ANCHOR PERFORMANCE SECTIONS

8. MACSIM HLS; HIGH LOAD SAFETY ANCHOR 

9. MACSIM WEDGE ANCHOR; THROUGH BOLT 

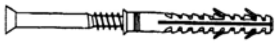
10. MACSIM MASONBOLT; SLEEVE ANCHOR 

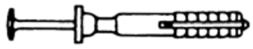
11. MACSIM MASONANCHOR; DROP IN ANCHOR 

12. MACSIM CHEMCAP SYSTEM; RESIN ANCHOR 

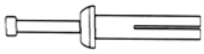
13. MACSIM QUICKFIX SYSTEM; INJECTION RESIN 

15. MACSIM SCREWBOLT ANCHOR 

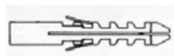
16. MACSIM FRAME ANCHOR 

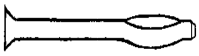
17. MACSIM BETTADRIVE ANCHOR 

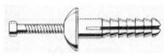
18. MACSIM METAL FRAME ANCHOR 

19. MACSIM MACDRIVE ANCHOR 

20. MACSIM MACLOC SHIELD ANCHOR 

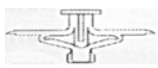
21. MACSIM MACPLUG NYLON PLUG 

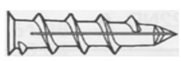
22. MACSIM SPLITZ ANCHOR 

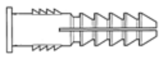
23. MACSIM NAIL-IN NYLON HAMMER PLUG 

24. MACSIM HOLLOW WALL ANCHOR 

25. MACSIM METAL TOGGLE ANCHORS 

26. MACSIM NYLON TOGGLE ANCHORS 

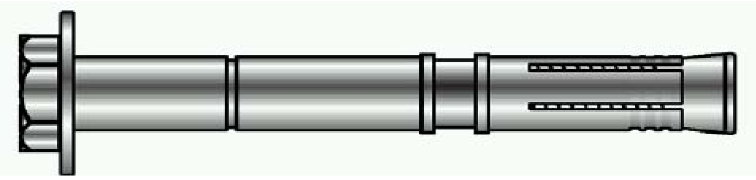
27. MACSIM WALLOK ANCHOR 

28. MACSIM PLASTICWALLPLUGS & SUPERPLUGS 

technical@macsim.com.au

HIGH LOAD SAFETY ANCHOR HLS 8

8.10 PRODUCT DESCRIPTION



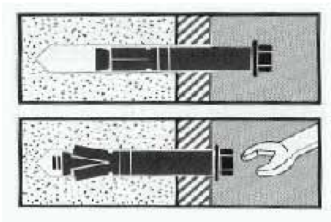
The Macsim HLS produces ultimate power from its heavy duty mechanical expansion design.

The anchor is ideal for structural steel connections to concrete, heavy equipment location, tilt-up prop anchoring and any other concrete based connection that requires a high degree of safety.

HLS can be used in areas where cracked concrete is a possibility as it will give a follow up expansion after slipping.

The HLS1225 (Size: 18mm x 120mm) conforms to Australian Standard AS3850-2003.

8.11 INSTALLATION



1) Drill Correct Diameter and depth of hole as specified.
2) Clean hole by brushing and blowing out dust carefully.
3) Push Anchor through fixture and hammer down until flush with surface.
4) Using a calibrated Torque Wrench apply correct torque setting as specified. The torque setting is critical, under torque may lead to slipping of the anchor before load capacity is reached, over torque may lead to permanent damage to the anchor and potential critical failure under loads.

Macsim Code	Thread Size (mm)	Anchor Dia. (mm)	Hole Dia. (mm)	Min. Hole Depth (mm)	Fixture Clearance Hole Dia. (mm)	Thickness Fastened Range (mm)	Min. Structural Thickness (mm)	Rec. Tight Torque (Nm)
HLS08	M8	12	12	80	14	10 - 50	110	25
HLS10	M10	14	14	90	16	10 - 50	140	50
HLS12	M12	18	18	105	20	10 - 50	160	80
HLS16	M16	24	24	125	26	10 - 50	200	180
HLS20	M20	28	28	160	30	10 - 50	250	400

8.12 SIMPLE LOAD CHARACTERISTICS

Thread Size (mm)	Hole Dia. (mm)	Min. Embed. Depth (mm)	Ultimate Tensile (kN)	Ultimate Steel Tensile Strength (kN)	Rec. Tensile Working Load (kN)	Rec. Shear Working Load (kN)	Rec. Anchor Spacing (mm)	Rec. Edge Distance (mm)
M8	12	60	23.4	23.4	9.4	11.7	200	150
M10	14	70	37.1	37.1	12.3	16.1	235	175
M12	18	80	50.3	54.0	16.7	23.1	265	200
M16	24	100	75.6	100.5	25.2	43.5	330	250
M20	28	125	109.8	166.6	36.6	63.2	420	315

Loads are applicable to 30 MPa Concrete and on the correct torque setting. Factors such as Close edge or neighboring anchor spacing may need to be applied; see following sections

A safety factor of 2.5:1 is included for M8 and 3:1 included for M10 to M20 of our Recommended Loads.

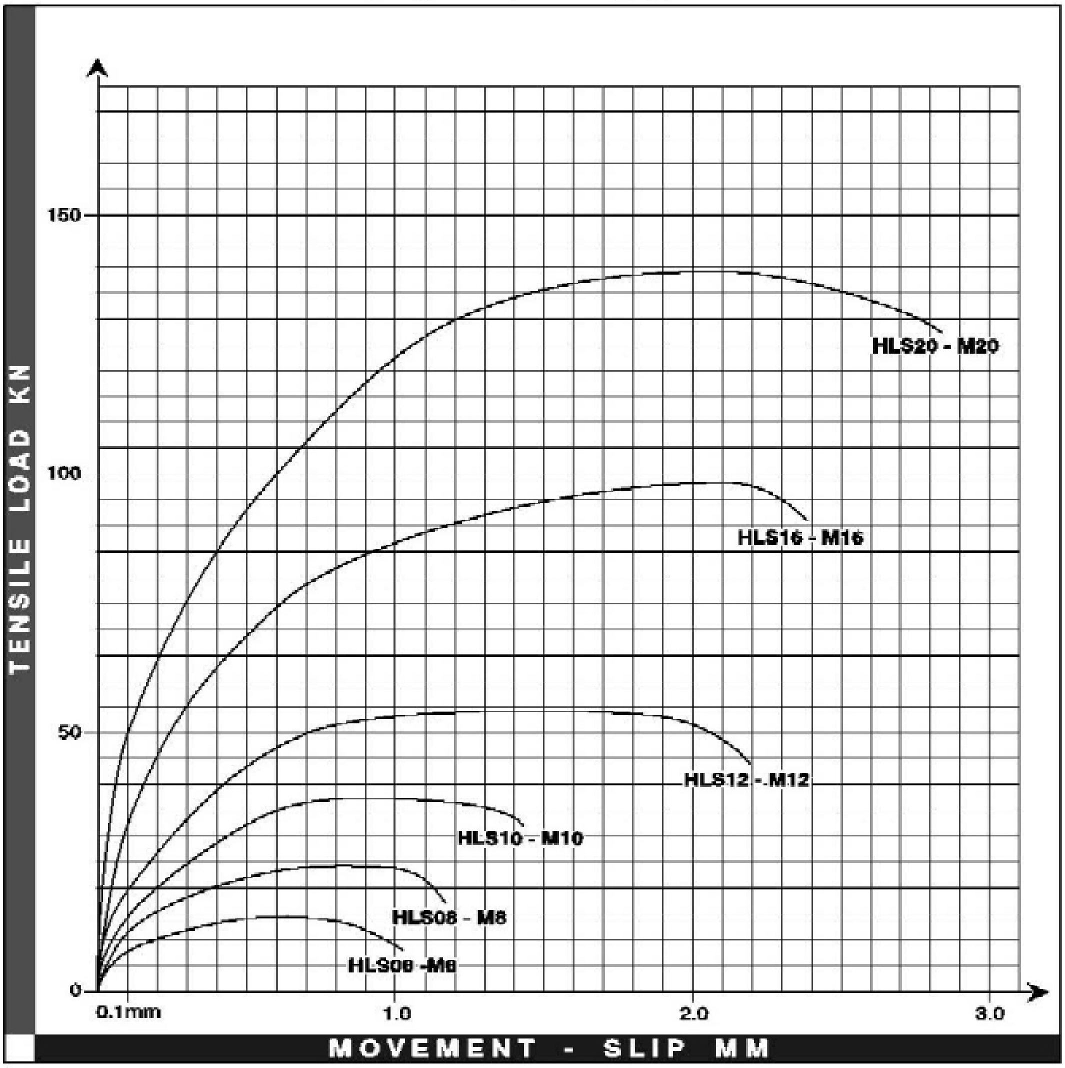
8.13 MATERIAL SPECIFICATION

Macsim Code	Thread Size (mm)	Anchor Dia. (mm)	Bolt Yield Strength N/mm^2	Bolt Ultimate Strength N/mm^2	Sleeve Yield Strength N/mm^2	Sleeve Ultimate Strength N/mm^2
HLS08	M8	12	640	800	410	510
HLS10	M10	14	640	800	410	510
HLS12	M12	18	640	800	410	510
HLS16	M16	24	640	800	375	460
HLS20	M20	28	640	800	375	460

HLS anchors are zinc plated to min. 6 microns in yellow passivation coating.

8.14 LOAD-SLIP CHARACTERISTICS

Macsim HLS may be applied where the load at first slip is critical. This chart shows the complete load movement characteristics with the specified torque setting applied and 24 hour relaxation allowed.

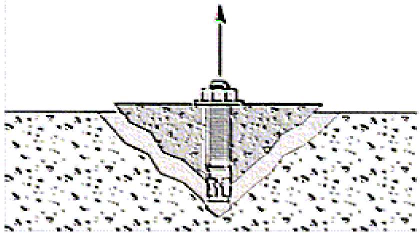


8.2 DETAILED DESIGN METHOD

STEP 1

T_{acc} : **THE CAPACITY TO RESIST CONCRETE CONE OR STRUCTURAL FAILURE IN TENSION**

$$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$$



T_{cfc} : CHARACTERISTIC DESIGN CAPACITY CONCRETE CONE

Thread Size	M8	M10	M12	M16	M20
T_{cfc} (kN)	12.90	19.50	23.50	34.80	47.20
Embedment Hs (mm)	60	70	80	100	125

f_{cst} CONCRETE STRENGTH FACTOR

Concrete Cube Compressive Strength* (MPa)	f_{cst}
25	0.9
30	1.0
35	TBA
40	TBA

TBA = To be advised

* 28th day concrete cube compressive strength tested in accordance with Construction Standard 1

f_{aet} ANCHOR EMBEDMENT FACTOR

The embedment depths shown must be achieved.

$f_{aet} = 1.0$

8.2 DETAILED DESIGN METHOD CON'T

STEP 1 (Con't)

f_{ast} CLOSE SPACING REDUCTION FACTOR

Thread Size	M8	M10	M12	M16	M20
Spacing S_p (mm)					
55					
65	0.64				
80	0.68	0.65			
95	0.72	0.68	0.66		
110	0.76	0.72	0.69	0.64	
135	0.83	0.78	0.74	0.68	0.64
165	0.91	0.84	0.80	0.73	0.68
200	1.00	0.92	0.87	0.79	0.72
235		1.00	0.94	0.84	0.77
265			1.00	0.89	0.81
330				1.00	0.89
420					1.00
Embedment Hs (mm)	60	70	80	100	125

$$f_{ast} = 0.467 + \frac{0.16 \times S_p}{H_s}$$

H_s = Embedment (mm)

S_p = Actual Spacing (mm)

For more than two anchors a factor must be considered for each spacing and multiplied.

8.2 DETAILED DESIGN METHOD CON'T

STEP 1 (Con't)

f_{ast} CLOSE SPACING REDUCTION FACTOR

Thread Size	M8	M10	M12	M16	M20
Spacing S_p (mm)					
55					
65	0.64				
80	0.68	0.65			
95	0.72	0.68	0.66		
110	0.76	0.72	0.69	0.64	
135	0.83	0.78	0.74	0.68	0.64
165	0.91	0.84	0.80	0.73	0.68
200	1.00	0.92	0.87	0.79	0.72
235		1.00	0.94	0.84	0.77
265			1.00	0.89	0.81
330				1.00	0.89
420					1.00
Embedment Hs (mm)	60	70	80	100	125

$$f_{ast} = 0.467 + \frac{0.16 \times S_p}{H_s}$$

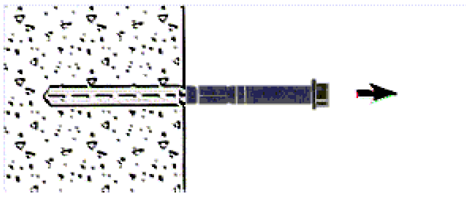
H_s = Embedment (mm)

S_p = Actual Spacing (mm)

For more than two anchors a factor must be considered for each spacing and multiplied.

8.2 DETAILED DESIGN METHOD CON'T

STEP 2



T_{apc} : ANCHOR PULL-OUT RESISTANCE

$$T_{apc} = T_{cfp} \times f_{csp} \times f_{aep}$$

T_{cfp} : CHARACTERISTIC DESIGN CAPACITY FOR ANCHOR PULL-OUT

Thread Size	M8	M10	M12	M16	M20
T_{cfp} (kN)	15.10	22.10	28.70	42.60	65.10
Embedment Hs (mm)	60	70	80	100	125

f_{csp} CONCRETE STRENGTH FACTOR

Concrete Cube Compressive Strength* (MPa)	f_{csp}
25	0.9
30	1.0
35	TBA
40	TBA

TBA = To be advised

* 28th day concrete cube compressive strength tested in accordance with Construction Standard 1.

f_{aep} ANCHOR EMBEDMENT FACTOR

The embedment depths shown must be achieved.

f_{aep} = 1.0

STEP 3

T_{cfs} : ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

Thread Size	M8	M10	M12	M16	M20
T_{cfs} (kN)	23.4	37.1	54.0	100.5	166.6

8.2 DETAILED DESIGN METHOD CON'T

STEP 4

T_{ulsd} : ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

The ultimate tensile resistance of a single anchor is the lower of the,

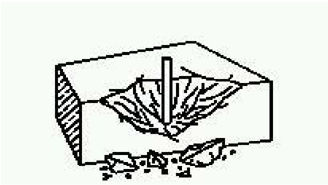
T_{acc} : THE CAPACITY TO RESIST CONCRETE CONE OR STRUCTURAL FAILURE IN TENSION

T_{apc} : ANCHOR PULL-OUT RESISTANCE

T_{cfs} : ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

STEP 5

S_{acc} : CONCRETE EDGE RESISTANCE SHEAR



$$S_{acc} = S_{cfc} \times f_{css} \times f_{dls} \times f_{ass} \times f_{asds}$$

S_{cfc} : CHARACTERISTIC DESIGN CAPACITY FOR CONCRETE EDGE SHEAR FAILURE

Thread Size	M8	M10	M12	M16	M20
S_{cfc} (kN)	5.50	7.50	9.80	15.60	24.90
Min. Edge Distance Ed (mm)	55	60	80	95	120
Embedment Hs (mm)	60	70	80	100	125

f_{css} CONCRETE STRENGTH FACTOR IN SHEAR

Concrete Cube Compressive Strength* (MPa)	f_{css}
25	0.9
30	1.0
35	TBA
40	TBA

TBA = To be advised

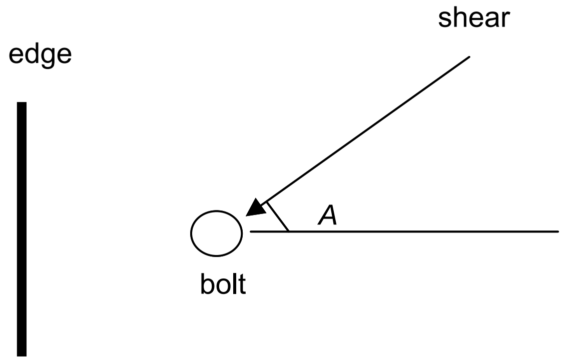
* 28th day concrete cube compressive strength tested in accordance with Construction Standard 1

8.2 DETAILED DESIGN METHOD CON'T

STEP 5 (Con't)

f_{dls} : FACTOR OF SHEAR LOADING DIRECTION TO EDGE

Load Angle A from perpendicular to edge (°)	f_{dls}
0 - 55	1.00
60	1.07
70	1.23
80	1.50
91 - 180	2.00



$$f_{dls} = \frac{1}{\cos A + 0.5 \sin A}$$

for A = 56° to 90°

f_{ass} CLOSE SPACING REDUCTION FACTOR FOR SHEAR

Thread Size	M8	M10	M12	M16	M20
Spacing S_p (mm)					
65	0.66				
80	0.70	0.67			
95	0.74	0.70	0.68		
110	0.78	0.74	0.71	0.67	
135	0.84	0.79	0.75	0.70	0.66
165	0.91	0.85	0.81	0.75	0.70
200	1.00	0.93	0.88	0.80	0.74
235		1.00	0.94	0.85	0.78
265			1.00	0.90	0.82
330				1.00	0.90
420					1.00
Embedment Hs (mm)	60	70	80	100	125

$$f_{ass} = 0.5 + \frac{0.15 \times S_p}{H_s}$$

H_s = Embedment (mm)

S_p = Actual Spacing (mm)

For more than two anchors a factor must be considered for each spacing and multiplied.

8.2 DETAILED DESIGN METHOD CON'T

STEP 5 (Con't)

f_{asds} CLOSE EDGE REDUCTION FACTOR

Thread Size	M8	M10	M12	M16	M20
Edge Distance E_d (mm)					
65	0.33				
75	0.41	0.32			
80	0.45	0.36	0.29		
105	0.64	0.53	0.44	0.31	
115	0.72	0.59	0.50	0.36	0.25
125	0.80	0.66	0.55	0.41	0.29
150	1.00	0.83	0.70	0.53	0.38
175		1.00	0.85	0.64	0.48
200			1.00	0.76	0.57
250				1.00	0.76
315					1.00
Embedment Hs (mm)	60	70	80	100	125

$$f_{asds} = \frac{0.47 \times E_d}{H_s} - 0.18$$

H_s = Embedment (mm)

E_d = Actual Edge Distance (mm)

For more than one edge a factor must be considered for each distance and multiplied.

The Min. edge distances shown must be achieved.

STEP 6

S_{cfs} : **ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)**

Thread Size	M8	M10	M12	M16	M20
S_{cfs} (kN)	22.48	38.56	55.12	104.56	151.68

8.2 DETAILED DESIGN METHOD CON'T

STEP 7

S_{ulsd} : ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

The ultimate shear resistance of a single anchor is the lower of the,

S_{acc} : CONCRETE EDGE RESISTANCE SHEAR
S_{cfs} : ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)

STEP 8

ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} \leq 1.20$$

T = Design Tensile load
S = Design Shear load

MACSIM WEDGE ANCHOR; THROUGH BOLT

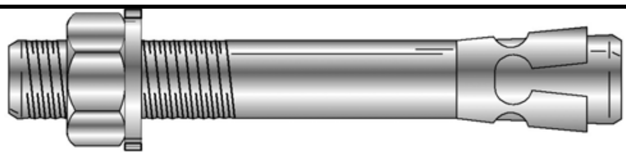
Product Description

THE MACSIM WEDGE ANCHOR IS DESIGNED TO FIX A COMPONENT TO CONCRETE AND OFFERS THE ADVANTAGE OF NEEDING THE SAME CLEARANCE HOLE DIAMETER AS THE DRILL HOLE.

THE DESIGN GIVES HIGH TENSILE AND SHEAR PERFORMANCE, WITH SIMPLE INSTALLATION AND INSTANTANEOUS LOAD CAPABILITY.

THE ANCHOR IS IDEAL FOR ATTACHING STEEL COMPONENTS TO CONCRETE SUCH AS LEDGER ANGLE, WALL TIES, SUPPORT BRACKETS, PROPS AND TIMBER BEAMS TO CONCRETE.

9.10 INSTALLATION



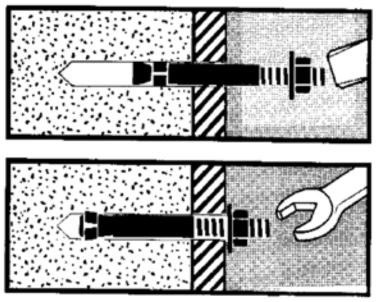
Macsim Code	Stud Dia	Anchor Dia mm	Drill Dia mm	Min Hole Depth mm	Fixture Clearance hole mm	Thickness Fastened Range mm	Min Structure thickness mm	Torque Setting Nm
3806XXX	M6	6	6	45	6.5	30 - 150	75	6
3808XXX	M8	8	8	65	10	5 - 45	85	15
3810XXX	M10	10	10	70	12	10 - 65	90	30
3812XXX	M12	12	12	80	13	10 - 60	95	45
3816XXX	M16	16	16	100	18	15 - 50	120	110
3820XXX	M20	20	20	120	22	15 - 95	150	180

INSTALLATION PROCEDURE: REINFORCED CONCRETE

Drill Correct Diameter and depth of hole as specified above. Clean hole by brushing and blowing out dust carefully.

Push Anchor through fixture and hammer down until flush with surface.

Using a calibrated Torque Wrench apply correct torque setting as specified above. The torque setting is critical, under torque may lead to slipping of the anchor before load capacity is reached, over torque may lead to permanent damage to the anchor and potential critical failure under load.



9.11 SIMPLE LOAD CHARACTERISTICS

Anchor Bolt Size	Hole Dia mm	Min Embed. Depth mm	Ultimate Tensile* Kn	Nom. Steel Tensile Strength Kn	Rec. Tens. Working Load Kn	Rec. Shear Working Load Kn	Rec. Anchor Spacing mm	Rec. Edge Distance mm
M6	6	37	6.50	4.95	1.50	1.60	110	55
M8	8	55	15.50	19.40	3.20	3.00	150	75
M10	10	60	17.50	27.50	4.30	4.00	165	85
M12	12	60	30.00	31.90	5.60	5.00	195	100
M16	16	80	45.00	56.90	10.30	11.00	240	120
M20	20	100	75.00	87.50	13.80	15.00	300	150

Loads are applicable to 30 MPa Concrete and on the correct torque setting. Factors such as Close edge or neighboring anchor spacing may need to be applied; see following sections.

**** From Actual Tested averages. Loads maybe increased by using greater embedment depth.***

9.12 MATERIAL SPECIFICATION

Macsim Wedge Anchor is available in a 5µm yellow passivated zinc plate, a 25µm min. galvanised coating or in Stainless Steel Grade 316 (AISI A4/70)

Zinc Plated/ Galvanised

Macsim Code	Anchor Dia mm	Hole Dia mm	Bolt Yield Strength N/mm^2	Bolt Ultimate Strength N/mm^2	Exp. Clip Yield Strength N/mm^2	Exp. Clip Ultimate Strength N/mm^2
3806XXX	6	6	240	300	360	460
3808XXX	8	8	430	580	360	460
3810XXX	10	10	430	580	360	460
3812XXX	12	12	430	580	360	460
3816XXX	16	16	430	580	360	460
3820XXX	20	20	430	580	360	460

Stainless Steel 316

Macsim Code	Anchor Dia mm	Hole Dia mm	Bolt Yield Strength N/mm^2	Bolt Ultimate Strength N/mm^2	Sleeve Yield Strength N/mm^2	Sleeve Ultimate Strength N/mm^2
38S08XXX	8	8	480	600	500	700
38S10XXX	10	10	480	600	500	700
38S12XXX	12	12	480	600	500	700
38S16XXX	16	16	480	600	500	700
38S20XXX	20	20	480	600	500	700

Tensile Strengths refer to the threaded section. The reduced section produces a consistently higher tensile stress

TENSILE LOADING

9.20 T_{acc} CONCRETE FAILURE RESISTANCE TENSION

$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$

THE CAPACITY TO RESIST CONE OR STRUCTURAL FAILURE

T_{cfc} = Characteristic Design Capacity, f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor; f_{aet}= Anchor Embed. Factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE CONE T_{cfc}

Bolt Dia	M6	M8	M10	M12	M16	M20
Tensile KN T_{cfc}	5.50	8.00	9.00	10.90	20.50	28.55
H_S embedment	37	55	60	60	80	100

Characteristic Ultimate Concrete Strength in Tension; Reduction factor = 1.70

CONCRETE STRENGTH FACTOR f_{cst}

Concrete Strength Mpa	20	25	30	35	40
	0.75	0.90	1.00	1.00	1.00

ANCHOR EMBEDMENT FACTOR f_{aet}

Characteristic Ultimate Design capacity Concrete Tension;

Anchor Size	M6	M8	M10	M12	M16	M20
Embed. Depth Hs						
35	1.0					
45	1.2	0.7				
55	1.7	1.0	0.7	0.7		
60	1.9	1.2	1.0	1.0		
70	2.5	1.5	1.1	1.2	0.7	
80		2.0	1.4	1.4	1.0	
90			1.7	1.7	1.2	0.8
100				2.0	1.4	1.0
120					1.7	1.4
140						1.7
160						2.0

TENSILE LOADING

CLOSE EDGE REDUCTION FACTOR f_{adt} Through Bolt

For more than one edge a factor must be considered for each distance and multiplied

	Bolt Dia	M6	M8	M10	M12	M16	M20
Edge Distance Ed							
50		0.93					
55		1.0	0.80				
60			0.85	0.80			
75			1.00	0.93			
80				0.98	0.87		
83				1.00	0.89		
95					0.98	0.84	
97					1.00	0.86	
110						0.94	
120						1.00	0.85
130							0.90
140							0.95
150							1.00
H_S Embedment mm		*37*	*50*	*55*	*65*	*80*	*100*

f_{adt} = 0.25 + 0.5 x Ed/Hs (Ed = Edge Distance, Hs = embed

The Min edge distances shown must be respected.

CLOSE SPACING REDUCTION FACTOR f_{ast} Through Bolt

For more than two anchors a factor must be considered for each spacing and multiplied

	Bolt Dia	M6	M8	M10	M12	M16	M20
Spacing Sp							
40		0.68					
55		0.75	0.68				
60		0.77	0.70	0.68			
80		0.86	0.77	0.74	0.71		
95		0.93	0.82	0.79	0.74	0.70	
110		1.00	0.87	0.83	0.78	0.73	
115			0.88	0.85	0.79	0.74	0.69
150			1.00	0.95	0.88	0.81	0.75
165				1.00	0.92	0.84	0.78
190					0.99	0.90	0.82
195					1.00	0.91	0.83
240						1.00	0.90
300							1.00
Embedment mm		*37*	*50*	*55*	*65*	*80*	*100*

f_{ast} = 0.5+ Sp/6xHs
Hs = embed; Sp = Spacing

9.20 T_{acc} CONCRETE FAILURE RESISTANCE TENSION (Cont.)

9.21 T_{apc} ANCHOR PULL-OUT RESISTANCE

$T_{apc} = T_{cfp} \times f_{cstp} \times f_{aetp}$

CHARACTERISTIC DESIGN CAPACITY ANCHOR PULL-OUT T_{cfp}

Bolt Dia		M6	M8	M10	M12	M16	M20
Tensile KN							
	Zinc Plated	2.60	5.80	6.40	9.70	19.10	27.60
	Galvanised	2.60	5.80	6.40	9.70	19.10	27.60
	Stainless 316	2.90	5.80	6.40	9.70	18.70	24.60
Hs embedment		37	50	55	65	80	100

CONCRETE STRENGTH FACTOR PULL OUT f_{cstp}

In the case of the Macsim Wedge Throughbolt Anchor in Tension f_{cst} = 1.0 the concrete strength must be greater than 25 MPa.

ANCHOR EMBEDMENT FACTOR PULL OUT $f_{aet\,p}$

In the case of the Macsim Wedge Throughbolt Anchor in Tension f_{aet} = 1.0 the minimum embedment depths shown must be achieved.

9.22 T_{cfs} ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

Bolt Dia		M6	M8	M10	M12	M16	M20
Tensile KN							
	Zinc Plated	4.10	13.95	20.00	23.00	41.50	63.00
	Galvanised	n/a	13.95	20.00	23.00	41.50	63.00
	Stainless 316	n/a	14.50	21.00	27.00	49.50	80.00

Characteristic Ultimate Steel Strength in Tension; Reduction factor = 1.30

9.23 T_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

T_{ulsd} = *LOWEST CALCULATED VALUE OF;* T_{acc} , T_{apc} , T_{cfs}

Check that your required Tensile Loading < or = to T_{ulsd}

SHEAR LOADING

9.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Characteristic Design Capacity, f_{asds} = Edge and spacing Factor,
f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE EDGE S_{cfc}

Bolt Dia		M6	M8	M10	M12	M16	M20
Shear KN							
	Zinc Plated	2.50	3.00	4.00	7.00	10.50	15.00
	Galvanised	2.50	3.00	4.00	7.00	10.50	15.00
	Stainless 316	2.50	3.00	4.00	7.00	10.50	15.00
Absolute Min	Edge mm	50	55	60	80	95	120
Hs embedment mm		37	50	55	65	80	100

Characteristic Design Capacity structural edge failure; Reduction factor = 1.70

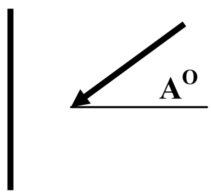
FACTOR OF CONCRETE STRENGTH IN SHEAR f_{css}

Concrete 30 Day Strength Mpa	f_{css}
20	0.80
25	1.00
30	1.10
35	1.15
40	1.20

The Macsim Wedge Through Bolt Anchor is only suitable for Concrete Strengths > 20MPa and there is no data available for strengths in excess of 40 MPa

FACTOR OF SHEAR LOADING DIRECTION TO EDGE f_{dls}

Load Angle A from perp' to edge(^{O})	f_{dls}
0 to 45	1.00
60	1.10
70	1.20
80	1.50
90 to 180	2.00



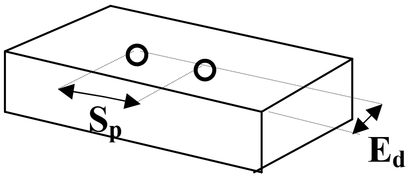
S = applied Shear Force

9.31 S_{acc} CONCRETE EDGE RESISTANCE SHEAR (Cont.)

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

FACTOR OF EDGE DISTANCE AND ANCHOR SPACING IN SHEAR f_{asds}

$$f_{asds} = \frac{3E_d + S_p}{6 \cdot E_{d(min)}} \cdot \sqrt{\frac{E_d}{E_{d(min)}}}$$



This formula (based on European data) is true for a pair of anchors resisting shear, close to an edge (edge distance < 3 x Hs embed) and where Sp is < 3 x Ed.

E_d = Actual Edge Distance

$E_{d(min)}$ = Min Edge allowed (Table sec. 9.2)

S_p = Actual Spacing between Anchors

Assumes no other edge < 3 x $E_{d(min)}$ present
(Not diameter dependant; factor of embedment)

9.32 S_{cfs} ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)

Bolt Dia		M6	M8	M10	M12	M16	M20
Shear KN							
	Zinc Plated	3.0	6.1	9.0	13.5	22.6	38.4
	Galvanised	n/a	6.1	9.0	13.5	22.6	38.4
	Stainless 316	n/a	n/a	n/a	16.5	31.5	49.0

Characteristic Ultimate Steel Strength in Shear; Reduction factor = 1.30

9.33 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

S_{ulsd} = *LOWEST CALCULATED VALUE OF;* S_{acc} , S_{cfs}

Check that your required Shear Loading < or = to S_{ulsd}

9.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

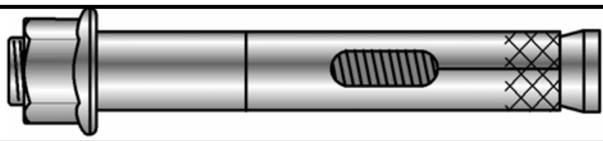
$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

T = Required Applied Tensile load Component, S = Required Applied Shear load Component
T_{ulsd} = Ultimate Limit State Tensile capacity, S_{ulsd} = Ultimate Limit State Shear Capacity

MACSIM MASONBOLT; SLEEVE ANCHOR

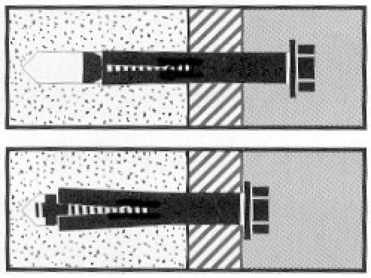
Product Description
THE MACSIM MASONBOLT IS A HIGH QUALITY SLEEVE ANCHOR DESIGNED TO GIVE OPTIMAL PERFORMANCE AT LOW PRICE IN CONCRETE, MASONRY AND OTHER SOLID BASE MATERIALS.
THE DESIGN GIVES MEDIUM-HIGH TENSILE AND SHEAR PERFORMANCE, WITH SIMPLE THROUGH—FIX INSTALLATION AND INSTANTANEOUS LOAD CAPABILITY.
THE ANCHOR IS IDEAL FOR ATTACHING STEEL COMPONENTS TO CONCRETE SUCH AS WALL TIES, SUPPORT BRACKETS, FENCE SUPPORTS ETC.

10.10 INSTALLATION



Macsim Code	Anchor Size	Stud/Bolt Thread Size	Drill Dia mm	Min Hole Depth mm	Fixture Clearance hole mm	Thickness Fastened Range mm	Min Structure thickness mm	Torque Setting Nm
0406XXX	6.5	M5	6.5	40	8	3 - 45	70	5
0408XXX	8	M6	8	45	10	5 - 50	80	10
0410XXX	10	M8	10	50	12	5 - 85	85	30
0412XXX	12	M10	12	70	14	10 - 79	100	50
0416XXX	16	M12	16	75	18	10 - 92	110	80
0420XXX	20	M16	20	80	22	15 - 90	130	160

INSTALLATION PROCEDURE: REINFORCED CONCRETE
Drill Correct Diameter and depth of hole as specified above. Clean hole by brushing and blowing out dust carefully.
Push Anchor through fixture and hammer down until flush with surface.
Using a calibrated Torque Wrench apply correct torque setting as specified above. The anchor should not be over tightened or it may be permanently damaged, leading to premature failure. The highly variable amount of expansion means that it may require several turns to fully tighten in softer materials than concrete.



10.11 SIMPLE LOAD CHARACTERISTICS

Anchor Size	Hole Dia mm	Min Embed. Depth mm	Ultimate Tensile Kn	Ult. Steel Tensile Strength Kn	Rec. Tens. Working Load Kn	Rec. Shear Working Load Kn	Rec. Anchor Spacing mm	Rec. Edge Distance mm
6.5	6.5	30	8.00	10.00	1.50	1.70	100	50
8	8	35	9.50	16.00	2.10	2.10	120	55
10	10	40	18.00	25.00	3.70	4.10	135	65
12	12	50	21.00	32.00	5.60	6.30	165	80
16	16	55	30.00	42.00	6.80	8.30	180	90
20	20	60	35.00	62.00	7.50	12.50	200	100

Loads are applicable to 30 MPa Concrete and on the correct torque setting. Factors such as Close edge or neighboring anchor spacing may need to be applied; see following sections. (Data for Zinc Plated Version)

10.12 MATERIAL SPECIFICATION

Macsim Masonbolt is available in a 8µm yellow passivated zinc plate, a 25µm min. galvanised coating (Bolt and Sleeve; 40µm on Hex Nut) or in Stainless Steel Grade 316 (AISI A4/70)

Zinc Plated/ Galvanised

Macsim Code	Anchor Size	Hole Dia mm	Bolt Yield Strength N/mm^2	Bolt Ultimate Strength N/mm^2	Sleeve Yield Strength N/mm^2	Sleeve Ultimate Strength N/mm^2
0406XXX	6.5	6.5	640	800	640	800
0408XXX	8	8	640	800	640	800
0410XXX	10	10	550	700	640	800
0412XXX	12	12	440	550	640	800
0416XXX	16	16	400	500	640	800
0420XXX	20	20	320	410	640	800

Stainless Steel 316

Macsim Code	Anchor Size	Hole Dia mm	Bolt Yield Strength N/mm^2	Bolt Ultimate Strength N/mm^2	Sleeve Yield Strength N/mm^2	Sleeve Ultimate Strength N/mm^2
0406XXX	6.5	6.5	480	600	480	600
0408XXX	8	8	480	600	480	600
0410XXX	10	10	480	600	480	600
0412XXX	12	12	480	600	480	600
0416XXX	16	16	n/a	n/a		
0420XXX	20	20	n/a	n/a		

Tensile Strengths refer to the threaded section. Core diameters and other dimensional information available on request.

TENSILE LOADING

10.20 T_{acc} CONCRETE FAILURE RESISTANCE TENSION

$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$

THE CAPACITY TO RESIST CONE OR STRUCTURAL FAILURE

T_{cfc} = Characteristic Design Capacity, f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor; f_{aet}= Anchor Embed. Factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE CONE T_{cfc}

Anchor Dia		6.5	8	10	12	16	20
Tensile KN T_{cfc}		4.80	5.70	10.80	12.60	18.00	21.00
Hs embedment		30	35	40	50	55	60

Characteristic Ultimate Concrete Strength in Tension; Reduction factor = 1.70

ANCHOR EMBEDMENT FACTOR f_{aet}

Anchor Size	6.5	8	10	12	16	20
Embed. Depth Hs						
25	0.77	0.77				
30	1.00	0.84	0.44			
35		1.00	0.53	0.45		
40			1.00	0.86	0.60	
50			1.16	1.00	0.70	0.60
55				1.40	1.00	0.86
60					1.15	1.00
80					1.50	1.30
90						1.60

CLOSE EDGE REDUCTION FACTOR f_{adt} MASONBOLT
For more than one edge a factor must be considered for each distance and multiplied

Bolt Dia	M5	M6	M8	M10	M12	M16
Edge Distance Ed	(6.5 dia)	(8 dia)	(10 dia)	(12 dia)	(16 dia)	(20 dia)
35	0.78					
45	0.95	0.84				
50	1.00	0.91	0.83			
55		1.00	0.89	0.75		
60			0.95	0.80	0.75	
65			1.00	0.85	0.79	0.74
75				0.95	0.88	0.83
80				1.00	0.93	0.87
90					1.00	0.95
100						1.00
Hs	30	35	40	50	55	60

Fedg = 0.2 + 0.5x Ed/Hs
Ed = Actual Edge Distance; Hs = Embed depth mm

The Min edge distances shown must be respected.

10.20 T_{acc} CONCRETE FAILURE RESISTANCE TENSION (Cont.)

CLOSE SPACING REDUCTION FACTOR f_{ast} MASONBOLT

For more than two anchors a factor must be considered for each spacing and multiplied

	Bolt Dia	M5	M6	M8	M10	M12	M16
Spacing Sp mm		(6.5 dia)	(8 dia)	(10 dia)	(12 dia)	(16 dia)	(20 dia)
40		0.66					
55		0.75	0.70				
65		0.80	0.75	0.71			
80		0.88	0.82	0.77	0.71		
85		0.91	0.84	0.79	0.72	0.70	
90		0.94	0.87	0.82	0.74	0.71	0.69
100		1.00	0.89	0.84	0.76	0.73	0.70
120			1.00	0.94	0.84	0.80	0.77
135				1.00	0.89	0.85	0.82
165					1.00	0.94	0.90
180						1.00	0.94
200							1.00
	Hs	30	35	40	50	55	60

f_{ast} = 0.44+ Sp/6xHs

Sp = Actual Anchor Spacing; Hs = Embed depth mm

CONCRETE STRENGTH FACTOR; CONCRETE FAILURE f_{cst}

In the case of the Macsim Masonbolt f_{cst} = 1.0 the concrete strength must be greater than 20 MPa.

CONCRETE FAILURE RESISTANCE;

$$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$$

10.21 T_{apc} ANCHOR PULL-OUT RESISTANCE

$$T_{apc} = T_{cfp} \times f_{cstp} \times f_{aetp}$$

CHARACTERISTIC DESIGN CAPACITY ANCHOR PULL-OUT T_{cfp}

Bolt Dia		M5	M6	M8	M10	M12	M16
		(6.5 dia)	(8 dia)	(10 dia)	(12 dia)	(16 dia)	(20 dia)
Tensile KN	Zinc Plated	5.25	6.25	11.85	13.80	19.75	23.05
	Galvanised	5.25	6.25	11.85	13.80	19.75	23.05
	Stainless 316	5.25	6.25	11.85	13.80	19.75	23.05
Hs embedment		25	35	40	50	55	60

Characteristic Ultimate Pull Out Strength in Tension; Reduction factor = 1.55

10.22 T_{cfs} ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

ANCHOR EMBEDMENT FACTOR f_{aetp}

In the case of the Macsim Masonbolt Anchor in Tension f_{aetp} = 1.0 the embedment depths shown must be achieved.

CONCRETE STRENGTH FACTOR f_{cstp}
In the case of the Macsim Masonbolt Anchor in Tension f_{cstp} = 1.0 the concrete strength must be greater than 20 MPa.

Bolt Dia		M5	M6	M8	M10	M12	M16
		(6.5 dia)	(8 dia)	(10 dia)	(12 dia)	(16 dia)	(20 dia)
Tensile KN	Zinc Plated	7.70	12.40	19.70	24.50	32.40	48.00
	Galvanised	7.70	12.40	19.70	24.50	32.40	48.00
	Stainless 316	n/a	9.30	16.90	26.90	n/a	n/a

Characteristic Ultimate Steel Strength in Tension; Reduction factor = 1.30

10.23 T_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

T_{ulsd} = *LOWEST CALCULATED VALUE OF;* T_{acc} , T_{apc} , T_{cfs}

Check that your required Tensile Loading < or = to T_{ulsd}

SHEAR LOADING

10.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Characteristic Design Capacity, f_{asds} = Edge and spacing Factor,
f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE EDGE S_{cfc}

Bolt Dia		M6	M8	M10	M12	M16	M20
Shear KN							
	Zinc Plated	2.10	3.50	4.50	5.4	7.8	9.5
	Galvanised	2.10	3.50	4.50	5.4	7.8	9.5
	Stainless 316	2.10	3.50	4.50	5.4	7.8	9.5
Absolute Min Edge mm		35	45	50	55	60	65
Hs embedment mm		30	35	40	50	55	60

FACTOR OF CONCRETE STRENGTH IN SHEAR f_{css}

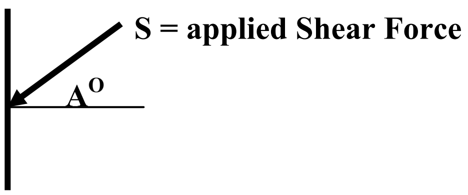
Concrete 30 Day strength Mpa	f_{css}
20	1.00
25	1.10
30	1.10
35	1.10
40	1.10

The Macsim Masonbolt Anchor is only suitable for Concrete Strengths > 20MPa and there is no data available for strengths in excess of 40 MPa

The Masonbolt will perform well in softer material such as Masonry, but we cannot give load performance Data without on site testing.

FACTOR OF SHEAR LOADING DIRECTION TO EDGE f_{dls}

Load Angle A from perp' to edge(^{O})	f_{dls}
0 to 45	1.00
60	1.10
70	1.20
80	1.50
90 to 180	2.00

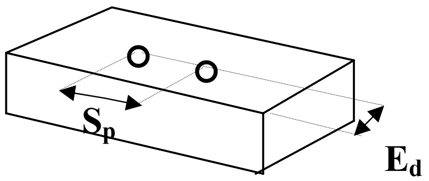


10.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR (Cont.)

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

FACTOR OF EDGE DISTANCE AND ANCHOR SPACING IN SHEAR f_{asds}

$$f_{asds} = \frac{3E_d + S_p}{6 \cdot E_{d(min)}} \sqrt{\frac{E_d}{E_{d(min)}}}$$



This formula (based on European data) is true for a pair of anchors resisting shear, close to an edge (edge distance < 3 x Hs embed) and where Sp is < 3 x Ed.

E_d = Actual Edge Distance

$E_{d(min)}$ = Min Edge allowed (See edge factor table)

S_p = Actual Spacing between Anchors

Assumes no other edge < 3 x $E_{d(min)}$ present

10.31 S_{cfs} ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)

Bolt Dia		M6	M8	M10	M12	M16	M20
Shear KN							
	Zinc Plated	4.8	7.8	12.5	15.5	20.5	31.0
	Galvanised	4.8	7.8	12.5	15.5	20.5	31.0
	Stainless 316	3.5	6.0	11.0	17.50	n/a	n/a

10.33 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

s_{ulsd} = *LOWEST CALCULATED VALUE OF;* S_{acc} , S_{cfs}

Check that your required Shear Loading < or = to S_{ulsd}

10.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

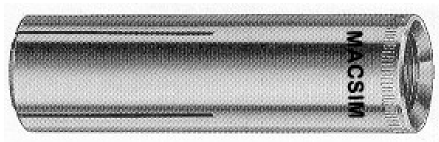
T = Required Applied Tensile load Component, S = Required Applied Shear load Component

MACSIM MASON ANCHOR; DROP IN ANCHOR

Product Description

THE MASON ANCHOR IS DESIGNED FOR MEDIUM DUTY APPLICATION IN SOLID CONCRETE OF 25MPa OR GREATER, WHERE A FEMALE SOCKET FIXING IS REQUIRED. MASON ANCHOR ENABLES FLUSH, SURFACE SETTING IN CONCRETE AND FOR THE REMOVAL AND RE-APPLICATION OF A FASTENER.

11.10 INSTALLATION

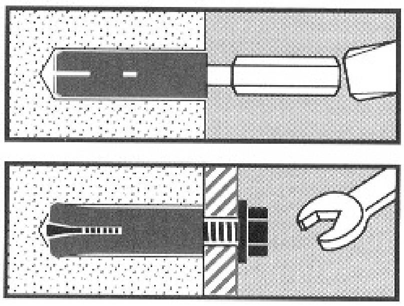


Macsim Code Metric	Macsim Code Imperial	Bolt Dia.	Drill Dia mm	Min. Drill Depth mm	Min. Embed. Depth mm	Min Structure thickness mm	Min** Anchor Spacing mm	Min** Edge Distance mm
10M06	1006	M6 / 1/4"	8	30	25	75	50	90
10M08	1008	M8 / 5/16"	10	40	35	75	60	120
10M10	1010	M10 / 3/8"	12	45	40	100	80	135
		M10	12	40	30	100	80	90
10M12	1012	M12 / 1/2"	16	60	50	125	100	180
10M16	1016	M16 / 5/8"	20	75	65	150	130	225
10M20		M20	25	90	82	200	160	270

** *Absolute distances, reduction factors apply.*

INSTALLATION PROCEDURE

Drill correct Diameter and Depth of Hole in Concrete Substrate and clean out by blowing dust clear.
Tap Anchor into hole, expansion end first.
Using Macsim Mason Anchor setting tool of the correct size, Hammer the expansion plug down until the shoulder of the tool meets the anchor surface.



11.11 MATERIAL SPECIFICATION

ANCHOR BODY ZINC PLATE STEEL		
Diameter	Yield Strength N/mm^2	Ultimate Strength N/mm^2
M6 / 1/4"	340	460
M8 / 5/16"	340	460
M10 / 3/8"	320	430
M12 / 1/2"	320	430
M16 / 5/8"	330	460
M20	330	460

ANCHOR BODY A4 STAINLESS STEEL		
Diameter	Yield Strength N/mm^2	Ultimate Strength N/mm^2
M6 / 1/4"	350	540
M8 / 5/16"	350	540
M10 / 3/8"	350	540
M12 / 1/2"	350	540
M16	350	540
M20	350	540

11.12 SIMPLE LOAD CHARACTERISTICS

Anchor Size	Hole Dia mm	Min Embed. Depth mm	Ultimate Tensile Kn	Ult. Shear Strength Kn	Rec. Tensile Working Load Kn	Rec. Shear Working Load Kn	Rec. Anchor Spacing mm	Rec. Edge Distance mm
M6 / 1/4"	8	25	8.40	7.70	2.10	1.70	85	90
M8 / 5/16"	10	35	11.05	13.70	3.30	2.90	100	120
M10 / 3/8"	12	40	17.90	20.80	5.30	4.10	135	135
M10 x 30	12	30	11.30	20.80	3.50	4.10	135	90
M12 / 1/2"	16	50	25.50	32.10	9.20	5.60	170	180
M16 / 5/8"	20	65	37.10	61.20	12.50	10.50	220	225
M20	25	82	49.50	96.50	18.00	16.20	280	270

Concrete Strength 35 MPa; Grade 8.8 Bolt employed for shear testing.

TENSILE LOADING

11.20 T_{acc} FAILURE RESISTANCE TENSION

$$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$$

THE CAPACITY TO RESIST CONE, STRUCTURAL OR PULL OUT FAILURE

T_{cfc} = Characteristic Design Capacity, f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor; f_{aet}= Anchor Embed. Factor

CHARACTERISTIC DESIGN CAPACITY T_{cfc}

Bolt Dia	M6	M8	M10	M10 x 30	M12	M16	M20
Tensile KN	4.9	6.50	10.5	6.60	14.90	21.80	29.06
Hs embedment	25	35	40	30	50	65	82

Characteristic Ultimate Concrete Strength in Tension; Reduction factor = 1.70

CONCRETE STRENGTH FACTOR f_{cst}

Concrete Strength Mpa	25	30	35	40
f_{cst}	0.80	0.90	1.00	1.10

ANCHOR EMBEDMENT FACTOR f_{aet}

In the case of the Macsim Mason Anchor f_{aet} = 1.0 the embedment depths shown must be achieved.

CLOSE EDGE REDUCTION FACTOR f_{adt} Mason Anchor

Macsim Mason Anchor must be a minimum of 3.5 times embedment depth (3.5 x Hs) at this point f_{adt} = 1.0

11.20 T_{acc} FAILURE RESISTANCE TENSION (Cont.)

CLOSE SPACING REDUCTION FACTOR TENSION f_{ast} Mason Anchor

For more than two anchors a factor must be considered for each spacing and multiplied

Bolt Diameter	M6	M8	M10	M12	M16	M20
Spacing						
50	0.80					
60	0.86	0.80				
80	0.98	0.90	0.80			
84	1.00	0.92	0.82			
100		1.00	0.88	0.80		
105			0.89	0.82		
130			0.99	0.89	0.80	
135			1.00	0.91	0.81	
140				0.92	0.82	
160				0.98	0.87	0.79
170				1.00	0.89	0.81
200					0.96	0.87
220					1.00	0.90
250						0.96
280						1.00
Hs	25	30	40	50	65	82

Fast= 0.5 + 0.15(Sp/Hs)

Limit Sp>2Hs.

$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$

11.21 T_{cfs} ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

Bolt Dia		M6	M8	M10	M12	M16	M20
Tensile KN							
	Zinc Plated	8.50	11.00	13.60	24.50	40.00	51.00
	Stainless 316	8.50	11.00	13.60	24.50	n/a	n/a

Characteristic Ultimate Steel Tensile Strength; Reduction factor = 1.25

NOTE:- The fixing performance may be affected by the bolt or fastener strength used with the Anchor

11.22 T_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

T_{ulsd} = *LOWEST CALCULATED VALUE OF;* T_{acc} , T_{cfs}

Check that your required Tensile Loading < or = to T_{ulsd}

SHEAR LOADING

11.30 S_{acc} FAILURE RESISTANCE SHEAR

Anchor Design Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{ass} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Design Capacity, f_{ass} = spacing Factor, f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

CHARACTERISTIC DESIGN CAPACITY SHEAR S_{cfc}

Bolt Dia	M6	M8	M10	M12	M16	M20
Tensile KN	3.18	5.48	8.23	12.80	22.58	34.45
Hs embedment	25	35	40	50	65	82

FACTORS OF CONCRETE STRENGTH, LOADING DIRECTION AND EDGE IN SHEAR

The Macsim Mason Anchor Shear strength is measured at 25MPa and there is no benefit from increased strength. Edge Distance must be greater than 3.5 times embedment; Ed min = 3.5 Hs. There is no effect of loading direction at this distance.

CLOSE SPACING REDUCTION FACTOR SHEAR f_{ass} Masonanchor

For more than two anchors a factor must be considered for each spacing and multiplied

Bolt Diameter	M6	M8	M10	M12	M16	M20
Spacing						
50	0.80					
60	0.86	0.80				
80	0.98	0.90	0.80			
84	1.00	0.92	0.82			
100		1.00	0.88	0.80		
130			0.99	0.89	0.80	
135			1.00	0.91	0.81	
160				0.98	0.87	0.79
170				1.00	0.89	0.81
220					1.00	0.90
280						1.00
Hs	25	30	40	50	65	82

Fast= 0.5 + 0.15(Sp/Hs)

Limit Sp>2Hs.

11.31 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

$$S_{ulsd} = S_{acc} = S_{cfc} \times f_{css} \times f_{ass} \times f_{dls}$$

Check that your required Shear Loading < or = to S_{ulsd}

11.32 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

$$S_{ulsd} = S_{acc} = S_{cfc} \times f_{css} \times f_{ass} \times f_{dls}$$

Check that your required Shear Loading < or = to S_{ulsd}

11.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

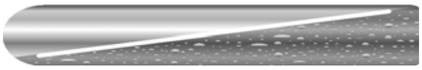
$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

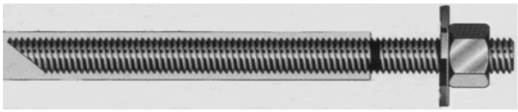
T = Required Applied Tensile load Component, S = Required Applied Shear load Component
T_{ulsd} = Ultimate Limit State Tensile capacity, S_{ulsd} = Ultimate Limit State Shear Capacity

MACSIM CHEMCAP HIGH PERFORMANCE CHEMICAL ANCHOR

Product Description

THE MACSIM CHEMCAP ANCHOR SYSTEM COMBINES A GLASS ENCAPSULATED EPOXY ACRYLATE RESIN AND A HIGH QUALITY THREADED STUD SPECIFICALLY DESIGNED TO SUIT THE ANCHOR DIMENSIONS. THE SYSTEM APPLIES NO STRESS TO THE BASE MATERIAL AND ACTUALLY ENHANCES MATERIAL STRENGTH.
HIGHER LOADINGS CAN BE ACHIEVED BY INCREASING DEPTH AND USING MULTIPLE CAPSULES COMBINED WITH HIGH STRENGTH STUDS.



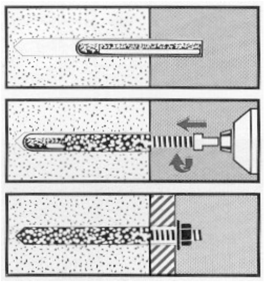


12.10 INSTALLATION

Macsim Code	Stud Dia	Drill Dia mm	Embed. Hole Depth mm	Fixture Clear. hole mm	Std Stud Length mm	Max Std Thickness Fastened mm	Min Structure thickness mm	Min Spacing Full Load mm	Min Edge Distance Full Load mm
37C08	M8	10	80	9	110	16	100	160	80
37C10	M10	12	90	11	130	22	110	180	90
37C12	M12	14	110	13	160	30	130	220	110
37C16	M16	18	125	17	190	40	145	250	125
37C20	M20	25	180	22	260	70	190	340	170
37C24	M24	28	220	26	300	65	230	420	210

INSTALLATION PROCEDURE

Drill correct Diameter and Depth of Hole in Concrete Substrate and clean out by brushing and blowing dust clear. Place Macsim Chemcap capsule in hole.
Attach supplied hexagonal key (male or female) and insert into stud top. Using a Rotary Hammer drilling machine, attach hex key and drive the stud on hammer action into the capsule until the bottom of the hole is reached. There is a clear mark on the stud which should meet the concrete surface. Do not over drive as this will simply draw out the resin. Leave anchor to cure according to the time –temperature table, before applying fixture and tightening nuts to torque setting.



12.11 MATERIAL SPECIFICATION

5.8 Spec Stud Dia	Maximum Tightening Torque Nm	Nominal Tensile Strength 5.8 ZP Stud N/mm^2	Nominal Tensile Strength 5.8 Galv. Stud N/mm^2	Nom. Tens Strength Stainless A4/70 Stud N/mm^2	Effective Cross Section mm^2	Nut Width Across Flats mm	Washer Dia mm
M8	15	580	580	700	32	13	16
M10	25	580	580	700	52	17	20
M12	40	580	580	700	76	19	24
M16	80	520	520	700	144	24	30
M20	160	520	520	700	225	30	37
M24	300	520	520	700	324	36	44

MACSIM CHEMCAP HIGH PERFORMANCE CHEMICAL ANCHOR

12.12 CURING SPECIFICATION

Anchor Curing depends on the temperature of the base material at time of application. Care must be taken not to apply loading, including setting torque to the anchor until the hardening time has expired. The anchor will not accept full load capability until the cure time is exceeded and will be permanently damaged by premature loading.

Base Material Temperature Deg C	Hardening Time mins	Full Load curing time mins
> + 20 ^{0}C	10	20
+10 ^{0}C to +20 ^{0}C	15	30
0 ^{0}C to +10 ^{0}C	40	60
- 5 ^{0}C to 0 ^{0}C	200	300

12.13 SIMPLE LOAD CHARACTERISTICS

Anchor Size	Hole Dia mm	Min Embed. Depth mm	Ultimate Tensile Strength Kn	Ultimate Shear Strength Kn	Rec. Tensile Working Load Kn	Rec. Shear Working Load Kn	Rec.** Anchor Spacing mm	Rec.** Edge Distance mm
M8	10	80	18.00*	14.50	5.00	3.40	160	80
M10	12	90	28.00*	22.00	7.30	4.60	180	90
M12	14	110	42.00*	30.90	10.70	6.60	220	110
M16	18	125	74.30	57.50	16.70	11.90	250	125
M20	25	180	110.00	87.20	30.10	18.40	340	170
M24	28	220	160.90	129.10	43.10	35.10	420	210

Concrete Strength 25MPa.
**   Load limited by 5.8 grade stud capacity*
*** Reduction Factors apply for distances less than these.*

TENSILE LOADING

12.20 T_{acc} CONCRETE/PULL OUT FAILURE RESISTANCE TENSION

$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$

THE CAPACITY TO RESIST CONE OR STRUCTURAL FAILURE OR PULL OUT

T_{cfc} = Characteristic Design Capacity, f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor; f_{aet}= Anchor Embed. Factor

CHARACTERISTIC DESIGN CAPACITY CONE/PULL OUT T_{cfc}

Bolt Dia	M8	M10	M12	M16	M20	M24
Tensile KN	10.70	15.05	20.53	30.44	50.95	74.49

Hs embedment 80 90 110 125 170 210

CONCRETE STRENGTH FACTOR f_{cst}

Concrete Strength Mpa	20	25	30	35	40
f_{cst}	0.95	1.00	1.05	1.15	1.25

ANCHOR EMBEDMENT FACTOR f_{aet}

Actual Anchor depth H_{sact} limited to 2 x H_S; $f_{aet} = H_{sact} / H_s$ (to max 2.0)

CLOSE EDGE REDUCTION FACTOR f_{adt} Chemcap

For more than one edge a factor must be considered for each distance and multiplied

Bolt Diameter	M8	M10	M12	M16	M20	M24
Edge Distance						
40	0.63					
45	0.67	0.63				
55	0.77	0.71	0.63			
63	0.84	0.78	0.68	0.63		
80	1.00	0.92	0.80	0.73		
85		0.96	0.83	0.76	0.63	
90		1.00	0.86	0.79	0.65	
105			0.97	0.88	0.71	0.63
110			1.00	0.91	0.74	0.64
125				1.00	0.80	0.70
170					1.00	0.86
190						0.93
210						1.00
Hs	80	90	110	125	170	210

$f_{adt} = 0.25 + 0.75 \times Ed/Hs$

For Chemcap Ed min = 0.5xHs.

The Min edge distances shown must be respected.

12.20 T_{acc} CONCRETE/PULL OUT FAILURE RESISTANCE TENSION (Cont.)

CLOSE SPACING REDUCTION FACTOR f_{ast} Chemcap

For more than two anchors a factor must be considered for each spacing and multiplied

Bolt Diameter	M8	M10	M12	M16	M20	M24
Spacing						
40	0.63					
45	0.64	0.63				
55	0.67	0.65	0.63			
63	0.70	0.68	0.64	0.63		
70	0.72	0.69	0.66	0.64		
85	0.77	0.74	0.69	0.67	0.63	
95	0.80	0.76	0.72	0.69	0.64	
105	0.83	0.79	0.74	0.71	0.65	0.63
120	0.88	0.83	0.77	0.74	0.68	0.64
140	0.94	0.89	0.82	0.78	0.71	0.67
160	1.00	0.94	0.86	0.82	0.74	0.69
180		1.00	0.91	0.86	0.76	0.71
200			0.95	0.90	0.79	0.74
220			1.00	0.94	0.82	0.76
250				1.00	0.87	0.80
310					0.96	0.87
340					1.00	0.90
390						0.96
420						1.00
Hs	80	90	110	125	170	210

f_{ast} = 0.5 + Sp/4Hs
Limit Sp>0.5Hs.

12.21 T_{cfs} ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

Bolt Dia		M8	M10	M12	M16	M20	M24
Tensile KN							
Grade 5.8	Zinc Plated	14.00	22.50	33.80	64.00	96.50	140.00
Grade 5.8	Galvanised	14.00	22.50	33.80	64.00	96.50	140.00
Grade 70	Stainless 316	16.50	26.00	38.00	70.50	110.25	159.00

Characteristic Ultimate Steel Tensile Strength; Reduction factor = 1.25

12.22 T_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

T_{ulsd} = *LOWEST CALCULATED VALUE OF;* T_{acc} , T_{cfs}

Check that your required Tensile Loading < or = to T_{ulsd}

SHEAR LOADING

12.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Characteristic Design Capacity, f_{asds} = Edge and spacing Factor,
f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE EDGE S_{cfc}

Bolt Dia		M8	M10	M12	M16	M20	M24
Shear KN							
	Zinc Plated	2.50	3.00	4.50	6.00	11.00	16.00
	Galvanised	2.50	3.00	4.50	6.00	11.00	16.00
	Stainless 316	2.50	3.00	4.50	6.00	11.00	16.00
Abs Min Edge mm		40	45	55	63	85	105
Hs embedment mm		80	90	110	125	170	210

Characteristic Ultimate Concrete Strength in Shear; Reduction factor = 1.70

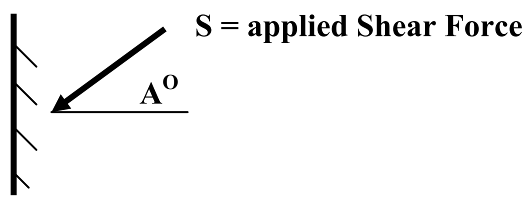
FACTOR OF CONCRETE STRENGTH IN SHEAR f_{css}

Concrete 30 Day strength Mpa	f_{css}
20	1.00
25	1.10
30	1.25
35	1.30
40	1.40

The Macsim Chemcap Anchor is suitable for all Concrete Strengths. Data is only available from 20MPa to 40MPa.

FACTOR OF SHEAR LOADING DIRECTION TO EDGE f_{dls}

Load Angle A from perp. to edge(^{O})	f_{dls}
0 to 45	1.00
60	1.10
70	1.20
80	1.50
90 to 180	2.00

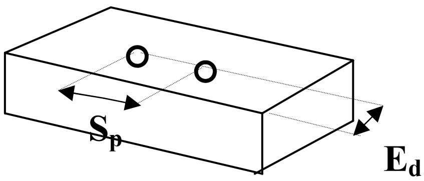


12.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR (Cont.)

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

FACTOR OF EDGE DISTANCE AND ANCHOR SPACING IN SHEAR f_{asds}

$$f_{asds} = \frac{3E_d + S_p}{6 \cdot E_{d(min)}} \cdot \sqrt{\frac{E_d}{E_{d(min)}}}$$



This formula (based on European data) is true for a pair of anchors resisting shear, close to an edge (edge distance < 3 x Hs embed) and where Sp is < 3 x Ed.

E_d = Actual Edge Distance

$E_{d(min)}$ = Min Edge allowed (See Table)

S_p = Actual Spacing between Anchors

Assumes no other edge < 3 x $E_{d(min)}$ present

12.31 S_{cfs} ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)

Bolt Dia		M8	M10	M12	M16	M20
Shear KN						
Grade 5.8	Zinc Plated	9.00	14.00	21.00	39.50	60.00
Grade 5.8	Galvanised	9.00	14.00	21.00	39.50	60.00
Grade 70	Stainless 316	12.50	24.00	34.50	64.50	100.00

Characteristic Ultimate Stud strength in Shear; Reduction factor = 1.25

12.32 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

s_{ulsd} = *LOWEST CALCULATED VALUE OF;* S_{acc} , S_{cfs}

Check that your required Shear Loading < or = to S_{ulsd}

12.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

T = Required Applied Tensile load Component, S = Required Applied Shear load Component
T_{ulsd} = Ultimate Limit State Tensile capacity, S_{ulsd} = Ultimate Limit State Shear Capacity

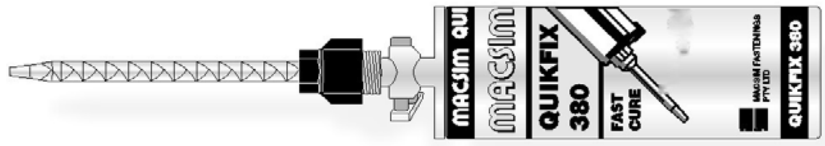
MACSIM QUICKFIX EPOXY MORTAR AND POLYESTER CHEMICAL INJECTION SYSTEMS

Product Description

THE MACSIM QUICKFIX SYSTEM ENABLES SIMPLE STRESS FREE ANCHORING IN SOLID AND POROUS BASE MATERIALS.

THE HIGH PERFORMANCE, FAST CURE MORTAR DEVELOPS A POWERFUL BOND WITH THE BASE MATERIAL AND CAN BE USED TO FIX SEVERAL KINDS OF ROD, OF ALL SHAPES AND SIZES. MACSIM CHEMCAP STUD RANGE IS IDEAL FOR USE WITH QUICKFIX AND PERFORMANCE DATA IS BASED ON THEIR APPLICATION. THE QUICKFIX INJECTION SLEEVES CAN BE USED TO APPLY THE MORTAR IN HOLLOW WALLS GIVING A HIGH LOAD PERFORMANCE IN WEAK, POROUS MATERIALS

13.10 INSTALLATION

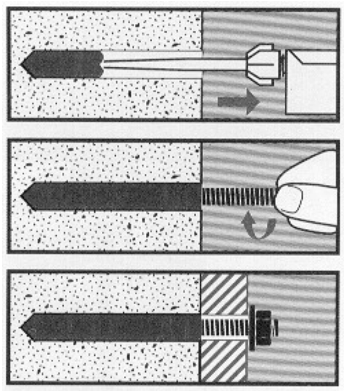


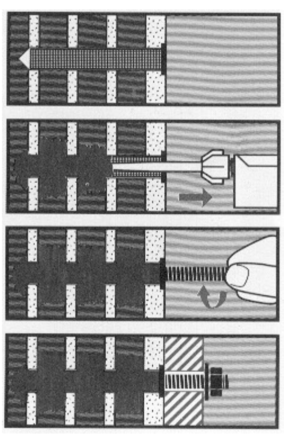
Stud Dia	Drill Dia mm	Min Embed./ Hole Depth mm	Fixture Clearance hole mm	Min Structure thickness mm	Drill Dia Hollow Base for sleeve mm	Drill Depth Hollow Base for sleeve mm	Typical Number Fixings/ cartridge	Tightening Torque 4.6 std rod Nm
M6	8	70	7	90	n/a	n/a	90	6
M8	10	80	9	100	n/a	n/a	70	10
M10	12	90	11	120	12	50	40	20
M12	15	110	13	140	15	80	28	30
M16	20	130	17	170	20	85	16	60
M20	24	170	22	220	n/a	n/a	8	120
M24	30	215	26	270	n/a	n/a	4	200
M30	36	305	32	370	n/a	n/a	2	260

INSTALLATION PROCEDURE: SOLID MATERIAL

Drill Correct Diameter and depth of hole as specified above. Clean hole by brushing and blowing out dust carefully.

Assemble Quickfix Nozzle on to tube and place in the Quickfix applicator tool. Turn tap (if present) to on position. Squeeze until resin is exuded from nozzle. Waste about 5ml of resin to ensure correct mixing. Place nozzle to end of hole, squeeze resin in. Aim to fill approximately 2/3rds of hole. Push stud into hole rotating as you enter until bottom is reached. Allow to cure before applying fixture. Do not load until full curing time has elapsed.





INSTALLATION PROCEDURE: HOLLOW MATERIAL

Drill Correct Diameter and depth of hole as specified above. Clean hole by blowing out and insert Macsim sleeve of correct diameter.

Set up Quickfix as above. Insert nozzle to end of sleeve and inject resin. Ensure sleeve is totally filled.

Push in rod, rotating as you enter until end of sleeve is reached.

Allow to cure before applying fixture. Do not load until full curing time has elapsed.

13.11 MATERIAL SPECIFICATION

Macsim Code	Description	Volume ml	Cure Rating	Resin Type	Hardener	Shut Off Valve
71PC	Quickfix Basic	380	Standard	Polyesther	Styrene	no
71PCTM	Quickfix Tropical	380	Tropical	Polyesther	Styrene	no
71PCT	Low Odour Mortar	380	Standard	Polyesther	Styrene	yes
71PCTMT	Low Odour Mortar	380	Tropical	Polyesther	Styrene	yes
71PC825	Epoxy Jumbo	825	Standard	Epoxy Acrylate	Styrene	yes
71UB300	Ultrabond	300	Standard	Epoxy Acrylate	Acrylic	no

13.12 SIMPLE LOAD CHARACTERISTICS *(Applies to all Mortars)*

Nominal Stud Size	Hole Dia mm	Embed. Depth mm	Ultimate Tensile* Kn	Rec. Tens. Working Load Kn	Rec. Shear Working Load Kn	Ult. Stud Tensile (5.8 gr)Kn
M6	8	70	8.50	2.10	1.90	9.50
M8	10	80	22.36	4.40	3.40	15.10
M10	12	45	15.90	2.90	4.60	26.00
M10	12	90	29.14	7.50	4.60	26.00
M10	12	135	43.70	11.20	4.60	26.00
M12	15	55	19.90	3.70	6.60	37.40
M12	15	110	31.43	11.10	6.60	37.40
M12	15	165	47.15	17.10	6.60	37.40
M16	20	65	27.70	4.90	11.90	72.10
M16	20	130	71.80	15.40	11.90	72.10
M16	20	195	107.70	23.90	11.90	72.10
M20	24	85	41.40	6.50	18.40	111.30
M20	24	170	78.05	18.60	18.40	111.30
M20	24	255	117.10	28.30	18.40	111.30

***** *Ultimate Tensile Load tested using 8.8 grade studs.*

Loads are applicable in Concrete strength greater than 25N/mm^2
Loading in other base materials is highly dependant on strength and would require on site testing to validate performance.

Loads assume edge distances are > than 1.2 x embedment and spacing 2.4 x embedment.

13.13 ULTIMATE RESIN PHYSICAL PROPERTIES

Factor	Resin Type		
	Polyesther	Epoxy Acrylate	EA Styrene Free
Compressive Strength N/mm^2 (ASTM 695)	48.0	58.4	> 56
Tensile Strength N/mm^2 (ASTM 638)	10.0	14.5	< 10
Flexural Strength N/mm^2 (ASTM 790)	20.0	26.5	> 16
Elastic Modulus N/mm^2	4206	4941	3034
Flexural Modulus N/mm^2	3238	4472	3462
Mixed Density g/cm^3	1.65	1.65	1.65

13.14 SAFETY OF USE

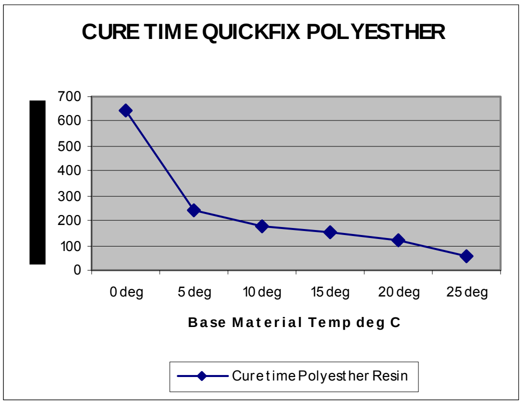
Macsim Quickfix Chemical Injection Systems should be used with care. They contain substances that are harmful to health and flammable.
Macsim publish a safety data sheet for all three resin types and these are readily available to our customers.
It is the users responsibility to ensure the instructions are followed and that the correct form of protective equipment is employed. Macsim cannot be held responsible for the misuse or miss-application of the Quickfix Products. Please contact our Service centres for further information.

13.15 CURING SPECIFICATION

Anchor Curing depends on the temperature of the base material at time of application. Care must be taken not to apply loading, including setting torque to the anchor until the hardening time has expired. The anchor will not accept full load capability until the cure time is exceeded and will be permanently damaged by premature loading.

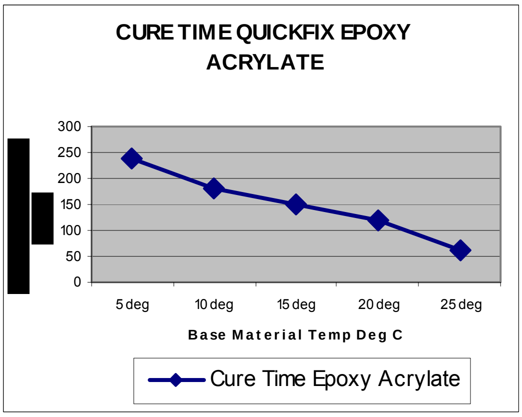
POLYESTHER UNSATURATED RESIN (71PC/71PCTM)

Base Material Temperature Deg C	Gelling Time mins	Full Load curing time mins	Gelling Time mins	Full Load curing time mins
Polyesther	Standard Mix		Tropical Mix	
0 deg	30	640	n/a	n/a
5 deg	12	240	n/a	n/a
10 deg	9	180	n/a	n/a
15 deg	6	150	n/a	n/a
20 deg	5	120	n/a	n/a
25 deg	3	60	n/a	n/a
30 deg	n/a	n/a	11	180
40 deg	n/a	n/a	6	150



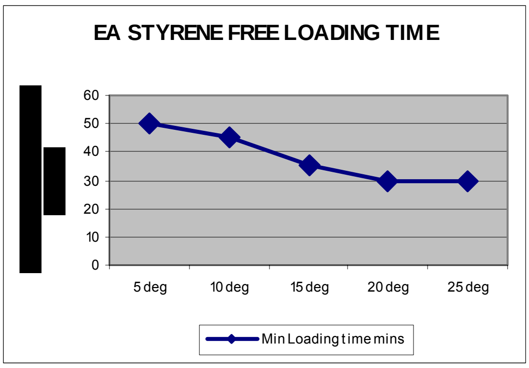
EPOXY ACRYLATE RESIN (71PCT/71PCTMT, 71PC825)

Base Material Temperature Deg C	Gelling Time mins	Full Load curing time mins	Gelling Time mins	Full Load curing time mins
Epoxy Acrylate	Standard Mix		Tropical Mix	
5 deg	12	240	n/a	n/a
10 deg	9	180	n/a	n/a
15 deg	6	150	n/a	n/a
20 deg	5	120	n/a	n/a
25 deg	3	60	n/a	n/a
30 deg	n/a	n/a	11	180
40 deg	n/a	n/a	6	150



EPOXY ACRYLATE STYRENE FREE RESIN (71UB300 ULTRABOND, 71PC150)

Base Material Temperature Deg C	Gelling Time mins	Min Load. time mins	Gelling Time mins	Full Load curing time mins
EA Styrene Free	Standard Mix		Tropical Mix	
5 deg	12	50	n/a	n/a
10 deg	9	45	n/a	n/a
15 deg	6	35	n/a	n/a
20 deg	5	30	n/a	n/a
25 deg	3	30	n/a	n/a



TENSILE LOADING (ALL DATA APPLIES TO EPOXY MORTAR

13.20 T_{acc} CONCRETE/PULL OUT FAILURE RESISTANCE TENSION

$T_{acc} = T_{cfc} \times f_{cst} \times f_{aet} \times f_{adt} \times f_{ast}$

THE CAPACITY TO RESIST CONE OR STRUCTURAL FAILURE OR PULL OUT

T_{cfc} = Characteristic Design Capacity, f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor; f_{aet}= Anchor Embed. Factor

CHARACTERISTIC DESIGN CAPACITY CONE/PULL OUT T_{cfc}

Bolt Dia	M8	M10	M12	M16	M20	M24
Tensile KN	9.95	12.96	14.55	31.94	34.72	46.76

Hs embedment	80	90	110	125	170	210

CONCRETE STRENGTH FACTOR f_{cst}

Concrete Strength Mpa	20	25	30	35	40
f_{cst}	0.90	0.95	1.00	1.15	1.25

ANCHOR EMBEDMENT FACTOR f_{aet}

Actual Anchor depth H_{sact} limited to 2 x H_S; $f_{aet} = H_{sact} / H_s$ (to max 2.0)

CLOSE EDGE REDUCTION FACTOR f_{adt} Quickfix

For more than one edge a factor must be considered for each distance and multiplied

Bolt Diameter	M8	M10	M12	M16	M20	M24
Edge Distance						
40	0.63					
45	0.67	0.63				
55	0.77	0.71	0.63			
63	0.84	0.78	0.68	0.63		
80	1.00	0.92	0.80	0.73		
85		0.96	0.83	0.76	0.63	
90		1.00	0.86	0.79	0.65	
105			0.97	0.88	0.71	0.63
110			1.00	0.91	0.74	0.64
125				1.00	0.80	0.70
170					1.00	0.86
190						0.93
210						1.00
Hs	80	90	110	125	170	210

$f_{adt} = 0.25 + 0.75x\ Ed/Hs$
For Chemcap Ed min = 0.5xHs.

The Min edge distances shown must be respected.

13.20 T_{acc} CONCRETE/PULL OUT FAILURE RESISTANCE TENSION (Cont.)

CLOSE SPACING REDUCTION FACTOR f_{ast} Quickfix

For more than two anchors a factor must be considered for each spacing and multiplied

Bolt Diameter	M8	M10	M12	M16	M20	M24
Spacing						
40	0.63					
45	0.64	0.63				
55	0.67	0.65	0.63			
63	0.70	0.68	0.64	0.63		
70	0.72	0.69	0.66	0.64		
85	0.77	0.74	0.69	0.67	0.63	
95	0.80	0.76	0.72	0.69	0.64	
105	0.83	0.79	0.74	0.71	0.65	0.63
120	0.88	0.83	0.77	0.74	0.68	0.64
140	0.94	0.89	0.82	0.78	0.71	0.67
160	1.00	0.94	0.86	0.82	0.74	0.69
180		1.00	0.91	0.86	0.76	0.71
200			0.95	0.90	0.79	0.74
220			1.00	0.94	0.82	0.76
250				1.00	0.87	0.80
310					0.96	0.87
340					1.00	0.90
390						0.96
420						1.00
Hs	80	90	110	125	170	210

$f_{ast} = 0.5 + Sp/4Hs$

Limit Sp>0.5Hs.

13.21 T_{cfs} ANCHOR FAILURE IN TENSION (STEEL STRENGTH)

Bolt Dia		M8	M10	M12	M16	M20	M24
Tensile Kn							
Macsim 5.8	Zinc Plated	14.00	22.50	33.80	64.00	96.50	140.00
Macsim 5.8	Galvanised	14.00	22.50	33.80	64.00	96.50	140.00
Macsim A4/70	Stainless 316	16.50	26.00	38.00	70.50	110.25	159.00
Effective X Sectional Area mm2		*33*	*52*	*76*	*144*	*225*	*324*

Characteristic Ultimate Steel Tensile Strength; Reduction factor = 1.25

13.22 T_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN TENSION

T_{ulsd} = *LOWEST CALCULATED VALUE OF;* T_{acc} , T_{cfs}

Check that your required Tensile Loading < or = to T_{ulsd}

SHEAR LOADING

13.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Characteristic Design Capacity, f_{asds} = Edge and spacing Factor,
f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

CHARACTERISTIC DESIGN CAPACITY CONCRETE EDGE S_{cfc}

Bolt Dia	M8	M10	M12	M16	M20	M24
Shear KN						
	2.21	2.75	4.10	5.50	9.90	15.50
Abs Min Edge mm	40	45	55	65	85	105
Hs embedment mm	80	90	110	125	170	210

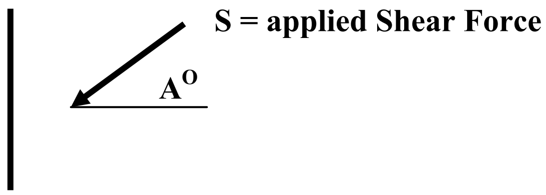
FACTOR OF CONCRETE STRENGTH IN SHEAR f_{css}

Concrete 30 Day strength Mpa	f_{css}
20	1.00
25	1.10
30	1.25
35	1.30
40	1.40

The Macsim Quickfix is suitable for all Concrete Strengths and can also be applied in natural rock, brickwork and lightweight blocks. Using the sleeve systems, it can provide secure fixing in hollow base materials. Data is only available in Concrete from 20MPa to 40MPa.

FACTOR OF SHEAR LOADING DIRECTION TO EDGE f_{dls}

Load Angle A from perp' to edge(^{O})	f_{dls}
0 to 45	1.00
60	1.10
70	1.20
80	1.50
90 to 180	2.00

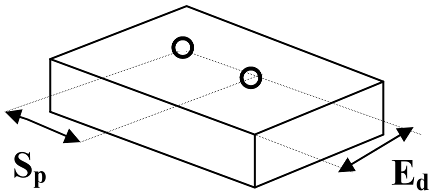


13.30 S_{acc} CONCRETE EDGE RESISTANCE SHEAR; CONT.

Anchor Concrete Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

FACTOR OF EDGE DISTANCE AND ANCHOR SPACING IN SHEAR f_{asds}

$$f_{asds} = \frac{3E_d + S_p}{6 \cdot E_{d(min)}} \cdot \frac{E_d}{E_{d(min)}}$$



This formula (based on European data) is true for a pair of anchors resisting shear, close to an edge (edge distance < 3 x Hs embed) and where Sp is < 3 x Ed.

E_d = Actual Edge Distance

$E_{d(min)}$ = Min Edge allowed (Table 12.xxx)

S_p = Actual Spacing between Anchors

Assumes no other edge < 3 x $E_{d(min)}$ present

13.31 S_{cfs} ANCHOR FAILURE IN SHEAR (STEEL STRENGTH)

Bolt Dia		M8	M10	M12	M16	M20	M24
Shear Kn							
Macsim 5.8	Zinc Plated	9.00	14.00	21.00	39.50	60.00	86.50
Macsim 5.8	Galvanised	9.00	14.00	21.00	39.50	60.00	86.50
Macsim A4/70	Stainless 316	12.50	24.00	34.50	64.50	100.00	140.00
Effective X Sectional Area mm2 (ISO898)		33	52	76	144	225	324

Characteristic Ultimate Steel Shear Strength; Reduction factor = 1.25

13.32 S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

S_{ulsd} = *LOWEST CALCULATED VALUE OF;* S_{acc} , S_{cfs}

Check that your required Shear Loading < or = to S_{ulsd}

13.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

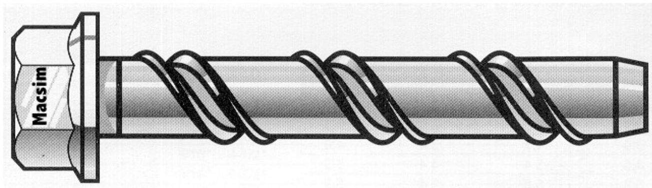
$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

T = Required Applied Tensile load Component, S = Required Applied Shear load Component

T_{ulsd} = Ultimate Limit State Tensile capacity, S_{ulsd} = Ultimate Limit State Shear Capacity

MACSIM SCREWBOLT MECHANICAL KEY ANCHOR

Product Description
THE SCREWBOLT IS DESIGNED FOR MEDIUM TO HEAVY DUTY APPLICATION IN SOLID CONCRETE OF 25MPa OR GREATER, OFFERING A VARIETY OF HEAD FINISHES. THE SCREWBOLT EXERTS NO EXPANSION PRESSURE AND CAN BE USED CLOSE TO EDGES.

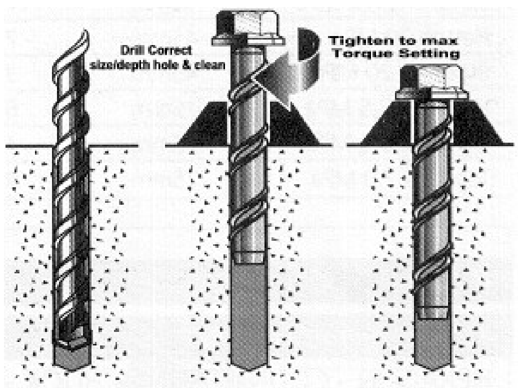


15.10 INSTALLATION

Macsim Size Code	Bolt Dia. mm	Length mm	HEXHEAD	CSK HD	EYE	HOOK	Drill Dia mm	Min. Embed. Depth mm	Min Hole Depth mm	Min Structure thickness mm	Min** Anchor Spacing mm	Min** Edge Spacing mm
SB06030	6	30	♦	♦			6	30	45	75	30	20
SB06050	6	50	♦	♦	♦	♦	6	30	45	75	30	20
SB06075	6	75	♦	♦			6	30	45	75	30	20
SB06100	6	100	♦	♦			6	30	45	75	30	20
SB08050	8	50	♦	♦	♦	♦	8	40	60	90	40	20
SB08075	8	75	♦	♦			8	40	60	90	40	20
SB08100	8	100	♦	♦			8	40	60	90	40	20
SB10060	10	60	♦	♦	♦	♦	10	50	70	100	60	30
SB10075	10	75	♦	♦			10	50	70	100	60	30
SB10100	10	100	♦	♦			10	50	70	100	60	30
SB10150	10	150	♦				10	50	70	100	60	30
SB12075	12	75	♦	♦	♦	♦	12	60	85	115	60	30
SB12100	12	100	♦	♦			12	60	85	115	60	30
SB12150	12	150	♦	♦			12	60	85	115	60	30

*** Absolute distances; reduction factors apply*

INSTALLATION PROCEDURE
Drill correct Diameter and Depth of Hole in Substrate and clean out by blowing dust clear. A clearance hole of at least 1mm dia > drill dia is required through component. The hole depth must be at least 2 x the bolt/drill dia deeper than the bolt embedment.
Place Screwbolt through Fixture and Tighten using torque wrench to required Setting (see Material Specification). It is important to keep pressure applied during tightening to ensure grip. If the bolt becomes jammed, back off one turn and re-tighten.



15.11 MATERIAL SPECIFICATION

ANCHOR YZP/CLASS 3 STEEL			
DIAMETER	YIELD STRENGTH N/mm^2	ULTIMATE STRENGTH N/mm^2	TORQUE SETTING (Concrete) Nm
6	640	800	32
8	640	800	55
10	640	800	55
12	640	800	80

ANCHOR BODY A4 STAINLESS STEEL			
DIAMETER	YIELD STRENGTH N/mm^2	ULTIMATE STRENGTH N/mm^2	TORQUE SETTING (Concrete) Nm
6	480	600	25
8	480	600	40
10	480	600	40
12	480	600	60

Torque Settings are based on installation in 30 MPa min. Concrete; installation in materials other than Concrete are available on request if the material strength is known.
All load data in this document is based on tests in 30 MPa Concrete but other data may be available on request.

15.12 SIMPLE LOAD CHARACTERISTICS

Anchor Size	Hole Dia mm	Min Embed. Depth mm	Ultimate Tensile Strength Kn	Ultimate Shear Strength Kn	Rec. Tensile Working Load Kn	Rec. Shear Working Load Kn	Rec.** Anchor Spacing mm	Rec.** Edge Distance mm
6	6	30	8.00	10.00	2.00	2.50	100	60
8	8	40	12.00	24.00	3.00	6.00	120	80
10	10	50	18.00	40.00	4.50	10.00	170	100
12	12	60	26.00	54.00	6.50	13.50	200	120

Concrete Strength 25MPa.
*** Reduction Factors apply for distances less than these.*

15.20 T_{acc} FAILURE RESISTANCE TENSION

$$T_{acc} = T_{cfc} \times f_{cst} \times f_{adt} \times f_{ast}$$

THE RECOMMENDED SAFE WORKING CAPACITY TO RESIST CONE, STRUCTURAL OR PULL OUT FAILURE

T_{cfc} = Recommended Safe Load, Tensile; f_{adt} = Edge Distance Factor,
f_{ast} = Anchor Spacing Factor, f_{cst} = Concrete Strength Factor

T_{cfc} in the case of Screwbolt is the Safe Working Load recommended by the manufacturers.
This value has been derived directly from the average ultimate tensile loading achieved less 2 times standard deviation. A Safety Factor has then been applied.
Load values apply to the Hexagonal Head version only.
Loadings for other styles maybe less. Contact our Technical Dept. for details.

Bolt Dia	Embedment	Ultimate Tensile Load Cap. Kn	Tcfc Rec. Tensile Load Cap. Kn
6	30	5.2	1.5
6	45	11.5	4.0
8	40	14.6	4.2
8	60	21.0	6.0
10	50	18.8	5.4
10	75	33.4	9.5
12	60	26.5	7.6
12	90	43.0	12.3

f_{cst} is the factor applied according to the concrete strength. The result is limited by the anchor steel strength.

Concrete Strength Mpa	20	25	30	40
f_{cst}	0.90	1.00	1.10	1.20

15.20 T_{acc} FAILURE RESISTANCE TENSION. Cont.

f_{adt} is the factor applied to allow for close edge distance. This is where the 'cone of influence' is reduced by the concrete edge proximity. For Screwbolt, tests have shown that distances greater than 10 times bolt diameter, regardless of embedment depth, do not effect load capacity in tension or shear. Edge limit is 5 times bolt diameter. These factors do not apply in concrete of less than 30MPa or other base materials.

Edge Distance mm	20	30	40	50	60	70	80	90
Bolt Diameter								
6	0.56	0.59	0.73	0.86	1.00			
8	0.58	0.72	0.86	0.93	1.00			
10		0.39	0.52	0.64	0.77	0.99	1.00	
12		0.52	0.60	0.69	0.77	0.85	0.92	1.00

f_{ast} is the factor applied to allow for close anchor spacing. This is where the 'cone of influence' is reduced by the proximity of a neighboring anchor. For Screwbolt, tests have shown that distances greater than 10 times bolt diameter, regardless of embedment depth, do not effect load capacity in tension or shear. Spacing limit is 5 times bolt diameter. These factors do not apply in concrete of less than 30MPa or other base materials.

Spacing mm	30	40	50	60	70	80	90	100	120	140	170	200
Bolt Diameter												
6	0.52	0.59	0.66	0.73	0.80	0.86	0.93	1.00				
8		0.78	0.81	0.84	0.87	0.89	0.92	0.95	1.00			
10				0.69	0.70	0.70	0.71	0.72	0.73	0.84	1.00	
12				0.76	0.77	0.77	0.78	0.78	0.79	0.85	0.92	1.00

$$T_{acc} = T_{cfc} \times f_{cst} \times f_{adt} \times f_{ast}$$

Check that the result is not greater than the recommended safe steel strength S_{cfs}
Steel strength in tension and shear limits potential strength and must be > T_{acc} & S_{acc}

Bolt Dia		6	8	10	12
Tensile KN	S_{cfs}				
	Zinc Plated	13.0	28.50	48.50	69.00
	Stainless 316	tba	tba	tba	tba

15.30 S_{acc} FAILURE RESISTANCE SHEAR

Safe Working Shear Capacity $S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

THE CAPACITY TO RESIST STRUCTURAL EDGE FAILURE

S_{cfc} = Recommended Safe Shear Capacity, f_{asds} = Edge and spacing Factor,
f_{css} = Concrete Strength Factor; f_{dls} = loading direction factor

S_{cfc} Recommended Safe Shear Capacity

Bolt Dia	6	8	10	12
**Ultimate Kn	11.60	20.40	36.80	47.84
S_{cfc} Rec. SWL Kn	4.14	7.28	13.10	17.08

S_{cfc} in the case of Screwbolt is the Safe Working Load recommended by the manufacturers.

**This value has been derived directly from the average ultimate shear loading achieved less 2 times standard deviation, away from any influencing factors and with a 0.8 nominal factor.

f_{css} is the concrete strength factor for shear loading for Screwbolt

Concrete Strength Mpa	20	25	30	40
f_{css}	0.90	1.00	1.00	1.00

f_{asds} is the Edge and Spacing factor and considers all load directions
f_{dls} is considered to be 1.0 for Screwbolt.

Bolt Diameter	6	8	10	12
Edge & spacing Distance				
30	0.80			
40	0.85	0.70		
50	0.90	0.80	0.70	
60	1.00	0.85	0.78	0.70
80		1.00	0.85	0.80
100			1.00	0.85
120				1.00
160				
200				

$S_{acc} = S_{cfc} \times f_{css} \times f_{asds} \times f_{dls}$

Check that the result is not greater than the recommended safe steel strength S_{cfs}
Steel strength in tension and shear limits potential strength and must be > T_{acc} & S_{acc}

Bolt Dia		6	8	10	12
Shear KN	S_{cfs}				
	Zinc Plated	14.50	25.50	46.00	59.80
	Stainless 316	tba	tba	tba	tba

15.30 S_{acc} FAILURE RESISTANCE SHEAR Cont.

S_{ulsd} ANCHOR ULTIMATE LIMIT STATE DESIGN SHEAR

S_{ulsd} = *LOWEST CALCULATED VALUE OF;* S_{acc} , S_{cfs}

Check that your required Shear Loading < or = to S_{ulsd}

15.40 ANCHOR ULTIMATE LIMIT STATE DESIGN COMBINED

To ensure the Fastening system's suitability in the case of combined shear and tensile loading for the application the following formula must be satisfied;

$$\frac{T}{T_{ulsd}} + \frac{S}{S_{ulsd}} < 1.2$$

T = Required Applied Tensile load Component, S = Required Applied Shear load Component
T_{ulsd} = Ultimate Limit State Tensile capacity, S_{ulsd} = Ultimate Limit State Shear Capacity

MACSIM NYLON FRAME ANCHOR

Description

NYLON POLYAMIDE GRADE 6, ONE PIECE PLUG WITH SCREW GUIDE. EXPANDED BY TURNING SCREW INTO PLUG AFTER THROUGH FIXING ENTIRE ASSEMBLY. DESIGNED FOR THE FIXING OF DOOR/WINDOW FRAMES TO PREVENT DISTORTION.

PERFORMANCE DATA

INSTALLATION

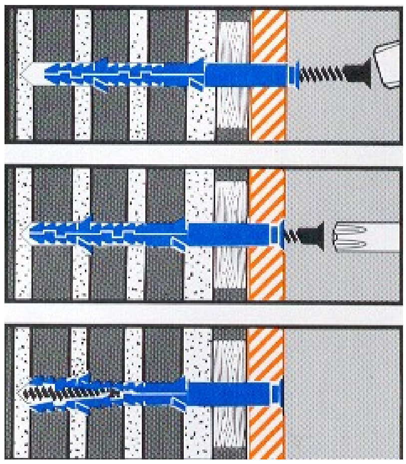
Code	Size	hole dia mm	Embedment Depth mm	max fasten thickness mm
16FA06060	6 x 60	6	35	25
16FA06080	6 x 80	6	35	45
16FA08080	8 x 80	8	40	40
16FA10080	10 x 80	10	50	30
16FA10100	10 x 100	10	50	50
16FA10120	10 x 120	10	50	70
16FA10140	10 x 140	10	50	90
16FA10160	10 x 160	10	50	110
16FA10180	10 x 180	10	50	130

INSTALLATION PROCEDURE

Drill correct Diameter Hole through component and into base at least as deep as overall plug length.

Insert frame plug and screw assembled into hole. Turn screw until head sits within plug flange.

Plug will not draw in component, it is designed to securely lock in a “stand off” position. Over tightening will damage the plug.



MATERIAL SPECIFICATION

Code	Size	Screw Size dia mm	Hex/Csk Screw Spec	Plug
16FA06060	6 x 60	n/a	n/a	Polyamide PA 6
16FA06080	6 x 80	n/a	n/a	Polyamide PA 6
16FA08080	8 x 80	n/a	n/a	Polyamide PA 6
16FA10080	10 x 80	7	5.8 Steel ZP	Polyamide PA 6
16FA10100	10 x 100	7	5.8 Steel ZP	Polyamide PA 6
16FA10120	10 x 120	7	5.8 Steel ZP	Polyamide PA 6
16FA10140	10 x 140	7	5.8 Steel ZP	Polyamide PA 6
16FA10160	10 x 160	7	5.8 Steel ZP	Polyamide PA 6
16FA10180	10 x 180	7	5.8 Steel ZP	Polyamide PA 6

TECHNICAL PERFORMANCE

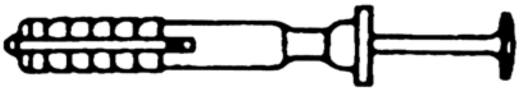
Code	Size	Advisory SWL Tension; Concrete N	Advisory SWL Tension Brick N	Advisory SWL Tension; light agg. N	Advisory SWL Shear N
16FA06***	6mm	280	280	250	n/a
16FA08***	8mm	700	600	300	n/a
16FA10***	10mm	1000	850	350	1400

Nylon Polyamide PA 6 is heat (60^0) and UV resistant.

MACSIM BETTADRIVE NYLON ANCHOR

Description
NYLON GRADE 6, FILLED PLUG WITH HELICAL SHANKED SCREW ASSEMBLED. EXPANDED BY HAMMERING SCREW INTO PLUG AFTER THROUGH FIXING ENTIRE ASSEMBLY. CAN BE REMOVED BY UNSCREWING FROM PLUG

PERFORMANCE DATA



INSTALLATION

Code	Size	hole dia mm	Embedment Depth mm	max fasten thickness mm
39425	4 x 25	4	20	5
39533	5 x 33	5	25	5
39550	5 x 50	5	25	22
39637	6 x 37	6	25	5
39655	6 x 55	6	25	25
39670	6 x 70	6	25	40
39854	8 x 54	8	30	20
39872	8 x 72	8	30	35
39899	8 x 100	8	30	65

INSTALLATION PROCEDURE
Drill correct Diameter Hole through component and into base at least as deep as overall plug length.
Insert Bettadrive into hole. Hammer screw until head sits within plug flange.
Remove if required by unscrewing with Ph2 bit and pulling assembly out. Can be re-used if not damaged.

MATERIAL SPECIFICATION

Code	Size	Screw Size guage	Screw Spec	Screw Spec	Plug
39425	4 x 25		Steel ZP 5µ		Polyamide 6
39533	5 x 33	4	Steel ZP 5µ	Stainless316	Polyamide 6
39550	5 x 50	4	Steel ZP 5µ		Polyamide 6
39637	6 x 37	6	Steel ZP 5µ	Stainless316	Polyamide 6
39655	6 x 55	6	Steel ZP 5µ	Stainless316	Polyamide 6
39670	6 x 70	6	Steel ZP 5µ	Stainless316	Polyamide 6
39854	8 x 54	10	Steel ZP 5µ	Stainless316	Polyamide 6
39872	8 x 72	10	Steel ZP 5µ	Stainless316	Polyamide 6
39899	8 x 100	10	Steel ZP 5µ		Polyamide 6

TECHNICAL PERFORMANCE

Code	Size	Advisory SWL Tension; Concrete N	Advisory SWL Tension Brick N	Advisory SWL Tension; Sandstone N	Advisory SWL Shear N
394***	4mm	150	150	100	300
395***	5mm	220	220	170	700
396***	6mm	280	280	250	1000
398***	8mm	410	410	380	1200

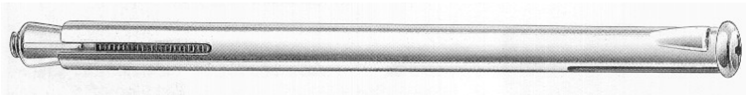
Nylon Polyamide is heat (60^0)and UV resistant.

MACSIM METAL FRAME ANCHOR

Description

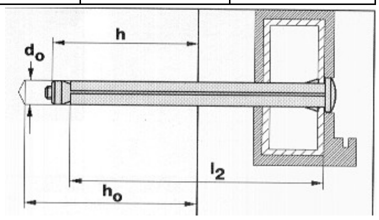
TENSIONED STEEL ONE PIECE EXPANSION SHELL WITH MACHINE SCREW AND PLUG. ZINC PLATED AND PASSIVATED. EXPANDED BY TIGHTENING SCREW AFTER THROUGH FIXING ENTIRE ASSEMBLY. DESIGNED FOR THE FIXING OF METAL DOOR/WINDOW FRAMES; SPECIAL TOP LUGS LOCK INTO METAL FRAMES AND PREVENT DISTORTION WHILST HOLDING SECURELY. FIRE RESISTANT.

PERFORMANCE DATA



INSTALLATION

Code	Size	hole dia mm	Embedment Depth mm	max fasten thickness mm
16F112	10 x 112	10	30	75
16F132	10 x 132	10	30	95



INSTALLATION PROCEDURE

Drill correct Diameter Hole through component and into base at least as deep as overall plug length.

Insert frame plug and screw assembled into hole. Turn screw until tight and lugs have located securely.

Anchor will not draw in component, it is designed to securely lock in a “stand off” position. Over tightening will damage the fixing and not improve performance.

MATERIAL SPECIFICATION

Code	Size	Screw Hd Size mm	Hex/Csk Screw Spec	Plug
16F112	10 x 112	13	Steel YZP	Steel ZP Pass.
16F132	10 x 132	13	Steel YZP	Steel ZP Pass.

TECHNICAL PERFORMANCE

Code	Size	Advisory SWL Tension; Concrete N	Advisory SWL Tension Brick N	Advisory SWL Tension; light agg. N	Advisory SWL Shear N
16F112	10 x 112	500	500	350	500
16F132	10 x 132	500	500	350	500

Macsim Metal Frame is ideal for Fire Resistant Door and Window frame fixing.

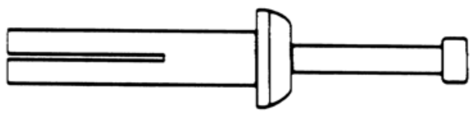
MACSIM MACDRIVE METAL NAIL IN ANCHOR

Description

ZINC ALLOY PLUG WITH ZINC PLATED ASSEMBELED NAIL. EXPANDED BY DRIVING NAIL INTO MUSHROOM HEADED PLUG.

PERFORMANCE DATA

INSTALLATION

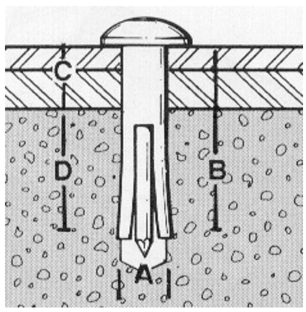


Code	Size	hole dia mm	Embedment Depth mm	max fasten thickness mm
1422	5 x 22	5	16	3
1425	6.5 x 25	6.5	20	5
1432	6.5 x 32	6.5	20	10
1440	6.5 x 40	6.5	20	18
1450	6.5 x 50	6.5	20	25
1475	6.5 x 75	6.5	20	50

INSTALLATION PROCEDURE

Drill correct Diameter Hole through component and into base at least as deep as plug length (B).

Insert Macdrive into hole. Hammer home nail until head is located in plug. Do not over hit or the plug will be damaged.



MATERIAL SPECIFICATION

Code	Size	Nail Spec	Plug
all	all	Steel ZP	Zinc Alloy

TECHNICAL PERFORMANCE

Code	Size	Advisory SWL Tension; Concrete N	Advisory SWL Tension Brick N	Advisory SWL Tension; Sandstone N	Advisory SWL Shear N
1422	5mm	900	n/a	n/a	900
425-75	6.5mm	1100	n/a	n/a	1100

Zinc Alloy is heat (200^0) resistant.