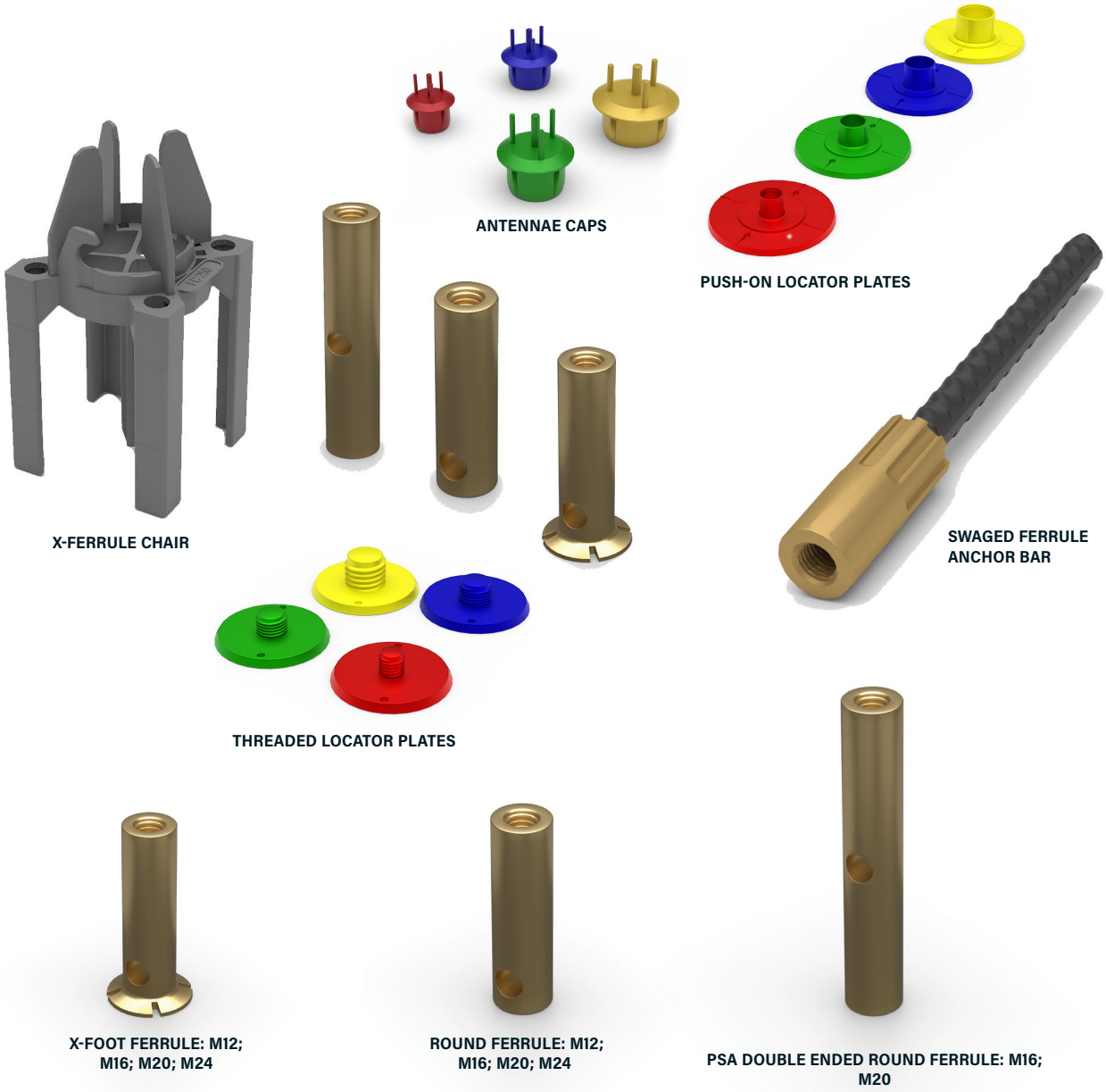
PSA CONNECTION SYSTEMS

PSA METRIC THREADED CONNECTIONS DESIGN GUIDE

PSA METRIC THREADED CONNECTIONS



Our high-quality metric threaded connections for structural permanent connections, temporary bracing and strongbacks, have been tested to conform to AS3850 and associated industry standards. PSA ferrules are available with metric threads from M12 to M24 with zinc plated, hot-dip galvanized and stainless-steel finish.

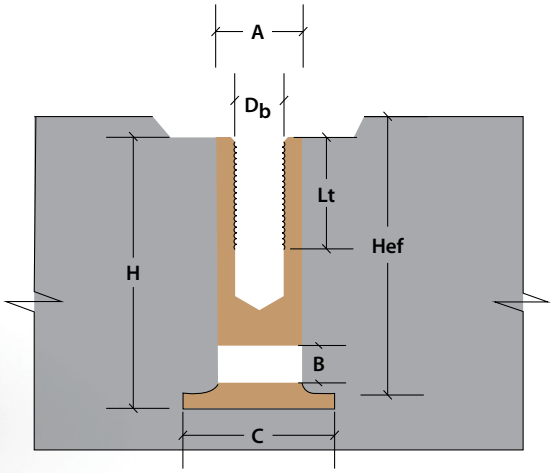
Complementing the ferrules, PSA provides uniquely designed ferrule chairs (X-chair), nailing/locator plates and antenna caps specially designed to be compatible as a whole connection system.

Refer to PSA Product Catalogue for information about complementary accessories.

PSA X- FOOT FERRULE

- PSA X-foot ferrule does not require a crossbar to develop the published design capacities due to the enlarged foot.
- Applicable to all structural permanent and temporary connections using Grade 4.6 metric bolts.
- Crossbar can be used in the cross hole to tie the ferrules in place.
- Convenient installation with PSA X-chair, nailing/ locator plate, or antenna caps.
- Refer PSA Product Catalogue for all accessories related to X-foot ferrules.





PRODUCT DESCRIPTION

PART NUMBER (ZINC)	PART NUMBER (GALVANISED)	PART NUMBER (STAINLESS STEEL)	FERRULE SIZE, D_b	FERRULE LENGTH, H (mm)	OUTER DIAMETER, A (mm)	FOOT DIAMETER, C (mm)	THREAD LENGTH L_t (mm)	CROSS HOLE DIAMETER, B (mm)
FP1250ZNS	FP1250GNS	FP1250SSNS	M12	50	20	35	30	11
FP1275ZF	FP1275GF	FP1275SSNS	M12	75	28	50	35	15
FP1296ZF	FP1296GF	FP1296SSNS	M12	96	28	50	40	15
FP1675ZF	FP1675GF	FP1675SS	M16	75	28	50	35	15
FP1696ZF	FP1696GF	FP1696SS	M16	96	28	50	40	15
FP2075ZF	FP2075GF	FP2075SS	M20	75	28	50	35	15
FP2096ZF	FP2096GF	FP2096SS	M20	96	28	50	40	15
FP20120ZF	FP20120GF	FP20120SS	M20	120	28	50	40	15
FP2496ZF	FP2496GF	FP2496SS	M24	96	32	50	45	15

INSTALLATION

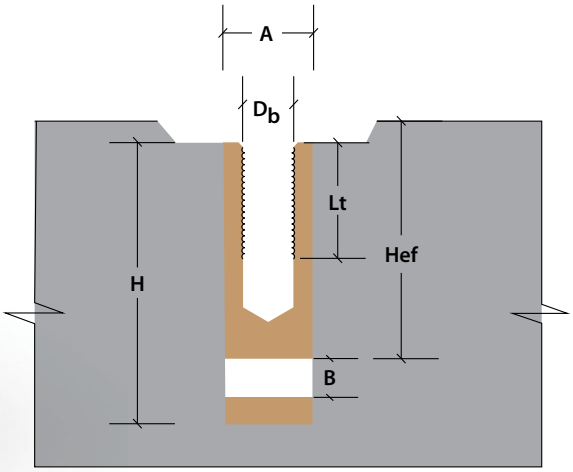
FERRULE LENGTH, H (mm)	50	75	96	120
EFFECTIVE EMBEDMENT DEPTH, H_{ef} (mm)	54	79	100	124
TOTAL INSTALLATION DEPTH (mm)	58	83	104	128
FERRULE SIZE	**M12**	**M16**	**M20**	**M24**
TIGHTENING TORQUE, T_R (Nm)	30	75	143	250

NOTES:
- *Tightening torque based on Grade 4.6 bolt allowable torque*
- *Tightening shall be done using a calibrated torque wrench. Impact wrenches or "rattle guns" should not be used*
- *Effective embedment depth and total installation depth includes a 8mm thick nailing plate.*

PSA ROUND FERRULE

+ Round ferrules should be installed with a N12 cross bar of minimum 300mm long through the cross hole to achieve the published capacities.
+ Applicable to all structural permanent and temporary connections using Grade 4.6 metric bolts.
+ Tensile capacity of the ferrules will be limited by the shear capacity of the N12 cross bar.
+ Refer the PSA Product Catalogue for all accessories related to round ferrules.





PRODUCT DESCRIPTION

PART NUMBER (ZINC)	PART NUMBER (GALVANISED)	FERRULE SIZE, D_b	FERRULE LENGTH, H (mm)	OUTER DIAMETER, A (mm)	THREAD DEPTH L_t (mm)	CROSS HOLE DIAMETER, B (mm)
P1275ZF	P1275GF	M12	75	28	35	15
P1296ZF	P1296GF	M12	96	28	40	15
P1675ZF	P1675GF	M16	75	28	35	15
P1696ZF	P1696GF	M16	96	28	40	15
P2075ZF	P2075GF	M20	75	28	35	15
P2096ZF	P2096GF	M20	96	28	40	15
P2496ZF	P2496GF	M24	96	32	45	15

INSTALLATION

FERRULE LENGTH (mm)	75		96	
EFFECTIVE EMBEDMENT DEPTH, H_{ef} (mm)	57		78	
INSTALLATION DEPTH (mm)	83		104	
FERRULE SIZE	**M12**	**M16**	**M20**	**M24**
TIGHTENING TORQUE, T_R (Nm)	30	75	143	250

NOTES:
- *Tightening torque based on Grade 4.6 bolt allowable torque*
- *Tightening shall be done using a calibrated torque wrench. Impact wrenches or "rattle guns" should not be used*
- *N12 x 300mm long cross bar is required for all PSA Round ferrules to develop the rated capacities*
- *Effective embedment depth and total installation depth includes a 8mm thick nailing plate*

PSA DOUBLE ENDED FERRULE

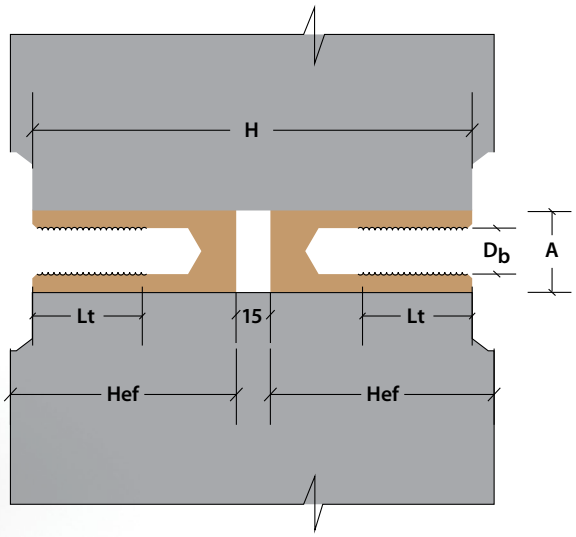
Double ended ferrule provides,

+ Two fixing points in one cast-in connection

Applications:

+ Slab to floor connections
+ Structural steel connections





PRODUCT DESCRIPTION

PART NUMBER (ZINC)	FERRULE SIZE, D_b	FERRULE LENGTH, H (mm)	OUTER DIAMETER, A (mm)	THREAD LENGTH L_t (mm)	EFFECTIVE EMBEDMENT DEPTH, H_{ef}	TIGHTENING TORQUE, T_R (Nm)
PD16120ZF	M16	120	28	32	68*	75
PD20120ZF	M20	120	28	38	68*	143
PD20140ZF	M20	140	28	40	80**	143
PD20170ZF	M20	170	28	40	93***	143

**150mm thick panel considered*
***175mm thick panel considered*
****200mm thick panel considered*

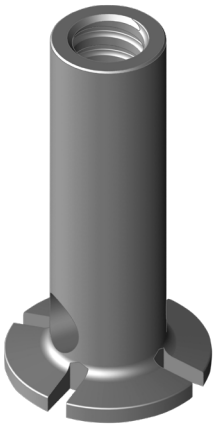
- *Design engineer shall assess the suitability of double ended ferrules for the application. Concrete design capacities can vary depending on the application.*
- *All double ended ferrules shall be installed with N12 x 300mm long cross bar to achieve concrete breakout capacities*

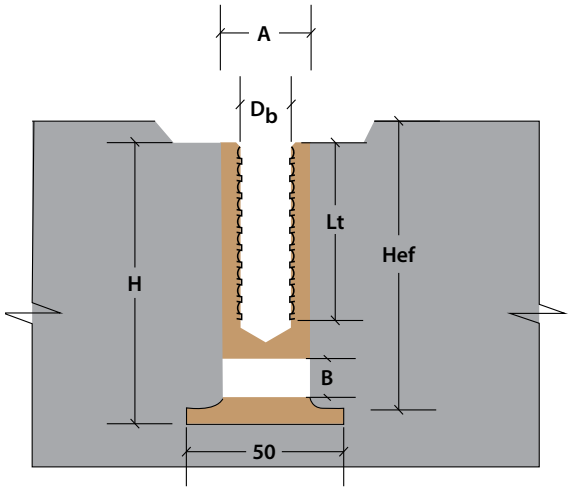
ENGINEERING PROPERTIES

FERRULE SIZE, D_b	CARBON STEEL		CROSS HOLE DIAMETER, B (mm)	CROSS BAR SIZE (mm)	AREA AT CROSS HOLE(mm^2)	STEEL DESIGN CAPACITY IN TENSION, $\Phi N_{u,s}$(kN)
	YIELD STRENGTH, f_{sy}(MPa)	UTS, f_{su}(MPa)				
M16	300	420	15	N12 x 300	217	80.8
M20	300	420	15	N12 x 300	217	80.8

- *Design capacity includes design factor Φ = 0.8*

PSA COIL THREAD FERRULE





PRODUCT DESCRIPTION

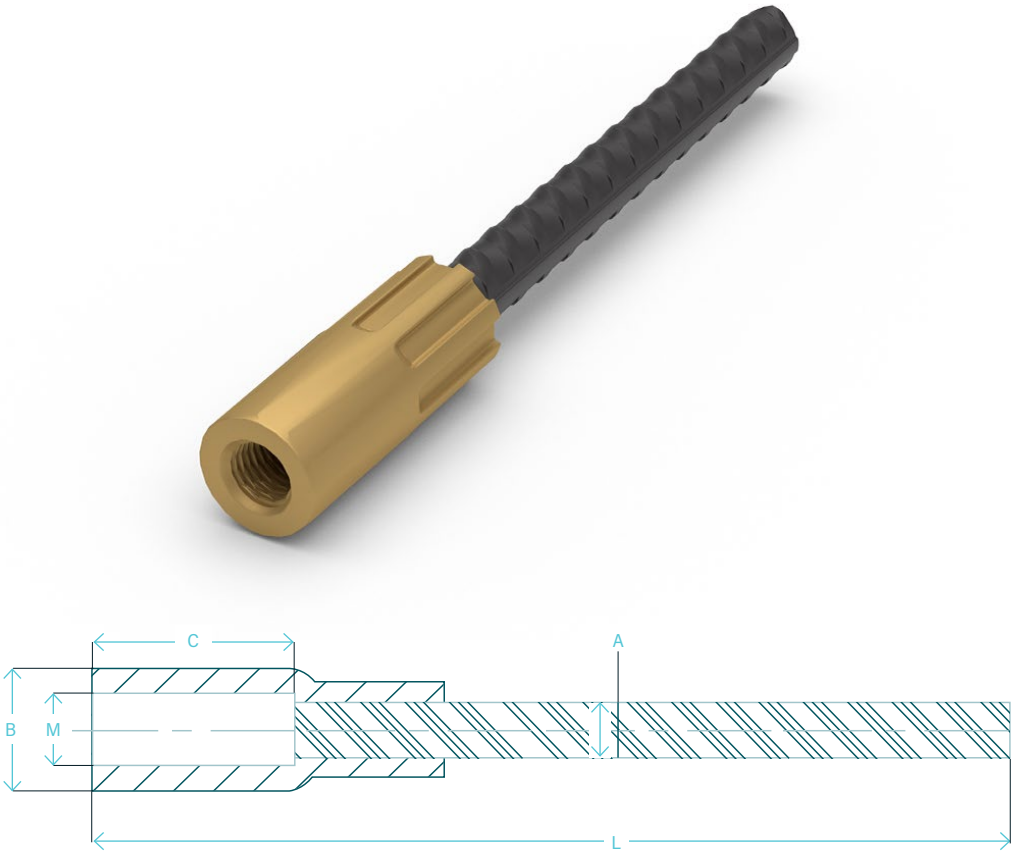
PART NUMBER (ZINC)	FERRULE SIZE, D_b	FERRULE LENGTH, H (mm)	OUTER DIAMETER, A (mm)	THREAD DEPTH L_t (mm)	EFFECTIVE EMBEDMENT DEPTH, H_{ef} (mm)
FC2096ZF	20	96	28	40	100

INSTALLATION DETAILS

PART NUMBER (ZINC)	FERRULE SIZE, D_b	INSTALLATION DETAILS		CRITICAL DIMENSIONS	
		CROSS HOLE TO SUIT	TIGHTENING TORQUE. T_R (Nm)	MIN SUBSTRATE THICKNESS (mm)	MIN EDGE DISTANCE IN LOAD DIRECTION (mm)
FC2096ZF	20	N12	143	120	300

FERRULE ANCHOR BARS

PSA swaged anchor bars provide a full bar strength joint for precast concrete panels and floors. The standard metric thread is easy to install, as it is simply tied to the central mesh, with no welding required. The swaging provides a permanent fitting connection that is ready to use.



PRODUCT DESCRIPTION

PART NUMBER (ZINC)	FERRULE SIZE, M	STARTER BAR SIZE, A	STARTER BAR STEEL GRADE (MPa)	TOTAL LENGTH (mm)	ULTIMATE CAPACITY OF SYSTEM (kN)	THREAD DEPTH, C (mm)	OUTER DIAMETER, B (mm)
SB12N8	M12	8mm	400	500	22	28	17
SB16N12	M16	12mm	400	500	63	35	22
SB20N16	M20	16mm	400	500	110	38	28

Concrete failure mode to be considered by design engineer depending on the application.

STRENGTH LIMIT STATE DESIGN OF CONNECTIONS

A combination of cast-in ferrules and bolts is in use as permanent structural fixings. Design capacities (R_d) are evaluated by characteristic resistances (R_u) and capacity reduction factors (Φ) in accordance with AS3600 and AS4100.

$$\text{Design capacity, } R_d = \Phi R_u$$

When threaded cast-in inserts and bolts are used either as permanent connections or for temporary works, the following failure modes shall be considered to obtain the characteristic strengths of the components. Most critical failure mode shall be considered for engineering designs.

+ Concrete breakout failure in tension (Only concrete cone failure is considered)
+ Concrete edge breakout failure in shear
+ Combined concrete failure in tension and shear
+ Steel failure of the threaded insert in tension
+ Steel failure of the bolt in tension
+ Steel failure of the bolt in shear
+ Combined steel failure of the bolt in tension and shear

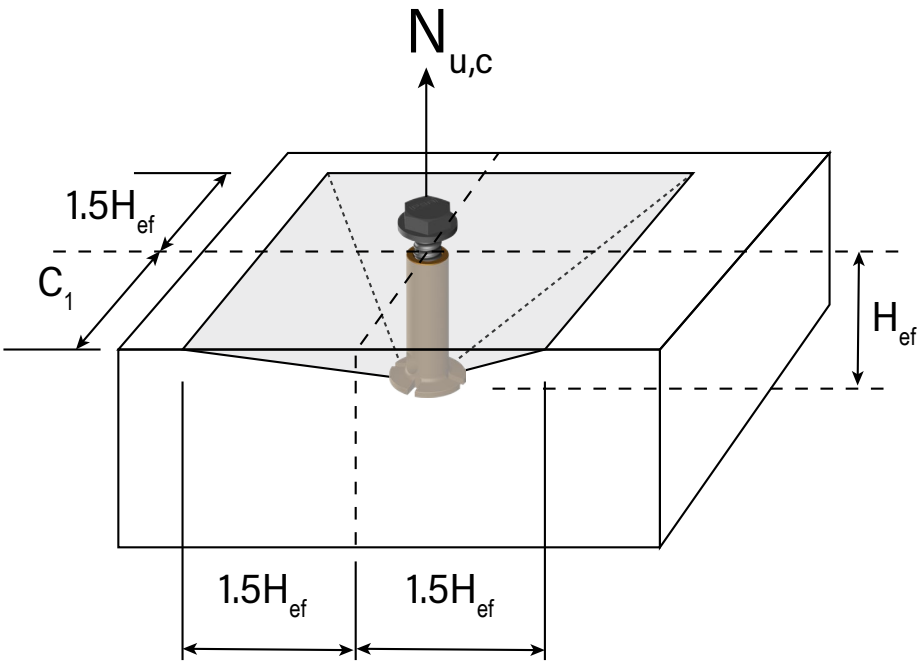
CONCRETE BREAKOUT FAILURE IN TENSION

+ Appendix B of AS3850.1 describes the Concrete Capacity Design (CCD) method for cast-in inserts under tension, shear and combined tension and shear loading.
+ The ultimate strength shall be multiplied by the capacity reduction factor (Φ) = 0.6 in accordance with Cl 19.3 in AS3600.
+ Among the four possible tensile failure modes mentioned in the standard, only the concrete cone failure has been considered in this guide since it will be the most critical failure mode in most of the scenarios and PSA cast-in ferrules have exceeded capacities in other failure modes.
+ It is considered as all the inserts are installed in uncracked concrete when calculating design capacities given in this guide.
+ For more specific loading conditions and geometric limitations, refer to AS3850.1

CONCRETE CONE FAILURE UNDER TENSILE LOADING

$N_{u,c} = N^0_{u,c} \cdot (A_{c,N}/A^0_{c,N}) \cdot \psi_{s,N}$

$N_{u,c}$	Characteristic tensile resistance of a cast-in insert in the case of concrete cone failure
$N^0_{u,c}$	Characteristic tensile resistance of a cast-in insert without any effect from concrete edges and adjacent inserts
$A_{c,N}$	Actual projected area of the idealized concrete cone on the concrete surface with the effect of edge distance and anchor spacing
$A^0_{c,N}$	Projected full cone failure area of a single insert without any effect from concrete edges and adjacent inserts
$\psi_{s,N}$	Stress disturbance factor due to the several edge distances = $0.7 + 0.3 * \left(\frac{C_1}{1.5 * H_{ef}}\right) \leq 1$
C_1	Edge distance to first edge (in the direction of the shear load), in millimetres

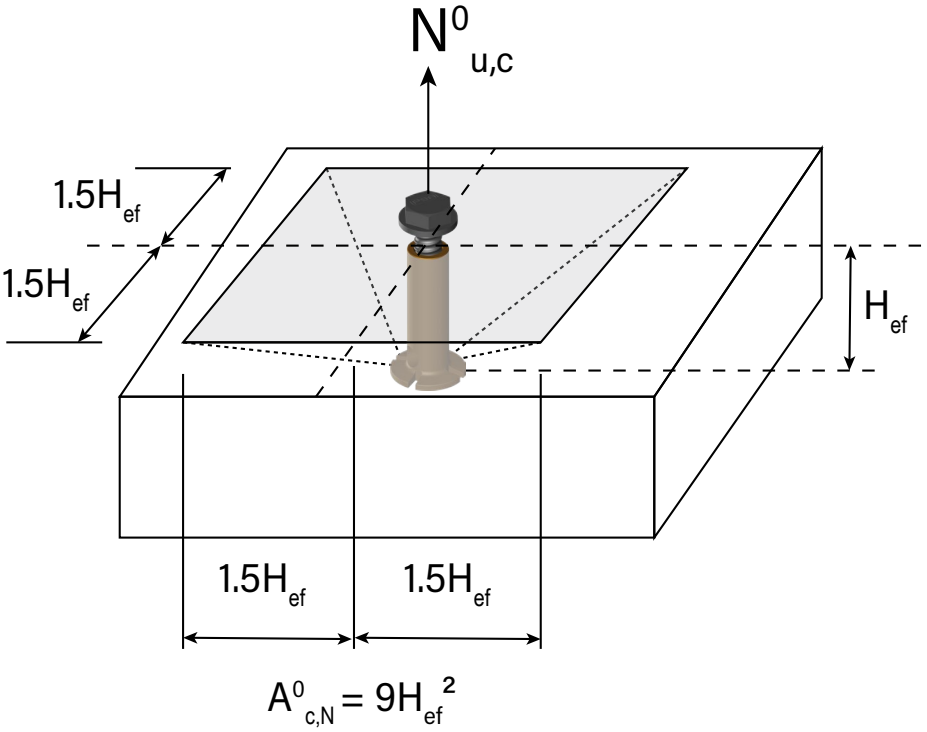


CHARACTERISTIC TENSILE RESISTANCE OF A SINGLE INSERT

The characteristic resistance to concrete cone failure for a single cast-in insert, placed at a minimum distance 1.5 x H_{ef} from any edge, shall be as follows:

$$N^0_{u,c} = k_{cr} * \sqrt{f'_c} * H_{ef}^{1.5}$$

k_{cr}	13 for inserts in uncracked concrete 10 for inserts in cracked concrete
f'_c	Characteristic concrete compressive strength (MPa)
H_{ef}	Effective embedment depth of the insert (mm)



EFFECT OF INSERT SPACING AND EDGE DISTANCE

The geometric effect of a cast-in insert spacing and edge distance on the characteristic resistance shall be taken into account by the following ratio:

$A_{c,N}/A^0_{c,N}$

Where,

$A_{c,N}$	= actual projected area for concrete cone failure of a single insert idealized as rectilinear pyramid of height H_{ef}
$A^0_{c,N}$	= projected concrete failure area of a single insert idealized as a rectilinear pyramid of height H_{ef} and base length $S_{cr,N}=3H_{ef,}$ where the distance to an edge is equal or greater than $1.5H_{ef}$

CONCRETE BREAKOUT TOWARDS AN EDGE UNDER SHEAR LOADING

$$V_{u,c} = V^0_{u,c}.(A_{c,V} / A^0_{c,V}).\ \psi_{s,v}.\ \psi_{h,V}.\ \psi_{re,V}$$

Where,

$V_{u,c}$	= characteristic resistance of a single cast-in insert in shear
$V^0_{u,c}$	= characteristic resistance of an insert loaded perpendicular to the edge in cracked concrete
$A_{c,V}$	= idealized area of concrete cone at the lateral concrete surface for shear failure
$A^0_{c,V}$	= idealized area of concrete cone of an individual insert at the lateral concrete surface not affected by edges, element thickness or adjacent inserts
$\psi_{s,V}$	= factor accounting for the disturbance of the distribution of stresses for shear failure
$\psi_{h,V}$	= factor accounting for the effect of element thickness on shear failure
$\psi_{re,V}$	= factor accounting for the state of concrete

CHARACTERISTIC SHEAR RESISTANCE OF A SINGLE INSERT

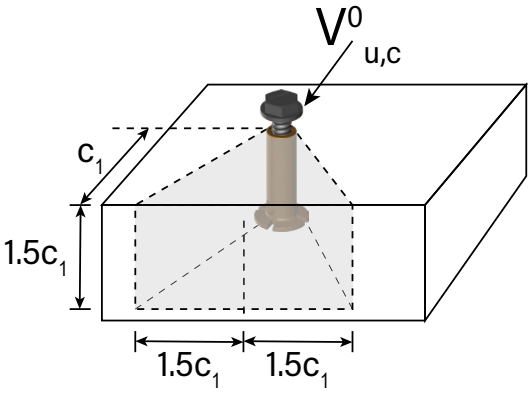
The characteristic shear resistance for a cast-in insert loaded perpendicular to the edge can be calculated as follows:

$$V^0_{u,c} = 1.8 * d_{i,nom}{}^{A} * l_f^{B} * \sqrt{f'_c} * C_1^{1.5}$$

$V^0_{u,c}$	= characteristic resistance of an insert loaded perpendicular to the edge in cracked concrete
$d_{i,nom}$	= nominal outside diameter of insert
l_f	= h_{ef} in case of a uniform diameter of the shank of the headed insert, in millimetres
f'_c	= Characteristic concrete compressive strength (MPa)
C_1	= edge distance to first edge (in the direction of the shear load), in millimetres
l_i	= h_{ef} in case of a uniform diameter of the shank of the headed insert, in millimetres

$$A = 0.1\left[\frac{l_i}{C_1}\right]^{0.5}$$

$$B = 0.1\left[\frac{d_{i,nom}}{C_1}\right]^{0.2}$$



$$A^0_{c,V} = 1.5c_1\ (3c_1)$$

$$A^0_{c,V} = 4.5c_1{}^2$$

Idealised concrete break-out area $A^0_{c,V}$ for a single insert.

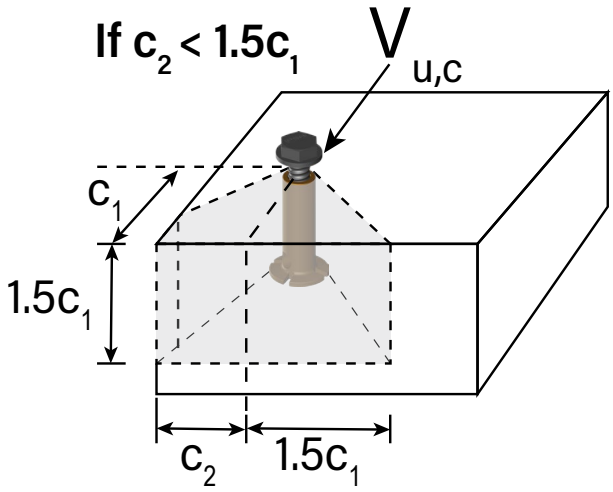
EFFECT OF INSERT SPACING, EDGE DISTANCE AND ELEMENT THICKNESS

The geometrical effect of spacing as well as of further edge distances and the effect of thickness of the concrete element on the characteristic resistance shall be taken into account by the ratio.

$$A_{c,V}/A^{0}_{c,V}$$

Where,

$A_{c,V}$	= idealized area of concrete cone at the lateral concrete surface for shear failure
$A^{0}_{c,V}$	= idealized area of concrete cone of an individual insert at the lateral concrete surface not affected by edges, element thickness or adjacent inserts
	$= 4.5\ C_1^2$
C_2	= Edge distance to the second edge



$$A_{c,V} = 1.5c_1\ (1.5c_1 + c_2)$$

COMBINED CONCRETE FAILURE IN TENSION AND SHEAR

Inserts subjected to combined tension and shear loading shall be designed using the following equation.

$$(N^*/\ \Phi N_{u,c})^{1.5} + (V^*/\ \Phi V_{u,c})^{1.5} \leq 1.0$$

Where,

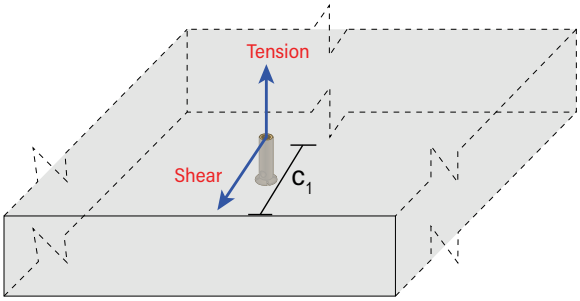
N^*	= Applied factored tension load
V^*	= Applied factored shear load
$\Phi N_{u,c}$	= Design tensile capacity
$\Phi V_{u,c}$	= Design shear capacity

DESIGN CONCRETE CAPACITIES

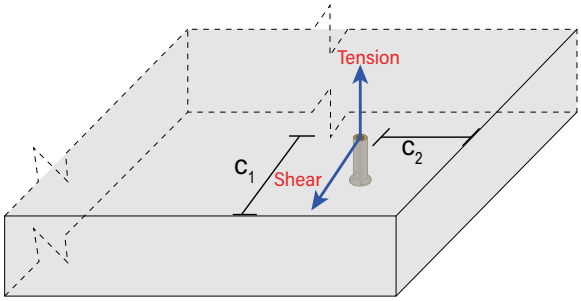
Design concrete breakout capacities of the full range of metric ferrules were determined, considering three scenarios.

Refer the tables in the following pages. Consider the most suitable scenario for the application.

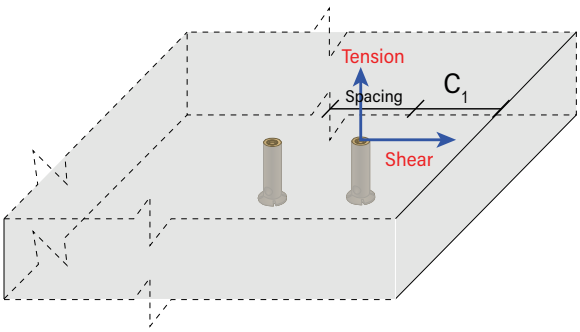
SCENARIO 1: SINGLE INSERT NEAR ONE EDGE



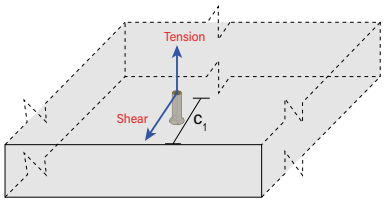
SCENARIO 2: SINGLE INSERT NEAR TWO EDGES



SCENARIO 3: SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION



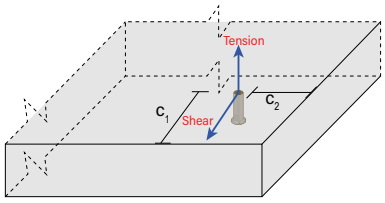
PSA X-FOOT FERRULES - CONCRETE BREAKOUT CAPACITIES



PSA 50mm LONG X-FOOT | M12 | SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
50	8.6	9.9	11.1	12.5	14.0	15.7	3.9	4.5	5.1	5.8	6.4	7.2
75	11.3	13.0	14.6	16.5	18.4	20.6	6.7	7.7	8.6	9.7	10.9	12.2
100	12.0	13.8	15.5	17.5	19.6	21.9	9.7	11.3	12.6	14.2	15.9	17.8
125	12.0	13.8	15.5	17.5	19.6	21.9	13.1	15.2	17.0	19.2	21.5	24.0
150	12.0	13.8	15.5	17.5	19.6	21.9	16.8	19.4	21.7	24.6	27.5	30.7
200	12.0	13.8	15.5	17.5	19.6	21.9	24.9	28.7	32.1	36.4	40.6	45.4

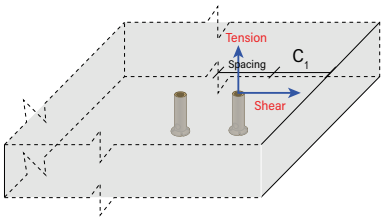
NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Effective embedment depth of 54mm considered in the capacity values; including the 8mm nailing plate*



PSA 50mm LONG X-FOOT | M12 | SINGLE INSERT NEAR TWO EDGES

1ST EDGE DISTANCE, C_1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	6.9	8.0	9.0	10.1	11.3	12.7	3.0	3.4	3.8	4.3	4.8	5.4
50	75	8.3	9.5	10.7	12.1	13.5	15.1	3.9	4.5	5.1	5.8	6.4	7.2
75	75	10.9	12.6	14.0	15.9	17.7	19.8	5.0	5.8	6.5	7.3	8.2	9.1
75	100	11.3	13.0	14.6	16.5	18.4	20.6	6.1	7.0	7.9	8.9	9.9	11.1
100	150	12.0	13.8	15.5	17.5	19.6	21.9	9.7	11.3	12.6	14.2	15.9	17.8
150	150	12.0	13.8	15.5	17.5	19.6	21.9	12.6	14.6	16.3	18.4	20.6	23.0

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Effective embedment depth of 54mm considered in the capacity values; including the 8mm nailing plate*

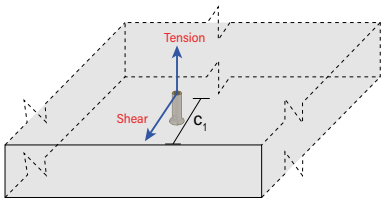


PSA 50mm LONG X-FOOT | M12 | SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1 (mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	6.6	7.6	8.5	9.6	10.7	12.0	3.9	4.5	5.1	5.8	6.4	7.2
100	100	8.6	9.9	11.1	12.5	14.0	15.7	9.7	11.3	12.6	14.2	15.9	17.8
150	100	8.6	9.9	11.1	12.5	14.0	15.7	16.8	19.4	21.7	24.6	27.5	30.7
50	150	8.2	9.5	10.6	12.0	13.4	14.9	3.9	4.5	5.1	5.8	6.4	7.2
100	150	11.3	13.0	14.6	16.5	18.4	20.6	9.7	11.3	12.6	14.2	15.9	17.8
150	150	11.3	13.0	14.6	16.5	18.4	20.6	16.8	19.4	21.7	24.6	27.5	30.7
50	200	8.6	9.9	11.1	12.5	14	15.7	3.9	4.5	5.1	5.8	6.4	7.2
100	200	12	13.8	15.5	17.5	19.6	21.9	9.7	11.3	12.6	14.2	15.9	17.8
150	200	12	13.8	15.5	17.5	19.6	21.9	16.8	19.4	21.7	24.6	27.5	30.7

NOTES:

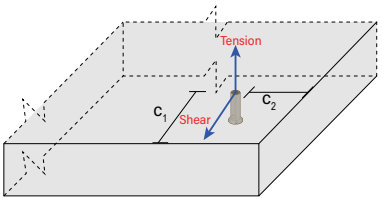
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Effective embedment depth of 54mm considered in the capacity values; including the 8mm nailing plate*



PSA 75mm LONG X-FOOT | M12,M16,M20 | SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
50	12.5	14.4	16.1	18.2	20.4	22.8	4.6	5.4	6.0	6.8	7.6	8.5
75	15.4	17.8	19.9	22.5	25.2	28.1	7.7	8.9	9.9	11.2	12.5	14.0
100	18.6	21.5	24.1	27.2	30.4	34.0	11.0	12.8	14.3	16.1	18.0	20.2
125	21.2	24.5	27.4	31.0	34.6	38.7	14.7	17.0	19.0	21.5	24.1	26.9
150	21.2	24.5	27.4	31.0	34.6	38.7	18.7	21.6	24.2	27.3	30.6	34.2
175	21.2	24.5	27.4	31.0	34.6	38.7	23.0	26.5	29.6	33.5	37.5	41.9
200	21.2	24.5	27.4	31.0	34.6	38.7	27.4	31.7	35.4	40.1	44.8	50.1

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 79mm considered in the capacity values; including the 8mm nailing plate*

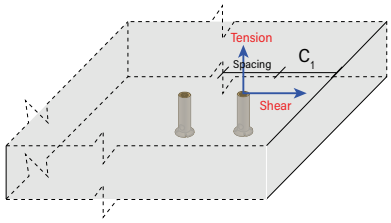


PSA 75mm LONG X-FOOT | M12,M16,M20 | SINGLE INSERT NEAR TWO EDGES

1ST EDGE DISTANCE, C_1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{U,C}$ (kN)						SHEAR CAPACITY, $\Phi V_{U,C}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	8.9	10.2	11.4	12.9	14.5	16.2	3.5	4.0	4.5	5.1	5.7	6.4
50	75	10.2	11.8	13.1	14.9	16.6	18.6	4.6	5.4	6.0	6.8	7.6	8.5
75	75	12.6	14.5	16.2	18.4	20.5	23.0	5.7	6.6	7.4	8.4	9.4	10.5
75	100	14.2	16.4	18.3	20.8	23.2	25.9	7.0	8.1	9.0	10.2	11.4	12.8
100	100	17.2	19.8	22.2	25.1	28.1	31.4	8.3	9.6	10.7	12.1	13.5	15.1
100	125	18.6	21.5	24.1	27.2	30.4	34.0	9.6	11.1	12.4	14.1	15.7	17.6
125	125	21.2	24.5	27.4	31.0	34.6	38.7	11.1	12.8	14.3	16.2	18.1	20.2
150	150	21.2	24.5	27.4	31	34.6	38.7	14	16.2	18.1	20.5	22.9	25.6
200	200	21.2	24.5	27.4	31	34.6	38.7	20.6	23.8	26.6	30	33.6	37.6

NOTES:

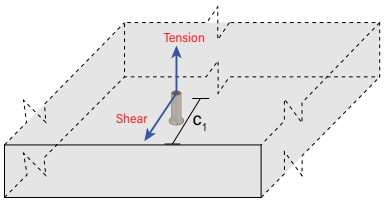
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 79mm considered in the capacity values; including the 8mm nailing plate*



PSA 75mm LONG X-FOOT | M12,M16,M20 |SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1 (mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	7.4	8.5	9.6	10.8	12.1	13.5	4.6	5.4	6.0	6.8	7.6	8.5
100	100	11.1	12.8	14.3	16.2	18.1	20.3	11.0	12.8	14.3	16.1	18.0	20.2
150	100	12.5	14.4	16.1	18.2	20.4	22.8	18.7	21.6	24.2	27.3	30.6	34.2
200	100	12.5	14.4	16.1	18.2	20.4	22.8	27.4	31.7	35.4	40.1	44.8	50.1
50	150	9.2	10.7	11.9	13.5	15.1	16.9	4.6	5.4	6.0	6.8	7.6	8.5
100	150	13.9	16.1	18.0	20.4	22.8	25.4	11.0	12.8	14.3	16.1	18.0	20.2
150	150	15.4	17.8	19.9	22.5	25.2	28.1	18.7	21.6	24.2	27.3	30.6	34.2
200	150	15.4	17.8	19.9	22.5	25.2	28.1	27.4	31.7	35.4	40.1	44.8	50.1
50	200	11.1	12.8	14.3	16.2	18.1	20.3	4.6	5.4	6.0	6.8	7.6	8.5
100	200	17.1	19.7	22.0	24.9	27.9	31.2	11.0	12.8	14.3	16.1	18.0	20.2
150	200	18.6	21.5	24.1	27.2	30.4	34.0	18.7	21.6	24.2	27.3	30.6	34.2
200	200	18.6	21.5	24.1	27.2	30.4	34.0	27.4	31.7	35.4	40.1	44.8	50.1
50	250	12.5	14.4	16.1	18.2	20.4	22.8	4.6	5.4	6.0	6.8	7.6	8.5
100	250	18.6	21.5	24.1	27.2	30.4	34.0	11.0	12.8	14.3	16.1	18.0	20.2
150	250	21.2	24.5	27.4	31.0	34.6	38.7	18.7	21.6	24.2	27.3	30.6	34.2
200	250	21.2	24.5	27.4	31.0	34.6	38.7	27.4	31.7	35.4	40.1	44.8	50.1

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 79mm considered in the capacity values; including the 8mm nailing plate*

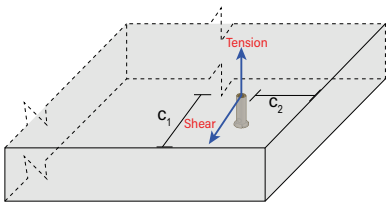


PSA 96mm LONG X-FOOT | M12,M16,M20,M24 |SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
50	16.1	18.6	20.8	23.5	26.3	29.4	5.0	5.8	6.5	7.3	8.2	9.1
75	19.3	22.2	24.9	28.1	31.4	35.2	8.2	9.4	10.5	11.9	13.3	14.9
100	22.7	26.2	29.3	33.1	37.0	41.4	11.7	13.5	15.1	17.1	19.1	21.3
125	26.3	30.4	34.0	38.4	43.0	48.0	15.5	17.9	20.0	22.7	25.3	28.3
150	30.2	34.9	39.0	44.1	49.3	55.2	19.6	22.7	25.3	28.7	32.1	35.8
175	30.2	34.9	39.0	44.1	49.3	55.2	24.0	27.7	31.0	35.1	39.2	43.8
200	30.2	34.9	39	44.1	49.3	55.2	28.6	33	36.9	41.8	46.7	52.2
250	30.2	34.9	39	44.1	49.3	55.2	38.5	44.4	49.7	56.2	62.8	70.2
300	30.2	34.9	39	44.1	49.3	55.2	49.1	56.7	63.4	71.8	80.2	89.7

NOTES:

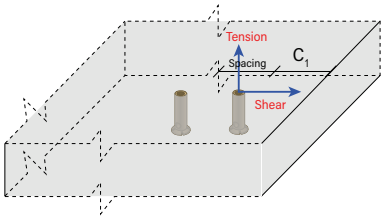
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 100mm considered in the capacity values; including the 8mm nailing plate*



PSA 96mm LONG X-FOOT | M12,M16,M20,M24 |SINGLE INSERT NEAR TWO EDGES

1ST EDGE DISTANCE, C_1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	8.1	9.3	10.4	11.8	13.2	14.7	3.7	4.3	4.8	5.5	6.1	6.8
50	75	10.1	11.6	13.0	14.7	16.4	18.4	5.0	5.8	6.5	7.3	8.2	9.1
75	75	12.8	14.8	16.6	18.8	21.0	23.4	6.1	7.1	7.9	8.9	10.0	11.2
75	100	15.0	17.3	19.3	21.9	24.5	27.3	7.4	8.6	9.6	10.9	12.2	13.6
100	100	18.1	20.9	23.4	26.5	29.6	33.1	8.8	10.1	11.3	12.8	14.3	16.0
100	125	20.4	23.5	26.3	29.8	33.3	37.2	10.2	11.7	13.1	14.9	16.6	18.6
125	125	23.9	27.6	30.9	34.9	39.1	43.7	11.6	13.4	15.0	17.0	19.0	21.2
125	150	26.3	30.4	34.0	38.4	43.0	48.0	13.1	15.2	16.9	19.2	21.4	24.0
150	150	30.2	34.9	39.0	44.1	49.3	55.2	14.7	17.0	19.0	21.5	24.0	26.9
200	200	30.2	34.9	39.0	44.1	49.3	55.2	21.5	24.8	27.7	31.3	35.0	39.2
200	250	30.2	34.9	39.0	44.1	49.3	55.2	24.9	28.8	32.2	36.4	40.7	45.5
250	300	30.2	34.9	39.0	44.1	49.3	55.2	32.5	37.6	42.0	47.5	53.1	59.4
300	300	30.2	34.9	39.0	44.1	49.3	55.2	36.8	42.5	47.6	53.8	60.2	67.3

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 100mm considered in the capacity values; including the 8mm nailing plate*

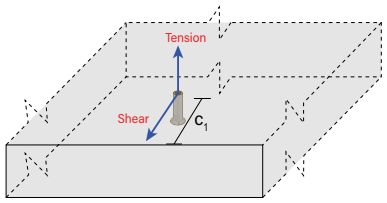


PSA 96mm LONG X-FOOT | M12,M16,M20,M24 |SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1 (mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	10.7	12.4	13.9	15.7	17.5	19.6	5.0	5.8	6.5	7.3	8.2	9.1
100	100	13.4	15.5	17.3	19.6	21.9	24.5	11.7	13.5	15.1	17.1	19.1	21.3
150	100	16.1	18.6	20.8	23.5	26.3	29.4	19.6	22.7	25.3	28.7	32.1	35.8
200	100	16.1	18.6	20.8	23.5	26.3	29.4	28.6	33.0	36.9	41.8	46.7	52.2
50	150	12.1	14.0	15.6	17.6	19.7	22.1	5.0	5.8	6.5	7.3	8.2	9.1
100	150	16.0	18.5	20.7	23.4	26.2	29.3	11.7	13.5	15.1	17.1	19.1	21.3
150	150	19.3	22.2	24.9	28.1	31.4	35.2	19.6	22.7	25.3	28.7	32.1	35.8
200	150	19.3	22.2	24.9	28.1	31.4	35.2	28.6	33.0	36.9	41.8	46.7	52.2
50	200	13.4	15.5	17.3	19.6	21.9	24.5	5.0	5.8	6.5	7.3	8.2	9.1
100	200	18.9	21.8	24.4	27.6	30.8	34.5	11.7	13.5	15.1	17.1	19.1	21.3
150	200	22.7	26.2	29.3	33.1	37.0	41.4	19.6	22.7	25.3	28.7	32.1	35.8
200	200	22.7	26.2	29.3	33.1	37.0	41.4	28.6	33.0	36.9	41.8	46.7	52.2
50	300	16.1	18.6	20.8	23.5	26.3	29.4	5.0	5.8	6.5	7.3	8.2	9.1
100	300	22.7	26.2	29.3	33.1	37.0	41.4	11.7	13.5	15.1	17.1	19.1	21.3
150	300	30.2	34.9	39.0	44.1	49.3	55.2	19.6	22.7	25.3	28.7	32.1	35.8
200	300	30.2	34.9	39.0	44.1	49.3	55.2	28.6	33.0	36.9	41.8	46.7	52.2

NOTES:

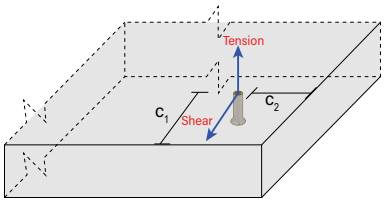
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 100mm considered in the capacity values; including the 8mm nailing plate*



PSA 120mm LONG X-FOOT | M20 |SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
75	24.0	27.7	31.0	35.1	39.2	43.9	8.7	10.0	11.2	12.7	14.2	15.8
100	27.6	31.9	35.7	40.3	45.1	50.4	12.3	14.2	15.9	18.0	20.1	22.5
125	31.4	36.3	40.6	45.9	51.3	57.4	16.3	18.8	21.0	23.8	26.6	29.8
150	35.5	41.0	45.8	51.8	58.0	64.8	20.6	23.7	26.5	30.0	33.6	37.5
175	39.8	45.9	51.3	58.1	64.9	72.6	25.1	28.9	32.4	36.6	40.9	45.8
200	41.7	48.2	53.9	60.9	68.1	76.2	29.8	34.4	38.5	43.5	48.7	54.4
250	41.7	48.2	53.9	60.9	68.1	76.2	40.0	46.1	51.6	58.4	65.2	72.9
300	41.7	48.2	53.9	60.9	68.1	76.2	50.9	58.8	65.7	74.3	83.1	92.9

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 124mm considered in the capacity values; including the 8mm nailing plate*

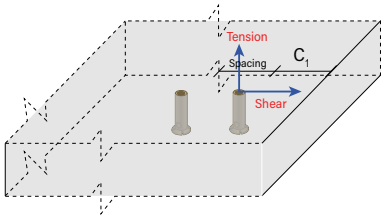


PSA 120mm LONG X-FOOT | M20 |SINGLE INSERT NEAR TWO EDGES

1ST EDGE DISTANCE, C_1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
75	75	13.8	15.9	17.8	20.2	22.5	25.2	6.5	7.5	8.4	9.5	10.6	11.9
75	100	16.1	18.6	20.8	23.5	26.3	29.4	7.9	9.1	10.2	11.6	12.9	14.5
100	100	19.3	22.3	24.9	28.2	31.5	35.3	9.2	10.7	11.9	13.5	15.1	16.9
100	125	21.7	25.1	28.1	31.7	35.5	39.7	10.7	12.4	13.9	15.7	17.5	19.6
125	125	25.3	29.2	32.6	36.9	41.3	46.1	12.2	14.1	15.8	17.9	20.0	22.3
125	150	27.8	32.1	35.9	40.6	45.4	50.8	13.8	15.9	17.8	20.1	22.5	25.2
150	150	31.7	36.6	40.9	46.3	51.7	57.9	15.4	17.8	19.9	22.5	25.2	28.1
200	200	33.6	38.8	43.4	49.1	54.9	61.4	22.4	25.8	28.9	32.7	36.5	40.8
200	250	33.6	38.8	43.4	49.1	54.9	61.4	26.0	30.0	33.5	37.9	42.4	47.4
250	300	33.6	38.8	43.4	49.1	54.9	61.4	33.8	39.0	43.6	49.4	55.2	61.7
300	300	33.6	38.8	43.4	49.1	54.9	61.4	38.2	44.1	49.3	55.7	62.3	69.7

NOTES:

- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 124mm considered in the capacity values; including the 8mm nailing plate*

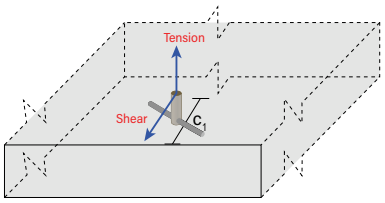


PSA 120mm LONG X-FOOT | M20 |SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1 (mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{U,C}$ (kN)						SHEAR CAPACITY, $\Phi V_{U,C}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
75	100	8.7	10.0	11.2	12.7	14.2	15.8	8.7	10.0	11.2	12.7	14.2	15.8
100	100	12.3	14.2	15.9	18.0	20.1	22.5	12.3	14.2	15.9	18.0	20.1	22.5
150	100	20.6	23.7	26.5	30.0	33.6	37.5	20.6	23.7	26.5	30.0	33.6	37.5
200	100	29.8	34.4	38.5	43.5	48.7	54.4	29.8	34.4	38.5	43.5	48.7	54.4
75	150	8.7	10.0	11.2	12.7	14.2	15.8	8.7	10.0	11.2	12.7	14.2	15.8
100	150	12.3	14.2	15.9	18.0	20.1	22.5	12.3	14.2	15.9	18.0	20.1	22.5
150	150	20.6	23.7	26.5	30.0	33.6	37.5	20.6	23.7	26.5	30.0	33.6	37.5
200	150	29.8	34.4	38.5	43.5	48.7	54.4	29.8	34.4	38.5	43.5	48.7	54.4
75	200	8.7	10.0	11.2	12.7	14.2	15.8	8.7	10.0	11.2	12.7	14.2	15.8
100	200	12.3	14.2	15.9	18.0	20.1	22.5	12.3	14.2	15.9	18.0	20.1	22.5
150	200	20.6	23.7	26.5	30.0	33.6	37.5	20.6	23.7	26.5	30.0	33.6	37.5
200	200	29.8	34.4	38.5	43.5	48.7	54.4	29.8	34.4	38.5	43.5	48.7	54.4
75	300	8.7	10.0	11.2	12.7	14.2	15.8	8.7	10.0	11.2	12.7	14.2	15.8
100	300	12.3	14.2	15.9	18.0	20.1	22.5	12.3	14.2	15.9	18.0	20.1	22.5
150	300	20.6	23.7	26.5	30.0	33.6	37.5	20.6	23.7	26.5	30.0	33.6	37.5
200	300	29.8	34.4	38.5	43.5	48.7	54.4	29.8	34.4	38.5	43.5	48.7	54.4

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 124mm considered in the capacity values; including the 8mm nailing plate*

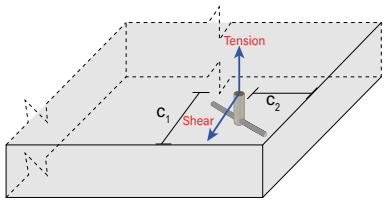
PSA ROUND FERRULES - CONCRETE BREAKOUT CAPACITIES



PSA 75mm LONG ROUND | M12,M16,M20 | SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
50	9.0	10.4	11.6	13.2	14.7	16.5	4.2	4.9	5.5	6.2	6.9	7.7
75	11.8	13.6	15.2	17.2	19.2	21.5	7.1	8.2	9.2	10.4	11.6	12.9
100	13.0	15.0	16.8	19.0	21.2	23.7	10.3	11.9	13.3	15.0	16.8	18.8
125	13.0	15.0	16.8	19.0	21.2	23.7	13.8	16.0	17.9	20.2	22.6	25.3
150	13.0	15.0	16.8	19.0	21.2	23.7	17.6	20.4	22.8	25.8	28.8	32.2
175	13.0	15.0	16.8	19.0	21.2	23.7	21.7	25.1	28.0	31.7	35.4	39.6
200	13.0	15.0	16.8	19.0	21.2	23.7	26.0	30.0	33.6	38.0	42.5	47.5
250	13.0	15.0	16.8	19.0	21.2	23.7	35.2	40.7	45.5	51.5	57.5	64.3
300	13.0	15.0	16.8	19.0	21.2	23.7	45.3	52.3	58.4	66.1	73.9	82.6

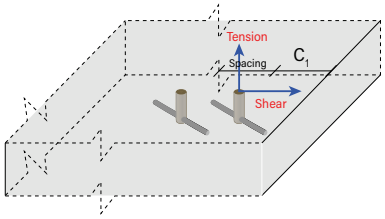
NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 57mm considered in the capacity values; including the 8mm nailing plate*



PSA 75mm LONG ROUND | M12,M16,M20 | SINGLE INSERT NEAR TWO EDGES

1ST EDGE DISTANCE, C_1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	7.1	8.3	9.2	10.4	11.7	13.0	3.2	3.7	4.1	4.6	5.2	5.8
50	75	8.5	9.8	10.9	12.4	13.8	15.5	4.2	4.9	5.5	6.2	6.9	7.7
75	75	11.0	12.7	14.2	16.1	18.0	20.1	5.3	6.1	6.9	7.8	8.7	9.7
75	100	11.8	13.6	15.2	17.2	19.2	21.5	6.5	7.5	8.4	9.5	10.6	11.8
100	100	13.0	15.0	16.8	19.0	21.2	23.7	7.7	8.9	10.0	11.3	12.6	14.1
100	125	13.0	15.0	16.8	19.0	21.2	23.7	9.0	10.4	11.6	13.1	14.7	16.4
125	125	13.0	15.0	16.8	19.0	21.2	23.7	10.4	12.0	13.4	15.2	16.9	18.9
150	150	13.0	15.0	16.8	19.0	21.2	23.7	13.2	15.3	17.1	19.3	21.6	24.2
200	200	13.0	15.0	16.8	19.0	21.2	23.7	19.5	22.5	25.2	28.5	31.8	35.6

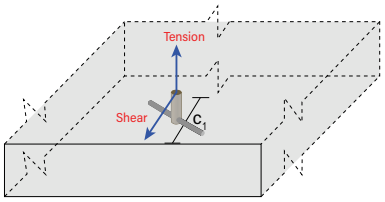
NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 57mm considered in the capacity values; including the 8mm nailing plate*



PSA 75MM LONG ROUND | M12,M16,M20| SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1(mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	6.7	7.7	8.6	9.7	10.9	12.2	4.2	4.9	5.5	6.2	6.9	7.7
100	100	9.0	10.4	11.6	13.2	14.7	16.5	10.3	11.9	13.3	15.0	16.8	18.8
150	100	9.0	10.4	11.6	13.2	14.7	16.5	17.6	20.4	22.8	25.8	28.8	32.2
200	100	9.0	10.4	11.6	13.2	14.7	16.5	26.0	30.0	33.6	38.0	42.5	47.5
50	150	8.3	9.6	10.7	12.2	13.6	15.2	4.2	4.9	5.5	6.2	6.9	7.7
100	150	11.8	13.6	15.2	17.2	19.2	21.5	10.3	11.9	13.3	15.0	16.8	18.8
150	150	11.8	13.6	15.2	17.2	19.2	21.5	17.6	20.4	22.8	25.8	28.8	32.2
200	150	11.8	13.6	15.2	17.2	19.2	21.5	26.0	30.0	33.6	38.0	42.5	47.5
50	200	9.0	10.4	11.6	13.2	14.7	16.5	4.2	4.9	5.5	6.2	6.9	7.7
100	200	13.0	15.0	16.8	19.0	21.2	23.7	10.3	11.9	13.3	15.0	16.8	18.8
150	200	13.0	15.0	16.8	19.0	21.2	23.7	17.6	20.4	22.8	25.8	28.8	32.2
200	200	13.0	15.0	16.8	19.0	21.2	23.7	26.0	30.0	33.6	38.0	42.5	47.5
50	250	9.0	10.4	11.6	13.2	14.7	16.5	4.2	4.9	5.5	6.2	6.9	7.7
100	250	13.0	15.0	16.8	19.0	21.2	23.7	10.3	11.9	13.3	15.0	16.8	18.8
150	250	13.0	15.0	16.8	19.0	21.2	23.7	17.6	20.4	22.8	25.8	28.8	32.2
200	250	13.0	15.0	16.8	19.0	21.2	23.7	26.0	30.0	33.6	38.0	42.5	47.5

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20 shall be 75mm*
- *Effective embedment depth of 57mm considered in the capacity values; including the 8mm nailing plate*

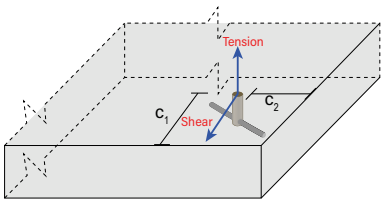


PSA 96MM LONG ROUND | M12,M16,M20,M24 | SINGLE INSERT NEAR ONE EDGE

EDGE DISTANCE, C_1(mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
50	12.3	14.2	15.9	18.0	20.1	22.5	4.6	5.3	6.0	6.8	7.6	8.4
75	15.2	17.6	19.7	22.3	24.9	27.8	7.6	8.8	9.9	11.2	12.5	14.0
100	18.5	21.3	23.8	27.0	30.1	33.7	11.0	12.7	14.2	16.1	18.0	20.1
125	20.8	24.0	26.9	30.4	34.0	38.0	14.7	17.0	19.0	21.5	24.0	26.9
150	20.8	24.0	26.9	30.4	34.0	38.0	18.7	21.6	24.1	27.3	30.5	34.1
175	20.8	24.0	26.9	30.4	34.0	38.0	22.9	26.4	29.6	33.5	37.4	41.8
200	20.8	24.0	26.9	30.4	34.0	38.0	27.4	31.6	35.3	40.0	44.7	50.0
250	20.8	24.0	26.9	30.4	34.0	38.0	36.9	42.7	47.7	53.9	60.3	67.4
300	20.8	24.0	26.9	30.4	34.0	38.0	47.3	54.6	61.1	69.1	77.2	86.3

NOTES:

- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 78mm considered in the capacity values; including the 8mm nailing plate*

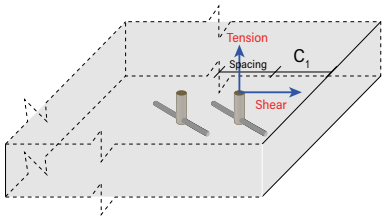


PSA 96MM LONG ROUND | M12,M16,M20,M24 | SINGLE INSERT NEAR TWO EDGES

1st EDGE DISTANCE, C1 (mm)	2nd EDGE DISTANCE, C_2 (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	8.8	10.1	11.3	12.8	14.3	16.0	3.5	4.0	4.5	5.1	5.7	6.3
50	75	10.1	11.7	13.0	14.7	16.5	18.4	4.6	5.3	6.0	6.8	7.6	8.4
75	75	12.5	14.4	16.1	18.3	20.4	22.8	5.7	6.6	7.4	8.4	9.4	10.5
75	100	14.1	16.3	18.2	20.6	23.1	25.8	7.0	8.1	9.0	10.2	11.4	12.7
100	100	17.1	19.8	22.1	25.0	28.0	31.3	8.3	9.5	10.7	12.1	13.5	15.1
100	125	18.5	21.3	23.8	27.0	30.1	33.7	9.6	11.1	12.4	14.0	15.7	17.5
125	125	20.8	24.0	26.9	30.4	34.0	38.0	11.0	12.7	14.2	16.1	18.0	20.1
125	150	20.8	24.0	26.9	30.4	34.0	38.0	12.4	14.4	16.1	18.2	20.3	22.7
150	150	20.8	24.0	26.9	30.4	34.0	38.0	14.0	16.2	18.1	20.5	22.9	25.6
200	200	20.8	24.0	26.9	30.4	34.0	38.0	20.5	23.7	26.5	30.0	33.5	37.5
200	250	20.8	24.0	26.9	30.4	34.0	38.0	23.8	27.5	30.8	34.8	38.9	43.5
250	300	20.8	24.0	26.9	30.4	34.0	38.0	31.2	36.1	40.3	45.6	51.0	57.1
300	300	20.8	24.0	26.9	30.4	34.0	38.0	35.5	41.0	45.8	51.8	57.9	64.8

NOTES:

- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 78mm considered in the capacity values; including the 8mm nailing plate*



PSA 96MM LONG ROUND | M12,M16,M20,M24 | SINGLE INSERT WITH EDGE DISTANCE AND SPACING RESTRICTION

EDGE DISTANCE, C_1(mm)	SPACING (mm)	TENSILE CAPACITY, $\Phi N_{u,c}$ (kN)						SHEAR CAPACITY, $\Phi V_{u,c}$ (kN)					
		CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	7.4	8.5	9.5	10.8	12.0	13.4	4.6	5.3	6.0	6.8	7.6	8.4
100	100	11.0	12.8	14.3	16.1	18.0	20.2	11.0	12.7	14.2	16.1	18.0	20.1
150	100	12.3	14.2	15.9	18.0	20.1	22.5	18.7	21.6	24.1	27.3	30.5	34.1
200	100	12.3	14.2	15.9	18.0	20.1	22.5	27.4	31.6	35.3	40.0	44.7	50.0
50	150	9.2	10.6	11.9	13.4	15.0	16.8	4.6	5.3	6.0	6.8	7.6	8.4
100	150	13.9	16.0	17.9	20.3	22.7	25.4	11.0	12.7	14.2	16.1	18.0	20.1
150	150	15.2	17.6	19.7	22.3	24.9	27.8	18.7	21.6	24.1	27.3	30.5	34.1
200	150	15.2	17.6	19.7	22.3	24.9	27.8	27.4	31.6	35.3	40.0	44.7	50.0
50	200	11.0	12.8	14.3	16.1	18.0	20.2	4.6	5.3	6.0	6.8	7.6	8.4
100	200	17.0	19.6	22.0	24.8	27.8	31.1	11.0	12.7	14.2	16.1	18.0	20.1
150	200	18.5	21.3	23.8	27.0	30.1	33.7	18.7	21.6	24.1	27.3	30.5	34.1
200	200	18.5	21.3	23.8	27.0	30.1	33.7	27.4	31.6	35.3	40.0	44.7	50.0
50	300	12.3	14.2	15.9	18.0	20.1	22.5	4.6	5.3	6.0	6.8	7.6	8.4
100	300	18.5	21.3	23.8	27.0	30.1	33.7	11.0	12.7	14.2	16.1	18.0	20.1
150	300	20.8	24.0	26.9	30.4	34.0	38.0	18.7	21.6	24.1	27.3	30.5	34.1
200	300	20.8	24.0	26.9	30.4	34.0	38.0	27.4	31.6	35.3	40.0	44.7	50.0

NOTES:
- *All design capacities include a reduction factor $\Phi = 0.6$*
- *Shear capacities based on a minimum element thickness of 1.5 x C_1*
- *Absolute minimum edge distance for M20/M24 shall be 75mm*
- *Effective embedment depth of 78mm considered in the capacity values; including the 8mm nailing plate*

STEEL FAILURE OF THREADED INSERTS IN TENSION

PSA X-FOOT FERRULES

FERRULE SIZE, D_b	ZINC AND GALVANISED		STAINLESS STEEL		DESIGN TENSION CAPACITY OF FERRULE, ΦNus	
	YIELD STRENGTH, f_y(MPa)	UTS, f_{su} (MPa)	YIELD STRENGTH, f_y(MPa)	UTS, f_{su} (MPa)	ZINC AND GALVANISED FINISH(kN)	STAINLESS STEEL(kN)
M12 50mm long	370	440	350	600	35.3	41.2
M12 75mm and 96mm long	370	440	350	600	80.8	104
M16 75mm and 96mm long	370	440	350	600	80.8	104
M20 75mm and 96mm long	370	440	350	600	80.8	104
M24 96mm long	370	440	350	600	125.8	-

NOTE: All design capacities include a reduction factor Φ = 0.8

PSA ROUND FERRULES

FERRULE SIZE, D_b	ZINC AND GALVANISED		DESIGN TENSION CAPACITY OF FERRULE, ΦNus(kN)
	YIELD STRENGTH, f_y(MPa)	UTS, f_{su}(MPa)	
M12 75mm and 96mm long	370	440	80.8
M16 75mm and 96mm long	370	440	80.8
M20 75mm and 96mm long	370	440	80.8
M24 96mm long	370	440	120.4

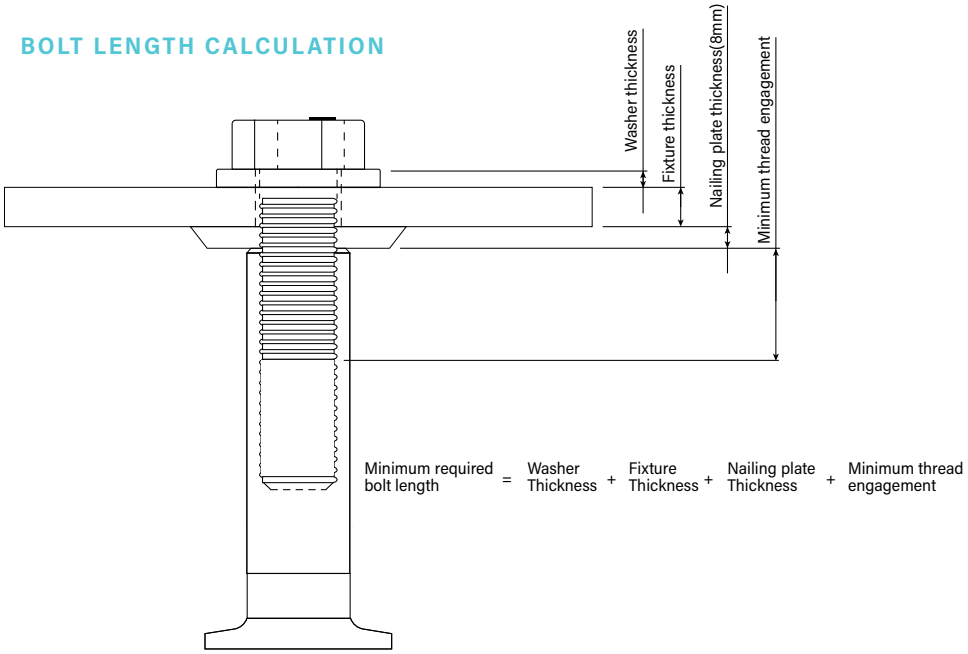
NOTE: All design capacities include a reduction factor Φ = 0.8

TYPICAL BOLT PERFORMANCE INFORMATION

REDUCED NOMINAL BOLT TENSILE CAPACITY, ΦN_{sb}, (kN), Φ = 0.8				
BOLT TYPE	**M12**	**M16**	**M20**	**M24**
Grade 4.6	27	50	78	113

REDUCED NOMINAL BOLT SHEAR CAPACITY, ΦV_{sb}, (kN), Φ = 0.8				
BOLT TYPE	**M12**	**M16**	**M20**	**M24**
Grade 4.6	14	27	43	62

BOLT LENGTH CALCULATION



FERRULE/BOLT SIZE	M12	M16	M20	M24
MINIMUM THREAD ENGAGEMENT (mm)	16	24	30	36

COMBINED STEEL FAILURE OF BOLT IN TENSION AND SHEAR

Bolts subjected to combined tension and shear loading shall be designed using the following equation.

$$(N^*/\Phi N_{s,b})^2 + (V^*/\Phi V_{s,b})^2 \leq 1.0$$

N^*	Applied factored tension load
V^*	Applied factored shear load
$\Phi N_{s,b}$	Design bolt tensile capacity
$\Phi V_{s,b}$	Design bolt shear capacity

WORKING LOAD LIMITS FOR TEMPORARY CONNECTIONS

Temporary connections are widely used for temporary works in precast concrete elements such as temporary bracing and strongbacks. The design is based on Working Load Limit (WLL) as per AS3850 and the Factor of Safety (FoS) shall be adopted accordingly.

$$\text{Working Load Limit (WLL)} = R_u / \text{FoS}$$

Inserts recommended by PSA for temporary connections are M20 X-Foot Ferrules (96mm and 120mm long), M20 Round Ferrules (96mm long) and 20mm Coil Thread Ferrules (96mm long).

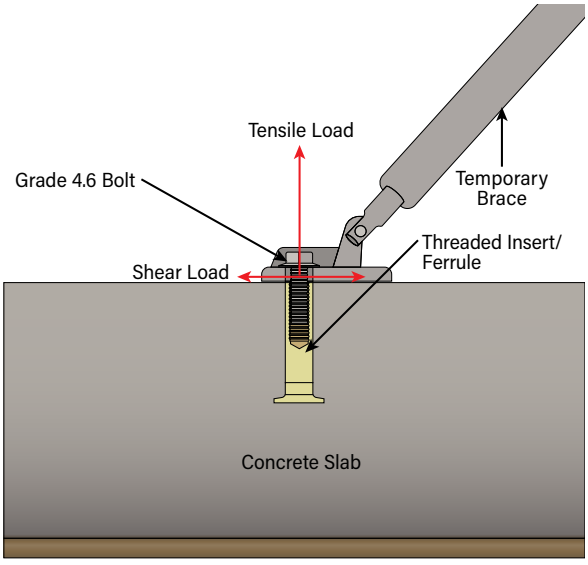
Working load limits of inserts are calculated using a factor of safety of 2.25 as AS3850.1 and are tabulated below. For design purposes, select the minimum of, insert WLL and bolt WLL in both tensile and shear.

WORKING LOAD LIMITS OF PSA INSERTS

PART NUMBER	TENSILE WLL (kN)						SHEAR WLL (kN)					
	CONCRETE COMPRESSIVE STRENGTH (MPa)						CONCRETE COMPRESSIVE STRENGTH (MPa)					
	15	20	25	32	40	50	15	20	25	32	40	50
FP2096ZF, FP2096GF, FP2096SS	22.4	25.8	28.9	32.7	36.5	40.9	21.0	24.3	27.1	30.7	34.3	38.4
FP20120ZF, FP20120GF	30.9	35.7	39.9	45.1	50.5	56.4	21.8	25.1	28.1	31.8	35.5	39.7
P2096ZF, P2096GF	15.4	17.8	19.9	22.5	25.2	28.1	20.2	23.4	26.1	29.5	33.0	36.9
FC2096ZF	22.4	25.8	28.9	32.7	36.5	40.9	21.0	24.3	27.1	30.7	34.3	38.4

NOTES:

- *Minimum edge distance of 150mm in all directions required to achieve tensile WLL of FP2096ZF, FP2096GF, FP2096SS, P2096ZF, P2096GF and FC2096ZF*
- *Minimum edge distance of 200mm in all directions required to achieve tensile WLL of FP20120ZF, FP20120GF*
- *Minimum edge distance of 300mm towards load direction, minimum edge distance of 450mm in all other directions and minimum element thickness of 150mm required to achieve shear WLL*
- *N12 300mm long cross bar required in P2096ZF/GF to develop rated capacities*
- *Minimum FoS of 2.25 included in all above WLL values*



Example of a temporary connection

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