SpaTec™ Xtrem™

SAFETY ANCHORS - NON-CRACKED & CRACKED CONCRETE

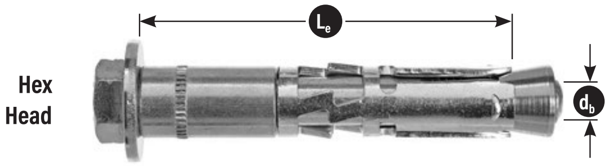
GENERAL INFORMATION

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.

XTREM PREMIUM ANCHORING | FIRE TESTED | SEISMIC | ETA | CRACKED CONCRETE CERTIFIED



Benefits, Advantages and Features

European Technical Approval (option1) – ETA-10/0276:
Design According to AS5216 (formerly TS101) and European design method EN 1992-4 (formerly ETAG001 Annex C & TR045)

- 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 M20

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

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:

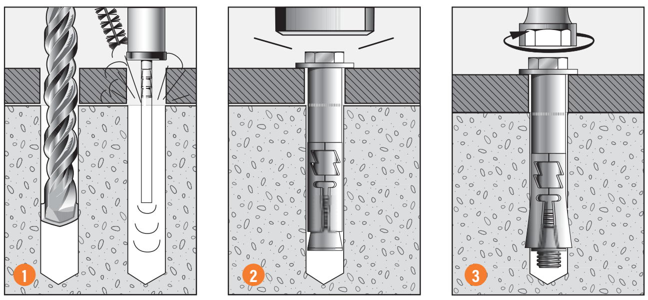
- Hex Nut & Hex Bolt versions available
- Countersunk heads available.
- Through fixing eliminates marking out and repositioning of fixtures.

Fire rated: Refer Fire rated mechanical anchor section.

Principal Applications

- 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
- Intended working life of the anchor of 50 years

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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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)	Non-Cracked Concrete Tension, ϕN_{uc} (kN)**		
							Concrete Compressive Strength, f'$_c$		
							20 MPa	32 MPa	40 MPa
M10	15	17	70	90	50	140	19.1	24.2	27.1
M12	18	20	80	105	80	160	23.4	29.6	33.1
M16	24	26	100	131	120	200	32.7	41.4	46.3
M20	28	30	125	157	200	250	45.8	57.9	64.7

* 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.
** Data is based on optimal dimensions, anchor spacing = 3*h, edge distance = 1.5*h
** Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.67 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.50
For Cracked Concrete performance, 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
M20	28	150	25	V20-28/25	SP20170

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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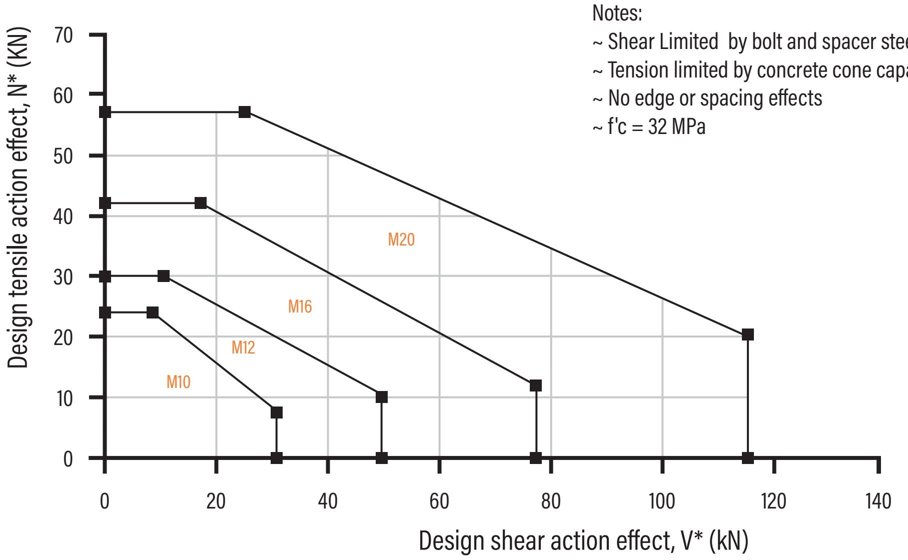
STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram



Notes:
~ Shear Limited by bolt and spacer steel capacity
~ Tension limited by concrete cone capacity
~ No edge or spacing effects
~ f'c = 32 MPa

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

Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	70	80	100	125
Min. Anchor spacing - a_m	70	80	100	125
For - e_m	100	160	180	300
Min. Edge Distance - e_m	70	80	100	150
For - a_m	160	200	220	300

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 concrete tensile capacity - per anchor

Table 2a - Reduced characteristic ultmate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Drill hole dia, d_h (mm)	15	18	24	28
Effective depth, h (mm)				
70	24.2			
80		29.6		
100			41.4	
125				57.9

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

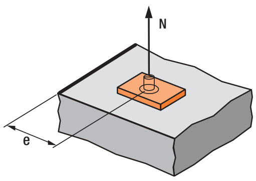
Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

Anchor Size d_b	M10	M12	M16	M20
X_{ncr}	0.67	0.70	0.70	0.70

For Non-cracked concrete X_{ncr} = 1.0

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

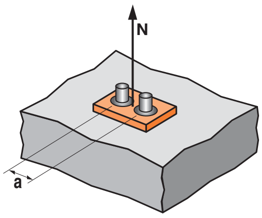
f'_c (MPa)	20	25	32	40	50
X_{nc}	0.79	0.88	1.00	1.12	1.25



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

Anchor size, d_b	10	12	16	20
Edge distance, e (mm)				
70	0.75			
80	0.82	0.75		
90	0.89	0.81		
100	0.96	0.88	0.75	0.65
120	1.00	1.00	0.85	0.73
150			1.00	0.85
165				0.91
187				1.00



$X_{na} = 0.5 + a/(6*h)$
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 -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	0.67
150	0.86	0.81	0.75	0.70
180	0.93	0.88	0.80	0.74
210	1.00	0.94	0.85	0.78
240		1.00	0.90	0.82
300			1.00	0.90
330				0.94
375				1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

$\phi N_{urc} = \phi N_{uc} * X_{ncr} * X_{nc} * X_{ne} * X_{na}$

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STRENGTH LIMIT STATE DESIGN

STEP 3

Verify Anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us}, (kN) where ϕ_n = 1/1.5 = 0.67

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	30.5	44.7	84.0	130.7

Table 3b-1 Reduced characteristic ultimate pull-out capacity, ϕN_{up} (kN),ϕ= 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Drill hole dia d_h (mm)	15	18	24	28
Effective depth, h (mm)				
70	24.2			
80		N/A		
100			N/A	
125				N/A

Table 3b-2 Cracked Concrete effect, pull-out, X_{pcr}

Anchor size, d_b	M10	M12	M16	M20
X_{pcr}	0.534	N/A	N/A	N/A

Note: For Non-Cracked Concrete, X_{pcr} = 1.0

Checkpoint 3a

Design reduced ultimate pull-out capacity,ϕN_{urp}

$\phi N_{urp} = \phi N_{up} * X_{pcr} * X_{npc}$

Checkpoint 3b

Design reduced ultimate tensile capacity, ϕN_{ur}

ϕN_{ur} = minimum of ϕN_{urc}, ϕN_{urp} ,ϕN_{us}

Check $N^*/\phi N_{ur} \leq 1$,

if not satisfied return to step 1

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STRENGTH LIMIT STATE DESIGN

STEP 4

Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

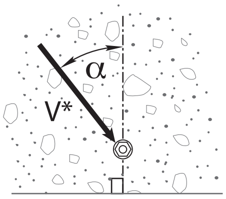
Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Edge distance, e_m				
70	8.3			
80		11.3		
100			16.6	
150				31.8

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

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

Anchor Size d_b	M10	M12	M16	M20
X_{vcr}	0.70			

For Non-cracked concrete X_{vcr} = 1.0



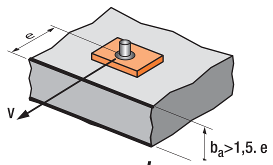
Load direction effect, conc. edge shear, X_{vd}

Table 4b Concrete compressive strength effect, concrete edge shear, X_{vc}

f'_c (MPa)	20	25	32	40	50
X_{vc}	0.82	0.90	1.00	1.16	1.27

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

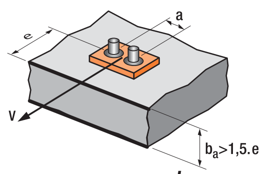


$X_{ve} = e/e_m * \sqrt{e/e_m}$

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

For single anchor fastening X_{ve}

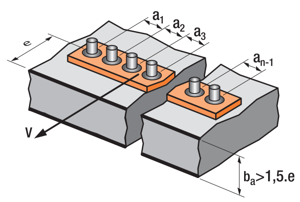
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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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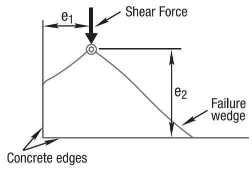
STRENGTH LIMIT STATE DESIGN

Table 4e Reduced characteristic ultimate concrete pryout capacity, ϕV_{ucp} (kN), ϕ = 1/1.5 = 0.67, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Edge distance, e				
70	48.6			
80		59.4		
100			83.0	
150				116.0



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 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 ϕ_v = 0.67

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	32.9	48.7	78.5	116.2

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

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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

Ramset™ SpaTec™ Xtrem™ Anchor,
(Anchor Size) (Part Number)
Maximum fixed thickness to be (t) mm.

Example

Ramset™ SpaTec™ Xtrem™ Anchor, M12 (SP12120).
Maximum fixed thickness to be 8 mm. To be installed in accordance to Ramset™ Installation Instructions.