Introduction

MECHANICAL ANCHORING

Ramset™ has been offering mechanical anchors in the Australia and New Zealand market place for over 50 years. During this time **Ramset**™ brand names have entered into common language on building sites all over Australia and New Zealand. Names like DynaBolt™ and TruBolt™ have become recognised as the best sleeve anchors and stud anchors alike. But only **Ramset**™ supplies the original, proven products like DynaBolt™ Plus sleeve anchors, TruBolt™ stud anchors, SpaTec™ Plus safety anchors, WERCS AnkaScrew™ screw-in anchors and DynaSet™ internally threaded anchors. These tried and tested **Ramset**™ brand names represent Quality, Reliability and Performance. The **Ramset**™ **ISO9001 accreditation** assures it.

Not only does **Ramset**™ offer reliable, quality products, **Ramset**™ understands masonry anchoring technology and offers published information, such as this book, to guide correct product selection and safe installation. Extensive research, development and testing are invested in **Ramset**™ products so that designers can be secure in the knowledge that they have access to the real performance and capabilities of the anchors.

It is performance that defines an anchor's capabilities. An anchor's performance cannot be deduced from its description.
For example not all sleeve anchors perform like DynaBolt™ Plus sleeve anchors and not all stud anchors perform like TruBolt™ stud anchors. Product design, manufacturing tolerances and manufacturing quality control has a major effect on anchor performance. The only way to determine an anchor's actual performance is to measure it at all of its design and tolerance limits. The performance of **Ramset**™ Anchors are determined by extensive and rigorous testing to enable us to provide information on how our products will perform over a wide range of conditions and advise as to their limitations.

The correct anchor for a particular load case can only be selected by referring to reliable design information issued by the supplier for their anchors. Performance and design information from one supplier does not apply to anchors from other suppliers, even if they appear to be the same or have the same generic description.

The following section introduces the designer and/or engineer to the **Ramset**™ mechanical anchoring range and provides performance information to allow selection of the right anchor for the job.

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.

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.

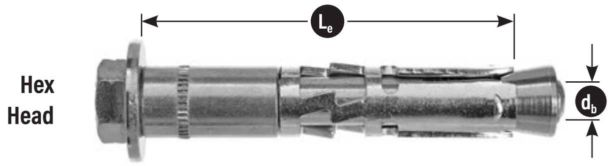
Improved security:
- Large expansion reserve that ensures retention in concrete if overloaded.
- Torque induced pull down closes gaps and induces preload.

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.

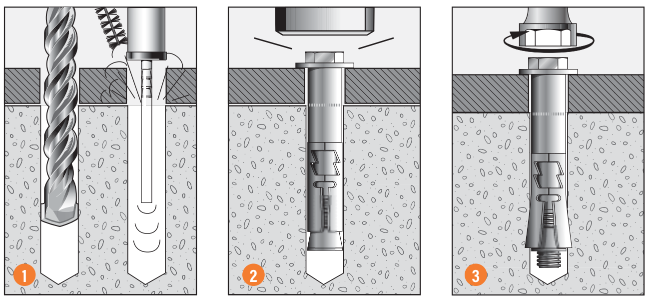
XTREM PREMIUM ANCHORING · FIRE TESTED · SEISMIC · ETA · CRACKED CONCRETE CERTIFIED



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.

SpaTec™ Xtrem™

SAFETY ANCHORS - NON-CRACKED & CRACKED CONCRETE

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

SpaTec™ Xtrem™

SAFETY ANCHORS - NON-CRACKED & CRACKED CONCRETE

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading - interaction diagram

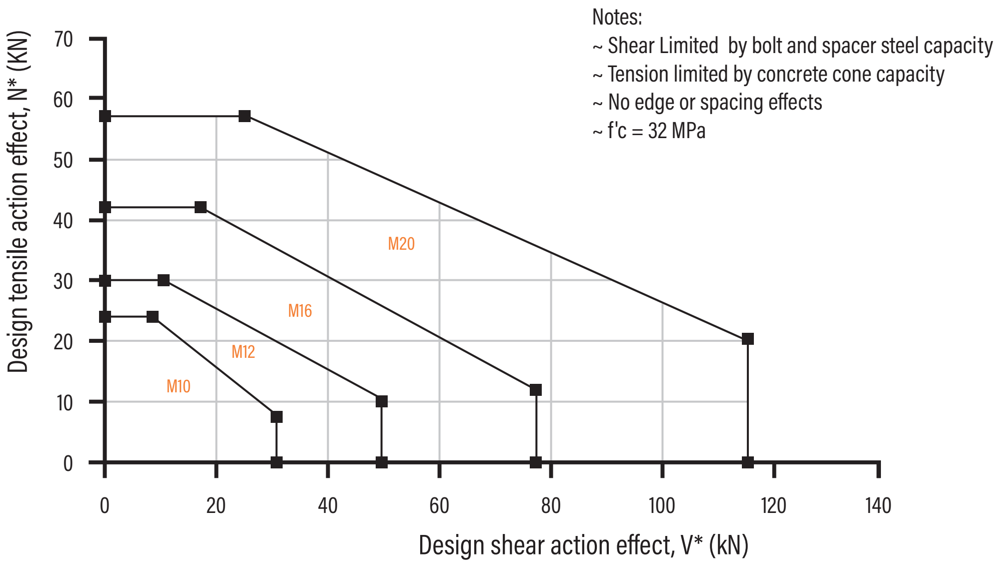


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	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.

SpaTec™ Xtrem™

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.

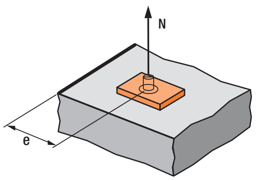
Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

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}

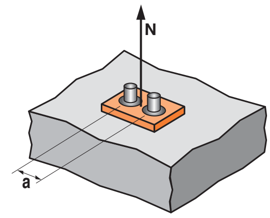
f'_c (MPa)	20	25	32	40	50
X_{nc}	0.79	0.88	1.00	1.12	1.25



$X_{ne} = 0.25 + 0.5*(e/h)$
Where $e_m \le e \le e_c$
$e_c = 1.5*h$
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 - 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 $a_m \le a \le a_c$
$a_c = 3*h$
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 -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

SpaTec™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 4

Verify concrete shear capacity - per anchor

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

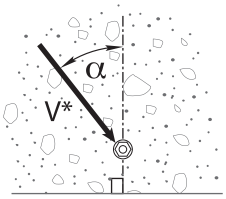
Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Edge distance, e_m				
70	8.3			
80		11.3		
100			16.6	
150				31.8

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 $X_{vcr} = 1.0$



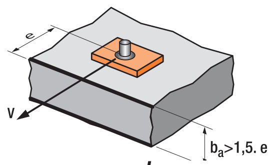
Load direction effect, conc. edge shear, X_{vd}

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

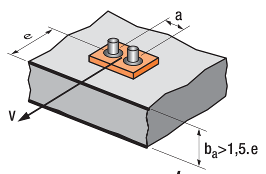


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

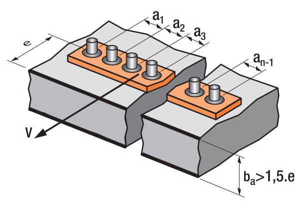
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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}

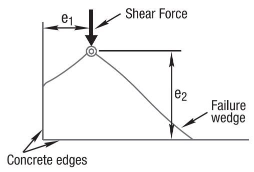
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

SpaTec™ Xtrem™

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 $V^*/\phi V_{ur} \le 1$,

if not satisfied return to step 1

SpaTec™ Xtrem™

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.

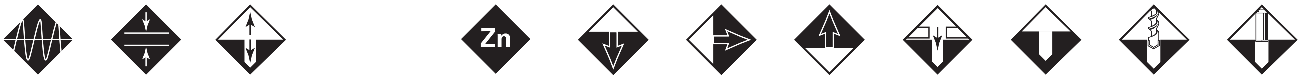
Ramset™

Boa™ Coil

EXPANSION ANCHORS - NON-CRACKED CONCRETE

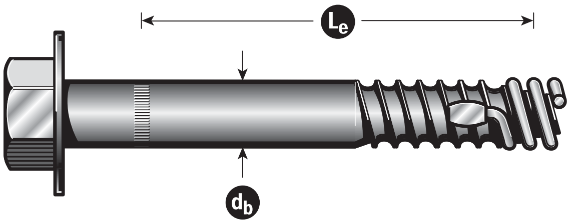
GENERAL INFORMATION

Performance Related | Material | Installation Related



Product

The Boa™ Coil Anchor is a heavy duty, rotation setting expansion anchor.



Benefits, Advantages and Features

High load capacity:
- Expansion coil locks into concrete to give cast-in type performance.
- High tensile capacity of grade 8.8 steel bolt.

High clamping load:
- Rotation setting action pulls down.

Resistant to cyclic loading:
- Pull-down action.

Fast installation:
- hrough fixing eliminates marking out and repositioning of fixtures.

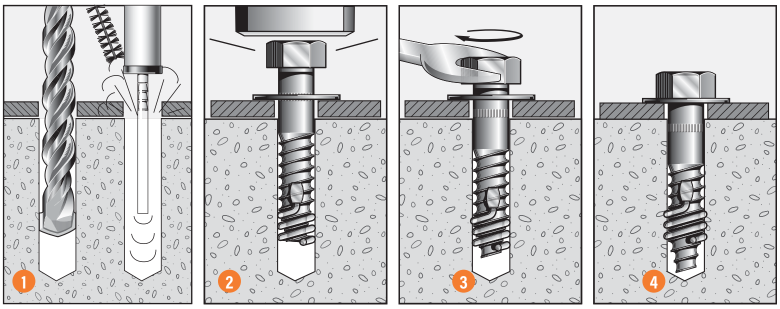
Easy and fast to remove:
- Expansion coil stays in hole leaving no protruding metal parts to grind off.

Ramset Design Method:
- Uses technical data validated from testing in ANZ concrete substrates

Principal Applications

- Installing handrails and balustrades
- Machinery hold down
- Formwork support
- Safety barriers
- Scaffolding

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 (the coil tab points up the anchor), insert the anchor through the fixture.
3. Tap the anchor down to the depth set mark, with a hammer, and stop.
4. Wind the anchor down, with an appropriately sized spanner or socket wrench, until the washer is firmly held to the fixture and stop (5 turns). Ensure washer is tight and snug fit.
5. The Boa™ Coil anchor is ready to take load. (The bolt can be removed leaving the coil in the hole. To re-insert, follow steps 3 - 4.)

Boa™ Coil

EXPANSION ANCHORS - NON-CRACKED CONCRETE

Installation and performance details

Anchor Size, d_b (mm)	Installation details				Optimum dimensions*		Reduced Characteristic Capacity			
							Steel	Non-Cracked Concrete		
	Drilled Hole diam., d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Turns to set anchor	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Shear, $ØV_{us}$ (kN)	Tension, ϕN_{uc} (kN)** Concrete compressive strength, f'_c 20 MPa	32 MPa	40 MPa
13	13	14	40	5	80	160	16.4	9.6	12.1	13.5
			75				30.8	17.9	22.7	25.3
			110				32.0	26.3	33.2	37.2
16	16	19	50	5	100	200	28.9	14.7	18.6	20.8
			70				40.3	20.6	26.0	29.1
			90				51.8	26.5	33.5	37.4
19	19	21	57	5	120	230	40.3	19.9	25.2	28.2
			80				56.6	27.9	35.3	39.5
			90				63.6	31.4	39.8	44.5

* 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.
**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.6 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.55
All data relevant for Non-cracked concrete

DESCRIPTION AND PART NUMBERS

Anchor size, d_b (mm)	Effective length, L_e (mm)	Part No. Zn
13	59	BAC08075
	84	BAC08100
16	71	BAC10090
	106	BAC10125
19	93	BAC12115

Effective depth, h (mm)

$h = L_e - t$

t = total thickness of material(s) being fixed

Substrate thickness, b_m (mm)

$b_m = h + (5 \times d_h)$

Drilled hole depth, h_1 (mm)

$h_1 = h + (3 \times d_h)$

h = Effective depth

ENGINEERING PROPERTIES - Carbon Steel

Anchor size, db (mm)	Bolt stress area, A_s (mm²)	Bolt yield strength, f_y (MPa)	Bolt UTS, f_u (MPa)	Section modulus, Z (mm³)
13	77.8	680	830	97.0
16	134.4	680	830	219.8
19	196.0	680	830	387.2

Boa™ Coil

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

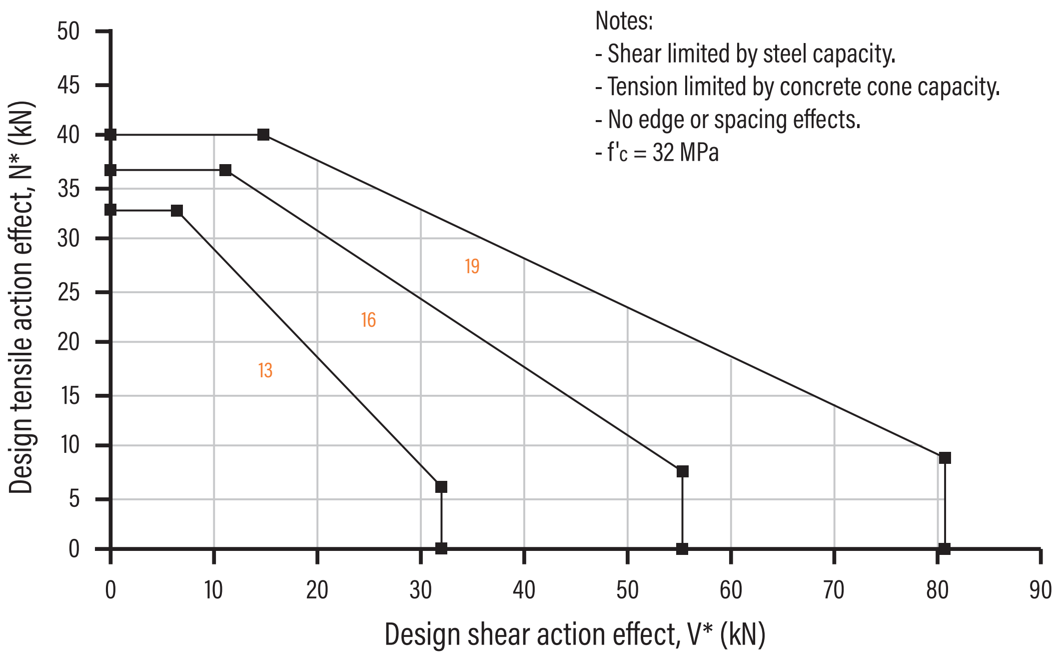


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b (mm)		13	16	19
Edge distance, e_m		65	80	95
Anchor spacing, a_m	$e \geq 6\,d_b$	105	130	150
	$e < 6\,d_b$	130	160	190

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

Refer to "Description and Part Numbers" table 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.

Boa™ Coil

STRENGTH LIMIT STATE DESIGN

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 0.6, f'$_c$ = 32 MPa

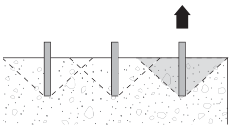
Anchor size, d_b (mm)	13	16	19
Effective depth, h (mm)			
40	12.1		
45	13.6		
50	15.1	18.6	
55	16.6	20.5	
60	18.1	22.3	26.5
70	21.2	26.0	30.9
80	24.2	29.8	35.3
90	27.2	33.5	**39.8**
100	30.2	**37.2**	
105	31.7		
110	**33.2**		

Note: Effective depth, h must be ≥ 3 x anchor size, d_b in order to achieve tabled shear capacities.
All data relevant for Non-cracked concrete

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

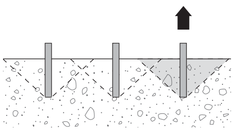
Table 2c Edge distance effect, tension, X_{ne}



Anchor size, d_b (mm)	13	16	19
Edge distance, e (mm)			
70	0.93		
80	1.00	0.88	
90		0.96	
100		1.00	0.91
120			1.00

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Note: For single anchor designs, X_{nae} = 1.0



Anchor size, d_b (mm)	13	16	19
Anchor spacing, a (mm)			
100	0.82		
120	0.88		
140	0.95	0.86	
160	1.00	0.92	0.85
180		0.97	0.89
200		1.00	0.94
220			0.98
230			1.00

Boa™ Coil

STRENGTH LIMIT STATE DESIGN

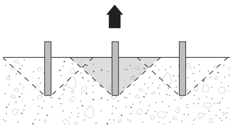


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

Note: For single anchor designs, X_{nai} = 1.0

Anchor size, d_b (mm)	13	16	19
Anchor spacing, a (mm)			
100	0.64		
120	0.77		
140	0.90	0.73	
150	0.96	0.78	0.66
160	1.00	0.83	0.70
180		0.94	0.79
200		1.00	0.88
220			0.96
230			1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

$$\phi N_{urc} = \phi N_{uc} * X_{nc} * X_{ne} * (X_{nae} \text{ or } X_{nai})$$

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN), ϕ_n = 0.8

Anchor size, d_b (mm)	13	16	19
Carbon steel	51.7	89.2	130.1

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}

$$\phi N_{ur} = \text{minimum of } \phi N_{urc}, \phi N_{us}$$

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

if not satisfied return to step 1

Tensile performance conversion table

Performance Required	Concrete Tensile Performance		Steel Tensile Performance	
	Notation	Concrete Tension Capacity	Notation	Carbon Steel Tension Capacity
Strength Limit State	ϕN_{urc}	MULTIPLY ϕN_{urc} x 1.00	ϕN_{us}	MULTIPLY ϕN_{us} x 1.00
Working Load Limit	N_{ac}	MULTIPLY ϕN_{urc} x 0.55	N_{as}	MULTIPLY ϕN_{us} x 0.56
Cyclic Loading	N_{yc}	MULITPLY ϕN_{urc} x 0.55	N_{ys}	MULITPLY ϕN_{us} x 0.56
Fire Resistance	$N_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$N_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$N^0_{Rd,p,sis}$	Refer to Seismic Anchors	$N_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

Boa™ Coil

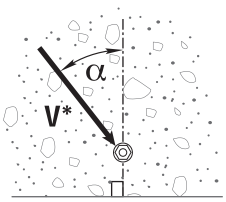
STRENGTH LIMIT STATE DESIGN

STEP 4 Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ_q = 0.6, f'$_c$ = 32 MPa

Anchor size, d_b (mm)	13	16	19
Edge distance, e (mm)			
70	8.7		
80	10.7	11.9	
100	14.9	16.6	18.0
150	27.4	30.4	33.2
200	42.2	46.8	51.1
250	59.0	65.5	71.3
300	77.6	86.1	93.8
400	119.4	132.5	144.4
500	166.9	185.2	201.8
600	219.4	243.4	265.3

Note: Effective depth, h must be ≥ 3 x anchor size, d_b in order to achieve tabled shear capacities.
All data relevant for Non-cracked concrete



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}	0.79	0.88	1.00	1.12	1.25

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

Note: For single anchor designs, X_{va} = 1.0

Edge distance, e (mm)	35	50	70	80	100	150	200	250	300	400	500	600
Anchor spacing, a (mm)												
50	0.79	0.70	0.64	0.63	0.60	0.57	0.55	0.54	0.53	0.53	0.52	0.52
75	0.93	0.80	0.71	0.69	0.65	0.60	0.58	0.56	0.55	0.54	0.53	0.53
100	**1.00**	0.90	0.79	0.75	0.70	0.63	0.60	0.58	0.57	0.55	0.54	0.53
125		**1.00**	0.86	0.81	0.75	0.67	0.63	0.60	0.58	0.56	0.55	0.54
150			0.93	0.88	0.80	0.70	0.65	0.62	0.60	0.58	0.56	0.55
175			**1.00**	0.94	0.85	0.73	0.68	0.64	0.62	0.59	0.57	0.56
200				**1.00**	0.90	0.77	0.70	0.66	0.63	0.60	0.58	0.57
225					0.95	0.80	0.73	0.68	0.65	0.61	0.59	0.58
250					**1.00**	0.83	0.75	0.70	0.67	0.63	0.60	0.58
275						0.87	0.78	0.72	0.68	0.64	0.61	0.59
300						0.90	0.80	0.74	0.70	0.65	0.62	0.60
400						**1.00**	0.90	0.82	0.77	0.70	0.66	0.63
500							**1.00**	0.90	0.83	0.75	0.70	0.67
750								**1.00**	**1.00**	0.88	0.80	0.75
1000										**1.00**	0.90	0.83
1250											**1.00**	0.92
1500												**1.00**

Boa™ Coil

STRENGTH LIMIT STATE DESIGN

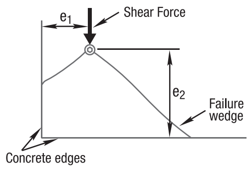
Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

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 dustance, 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 4

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$$

STEP 5 Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us} (kN), ϕ_v = 0.8

Anchor size, d_b (mm)	13	16	19
$h \geq 6 \times d_b$	32.0	55.3	80.7
$h \geq 5 \times d_b$	26.7	46.1	67.2
$h \geq 4 \times d_b$	21.3	36.9	53.8
$h \geq 3 \times d_b$	16.0	27.7	40.3

Ramset™

Boa™ Coil

STRENGTH LIMIT STATE DESIGN

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{us}

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

if not satisfied return to step 1

Shear performance conversion table

Performance Required	Concrete Shear Performance		Steel Shear Performance	
	Notation	Concrete Shear Capacity	Notation	Carbon Steel Shear Capacity
Strength Limit State	ϕV_{uc}	MULTIPLY ϕV_{uc} x 1.00	ϕV_{us}	MULTIPLY ϕV_{us} x 1.00
Working Load Limit	V_{ac}	MULTIPLY ϕV_{uc} x 0.55	V_{as}	MULTIPLY ϕV_{us} x 0.50
Cyclic Loading	V_{yc}	MULITPLY ϕV_{uc} x 0.55	V_{ys}	MULITPLY ϕV_{us} x 0.50
Fire Resistance	$V_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$V_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$V^0_{Rd,c,sis}$	Refer to Seismic Anchors	$V^0_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Shear Capacity is the minimum of Concrete Shear and Steel Shear Capacities

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™ Boa™ Coil Anchor,
(Anchor Size) ((Part Number)).
Maximum fixed thickness to be (t) mm.

Example

Ramset™ Boa™ Coil Anchor,
16 mm (BAC10125).
Maximum fixed thickness to be 14 mm.
To be installed in accordance to Ramset™ Installation Instructions.

TruBolt™ Xtrem™

STUD ANCHORS - NON-CRACKED & CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related
	A4 316, Zn	

Product

A seismic certified heavy duty, torque controlled expansion anchor for permanent anchoring into concrete. Certified for seismic C1 & C2 applications.

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

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

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:

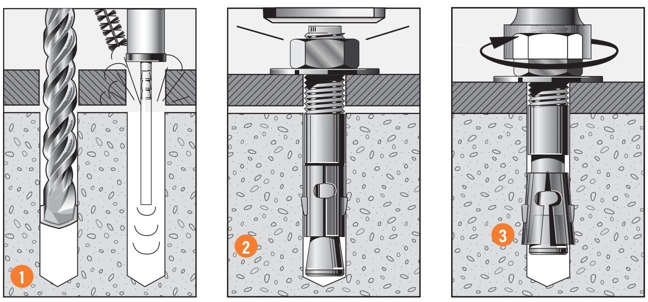
- Torque induced pull down closes gaps and induces preload.

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.



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.

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

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
- Intended working life of the anchor of 50 years

TruBolt™ Xtrem™

STUD ANCHORS - NON-CRACKED & CRACKED CONCRETE

Installation and Working Load Limit 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_{ur} (kN)* Concrete Compressive Strength, f'_c		
							20 MPa	32 MPa	40 MPa
M10	10	12	60	75	45	120	13.3	14.4	15.3
M12	12	14	70	90	60**	140	19.1	21.6	23.0
M16	16	18	85	110	110	170	25.7	30.6	33.8
M20	20	22	100	130	160	200	32.7	40.0	46.2

NOTE: M20 not available in SS

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

* 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 limit state design process to verify capacity.

** Tightening Torque. T_r taken as 75Nm for stainless steel Trubolt Xtrem.

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

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	Part Number S/S
M10	10	50	10	10x70/10	1	-	T10070SSX #
		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	70	20	12x95/20	1	-	T12095SSX #
		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	85	20	16x120/20	1	-	T16120SSX #
		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	-

#Note: Effective depth not addressed in performance tables. Refer to iExpert for performance details.

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		

TruBolt™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 1

Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

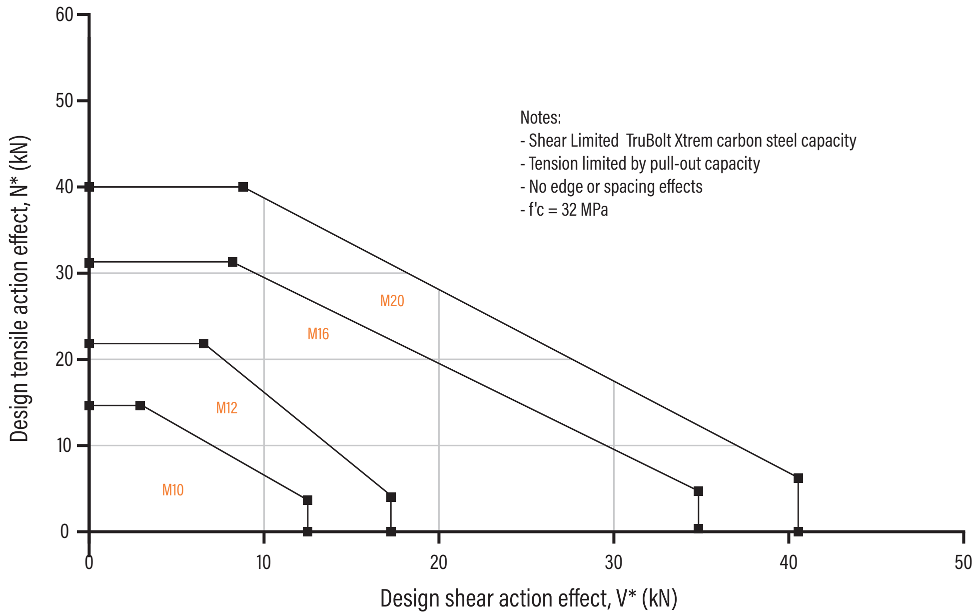


Table 1b-1 Cracked Concrete absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for Trubolt Xtrem Carbon Steel and Stainless Steel

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

** for Trubolt Xtreme SS - e_m = 65

Table 1b-2 Uncracked Concrete absolute minimum edge distance and anchor spacing values, em and am (mm) for Trubolt Xtrem Carbon Steel and Stainless Steel

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	130
For - e_m	70**	100	105	120
Min. Edge Distance - e_m	60	60	90	100
For - a_m	120	145	140	160

*Note: For performance based on smaller concrete substrate 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 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 minimal compliance achieved, effective depth (h) calculated.

TruBolt™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 2

Verify tensile capacity - per anchor

Table 2a-1 Reduced characteristic ultmate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 1/1.5 =0.67, f'c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Drill hole dia, d_h (mm)	10	12	16	20
Effective depth, h (mm)				
60	19.2			
70		24.2		
85			32.5	
100				41.4

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

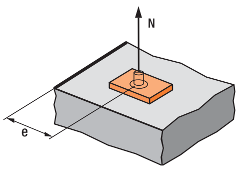
Table 2a-2 Cracked Concrete effect, tension, X_{ncr}

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

If Concrete is Non-Cracked then X_{ncr} = 1.0

Table 2b 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	0.79	0.93	0.93	0.87	0.82
25	0.88	0.96	0.96	0.93	0.9
32	1.00	1.00	1.00	1.00	1.00
40	1.12	1.06	1.06	1.10	1.16
50	1.25	1.10	1.10	1.18	1.27



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

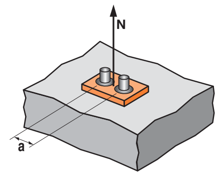
Where $e_m \le e \le e_c$

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 - Concrete Edge distance effect, tension, X_{ne}

Anchor size, d_b	M10	M12	M16	M20
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	0.9
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 - Concrete anchor spacing effect, tension, X_{na}

Anchor size, d_b	M10	M12	M16	M20
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	0.92	0.85	0.80
210		1	0.91	0.85
255			1	0.92
300				1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

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

TruBolt™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN)

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

Carbon Steel:

ϕ_n = 1/1.5 = 0.67

Stainless Steel:

ϕ_n = 1/1.76 = 0.57 (M10-M12)

ϕ_n = 1/2.11 = 0.47 (M16)

Table 3b-1 Reduced characteristic ultimate pull-out capacity, ϕN_{up} (kN) ϕ_p = 1/1.5 = 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)				
60	14.4			
70		21.6		
85			30.6	
100				40.0

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

Anchor size, db	M10	M12	M16	M20
X_{pcr}	0.44	0.53	0.50	0.61

For Non-Cracked Concrete X_{pcr} = 1

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

TruBolt™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 4

Verify concrete edge shear capacity - per anchor

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

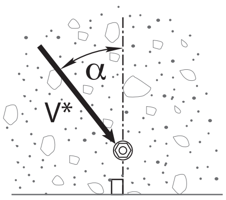
Anchor size, d_b	M10	M12	M16	M20
Effective depth, h (mm)	60	70	85	100
Edge distance, e_m				
60	7.0	7.5		
90			13.9	
100				17.1

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



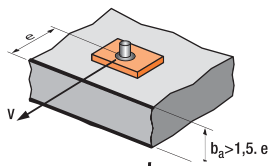
Load direction effect, conc. edge shear, X_{vd}

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

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

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

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1.0	1.1	1.2	1.5	2.0

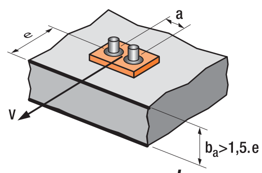


$$X_{ve} = e/e_m * \sqrt{e/e_m}$$

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

For single anchor fastening X_{ve}

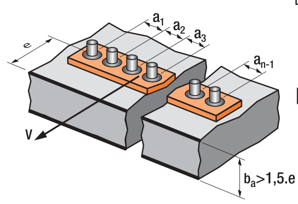
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

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}

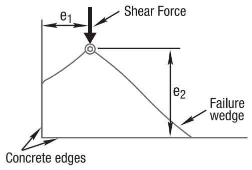
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

TruBolt™ Xtrem™

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
60	38.4			
70		48.4		
85			65.0	
100				82.8



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)

Anchor size, d_b	M10	M12	M16	M20
TruBolt Xtrem™ - Carbon Steel	12.6	18.1	35.4	40.7
TruBolt Xtrem™ - Stainless Steel	12.7	19.2	18.1	-

Carbon Steel:

ϕ_v = 1/1.27 = 0.79 (M10-M16)

ϕ_v = 1/1.5 = 0.67 (M20))

Stainless Steel:

ϕ_v = 1/1.47 = 0.68 (M10-M12)

ϕ_v = 1/1.75 = 0.57 (M16)

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

TruBolt™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 6 Combined Loading

Checkpoint 6

Check

$N^*/\phi N_{ur} + V^*/\phi V_{ur} \leq 1.2$,

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 to Ramset™ Installation Instructions..

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

TruBolt™

STUD ANCHORS - NON-CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related

Product

The Trubolt Anchor is a Heavy duty, torque setting expansion anchor.

Benefits, Advantages and Features

Maximum shear capacity for hole size:
- Stud diameter equals hole diameter.

Fast installation:
- Through fixing eliminates marking out and repositioning of fixtures.

High clamp load:
- Stud design ensures pull-down on fixture.

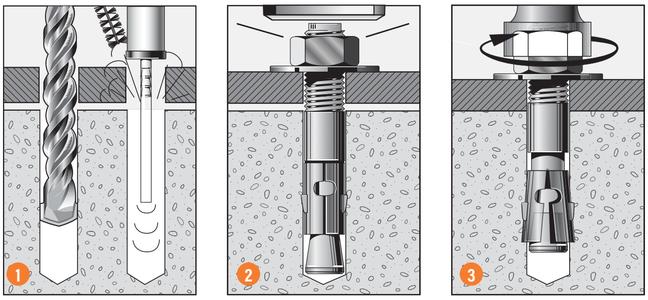
Outstanding exterior durability:
- 42 micron hot dip galvanised coating.

Superior strength:
- Cold forged steel construction.

Ramset Design Method:
- Uses technical data validated from testing in ANZ concrete substrates

Principal Applications
- Structural beams and columns
- Bottom plate and batten fixing
- Formwork support
- Installing signs, handrails, balustrades and gates
- Safety barriers

Installation



1. Drill hole to correct diameter and depth. Important: Use **Ramset™** Dustless Drilling System to ensure holes are clean. Alternatively,clean clean thoroughly with brush and remove debris by way of vacuum or hand pump, compressed air etc.
2. Insert the **Trubolt™** through the fixture and drive with a hammer until washer contacts the fixture.
3. Tighten the **Trubolt™** nut with a torque wrench to specified assembly torque.

Ramset™

TruBolt™

STUD ANCHORS - NON-CRACKED CONCRETE

Installation and performance details

Anchor Size, d_b (mm)	Installation details				Optimum dimensions*		Reduced Characteristic Capacity			
	Drilled Hole diam., d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Steel: Shear, ϕV_{us} (kN)	Concrete: Tension, ϕN_{uc} (kN)** — Concrete compressive strength, f'_c 20MPa	25MPa	32MPa
M10	10	12	40	35	60	120	13.5	6.7	7.5	8.5
M12	12	14	48	50	75	150	17.1	8.8	9.9	11.2
M16	16	18	64	155	100	200	28.8	13.6	15.2	17.2
M20	20	24	80	355	120	240	54.7	19.0	21.3	24.0

* 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.
**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc}, where ϕ = 0.60 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.55

DESCRIPTION AND PART NUMBERS

Anchor size, d_b (mm)	Drilled hole diameter, d_h (mm)	Effective length, L_e (mm)	Part No.
M10	10	67	T10090GH
M12	12	58	T12080GH
		71	T12100GH
		111	T12140GH
		151	T12180GH
M16	16	70	T16110GH
		85	T16125GH
		110	T16150GH
		135	T16175GH
M20	20	95	T20140GH
		115	T20160GH
		170	T20215GH

Effective depth, h (mm)

$h = L_e - t$

t = total thickness of material(s) being fixed

Substrate thickness, b_m (mm)

$b_m = 2 \times h$

Drilled hole depth, h_1 (mm)

$h_1 = h + (2 \times d_h)$

h = Effective depth

ENGINEERING PROPERTIES

Anchor size d_b	Stress area thread section A_s (mm²)	Minimum diameter reduced section d_m (mm)	Threaded Section: Yield Strength, f_y (Mpa)	Threaded Section: UTS, f_u (Mpa)	Reduced Section: Yield Strength, f_y (Mpa)	Reduced Section: UTS, f_u (Mpa)	Section Modulus Z (mm³)
M10	58.0	7.6	380	470	480	600	62.3
M12	84.3	8.9	330	410	450	560	109.2
M16	157.0	12.1	290	370	400	500	277.5
M20	245.0	16.1	360	450	360	450	540.9

TruBolt™

STUD ANCHORS - NON-CRACKED CONCRETE

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

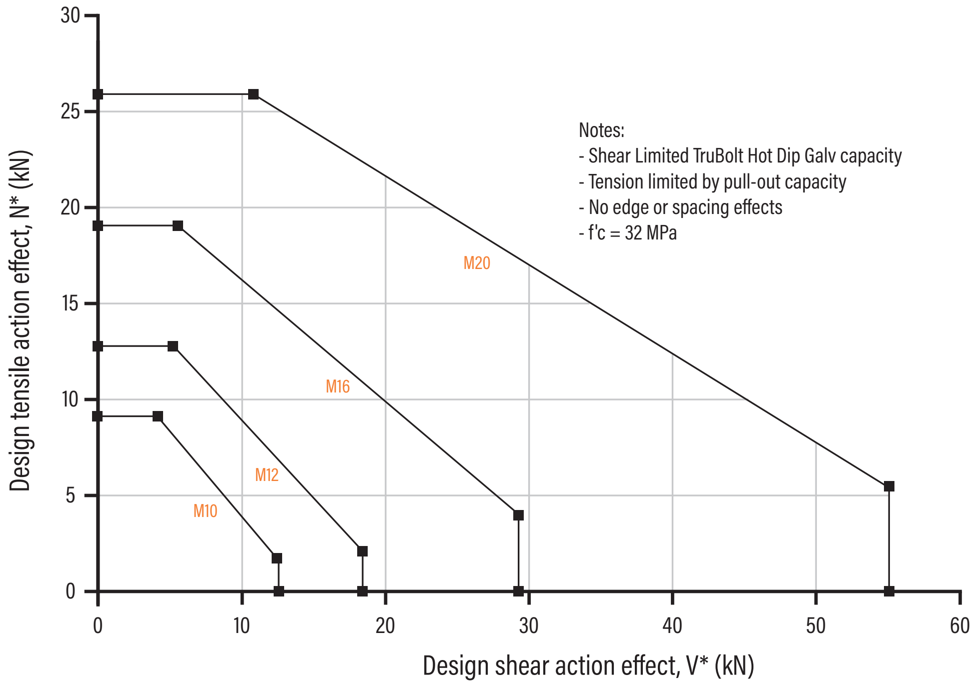


Table 1b Uncracked Concrete absolute minimum edge distance and anchor spacing values, e_m and a_m (mm) for Trubolt Hot Dip Gal

Anchor size, d_b	M10	M12	M16	M20
Min. Anchor Spacing - a_m	40	45	50	60
Min. Anchor Spacing - e_m	60	65	75	95

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

Refer to "Description and Part Numbers" table 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 minimal compliance achieved, effective depth (h) calculated.

TruBolt™

STUD ANCHORS - NON-CRACKED CONCRETE

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultmate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 0.6, f'c = 32 MPa

Anchor Size, d_b	M10	M12	M16	M20
Drilled Hole Dia, d_h (mm)	10	12	16	20
Effective Depth, h (mm)				
40	8.5			
50	11.9	11.9		
65	17.6	17.6	17.6	
80	24.0	24.0	24.0	24.0
95	31.0	31.0	31.0	31.0
110	38.7	38.7	38.7	38.7
125		46.8	46.8	46.8
145		58.5	58.5	58.5
160			67.8	67.8
180				81.0

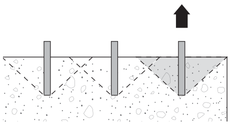
All data relevant for Non-cracked concrete

Note: Effective depth, h must be ≥ 4 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.

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

f'c (Mpa)	20	25	32	40	50
Xnc	0.79	0.88	1.00	1.00	1.00

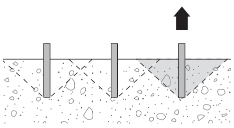
Table 2c Edge distance effect, tension, X_{ne}



Edge distance, e(mm)	60	70	80	100	125	150	175	200	230
Effective depth, h (mm)									
40	1.00	1.00							
50	0.86	0.95	1.00						
65	0.73	0.80	0.87	1.00					
80	0.65	0.71	0.77	0.88	1.00				
95	0.59	0.64	0.69	0.79	0.91	1.00			
110	0.55	0.60	0.64	0.72	0.83	0.94	1.00		
125	0.52	0.56	0.60	0.67	0.77	0.86	0.95	1.00	
145	0.49	0.53	0.56	0.62	0.70	0.78	0.86	0.94	1.00
160	0.48	0.50	0.53	0.59	0.66	0.74	0.81	0.88	0.97

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Note: For single anchor designs, X_{nae} = 1.0



Edge distance, a(mm)	40	50	60	80	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)													
40	0.67	0.71	0.75	0.83	0.92	1.00							
50	0.63	0.67	0.70	0.77	0.83	0.92	1.00	1.00					
65	0.60	0.63	0.65	0.71	0.76	0.82	0.88	0.95	1.00				
80	0.58	0.60	0.63	0.67	0.71	0.76	0.81	0.86	0.92	1.00			
95	0.57	0.59	0.61	0.64	0.68	0.72	0.76	0.81	0.85	0.94	1.00		
110	0.56	0.58	0.59	0.62	0.65	0.69	0.73	0.77	0.80	0.88	0.95	1.00	
125	0.55	0.57	0.58	0.61	0.63	0.67	0.70	0.73	0.77	0.83	0.90	0.97	1.00
145	0.55	0.56	0.57	0.59	0.61	0.64	0.67	0.70	0.73	0.79	0.84	0.90	0.96
160	0.54	0.55	0.56	0.58	0.60	0.63	0.66	0.68	0.71	0.76	0.81	0.86	0.92

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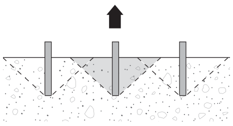

Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

Note: For single anchor designs, $X_{nai} = 1.0$

Edge distance, a (mm)	40	50	60	80	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)													
40	0.33	0.42	0.50	0.67	0.83	1.00							
50	0.27	0.33	0.40	0.53	0.67	0.83	1.00	1.00					
65	0.21	0.26	0.31	0.41	0.51	0.64	0.77	0.90	1.00				
80	0.17	0.21	0.25	0.33	0.42	0.52	0.63	0.73	0.83	1.00			
95	0.14	0.18	0.21	0.28	0.35	0.44	0.53	0.61	0.70	0.88	1.00		
110	0.12	0.15	0.18	0.24	0.30	0.38	0.45	0.53	0.61	0.76	0.91	1.00	
125	0.11	0.13	0.16	0.21	0.27	0.33	0.40	0.47	0.53	0.67	0.80	0.93	1.00
145	0.09	0.11	0.14	0.18	0.23	0.29	0.34	0.40	0.46	0.57	0.69	0.80	0.92
160		0.10	0.13	0.17	0.21	0.26	0.31	0.36	0.42	0.52	0.63	0.73	0.83

Checkpoint 2

Design reduced ultimate concrete tensile capacity, ϕN_{urc}

$$\phi N_{urc} = \phi N_{uc} *X_{nc} *X_{ne} *(X_{nae} \text{ or } X_{nai})$$

STEP 3

Verify Concrete Tensile Resistance - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN), $\phi_n = 0.8$

Anchor size, d_b	M10	M12	M16	M20
Trubolt - Hot Dip Galvanized	21.8	27.8	45.5	72.5

Table 3b Reduced characteristic ultimate pull-out capacity*, ϕN_{up} (kN), $\phi_p = 0.65$, f'c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Hole Diameter, d_h (mm)	10	12	16	20
Effective depth, h (mm)				
40	9.2			
50		12.9		
65			19.0	
80				26.0

*Note: Reduced characteristic ultimate Pull-through capacity is not influenced by reduced anchor spacing or edge distance

Checkpoint 3a

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

$$\phi N_{urp} = \phi N_{up} *X_{nc}$$

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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Tensile performance conversion table

Performance Required	ConcreteTensile Performance		Pull - Through Performance		Steel Tensile Performance	
	Notation	Concrete Tension Capacity	Notation	Pull - Through Tension Capacity	Notation	Carbon Steel Tension Capacity
Strength Limit State	ϕN_{urc}	MULTIPLY ϕN_{urc} x 1.00	ϕN_{up}	MULTIPLY ϕN_{up} x 1.00	ϕN_{us}	MULTIPLY ϕN_{us} x 1.00
Working Load Limit	N_{ac}	MULTIPLY ϕN_{urc} x 0.55	N_{ap}	MULTIPLY ϕN_{up} x 0.51	N_{as}	MULTIPLY ϕN_{us} x 0.56
Cyclic Laoding	N_{yc}	MULTIPLY ϕN_{urc} x 0.19	N_{yp}	MULTIPLY ϕN_{up} x 0.18	N_{ys}	MULTIPLY ϕN_{us} x 0.19
Fire Resistance	$N_{Rk,c,f,t}$	Refer to Fire Resistance Section	$N_{Rk,p,f,t}$	Refer to Fire Resistance Section	$N_{Rk,s,f,t}$	Refer to Fire Resistance Section
Seismic	$N^{0}_{Rd,c,sis}$	Refer to Seismic Section	$N^{0}_{Rd,p,sis}$	Refer to Seismic Section	$N^{0}_{Rd,s,sis}$	Refer to Seismic Section

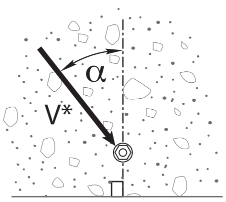
NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

STEP 4 Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN),ϕ = 0.6, f'_c = 32 MPa

Anchor size, d_b	M10	M12	M16	M20
Hole Diameter, d_h (mm)	10	12	16	20
Edge distance, e (mm)				
60	6.1			
75	8.5	9.3	10.8	
100	13.1	14.3	16.6	18.5
150	24.1	26.4	30.4	34.0
200	37.0	40.6	46.9	52.4
250	51.8	56.7	65.5	73.2
300	68.0	74.5	86.1	96.2
350	85.7	93.9	108.5	121.3
450		136.9	158.1	176.8
600				272.2

Note: Effective depth, h must be ≥ 4 x drilled hole diameter, d_h for anchor to achieve tabled shear capacities.



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}	0.79	0.88	1.00	1.12	1.25

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

Angle, α°	0-55	60	70	80	90-180
X_{vd}	1.0	1.1	1.2	1.5	2.0

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STUD ANCHORS - NON-CRACKED CONCRETE

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

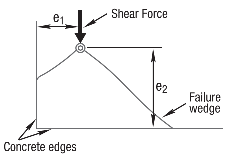
Note: For single anchor designs, X_{va} = 1.0

Edge distance, e (mm)	60	75	100	150	200	250	300	350	450	600	850
Anchor spacing, a (mm)											
40	0.63	0.61	0.58	0.55	0.54	0.53	0.53	0.52	0.52	0.51	0.51
60	0.70	0.66	0.62	0.58	0.56	0.55	0.54	0.53	0.53	0.52	0.51
80	0.77	0.71	0.66	0.61	0.58	0.56	0.55	0.55	0.54	0.53	0.52
100	0.83	0.77	0.70	0.63	0.60	0.58	0.57	0.56	0.54	0.53	0.52
125	0.92	0.83	0.75	0.67	0.63	0.60	0.58	0.57	0.56	0.54	0.53
150	1.00	0.90	0.80	0.70	0.65	0.62	0.60	0.59	0.57	0.55	0.54
200		1.00	0.90	0.77	0.70	0.66	0.63	0.61	0.59	0.57	0.55
250			1.00	0.83	0.75	0.70	0.67	0.64	0.61	0.58	0.56
300				0.90	0.80	0.74	0.70	0.67	0.63	0.60	0.57
400				1.00	0.90	0.82	0.77	0.73	0.68	0.63	0.59
500					1.00	0.90	0.83	0.79	0.72	0.67	0.62
600						0.98	0.90	0.84	0.77	0.70	0.64
800						1.00	1.00	0.96	0.86	0.77	0.69
1000								1.00	0.94	0.83	0.74
1500									1.00	1.00	0.85
2000											0.97

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a/e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of Anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00



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 4

Design reduced ultimate concrete pryout capacity, ϕV_{urcp}

$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$

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STUD ANCHORS - NON-CRACKED CONCRETE

STEP 5 Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us}, (kN), ϕ_v = 0.8

Anchor size, d_b	M10	M12	M16	M20
Trubolt - Hot Dip Galvanized	13.5	17.1	28.8	54.7

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}
ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{us}
Check $V^*/\phi V_{ur} \leq 1$, if not satisfied return to step 1

Shear performance conversion table

Performance Required	Concrete Shear Performance		Steel Shear Performance	
	Notation	Concrete Shear Capacity	Notation	Carbon Steel Shear Capacity
Strength Limit State	ϕV_{uc}	MULTIPLY ϕV_{uc} x 1.00	ϕv_{us}	MULTIPLY ϕV_{us} x 1.00
Working Load Limit	V_{ac}	MULTIPLY ϕV_{uc} x 0.55	V_{as}	MULTIPLY ϕV_{us} x 0.50
Cyclic Laoding	V_{yc}	MULTIPLY ϕV_{uc} x 0.55	V_{ys}	MULTIPLY ϕV_{us} x 0.50
Fire Resistance	$V_{Rk,c,f,t}$	Refer to Fire Resistance Section	$V_{Rk,s,f,t}$	Refer to Fire Resistance Section
Seismic	$V^0_{Rd,c,sis}$	Refer to Seismic Section	$V^0_{Rd,s,sis}$	Refer to Seismic Section

NOTE: Design Shear Capacity is the minimum of Concrete Shear and Steel Shear Capacities.

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™ Trubolt™ Hot Dip Galv. Anchor, (Anchor Size) (Part Number)
Maximum fixed thickness to be (t) mm.

Example
Ramset™ Trubolt™ Hot Dip Galv. Anchor, M12 T12140GH.
Maximum fixed thickness to be 20mm. To be installed in accordance to Ramset™ Installation Instructions.

AnkaScrew™ Xtrem™

SCREW IN ANCHORS - NON-CRACKED & CRACKED CONCRETE

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.

Compliance

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

Design According to:

- Stud diameter equals hole diameter.
- 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

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 Plating 5μm
- Anchor diameters 6mm to 12mm

Fast and easy to use:

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

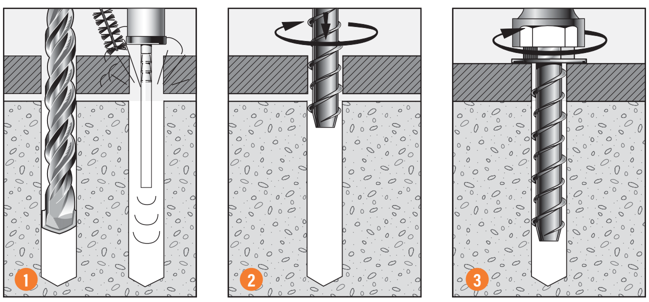
Close to edge and for close anchor spacing:

- Does not expand and burst concrete.

Principal Applications

- **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 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.

Ramset™

AnkaScrew™ Xtrem™

SCREW IN ANCHORS - NON-CRACKED & CRACKED CONCRETE

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_{ur} (kN) ** Concrete Compressive Strength, f'c 20 MPa	30 MPa	40 MPa
6	6	8	31	45	10	80	2.7	3.3	3.8
			44	60		90	6.0	7.3	8.5
8	8	12	35	55	20	80	5.0	6.1	7.1
			43	65		90	8.0	9.8	11.3
			52	75		105	10.7	13.0	15.0
10	10	14	43	65	40	90	8.0	9.8	11.3
			60	85		120	13.3	16.3	18.8
			68	95		136	17.3	21.1	24.4
12	12	16	50	75	60	100	10.7	13.0	15.0
			67	95		134	18.0	22.8	25.4
			80	110		160	23.5	29.7	33.2

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 verify capacity
** Reduced characteristic ultimate tensile capacity = ϕN_{ur} where ϕ = 0.67 and N_{ur} is based on characteristic ultimate pull-out tensile capacity for sizes 6-10 and concrete tensile capacity for size 12 where h≥67.
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.
***Note: For performance based on smaller concrete substrate thickness, refer to iExpert Anchor Software or Ramset™ Engineer.

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	AS06050X
		71	40	6mmx80mm zinc	AS06080X
8	8	50	15	8mmx60mm zinc	AS08060X
		67	32	8mmx80mm zinc	AS08080X
10	10	48	5	10mmx60mm zinc	AS10060X
		88	45	10mmx100mm zinc	AS10100X
12	12	65	15	12mmx80mm zinc	AS12080X
		95	45	12mmx110mm zinc	AS12110X
		135	85	12mmx150mm zinc	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

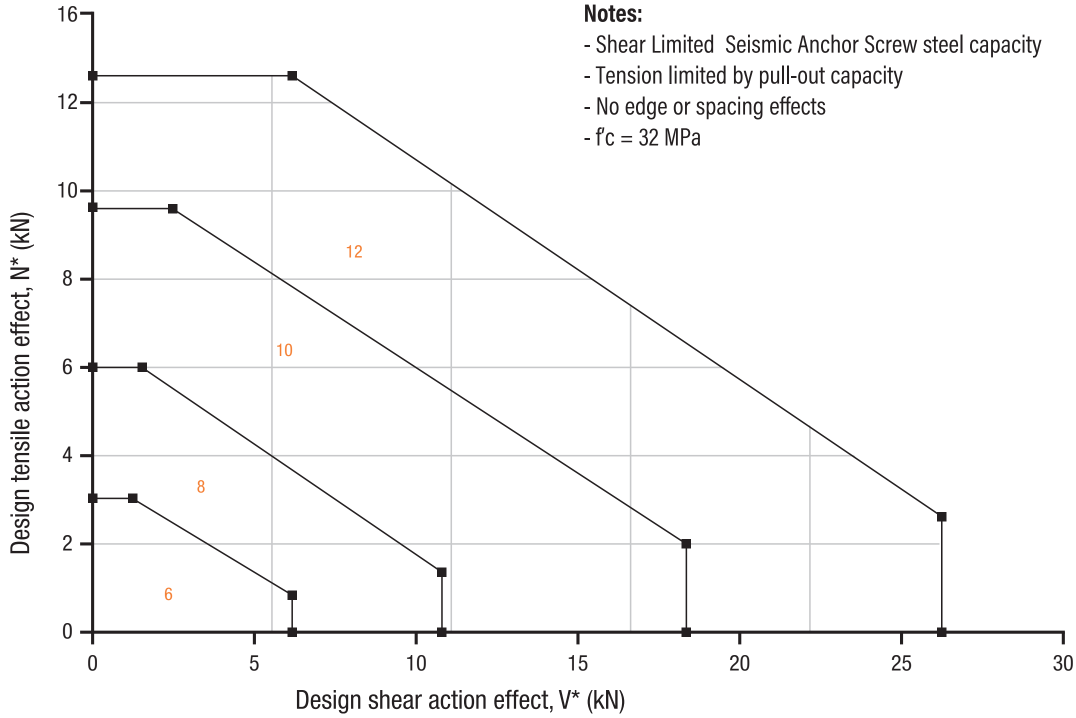
AnkaScrew™ Xtrem™

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)



Notes:
- Shear Limited Seismic Anchor Screw steel capacity
- Tension limited by pull-out capacity
- No edge or spacing effects
- f'c = 32 MPa

Anchor size, d_b	6		8			10			12		
Effective depth, h (mm)	31	44	35	43	52	43	60	68	50	67	80
*Min. member thickness (mm)	80	90	80	90	105	90	120	136	100	134	160
Min. Anchor Spacing - a_m	40	40	40	50	50	50	50	50	50	50	70
Min. Edge Distance - e_m	40	40	40	50	50	50	50	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 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 Non-cracked & cracked concrete tensile resistance - per anchor

Table 2a - Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), $\phi_c = 1/1.5 = 0.67$, f'c = 32 MPa

Anchor size, d_b	6	8	10	12
Drill hole dia, d_h (mm)	6	8	10	12
Effective depth, h (mm)				
31	7.2			
35		8.6		
43		11.7	11.7	
44	12.1			
50				14.7
52		15.6		
60			19.3	
67				22.8
68			23.3	
80				29.7

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

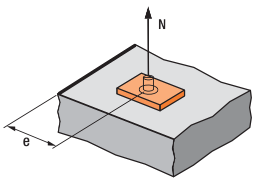
Table 2a-2-Cracked Concrete effect, tension, X_{ncr}

Anchor size, db	6	8	10	12
X_{ncr}	0.70			

Table 2b - Concrete compressive strength effect, tension, X_{nc} and Pull-out, X_{npc}

f'c (MPa)	20	25	32	40	50
Tension X_{nc}	0.79	0.88	1.00	1.12	1.25
Pull-out X_{npc}	0.82	0.92	1.00	1.16	1.30

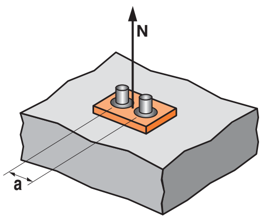
Table 2c - Concrete Edge distance effect, tension, X_{ne}



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

Anchor size, d_b	6	8	10	12
Effective depth, h (mm)	44	52	68	80
Edge distance, e (mm)				
40	0.70			
50	0.82	0.73	0.62	
55	0.88	0.78	0.65	
70	1	0.92	0.76	0.69
75		0.97	0.80	0.72
80		1	0.84	0.75
85			0.88	0.78
90			0.91	0.81
100			0.99	0.88
105			1	0.91
110				0.94
115				0.97
120				1

Table 2d - Concrete anchor spacing effect, tension, X_{na}



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

Anchor size, d_b	6	8	10	12
Effective depth, h (mm)	44	52	68	80
Edge distance, a (mm)				
40	0.65			
50	0.69	0.66	0.62	
60	0.73	0.69	0.65	
70	0.77	0.72	0.67	
80	0.80	0.76	0.70	
90	0.84	0.79	0.72	
100	0.88	0.82	0.75	0.71
110	0.92	0.85	0.77	0.73
120	0.95	0.88	0.79	0.75
130	0.99	0.92	0.82	0.77
140	1	0.95	0.84	0.79
150		0.98	0.87	0.81
160		1	0.89	0.83
170			0.92	0.85
180			0.94	0.88
190			0.97	0.90
200			0.99	0.92
250			1	1

Checkpoint 2

Design reduced ultimate cracked concrete tensile capacity ϕN_{urc}

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

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 3

Verify Non-cracked & cracked concrete tensile resistance - per anchor

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

Anchor size, db	6	8	10	12
AnkaScrew™ Xtrem™	9.3	18.0	30.0	44.7

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

Anchor size, d_b	6	8	10	12
Drill hole dia, d_h (mm)	6	8	10	12
Effective depth, h (mm)				
31	3.3			
35		6.1		
43		9.8	9.8	
44	7.3			
50				13.0
52		13.0		
60			16.3	
67				N/A
68			21.1	
80				N/A

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

Anchor size, db	6	8	10	12
Effective Depth, h (mm)	X_{ncr}			
31	0.50			
35		0.67		
43		0.75	0.75	
44	0.44			
50				0.75
52		0.75		
60			N/A*	
67				N/A*
68			N/A*	
80				N/A*

*Governed by cracked concrete tensile capacity

For Non-Cracked concrete X_{pcr} = 1

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 $N^*/\Phi N_{ur} \le 1$,

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

Anchor size, d_b	6		8		
Effective Depth, h (mm)	31	44	35	43	52
Edge distance, e_m					
40	3.4	3.6	3.6	3.7	3.9
50			4.9	5.0	5.2

Anchor size, d_b	10			12		
Effective Depth, h (mm)	43	60	68	50	67	80
Edge distance, e_m						
50	5.2	5.5	5.7	5.5	5.9	6.1
70				8.6	9.1	9.4

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

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

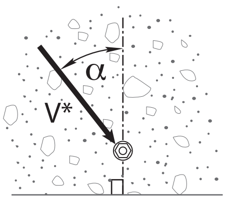
Anchor size, d_b	6	8	10	12
X_{vcr}	0.7			

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

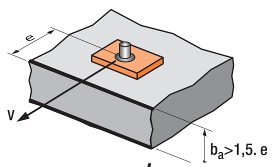


Load direction effect, conc. edge shear, X_{vd}

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

For single anchor fastening X_{ve}

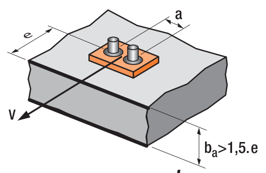
e/e_m	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2
X_{ve}	1.00	1.31	1.66	2.02	2.41	2.83	3.26	3.72	4.19	4.69	5.20	5.72



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

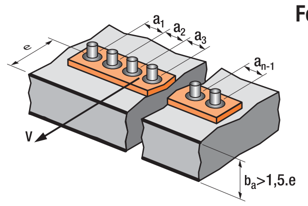
For 2 anchors fastening X_{ve}

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



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

For 3 anchors fastening and more X_{ve}



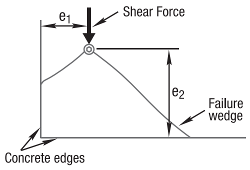
$$X_{ve} = \frac{3*e + a_1 + a_2 + a_3 + ... + a_{n-1}}{3*n*e_m} * \sqrt{e/e_m}$$

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

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

Anchor size, db	6	8	10	12
Effective depth, h (mm)				
31	7.2			
35		8.6		
43		11.7	11.7	
44	12.1			
50				14.7
52		15.6		
60			38.6	
67				45.5
68			46.5	
80				59.4



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 cracked concrete shear resistance - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us}, (kN) where $\phi_v = 0.8$

Anchor size, db	6		8		
Effective depth, h (mm)	31	44	35	43	52
AnkaScrew™ Xtrem™	5.6	5.6	10.8	10.8	13.6

Anchor size, db	10			12		
Effective depth, h (mm)	43	60	68	50	67	80
AnkaScrew™ Xtrem™	18.0	27.2	27.2	26.8	33.6	33.6

Checkpoint 5

Design reduced ultimate tensile 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

AnkaScrew™ Xtrem™

STRENGTH LIMIT STATE DESIGN

STEP 6 Combined Loading

Checkpoint 6

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

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

Example
Ramset™ AnkaScrew™ Xtrem™ Anchor, 12mm AS12110X.
Maximum fixed thickness to be 20mm.
To be installed in accordance to Ramset™ Installation Instructions..

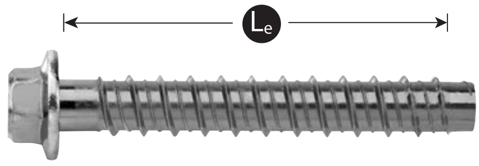
Use Ramset™ iExpert Anchor Software for optimised calculation or where a greater range of anchor layout detail is needed.

WERCS AnkaScrew™

SCREW IN ANCHORS - NON-CRACKED CONCRETE

GENERAL INFORMATION

Performance Related	Material Specification	Installation Related
	Zn MGAL	



Product

The WERCS AnkaScrew™ Anchor is a medium duty, rotation setting thread forming anchor.

Benefits, Advantages and Features

Fast and easy to install:
- Simply screws into hole.

Fast and easy to remove:
- Screws out leaving an empty hole with no protruding metal parts to grind off.

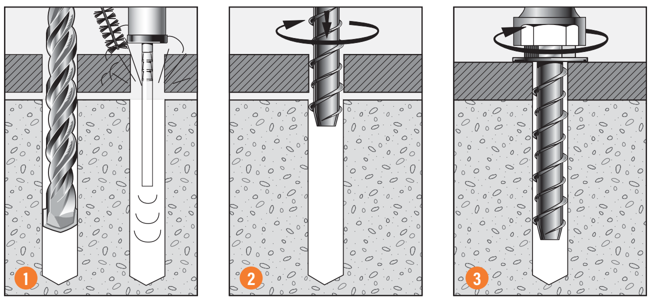
Close to edge and for close anchor spacing:
- Does not expand and burst concrete.

Ramset Design Method:
- Uses technical data validated from testing in ANZ concrete substrates

Principal Applications

- Pallet racking
- Temporary safety barriers
- Conveyors
- Pipe brackets
- Gate hinges into brickwork
- Temporary hand rails
- Bottom plates

Installation



1. Drill hole to correct diameter and depth. Clean thoroughly with brush. Remove debris by way of vacuum or hand pump, compressed air etc.
2. Using a socket wrench, screw the WERCS AnkaScrew™ into the hole using slight pressure until the self tapping action starts.
3. Tighten the WERCS AnkaScrew™ until flush with fixture. If resistance is experienced when tightening, unscrew anchor one turn and re-tighten. Ensure not to over tighten.

WERCS AnkaScrew™

SCREW IN ANCHORS - NON-CRACKED CONCRETE

Installation and performance details

Anchor size, d_b (mm)	Installation details				Optimum dimensions*		Reduced Characteristics Capacity			
	Drilled hole diameter, d_h (mm)	Fixture hole diameter, d_f (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Shear (concrete) ϕV_{uc} (kN)*** f'_c > 20 MPa	Non-Cracked Concrete Tension, ϕN_{uc} (kN)** Concrete compressive strength, f'_c 20 MPa	25 MPa	32 MPa
5	5	7	25	5	15	15	0.9	2.1	2.3	2.5
6	6	8	30	15	60	35	6.8 #	3.7	4.0	4.3
			37				7.5	4.7	5.0	5.5
			45				7.5	5.8	6.3	6.9
8	8	10	40	40	80	45	12.6 #	5.5	5.9	6.4
			50				13.3	7.3	7.9	8.6
			60				13.3	9.3	10.0	10.9
10	10	12	50	55	100	60	20.7	7.9	8.5	9.3
			62				20.7	10.6	11.5	12.5
			75				20.7	13.9	15.0	16.3
12	12	15	60	80	120	70	25 #	11.2	12.1	13.2
			75				28.4 #	15.5	16.8	18.3
			90				29.8	20.3	21.9	23.9
16	16	19	90	-	160	100	53.0	20.7	24.1	28.4
			105				53.0	25.4	29.5	34.8
			120				53.0	30.3	35.2	41.5

* 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.

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.60 and N_{uc} = Characteristic ultimate concrete tensile capacity.

For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.55

*** Note: Values are for shear load direction away from concrete edge - Reduce characteristic ultimate concrete edge shear capacity = ϕV_{uc} where ϕ = 0.6 and V_{uc} = Charecteristic ultimate concrete edge shear capacity.

Note: Values for shear limited by steel - Reduced characteristic ultimate steel shear capacity = ϕV_{us} where ϕ = 0.80 and V_{us} = Characteristic ultimate steel shear capacity.

All data relevant for Non-cracked concrete

DESCRIPTION AND PART NUMBERS

Anchor size, db	Effective length, Le (mm)	Part No. Zn Hex Head	Gal Hex Head
5	28	AS05030	-
6	44	AS06050W100	AS06050WGM100
	69	AS06075W100	AS06075WGM100
	94	AS06100W100	AS06100WGM100
8	54	AS08060W100	AS08060WGM100
	69	AS08075W100	AS08075WGM100
	94	AS08100W100	AS08100WGM100
10	54	AS10060W50	AS10060WGM50
	69	AS10075W50	AS10075WGM50
	94	AS10100W50	AS10100WGM50
12	69	AS12075W50	AS12075WGM50
	94	AS12100W50	AS12100WGM50
	144	AS12150W20	AS12150WGM20
16	115	AS16115	-
	140	AS16140	-
	160	AS16160	-

Effective depth, h (mm)

$h = L_e - t,$

t = total thickness of material(s) being fixed

Substrate thickness, b_m (mm)

b_m = greater of: $1.25 \times h$, $h + (3 \times d_h)$

Drilled hole depth, h_1 (mm)

$h_1 = h + d_h$

h = Effective depth

ENGINEERING PROPERTIES

Anchor size, d_b (mm)	Stress area, A_s (mm²)	Yield strength, f_y (MPa)	UTS, f_u (MPa)
5	15.9	600	800
6	22.9	640	800
8	42.4	640	800
10	69.4	640	800
12	84.1	640	800
16	186.3	640	800

WERCS AnkaScrew™

STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram

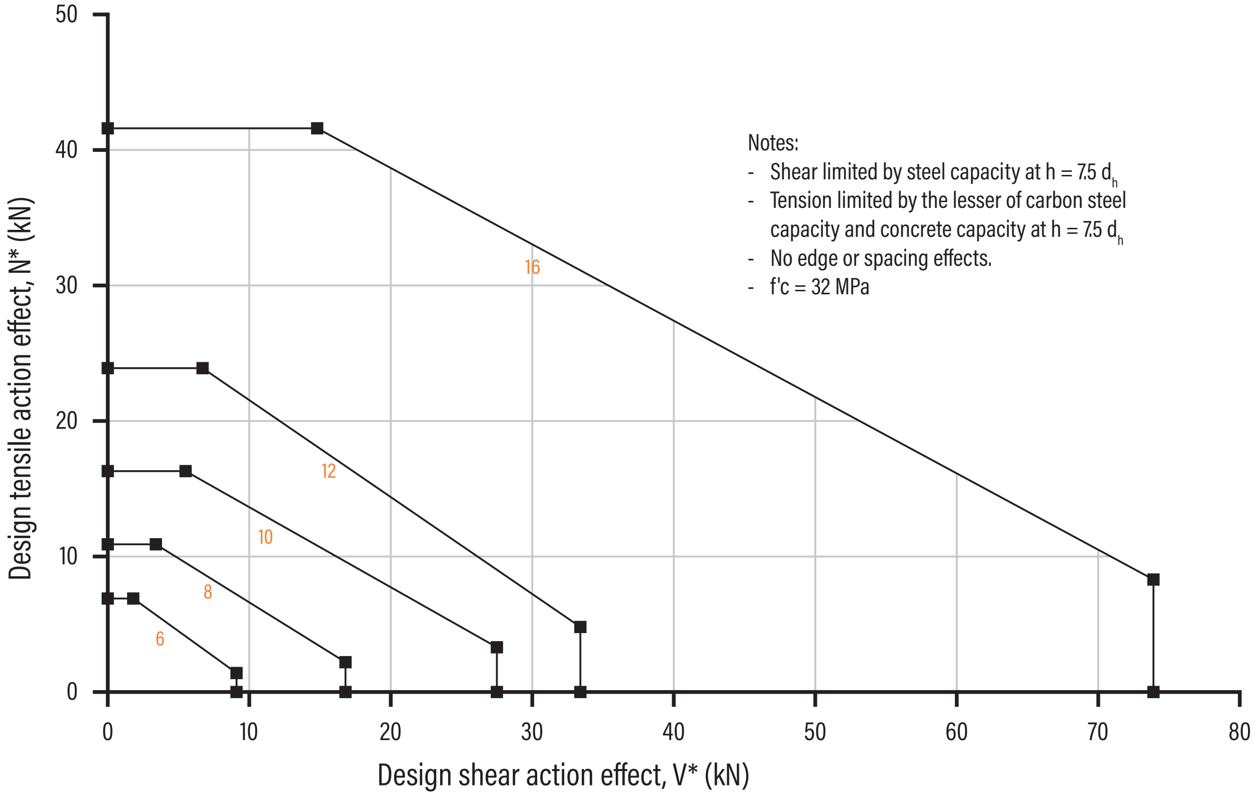


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor Size, d_b (mm)	6	8	10	12	16
e_m, a_m	20	25	30	35	50

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

Refer to "Description and Part Numbers" table 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.**

WERCS AnkaScrew™

STRENGTH LIMIT STATE DESIGN

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ_c = 0.6, f'_c = 32 MPa

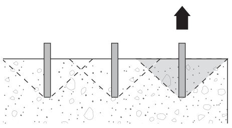
Anchor Size, d_b	6	8	10	12	16
Drilled Hole Dia, d_h (mm)	6	8	10	12	16
Effective Depth, h (mm)					
30	4.3				
35	5.1				
40	6.0	6.4			
45	6.9	7.5			
50		8.6	9.3		
55		9.8	10.6		
60		10.9	12.0	13.2	
75			16.3	18.3	22.3
90				23.9	28.4
105					34.8
120					41.6

All data relevant for Non-cracked concrete

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

f'_c (MPa)	20	25	32	40
X_{nc} - Anchor size d_b = 6-12	0.85	0.92	1	1.08
X_{nc} - Anchor size d_b = 16 only	0.73	0.85	1	1.16

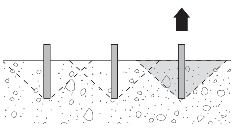
Table 2c Edge distance effect, tension, X_{ne}



Anchor Size, d_b	6	8	10	12	16
Edge Distance e, (mm)					
20	0.53				
25	0.59	0.52			
30	0.65	0.56	0.51		
35	0.71	0.61	0.55	0.50	
40	0.77	0.65	0.58	0.53	
50	0.88	0.74	0.65	0.59	0.51
60	1.00	0.83	0.72	0.65	0.55
70		0.91	0.79	0.71	0.60
80		1.00	0.86	0.77	0.64
90			0.93	0.83	0.69
100			1.00	0.88	0.73
110				0.94	0.78
120				1.00	0.82
145					0.93
160					1.00

Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

Note: For single anchor designs, X_{nae} = 1.0



Anchor Size, d_b	6	8	10	12	16
Anchor Spacing a, (mm)					
20	0.78				
25	0.85	0.76			
30	0.92	0.81	0.75		
35	1.00	0.86	0.79	0.78	
40		0.92	0.83	0.81	
45		1.00	0.88	0.81	
50			0.92	0.85	0.76
55			0.96	0.88	0.79
60			1.00	0.92	0.81
70				1.00	0.86
80					0.92
90					0.97
100					1.00

WERCS AnkaScrew™

STRENGTH LIMIT STATE DESIGN

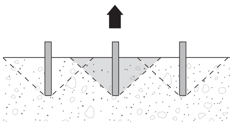


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

Note: For single anchor designs, X_{nai} = 1.0

Anchor Size, d_b	6	8	10	12	16
Anchor Spacing a, (mm)					
20	0.56				
25	0.69	0.52			
30	0.83	0.63	0.50		
35	1.00	0.73	0.58	0.49	
40		0.83	0.67	0.56	
45		0.94	0.75	0.63	
50		1.00	0.83	0.69	0.52
55			0.92	0.76	0.57
60			1.00	0.83	0.63
70				1.00	0.73
80					0.83
90					0.94
100					1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

$$\phi N_{urc} = \phi N_{uc} * X_{nc} * X_{ne} * (X_{nae} \text{ or } X_{nai})$$

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, ϕN_{us} (kN), ϕ_n = 0.8

Anchor size, d_b (mm)	6	8	10	12	16
Heat Treated Carbon Steel	14.6	27.1	44.4	53.8	119.2

Checkpoint 3

Design reduced ultimate tensile capacity, ϕN_{ur}

$$\phi N_{ur} = \text{minimum of } \phi N_{urc}, \phi N_{us}$$

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

if not satisfied return to step 1

Tensile performance conversion table

Performance Required	Concrete Tensile Performance		Steel Tensile Performance	
	Notation	Concrete Tension Capacity	Notation	Carbon Steel Tension Capacity
Strength Limit State	ϕN_{urc}	MULTIPLY ϕN_{urc} x 1.00	ϕN_{us}	MULTIPLY ϕN_{us} x 1.00
Working Load Limit	N_{ac}	MULTIPLY ϕN_{urc} x 0.55	N_{as}	MULTIPLY ϕN_{us} x 0.56
Cyclic Loading	N_{yc}	MULITPLY ϕN_{urc} x 0.55	N_{ys}	MULITPLY ϕN_{us} x 0.56
Fire Resistance	$N_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$N_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$N^0_{Rd,p,sis}$	Refer to Seismic Anchors	$N_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

WERCS AnkaScrew™

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_q = 0.6, f'_c = 32 MPa

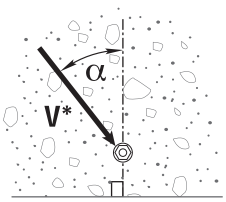
Anchor Size, d_b	6	8	10	12	16
Edge Distance e, (mm)					
20	0.9				
25	1.3	1.5			
30	1.7	1.9	2.2		
35	2.1	2.4	2.7	3.0	
50	3.6	4.1	4.6	5.1	5.9
75	6.6	7.6	8.5	9.3	10.8
100	10.1	11.7	13.1	14.3	16.6
150	18.6	21.5	24.1	26.4	30.4
200	28.7	33.1	37.0	40.6	46.8
250		46.3	51.8	56.7	65.5
300			68.0	74.5	86.1
400				114.8	132.5
500					185.2

Note: Effective depth, h must be ≥ 3.5 x Anchor size, d_h for anchor to achieve tabled shear capacities

All data relevant for Non-cracked concrete

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

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



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

Table 4c Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d Anchor spacing effect, concrete edge shear, X_{va}

Note: For single anchor designs, X_{va} = 1.0

Edge distance, e (mm)	20	25	30	35	50	75	100	150	200	250	300	400	500
Anchor spacing, a (mm)													
20	0.70	0.66	0.63	0.61	0.58	0.55	0.54	0.53	0.52				
25	0.75	0.70	0.67	0.64	0.60	0.57	0.55	0.53	0.53	0.52			
30	0.80	0.74	0.70	0.67	0.62	0.58	0.56	0.54	0.53	0.52	0.52		
35	0.85	0.78	0.73	0.70	0.64	0.59	0.57	0.55	0.54	0.53	0.52	0.52	
40	0.90	0.82	0.77	0.73	0.66	0.61	0.58	0.55	0.54	0.53	0.53	0.52	0.52
50	1.00	0.90	0.83	0.79	0.70	0.63	0.60	0.57	0.55	0.54	0.53	0.53	0.52
65		1.00	0.93	0.87	0.76	0.67	0.63	0.59	0.57	0.55	0.54	0.53	0.53
80			1.00	0.96	0.82	0.71	0.66	0.61	0.58	0.56	0.55	0.54	0.53
100				1.00	0.90	0.77	0.70	0.63	0.60	0.58	0.57	0.55	0.54
125					1.00	0.83	0.75	0.67	0.63	0.60	0.58	0.56	0.55
150						0.90	0.80	0.70	0.65	0.62	0.60	0.58	0.56
200						1.00	0.90	0.77	0.70	0.66	0.63	0.60	0.58
250							1.00	0.83	0.75	0.70	0.67	0.63	0.60
300								0.90	0.80	0.74	0.70	0.65	0.62
450								1.00	0.95	0.86	0.80	0.73	0.68
600									1.00	0.98	0.90	0.80	0.74
1000										1.00	1.00	1.00	0.90
1250													1.00

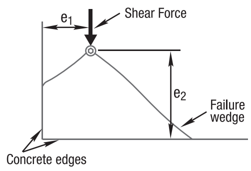
WERCS AnkaScrew™

STRENGTH LIMIT STATE DESIGN

Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

Note: For single anchor designs, X_{vn} = 1.0

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00



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 dustance, 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 4

Design reduced ultimate concrete edge shear capacity, ϕV_{urc}

$$\phi V_{urc} = \phi V_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn} * X_{vs}$$

STEP 5 Verify anchor shear capacity - per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, ϕV_{us} (kN), ϕ_v = 0.8

Anchor size, d_b (mm)	6	8	10	12	16
$h \geq 5 \times d_h$	6.8	12.6	20.7	25.0	55.4
$h \geq 6 \times d_h$	7.7	14.3	23.4	28.4	62.8
$h \geq 7 \times d_h$	8.6	16.0	26.2	31.7	70.2
$h \geq 7.5 \times d_h$	9.1	16.8	27.5	33.4	73.9

Ramset™

WERCS AnkaScrew™

STRENGTH LIMIT STATE DESIGN

Checkpoint 5

Design reduced ultimate shear capacity, ϕV_{ur}

ϕV_{ur} = minimum of ϕV_{urc}, ϕV_{us}

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

if not satisfied return to step 1

Shear performance conversion table

Performance Required	Concrete Shear Performance		Steel Shear Performance	
	Notation	Concrete Shear Capacity	Notation	Carbon Steel Shear Capacity
Strength Limit State	ϕV_{uc}	MULTIPLY ϕV_{uc} x 1.00	ϕV_{us}	MULTIPLY ϕV_{us} x 1.00
Working Load Limit	V_{ac}	MULTIPLY ϕV_{uc} x 0.55	V_{as}	MULTIPLY ϕV_{us} x 0.50
Cyclic Loading	V_{yc}	MULITPLY ϕV_{uc} x 0.55	V_{ys}	MULITPLY ϕV_{us} x 0.50
Fire Resistance	$V_{Rk,c,fi,t}$	Refer to Fire Rated Anchors	$V_{Rk,s,fi,t}$	Refer to Fire Rated Anchors
Seismic	$V^0_{Rd,c,sis}$	Refer to Seismic Anchors	$V^0_{Rd,s,sis}$	Refer to Seismic Anchors

NOTE: Design Shear Capacity is the minimum of Concrete Shear and Steel Shear Capacities

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™ WERCS AnkaScrew™ Anchor,
(Anchor Size) ((Part Number).
Maximum fixed thickness to be (t) mm.

Example

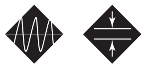
Ramset™ WERCS AnkaScrew™ Anchor,
12 mm (AS12100W50).
Maximum fixed thickness to be 40 mm.
To be installed in accordance to Ramset™
Installation Instructions.

DynaBolt™ Plus

SLEEVE ANCHORS - NON-CRACKED CONCRETE

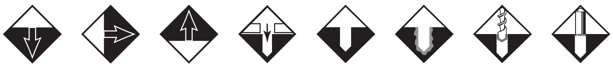
GENERAL INFORMATION

Performance Related



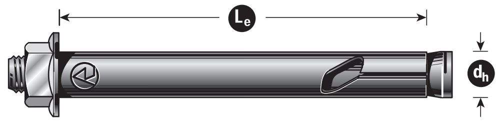
Material Specification

Installation Related



Product

The DynaBolt™ Plus Sleeve Anchor is a medium duty, torque setting expansion anchor.



Benefits, Advantages and Features

Improved security:

- Patented sleeve crushes to close gaps up to 5 mm and pulls down to induce clamp load.

Fast installation:

- Through fixing eliminates marking out and repositioning of fixtures.

Versatile:

- Choice of head styles.

Superior corrosion resistance:

- From **AISI 316(A4)** Stainless Steel.

Outstanding exterior durability:

- 42 micron Hot Dip Galvanised coating.

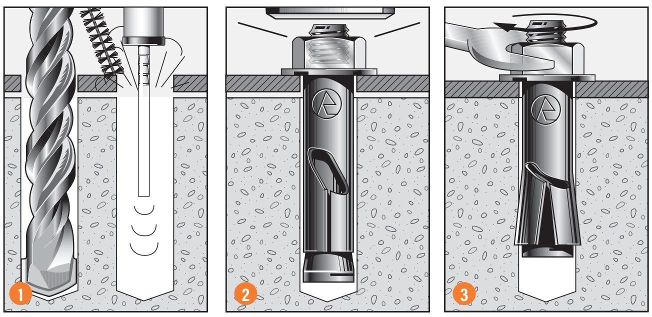
Ramset Design Method:

* Uses technical data validated from testing in ANZ concrete substrates.

Principal Applications

- Bottom plate and batten fixing
- Installing signs, handrails and gates
- Installing duct work, pipe brackets and suspended ceilings
- Corner guards

Installation



1. Use fixture as a template, drill a hole to the correct diameter and depth. Clean hole thoroughly with brush.
2. Remove debris by way of a vacuum or hand pump, compressed air, etc. Insert anchor tightly against fixture and tighten with spanner.
3. Continue tightening, allowing the sleeve to twist and pull down the fixture firmly onto the base material.

DynaBolt™ Plus

SLEEVE ANCHORS - NON-CRACKED CONCRETE

Installation and performance details

Anchor size, d_b (mm)	Installation details: Drilled hole diameter, d_h (mm)	Installation details: Fixture hole diameter, d_f (mm)	Installation details: Anchor effective depth, h (mm)	Installation details: Tightening torque, T_r (Nm)	Optimum dimensions*: Edge distance, e_c (mm)	Optimum dimensions*: Anchor spacing, a_c (mm)	Reduced Characteristic Capacity - Non-Cracked Concrete: Shear (steel) ϕV_{us} (kN)***	Tension (Pull-Through), ϕN_{up} (kN)**, Concrete compressive strength, f'_c: 20 MPa	32 MPa	40 MPa
6	6	8	20	10	55	60	5.0	2.9	3.7	4.1
			25		55	75	5.0	2.9	3.7	4.1
8	8	10	30	15	60	90	8.0	4.1	5.2	5.8
			35		60	105	8.0	4.1	5.2	5.8
10	10	12	35	35	70	105	12.7	5.2	6.6	7.4
			45		70	135	12.7	5.2	6.6	7.4
12	12	15	40	55	70	120	15.8	7.2	9.1	10.2
			50		75	150	15.8	7.2	9.1	10.2
16	16	19	55	85	85	165	20.9	11.3	14.3	16.0
			65		100	195	20.9	11.3	14.3	16.0
20	20	24	70	165	105	210	31.1	15.3	19.4	21.7
			85		130	255	31.1	15.3	19.4	21.7

* 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.

**Note: Reduced characteristic ultimate Pull-Through tensile capacity = ϕN_{up} where ϕ = 0.65 and N_{up} = Characteristic ultimate Pull-Through tensile capacity.

For conversion to Working Load Limit MULTIPLY $ØN_{up}$ x 0.51

***Note: Values for shear limited by steel - Reduced characteristic ultimate steel shear capacity = ϕV_{us} where ϕ = 0.80 and V_{us} = Characteristic ultimate steel shear capacity.

All data relevant for Non-cracked concrete

DESCRIPTION AND PART NUMBERS

Anchor size, d_h (mm)	Effective length, L_e (mm)	Part No.: Zn	Gal	S/S
6	23	DP6026	-	-
	34	DP06040	-	DP06040SS
	53	DP06060	-	DP06060SS
8	34	DP08040	-	DP08040SS
	60	DP08065	-	DP08065SS
	86	DP08090	-	-
10	34	DP10040	DP10040GH	-
	42	DP10050	DP10050GH	DP10050SS
	69	DP10075	DP10075GH	DP10075SS
	96	DP10100	DP10100GH	DP10100SS
	117	DP10125	-	-

Anchor size, d_h (mm)	Effective length, L_e (mm)	Part No.: Zn	Gal	S/S
12	47	DP12060	DP12060GH	DP12060SS
	62	DP12070	DP12070GH	DP12070SS
	90	DP12100	DP12100GH	DP12100SS
	118	DP12125	DP12125GH	DP12125SS
16	51	DP16065	DP16065GH	-
	95	DP16110	DP16110GH	-
	129	DP16140	DP16140GH	-
20	70	DP20080	DP20080GH	-
	102	DP20115	DP20115GH	-
	146	DP20160	-	-

Effective depth, h (mm)

$$h = \text{lesser of } L_e - t,\; 5 * d_h$$

t = total thickness of material(s) being fixed

Substrate thickness, b_m (mm)

$$b_m = 2 \times h$$

Drilled hole depth, h_1 (mm)

$h_1 = h + d_h$

h = Effective depth

ENGINEERING PROPERTIES

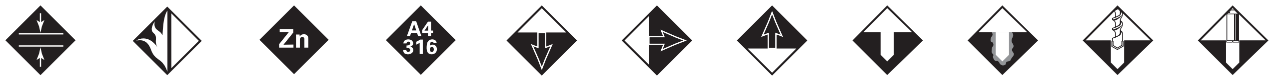
Anchor size, d_h (mm)	Thread size, d_b	Stress area, A_s (mm²)	Carbon steel: Yield strength, f_y (MPa)	Carbon steel: UTS, f_u (MPa)	Stainless steel: Yield strength, f_y (MPa)	Stainless steel: UTS, f_u (MPa)	Section modulus Z (mm³)
6	M4.5	11.3	720	900	480	600	5.4
8	M6	20.1	640	800	480	600	12.7
10	M8	36.6	560	700	480	600	31.2
12	M10	58.0	440	550	480	600	62.3
16	M12	84.3	400	500	-	-	109.2
20	M16	157.0	320	400	-	-	277.5

DynaSet™

DROP IN ANCHORS - NON-CRACKED CONCRETE

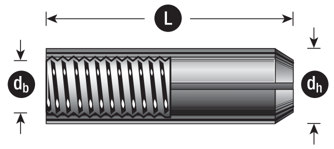
GENERAL INFORMATION

Performance Related	Material Specification	Installation Related



Product

The DynaSet™ Drop-In Anchor is a medium duty, displacement setting expansion anchor.



Benefits, Advantages and Features

Fast installation:
- Shallow embedment and simple setting action.

Convenient:
- Threaded rod can be cut to equal lengths.
- Flanged version sits flush with surface in overdrilled holes.

Ideal as reusable anchorage point:
- Internal threaded design.
- No protruding metal parts when bolt or rod is removed.

Superior corrosion resistance:
- **AISI 316(A4)** Stainless Steel.

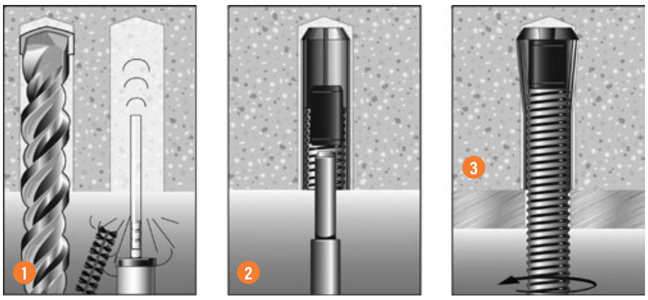
Ramset Design Method:

* Uses technical data validated from testing in ANZ concrete substrates

Principal Applications

- **Suspended services, such as cable tray, ventilation ducts or plumbing fixtures**
- **Stadium seating**
- **Holding down machinery**
- **Installing racking**
- **Suspended ceilings**

Installation



1. Drill hole at recommended diameter, to at least the anchor length in depth. Clean hole thoroughly with a brush. Remove debris by way of a vacuum pump, compressed air, hand pump etc.
2. Insert anchor and push to required depth. Using the special setting tool, drive the expander plug down until shoulder of the setting punch meets top of the anchor.
3. Position fixture then insert the bolt and tighten with spanner. The DynaSet™ Drop-In anchor remains set in position if the bolt is removed.

Ramset™

DynaSet™

DROP IN ANCHORS - NON-CRACKED CONCRETE

Installation and performance details

Anchor size, db	Installation details			Optimum dimensions*		Reduced Characteristic Capacity - Non-Cracked Concrete			
						Shear (steel)	Tension (concrete), ϕN_{uc} (kN)**		
	Drilled hole diameter, d_h (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	ϕV_{us} (kN)***	Concrete compressive strength, f'_c		
							20 MPa	32 MPa	40 MPa
M6	8	23	6	80	60	4.5	3.6	4.6	5.1
M6 Flanged	8	23	6	80	60	5.8	3.6	4.6	5.1
M8	10	28	10	100	70	5.8	4.9	6.1	6.9
M10	12	38	20	135	95	7.1	7.7	9.7	10.8
M10 Flanged	12	28	12	100	70	5.8	4.9	6.1	6.9
M12	16 #	48	40	170	120	13.2	10.9	13.8	15.4
M12 Flanged	16	48	40	170	120	13.2	10.9	13.8	15.4
M16	20	63	95	220	160	20.9	16.4	20.7	23.2
M20	25	78	180	275	195	26.3	22.6	28.5	31.9

* 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.

**Note: Reduced characteristic ultimate concrete tensile capacity = ϕN_{uc} where ϕ = 0.60 and N_{uc} = Characteristic ultimate concrete tensile capacity.

For conversion to Working Load Limit MULTIPLY ϕN_{uc} x 0.55

*** Note: Values for shear limited by steel - Reduced characteristic ultimate steel shear capacity = ϕV_{us} where ϕ = 0.80 and V_{us} = Characteristic ultimate steel shear capacity.

Note: Hole diameter = 15mm for M12SS

All data relevant for Non-cracked concrete

DESCRIPTION AND PART NUMBERS

Anchor size, d_b	Anchor length, L (mm)	Effective depth, h (mm)	Thread length, L_t (mm)	Part No.	
				Zn	S/S
M6	25	23	11	DSM06	DSM06SS
M6 Flanged	25	23	11	DSF06	-
M8	30	28	13	DSM08	DSM08SS
M10	40	38	16	DSM10	DSM10SS
M10 Flanged	30	28	14	DSF10	-
M12	50	48	21	DSM12	DSM12SS
M12 Flanged	50	48	21	DSF12	-
M16	65	63	28	DSM16	-
M16	60	58	28	-	DSM16SS
M20	80	78	35	DSM20	-

Substrate thickness, b_m (mm)

$b_m = 2 \times h$

Drilled hole depth, h_1 (mm)
$h_1 = L + 3$
L = Anchor Length

ENGINEERING PROPERTIES

Anchor size, d_b	Anchor stress area, A_s (mm^2)	Carbon Steel		Stainless Steel		Section modulus, Z (mm^3)
		Yield strength, f_y (MPa)	UTS, f_u (MPa)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	
M6	24.3	350	440	480	600	36.9
M8	32.0	350	440	480	600	63.7
M10	40.7	340	430	480	600	100.2
M12	96.3	260	320	-	-	292.9
M12 S/S	72.0	-	-	480	600	214.9
M16	125.5	320	450	480	600	502.1
M20	198.3	198.3	450	480	600	789.6

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Notes

DROP IN ANCHORS