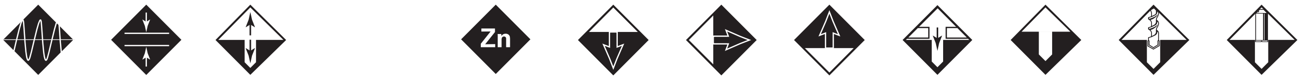
Boa™ Coil

EXPANSION ANCHORS - NON-CRACKED CONCRETE

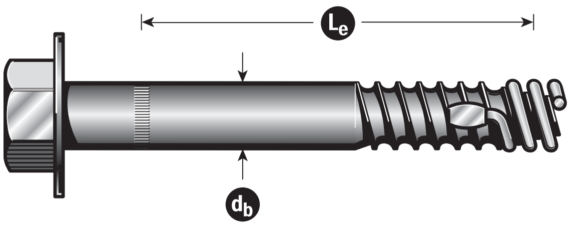
GENERAL INFORMATION

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

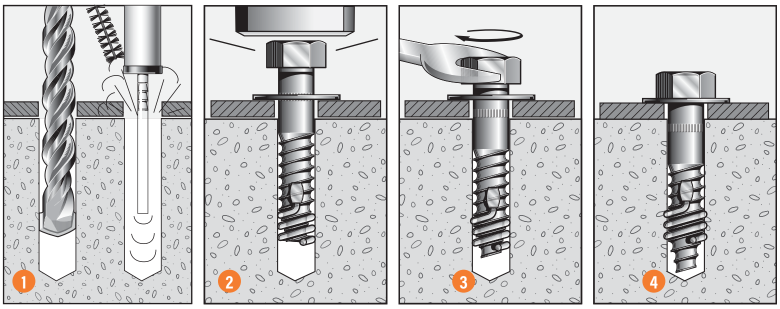
Easy and fast to remove:
- Expansion coil stays in hole leaving no protruding metal parts to grind off.

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 (3-4 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.)

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EXPANSION 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)	Turns to set anchor	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Steel	Non-Cracked Concrete		
							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

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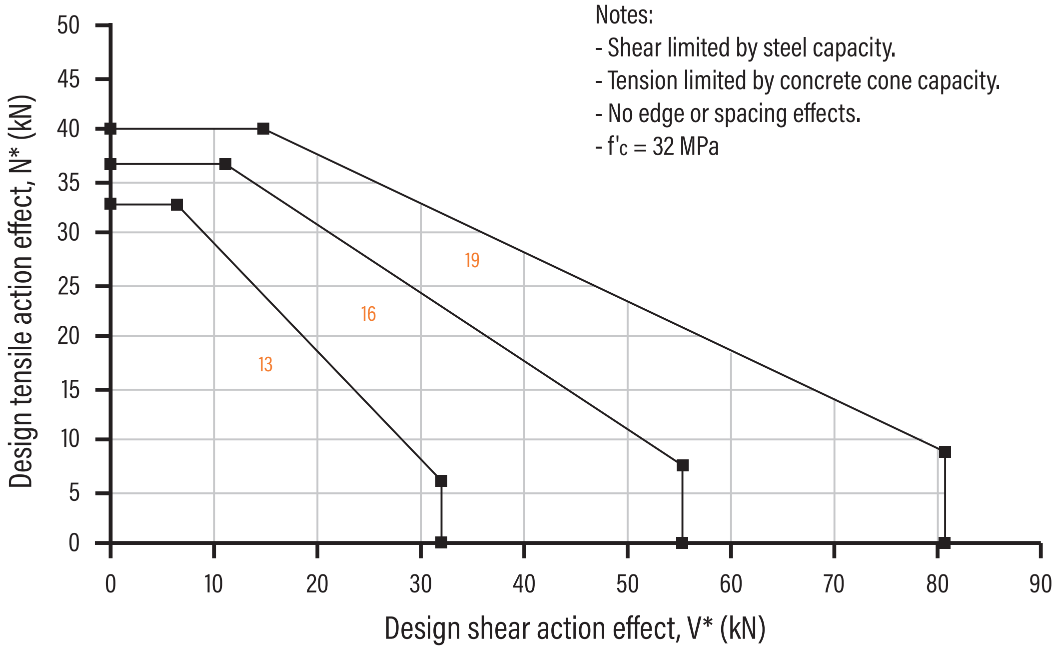
STRENGTH LIMIT STATE DESIGN

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading - interaction diagram



Notes:
- Shear limited by steel capacity.
- Tension limited by 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)		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.

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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

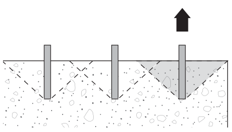
Anchor size, d_b (mm)	13	16	19
Effective depth, h (mm)			
40	12.1		
45	13.6		
50	15.1	18.6	
55	16.6	20.5	
60	18.1	22.3	26.5
70	21.2	26.0	30.9
80	24.2	29.8	35.3
90	27.2	33.5	**39.8**
100	30.2	**37.2**	
105	31.7		
110	**33.2**		

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

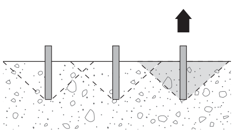
Table 2c Edge distance effect, tension, X_{ne}



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

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STRENGTH LIMIT STATE DESIGN

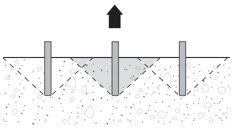

Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

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

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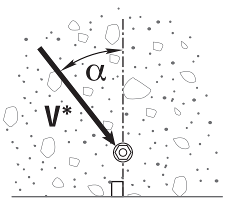
STRENGTH LIMIT STATE DESIGN

STEP 4 Verify concrete shear capacity - per anchor

Table 4a Reduced characteristic ultimate concrete edge shear capacity, ϕV_{uc} (kN), ϕ_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**

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STRENGTH LIMIT STATE DESIGN

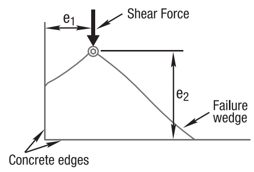
Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

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), $\phi_v = 0.8$

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

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.