TruBolt™ Xtrem™

SEISMIC - MECHANICAL ANCHORS

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

A seismic certified heavy duty, torque controlled expansion 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 (option 1) - ETA-21/0973

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

- Highest level of European approval for mechanical expansion anchors
- Approved for all directions (floor, wall, overhead)
- Maximum Tensile & Shear capacities in cracked concrete
- Zinc Plating 5µm and Stainless Steel A4 316
- Anchor diameters M10 to M20

Suitable for structural loads:

- "True to size" through fixture anchor

Improved security:

- Torque induced pull down closes gaps and induces preload.

Resistant to cyclic loading:

- Heavy duty sleeve with pull-down of fixture
- Anti rotation expansion sleeve

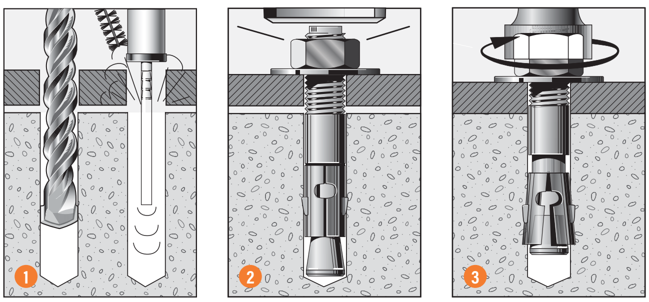
Fast installation:

- Anchor diameter equals hole diameter
- Shallow embedment depths
- Through fixing eliminates marking out and repositioning of fixtures.

Principal Applications

- Seismic anchoring to Category C1/C2
- Anchoring into cracked & non cracked concrete
- Structural Steel columns & beams
- Road barrier hold down
- Bridge refurbishment
- Road & Rail tunnel construction
- Wall Plates
- Safety barriers
- Stadium seating
- Pallet racking
- Shallow embedment depths from 50mm
- Intended working life of the anchor of 50 years

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. Insert the **Trubolt™ Xtrem™** through the fixture and drive with a hammer until washer contacts the fixture.
3. Tighten the **Trubolt™ Xtrem™** nut with a torque wrench to 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_{ef} (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, $N^0_{Rd,p,seis}$ (kN) *					
							Concrete Compressive Strength, f'c					
							20 MPa		30 MPa		40 MPa	
							C1	C2***	C1	C2***	C1	C2***
M10	10	12	60	75	45	120	4.1	1.5	4.5	1.7	4.8	1.8
M12	12	14	70	90	60**	140	9.0	3.3	9.7	3.6	10.3	3.8
M16	16	18	85	110	110	170	11.3	10.1	13.0	11.7	14.3	12.9
M20	20	22	100	130	160	200	16.9	14.4	20.7	17.6	23.9	20.3

Note: M20 not available in SS

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

** Tightening Torque, T_r taken as 75 Nm for stainless steel M12 TruBolt Xtrem

***For C2 Seismic cracked concrete for stainless steel Trubolt Xtrem variant reduced characteristic tensile capacity:

For M10 SS Multiply $N^0_{Rd,p,seis}$ * 0.88

For M12 SS Multiply $N^0_{Rd,p,seis}$ * 1.0

For M16 SS Multiply $N^0_{Rd,p,seis}$ * 0.81

 # 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)	ETA Designation Number		Part Number	
						Zn	S/S
M10	10	65	5	10x85/25-5	D	T10085X	-
		75	15	10x95/35-15	2	-	T10095SSX
		80	20	10x100/40-20	F	T10100X	-
		85	25	10x105/45-25	3	-	T10105SSX
		100	40	10x120/60-40	G	T10120X	-
		110	50	10x130/70-50	4	-	T10130SSX
		120	60	10x140/80-60	I	T10140X	-
M12	12	80	10	12x105/30-10	F	T12105X	-
		85	15	12x110/35-15	2	-	T12110SSX
		90	20	12x115/40 -20	G	T12115X	-
		95	25	12x120/45-25	3	-	T12120SSX
		110	40	12x135/60-40	I	T12135X	-
		115	45	12x140/65-45	4	-	T12140SSX
		155	85	12x180/105-85	L	T12180X	-
M16	16	105	20	16x140/40-20	2	-	T16140SSX
		110	25	16x145/45-25	I	T16145X	-
		135	50	16x170/70-50	K	T16170X	-
M20	20	130	30	20x170/30	K	T20170X	-
		160	60	20x200/60	M	T20200X	-

ENGINEERING PROPERTIES

Decription	Zn		S/S	
	Material	Protection	Material	Protection
Bolt	Carbon Steel	M10 - M20: Zinc electroplated (>5µm) EN ISO 4042:2018	M10-M16 Stainless Steel A4	M10-M16 Stainless Steel A4, EN 10088.3:2014 + ,coated
Clip	M10 - M20 Carbon Steel	M10 - M20: Zinc electroplated (>5µm) EN ISO 4042:2018	M10-M16 Stainless Steel A4	M10-M16 Stainless Steel A4, EN 10088.3:2014
Washer	M10 - M20 EN ISO 7092:200	M10 - M20: Zinc electroplated (>5µm) EN ISO 4042:2018	M10 - M16 EN ISO 7092:200	M10-M16 Stainless Steel A4
Nut	Steel, Strenth class 8, ISO 898-2:2012	M10: Zinc electroplated (>5µm) EN ISO 4042:2018	M10-M16 Stainless Steel A4-80	M10-M16 Stainless Steel A4-80, EN ISO 3506-2:2019, coated
		M12 - M20: Zinc electroplated (>5µm) EN ISO 4042:2018		

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STRENGTH LIMIT STATE DESIGN

STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

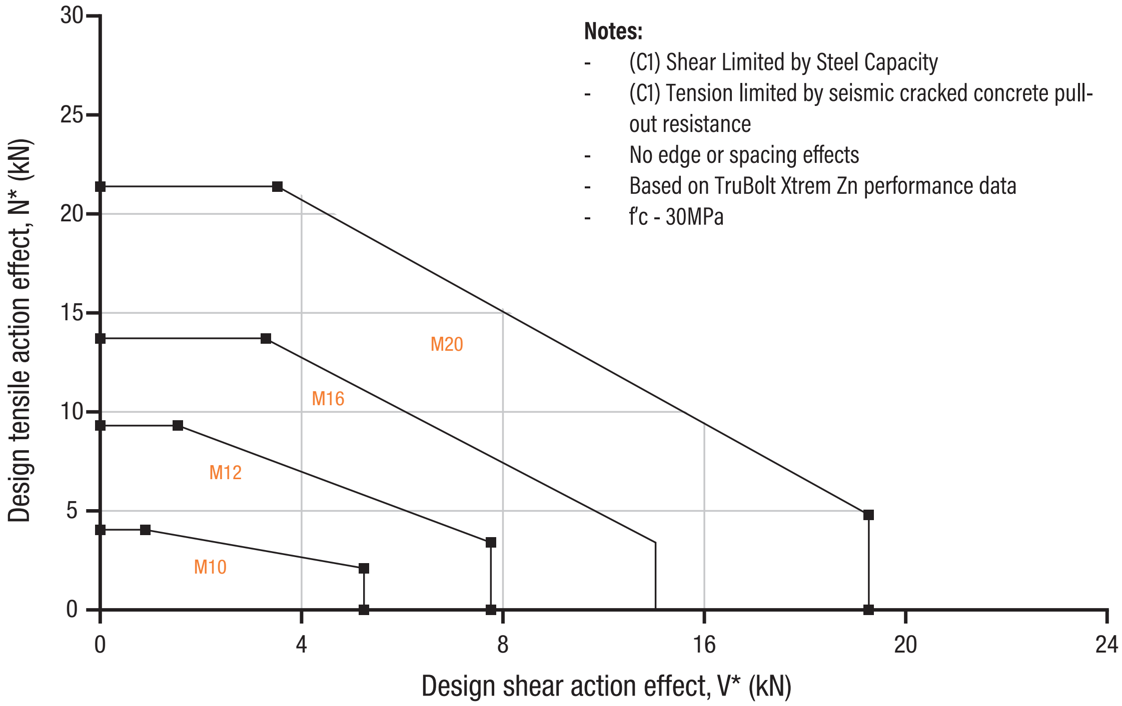

Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Min. member thickness (mm)*	120	140	170	200
Min. Anchor spacing - a_m	55	60	90	100
For - e_m	70**	100	100	120
Min. Edge Distance - e_m	55	60	80	100
For - a_m	90	145	110	130

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

** for Trubolt Xtreme SS - e_m = 65

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

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

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

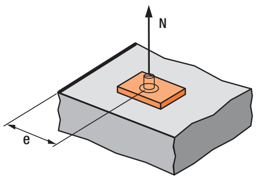
Anchor size, d_b	M10	M12	M16	M20
Drill hole dia, d_h (mm)	10	12	16	20
Effective depth, h (mm)				
60	9.8			
70		12.3		
85			16.5	
100				21.0

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} and Pull-out, X_{npc}

Anchor size, d_b	Tension	M10	M12	M16	M20
f'c (MPa)	X_{nc}	Pull-out X_{npc}			
20	0.81	0.93	0.93	0.87	0.82
25	0.91	0.97	0.97	0.94	0.92
30	1.00	1.00	1.00	1.00	1.00
40	1.15	1.06	1.06	1.10	1.16
50	1.29	1.11	1.11	1.20	1.30



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

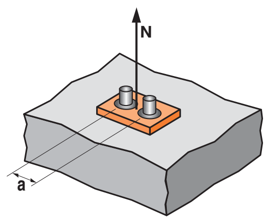
Where $e_m \le e \le e_c$

$e_c = 1.5*h$

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
Edge distance, e (mm)				
55	0.70			
60	0.75	0.67		
70	0.83	0.75		
80	0.91	0.82	0.72	
90	1	0.89	0.77	
100		0.96	0.83	0.75
110		1	0.89	0.80
120			0.95	0.85
130			1	0.90
150				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
Anchor spacing, a (mm)				
55	0.65			
60	0.66	0.64		
70	0.69	0.66		
80	0.72	0.69		
90	0.75	0.71	0.67	
100	0.77	0.73	0.69	0.66
125	0.84	0.79	0.74	0.70
150	0.91	0.85	0.79	0.75
180	1.00	0.92	0.85	0.80
210		1.00	0.91	0.85
255			1.00	0.92
300				1.00

Checkpoint 2

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

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

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STEP 3

Verify cracked concrete tensile resistance tension - per anchor

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

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	19.5	25.5	43.1	66.1
Stainless Steel	20.5	29.7	43.2	-

Carbon Steel:

$\gamma_{Ms} = 1.5$

Stainless Steel:

$\gamma_{Ms} = 1.76$ (M10-M12)

$\gamma_{Ms} = 2.11$ (M16)

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	M20*
Drill hole dia, d_h (mm)	10	18	24	20
Effective depth, h (mm)				
60	4.5			
70		9.7		
80			13.0	
100				20.7

**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	M20
Drill hole dia, d_h (mm)	10	18	24	20
Effective depth, h (mm)				
60	1.7			
70		3.6		
80			11.7	
100				17.6

** 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

For M10 SS Multiply $N^0_{Rd,p,seis}$ * 0.88

For M12 SS Multiply $N^0_{Rd,p,seis}$ * 1.0

For M16 SS Multiply $N^0_{Rd,p,seis}$ * 0.81

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

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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	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Edge distance, e_m				
55	1.8			
60		2.2		
80			3.5	
100				5.0

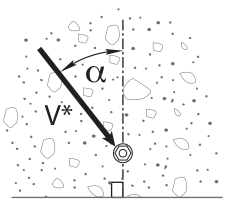
Note: Data includes annular gap reduction factor of 0.5

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}

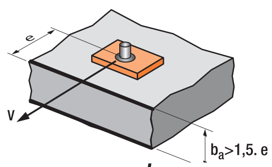
f'_c (MPa)	20	25	30	40	50
X_{vc}	0.82	0.91	1	1.15	1.29



Load direction effect, conc. edge shear, Xvd

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

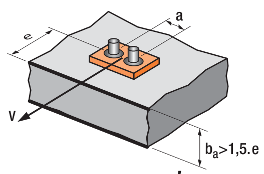


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

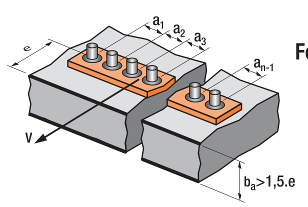
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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

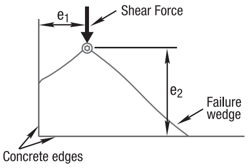
$\gamma_{Mpr} = 1.5$, $\alpha_{seis} = 0.75$, $f'_c = 30$ MPa

Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)				
60	9.8			
70		12.4		
85			16.5	
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

Table 4f Anchor at a corner effect, concrete edge shear, X_{VS}



ANCHOR AT A CORNER

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, $V_{Rd,c,seis}$

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

Checkpoint 4b

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

$V_{Rd,cp,seis} = V^o_{Rd,cp,seis} * X_{nc} * X_{ne} * X_{na}$

STEP 5

Verify cracked concrete shear resistance - per anchor

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

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	5.4	7.7	15.3	17.3
Stainless Steel	3.5	5.1	8.2	-

Carbon Steel:

$\gamma_{Ms,c1} = 1.27$ (M10 - M12)

$\gamma_{Ms,c1} = 1.25$ (M16)

$\gamma_{Ms,c1} = 1.5$ (M20)

Stainless Steel:

$\gamma_{Ms,c1} = 1.47$ (M10 - M12)

$\gamma_{Ms,c1} = 1.75$ (M16)

Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V_{Rk,c,seis}$*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 $\alpha_{seis} = 0.85$,

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	3.2	4.7	11.5	12.7
Stainless Steel	2.1	3.1	6.1	-

Carbon Steel:

$\gamma_{Ms,c2} = 1.27$ (M10 - M12)

$\gamma_{Ms,c2} = 1.25$ (M16)

$\gamma_{Ms,c2} = 1.5$ (M20)

Stainless Steel:

$\gamma_{Ms,c2} = 1.47$ (M10 - M12)

$\gamma_{Ms,c2} = 1.75$ (M16)

Note: Data includes annular gap reduction factor of 0.5

For single anchor values: Multiply $V_{Rk,c,seis}$*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 $V^*/V_{Rd,seis} \leq 1$

if not satisfied return to step 1

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

Example
Ramset™ TruBolt™ Xtrem™ Anchor, M12 T12115X.
Maximum fixed thickness to be 20mm. 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.