm)				
31	3.6			
43			5.9	
44	6.1			
52		7.9		
68			11.8	
80				15.0

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} and Pull-out, X_{npc}

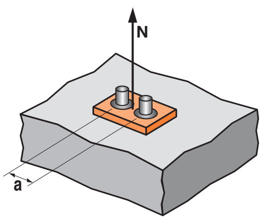
f'c (MPa)	20	25	30	40	50
Tension X_{nc}	0.82	0.91	1.00	1.15	1.29
Pull-out X_{npc}	0.82	0.91	1.00	1.15	1.29



$X_{ne} = 0.25 + 0.5*(e/h)$
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	6		8	10		12
Effective depth, h (mm)	31	44	52	43	68	80
Edge distance, e (mm)						
40	0.90	0.70				
45	0.98	0.76				
50	1	0.82	0.73	0.83	0.62	
55		0.88	0.78	0.89	0.65	
65		0.99	0.88	1	0.73	
70		1	0.92		0.76	0.69
80			1		0.84	0.75
85					0.88	0.78
90					0.91	0.81
105					1	0.91
120						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	6		8	10		12
Effective depth, h (mm)	31	44	52	43	68	80
Anchor spacing, a (mm)						
40	0.72	0.65				
45	0.74	0.67				
50	0.77	0.69	0.66	0.69	0.62	
65	0.85	0.75	0.71	0.75	0.66	
70	0.88	0.77	0.72	0.77	0.67	0.65
80	0.93	0.80	0.76	0.81	0.70	0.67
85	0.96	0.82	0.77	0.83	0.71	0.68
90	0.98	0.84	0.79	0.85	0.72	0.69
100	1	0.88	0.82	0.89	0.75	0.71
130		0.99	0.92	1	0.82	0.77
155		1	1		0.88	0.82
195					0.98	0.91
205					1	0.93
240						1

Checkpoint 2

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

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

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 3

Verify 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	6	8	10	12
Carbon Steel	9.3	18.0	30.0	44.7

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	6	8	10	12
Drill hole dia, d_h (mm)	6	8	10	12
Effective depth, h (mm)				
31	1.4			
43			6.2	
44	2.8			
52		8.2		
68			N/A	
80				N/A

**Cracked concrete Pull-out resistance is not influenced by reduced anchor spacing or edge distance.
For single anchor values: Multiply $N_{Rk,p,seis}$*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	8	10	12
Drill hole dia, d_h (mm)	8	10	12
Effective depth, h (mm)			
52	1.6		
68		3.7	
80			4.9

** Cracked concrete Pull-out resistance is not influenced by reduced anchor spacing or edge distance.
For single anchor values: Multiply $N_{Rd,c,seis}$*1.17

Checkpoint 3a

Design Seismic cracked concrete pull-out resistance, $N_{Rd,p,seis}$
$N_{Rd,p,seis} = N°_{Rd,p,seis} * X_{npc}$

Checkpoint 3b

Design Seismic 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

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 4

Verify 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	6		8	10		12
Effective depth, h (mm)	31	44	52	43	68	80
Edge distance, e_m						
40	1.0	1.0				
50			1.5	1.5	1.7	
70						2.7

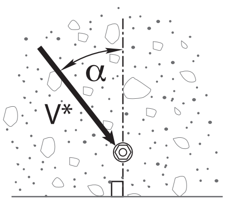
Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V^0_{Rd,c,seis}$*1.17

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

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

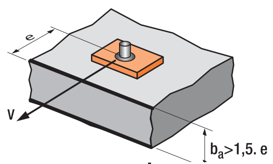
f'_c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.91	1	1.15	1.29



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

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

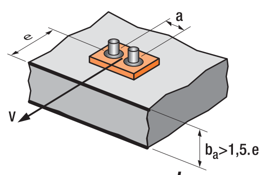


$X_{ve} = e/e_m * \sqrt{e/e_m}$

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

For single anchor fastening X_{ve}

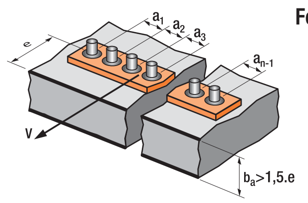
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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}

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

AnkaScrew™ Xtrem™

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)

$\gamma_{Mpr} = 1.5$, $\alpha_{seis} = 0.75$, $f'_c = 30$ MPa

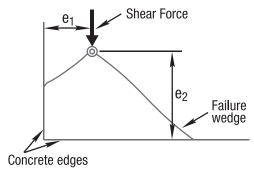
Anchor size, d_b	6	8	10	12
Effective depth, h (mm)				
31	1.8			
43			3.0	
44	3.1			
52		4.0		
68			11.8	
80				15.1

Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V^0_{Rd,c,seis}$*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, $V_{Rd,c,seis}$

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

Checkpoint 4b

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

$V_{Rd,cp,seis} = V°_{Rd,cp,seis} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify cracked concrete shear resistance - per anchor

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

$\alpha_{seis} = 0.85$, $\gamma_{Ms} = 1.25$

Anchor size, d_b	6		8	10		12
Effective depth, h (mm)	31	44	52	43	68	80
Carbon Steel	1.6	1.9	2.9	4.6	5.2	7.1

Note: Data includes annular gap reduction factor of 0.5.

For single anchor multiply $V_{Rd,c,seis}$ x 1.17

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

$\alpha_{seis} = 0.85$, $\gamma_{Ms} = 1.25$

Anchor size, d_b	8	10	12
Effective depth, h (mm)	52	68	80
Carbon Steel (with annular gap)	3.5	7.4	8.3
Carbon Steel (annular gap being filled)	6.7	12.6	21.5

For single anchor multiply $V_{Rd,s,seis}$ x 1.17

Checkpoint 5

Design Seismic 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

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 6

Combined Loading

Checkpoint 6

Check

$N^*/N_{Rd,seis} + V^*/V_{Rd,seis} \leq 1.0$,

if not satisfied return to step 1

Specify	Example
Ramset™ AnkaScrew™ Xtrem™ Anchor, (Anchor Size) (Part Number) Maximum fixed thickness to be (t) mm.	Ramset™ AnkaScrew™ Xtrem™ Anchor, 12mm AS12110X. Maximum fixed thickness to be 15mm. 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.