

## 47.1 GENERAL INFORMATION

PERFORMANCE RELATED	MATERIAL	INSTALLATION RELATED

### Product

A Heavy duty, torque controlled expansion anchor, made of stainless steel for use in Cracked and Non-Cracked concrete.

### Benefits, Advantages and Features

European Technical Approval (option1) – ETA-04/0010 (FIX Z A4):

- Highest level of European approval for mechanical expansion anchors
- Approved for all directions (floor, wall, overhead)
- Maximum Tensile & Shear load in cracked concrete
- A4 (AISI 316) Stainless Steel
- Anchor diameters M8 to M16

### Suitable for structural loads:

- "True to size" through fixture anchor
- A4-80 Stainless Steel Hexagonal Nut

### Improved security:

- Torque induced pull down closes gaps and induces preload.

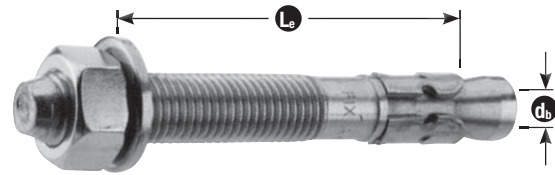
### Resistant to cyclic loading:

- 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.

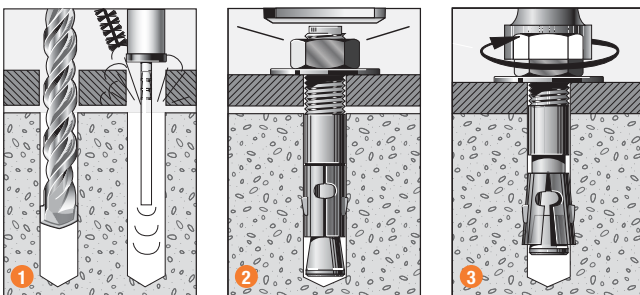
Fire rated: Refer Fire rated mechanical anchor section for details.



### Principal Applications

- 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
- Long working life

## Installation



1. Drill or core a hole to the recommended diameter (same as the TruBolt™ A4 316 SS) 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. Insert the anchor through the fixture and drive with a hammer until the washer contacts the fixture.
3. Tighten the nut with a torque wrench to the specified assembly torque.

**Installation and Working Load Limit performance details**

Anchor size, d <sub>b</sub>	Drilled hole diameter, d <sub>h</sub> (mm)	Fixture hole diameter, d <sub>f</sub> (mm)	Anchor effective depth, h (mm)	Depth of drill hole, h <sub>1</sub> (mm)	Tightening torque, T <sub>r</sub> (Nm)	Concrete substrate thickness, b <sub>m</sub> (mm)	Optimum dimensions*		Reduced Characteristic Capacity Cracked Concrete Tension, N <sup>0</sup> <sub>Rd,c</sub> (kN) **		
							Anchor spacing, a <sub>c</sub> (mm)	Edge distance, e <sub>c</sub> (mm)	Concrete Compressive Strength, f <sub>c</sub>		
									20 MPa	30 MPa	40 MPa
M8	8	9	35	52	20	100	140	70	5.0	6.1	7.0
			48	65		100	192	96	8.0	9.8	11.3
M10	10	12	42	62	35	100	168	84	6.5	7.9	9.2
			58	78		116	232	116	10.6	12.9	14.9
M12	12	14	50	75	50	100	200	100	8.5	10.4	12.0
			70	95		140	280	140	14.1	17.2	19.9
M16	16	18	64	95	100	128	256	128	12.3	15.0	17.3
			86	117		172	344	172	19.1	23.3	26.9

\*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.

**47.2 DESCRIPTION AND PART NUMBERS**

Anchor size, d <sub>b</sub>	Drilled hole diameter, d <sub>h</sub> (mm)	Effective Length, L <sub>e</sub> (mm)	ETA Designation Number	Part Number
				316 A4 SS
M8	8	40	M8/5	T08055SSA
		55	M8/20-7	T08070SSA
		75	M8/40-27	T08090SSA
		115	M8/80-67	T08130SSA
M10	10	47	M10/5	T10065SSA
		57	M10/15	T10075SSA
		78	M10/35-20	T10095SSA
		103	M10/60-45	T10120SSA
M12	12	55	M12/5	T12080SSA
		76	M12/25-6	T12100SSA
		91	M12/40-21	T12115SSA
		116	M12/65-46	T12140SSA
M16	16	94	M16/30-8	T16125SSA
		119	M16/55-33	T16150SSA
		139	M16/75-53	T16170SSA

Effective depth, h (mm)  
 $h = L_e - t$   
 t = total thickness of material(s) being fixed

**47.3 ENGINEERING PROPERTIES - Stainless Steel**

Anchor size, d <sub>b</sub>	Stress area threaded section, A <sub>s</sub> (mm <sup>2</sup> )	Minimum diameter reduced section, d <sub>s</sub> (mm)	Threaded section		Reduced section		Section modulus Z (mm <sup>2</sup> )
			Yield strength, f <sub>y</sub> (MPa)	UTS, f <sub>u</sub> (MPa)	Yield strength, f <sub>y</sub> (MPa)	UTS, f <sub>u</sub> (MPa)	
M8	36.6	5.6	420	620	780	900	31.2
M10	58.0	7.3	420	620	780	900	62.3
M12	84.3	8.6	420	620	780	900	109.2
M16	157.0	11.7	420	620	780	900	277.5

**STEP 1** Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

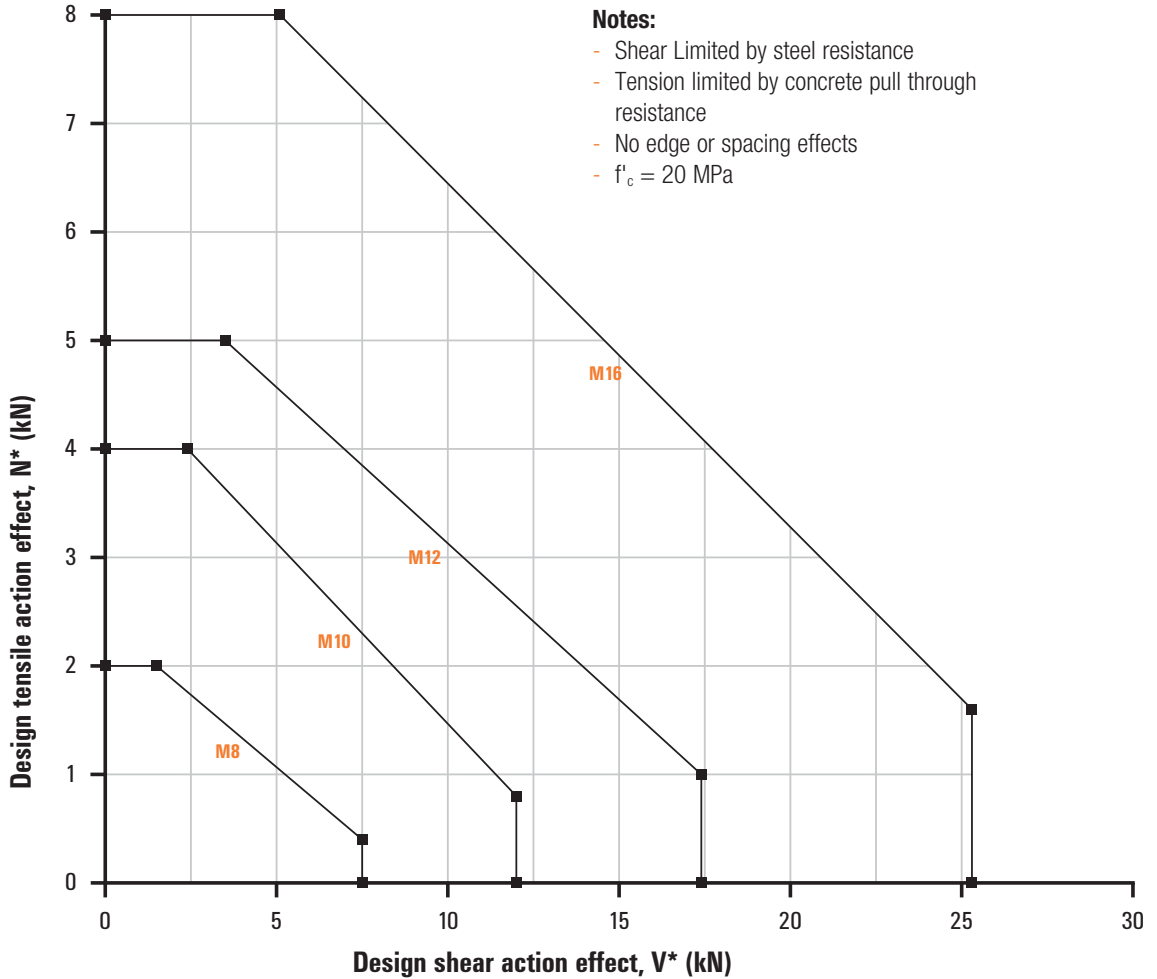


Table 1b Absolute minimum edge distance and anchor spacing values,  $e_m$  and  $a_m$  (mm)

Anchor size, $d_b$	M8		M10		M12		M16	
Effective depth, $h$ (mm)	35	48	42	58	50	70	64	86
Min. Anchor spacing - $a_m$	60	50	75	55	170	75	150	90
Min. Edge Distance - $e_m$	60	60	65	65	100	90	100	105

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

Refer to "Description and Part Numbers" table on page 292.

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.

**STEP 2** Verify cracked concrete cone tensile resistance - per anchor

Table 2a - Cracked concrete cone resistance, tension,  $N_{Rd,c}^0 = N_{Rk,c} / \gamma_{Mc}$  (kN)  $\gamma_{Mc} = 1.5, f'_c = 20$  MPa

Anchor size, $d_b$ Drill hole dia, $d_h$ (mm)	M8 8	M10 10	M12 12	M16 16
Effective depth, h (mm)				
35	5			
42		6.5		
48	8			
50			8.5	
58		10.6		
64				12.3
70			14.1	
86				19.1

NOTE: For capacity in Non-cracked concrete, refer to pages 201-210.

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

$f'_c$ (MPa)	20	30	40	50
$X_{nc}$	1	1.22	1.41	1.55

Table 2c - Cracked concrete Edge distance effect, tension,  $X_{ne}$

2c-1 - For Minimum Effective Depth

Anchor size, $d_b$	M8	M10	M12	M16
Effective depth, h (mm)	35	42	50	64
Edge distance, e (mm)				
60	1.00			
65		1.00		
100			1.00	
100				1.00

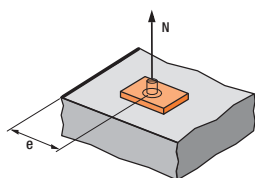
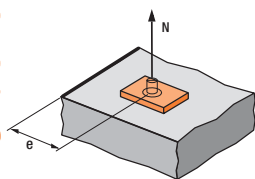
2c-2 - For Maximum Effective Depth

Anchor size, $d_b$	M8	M10	M12	M16
Effective depth, h (mm)	48	58	70	86
Edge distance, e (mm)				
60	0.91			
65	0.95	0.91		
72	1.00	0.96		
80		1.00		
90			0.94	
105			1.00	0.90
130				1.00

Table 2d - Cracked concrete anchor spacing effect, tension,  $X_{na}$

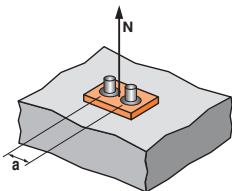
2d-1 - For Minimum Effective Depth

Anchor size, $d_b$	M8	M10	M12	M16
Effective depth, h (mm)	35	42	50	64
Anchor spacing, a (mm)				
60	0.78			
75	0.86	0.80		
100	0.98	0.90	0.83	0.76
105	1.00	0.92	0.85	0.77
110		0.94	0.87	0.79
125		1.00	0.92	0.83
150			1.00	0.89
170				0.94
192				1.00



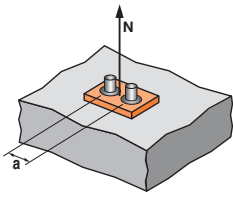
$X_{ne} = 0.5 + 0.33*(e/h)$   
Where  $e_m \leq e \leq e_c$   
 $e_c = 1.5*h$

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.



$X_{na} = 0.5 + a/(6*h)$   
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 of  $X_{na}$ , please use equation shown above.



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

Where  $a_m \leq a \leq a_c$   
 $a_c = 3 \cdot h$

Note: Tabled values are based on the nominal effective depth, h shown in the installation details. For other values of  $X_{na}$ , please use equation shown above.

### 2d-2 - For Maximum Effective Depth

Anchor size, d <sub>b</sub>	M8	M10	M12	M16
Effective depth, h (mm)	48	58	70	86
Anchor spacing, a (mm)				
50	0.67			
55	0.69	0.66		
75	0.76	0.72	0.68	
90	0.81	0.76	0.71	0.67
110	0.88	0.82	0.76	0.71
130	0.95	0.87	0.81	0.75
145	1.00	0.92	0.85	0.78
155		0.95	0.87	0.80
175		1.00	0.92	0.84
205			0.99	0.90
210			1.00	0.91
258				1.00

### Checkpoint 2

Design cracked concrete cone resistance,  $N_{Rd,c}$   
 $N_{Rd,c} = N_{Rd,c}^0 \cdot X_{nc} \cdot X_{ne} \cdot X_{na}$

### STEP 3

### Verify cracked concrete tensile resistance - per anchor

Table 3a - Cracked Concrete steel resistance, tension,  $N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$  (kN),  
 $\gamma_{Ms} = 1.5$  for M8 to M12 and  $\gamma_{Ms} = 2.1$  for M16

Anchor size, d <sub>b</sub>	M8	M10	M12	M16
Stainless Steel	8.5	14.4	20.0	29.7

Table 3b - Cracked concrete Pull-through resistance\*\*,  $N_{Rd,p}^0 = N_{Rk,p} / \gamma_{Mp}$  (kN)  $\gamma_{Mp} = 1.5$ ,  $f'_c = 20$  MPa

Anchor size, d <sub>b</sub>	M8	M10	M12	M16
Drill hole dia, d <sub>h</sub> (mm)	8	10	12	16
Effective depth, h (mm)				
35	2.0			
42		4.0		
48	2.7			
50			5.0	
58		5.0		
64				8.0
70			6.0	
86				10.7

\*\* Cracked concrete Pull-through resistance is not influenced by reduced anchor spacing or edge distance.

### Checkpoint 3a

Design cracked concrete pull-through resistance,  $N_{Rd,p}$   
 $N_{Rd,p} = N_{Rd,p}^0 \cdot X_{nc}$

### Checkpoint 3b

Design cracked concrete tensile resistance,  $N_{Rd}$   
 $N_{Rd} = \text{minimum of } N_{Rd,c}, N_{Rd,p}, N_{Rd,s}$   
 Check  $N^*/N_{Rd} \leq 1$ ,  
 if not satisfied return to step 1

## STEP 4 Verify cracked concrete edge shear resistance - per anchor

Table 4a - Cracked concrete edge resistance, shear,  $V_{Rd,c}^0 = V_{Rk,c} / \gamma_{Mc}$  (kN)  $\gamma_{Mc} = 1.5$ ,  $f'_c = 20$  MPa

Anchor size, $d_b$	M8		M10		M12		M16	
Min. Anchor spacing - $a_m$	60	50	75	55	170	75	150	90
Min. Edge Distance - $e_m$	60	60	65	65	100	90	100	105
Effective depth, $h$ (mm)								
35	3.3							
42			4.1					
48		3.7						
50					8.7			
58				4.4				
64							10.1	
70						8.2		
86								11.8

NOTE: For capacity in Non-cracked concrete, refer to pages 201-210.

Table 4b - Cracked concrete compressive strength effect, shear,  $X_{vc}$

$f'_c$ (MPa)	20	30	40	50
$X_{vc}$	1	1.22	1.41	1.55

Table 4c - Cracked concrete load direction effect, concrete edge shear,  $X_{vd}$

Angle, $\alpha$ °	0-55	60	70	80	90-180
$X_{vd}$	1	1.1	1.2	1.5	2

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

For single anchor fastening  $X_{ve}$

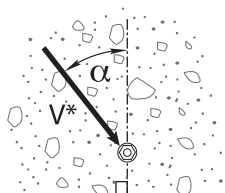
$e/e_m$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$X_{ve}$	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72

For 2 anchors fastening  $X_{ve}$

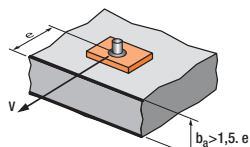
$e/e_m$	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
$a/e_m$												
1.0	0.67	0.84	1.03	1.22	1.43	1.65	1.88	2.12	2.36	2.62	2.89	3.16
1.5	0.75	0.93	1.12	1.33	1.54	1.77	2.00	2.25	2.50	2.76	3.03	3.31
2.0	0.83	1.02	1.22	1.43	1.65	1.89	2.12	2.38	2.63	2.90	3.18	3.46
2.5	0.92	1.11	1.32	1.54	1.77	2.00	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  $X_{ve}$

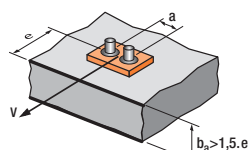
$$X_{ve} = \frac{3 \cdot e + a_1 + a_2 + a_3 + \dots + a_{n-1}}{3 \cdot n \cdot e_m} \cdot \sqrt{e/e_m}$$



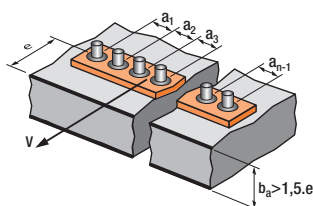
Load direction effect, conc. edge shear,  $X_{vd}$



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



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

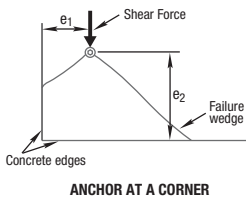


**Table 4e - Cracked concrete Pryout failure,  $V_{Rd,cp} = V_{Rk,cp} / \gamma_{Mpr}$  (kN)  $\gamma_{Mpr} = 1.5, f'_c = 20$  Mpa**

Anchor size, $d_b$	M8	M10	M12	M16
<b>Effective depth, h (mm)</b>				
35	5.0			
42		6.5		
48	8.0			
50			8.5	
58		10.6		
64				24.6
70			28.2	
86				38.2

**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
<b>Edge distance, <math>e_1</math> (mm)</b>												
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 cracked concrete edge shear resistance,  $V_{Rd,c}$

$$V_{Rd,c} = V_{Rd,c}^0 * X_{vc} * X_{vd} * X_{ve} * X_{vs}$$

**Checkpoint 4b**

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

$$V_{Rd,cp} = V_{Rd,cp}^0 * X_{vc} * X_{vd} * X_{ne} * X_{na}$$

**STEP 5**

**Verify cracked concrete shear resistance - per anchor**

**Table 5a - Cracked concrete steel shear resistance,  $V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$  (kN),**

$\gamma_{Ms} = 1.5$  for M8 to M12 and  $\gamma_{Ms} = 1.8$  for M16

Anchor size, $d_b$	M8	M10	M12	M16
<b>A4 316 Stainless Steel</b>	7.5	12.0	17.4	25.3

**Checkpoint 5**

Design cracked concrete shear resistance,  $V_{Rd}$

$$V_{Rd} = \text{minimum of } V_{Rd,c}, V_{Rd,cp}, V_{Rd,s}$$

Check  $V^*/V_{Rd} \leq 1$ ,

if not satisfied return to step 1

**STEP 6** Combined loading and specification

**Checkpoint 6**

Check  
 $N^*/N_{Rd} + V^*/V_{Rd} \leq 1.2$ ,  
 if not satisfied return to step 1

**Specify**  
 Ramset™ FIX Z™ A4 Anchor  
 (Anchor Size) ((Part Number)).  
 Maximum fixed thickness to be (t) mm.

**Example**  
 Ramset™ FIX Z™ A4 Anchor  
 M12 (054650)  
 Maximum fixed thickness to be 6 mm.  
 To be installed in accordance with  
 Ramset™ Technical Data Sheet.

**Tension - Sustained Loading - Cracked Concrete**

Concrete Strength  $f'_c = 20 \text{ MPa}$

Anchor Size ( $d_b$ )		M8		M10		M12		M16	
Effective Depth, h (mm)		35	48	42	58	50	70	64	86
Tension load in Cracked Concrete	(kN)	1.2	1.6	2.4	3.0	3.0	3.6	4.8	6.4
	Displacement								
	$\delta_{N0}$ (mm) (short term)	0.4	0.6	0.4	0.6	0.5	0.6	0.6	0.3
	$\delta_{N\infty}$ (mm) (long term)	0.5	1.0	0.8	1.0	0.8	1.0	1.0	1.0

Concrete Strength  $f'_c = 50 \text{ MPa}$

Anchor Size ( $d_b$ )		M8		M10		M12		M16	
Effective Depth, h (mm)		35	48	42	58	50	70	64	86
Tension load in Cracked Concrete	(kN)	1.9	2.5	3.7	4.6	4.6	5.5	7.4	9.8
	Displacement								
	$\delta_{N0}$ (mm) (short term)	0.8	0.8	1.1	1.1	0.5	0.6	0.5	0.6
	$\delta_{N\infty}$ (mm) (long term)	0.8	1.0	1.1	1.1	0.8	1.0	1.0	1.0

**Shear - Sustained Loading - Cracked Concrete**

Concrete Strength  $f'_c = 20 \text{ MPa to } 50 \text{ MPa}$

Anchor Size ( $d_b$ )		M8		M10		M12		M16	
Effective Depth, h (mm)		35	48	42	58	50	70	64	86
Shear load in Cracked Concrete	(kN)	5.4	5.4	8.6	8.6	12.4	12.4	18.1	18.1
	Displacement								
	$\delta_{N0}$ (mm) (short term)	4.2 (+0.7)	4.2 (+0.7)	4.4 (+1.2)	4.4 (+1.2)	4.6 (+1.2)	4.6 (+1.2)	5.0 (+1.2)	5.0 (+1.2)
	$\delta_{N\infty}$ (mm) (long term)	4.2 (+0.7)	4.2 (+0.7)	4.4 (+1.2)	4.4 (+1.2)	4.6 (+1.2)	4.6 (+1.2)	5.0 (+1.2)	5.0 (+1.2)

Note: Displacement – the tables above show the deformation to be expected from the anchor itself whilst the bracketed value indicates the additional movement between the anchor body and the hole in the fixture.