Ramset™

MECHANICAL ANCHORING

Specifiers Anchoring Resource Book
Book 2.3 of 3

MECHANICAL ANCHORING

Book 2.3 | 2009

Ramset™
www.ramset.co.nz

Welcome to the Ramset Anchoring Resource Book

These concise and systematically presented books contain the information useful to Architects, Specifiers and Engineers when selecting the masonry anchoring solution that best suits their project.

Selection of a masonry anchoring product is made on the basis of the basic type of fixing (male or female, bolt or stud), macro environment, (eg coastal or inland), micro environment (particular chemicals) and of course the capacity that best meets the design load case.

Where the fixing is simple and does not warrant strength limit state calculations, selection on the basis of load tables for each masonry anchor.

Where more rigorous design and strength limit state calculation is required, the simplified step-by-step method presented in this booklet will allow rapid selection and verification of the appropriate masonry anchor.

This “Mechanical Anchoring” booklet contains information relating to Ramset Mechanical Anchor range.

We know that you will find these books both useful and informative.

Table of contents

1 Legend of symbols

Performance related symbols


Has good resistance to cyclic, and pulse loading.
Resists loosening under vibration.


Anchor has a fully functioning pull-down feature, or is a stud anchor. It has the ability to clamp the fixture to the base material and provide high resistance to cyclic loading.


Suitable for use in seismic design.


Suitable for elevated temperate applications. Structural anchor components made from steel. Any plastic or non-ferrous parts make no contribution to holding power under elevated temperatures.


May be used close to edges (or another anchor) without risk of splitting the concrete.

Material specification symbols

Zinc plated to AS1791-1986 Minimum thickness 6 µm.

Hot dipped galvanized to AS1650-1989 Minimum thickness 42 µm.

Stainless steel, resistant to corrosive agents including chlorides and industrial pollutants.

Corrosion resistant. Impact resistant.
Not recommended for direct exposure to sunlight.

Installation related symbols


Suitable for floor applications.


Suitable for wall applications.


Suitable for overhead applications.


Suitable for hollow brick/block and hollow core concrete applications.


Anchor is cast into substrate by either puddling, attaching to reinforcing or formwork.


Anchor can be through fixed into substrate using fixture as template.


Suitable for use in dry holes.


Suitable for use in damp holes.


Suitable for use in holes filled with water.


Suitable for use in drilled holes.


Suitable for use in cored holes.


Temporary or removable fixing.


Suitable for AAC and lightweight concrete applications.

2 Notation

a = actual anchor spacing (mm)

a_c = critical anchor spacing (mm)

a_m = absolute minimum anchor spacing (mm)

A_s = stress area (mm^2)

b_m = minimum substrate thickness (mm)

d_b = bolt diameter (mm)

d_f = fixture hole diameter (mm)

d_h = drilled hole diameter (mm)

e = actual edge distance (mm)

e_c = critical edge distance (mm)

e_m = absolute minimum edge distance (mm)

f'_c = concrete cylinder compressive strength (MPa)

f_u = characteristic ultimate steel tensile strength (MPa)

f_y = characteristic steel yield strength (MPa)

h = anchor effective depth (mm)

L = anchor length (mm)

L_e = anchor effective length (mm)

M^* = design bending action effect (Nmm)

N^* = design tensile action effect (kN)

N_u = ultimate tensile capacity (kN)

N_{uc} = characteristic ultimate concrete tensile capacity (kN)

N_{ur} = design ultimate concrete capacity (kN)

N_{urc} = design ultimate concrete tensile capacity (kN)

N_{us} = characteristic ultimate steel tensile capacity (kN)

t = total thickness of fastened material(s) (mm)

V^* = design shear action effect (kN)

V_u = ultimate shear capacity (kN)

V_{uc} = characteristic ultimate concrete edge shear capacity (kN)

V_{ur} = design ultimate shear capacity (kN)

V_{urc} = design ultimate concrete edge shear capacity (kN)

V_{us} = characteristic ultimate steel shear capacity (kN)

V_{usc} = characteristic ultimate combined concrete/steel shear capacity (kN)

X_{nae} = anchor spacing effect, end of a row, tension

X_{nai} = anchor spacing effect, internal to a row, tension

X_{nc} = concrete compressive strength effect, tension

X_{ne} = edge distance effect, tension

X_{va} = anchor spacing effect, concrete edge shear

X_{vc} = concrete compressive strength effect, shear

X_{vd} = load direction effect, concrete edge shear

X_{vn} = multiple anchors effect, concrete edge shear

X_{vsc} = concrete compressive strength effect, combined concrete/steel shear

Z = section modulus (mm^3)

ß = concrete cube compressive strength (N/mm^2)

$Ø_c$ = capacity reduction factor, concrete tension recommended as 0.6

$Ø_m$ = capacity reduction factor, steel bending recommended as 0.8

$Ø_n$ = capacity reduction factor, steel tension recommended as 0.8

$Ø_q$ = capacity reduction factor, concrete edge shear recommended as 0.6

$Ø_v$ = capacity reduction factor, steel shear recommended as 0.8

Overview

Ramset have been offering mechanical anchor in the Australiasian market place for over 40 years. During this time Ramset brand names have entered into common language on building sites all over Australasia. Names like DynaBolt and TruBolt have become recognized as the best sleeve anchors and stud anchors alike. But only Ramset supplies the original, proven products like DynaBolt sleeve anchors, TruBolt stud anchors, Spatec PLUS heavy duty anchors and DynaSet female anchors. These tried and tested Ramset brand names represent Quality, Reliability and Performance assures it.

Not only does Ramset offer reliable, quality product. 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.

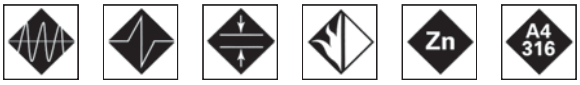
It is performance that defines an anchor's capabilities. An anchor's performance cannot be deduced from its description. For example not all sleeve anchors perform like DynaBolt sleeve anchors and not all stud anchors perform like TruBolt stud anchors. Product design, manufacturing tolerances and manufacturing quality control have a major affect 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 Masonry Anchors is 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 masonry fixing for the job.

3 Spatec PLUS™ Safety Anchor

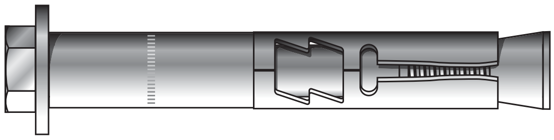
General Information



10mm &
12mm

Product

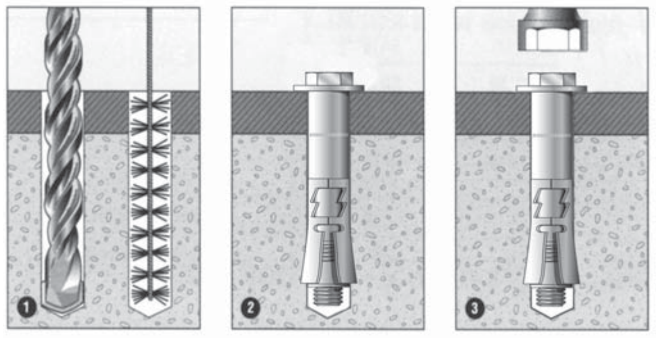
The **New Spatec PLUS** anchor is a through fixing, torque controlled, heavy duty sleeve type expansion anchor ideally suited where security and reliability are paramount.
Now available in 316 Stainless Steel.



Features and Benefits

- Large expansion reserve.
- Through fixing.
- Torque induced pull down.
- Low profile "hex" head.
- Heavy duty, heat treated washer.
- Zinc plated.
- Grade 8.8 steel bolt.
- Resistant to cyclic loading

Installation



1. Drill recommended sized holes as per technical specifications. Clean hole thoroughly with brush. Remove debris by way of a vacuum or hand pump, compressed air, etc.
2. After ensuring anchor is assembled correctly, insert anchor through fixture and drive in until washer contacts fixture.
3. Tighten bolt with torque wrench to specified assembly torque.

Principal Applications

- Structural beams and columns.
- Anchoring braces for precast panels.
- Safety barriers.
- Racking.
- Machinery and heavy plant hold down.
- Lift guide rails.
- Commercial building facades.

3 Spatec PLUS™ Safety Anchor

Installation and Performance Details

Installation details					Minimum Dimensions*			Reduced Characteristic Capacity			
Anchor size d_b (mm)	Hole Ø, d_h (mm)	Fixture hole Ø, d_f (mm)	Effective depth, h (mm)	Tight torque T (Nm)	Edge distance e_c (mm)	Anchor spacing a_c (mm)	Substrate thickness b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M10	15	17	60	50	100	180	100	23.0	15.5	19.6	21.9
			70		105	210	105	38.5	19.5	24.6	27.5
			80		120	240	120	38.5	23.8	30.1	33.7
M12	18	20	70	80	120	210	105	33.5	20.4	25.8	28.8
			85		130	255	135	55.1	27.3	34.5	38.6
			95		145	285	145	55.1	32.2	40.8	45.6
M16	24	26	95	120	160	285	145	62.3	34.6	43.8	49.0
			105		160	315	170	104.5	40.2	50.9	56.9
			115		175	345	175	104.5	46.1	58.3	65.2
M20	28	32	110	200	205	330	165	100.9	45.6	57.7	64.5
			125		205	375	195	100.9	55.3	69.9	78.2
			140		210	420	210	151.7	65.5	82.9	92.7

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

Reduced Characteristic

Description and Part Numbers

Anchor size, d_b	Drilled hole Ø d_h (mm)	Effective length L_e (mm)	Part No.
M10	15	90	SP10105
		90	SP10105SS (316 SS)
M12	18	90	SP12105
		105	SP12120
		105	SP12120SS (316 SS)
M16	24	125	SP16145
M20	28	150	SP20170

Effective depth, h (mm) $h = L_e - t$

t = total thickness of material(s) being fixed

Engineering Properties - Carbon Steel

Anchor size d_b	Shank Ø d_s (mm)	Bolt stress area A_s (mm²)	Bolt yield strength f_y (MPa)	Bolt UTS f_u (MPa)	Spacer area, A_s (mm²)	Spacer yield strength f_y (MPa)	Spacer UTS f_u (MPa)	Section modulus Z (mm³)
M10	9.8	58.0	640	800	65.2	350	480	62.3
M12	11.7	84.3	640	800	101.6	330	430	109.2
M16	15.7	157.0	640	800	198.0	330	430	277.5
M20	19.7	245.0	660	830	238.3	330	430	540.9

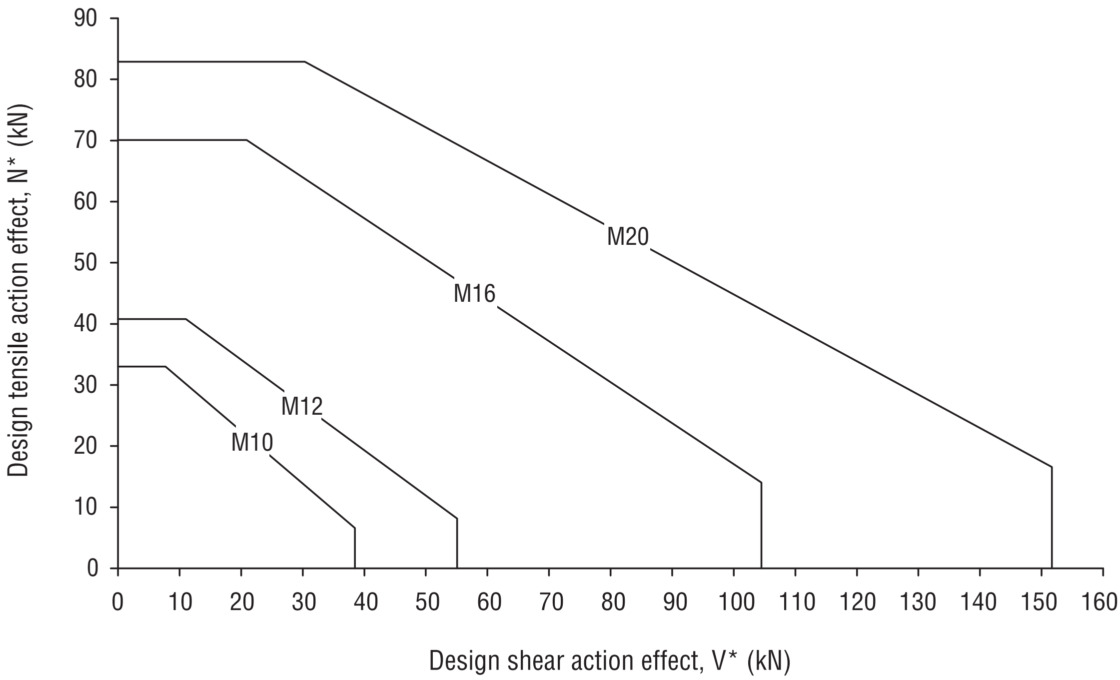
Engineering Properties - Stainless Steel

Anchor size d_b	Shank Ø d_s (mm)	Bolt stress area A_s (mm²)	Bolt yield strength f_y (MPa)	Bolt UTS f_u (MPa)	Spacer area, A_s (mm²)	Spacer yield strength f_y (MPa)	Spacer UTS f_u (MPa)	Section modulus Z (mm³)
M10	9.8	58.0	600	800	65.2	350	450	62.3
M12	11.7	84.3	600	800	101.6	350	450	109.2

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:
- Shear limited by bolt and spacer steel capacity.
- Tension limited by concrete cone capacity.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size d_b	M10	M12	M16	M20
Edge distance, e_m	100	120	160	205
Anchor spacing, a_m	65	80	105	135

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

Refer to “Description and Part Numbers” table on page 6

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.

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

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

Anchor size, d_b	M10	M12	M16	M20
Drilled hole dia, d_h (mm)	15	18	24	28
Effective depth, h (mm)				
60	19.6			
65	22.0			
70	24.6	25.8		
75	27.3	28.6		
80	30.1	31.5		
85	33.0	34.5		
90		37.6		
95		40.8	43.8	
100			47.3	50.0
110			54.6	57.7
120			62.2	65.8
130			70.1	74.2
140				82.9

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	>60
X_{nc}	0.79	0.88	1.00	1.12	1.25	1.37

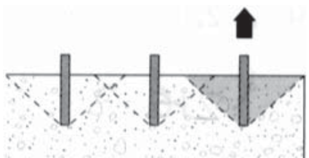


Table 2c Edge distance effect, tension X_{ne} (shaded = 1.00)

Edge distance, e (mm)	100	125	150	175	200	250
Effective depth, h (mm)						
60						
65	1.00					
70	0.97					
75	0.92					
80	0.88	1.00				
85	0.85	0.99				
90	0.82	0.95				
95	0.79	0.91				
100	0.77	0.88	1.00			
110	0.72	0.83	0.94	1.00		
120	0.69	0.79	0.88	0.98		
130	0.66	0.75	0.84	0.93	1.00	
140	0.63	0.72	0.80	0.88	0.97	1.00

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

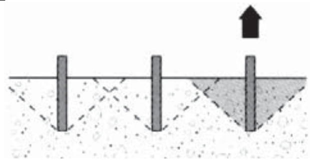


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} (shaded = 1.00)

Anchor spacing, a (mm)	75	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)										
60	0.71	0.78	0.85	0.92	0.99					
65	0.69	0.76	0.82	0.88	0.95	1.00				
70	0.68	0.74	0.80	0.86	0.92	0.98				
75	0.67	0.72	0.78	0.83	0.89	0.94				
80	0.66	0.71	0.76	0.81	0.86	0.92	1.00			
85	0.65	0.70	0.75	0.79	0.84	0.89	0.99			
90	0.64	0.69	0.73	0.78	0.82	0.87	0.96			
95	0.63	0.68	0.72	0.76	0.81	0.85	0.94			
100	0.63	0.67	0.71	0.75	0.79	0.83	0.92	1.00		
110	0.61	0.65	0.69	0.73	0.77	0.80	0.88	0.95		
120	0.60	0.64	0.67	0.71	0.74	0.78	0.85	0.92	1.00	
130	0.60	0.63	0.66	0.69	0.72	0.76	0.82	0.88	0.95	1.00
140	0.59	0.62	0.65	0.68	0.71	0.74	0.80	0.86	0.92	0.98

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

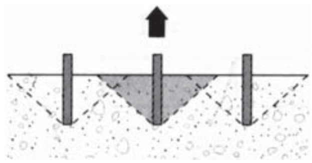


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} (shaded = 1.00)

Anchor spacing, a (mm)	75	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)										
60	0.42	0.56	0.69	0.83	0.97					
65	0.38	0.51	0.64	0.77	0.90	1.00				
70	0.36	0.48	0.60	0.71	0.83	0.95				
75	0.33	0.44	0.56	0.67	0.78	0.89				
80	0.31	0.42	0.52	0.63	0.73	0.83	1.00			
85	0.29	0.39	0.49	0.59	0.69	0.78	0.98			
90	0.28	0.37	0.46	0.56	0.65	0.74	0.93			
95	0.26	0.35	0.44	0.53	0.61	0.70	0.88			
100	0.25	0.33	0.42	0.50	0.58	0.67	0.83	1.00		
110	0.23	0.30	0.38	0.45	0.53	0.61	0.76	0.91	1.00	
120	0.21	0.28	0.35	0.42	0.49	0.56	0.69	0.83	0.97	
130	0.19	0.26	0.32	0.38	0.45	0.51	0.64	0.77	0.90	1.00
140	0.18	0.24	0.30	0.36	0.42	0.48	0.60	0.71	0.83	0.95

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

Checkpoint 2

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

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

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b	M10	M12	M16	M20
Carbon Steel	37.1	54.0	100.5	161.7
Stainless Steel	34.8	50.6	–	–

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$

Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 4 Verify concrete shear capacity – per anchor

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

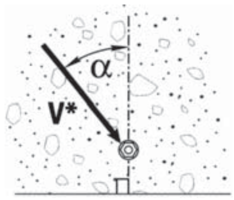
Anchor size, d_b	M10	M12	M16	M20
Edge distance, e (mm)				
100	16.0			
125	22.4	24.6		
150	29.5	32.3		
175	37.1	40.7	47.0	
200	45.4	49.7	57.4	62.0
250	63.4	69.4	80.2	86.6
300	83.3	91.3	105.4	113.9
400	128.3	140.5	162.3	175.3
500	128.3	196.4	226.8	245.0
600	128.3	258.2	298.1	322.0
800	128.3	258.2	459.0	495.8
1000	128.3	258.2	459.0	692.9
∞	128.3	258.2	459.0	692.9

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

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

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

f'_c (MPa)	20	25	32	40	50	60
X_{vc}	0.79	0.88	1.00	1.12	1.25	1.37



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}

(shaded) = 1.00

Edge distance, e (mm)	100	125	150	175	200	250	300	400	500	600	800	1000
Anchor spacing, a (mm)												
75	0.65	0.62	0.60	0.59	0.58	0.56	0.55	0.54				
85	0.67	0.64	0.61	0.60	0.59	0.57	0.56	0.54				
100	0.70	0.66	0.63	0.61	0.60	0.58	0.57	0.55	0.54			
120	0.74	0.69	0.66	0.64	0.62	0.60	0.58	0.56	0.55	0.54		
150	0.80	0.74	0.70	0.67	0.65	0.62	0.60	0.58	0.56	0.55	0.54	
175	0.85	0.78	0.73	0.70	0.68	0.64	0.62	0.59	0.57	0.56	0.54	0.54
200	0.90	0.82	0.77	0.73	0.70	0.66	0.63	0.60	0.58	0.57	0.55	0.54
300	1.00	0.98	0.90	0.84	0.80	0.74	0.70	0.65	0.62	0.60	0.58	0.56
400		1.00	1.00	0.96	0.90	0.82	0.77	0.70	0.66	0.63	0.60	0.58
600				1.00	1.00	0.98	0.90	0.80	0.74	0.70	0.65	0.62
800						1.00	1.00	0.90	0.82	0.77	0.70	0.66
1000								1.00	0.90	0.83	0.75	0.70
1200									0.98	0.90	0.80	0.74
1500									1.00	1.00	0.88	0.80
1800											0.95	0.86
2100											1.00	0.92
2500												1.00

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

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

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

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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

3 Spatec PLUS™ Safety Anchor / Strength Limit State Design

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v = 0.8$

Anchor Size, d_b	M10	M12	M16	M20
Bolt and spacer shear (kN) Carbon	38.5	55.1	104.5	151.7
Bolt and spacer shear (kN) SS	37.6	56.1	–	–
h (mm) min	70	80	105	130
Bolt shear only (kN) Carbon	23.0	33.5	62.3	100.9
Bolt shear only (kN) SS	23.0	33.5	–	–
h (mm) min	60	72	96	112

* See Note Table 4A*

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 5

Check
$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$,

if not satisfied return to step 1

Specify

Ramset Spatec PLUS Anchor, (Anchor Size) ((Part Number)).
Maximum fixed thickness to be (t) mm.

Example

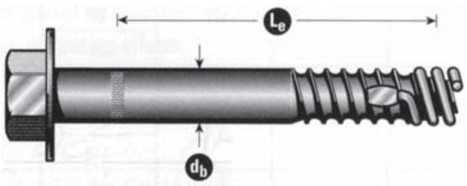
Ramset Spatec PLUS Anchor, M12 (SP12125)
Maximum fixed thickness to be 8 mm.

4 Boa™ Coil Expansion Anchors

General Information

Product

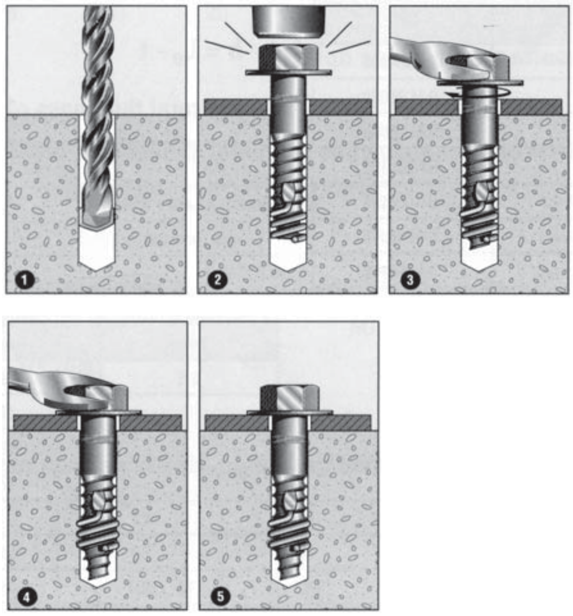
Boa Coil anchor is a high strength, expansion anchor, comprising of a specially designed tapered bolt, precisely manufactured from high tensile steel and a high tensile spring coil which when set gives a strong positive fix into concrete, solid brick and solid masonry.



Features and Benefits

- Self undercutting – cast-in performance.
- High clamping load.
- Resistant to cyclic loading.
- Through fixing.
- Removable.

Installation



1. Using the fixture as a template, drill the correct diameter and depth hole. Clean hole with a brush and remove debris with vacuum or hand pump.

2. Insert the assembled Boa Coil anchor. (The coil tab points up the anchor.) Tap anchor down to depth set mark and stop.

3. Wind the anchor down until the washer is firmly held to the fixture and stop. (For the number of turns required to set anchor refer to details on installation and performance).

4. 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 and 4.)

Principal Application

- Installing handrails and balustrades.
- Anchoring braces and precast panels.
- Fixing structural beams and columns.
- Machinery hold down.
- Formwork support.
- Safety barriers

Installation and Performance Details

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_F (mm)	Anchor effective depth, h (mm)	Turns to set anchor	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M10	10	12	30	5	60	120	45	**8.9**	**5.5**	**7.0**	**7.8**
			50				75	**14.3**	**9.2**	**11.6**	**13.0**
			75				113	**17.8**	**13.8**	**17.4**	**19.5**
M13	13	14	40	5	80	160	60	**16.0**	**9.6**	**12.1**	**13.5**
			75				113	**26.7**	**17.9**	**22.7**	**25.3**
			110				165	**32.0**	**26.3**	**33.2**	**37.2**
M16	16	19	50	5	100	200	75	**27.7**	**14.7**	**18.6**	**20.8**
			70				105	**36.9**	**20.6**	**26.0**	**29.1**
			90				135	**46.1**	**26.5**	**33.5**	**37.4**
M19	19	21	57	5	120	230	86	**40.3**	**19.9**	**25.2**	**28.2**
			80				120	**53.8**	**27.9**	**35.3**	**39.5**
			105				158	**67.2**	**36.7**	**46.4**	**51.9**

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

Reduced Characteristic

4 Boa™ Coil Expansion Anchors

Description and Part Numbers

Anchor size, d_b (mm)	Effective length, L_e (mm)	Part No. Zn
M10	47	BAC06060
	62	BAC06075
	87	BAC06100
	112	BAC06125
M13	59	BAC08075
	84	BAC08100
	124	BAC08140
M16	71	BAC10090
	106	BAC10125
M19	63	BAC12085
	93	BAC12115
	128	BAC12150

Effective depth, h (mm)

$h = L_e - t$

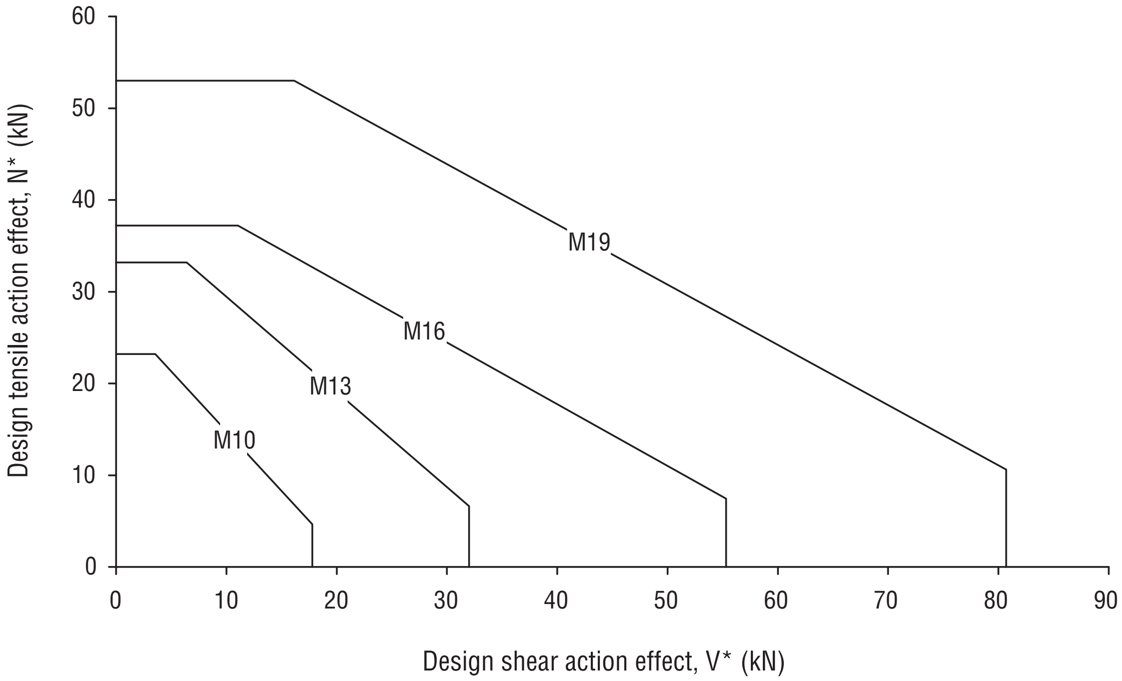
t = total thickness of material(s) being fixed

Engineering Properties - Carbon Steel

Anchor size, d_b (mm)	Bolt stress area, A_s (mm²)	Bolt yield strength, f_y (MPa)	Bolt UTS, f_u (MPa)	Section modulus, Z (mm³)
M10	43.2	680	830	40.0
M13	77.8	680	830	97.0
M16	134.4	680	830	219.8
M19	196.0	680	830	387.2

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:
- Shear limited by steel capacity.
- Tension limited by concrete cone capacity.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b (mm)		M10	M13	M16	M19
Edge distance, e_m		50	65	80	95
Anchor spacing, a_m	$e \geqslant 6\ d_b$	80	105	130	150
	$e < 6\ d_b$	100	130	160	190

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

Refer to “Description and Part Numbers” table on page 15

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.

4 Boa™ Coil Expansion Anchors / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

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

Anchor size, d_b (mm)	M10	M13	M16	M19
Effective depth, h (mm)				
20				
25				
30	7.0			
35	8.1			
40	9.3	12.1		
45	10.5	13.6		
50	11.6	15.1	18.6	
55	12.8	16.6	20.5	
60	13.9	18.1	22.3	26.5
70	16.3	21.2	26.0	30.9
80	18.6	24.2	29.8	35.3
90	20.9	27.2	33.5	39.8
100	23.2	30.2	37.2	44.2
110		33.2		48.6
120				53.0

Note: Effective depth, h must be ⩾3 x anchor size, d_b in order to achieve tabled shear capacities.

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

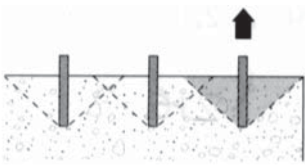


Table 2c Edge distance effect, tension, X_{ne} (shaded = 1.00)

Anchor size, d_b	M10	M13	M16	M19
Edge distance, e (mm)				
35				
40				
50	0.88			
60	1.00			
70		0.93		
80		1.00	0.88	
90			0.96	
100			1.00	0.91
120				1.00

4 Boa™ Coil Expansion Anchors / **Strength Limit State Design**

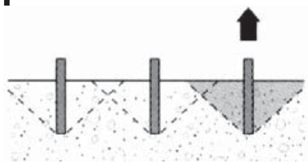


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} (shaded = 1.00)

Anchor size, d_b (mm)	M10	M13	M16	M19
Anchor spacing, a (mm)				
50				
60				
70				
80	0.83			
90	0.88			
100	0.92	0.82		
120	1.00	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

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

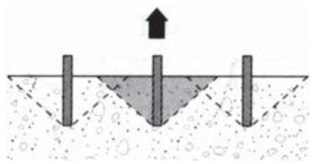


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} (shaded = 1.00)

Anchor size, d_b (mm)	M10	M13	M16	M19
Anchor spacing, a (mm)				
50				
60				
70				
80	0.67			
90	0.75			
100	0.83	0.64		
120	1.00	0.77		
140		0.90	0.73	
160		1.00	0.83	0.70
180			0.94	0.79
200			1.00	0.88
220				0.96
230				1.00

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

Checkpoint 2

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

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

4 Boa™ Coil Expansion Anchors / Strength Limit State Design

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_b (mm)	M10	M13	M16	M19
Carbon steel	27.6	51.7	89.2	130.1

Step 3b Reduced Characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check $N^* / ØN_{ur} \leqslant 1$

if not satisfied return to step 1

Step 4 Verify concrete shear capacity – per anchor

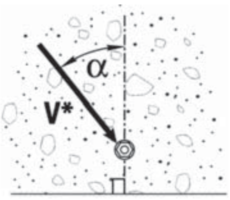
Table 4a Reduced characteristic ultimate concrete shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$, $f'_c = 32$ MPa

Anchor size, d_b	M10	M13	M16	M19
Edge distance, e (mm)				
35				
50	4.6			
70	7.7	8.7		
80	9.4	10.7	11.9	
100	13.1	14.9	16.6	18.0
150	24.1	27.4	30.4	33.2
200	37.0	42.2	46.8	51.1
250	51.8	59.0	65.5	71.3
300	68.0	77.6	86.1	93.8
400	68.0	119.4	132.5	144.4
500	68.0	119.4	185.2	201.8
600	68.0	119.4	185.2	265.3
∞	68.0	119.4	185.2	265.3

Note: Effective depth, h must be ⩾ 3 x anchor size, d_b in order to achieve tabled shear capacities.

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



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

4 Boa™ Coil Expansion Anchors / Strength Limit State Design

Table 4d Anchor spacing effect, concrete edge shear, X_{va} (shaded = 1.00)

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		
75	0.93	0.80	0.71	0.69	0.65	0.60	0.58	0.56	0.55	0.54		
100	1.00	0.90	0.79	0.75	0.70	0.63	0.60	0.58	0.57	0.55	0.54	
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

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

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} (shaded = 1.00)

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	0.9	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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

4 Boa™ Coil Expansion Anchors / Strength Limit State Design

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v = 0.8$

Anchor size, d_b (mm)	M10	M13	M16	M19
$h \geqslant 6 \times d_b$	17.8	32.0	55.3	80.7
$h \geqslant 5 \times d_b$	14.3	26.7	46.1	67.2
$h \geqslant 4 \times d_b$	11.4	21.3	36.9	53.8
$h \geqslant 3 \times d_b$	8.9	16.0	27.7	40.3

Step 5b Reduced Characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2$

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.

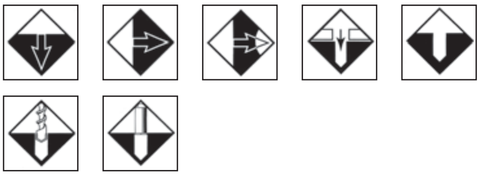
5 AnkaScrew™ Screw In Anchor

General Information

Performance Related

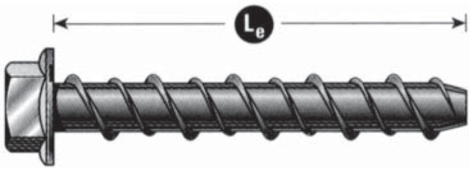
Material

Installation Related



Product

The Anka Screw Anchor is a medium duty, rotation setting thread forming anchor.



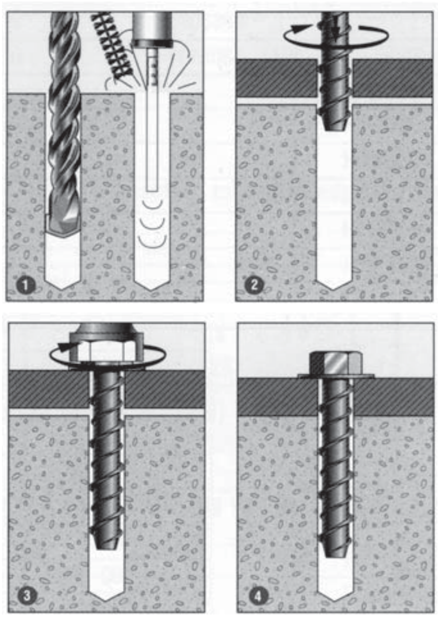
Benefits, Advantages and Features

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.

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 Anka Screw into the hole using slight pressure until the self tapping action starts.
3. Tighten the Anka Screw. If resistance is experienced when tightening, unscrew anchor one turn and re-tighten. Ensure not to over tighten.
4. For optimum performance, a torque wrench should be used.

Principal Application

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

5 AnkaScrew™ Screw In Anchor

Installation and Performance Details

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_F (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M6	6	8	30	25	25	50	55	6.8	3.7	4.3	4.7
			37				62	7.7	4.7	5.5	5.9
			45				70	8.6	5.8	6.9	7.4
M8	8	10	40	40	35	70	65	12.6	5.5	6.4	7.0
			50				75	14.3	7.3	8.6	9.3
			60				85	16.9	9.3	10.9	11.8
M10	10	12	50	60	40	80	75	20.7	7.9	9.3	10.0
			62				87	23.4	10.6	12.5	13.5
			75				100	26.2	13.9	16.3	17.7
M12	12	15	60	80	50	100	85	25.0	11.2	13.2	14.3
			75				100	28.4	15.5	18.3	19.8
			90				115	31.7	20.3	23.9	25.8

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

Reduced Characteristic

Description and Part Numbers

Anchor size, d_b (mm)	Effective length, L_e (mm)	Part No.
M6	50	AS06050H
	75	AS06075H
	100	AS06100H
M8	60	AS08060H
	75	AS08075H
	100	AS08100H
M10	60	AS10060H
	75	AS10075H
	100	AS10100H
M12	75	AS12075H
	100	AS12100H
	150	AS12150H

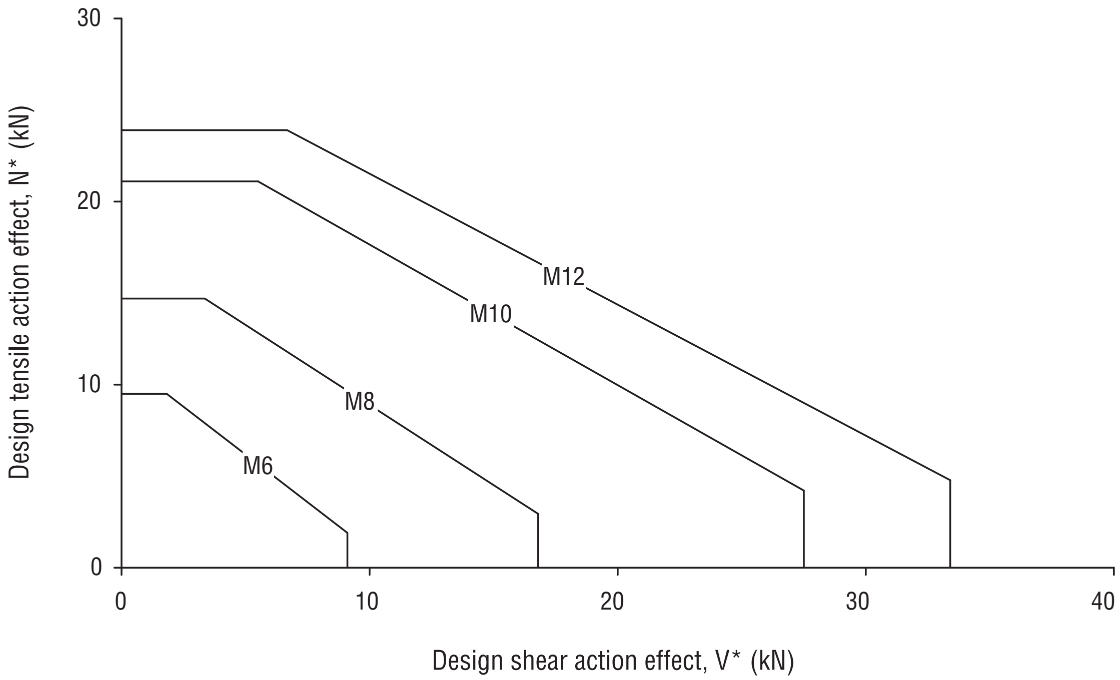
Engineering Properties

Anchor size, d_b (mm)	Bolt stress area, A_s (mm^2)	Yield strength, f_y (MPa)	UTS, f_u (MPa)
M6	22.9	640	800
M8	42.4	640	800
M10	69.4	640	800
M12	84.1	640	800

AnkaScrew™ Screw In Anchor / Strength Limit State Design

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity at h = 7.5 d_h.
- Tension limited by lesser of carbon steel capacity and concrete capacity at h = 7.5 d_h.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b	6	8	10	12
e_m, a_m	20	25	30	35

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

Refer to "Description and Part Numbers" table on page 24.

Effective depth, h (mm)

h = lesser of L_e - t

t = total thickness of material(s) being fixed

Checkpoint 1

Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

5 AnkaScrew™ Screw In Anchor / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

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

Anchor size, d_b (mm)	M6	M8	M10	M12
Effective depth, h (mm)				
30	4.3			
35	5.1			
40	6.0	6.4		
45	6.9	7.5		
50	7.7	8.6	9.3	
55	8.6	9.8	10.6	
60	9.5	10.9	12.0	13.2
75		14.7	16.3	18.3
90			21.1	23.9

Note: Effective depth, h must be ⩾ 3.5 x Anchor size, dh for anchor to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	32	>40
X_{nc}	0.85	0.92	1.00	1.08

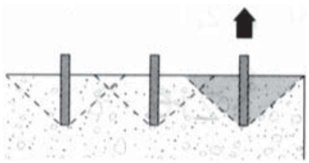


Table 2c Edge distance effect, tension, X_{ne} (shaded = 1.00)

Anchor size, d_b	M6	M8	M10	M12
Edge distance, e (mm)				
20	0.88			
25	1.00	0.85		
30		0.96	0.83	
35		1.00	0.91	0.81
40			1.00	0.88
45				0.96
50				1.00

5 AnkaScrew™ Screw In Anchor / Strength Limit State Design

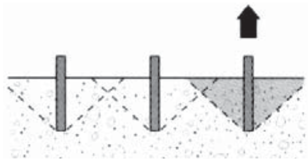


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} (shaded = 1.00)

Anchor size, d_b	M6	M8	M10	MM12
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	
40		0.92	0.83	
45		1.00	0.88	0.81
50			0.92	0.85
55			0.96	0.88
60			1.00	0.92
70				1.00

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

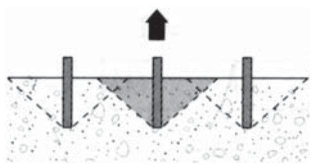


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} (shaded = 1.00)

Anchor size, d_h (mm)	M6	M8	M10	M12
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
55			0.92	0.76
60			1.00	0.83
70				1.00

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

Checkpoint 2

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

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

5 AnkaScrew™ Screw In Anchor / Strength Limit State Design

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), Øn = 0.8

Anchor size, d_b	M6	M8	M10	M12
Heat Treated Carbon Steel	14.6	27.1	44.4	53.8

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check N* / ØNur ⩽ 1,

if not satisfied return to step 1

Step 4 Verify concrete shear capacity – per anchor

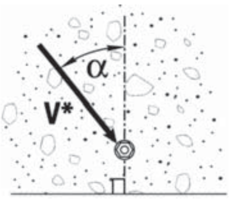
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q$ = 0.6 f'_c = 32 MPa

Anchor size, d_b	M6	M8	M10	M12
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
75	6.6	7.6	8.5	9.3
100	10.1	11.7	13.1	14.3
150	18.6	21.5	24.1	26.4
200	28.7	33.1	37.0	40.6
250	28.7	46.3	51.8	56.7
300	28.7	46.3	68.0	74.5
400	28.7	46.3	68.0	114.8
∞	28.7	46.3	68.0	114.8

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

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} (shaded = 1.00)

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

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

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} (shaded = 1.00)

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
Nbr Anchors												
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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

5 AnkaScrew™ Screw In Anchor / Strength Limit State Design

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v = 0.8$

Anchor size, d_h (mm)	M6	M8	M10	M12
$h \geqslant 7.5 \times d_h$	9.1	16.8	27.5	33.4
$h \geqslant 7 \times d_h$	8.6	16.0	26.2	31.7
$h \geqslant 6 \times d_h$	7.7	14.3	23.4	28.4
$h \geqslant 5 \times d_h$	6.8	12.6	20.7	25

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur} \leqslant 1.2$

if not satisfied return to step 1

Specify

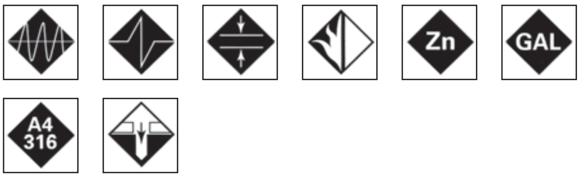
Ramset Anka Screw Anchor,
(Anchor Size) ((Part Number)).
Maximum fixed thickness to be (t) mm.

Example

Ramset Anka Screw Anchor,
12 mm (AS12100H),
Maximum fixed thickness to be 40 mm.
To be installed in accordance with Ramset Technical Data Sheet.

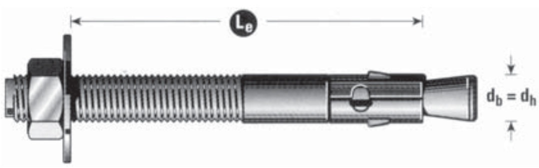
6 TruBolt™ Stud Anchors

General Information



Product

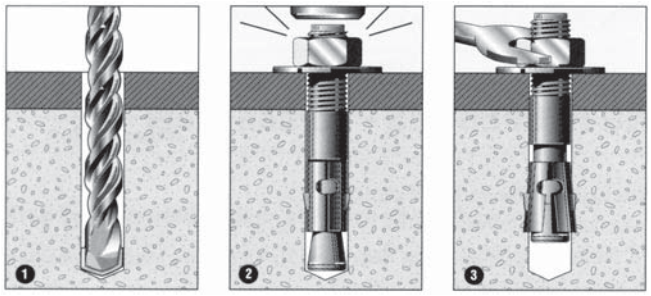
The TruBolt anchor is a true dimension all steel through fixing, torque controlled, stud type expansion anchor for masonry and concrete.



Features and Benefits

- "True dimension" anchor – hole size, thread size and anchor diameter are the same.
- Through fixing – no marking out and repositioning.
- Zinc plated, hot dipped galvanized or stainless steel.
- Resistant to cyclic loading.

Installation



1. Use fixture as a template, drill a hole the same diameter as the TruBolt.
2. Remove debris by way of vacuum or hand pump, compressed air, etc. Drive anchor into hole until washer is flush with the fixture.
3. Tighten with a spanner. For optimum anchor performance a torque wrench should be utilized.

Principal Applications

- Structural beams and columns.
- Anchoring braces for precast panels.
- Bottom plate and batten fixing.
- Formwork support.
- Installing signs, handrails, balustrades and gates.
- Safety barriers
- Racking.
- Stadium seating.
- Machinery hold down.
- Raking angles and corner guards.

6 TruBolt™ Stud Anchors

Installation and Performance Details

Anchor size, d_b (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_F (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M12	12	15	48	50	75	150	120	**17.1**	**9.1**	**11.5**	**12.9**
			86		130	260	160	**17.1**	**21.8**	**27.6**	**27.9**
M16	16	19	64	155	100	200	150	**28.8**	**14.0**	**17.7**	**19.8**
			115		170	340	220	**28.8**	**33.8**	**42.7**	**45.6**
M20	20	24	80	355	120	240	170	**54.7**	**19.6**	**24.8**	**27.7**
			145		220	440	270	**54.7**	**47.8**	**60.4**	**67.6**

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

Reduced Characteristic

Description and Part Numbers

Anchor size, d_b (mm)	Hole Ø, d_h, (mm)	Effective length, L_e (mm)	Part No.		
			Zn	Gal	S/S
M12	12	58	T12080	T12080GH	T12080SS
		71	T12100	T12100GH	T12100SS
		93	T12120	–	–
		111	T12140	T12140GH	T12140SS
		151	T12180	T12180GH	–
M16	16	67	T16100	T16100GH	T16100SS
		85	T16125	T16125GH	T16125SS
		110	T16150	–	–
		135	T16175	T16175GH	T16175SS
M20	20	85	T20120	T20120GH	T20120SS
		115	T20160	T20160GH	T20160SS
		170	–	T20215GH	–

Engineering Properties – Carbon Steel

Anchors with strengths higher in the reduced section than in the threaded section, are formed by cold working. The reduced section is located under the expansion sleeve. For shear loads, the critical plane is located in the threaded section, and for tensile loads, the critical plane is located at the reduced section.

Engineering Properties - Carbon Steel

Anchor Size. d_b	Stress area thread section, A_s (mm^2)	Minimum Ø reduced section, d_m (mm)	Threaded section		Reduced section		Section modulus, Z (mm^3)
			Yield strength, f_y (MPa)	UTS, f_u (MPa)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	
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

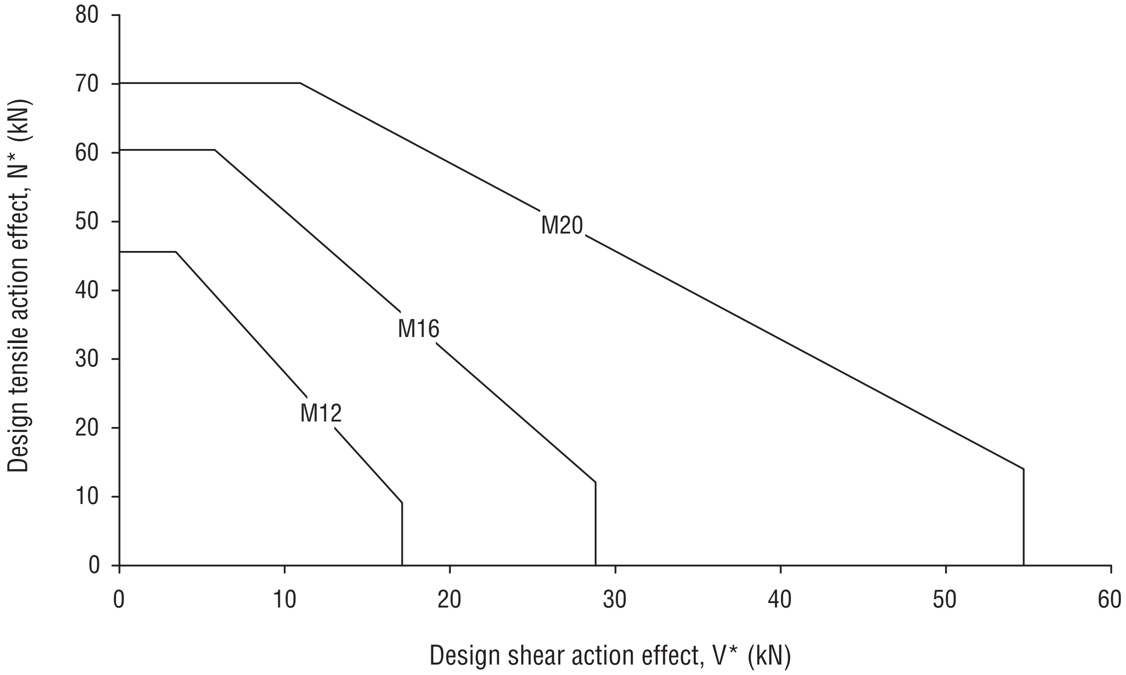
Engineering Properties - Stainless Steel

Anchor Size. d_b	Stress area thread section, A_s (mm^2)	Minimum Ø reduced section, d_m (mm)	Threaded section		Reduced section		Section modulus, Z (mm^3)
			Yield strength, f_y (MPa)	UTS, f_u (MPa)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	
M12	84.3	8.9	360	450	480	600	109.2
M16	157.0	12.1	480	600	480	600	277.5
M20	245.0	16.1	480	600	480	600	540.9

6 TruBolt™ Stud Anchors / Strength Limit State Design

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity.
- Tension limited by carbon steel capacity.
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_b	M12	M16	M20
Edge distance, e_m	65	75	95
Anchor spacing, a_m	45	50	60

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

Refer to “Description and Part Numbers” table on page 32.

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.

6 TruBolt™ Stud Anchors / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

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

Anchor size, d_b (mm)	M12	M16	M20
Hole Ø, d_h (mm)	12	16	20
Effective depth, h (mm)			
50	12.2		
65	18.1	18.1	
80	24.8	24.8	24.8
95	32.1	32.1	32.1
110	39.9	39.9	39.9
125	45.6	45.6	48.4
145		60.4	60.4
160			70.1

Note: Effective depth, h must be ⩾ 4 x drilled hole diameter, d_h in order to achieve tabled shear capacities.

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

f'_c (MPa)	20	25	>32
X_{nc}	0.79	0.88	1.00

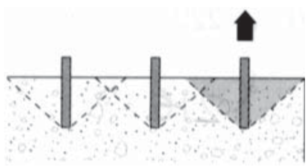


Table 2c Edge distance effect, tension, X_{ne}

(shaded) = 1.00

Edge distance, e (mm)	50	60	70	80	100	125	150	175	200	230
Effective depth, h (mm)										
30	1.00									
35	0.97									
40	0.88	1.00	1.00							
50	0.77	0.86	0.95	1.00						
65	0.66	0.73	0.80	0.87	1.00					
80	0.59	0.65	0.71	0.77	0.88	1.00				
95	0.55	0.59	0.64	0.69	0.79	0.91	1.00			
110	0.51	0.55	0.60	0.64	0.72	0.83	0.94	1.00		
125	0.49	0.52	0.56	0.60	0.67	0.77	0.86	0.95	1.00	
145	0.46	0.49	0.53	0.56	0.62	0.70	0.78	0.86	0.94	1.00
160	0.45	0.48	0.50	0.53	0.59	0.66	0.74	0.81	0.88	0.97
180	0.43	0.46	0.48	0.51	0.56	0.62	0.69	0.75	0.82	0.90
200	0.42	0.44	0.46	0.49	0.53	0.59	0.65	0.71	0.77	0.84

6 TruBolt™ Stud Anchors / Strength Limit State Design

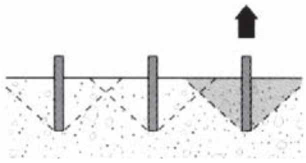


Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

(shaded) = 1.00

Anchor spacing, a (mm)	30	40	50	60	80	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)														
25	0.70	0.77	0.83	0.90	1.00									
30	0.67	0.72	0.78	0.83	0.94	1.00								
35	0.64	0.69	0.74	0.79	0.88	0.98								
40	0.63	0.67	0.71	0.75	0.83	0.92	1.00							
50	0.60	0.63	0.67	0.70	0.77	0.83	0.92	1.00	1.00					
65	0.58	0.60	0.63	0.65	0.71	0.76	0.82	0.88	0.95	1.00				
80	0.56	0.58	0.60	0.63	0.67	0.71	0.76	0.81	0.86	0.92	1.00			
95	0.55	0.57	0.59	0.61	0.64	0.68	0.72	0.76	0.81	0.85	0.94	1.00		
110	0.55	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	0.54	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	0.53	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
180		0.54	0.55	0.56	0.57	0.59	0.62	0.64	0.66	0.69	0.73	0.78	0.82	0.87
200		0.53	0.54	0.55	0.57	0.58	0.60	0.63	0.65	0.67	0.71	0.75	0.79	0.83

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

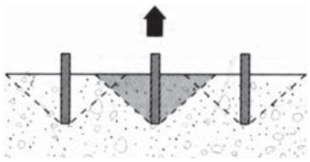


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

(shaded) = 1.00

Anchor spacing, a (mm)	30	40	50	60	80	100	125	150	175	200	250	300	350	400
Effective depth, h (mm)														
25	0.40	0.53	0.67	0.80	1.00									
30	0.33	0.44	0.56	0.67	0.89	1.00								
35	0.29	0.38	0.48	0.57	0.76	0.95								
40	0.25	0.33	0.42	0.50	0.67	0.83	1.00							
50	0.20	0.27	0.33	0.40	0.53	0.67	0.83	1.00	1.00					
65	0.15	0.21	0.26	0.31	0.41	0.51	0.64	0.77	0.90	1.00				
80	0.13	0.17	0.21	0.25	0.33	0.42	0.52	0.63	0.73	0.83	1.00			
95	0.11	0.14	0.18	0.21	0.28	0.35	0.44	0.53	0.61	0.70	0.88	1.00		
110	0.09	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
180			0.09	0.11	0.15	0.19	0.23	0.28	0.32	0.37	0.46	0.56	0.65	0.74
200				0.10	0.13	0.17	0.21	0.25	0.29	0.33	0.42	0.50	0.58	0.67

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

Checkpoint 2

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

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

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n$ = 0.8

Anchor size, d_b	M12	M16	M20
Carbon steel	25.4	45.5	71.1
316 Stainless steel	29.9	55.2	97.7

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check $N^* / ØN_{ur} \leqslant 1$,

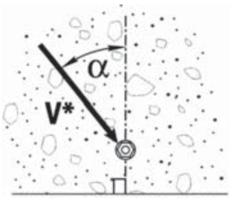
if not satisfied return to step 1

Step 4 Verify concrete shear capacity – per anchor

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

Anchor size, d_b	M12	M16	M20
Edge distance, e (mm)			
75	9.3		
100	14.3		
150	26.4	30.4	
200	40.6	46.9	52.4
250	56.7	65.5	73.2
300	74.5	86.1	96.2
350	93.9	108.5	121.3
450	136.9	158.1	176.8
600	136.9	158.1	272.2
∞	136.9	158.1	272.2

Note: Effective depth, h must be ⩾ 4 x drilled hole diameter, d_h in order 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
X_{vc}	0.79	0.88	1.00	1.12

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

6 TruBolt™ Stud Anchors / Strength Limit State Design

Table 4d Anchor spacing effect concrete edge shear, X_{va} (shaded = 1.00)

Edge distance, e (mm)	45	60	75	100	150	200	250	300	350	450	600	850
Anchor spacing, a (mm)												
30	0.63	0.60	0.58	0.56	0.54	0.53	0.52	0.52	0.52	0.51	0.51	0.51
50	0.72	0.67	0.63	0.60	0.57	0.55	0.54	0.53	0.53	0.52	0.52	0.51
60	0.77	0.70	0.66	0.62	0.58	0.56	0.55	0.54	0.53	0.53	0.52	0.51
80	0.86	0.77	0.71	0.66	0.61	0.58	0.56	0.55	0.55	0.54	0.53	0.52
100	0.94	0.83	0.77	0.70	0.63	0.60	0.58	0.57	0.56	0.54	0.53	0.52
125	1.00	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

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

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} (shaded = 1.00)

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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.8

Anchor size, d_b	M12	M16	M20
Carbon steel	17.1	28.8	54.7
316 Stainless steel	18.9	46.7	72.9

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$

Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leqslant 1.2$

if not satisfied return to step 1

Specify

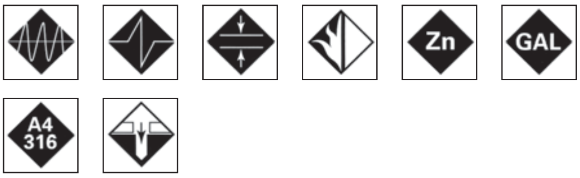
Ramset TruBolt Anchor,
(Anchor Size) ((Part Number)).
Maximum fixed thickness to be (t) mm.

Example

Ramset TruBolt Anchor,
M20 mm (T20160),
Maximum fixed thickness to be 20 mm.

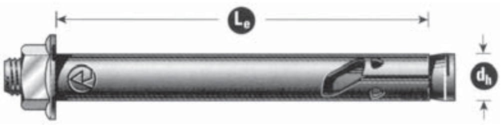
7 DynaBolt™ Sleeve Anchors

General Information



Product

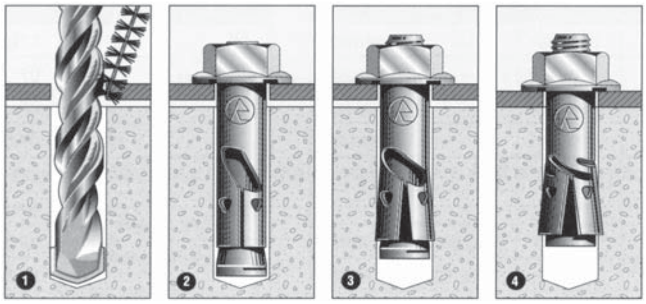
The DynaBolt anchor is a general purpose all steel medium duty through fixing, torque controlled, sleeve type expansion anchor for masonry and concrete.



Features and Benefits

- Collapsible sleeve provides pulldown onto fixture.
- Through fixing.
- Variety of head styles.
- Zinc plated, galvanized or stainless steel.

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 vacuum or hand pump, compressed air, etc. Insert anchor tightly against fixture.
3. Tighten with a spanner.
4. Continue tightening, allowing the sleeve to twist and pull down the fixture firmly onto the base material.

Principal Applications

- Batten fixing.
- Formwork support.
- Electrical junction boxes.
- Installing signs, handrails and gates.
- Installing duct work, pipe brackets, cable trays and suspended ceilings.
- Stadium seating.
- Raking angles and corner guards.

7 DynaBolt™ Sleeve Anchors

Installation and Performance Details

Anchor size, d_h (mm)	Installation details				Minimum Dimensions*			Reduced Characteristic Capacity			
	Drilled hole Ø, d_h (mm)	Fixture hole Ø, d_F (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
								Concrete compressive strength (MPa)			
								20 MPa	20 MPa	32 MPa	40 MPa
M6	6	8	20	10	30	60	40	3.4	3.0	3.7	4.2
			30		55	105	70	3.4	5.4	5.4	5.4
M8	8	10	30	15	50	95	65	6.0	5.4	6.9	7.7
			40		75	150	100	6.0	8.3	9.6	9.6
M10	10	12	35	35	50	100	70	10.9	6.8	8.6	9.7
			50		85	165	110	10.9	11.7	14.8	16.5
M12	12	15	40	55	65	125	85	15.8	8.3	10.6	11.8
			50		90	180	120	15.8	11.7	14.8	16.5
			60		105	210	140	15.8	15.3	19.4	21.7
M16	16	19	55	85	75	145	95	20.9	13.5	17.0	19.0
			70		105	210	140	20.9	19.3	24.4	27.3
			80		135	270	180	20.9	23.6	29.9	33.4
M20	20	24	70	165	90	180	120	31.1	19.3	24.4	27.3
			85		130	255	170	31.1	25.9	32.7	36.6
			100		195	390	260	31.1	33.0	41.7	46.7

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

Reduced Characteristic

DynaBolt™ Sleeve Anchors

7 DynaBolt™ Sleeve Anchors

Description and Part Numbers

Anchor size, d_h (mm)	Effective length, L_e (mm)	Part No.		
		Zn	Gal	S/S
M6	38	DP06040	-	DP06040SS
	57	DP06060	-	DP06060SS
M8	40	DP08040	-	DP08040SS
	66	DP08065	-	DP08065SS
	92	DP08090	-	-
M10	41	DP10040	-	-
	49	DP10050	DP10050GH	DP10050SS
	76	DP10075	DP10075GH	DP10075SS
	103	DP10100	DP10100GH	DP10100SS
M12	55	DP12060	DP12060GH	DP12060SS
	70	DP12070	DP12070GH	DP12070SS
	98	DP12100	DP12100GH	-
	126	DP12125	DP12125GH	-
M16	62	DP16065	DP16065GH	-
	106	DP16110	DP16110GH	-
	140	DP16140	-	-
M20	81	DP20080	DP20080GH	-
	113	DP20115	-	-
	157	DP20160	-	-

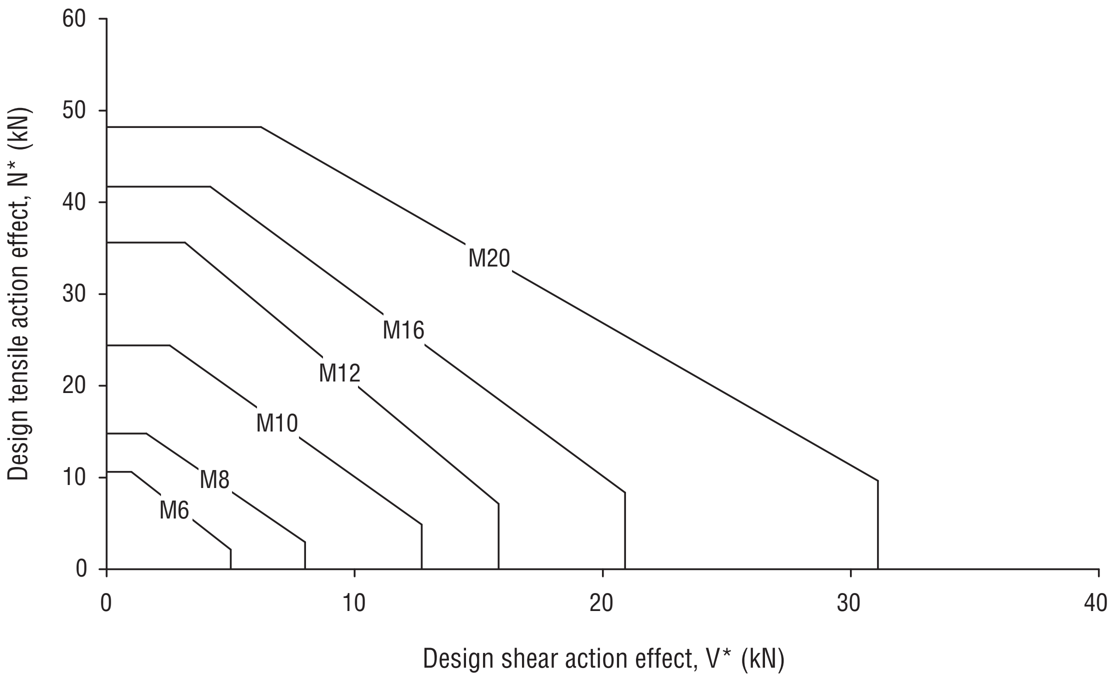
Engineering Properties

Anchor size, d_h	Thread size, d_b	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	M4.5	11.3	720	900	480	600	5.4
M8	M6	20.1	640	800	480	600	12.7
M10	M8	36.6	560	700	480	600	31.2
M12	M10	58.0	440	550	480	600	62.3
M16	M12	84.3	400	500	-	-	109.2
M20	M16	157.0	320	400	-	-	277.5

7 DynaBolt™ Sleeve Anchors / Strength Limit State Design

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:

- Shear limited by steel capacity.
- Tension limited by the lesser of carbon steel capacity and concrete cone capacity at h = 5*d_h
- No edge or spacing effects.
- f'_c = 32 MPa

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

Anchor size, d_h	M6	M8	M10	M12	M16	M20
Edge distance, e_m	55	60	70	70	75	85
Anchor spacing, a_m	35	40	45	45	50	55

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

Refer to "Description and Part Numbers" table on page 41

Effective depth, h (mm)

h = lesser of L_e - t

t = total thickness of material(s) being fixed

Checkpoint 1

Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

7 DynaBolt™ Sleeve Anchors / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

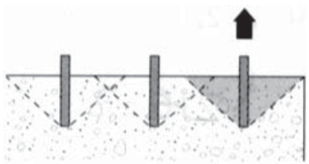
Table 2a Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN) $Ø_c$ = 0.6, f'_c = 32 MPa

Anchor size, d_h (mm)	M6	M8	M10	M12	M16	M20
Effective depth, h (mm)						
20	3.7	3.7				
25	5.2	5.2	5.2			
30	6.9	6.9	6.9	6.9		
40	10.6	10.6	10.6	10.6	10.6	
50		14.8	14.8	14.8	14.8	14.8
60			19.4	19.4	19.4	19.4
70			24.4	24.4	24.4	24.4
80				29.9	29.9	29.9
90				35.6	35.6	35.6
100					41.7	41.7
110						48.2

Note: Effective depth, h must be ⩾ 3.5 x drilled hole diameter, d_h in order to achieve tabled shear capacities.

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

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



(shaded) = 1.00

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

Edge distance, e (mm)	50	60	70	80	90	100	125	150
Effective depth, h (mm)								
30	1.00							
35	0.97							
40	0.88	1.00	1.00					
50	0.77	0.86	0.95	1.00				
60	0.69	0.77	0.84	0.92	1.00			
70	0.63	0.70	0.77	0.83	0.97			
75	0.61	0.67	0.74	0.80	0.92			
80	0.59	0.65	0.71	0.77	0.88	1.00		
85	0.57	0.63	0.68	0.74	0.85	0.96		
90	0.56	0.61	0.66	0.71	0.82	0.92	1.00	
95	0.55	0.59	0.64	0.69	0.79	0.89	0.94	1.00
100	0.53	0.58	0.63	0.67	0.77	0.86	0.91	0.95

7 DynaBolt™ Sleeve Anchors / Strength Limit State Design

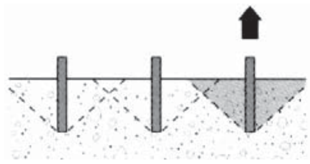


Table 2d Anchor spacing effect, end of a row, tension, X_{nae} (shaded = 1.00)

Anchor spacing, a (mm)	50	60	80	100	125	150	175	200	225	250	300
Effective depth, h (mm)											
25	0.83	0.90	1.00								
30	0.78	0.83	0.94	1.00							
35	0.74	0.79	0.88	0.98							
40	0.71	0.75	0.83	0.92	1.00						
50	0.67	0.70	0.77	0.83	0.92	1.00	1.00				
60	0.64	0.67	0.72	0.78	0.85	0.92	0.99	1.00			
70	0.62	0.64	0.69	0.74	0.80	0.86	0.92	0.98			
75	0.61	0.63	0.68	0.72	0.78	0.83	0.89	0.94	1.00		
80	0.60	0.63	0.67	0.71	0.76	0.81	0.86	0.92	0.97	1.00	
85	0.60	0.62	0.66	0.70	0.75	0.79	0.84	0.89	0.94	0.99	
90	0.59	0.61	0.65	0.69	0.73	0.78	0.82	0.87	0.92	0.96	
95	0.58	0.60	0.63	0.67	0.71	0.75	0.79	0.83	0.88	0.92	
100	0.58	0.60	0.63	0.67	0.71	0.75	0.79	0.83	0.88	0.92	1.00

Note: for single anchor design X_{nae} =1.0

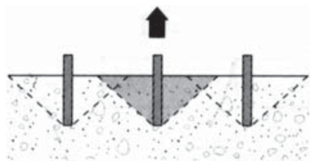


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} (shaded = 1.00)

Anchor spacing, a (mm)	50	60	80	100	125	150	175	200	225	250	300
Effective depth, h (mm)											
25	0.67	0.80	1.00								
30	0.56	0.67	0.89	1.00							
35	0.48	0.57	0.76	0.95							
40	0.42	0.50	0.67	0.83	1.00						
50	0.33	0.40	0.53	0.67	0.83	1.00	1.00				
60	0.28	0.33	0.44	0.56	0.69	0.83	0.97	1.00			
70	0.24	0.29	0.38	0.48	0.60	0.71	0.83	0.95	1.00		
75	0.22	0.27	0.36	0.44	0.56	0.67	0.78	0.89	1.00		
80	0.21	0.25	0.33	0.42	0.52	0.63	0.73	0.83	0.94	1.00	
85	0.20	0.24	0.31	0.39	0.49	0.59	0.69	0.78	0.88	0.98	
90	0.19	0.22	0.30	0.37	0.46	0.56	0.65	0.74	0.83	0.93	
95	0.18	0.21	0.28	0.35	0.44	0.53	0.61	0.70	0.79	0.88	
100	0.17	0.20	0.27	0.33	0.42	0.50	0.58	0.67	0.75	0.83	1.00

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

Checkpoint 2

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

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

7 DynaBolt™ Sleeve Anchors / Strength Limit State Design

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Anchor size, d_h	M6	M8	M10	M12	M16	M20
Carbon steel	8.1	12.9	20.5	25.5	33.7	50.2
316 Stainless steel	5.4	9.6	17.6	27.8	-	-

Step 3b Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Not appropriate for this product.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$
$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$
Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 4 Verify concrete shear capacity – per anchor

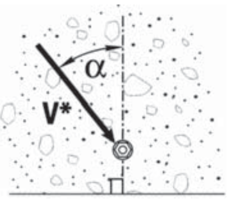
Table 4a Reduced characteristic ultimate concrete edge shear capacity, $ØV_{uc}$ (kN), $Ø_q = 0.6$ $f'_c = 32$ MPa

Anchor size, d_h	M6	M8	M10	M12	M16	M20
Edge distance, e (mm)						
35	2.1					
40	2.6	3.0				
50	3.6	4.1	4.6	5.1	5.9	
60	4.7	5.4	6.1	6.7	7.7	8.6
100	10.1	11.7	13.1	14.3	16.6	18.5
150	18.6	21.5	24.1	26.4	30.4	34.0
200	28.7	33.1	37	40.6	46.9	52.4
250	40.1	46.3	51.8	56.7	65.5	73.2
300	52.7	60.9	68	74.5	86.1	96.2
400	52.7	93.7	104.8	114.8	132.5	148.2
500	52.7	93.7	104.8	114.8	185.2	207.0
600	52.7	93.7	104.8	114.8	185.2	272.2
∞	52.7	93.7	104.8	114.8	185.2	272.2

Note: Effective depth, h must be ⩾ 4 x drilled hole diameter, d_h in order to achieve tabled shear capacities.

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

7 DynaBolt™ Sleeve Anchors / **Strength Limit State Design**

Table 4d Anchor spacing effect concrete edge shear, X_{va} (shaded = 1.00)

Edge distance, e (mm)	35	40	50	60	100	150	200	250	300	400	500	600
Anchor spacing, a (mm)												
55	0.81	0.78	0.72	0.68	0.61	0.57	0.56	0.54	0.54			
60	0.84	0.80	0.74	0.70	0.62	0.58	0.56	0.55	0.54	0.53		
70	0.90	0.85	0.78	0.73	0.64	0.59	0.57	0.56	0.55	0.54		
75	0.93	0.88	0.80	0.75	0.65	0.60	0.58	0.56	0.55	0.54		
85	0.99	0.93	0.84	0.78	0.67	0.61	0.59	0.57	0.56	0.54	0.53	
100	1.00	1.00	0.90	0.83	0.70	0.63	0.60	0.58	0.57	0.55	0.54	0.53
125			1.00	0.92	0.75	0.67	0.63	0.60	0.58	0.56	0.55	0.54
150				1.00	0.80	0.70	0.65	0.62	0.60	0.58	0.56	0.55
200					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
500						1.00	1.00	0.90	0.83	0.75	0.70	0.67
625								1.00	0.92	0.81	0.75	0.71
750									1.00	0.88	0.80	0.75
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

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

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} (shaded = 1.00)

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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

7 DynaBolt™ Sleeve Anchors / Strength Limit State Design

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v = 0.8$

Anchor size, d_h	M6	M8	M10	M12	M16	M20
Carbon steel	5.0	8.0	12.7	15.8	20.9	31.1
316 Stainless steel	3.4	6.0	10.9	17.3	-	-

Step 5b Reduced characteristic ultimate steel capacity, $ØV_{sf}$ (kN)

Not appropriate for this product.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur} \leqslant 1.2$,

if not satisfied return to step 1

Specify

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

Example

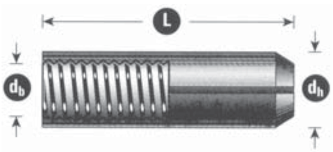
Ramset DynaBolt Anchor,
16 mm (DP16110GH),
Maximum fixed thickness to be 12 mm.

8 DynaSet™ Drop In Anchors

General Information

Product

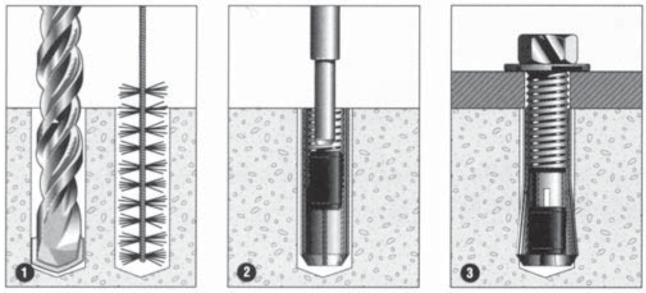
The DynaSet drop-in anchor is an internally threaded socket anchor for use with bolts or threaded rod of any length.



Features and Benefits

- Zinc electro-plated with chromate conversion coating.
- Shallow embedment.
- For use with headed bolts or threaded rod.
- Flush fitting.
- Deeper embedment provides greater capacity.
- Anchor remains set when bolt or rod is removed.

Installation



1. Drill hole at recommended diameter, to at least the anchor length in depth. Clean thoroughly with brush. Remove debris by way of vacuum or hand pump, compressed air 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 anchor remains set in position if the bolt is removed.

Principal Applications

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

8 DynaSet™ Drop In Anchors

Installation and Performance Details

Anchor size, d_b (mm)	Installation details			Minimum Dimensions*			Reduced Characteristic Capacity			
	Fixture hole Ø, d_F (mm)	Anchor effective depth, h (mm)	Tightening torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear V_a (kN)	Tension N_a (kN)		
							Concrete compressive strength (MPa)			
							20 MPa	20 MPa	32 MPa	40 MPa
M6	8	23	6	80	60	50	**4.5**	**4.0**	**5.1**	**5.7**
M8	10	28	10	100	70	60	**5.8**	**5.4**	**6.8**	**7.6**
M10	12	38	20	135	95	80	**7.1**	**8.5**	**10.7**	**12.0**
M10 Flanged	12	28	12	100	70	60	**5.8**	**5.4**	**6.8**	**7.6**
M12	16**	48	40	170	120	100	**13.2**	**12.0**	**15.2**	**17.0**
M16	20	63	95	220	160	130	**20.9**	**18.1**	**22.9**	**25.6**
M20	24	78	180	275	195	160	**26.3**	**25.0**	**31.6**	**35.3**

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

** Hole diameter = 15 mm for M12SS

Reduced Characteristic

Description and Part Numbers

Anchor size, d_b	Anchor length, L (mm)	Effective depth, h (mm)	Part No.	
			Zn	S/S
M6	25	23	DSM06	DSM06SS
M8	30	28	DSM08	DSM08SS
M10	40	38	DSM10	DSM10SS
M10 Flanged	30	28	DSF10	DSF10SS
M12	50	48	DSM12	DSM12SS
M16	65	63	DSM16	-
	60	58	-	DSM16SS
M20	80	78	DSM20	DSM20SS

Effective depth, h (mm)

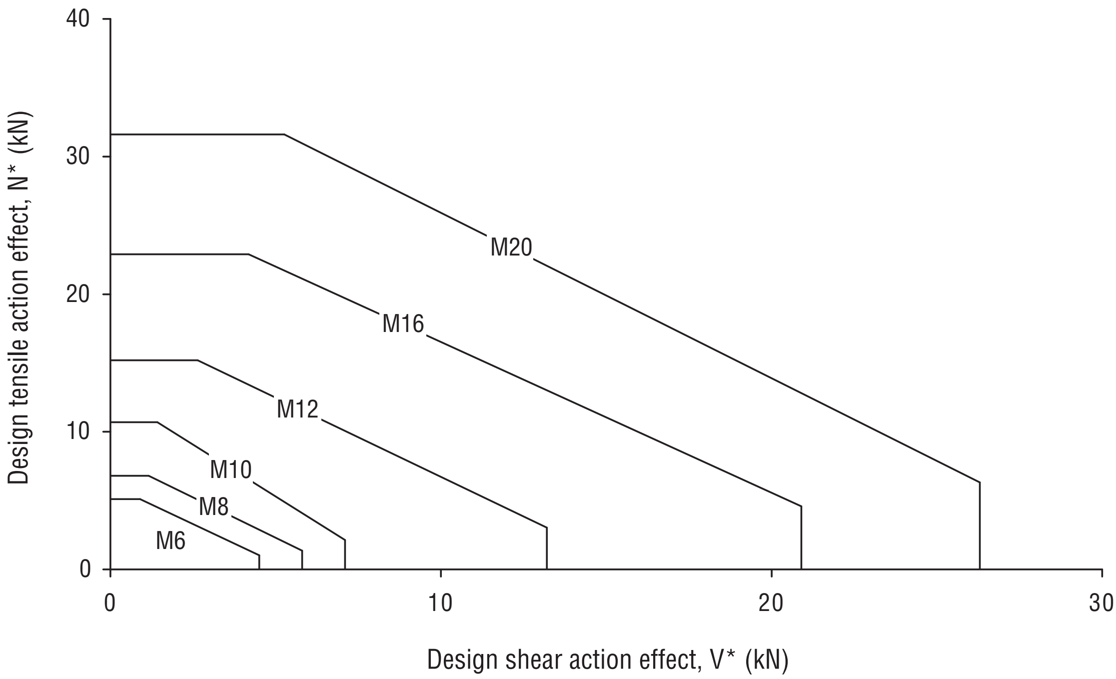
Read value form "Description and Part Numbers" table.

Engineering Properties

Anchor size, d_b	Anchor stress area, A_s (mm²)	Carbon steel		Stainless steel		Section modulus Z (mm³)
		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	159.8	320	450	480	600	789.6

Step 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram



Notes:
- Shear limited by steel capacity.
- Tension limited by carbon steel capacity
- No edge or spacing effects.
- f'_c = 32 MPa
- Bolt capacity to be confirmed separately.

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

Anchor size, d_b	M6	M8	M10	M10 F	M12	M16	M20
Edge distance, e_m	80	100	135	100	170	220	275
Anchor spacing, a_m	60	70	95	70	120	160	195

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

Effective depth, h (mm)

Read value form "Description and Part Numbers" table on page 50.

Checkpoint 1

Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

8 DynaSet™ Drop In Anchors / Strength Limit State Design

Step 2 Verify concrete tensile capacity – per anchor

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

Anchor size, d_b	M6	M8	M10	M10 F	M12	M16	M20
Effective depth, h (mm)	23	28	38	28	48	63	78
Concrete compressive strength, f'_c (MPa)							
20	4.0	5.4	8.5	5.4	12.0	18.1	25.0
25	4.5	6.0	9.5	6.0	13.5	20.3	27.9
32	5.1	6.8	10.7	6.8	15.2	22.9	31.6
>40	5.7	7.6	12.0	7.6	17.0	25.6	35.3

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

$X_{nc} = 1.0$ as concrete compressive strength effect included in table 2a

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

$X_{ne} = 1.0$ for all valid edge distance values.

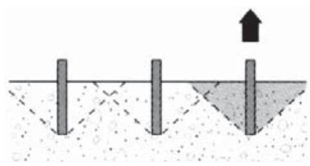


Table 2d Anchor spacing effect, end of a row, tension, X_{nae}

[shaded] = 1.00

Anchor size, d_b	M6	M8	M10	M10 F	M12	M16	M20
Anchor spacing, a (mm)							
60	0.93						
65	0.97						
70	1.00	0.92					
80		0.98					
90		1.00					
100			0.94				
110			0.98	0.92			
120			1.00	0.98	0.92		
130				1.00	0.95		
150					1.00	0.90	
170						0.95	
180						0.98	
190						1.00	
200							0.93
220							0.97
230							0.99
235							1.00

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

8 DynaSet™ Drop In Anchors / Strength Limit State Design

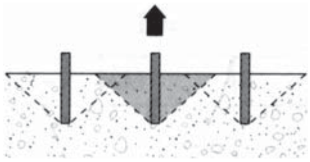


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai} (shaded = 1.00)

Anchor size, d_b	M6	M8	M10	M10 F	M12	M16	M20
Anchor spacing, a (mm)							
60	0.87						
65	0.94						
70	1.00	0.83					
80		0.95					
90		1.00					
100			0.88				
110			0.96	0.83			
120			1.00	0.95	0.83		
130				1.00	0.90		
150					1.00	0.79	
170						0.90	
180						0.95	
190						1.00	0.81
200							0.85
220							0.94
230							0.98
235							1.00

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

Checkpoint 2

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

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

Step 3 Verify anchor tensile capacity – per anchor

Table 3a Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n$ = 0.8

Anchor size, d_b	M6	M8	M10	M12	M16	M20
Carbon steel	8.5	11.2	13.8	24.7	40.2	51.1
316 Stainless steel	11.7	15.4	19.5	34.6	60.2	-

Step 3b Reduced characteristic ultimate bolt steel capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to section 10.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$, $ØN_{tf}$

Check $N^* / ØN_{ur} \leqslant 1$,

if not satisfied return to step 1

8 DynaSet™ Drop In Anchors / Strength Limit State Design

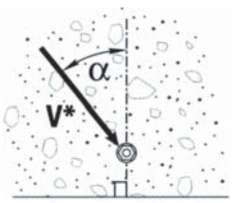
Step 4 Verify concrete shear capacity – per anchor

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

Anchor size, d_b	M6	M8	M10	M12	M12 S/S	M16	M20
Edge distance, e (mm)							
80	8.4						
100	11.7	13.1					
125	16.4	18.3					
150	21.5	24.1	26.4				
175	27.1	30.3	33.2	38.3	37.1		
200	33.1	37.0	40.6	46.9	45.4		
250	46.3	51.8	56.7	65.5	63.4	73.2	
300	46.3	68.0	74.5	86.1	83.3	96.2	105.4
350	46.3	68.0	93.9	108.5	105.0	121.3	132.8
400	46.3	68.0	114.8	132.5	128.3	148.2	162.3
500	46.3	68.0	114.8	132.5	128.3	207.0	226.8
650	46.3	68.0	114.8	132.5	128.3	207.0	336.2
∞	46.3	68.0	114.8	132.5	128.3	207.0	336.2

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

DynaSet™ Drop In Anchors / Strength Limit State Design

Table 4d Anchor spacing effect, concrete edge shear, X_{va} (shaded = 1.00)

Edge distance, e (mm)	80	100	125	150	175	200	250	300	350	400	500	650
Anchor spacing, a (mm)												
60	0.65	0.62	0.60	0.58	0.57	0.56	0.55					
70	0.68	0.64	0.61	0.59	0.58	0.57	0.56	0.55				
80	0.70	0.66	0.63	0.61	0.59	0.58	0.56	0.55				
100	0.75	0.70	0.66	0.63	0.61	0.60	0.58	0.57	0.56	0.55		
120	0.80	0.74	0.69	0.66	0.64	0.62	0.60	0.58	0.57	0.56		
160	0.90	0.82	0.76	0.71	0.68	0.66	0.63	0.61	0.59	0.58	0.56	
200	1.00	0.90	0.82	0.77	0.73	0.70	0.66	0.63	0.61	0.60	0.58	0.56
250		1.00	0.90	0.83	0.79	0.75	0.70	0.67	0.64	0.63	0.60	0.58
300			0.98	0.90	0.84	0.80	0.74	0.70	0.67	0.65	0.62	0.59
400			1.00	1.00	0.96	0.90	0.82	0.77	0.73	0.70	0.66	0.62
500					1.00	1.00	0.90	0.83	0.79	0.75	0.70	0.65
625							1.00	0.92	0.86	0.81	0.75	0.69
750								1.00	0.93	0.88	0.80	0.73
875									1.00	0.94	0.85	0.77
1000										1.00	0.90	0.81
1250											1.00	0.88
1625												1.00

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

Table 4e Multiple anchors effect, concrete edge shear, X_{vn} (shaded = 1.00)

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

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

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

$ØV_{urc} = ØV_{uc} * X_{vc} * X_{vd} * X_{va} * X_{vn}$

8 DynaSet™ Drop In Anchors / Strength Limit State Design

Step 5 Verify anchor shear capacity – per anchor

Table 5a Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v = 0.8$

Anchor size, d_b	M6	M8	M10	M12	M16	M20
Carbon steel	4.5	5.8	7.1	13.2	20.9	26.3
316 Stainless steel	6.1	7.9	10.0	17.8	31.3	39.4

Step 5b Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Establish the reduced characteristic ultimate bolt steel shear tensile capacity, $ØV_{sf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to section 10.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$
$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$
Check $V^* / ØV_{ur} \leqslant 1$,

if not satisfied return to step 1

Step 6 Combined loading and specification

Checkpoint 6

Check
$N^*/ØN_{ur} + V^*/ØV_{ur}, \leqslant 1.2$

if not satisfied return to step 1

Specify

Ramset DynaSet Anchor,
(Anchor Size) ((Part Number)),
with a (Bolt Grade) bolt.

Example

Ramset DynaSet Anchor,
M16 mm (DSM16),
With a Gr. 4.6 bolt.

9 Typical Bolt Performance Information

Tabulated below are nominal reduced ultimate characteristic capacities for bolts manufactured in accordance with ISO 898-1.

The expected capacity of bolts should be independently checked by the designer based on the bolt manufacturers published performance information.

Strength Limited State Design Information

Tension

Table 10a Reduced nominal bolt tensile capacity, $ØN_{tf}$ (kN), $Ø_n$ = 0.8

Bolt type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	6.4	11.7	18.6	27.0	50.2	78.4	113.0
Grade 8.8 Carbon Steel	13.3	24.3	38.5	56.0	104.2	162.7	234.4
Stainless Steel A4-70 (AISI 316)	11.3	20.5	32.5	47.2	87.9	137.2	-

Shear

Table 10b Reduced nominal bolt shear capacity, $ØV_{sf}$ (kN), $Ø_r$ = 0.8

Bolt type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	3.3	6.1	9.8	14.4	27.4	43.0	62.0
Grade 8.8 Carbon Steel	6.6	12.4	20.0	29.3	56.1	88.3	127.2
Stainless Steel A4-70 (AISI 316)	5.6	10.5	16.8	24.7	47.4	74.5	-

Working Load Limit Design Information

Tension

Table 10c Allowable tensile load steel (kN), F_{ss} = 2.2

Bolt type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	3.6	6.6	10.6	15.3	28.5	44.5	64.2
Grade 8.8 Carbon Steel	7.6	13.8	21.9	31.8	59.2	92.4	133.2
Stainless Steel A4-70 (AISI 316)	6.4	11.6	18.5	26.8	49.9	77.9	-

Shear

Table 10d Allowable shear load steel (kN), F_{sv} = 2.5

Bolt type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	1.7	3.1	4.9	7.2	13.7	21.5	31.0
Grade 8.8 Carbon Steel	3.3	6.2	10.0	14.7	28.1	44.2	63.6
Stainless Steel A4-70 (AISI 316)	2.8	5.3	8.4	12.4	23.7	37.3	-

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