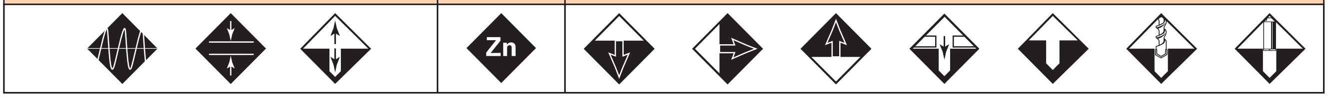
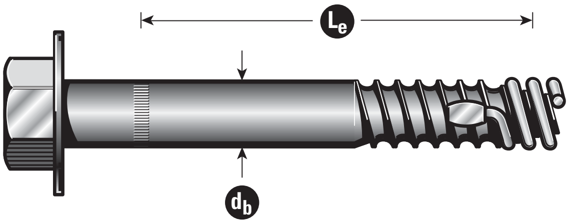
28.1 GENERAL INFORMATION

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.

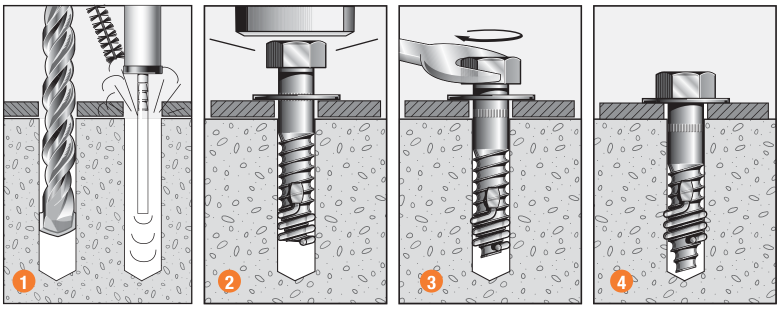
Fast installation:
- Through fixing eliminates marking out and repositioning of fixtures.

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

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. Tap the anchor down to the depth set mark, with a hammer, and stop.
3. Wind the anchor down, with an appropriately sized spanner or socket wrench, until the washer is firmly held to the fixture and stop (5 turns). Ensure washer is tight and snug fit.
4. 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.)

Mechanical Anchoring

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: Shear, $ØV_{us}$ (kN)	Concrete: Tension, $ØN_{uc}$ (kN)** Concrete compressive strength, f'c: 20 MPa	32 MPa	40 MPa
10	10	12	30	5	60	120	8.9	5.5	7.0	7.8
			50				14.3	9.2	11.6	13.0
			75				17.8	13.8	17.4	19.5
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
			105				74.3	36.7	46.4	51.9

* Note: For shear loads acting towards an edge or where these optimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
**Note: Reduced characteristic ultimate concrete tensile capacity = $ØN_{uc}$ where Ø = 0.6 and N_{uc} = Characteristic ultimate concrete tensile capacity.
For conversion to Working Load Limit MULTIPLY $ØN_{uc}$ x 0.55

28.2 DESCRIPTION AND PART NUMBERS

Anchor size, d_b (mm)	Effective length, L_e (mm)	Part No. Zn
10	47	BAC06060*
	62	BAC06075*
	87	BAC06100*
	112	BAC06125*
13	59	BAC08075
	84	BAC08100
	124	BAC08140
16	71	BAC10090
	106	BAC10125
19	63	BAC12085*
	93	BAC12115

*Note: Available in New Zealand only

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

28.3 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)
10	43.2	680	830	40.0
13	77.8	680	830	97.0
16	134.4	680	830	219.8
19	196.0	680	830	387.2

STEP 1 Select anchor to be evaluated

Table 1a Indicative combined loading – interaction diagram

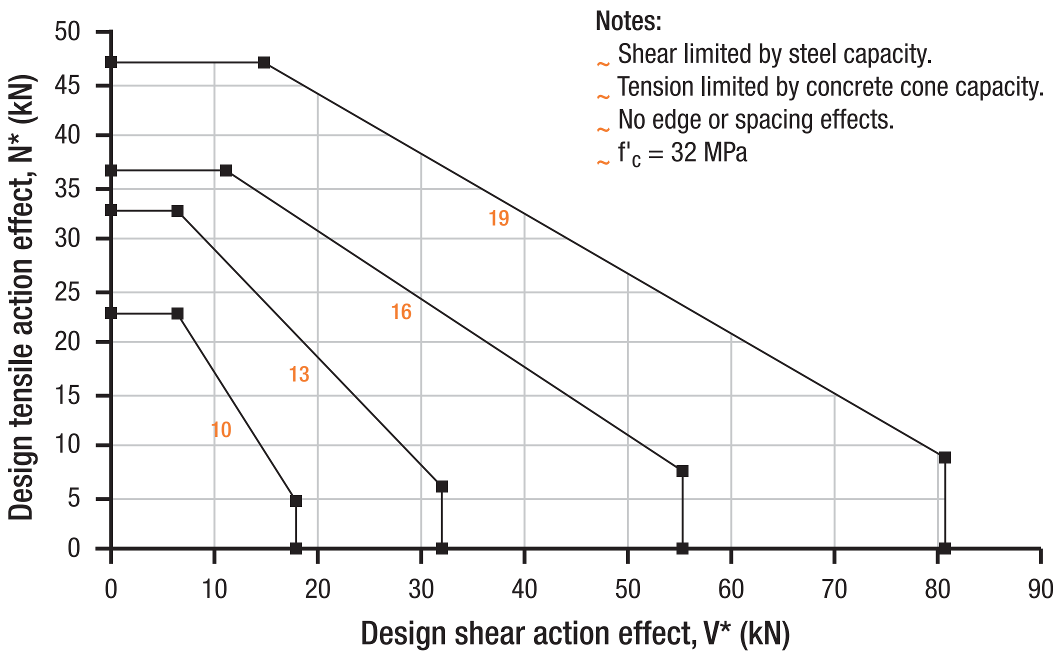


Table 1b Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Anchor size, d_b (mm)		10	13	16	19
Edge distance, e_m		50	65	80	95
Anchor spacing, a_m	$e \geq 6\ d_b$	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 194.

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.

Mechanical Anchoring

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

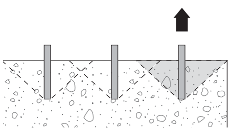
Anchor size, d_b (mm)	10	13	16	19
Effective depth, h (mm)				
30	7.0			
35	8.1			
40	9.3	12.1		
45	10.5	13.6		
50	11.6	15.1	18.6	
55	12.8	16.6	20.5	
60	13.9	18.1	22.3	26.5
70	16.3	21.2	26.0	30.9
80	18.6	24.2	29.8	35.3
90	20.9	27.2	33.5	39.8
100	**23.2**	30.2	**37.2**	44.2
105		31.7		**46.4**
110		**33.2**		

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

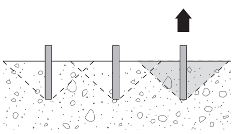
Table 2c Edge distance effect, tension, X_{ne}



Anchor size, d_b (mm)	10	13	16	19
Edge distance, e (mm)				
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

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)	10	13	16	19
Anchor spacing, a (mm)				
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

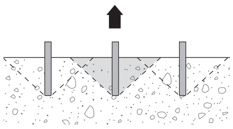


Table 2e Anchor spacing effect, internal to a row, tension, X_{nai}

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

Anchor size, d_b (mm)	10	13	16	19
Anchor spacing, a (mm)				
80	0.67			
90	0.75			
100	0.83	0.64		
120	1.00	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, $ØN_{urc}$

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

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 (mm)	10	13	16	19
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, $ØN_{ur}$

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

Check $N^* / ØN_{ur} \leq 1$,

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	$ØN_{urc}$	MULTIPLY $ØN_{urc}$ x 1.00	$ØN_{us}$	MULTIPLY $ØN_{us}$ x 1.00
Working Load Limit	N_{ac}	MULTIPLY $ØN_{urc}$ x 0.55	N_{as}	MULTIPLY $ØN_{us}$ x 0.56
Cyclic Loading	N_{yc}	MULITPLY $ØN_{urc}$ x 0.55	N_{ys}	MULITPLY $ØN_{us}$ x 0.56
Fire Resistance	$N_{Rk,c,fi,t}$	Refer to pages 238-257	$N_{Rk,s,fi,t}$	Refer to pages 238-257
Cracked Concrete/Tension Zone	$N^0_{Rd,p}$	Refer to pages 258-298	$N_{Rd,s}$	Refer to pages 258-298
Seismic	$N^0_{Rd,p,sis}$	Refer to pages 299-325	$N_{Rd,s,sis}$	Refer to pages 299-325

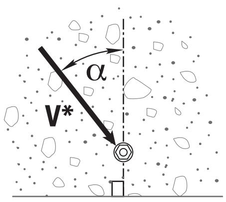
NOTE: Design Tensile Capacity is the minimum of Concrete Tension and Steel Tension Capacities

STEP 4 Verify concrete shear capacity - per anchor

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

Anchor size, d_b (mm)	10	13	16	19
Edge distance, e (mm)				
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	104.8	119.4	132.5	144.4
500	146.4	166.9	185.2	201.8
600	192.4	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.



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**

Mechanical Anchoring

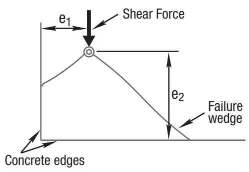
Table 4e Multiple anchors effect, concrete edge shear, X_{vn}

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, $ØV_{urc}$

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

STEP 5 Verify anchor shear capacity - per anchor

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

Anchor size, d_b (mm)	10	13	16	19
h ≥ 6 x d_b	17.8	32.0	55.3	80.7
h ≥ 5 x d_b	14.3	26.7	46.1	67.2
h ≥ 4 x d_b	11.4	21.3	36.9	53.8
h ≥ 3 x 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

Shear performance conversion table

Performance Required	Concrete Shear Performance		Steel Shear Performance	
	Notation	Concrete Shear Capacity	Notation	Carbon Steel Shear Capacity
Strength Limit State	$ØV_{uc}$	MULTIPLY $ØV_{uc}$ x 1.00	$ØV_{us}$	MULTIPLY $ØV_{us}$ x 1.00
Working Load Limit	V_{ac}	MULTIPLY $ØV_{uc}$ x 0.55	V_{as}	MULTIPLY $ØV_{us}$ x 0.50
Cyclic Loading	V_{yc}	MULITPLY $ØV_{uc}$ x 0.55	V_{ys}	MULITPLY $ØV_{us}$ x 0.50
Fire Resistance	$V_{Rk,c,fi,t}$	Refer to pages 238-257	$V_{Rk,s,fi,t}$	Refer to pages 238-257
Cracked Concrete/Tension Zone	$V^0_{Rd,c}$	Refer to pages 258-298	$V^0_{Rd,s}$	Refer to pages 258-298
Seismic	$V^0_{Rd,c,sis}$	Refer to pages 299-325	$V^0_{Rd,s,sis}$	Refer to pages 299-325

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

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.
To be installed in accordance with
Ramset™ Technical Data Sheet.