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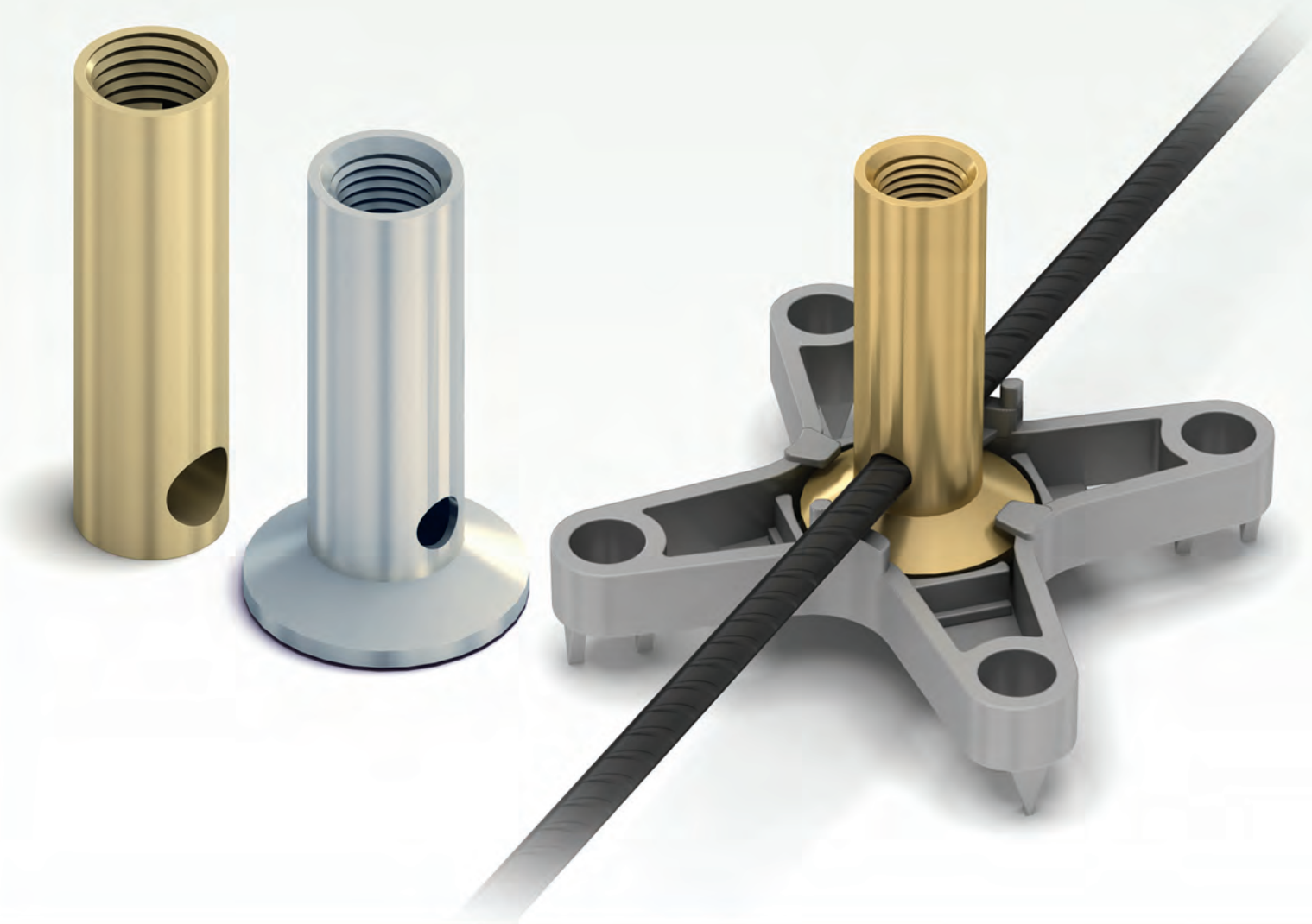
New Zealand Edition

QwikFoot and QwikFix Threaded Inserts

Design Guide



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December 2020

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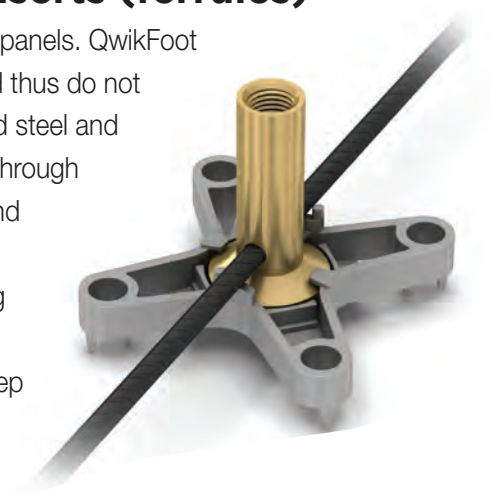
Threaded Inserts and Accessories

Ancon QwikFoot and QwikFix Cast-in Inserts (ferrules)

Leviat provides a wide range of Threaded Inserts to be used in precast panels. QwikFoot threaded inserts provide a safe load transfer through a forged head and thus do not require a crossbar to transfer loads. QwikFix inserts are made from solid steel and have a cross hole. The anchorage is provided by a crossbar being fed through this hole. Ferrules are available with metric threads from M10 to M24 and Unicoil threads UC16. The inserts are available in zinc plated or hot-dip galvanized G350 steel and stainless steel grade 316. We provide nailing plates to safely attach the inserts to the formwork and avoid ingress of concrete. Precast Chairs are available to simplify the installation and keep the inserts in place while casting.



Contents

QwikFoot Threaded Inserts 5

Short QwikFoot Threaded Inserts 6

QwikFix Threaded Inserts 7

Manufacture & Materials 8

Installation 9-11

Structural Fixing Design 12-17

QwikFoot Design for Structural Fixings 18-25

QwikFix Round Insert Design for Structural Fixings 26-28

Working Load Limit - Design of Brace & Strongback Inserts 29-32

Additional Design Requirements for Earthquake Effects 33

Applications

Cast-in, threaded inserts are used for two distinct applications in precast concrete elements:

The attachment of permanent structural fixtures

Metric threaded inserts with M12, M16 and M20 threads are used in combination with Grade 4.6 or 8.8 bolts. For this application the capacities are calculated from the characteristic strength of insert and bolt using capacity reduction factors in accordance with NZS 3101 and NZS 3404 i.e. the design capacity $R_d = fR_u$

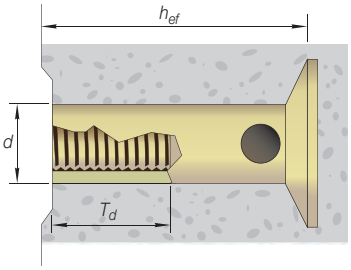
The attachment of temporary braces and strongbacks

For the erection of precast concrete elements using M20 Grade 4.6 bolts or Unicoil bolts. These applications are designed using the Working Load Limit (WLL) method in accordance with Good Practice Guidelines - Safe work with precast concrete:2018 (GPG2018) where the WLL is determined from the characteristic strength of the insert and bolt using a Factor of Safety (FoS) not less than 2.5 i.e. WLL = R_u / 2.5

QwikFoot Threaded Inserts

QwikFoot inserts are heavy duty, hot forged inserts with a large foot for high strength anchorage to concrete.

- Applicable for all structural connections using Grade 4.6 and 8.8 metric bolts
- Available with Unicoil threads for fast connection of braces and strongbacks
- Cross-holed to fit a bar for positive tie-in to reinforcing to prevent movement during concrete pouring and vibration (not to increase the capacity of the insert)
- Easily installed with the click-in QwikFoot Precast Chair, nailing plate or antenna cap according to requirements
- The large diameter foot develops full anchorage capacity without requiring a crossbar
- Develops full strength for 'Puddle-in' applications



QwikFoot Dimensions and Part Codes

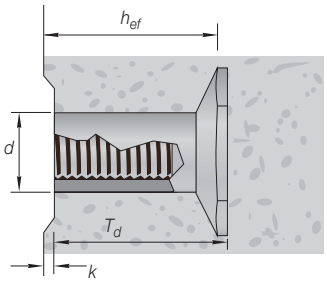
Internal Thread Size	Length L mm	Body Diameter d mm	Eff. Embement Depth * h_{ef} mm	Thread Depth T_d mm	Crosshole Diameter C_d mm	Crossbar for Tying mm	Foot Diameter F_d mm	Part Code Zinc Plated	Part Code Galvanised	Part Code T316 Stainless
M10	50	16	55	25	11	R10	35	FF1050G	FF1050G	FF1050S316
M12	50	20	55	25	11	R10	35	FF1250Z	FF1250G	FF1250S316
M12	70	20	75	30	11	R10	50	FF1270Z	FF1270G	FF1270S316
M12	96	20	101	30	11	R10	50	FF1296Z	FF1296G	FF1296S316
M16	70	25	75	35	11	R10	50	FF1670Z	FF1670G	FF1670S316
M16	96	28	101	35	15	H12	50	FF1696ZH	-	-
M16	96	25	101	40	11	R10	50	-	FF1696G	FF1696S316
M20	70	28	75	30	15	H12	50	FF2070ZH	FF2070G	FF2070S316
M20	96	28	101	50	15	H12	50	FF2096ZH	FF2096G	FF2096S316
M20	120	28	125	50	15	H12	50	FF20120ZH	FF20120G	-
M24	96	36	101	45	15	H12	50	FF2496Z	-	FF2496S316
M24	96	40	101	45	20	H12/H16	50	-	FF2496G	-
QwikFoot Unicoil Bracing Insert										
UC16	96	28	101	50	15	H12	50	UCQF1696Z	-	-

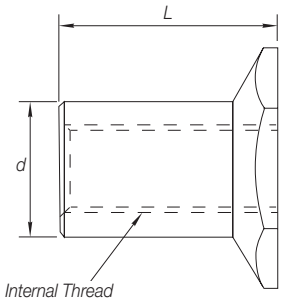
** Includes 8mm for the nailing plate*

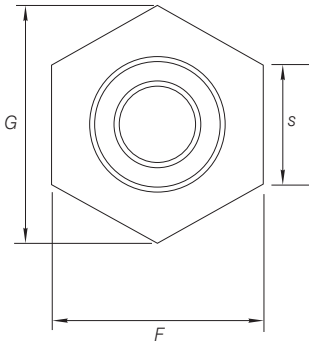
Short QwikFoot Threaded Inserts

Short QwikFoot inserts are heavy duty, hot forged inserts with a large hex foot for high strength anchorage to concrete.

- Applicable for all structural connections using Grade 4.6 and 8.8 metric bolts
- Easily installed with nailing plate or antenna cap according to requirements. Short QwikFoots do not match with QwikFoot Precast Chair.
- The large hex foot develops full anchorage capacity without requiring a crossbar
- Develops full strength for 'Puddle-in' applications







Short QwikFoot Dimensions and Part Codes

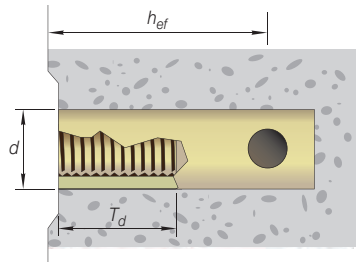
Internal Thread Size	Length L mm	Body Diameter d mm	Eff. Embedment Depth * h_{ef} mm	Thread Depth T_d mm	Max. Foot Width G mm	Min. Foot Width F mm	Hex Side Length s mm	Part Code Galvanised	Part Code T316 Stainless
M12	45	28	50	42	50	43.3	25	FF1245G	FF1245S316
M16	45	28	50	42	50	43.3	25	FF1645G	FF1645S316
M20	45	28	50	42	50	43.3	25	FF2045G	FF2045S316

** Includes 8mm for the nailing plate*

QwikFix Threaded Inserts

QwikFix inserts are medium duty, round bodied inserts, machined and cross-holed from solid G350 steel.

- Popular for medium duty Grade 4.6 metric bolt connections
- Available with Unicoil threads for quick connection of braces and strongbacks
- Cross-holed to fit an H12 bar. This bar should be minimum 300mm long for effective concrete anchorage
- May be installed with a Super Chair, nailing plate or antenna cap according to requirements
- Tension capacity limited by the shear resistance of the inserted H12 crossbar



Double ended ferrule

QwikFix Dimensions and Part Codes

Internal Thread M Size	Length L mm	Body Diameter d mm	Eff. Embedment Depth * h_{ef} mm	Thread Depth T_d mm	Crosshole Diameter C_d mm	Crossbar for Tying mm	Part Code Zinc Plated	Part Code Galvanised
M12	96	28	89	25	15	H12	FER1296Z	FER1296G
M16	76	28	69	35	15	H12	FER1676Z	-
M16	96	28	89	35	15	H12	FER1696Z	-
M16	96	28	89	55	15	H12	-	FER1696G
M20	76	28	69	35	15	H12	FER2076Z	-
M20	96	28	89	40	15	H12	FER2096Z	-
M20	96	28	89	55	15	H12	-	FER2096G
Unicoil thread Bracing Insert								
UC16	96	28	89	50	15	H12	FERB3496Z	-

** Includes 8mm for the nailing plate*

QwikFix Double Ended Inserts Dimensions and Part Codes

M16	140	28	70	40	15	H12	FERD16140Z	-
M16	170	28	85	40	15	H12	FERD16170Z	-
M16	190	28	95	40	15	H12	FERD16190Z	-
M20	140	28	70	40	15	H12	FERD20140Z	-
M20	165	28	82	40	15	H12	FERD20165Z	-
M20	170	28	85	40	15	H12	FERD20170Z	-
M20	190	28	95	40	15	H12	FERD20190Z	-

Design of QwikFix Double Ended Inserts:

For the design loads and Working Load Limits of Double Ended Inserts please refer to the steel capacities and the concrete capacities for QwikFix Threaded Inserts with similar thread and similar h_{ef}, (for FERD16140Z refer to FER1676Z, for FERD20190Z refer to FER2096Z).

Manufacture and Materials

Unicon threaded inserts are manufactured from G350 structural steel or T316 A4 stainless steel. These are ductile steels, ideal for tension, shear and moment carrying structural connections.

Material Selection

- **Zinc Electroplated** (5µ coating thickness) – for use in non-corrosive environment (e.g. interior use)
  Gold passivated: Metric coarse thread
  Silver passivated: Coil thread
- **Hot Dip Galvanised** (50µ coating thickness) – for exterior non-marine environments
- **Stainless T316 (A4)** – for all exposed applications including coastal environments

Testing

Material certificates and breaking strength results are recorded for all manufacturing batches. Please inform us at the time of order if you require certificates for your project.

Weldability

All Ancon QwikFoot and QwikFix inserts are fully weldable with no requirement for preheat or post heat treatment.

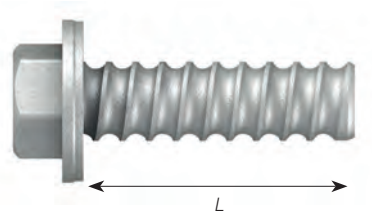
The zinc coating should be removed from standard and hot dip galvanised inserts by light grinding before welding with low hydrogen welding consumables.

Stainless steel inserts should be cleaned and welded with T316L stainless welding consumables.

Bracing Insert Bolt (UC16)

For non-permanent fixings like brace connections, Leviat offers the UniCoil Bracing Insert Bolts BIB. These bolts are equipped with the UniCoil thread and can be used with Ancon UCQF1696Z QwikFoot Threaded Inserts and Ancon FERB3496Z QwikFix Threaded Inserts. Unicoil products have smooth rounded threads which resist damage and clogging and are designed to be re-used.

Unicoil Threaded Inserts UCQF16967 and FERB3496Z are designed to exceed the capacity of the BIB bolts.

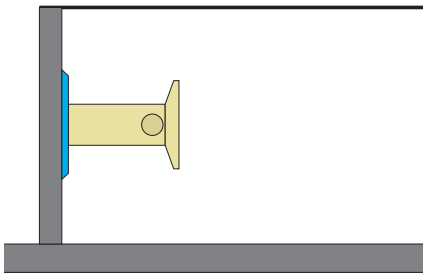


Product Code	Product Description	Length L mm	Spanner size mm	Cross section A mm^2	Tensile Strength MPa	Tensile Capacity kN
BIB3465Z	Bracing Insert Bolt ¾ x 65	65	30	198.6	490	97.3
BIB3485Z	Bracing Insert Bolt ¾ x 85	85	30	198.6	490	97.3

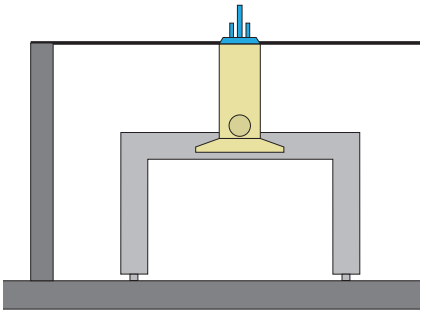
Installation

Installation in Concrete

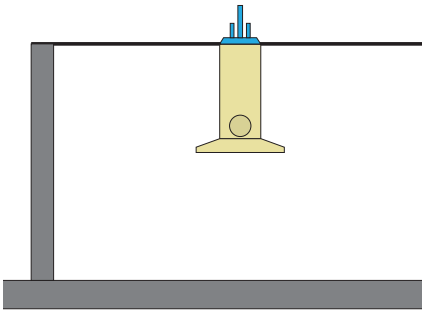
Threaded inserts can be installed using different installation methods depending on the situation and the preferences of the installer.



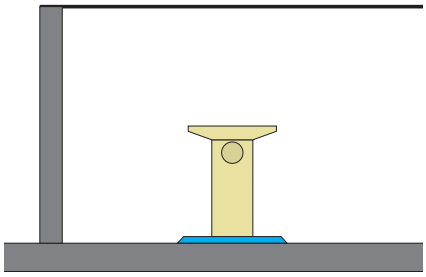
Panel edge using Nailing Plate



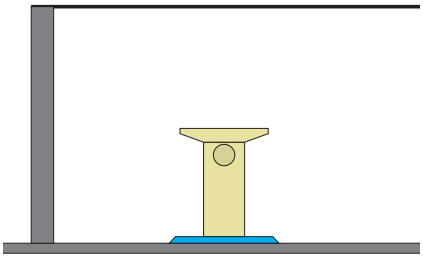
Top side using Precast Chair



“Puddle in” using Antenna Cap*



Bottom side using nailing plate



Bottom side using stick on Nailing Plate (normally in combination with steel formwork)

**To achieve consistent results in regards to location and orientation of the insert, we recommend the use of the Precast Chair instead of “puddling in”.*

Check **www.ancon.co.nz** for Installation Instructions.

Installation of the bolts

Ancon QwikFoot and QwikFix Threaded Inserts are designed to exceed the capacity of a grade 4.6 bolt. The bolts should be installed using a calibrated torque wrench with the torque recommended by Leviat. If bolts of a higher grade are installed, the torque must be limited to the installation torque of a grade 4.6 bolt to avoid possible damage to bolt, Threaded Insert and surrounding concrete.

Impact wrenches, so called “rattle guns” should not be used. They can cause serious, uncontrolled overload of bolt and Threaded Insert with unknown consequences.

Recommended tightening torques in Nm

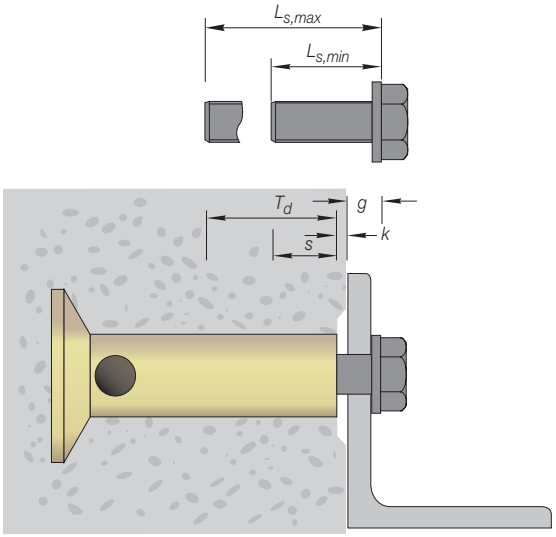
Thread	Grade 4.6 Dry condition	Grade 4.6 lubricated
M10	18	16
M12	31	27
M16	75	66
M20	150	130
M24	170	150
UC16	100	-

These recommended torque values for new metric bolts are based on a proof stress of 180MPa which relates to 75% of the yield strength for grade 4.6 bolt for diameters M10 to M20 and on 120MPa, which relates to 50% yield for bolts diameter M24.

The torque for the UC 16 bolt is based on testing.

Determining the Bolt Length

The bolt should be of sufficient length to ensure a minimum thread engagement of 1.5 times bolt diameter.



$L_{S,max} = T_d + k + g$
$L_{S,min} = s + k + g$

with:
T_d = Thread depth of the insert as shown on page 5,6 and 7
s = required thread engagement as shown below
k = Recess (8 mm for Ancon Nail Plate)
g = clamp thickness (includes washers)

Minimum Thread Engagement

Thread	Required Thread Engagement s mm
M10	15
M12	18
M16	24
M20	30
M24	36
UC16	25

Precast Chairs for QwikFoot

QwikFoot inserts when used with the Precast Chair lock into position which eliminates the costs associated with the repair of lost, misplaced inserts.

- Easy to assemble, fast to install, saves labour costs
- Strong, robust one-piece design
- Positive click together lock between chair and insert
- Designed to fit within the mesh
- Rigidly locates the crossbar providing positive location
- Stable, does not float or move
- One chair fits all QwikFoot inserts
- Available for panel thicknesses from 100 to 200mm

Precast Chairs

Part Code	For Panel Thickness (mm)	Quantity Per bag
PC125	125	100
PC145	145	100
PC150	150	100
PC170	170	100
PC175	175	100
PC180	180	100
PC195	195	100
PC200	200	100

The panel thickness in the above table is based on 96mm QwikFoot inserts.

Super Chair for QwikFix

The Super Chair supports the cross bar to ensure that the QwikFix insert is positioned at the correct height. A unique feature of the Super Chair design is that it provides for two different panel thicknesses by simply rotating the chair 90 degrees.

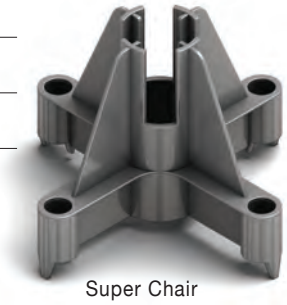
Super Chairs

Size (mm)	Part Code	Quantity per Bag
125 / 150	SC125150	50
150 / 175	SC150175	50
175 / 200	SC175200	50

Super Chair Plugs/Dowels

Product	Part Code	Quantity per Bag
Super Chair Plug Short	SCPLUGS	100
Super Chair Plug Long	SCPLUGL	100
Super Chair Dowel 85mm	SCDOWEL	100

For 'tilt-up' applications Super Chair Plugs and Super Chair Dowels are used to accurately position inserts. The plug or the dowel are placed into a drilled hole to avoid movement. One Super Chair plug or two Super Chair dowels should be used with every Super Chair.



Super Chair

Super Chair Plug and Dowel

Antenna Caps

The use of Antenna Caps is recommended with all ferrules that are installed in the face of a panel. The use of Antenna caps ensures that the ferrules can be found after the concrete is poured.

Nailing Plates

Typically used for attachment to formwork. Nailing plates are available as threaded nailing plates in diameters M10 to M24 as well as stick-on plates in diameters M12 to M20.

Stick-on Plate

Nailing Plate

Structural Fixing Design

For the design of QwikFoot and QwikFix Threaded Inserts the following failure modes need to be taken in account:

- Steel failure of the bolt in tension - (NZS 3404:1997 - Cl 9.3.2.2)
- Steel failure of the bolt in shear - (NZS 3404:1997 - Cl 9.3.2.1)
- Combined Steel failure of the bolt
- Steel Failure of the Threaded Insert in Tension - (NZS 3101:2006 - Cl 17.5.7.1)
- Concrete Breakout failure in tension (Concrete cone failure) - (NZS 3101:2006 - Cl 17.5.7.2)
- Concrete Pull-out failure*
- Concrete blow-out failure*
- Concrete Edge failure in shear - (NZS 3101:2006 - Cl 17.5.8.2 and Cl 17.5.8.3)
- Concrete pry-out failure - (NZS 3101:2006 - Cl 17.5.8.4)
- Combined Concrete failure

** The concrete pull-out capacity and the concrete blow-out capacity exceed the concrete cone capacity for all Ancon Threaded Inserts and do not need to be checked.*

The calculated lower characteristic strength in tension N and the calculated lower characteristic strength in shear V are the smallest of the above mentioned lower characteristic capacities of the connection.

Connections should be designed and detailed to avoid brittle failure of the connection point (NZS 3101 C17.6.5). All capacities that are related to concrete failure are considered brittle. The threaded insert should be designed in a way that steel failures govern the design. Alternatively the fixing can be designed as the weak link.

Bolt Capacities

The table below shows the capacities for structural bolts Grade 4.6 and 8.8.

Bolt Strengths and Capacities in kN

	Characteristic Strength kN ISO 898-1:2009 Table 4 N_{tf}		Tension Capacity kN NZS 3404:1997 Cl. 9.3.2.2 $\phi_s \cdot N_{tf}$		Shear Capacity kN NZS 3404:1997 Cl. 9.3.2.1 $0.62 \cdot \phi_s \cdot N_{tf}$	
Thread	**Grade 4.6**	**Grade 8.8**	**Grade 4.6**	**Grade 8.8**	**Grade 4.6**	**Grade 8.8**
M10	23.2	46.4	18.6	37.1	11.5	23.0
M12	33.7	67.4	27.0	53.9	16.7	33.4
M16	62.8	125.0	50.2	100.0	31.1	62.0
M20	98.0	203.0	78.4	162.4	48.6	100.7
M24	141.0	293.0	112.8	234.4	69.9	145.3
UC16	76.8	-	not used for permanent structural connections			

Note: f_s *= 0.8 (NZS 3404:1997 Table 3.3: bolt in tension or shear)*

T316 Stainless A4 bolts of strength class A4-50 can be designed using the capacities stated for Grade 4.6 bolts.

Combined loading in tension and shear for bolts

If bolts are subject to combined tension and shear the design should be done using the following formula:

$$\left(\frac{N^*}{f_s \cdot N_{tf}}\right)^2 + \left(\frac{V^*}{f_s \cdot V_{tf}}\right)^2 \leq 1$$

with

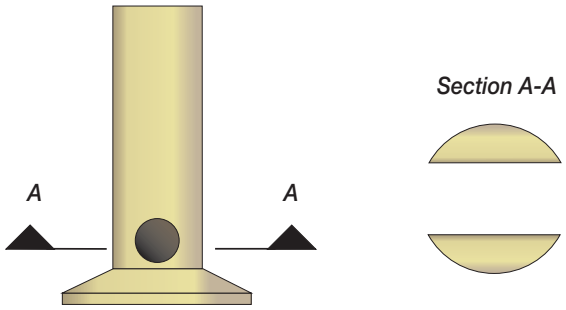
N^* = Design load in tension

V^* = Design load in shear

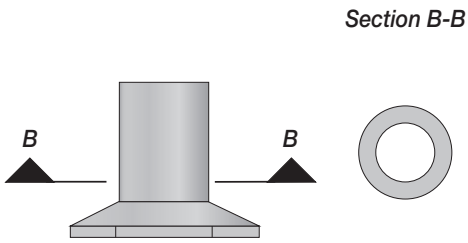
When Threaded Inserts are installed with a recess, shear loads will create bending in the bolt that will have to be taken into consideration!

Tension Capacities of the Threaded Insert

The tension capacity of the threaded insert is defined by the steel capacity N_S of the section at the cross hole of the Threaded Insert:



Relevant section area of QwikFoot and QwikFix



Relevant section area of Short QwikFoot

The table below shows the tension capacities for Ancon Threaded Inserts type QwikFix and QwikFoot:

Product Code	Char. Tensile Capacity N_s kN	WLL according to GPG2018 - Cl 10.5 N_s / 2.5 kN	Tension capacity NZS 3101:2006 - Cl 17.5.7.1 0.75 * N_s kN
FF1050	30.6	12.2	23.0
FF1050S316	33.8	13.5	25.4
FF1245G	236.2	94.4	177.3
FF1250, FF1270, FF1296	49.7	19.9	37.3
FF1250S316	55.0	22.0	41.3
FF1645G	194.9	77.9	146.1
FF1670, FF1696G	105.8	42.3	79.4
FF1670S316, FF1696S316	130.5	52.2	97.9
FF2045G	141.7	56.6	106.2
FF2070, FF2096 ,FF20120	101.9	40.8	76.4
FF2096S316, FF2070SS316	112.7	45.1	84.5
FF2496G	230.9	92.4	173.2
FF2496Z	232.1	92.8	174.1
FF2496S316	256.8	102.7	192.6
FF1696ZH	101.9	40.8	76.4
FER1296*, FER1676*, FER1696*, FER2076*, FER2096*, FERB3496*	101.9 (70.1*)	40.8 (28.0)	76.4 (52.6)

** The tension capacity of the QwikFix Threaded Inserts is limited by shear capacity of the H12 cross bar (70.1kN) which provides the anchorage in concrete unless anchorage is achieved by structural welding to the reinforcement.*

Tension Capacity of the Concrete

Concrete Capacity Design (CCD)

NZS 3101:2006 introduced the Concrete Capacity Design (CCD) method to determine the strength of the concrete breakout in tension. The capacities in this guide have been calculated in accordance with the CCD method as described in NZS 3101:2006 Cl 17.5.7.2 for anchors in uncracked concrete.

Anchors Loaded in Tension

Concrete breakout (cone) failure

N_{cb}	=	$\psi_1 . \psi_2 . \psi_3 \frac{A_n}{A_{no}} . N_b$
where		
N_{cb}	=	Nominal concrete breakout strength in tension of a Threaded Insert or group of Threaded Inserts
N_b	=	Basic concrete breakout strength in tension of a single Threaded Insert in cracked concrete
A_n	=	Projected rectilinear area on the free surface of the concrete member due to the assumed 35° concrete failure surface of a single Threaded Insert or a group of Threaded Inserts
A_{no}	=	Projected concrete failure area of one Threaded Insert when not limited by edge distance

The modification factors ψ_1 ,ψ_2 and ψ_3 are defined as follows:

Modification factor to account for anchor groups ψ_1

ψ_1	=	$\frac{1}{\left(1 + \frac{2 \cdot e'_n}{3 \cdot h_{ef}}\right)} \leq 1.0$
where		
e'_n	=	The distance between the resultant tension load on a group of Threaded Inserts loaded in tension and the centroid of the group (always taken as positive)
h_{ef}	=	Effective embedment depth

ψ_1 = 1 for single anchors and for anchor groups of two anchors that are centrally loaded.

Modification factor to account for edge distances smaller than $1.5 \cdot h_{ef}$: ψ_2

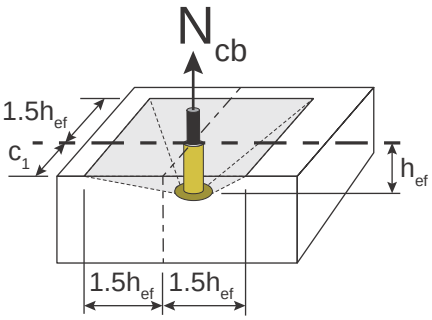
ψ_2	=	$0.7 + 0.3 \cdot \left(\frac{c_i}{1.5 \cdot h_{ef}}\right) \leq 1.0$
where		
c_i	=	Smallest edge distance

Modification factor to account for cracking ψ_3

ψ_3	=	1.25 for threaded inserts in uncracked concrete
ψ_3	=	1.00 for concrete which is cracked at service levels

Note: The capacity tables in the back of this brochure show the values for anchors in uncracked concrete. When inserts are located in tension zones where cracks may be expected, the loads in the table should be reduced by 20%

If $c_1 < 1.5h_{ef}$

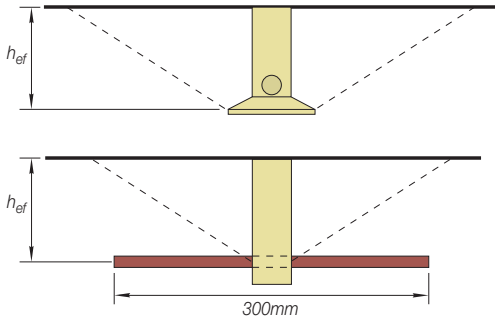


$A_n = 3 \cdot h_{ef} \cdot (1.5h_{ef} + c_1)$

Characteristic tension resistance of a single insert

The characteristic resistance to concrete cone failure for a single insert, placed at a minimum distance $1.5h_{ef}$ from any edge is -

N_b	=	$k \cdot \sqrt{f'_c} \cdot h_{ef}^{1.5}$
where		
k	=	10 for cast-in anchors (NZS 3101:2006 Cl 17.5.7.2)
f'_c	=	Characteristic concrete strength (not exceeding 70MPa)
h_{ef}	=	Effective embedment depth, mm



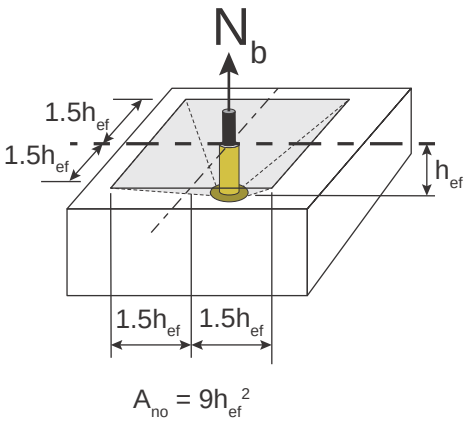
Effective embedment depth h_{ef}

Effect of insert spacing and edge distance

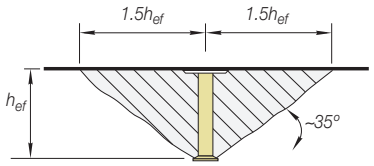
The geometric effect of insert spacing and edge distances is determined by the ratio A_n / A_{no}, where -

A_{no}	=	Actual projected area, limited by overlapping concrete cones of adjacent inserts ($s < s_{cr,N}$) as well as by edges of the concrete member ($c < c_{cr,N}$) (refer to Figure).
A_n	=	Reference projected area of a single insert
	=	$s_{cr,N} \cdot s_{cr,N}$
$s_{cr,N}$	=	$2c_{cr,N}$
$c_{cr,N}$	=	$1.5h_{ef}$
A_{no}	=	$9h_{ef}^2$

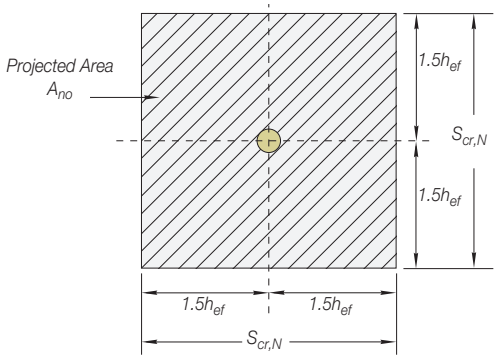
If c_1 & c_2 & c_3 & $c_4 \geq 1.5h_{ef}$



$A_{no} = 9h_{ef}^2$



Section through concrete breakout cone



Threaded Inserts loaded in shear towards an edge

The concrete breakout strength of a Threaded Insert, or group of Threaded Inserts, in shear when loaded perpendicular to an edge shall not exceed:

$$V_{cb} = \frac{A_V}{A_{Vo}} \cdot \psi_5 \cdot \psi_6 \cdot \psi_7 \cdot V_b$$

where

V_{cb}	=	Lower characteristic concrete breakout strength in shear of a single or a group of Threaded Inserts
A_v	=	Projected concrete failure area of a Threaded Insert or group of Threaded Inserts in shear
A_{vo}	=	Projected concrete failure area of a Threaded Insert in shear, when not limited by corner influences, spacing or member thickness
V_b	=	Basic concrete breakout strength for a single anchor in shear

Basic concrete breakout strength for a single anchor in shear

$$V_b = \min\left(0.6 \cdot \left(\frac{1}{d_o}\right)^{0.2} \cdot \lambda \cdot \sqrt{d_o \cdot f'_c} \cdot (c_1)^{1.5},\quad 3.8 \cdot \lambda \cdot \sqrt{f'_c} \cdot (c_1)^{1.5}\right)$$

where

d_o	=	Outside diameter of the Threaded Insert
c_1	=	Distance from the centre of an anchor to the edge of the concrete in direction of the load

The modification factors ψ_5 ,ψ_6 and ψ_7 are defined as follows:

Modification factor to account for cracking ψ_5

$$\psi_5 = \frac{1}{\left(1 + \frac{2 \cdot e'_v}{3 \cdot c_1}\right)} \leq 1.0$$

where

e'_v	=	The distance between the point of shear force application and centroid of the group of anchors resisting in shear in the direction of the applied shear
h_{ef}	=	Effective embedment depth

ψ_5 = 1 for single anchors and for anchor groups of two anchors that are centrally loaded.

Modification factor to account for edge distance ψ_6

$$\psi_6 = 0.7 + 0.3 \cdot \left(\frac{c_2}{1.5 \cdot c_1}\right) \leq 1.0$$

where

c_2	=	Edge distance perpendicular to the load direction

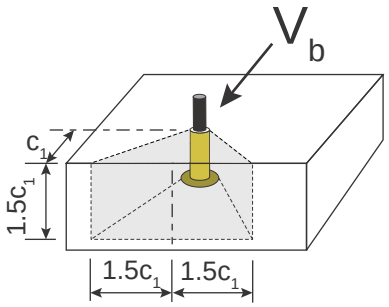
Modification factor to account for cracking ψ_7

ψ_7	=	1.4 for threaded inserts in uncracked concrete

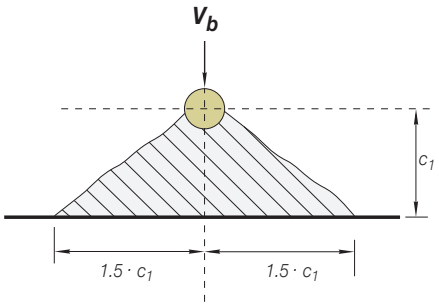
where

ψ_7	=	1.0 for concrete which is cracked at service levels

Note: The capacity tables in the back of this brochure show the values for anchors in uncracked concrete. When inserts are located in tension zones where cracks may be expected, the loads in the table should be reduced by 30%

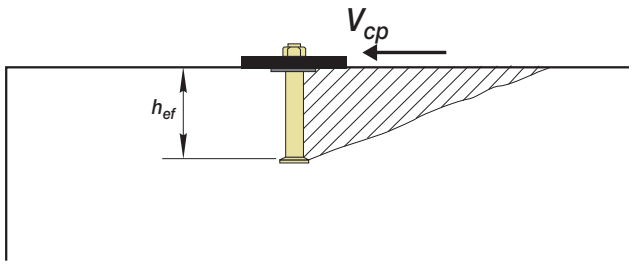


$A_{vo} = 1.5 \cdot c_1 \cdot (3c_1) = 4.5 \cdot c_1^2$



Concrete pry-out failure

Shear loaded inserts may fail by concrete pry-out where the insert is located well away from an edge. This type of failure can occur with short inserts, low concrete strengths and high strength bolts. The characteristic resistance to pry-out V_{cp} may be calculated as follows:



V_{cp}	=	$K_{cp} \cdot N_{cb}$
where		
V_{cp}	=	Lower characteristic concrete pry-out strength
N_{cb}	=	Nominal concrete breakout strength in tension in a single Threaded Insert or group of Threaded Inserts
k_{cp}	=	1.0 for $h_{ef} < 60mm$
k_{cp}	=	2.0 for $h_{ef} \geq 60mm$

Threaded inserts subject to combined tension and shear loads

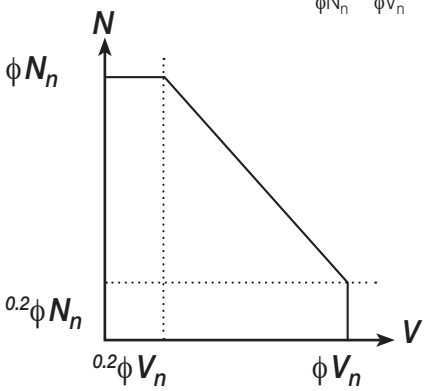
Inserts subject to combined tension and shear loads may be designed using the following tri-linear approach.

If $\frac{V^*}{\phi V_n} \leq 0.2$ then the full tensile capacity ϕV_n is permitted

If $\frac{N^*}{\phi N_n} \leq 0.2$ then the full tensile capacity ϕV_n is permitted

For all other cases then the following inequality must be satisfied:

$$\frac{N^*}{\phi N_n} + \frac{V^*}{\phi V_n} \leq 1.2$$



QwikFoot Design for Structural Fixings

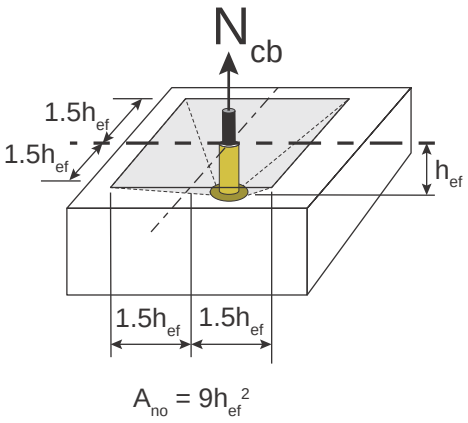
The following values are based on NZS 3101:2006 section 17

Inserts located in elements with a minimum edge distance, min $c_1 \geq 1.5h_{ef}$

Minimum edge distance c_1 and insert spacing s_1 to reach full concrete cone capacity

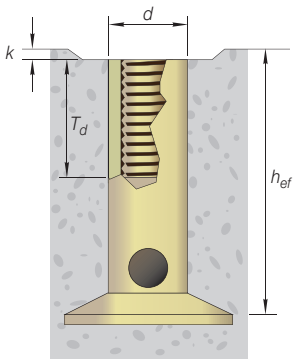
Insert Length (mm)	50	70	96
min c_1 (mm)	85	115	155
min s_1 (mm)	165	225	305

If c_1 & c_2 & c_3 & $c_4 \geq 1.5h_{ef}$



$A_{no} = 9h_{ef}^2$

Cone breakout (tension) capacity of a QwikFoot Threaded Insert located with minimum edge distance and insert spacing



Concrete Cone Breakout Capacity ($\phi_c N_{cb}$); kN

QwikFoot Part Code	Concrete Compressive Strength MPa					
	15	20	25	32	40	50
FF1245G, FF1645G, FF2045G	11.1	12.8	14.4	16.3	18.2	20.3
FF1050, FF1250	12.8	14.8	16.6	18.7	21.0	23.4
FF1270, FF1670, FF2070	20.2	23.4	26.1	29.6	33.0	36.9
FF1296, FF1696, FF2096, FF2496	31.7	36.6	40.9	46.3	51.7	57.8

Note: QwikFoot inserts do not require a crossbar to achieve the capacities shown in this table.
All capacities assume that a nailing plate is used to increase h_{ef} by 8mm.
All design values calculated using a reduction factor f_c = 0.65 according to NZS 3101-Eq.17-4(a)

Concrete capacities of inserts located close to edges or each other

The design tables on pages 21 - 25 provide tension and shear capacities based on steel failure or concrete breakout, whichever is the minimum. There are three cases considered:

- close to one edge
- close to two edges at right angles to each other
- a group of two inserts at close spacing

For more complicated configurations please refer either to NZS 3101:2006 or contact us.

In each table, the loads are colour coded to show the load range for each bolt size M10-M24 and grades G4.6 and 8.8.

Design Method

Sample Calculation 1

Fix a bearing plate with a Grade 4.6 bolt using a single QwikFoot Threaded Insert in 50MPa concrete with the nearest edge at 300mm.
The factored tension load N* = 15kN and factored shear load V* = 30kN.

Check steel capacity for the bolt (see page 12)

$N^* \leq 18.6kN$ ➔ minimum bolt diameter for tension is M10

$16.7kN$ (M12 G4.6 bolt) $< V^* \leq 31.1kN$ (M16 G4.6 bolt) ➔ minimum bolt diameter for shear is M16

$\left(\frac{15}{50.2}\right)^2 + \left(\frac{30}{31.1}\right)^2 = 1.02 > 1.0$ ➔ An M20 bolt is required for combined load.

Check concrete capacity for the threaded inserts:

For M20 bolt, inserts with length of 45, 70 and 96mm are available.

For FF2045 from first table on page 21,

$\phi_c N_{cb} = 20.3 > N^*$ and $\phi_c V_{cb} = 20.3 < V^*$ ➔ **not** OK, check FF2070

For FF2070 from first table on page 23,

$\phi_c N_{cb} = 36.9 > N^*$ and $\phi_c V_{cb} = 48.6 > V^*$ ➔ OK check combined loading

$\frac{15}{36.9} + \frac{30}{48.6} = 1.02 < 1.2$ ➔ **FF2070** is OK

Sample Calculation 2

Same application as Example 1 however the insert is located at a distance of 125mm from one edge.

Try the FF2070 as above:

From first table on page 23,

$\phi_c N_{cb} = 36.9 > N^*$ and $\phi_c V_{cb} = 34.2 > V^*$ ➔ OK check combined loading

$\frac{15}{36.9} + \frac{30}{34.2} = 1.28 > 1.2$ ➔ **not** OK, check FF2096

From first table on page 24,

$\phi_c N_{cb} = 50.2 > N^*$ and $\phi_c V_{cb} = 34.2 > V^*$ ➔ OK check combined loading

$\frac{15}{50.2} + \frac{30}{34.2} = 1.17 < 1.2$ ➔ **FF2096** is OK

How to find capacity values in tables

Table on page 23

Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	12.2	14.1	15.8	17.8	19.9	22.3	4.3	5.0	5.6	6.4	7.1	7.9
75	15.2	17.6	19.7	22.3	24.9	27.8	8.0	9.2	10.3	11.7	13.0	17.6
100	18.6	21.4	24.0	27.1	30.3	33.9	12.3	14.2	15.9	19.2	21.5	24.0
125	20.2	23.4	26.1	29.6	33.0	36.9	18.4	21.2	23.7	26.9	30.3	34.2
150	20.2	23.4	26.1	29.6	33.0	36.9	24.2	27.9	31.8	35.9	40.2	44.9

Table on page 24

Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	16.9	19.5	21.8	24.7	27.6	30.8	4.6	5.3	6.0	6.7	7.5	8.4
75	20.2	23.3	26.0	29.4	32.9	36.8	8.5	9.8	11.0	12.4	14.2	15.9
100	23.7	27.4	30.6	34.6	38.7	43.3	13.1	15.1	17.3	19.6	21.9	24.5
125	27.5	31.8	35.5	40.2	44.9	50.2	18.7	21.6	24.2	27.3	30.6	34.2
150	31.6	36.5	40.8	46.1	51.6	57.7	24.6	28.4	31.8	35.9	40.2	44.9

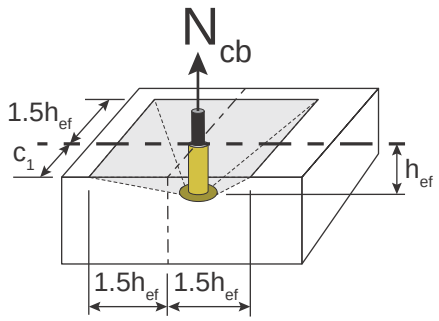
Threaded Inserts and Accessories

Break-out areas of inserts near edges or other inserts

QwikFoot insert located near to one edge

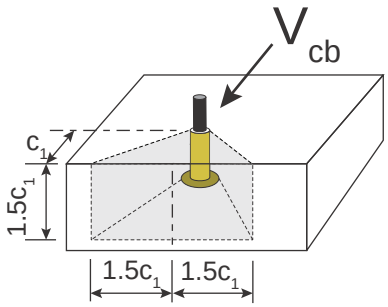
Tensile Capacity - kN: $\phi_c \cdot N_{cb}$

If $c_1 < 1.5h_{ef}$



$A_n = 3 \cdot h_{ef} \cdot (1.5h_{ef} + c_1)$

Shear Capacity - kN: $\phi_c \cdot V_{cb}$

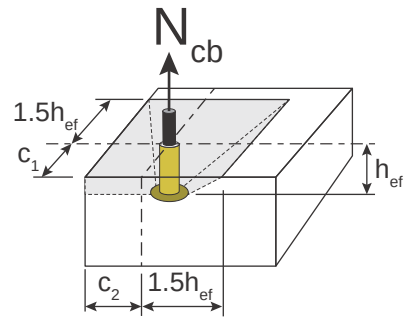


$A_{vo} = 1.5c_1 (3c_1)$

QwikFoot insert located near two edges at right angles to each other

Tensile Capacity - kN: $\phi_c \cdot N_{cb}$

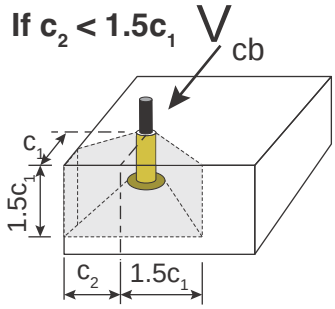
If c_1 & $c_2 < 1.5h_{ef}$



$A_n = (1.5h_{ef} + c_1)(1.5h_{ef} + c_2)$

Shear Capacity - kN: $\phi_c \cdot V_{cb}$

If $c_2 < 1.5c_1$

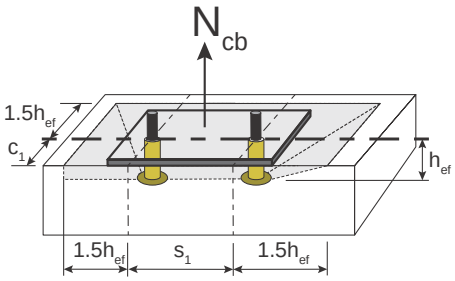


$A_v = 1.5c_1(1.5c_1 + c_2)$

A group of two QwikFoot inserts located near to one edge

Tensile Capacity - kN: $\phi_c \cdot N_{cb}$

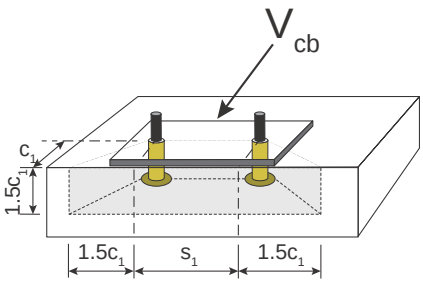
If $c_1 < 1.5h_{ef}$ & $s_1 < 3h_{ef}$



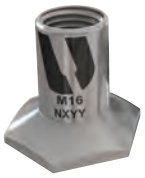
$A_n = (3h_{ef} + s_1)(1.5h_{ef} + c_1)$

Shear Capacity - kN: $\phi_c \cdot V_{cb}$

If $c_2 \leq 1.5h_{ef}$ & $s_1 < 3c_1$



$A_v = 1.5c_1 (3c_1 + s_1)$



Short QwikFoot 45mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple

Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f`c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f`c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	8.3	9.6	10.8	12.2	13.6	15.2	4.4	5.1	5.7	6.5	7.3	8.1
75	11.1	12.8	14.4	16.3	18.2	20.3	8.2	9.4	10.5	11.9	13.3	14.9
100	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3
125	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3
150	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Short QwikFoot 45mm long - Single insert located near two edges at right angles to each other

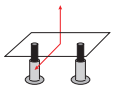
Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple

First Edge Distance c_1	Second Edge Distance c_2	Concrete or Steel Tensile Capacity Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f`c - MPa						Concrete or Steel Shear Capacity Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f`c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	7.0	8.0	9.0	10.2	11.4	12.7	3.3	3.8	4.3	4.9	5.4	6.1
50	100	8.3	9.6	10.8	12.2	13.6	15.2	4.4	5.1	5.7	6.5	7.3	8.1
100	100	11.1	12.8	14.4	16.3	18.2	20.3	9.4	10.9	12.2	13.8	15.4	17.2
100	150	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3
150	150	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3
200	150	11.1	12.8	14.4	16.3	18.2	20.3	11.1	12.8	14.4	16.3	18.2	20.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A group of TWO Short QwikFoot 50mm long - Threaded inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple



Single Edge Distance c_1	Spacing s_1	Concrete or Steel Tensile Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f`c - MPa						Concrete or Steel Shear Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f`c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	13.9	16.1	18.0	20.3	22.7	25.4	7.4	8.5	9.6	10.8	12.1	13.5
100	100	18.5	21.4	23.9	27.1	30.3	33.9	16.8	19.3	21.6	24.5	27.4	30.6
200	100	18.5	21.4	23.9	27.1	30.3	33.9	18.5	21.4	23.9	27.1	30.3	33.9
50	200	16.7	19.3	21.5	24.4	27.3	30.5	8.9	10.3	11.5	13.0	14.5	16.2
100	200	22.3	25.7	28.7	32.5	36.3	40.6	20.9	24.2	27.0	30.6	34.2	38.2
200	200	22.3	25.7	28.7	32.5	36.3	40.6	22.3	25.7	28.7	32.5	36.3	40.6
50	300	16.7	19.3	21.5	24.4	27.3	30.5	8.9	10.3	11.5	13.0	14.5	16.2
100	300	22.3	25.7	28.7	32.5	36.3	40.6	22.3	25.7	28.7	32.5	36.3	40.6
200	300	22.3	25.7	28.7	32.5	36.3	40.6	22.3	25.7	28.7	32.5	36.3	40.6
50	400	16.7	19.3	21.5	24.4	27.3	30.5	8.9	10.3	11.5	13.0	14.5	16.2
100	400	22.3	25.7	28.7	32.5	36.3	40.6	22.3	25.7	28.7	32.5	36.3	40.6
200	400	22.3	25.7	28.7	32.5	36.3	40.6	22.3	25.7	28.7	32.5	36.3	40.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Threaded Inserts and Accessories

QwikFoot 50mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M10 Orange, M12 Green

Single Edge Distance	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
c_1	15	20	25	32	40	50	15	20	25	32	40	50
50	9.1	10.5	11.7	13.3	14.8	16.6	3.8	4.4	4.9	5.6	6.3	7.0
75	11.9	13.8	15.4	17.4	19.5	21.8	7.0	8.1	9.1	10.3	11.5	16.7
100	12.8	14.8	16.6	18.7	21.0	23.4	10.8	13.4	14.9	16.7	16.7	16.7
125	12.8	14.8	16.6	18.7	21.0	23.4	12.8	14.8	16.6	16.7	16.7	16.7
150	12.8	14.8	16.6	18.7	21.0	23.4	12.8	14.8	16.6	16.7	16.7	16.7

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 50mm long - Single insert located near two edges at right angles to each other

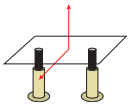
Design capacity in combination with G4.6 Bolts: M10 Orange, M12 Green

First Edge Distance	Second Edge Distance	Concrete or Steel Tensile Capacity Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Concrete or Steel Shear Capacity Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
c_1	c_2	15	20	25	32	40	50	15	20	25	32	40	50
50	50	7.3	8.4	9.4	10.7	11.9	13.3	2.9	3.3	3.7	4.2	4.7	5.2
50	100	9.1	10.5	11.7	13.3	14.8	16.6	3.8	4.4	4.9	5.6	6.2	7.0
100	100	12.8	14.8	16.6	18.6	21.0	23.4	8.1	9.4	10.5	12.7	14.2	15.9
100	150	12.8	14.8	16.6	18.6	21.0	23.4	9.7	13.5	14.9	16.7	16.7	16.7
150	150	12.8	14.8	16.6	18.6	21.0	23.4	12.8	14.8	16.6	16.7	16.7	16.7
200	150	12.8	14.8	16.6	18.6	21.0	23.4	12.8	14.8	16.6	16.7	16.7	16.7

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFoot 50mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M10 Orange, M12 Green



Single Edge Distance	Spacing	Concrete or Steel Tensile Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Concrete or Steel Shear Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
c_1	s_1	15	20	25	32	40	50	15	20	25	32	40	50
50	100	14.6	16.9	18.8	21.3	23.8	26.7	6.4	7.4	8.2	9.3	10.4	11.6
100	100	20.6	23.8	26.6	30.1	33.7	37.6	14.4	16.7	18.6	21.1	25.2	28.2
200	100	20.6	23.8	26.6	30.1	33.7	37.6	20.6	23.8	26.6	30.1	33.4	33.4
50	200	18.2	21.0	23.5	26.6	29.7	33.2	7.7	8.8	9.9	11.2	12.5	14.0
100	200	25.7	29.6	33.1	37.5	41.9	46.9	18.0	20.8	24.9	28.2	31.5	33.4
200	200	25.7	29.6	33.1	37.5	41.9	46.9	25.7	29.6	33.1	33.4	33.4	33.4
50	300	18.2	21.0	23.5	26.6	29.7	33.2	7.7	8.8	9.9	11.2	12.5	14.0
100	300	25.7	29.6	33.1	37.5	41.9	46.9	21.7	26.7	29.9	33.4	33.4	33.4
200	300	25.7	29.6	33.1	37.5	41.9	46.9	25.7	29.6	33.1	33.4	33.4	33.4
50	400	18.2	21.0	23.5	26.6	29.7	33.2	7.7	8.8	9.9	11.2	12.5	14.0
100	400	25.7	29.6	33.1	37.5	41.9	46.9	21.7	26.7	29.9	33.4	33.4	33.4
200	400	25.7	29.6	33.1	37.5	41.9	46.9	25.7	29.6	33.1	33.4	33.4	33.4

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 70mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red

Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	12.2	14.1	15.8	17.8	19.9	22.3	4.3	5.0	5.6	6.4	7.1	7.9
75	15.2	17.6	19.7	22.3	24.9	27.8	8.0	9.2	10.3	11.7	13.0	17.6
100	18.6	21.4	24.0	27.1	30.3	33.9	12.3	14.2	15.9	19.2	21.5	24.0
125	20.2	23.4	26.1	29.6	33.0	36.9	18.4	21.2	23.7	26.9	30.3	34.2
150	20.2	23.4	26.1	29.6	33.0	36.9	24.2	27.9	31.8	35.9	40.2	44.9
175	20.2	23.4	26.1	29.6	33.0	36.9	30.5	35.8	48.6	45.3	48.6	48.6
200	20.2	23.4	26.1	29.6	33.0	36.9	37.9	43.7	48.6	48.6	48.6	48.6
225	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6
250	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6
275	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6
300	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 70mm long - Single insert located near two edges at right angles to each other

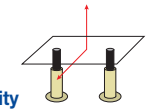
Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red

First Edge Distance c_1	Second Edge Distance c_2	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	8.8	10.2	11.4	12.9	14.4	16.1	3.3	3.8	4.2	4.8	5.3	6.0
50	100	11.6	13.4	14.9	16.9	18.9	21.1	4.3	5.0	5.6	6.4	7.1	7.9
100	100	17.6	20.3	22.7	25.7	28.7	32.1	9.2	10.7	11.9	13.5	15.1	18.0
100	150	18.6	21.4	24.0	27.1	30.3	33.9	12.3	14.2	15.9	19.2	21.5	24.0
150	150	20.2	23.4	26.1	29.6	33.0	36.9	18.1	20.9	23.4	26.5	29.6	33.7
200	150	20.2	23.4	26.1	29.6	33.0	36.9	23.7	27.4	30.6	35.3	39.4	44.1
200	200	20.2	23.4	26.1	29.6	33.0	36.9	27.9	32.8	36.7	41.5	46.4	48.6
300	150	20.2	23.4	26.1	29.6	33.0	36.9	37.1	42.9	47.9	48.6	48.6	48.6
300	200	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6
300	300	20.2	23.4	26.1	29.6	33.0	36.9	40.5	46.8	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFoot 70mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red



Single Edge Distance c_1	Spacing s_1	Concrete or Steel Tensile Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Concrete or Steel Shear Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	17.7	20.4	22.8	25.8	28.9	32.3	7.2	8.4	9.4	10.6	11.8	13.2
100	100	26.9	31.0	34.7	39.3	43.9	49.1	16.4	18.9	21.2	24.0	26.8	29.9
200	100	29.3	33.8	37.8	42.8	47.8	53.5	43.4	50.1	56.0	64.5	72.2	80.7
300	100	29.3	33.8	37.8	42.8	47.8	53.5	62.2	89.3	97.1	97.1	97.1	97.1
50	200	23.1	26.7	29.9	33.8	37.8	42.3	8.7	10.0	11.2	12.7	14.2	15.9
100	200	35.2	40.6	45.4	51.4	57.4	64.2	20.5	23.7	26.5	29.9	35.8	40.0
200	200	38.3	44.3	49.5	56.0	62.6	70.0	49.6	57.3	65.2	73.8	82.5	92.2
300	200	38.3	44.3	49.5	56.0	62.6	70.0	85.3	97.1	97.1	97.1	97.1	97.1
50	300	24.4	28.2	31.5	35.7	39.9	44.6	8.7	10.0	11.2	12.7	14.2	15.9
100	300	37.1	42.9	47.9	54.2	60.6	67.8	24.6	28.4	31.8	38.4	43.0	48.0
200	300	40.5	46.7	52.2	59.1	66.1	73.9	55.8	65.6	73.4	83.0	92.8	97.1
300	300	40.5	46.7	52.2	59.1	66.1	73.9	92.8	97.1	97.1	97.1	97.1	97.1
50	400	24.4	28.2	31.5	35.7	39.9	44.6	8.7	10.0	11.2	12.7	14.2	15.9
100	400	37.1	42.9	47.9	54.2	60.6	67.8	24.6	28.4	31.8	38.4	43.0	48.0
200	400	40.5	46.7	52.2	59.1	66.1	73.9	62.0	72.9	81.5	92.2	97.1	97.1
300	400	40.5	46.7	52.2	59.1	66.1	73.9	97.1	97.1	97.1	97.1	97.1	97.1

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Threaded Inserts and Accessories

QwikFoot 96mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red, M24 Blue.

Single Edge Distance	Tensile Capacity kN						Shear Capacity kN					
	Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
	Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	15	20	25	32	40	50	15	20	25	32	40	50
50	16.9	19.5	21.8	24.7	27.6	30.8	4.6	5.3	6.0	6.7	7.5	8.4
75	20.2	23.3	26.0	29.4	32.9	36.8	8.5	9.8	11.0	12.4	14.2	15.9
100	23.7	27.4	30.6	34.6	38.7	43.3	13.1	15.1	17.3	19.6	21.9	24.5
125	27.5	31.8	35.5	40.2	44.9	50.2	18.7	21.6	24.2	27.3	30.6	34.2
150	31.6	36.5	40.8	46.1	51.6	57.7	24.6	28.4	31.8	35.9	40.2	44.9
175	31.7	36.6	40.9	46.3	51.8	57.9	31.0	35.8	40.0	45.3	50.6	56.6
200	31.7	36.6	40.9	46.3	51.8	57.9	37.9	43.7	48.9	55.3	61.9	69.2
225	31.7	36.6	40.9	46.3	51.8	57.9	45.2	52.2	54.8	66.0	69.9	69.9
250	31.7	36.6	40.9	46.3	51.8	57.9	52.9	61.6	68.3	69.9	69.9	69.9
275	31.7	36.6	40.9	46.3	51.8	57.9	61.6	69.6	69.6	69.9	69.9	69.9
300	31.7	36.6	40.9	46.3	51.8	57.9	63.4	69.6	69.6	69.9	69.9	69.9

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 96mm long - Single insert located near two edges at right angles to each other

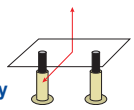
Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red, M24 Blue.

First Edge Distance	Second Edge Distance	Tensile Capacity kN						Shear Capacity kN					
		Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
		Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	c_2	15	20	25	32	40	50	15	20	25	32	40	50
50	50	11.2	13.0	14.5	16.4	18.4	20.5	3.5	4.0	4.5	5.1	5.7	6.3
50	100	14.0	16.2	18.1	20.5	22.9	25.6	4.6	5.3	6.0	6.7	7.5	8.4
100	100	19.7	22.8	25.5	28.8	32.2	36.0	9.8	11.3	12.6	14.3	16.0	18.3
100	150	23.6	27.3	30.5	34.5	38.6	43.2	13.1	15.1	17.3	19.6	21.9	24.5
150	150	31.5	36.4	40.7	46.0	51.4	57.5	18.5	21.3	23.8	27.0	30.1	33.7
200	150	31.6	36.5	40.8	46.1	51.6	57.7	24.1	27.9	31.2	35.3	39.4	44.1
200	200	31.7	36.6	40.9	46.3	51.8	57.9	28.4	32.8	36.7	41.5	46.4	51.9
300	150	31.6	36.5	40.8	46.1	51.6	57.7	37.1	42.9	47.9	54.2	60.6	67.8
300	200	31.7	36.6	40.9	46.3	51.8	57.9	41.9	48.4	54.1	61.2	68.4	69.9
300	300	31.7	36.6	40.9	46.3	51.8	57.9	52.2	60.3	67.4	69.9	69.9	69.9
500	500	31.7	36.6	40.9	46.3	51.8	57.9	63.4	69.9	69.9	69.9	69.9	69.9

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFoot 96mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red, M24 Blue.

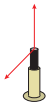


Single Edge Distance	Spacing	Concrete or Steel Tensile Capacity for a PAIR of Threaded Inserts						Concrete or Steel Shear Capacity for a PAIR of Threaded Inserts					
		Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
		Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	s_1	15	20	25	32	40	50	15	20	25	32	40	50
50	100	22.5	26.0	29.0	32.8	36.7	41.0	7.7	8.9	9.9	11.2	12.9	14.1
100	100	31.6	36.5	40.8	46.1	51.5	57.6	17.4	20.1	22.5	25.4	28.4	31.8
200	100	42.2	48.8	54.5	61.7	68.9	77.1	42.2	51.0	57.1	64.5	72.2	80.7
300	100	42.2	48.8	54.5	61.7	68.9	77.1	77.3	89.3	99.8	112.9	126.3	139.9
50	200	28.1	32.4	36.2	41.0	45.8	51.3	9.2	10.7	11.9	13.5	15.1	16.9
100	200	39.4	45.5	50.9	57.6	64.4	72.0	21.8	25.1	28.1	31.8	35.5	40.8
200	200	52.7	60.9	68.1	77.0	86.1	96.3	50.5	58.3	65.2	73.8	82.5	92.2
300	200	52.7	60.9	68.1	77.0	86.1	96.3	85.1	98.2	109.8	124.2	138.9	139.9
50	300	33.7	38.9	43.5	49.2	55.0	61.5	9.2	10.7	11.9	13.5	15.1	16.9
100	300	47.3	54.6	61.1	69.1	77.2	86.3	26.1	30.2	34.6	39.1	43.7	48.9
200	300	63.3	73.0	81.7	92.4	103.3	115.5	56.8	65.6	73.4	83.0	92.8	103.7
300	300	63.3	73.0	81.7	92.4	103.3	115.5	92.8	107.1	119.8	135.5	139.9	139.9
50	400	33.8	39.0	43.6	49.3	55.1	61.6	9.2	10.7	11.9	13.5	15.1	16.9
100	400	47.4	54.7	61.2	69.2	77.4	86.6	26.1	30.2	34.6	39.1	43.7	48.9
200	400	63.4	73.2	81.9	92.6	103.5	115.8	63.1	72.9	81.5	92.2	103.1	115.3
300	400	63.4	73.2	81.9	92.6	103.5	115.8	100.5	116.1	129.8	139.9	139.9	139.9

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 120mm long - Single insert located near one edge

Design capacity in combination with M20 G4.6 Bolts



Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{Rk,c}$ or $f_s \cdot N_{Rk,s}$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{Rk,c}$ or $f_s \cdot V_{Rk,s}$ Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	21.6	25.0	27.9	31.6	35.3	39.5	4.7	5.5	6.1	6.9	7.7	8.6
75	25.1	29.0	32.4	36.7	41.1	45.9	8.7	10.0	11.2	12.7	14.2	15.9
100	28.9	33.4	37.3	42.2	47.2	52.7	13.4	15.5	17.3	19.6	21.9	24.5
125	32.9	38.0	42.4	48.0	53.7	60.0	18.7	21.6	24.2	27.3	30.6	34.2
150	37.1	42.8	47.9	54.2	60.6	67.7	24.6	28.4	31.8	35.9	40.2	44.9
175	41.5	48.0	53.6	60.7	67.8	75.8	31.0	35.8	40.0	45.3	48.6	48.6
200	43.7	50.5	56.4	63.8	71.4	76.4	37.9	43.7	48.6	48.6	48.6	48.6
225	43.7	50.5	56.4	63.8	71.4	76.4	45.2	48.6	48.6	48.6	48.6	48.6
250	43.7	50.5	56.4	63.8	71.4	76.4	48.6	48.6	48.6	48.6	48.6	48.6
275	43.7	50.5	56.4	63.8	71.4	76.4	48.6	48.6	48.6	48.6	48.6	48.6
300	43.7	50.5	56.4	63.8	71.4	76.4	48.6	48.6	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 120mm long - Single insert located near two edges at right angles to each other

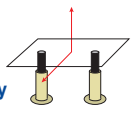
Design capacity in combination with M20 G4.6 Bolts

Single Edge Distance c_1	Second Edge Distance c_2	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{Rk,c}$ or $f_s \cdot N_{Rk,s}$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{Rk,c}$ or $f_s \cdot V_{Rk,s}$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	13.7	15.8	17.7	20.0	22.4	25.0	3.6	4.1	4.6	5.2	5.8	6.5
50	100	16.6	19.2	21.4	24.2	27.1	30.3	4.7	5.5	6.1	6.9	7.7	8.6
100	100	22.2	25.6	28.6	32.4	36.2	40.5	10.0	11.6	13.0	14.7	16.4	18.3
100	150	26.0	30.1	33.6	38.0	42.5	47.5	13.4	15.5	17.3	19.6	21.9	24.5
150	150	33.4	38.6	43.2	48.8	54.6	61.0	18.5	21.3	23.8	27.0	30.1	33.7
200	150	37.1	42.8	47.9	54.2	60.6	67.7	24.1	27.9	31.2	35.3	39.4	44.1
200	200	43.7	50.5	56.4	63.8	71.4	76.4	28.4	32.8	36.7	41.5	46.4	48.6
300	150	37.1	42.8	47.9	54.2	60.6	67.7	37.1	42.9	47.9	48.6	48.6	48.6
300	200	43.7	50.5	56.4	63.8	71.4	76.4	41.9	48.4	48.6	48.6	48.6	48.6
300	300	43.7	50.5	56.4	63.8	71.4	76.4	48.6	48.6	48.6	48.6	48.6	48.6
500	500	43.7	50.5	56.4	63.8	71.4	76.4	48.6	48.6	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFoot 120mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with M20 G4.6 Bolts



Single Edge Distance c_1	Spacing s_1	Concrete or Steel Tensile Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot N_{Rk,c}$ or $f_s \cdot N_{Rk,s}$ Concrete Compressive Strength f `c - MPa						Concrete or Steel Shear Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot V_{Rk,c}$ or $f_s \cdot V_{Rk,s}$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	27.4	31.7	35.4	40.0	44.8	50.0	7.9	9.1	10.2	11.5	12.9	14.4
100	100	36.6	42.3	47.3	53.5	59.8	66.9	17.9	20.6	23.1	26.1	29.2	32.6
200	100	55.4	64.0	71.5	80.9	90.5	101.2	44.2	51.0	57.1	64.5	72.2	80.7
300	100	55.4	64.0	71.5	80.9	90.5	101.2	77.3	89.3	97.1	97.1	97.1	97.1
50	200	33.2	38.3	42.9	48.5	54.2	60.6	9.5	10.9	12.2	13.8	15.5	17.3
100	200	44.4	51.2	57.3	64.8	72.4	81.0	22.3	25.8	28.8	32.6	36.5	40.8
200	200	67.1	77.5	86.7	98.0	109.6	122.5	50.5	58.3	65.2	73.8	82.5	92.2
300	200	67.1	77.5	86.7	98.0	109.6	122.5	85.1	97.1	97.1	97.1	97.1	97.1
50	300	39.0	45.0	50.3	56.9	63.4	71.2	9.5	10.9	12.2	13.8	15.5	17.3
100	300	52.1	60.1	67.2	76.1	85.1	95.1	26.8	30.9	34.6	39.1	43.7	48.9
200	300	78.8	91.0	101.8	115.1	128.7	143.9	56.8	65.6	73.4	83.0	92.8	97.1
300	300	78.8	91.0	101.8	115.1	128.7	143.9	92.8	97.1	97.1	97.1	97.1	97.1
50	400	49.9	19.2	55.8	63.2	70.6	79.0	9.5	10.9	12.2	13.8	15.5	17.3
100	400	57.8	25.6	74.6	84.4	94.3	105.5	26.8	11.6	34.6	39.1	43.7	48.9
200	400	66.7	101.0	112.9	127.7	142.8	152.9	63.1	72.9	81.5	92.2	97.1	97.1
300	400	87.4	101.0	112.9	127.7	142.8	152.9	97.1	97.1	97.1	97.1	97.1	97.1

QwikFix Round Insert Design for Structural Fixings

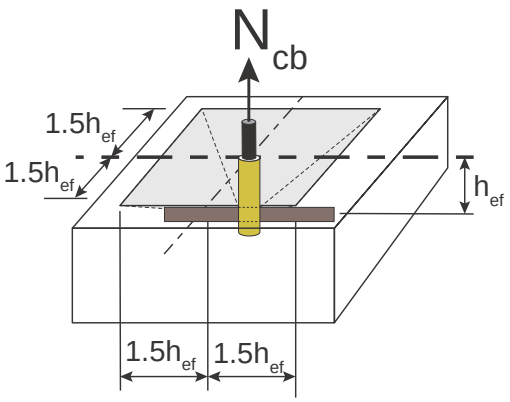
The following values are based on the CCD method as described in AS 3850.1:2015.

Minimum Edge Distance, min $c_1 = 1.5h_{ef}$

Minimum edge distance c_1 and insert spacing s_1 to reach full concrete cone capacity

Insert Length (mm)	76	96
min c_1 (mm)	105	135
min s_1 (mm)	205	270

If c_1 & c_2 & c_3 & $c_4 \geq 1.5h_{ef}$



$A_{no} = 9h_{ef}^2$

Cone breakout (tension) capacity ($\phi_c N_b$) of a QwikFix insert located with minimum edge distance and insert spacing; kN

	Concrete Compressive Strength f`c - MPa					
Part Code	**15**	**20**	**25**	**32**	**40**	**50**
FER1676, FER2076	18.0	20.8	23.3	26.3	29.5	32.9
FER1296, FER1696, FER2096	26.4	30.5	34.1	38.6	43.1	48.2

Note: QwikFix inserts require an H12x300 long crossbar which has a maximum shear capacity 37.9kN.

Design Method

How to use the tables

- Determine the factored load and required capacities in accordance with NZS 3101
- Determine the design compressive strength of the concrete.
- Check the edge distance and spacing of the insert. If the edge distances and insert spacing exceed the minimum, check the concrete breakout (tension) capacity in the table above
- Choose the size and grade of bolt to be used and its steel capacity from the table above
- If the insert is closer to one or more edges or to another insert, refer to the following tables for insert capacity.

QwikFix 76mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M16 Purple, M20 Red

Single Edge Distance c_1	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	11.3	13.0	14.6	16.5	18.5	20.6	4.7	5.5	6.1	6.9	7.7	8.6
75	14.3	16.5	18.4	20.8	23.3	26.0	8.7	10.0	11.2	12.7	14.2	15.9
100	17.6	20.3	22.7	25.6	28.7	32.0	13.4	15.5	17.3	19.6	21.9	24.5
125	18.0	20.8	23.3	26.3	29.5	32.9	18.7	21.6	24.2	27.3	30.6	34.2
150	18.0	20.8	23.3	26.3	29.5	32.9	24.6	28.4	31.8	35.9	40.2	44.9
175	18.0	20.8	23.3	26.3	29.5	32.9	31.0	35.8	40.0	45.3	48.6	48.6
200	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
225	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
250	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
275	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
300	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
400	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFix 76mm long - Single insert located near two edges at right angles to each other

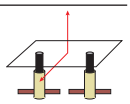
Design capacity in combination with G4.6 Bolts: M16 Purple, M20 Red

First Edge Distance c_1	Second Edge Distance c_2	Tensile Capacity kN Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity kN Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	8.4	9.7	10.8	12.2	13.7	15.3	3.6	4.1	4.6	5.2	5.8	6.5
50	100	11.1	12.8	14.3	16.2	18.1	20.3	4.7	5.5	6.1	6.9	7.7	8.6
100	100	17.3	19.9	22.3	25.2	28.2	31.5	10.0	11.6	13.0	14.7	16.4	18.3
100	150	17.6	20.3	22.7	25.6	28.7	32.0	13.4	15.5	17.3	19.6	21.9	24.5
150	150	18.0	20.8	23.3	26.3	29.5	32.9	18.5	21.3	23.8	27.0	30.1	33.7
200	150	18.0	20.8	23.3	26.3	29.5	32.9	24.1	27.9	31.2	35.3	39.4	44.1
200	200	18.0	20.8	23.3	26.3	29.5	32.9	28.4	32.8	36.7	41.5	46.4	48.6
300	100	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
300	200	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
300	300	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6
300	300	18.0	20.8	23.3	26.3	29.5	32.9	36.1	41.7	46.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFix 76 mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M16 Purple, M20 Red



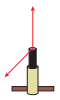
Single Edge Distance c_1	Spacing s_1	Tensile Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$ Concrete Compressive Strength f `c - MPa						Shear Capacity for a PAIR of Threaded Inserts Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$ Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	16.8	19.4	21.6	24.5	27.4	30.6	7.9	9.1	10.2	11.5	12.9	14.4
100	100	26.0	30.1	33.6	38.0	42.5	47.5	17.9	20.6	23.1	26.1	29.2	32.6
200	100	26.7	30.9	34.5	39.1	43.7	48.8	44.2	51.0	57.1	64.5	72.2	80.7
300	100	29.7	30.9	34.5	39.1	43.7	48.8	53.5	61.8	96.1	78.1	87.4	97.1
50	200	22.2	25.7	28.7	32.8	36.6	40.6	9.5	10.9	12.2	13.8	15.5	17.3
100	200	34.5	39.8	44.6	50.4	56.4	63.0	22.3	25.8	28.8	32.6	36.5	10.8
200	200	35.5	40.9	45.8	51.8	57.9	64.7	50.5	58.3	65.2	73.8	82.5	92.2
300	200	35.5	40.9	45.8	51.8	57.9	64.7	70.9	81.9	91.9	97.1	97.1	97.1
50	300	22.6	26.1	29.2	33.0	36.9	41.3	9.5	10.9	12.2	13.8	15.5	17.3
100	300	35.1	40.5	45.3	51.3	57.3	64.1	26.8	30.9	34.6	39.1	47.3	48.9
200	300	36.1	41.7	46.6	52.7	58.9	65.9	56.8	65.6	73.4	83.0	92.8	97.1
300	300	36.1	41.7	46.6	52.7	58.9	65.9	72.1	83.3	93.1	97.1	97.1	97.1
50	400	22.6	26.1	29.2	33.0	36.9	41.3	9.5	10.9	12.2	13.8	15.5	17.3
100	400	35.1	40.5	45.3	51.3	57.3	64.1	26.8	30.9	34.6	39.1	43.7	48.9
200	400	36.1	41.7	46.6	52.7	58.9	65.9	63.1	72.9	81.5	92.2	97.1	97.1
300	400	36.1	41.7	46.6	52.7	58.9	65.9	72.1	83.3	93.1	97.1	97.1	97.1

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Threaded Inserts and Accessories

QwikFix 96mm long - Single insert located near one edge

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red



Single Edge Distance	Tensile Capacity kN						Shear Capacity kN					
	Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
	Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	15	20	25	32	40	50	15	20	25	32	40	50
50	14.8	17.0	19.0	21.5	24.1	26.9	4.7	5.5	6.1	6.9	7.7	8.6
75	17.9	20.7	23.1	26.2	29.3	32.7	8.7	10.0	11.2	12.7	14.2	15.9
100	21.4	24.7	27.6	31.2	34.9	39.0	13.4	15.5	17.3	19.6	21.9	24.5
125	25.1	29.0	32.4	36.6	41.0	45.8	18.7	21.6	24.2	27.3	30.6	34.2
150	26.4	30.5	34.1	38.6	43.1	48.2	24.6	28.4	31.8	35.9	40.2	44.9
175	26.4	30.5	34.1	38.6	43.1	48.2	31.0	35.8	40.0	48.6	48.6	48.6
200	26.4	30.5	34.1	38.6	43.1	48.2	37.9	43.7	48.6	48.6	48.6	48.6
225	26.4	30.5	34.1	38.6	43.1	48.2	45.2	48.6	48.6	48.6	48.6	48.6
250	26.4	30.5	34.1	38.6	43.1	48.2	48.6	48.6	48.6	48.6	48.6	48.6
275	26.4	30.5	34.1	38.6	43.1	48.2	48.6	48.6	48.6	48.6	48.6	48.6
300	26.4	30.5	34.1	38.6	43.1	48.2	48.6	48.6	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFix 96mm long - Single insert located near two edges at right angles to each other

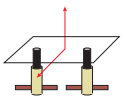
Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red

First Edge Distance	Second Edge Distance	Tensile Capacity kN						Shear Capacity kN					
		Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
		Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	c_2	15	20	25	32	40	50	15	20	25	32	40	50
50	50	10.1	11.7	13.1	14.8	16.6	18.5	3.6	4.1	4.6	5.2	5.8	6.5
50	100	12.9	14.9	16.7	18.8	21.1	23.6	4.7	5.5	6.1	6.9	7.7	8.6
100	100	18.7	21.6	24.1	27.3	30.5	34.1	10.0	11.6	13.0	14.7	16.4	18.3
100	150	21.4	24.7	27.6	31.2	34.9	39.0	13.4	15.5	17.3	19.6	21.9	24.5
150	150	26.4	30.5	34.1	38.6	43.1	48.2	18.5	21.3	23.8	27.0	30.1	33.7
200	150	26.4	30.5	34.1	38.6	43.1	48.2	24.1	27.9	31.2	35.3	39.4	44.1
200	200	26.4	30.5	34.1	38.6	43.1	48.2	28.4	32.8	36.7	41.5	46.4	48.6
300	100	26.4	30.5	34.1	38.6	43.1	48.2	37.1	42.9	47.9	48.6	48.6	48.6
300	200	26.4	30.5	34.1	38.6	43.1	48.2	41.9	48.4	48.6	48.6	48.6	48.6
300	300	26.4	30.5	34.1	38.6	43.1	48.2	48.6	48.6	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFix 96mm long - Threaded Inserts located near one edge at various insert spacings

Design capacity in combination with G4.6 Bolts: M12 Green, M16 Purple, M20 Red



Single Edge Distance	Spacing	Tensile Capacity for a PAIR of Threaded Inserts						Shear Capacity for a PAIR of Threaded Inserts					
		Capacity limited by either $f_c \cdot N_{cb}$ or $f_s \cdot N_s$						Capacity limited by either $f_c \cdot V_{cb}$ or $f_s \cdot V_s$					
		Concrete Compressive Strength $f`_c$ - MPa						Concrete Compressive Strength $f`_c$ - MPa					
c_1	s_1	15	20	25	32	40	50	15	20	25	32	40	50
50	100	20.3	23.4	26.2	29.6	33.1	37.0	7.9	9.1	10.2	11.5	12.9	14.4
100	100	29.4	33.9	37.9	42.9	48.0	53.6	17.9	20.6	23.1	26.1	29.2	32.6
200	100	36.3	41.9	46.9	53.0	43.7	66.3	44.2	51.0	57.1	64.5	72.2	80.7
300	100	36.3	41.9	46.9	53.0	43.7	66.3	72.6	83.9	93.8	97.1	97.1	97.1
50	200	12.9	29.8	33.3	37.7	42.1	47.1	4.7	10.9	12.2	13.8	15.5	17.3
100	200	37.4	43.2	48.2	54.6	61.0	68.2	22.3	25.8	28.8	32.6	36.5	40.8
200	200	46.2	53.4	59.7	67.5	75.5	84.4	50.5	58.3	65.2	73.8	82.5	92.2
300	200	46.2	53.4	59.7	73.8	75.5	84.4	85.1	97.1	97.1	97.1	97.1	97.1
50	300	29.5	34.1	38.1	43.1	48.2	53.9	9.5	10.9	12.2	13.8	15.5	17.3
100	300	42.7	49.3	55.2	62.4	69.8	78.0	26.8	30.9	34.6	39.1	43.7	48.9
200	300	52.8	61.0	68.2	77.2	86.3	96.5	56.8	65.6	73.4	83.0	92.8	97.1
300	300	52.8	61.0	68.2	77.2	86.3	96.5	92.8	97.1	97.1	97.1	97.1	97.1
50	400	29.5	34.1	38.1	43.1	48.2	53.9	9.5	10.9	12.2	13.8	15.5	17.3
100	400	42.7	49.3	55.2	62.4	69.8	78.0	26.8	30.9	34.6	39.1	43.7	48.9
200	400	52.8	61.0	68.2	77.2	86.3	96.5	63.1	72.9	81.5	92.2	97.1	97.1
300	400	52.8	61.0	68.2	77.2	86.3	96.5	97.1	97.1	97.1	97.1	97.1	97.1

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Working Load Limit (WLL)

Design of Brace and Strongback Inserts in accordance with Good Practice Guidelines - Safe work with precast concrete:2018 (GPG2018)

Inserts which are used to fasten braces and strongbacks for the erection of precast concrete elements are designed with working load limits which are determined by dividing the characteristic strength of either the steel or the concrete by a factor of safety (FoS) of 2.5.

Steel WLL
The following table provides the WLL for Unicoil 16 and M20 G4.6 bolts

AS 3850.1 Working Load Limit

Bolt	WLL Tension Grade 4.6	WLL Shear
UC16	38.9	24.1
M20	39.1	24.3

Concrete WLL
The characteristic strengths for tension N_{cb} and shear V_{cb} are determined by the CCD design method.

Minimum Edge Distance, min $c_1 = 1.5h_{ef}$

Minimum edge and spacing

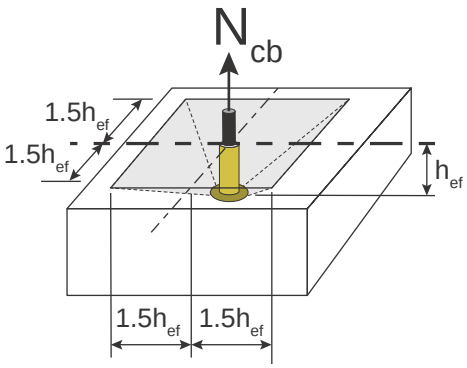
Insert Type	FF2096/ UCQF1696	FER2096/ FERB3496Z
min c_1	155	135
min s_1	305	270

WLL of a QwikFoot insert located with minimum edge and insert spacing

FF2096 and UCQF1696 Bracing Ferrule

Concrete Compressive Strength f`c - MPa			
15	20	25	32
WLL - kN: N_{cb} / 2.5			
19.5	22.5	25.2	28.5

If c_1 & c_2 & c_3 & $c_4 \geq 1.5h_{ef}$



$A_{no} = 9h_{ef}^2$

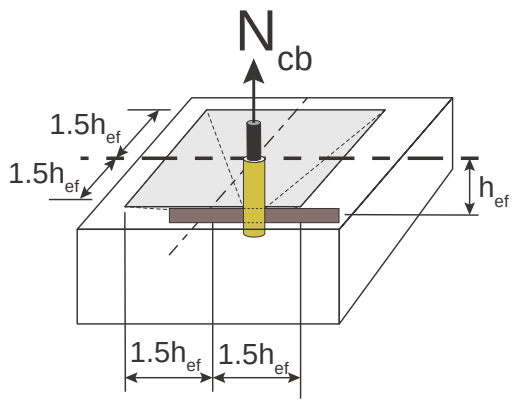
WLL of a QwikFix round insert fitted with a H12 Crossbar 300mm long located with minimum edge and insert spacing

FER2096 and FERB3496Z Bracing Ferrule

Concrete Compressive Strength f`c - MPa			
15	20	25	32
WLL - kN: N_{cb} / 2.5			
16.3	18.8	21.0	23.7

Note: QwikFix inserts require an H12x300 long crossbar which has a maximum WLL limited by shear of 38kN.

If c_1 & c_2 & c_3 & $c_4 \geq 1.5h_{ef}$



$A_{no} = 9h_{ef}^2$

Ancon Threaded Inserts are not designed to be used as lifting points. Please contact our Technical Team on **technical.nz@leviat.com** to learn more about compliant lifting solutions to suit your application.

Threaded Inserts and Accessories

WLL of inserts located close to edges or close to each other

The following design tables provide working loads limited either by the WLL of the Bolts (steel) or concrete breakout whichever is the minimum.

There are three cases considered:

- close to one edge
- close to two edges at right angles to each other
- a group of two inserts at close spacings (it is assumed the load is distributed equally between inserts)

For more complicated configurations please refer either to GPG2018 or contact us.

In each table, the loads are limited by either the concrete or the steel WLL and colour coded to show the load range for each bolt type (Unicoil 16 & M20 G4.6).

Design Method

How to use the tables

- Determine the factored load and required capacities in accordance with NZS 1170 .
- Determine the compressive strength of the concrete at the time of loading.
- Check the edge distance and spacing of the insert. If the edge distances and insert spacing exceed the minimum, check the Concrete WLL in the table above.
- Choose the type of bolt to be used, either Unicoil 16 or G4.6 and it's WLL from the table above.
- If the insert is closer to one or more edges or to another insert, refer to the following tables for insert capacity.

Example 1

A QwikFoot insert is required to fix a wind brace with an applied load of 20kN in tension in a footing which is designed to provide f_{cm}= 20MPa at the time of erection and where the closest edge distance is 300mm.

The applied load is less than the WLL of either the UCQF1696 in combination with a Unicoil bolt (38.9 kN) or FF2096 in combination with a M20 bolt (39.1kN) so either may be used.

The edge distance is greater than the minimum edge distance required to reach the full concrete cone capacity (160 mm). The WLL at 20MPa is 22.5kN (see table on page 29) so design OK.

Note: A QwikFix insert has a lower WLL (18.8kN at 20MPa) and could only be used if the concrete strength exceeded 25MPa.

Example 2

A QwikFoot insert is located at an edge distance 125mm from one edge. Refer to the first table on page 31.
The capacity in the table at 20MPa is 19.5kN, i.e. not sufficient.
A concrete strength of 25MPa is required. If the concrete strength can be increased either a Unicoil16 (purple) or M20 G4.6bolt (red) is OK.

Example 3

An insert is to be located 200mm from two adjacent edges at right angles with an applied load of 34kN. Refer to the second table on page 31.
The minimum required concrete strength to develop a WLL of at least 30kN is 40MPa (WLL=31.9kN). Use a Unicoil insert and bolt with a WLL of 38.9kN or an M20 G4.6 (red).

QwikFoot 96mm long - Single insert located near one edge

Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red

Single Edge Distance c_1	WLL in Tension kN WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f `c - MPa						WLL in Shear kN WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f `c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	10.4	12.0	13.4	15.2	17.0	19.0	2.9	3.4	3.8	4.3	4.8	5.3
75	12.4	14.3	16.0	18.1	20.3	22.7	5.4	6.2	6.9	7.8	8.7	9.8
100	14.6	16.8	18.8	21.3	23.8	26.6	8.2	9.5	10.6	12.0	13.5	15.0
125	16.9	19.5	21.9	24.7	27.6	30.9	11.5	13.3	14.9	16.8	18.8	21.0
150	19.4	22.4	25.1	28.4	31.7	35.5	15.1	17.5	19.5	22.1	24.3	24.3
175	19.5	22.5	25.2	28.5	31.9	35.6	19.1	22.0	24.3	24.3	24.3	24.3
200	19.5	22.5	25.2	28.5	31.9	35.6	23.3	24.3	24.3	24.3	24.3	24.3
225	19.5	22.5	25.2	28.5	31.9	35.6	24.3	24.3	24.3	24.3	24.3	24.3
250	19.5	22.5	25.2	28.5	31.9	35.6	24.3	24.3	24.3	24.3	24.3	24.3
275	19.5	22.5	25.2	28.5	31.9	35.6	24.3	24.3	24.3	24.3	24.3	24.3
300	19.5	22.5	25.2	28.5	31.9	35.6	24.3	24.3	24.3	24.3	24.3	24.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

QwikFix 96mm long - Single insert located near two edges at right angles to each other

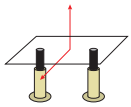
Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red

First Edge Distance c_1	Second Edge Distance c_2	WLL in Tension kN WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f `c - MPa						WLL in Shear kN WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	6.9	8.0	8.9	10.1	11.3	12.6	2.2	2.5	2.8	3.2	3.6	4.0
50	100	8.6	10.0	11.2	12.6	14.1	15.8	2.9	3.4	3.8	4.3	4.8	5.3
100	100	12.1	14.0	15.7	17.7	19.8	22.1	6.2	7.1	8.0	9.0	10.1	11.3
100	150	14.6	16.8	18.8	21.3	23.8	26.6	8.2	9.5	10.6	12.0	13.5	15.0
150	150	19.4	22.4	25.0	28.3	31.8	35.4	11.4	13.1	14.7	16.6	18.5	20.7
200	150	19.4	22.4	25.1	28.4	31.7	35.5	14.9	17.2	19.2	21.7	24.3	24.3
200	200	19.5	22.5	25.2	28.5	31.9	35.6	17.5	20.2	22.6	24.3	24.3	24.3
300	150	19.4	22.4	25.1	28.4	31.7	35.5	22.8	24.3	24.3	24.3	24.3	24.3
300	200	19.5	22.5	25.2	28.5	31.9	35.6	24.3	24.3	24.3	24.3	24.3	24.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFoot 96mm long - Threaded Inserts located near one edge at various insert spacings

Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red



Single Edge Distance c_1	Spacing s_1	WLL in Tension for a PAIR of Threaded Inserts WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f `c - MPa						WLL in Shear for a PAIR of Threaded Inserts WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f `c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	13.8	16.0	17.9	20.2	22.6	25.3	4.9	5.6	6.3	7.1	7.9	8.9
100	100	19.4	22.4	25.1	28.4	31.7	35.5	11.0	12.7	14.2	16.1	17.9	20.1
200	100	26.0	30.0	33.5	37.9	42.4	47.4	27.2	31.4	35.1	39.7	44.4	48.6
300	100	26.0	30.0	33.5	37.9	42.4	47.4	47.6	48.6	48.6	48.6	48.6	48.6
50	200	17.3	19.9	22.3	25.2	28.2	31.5	5.8	6.7	7.5	8.5	9.5	10.6
100	200	24.3	28.0	31.3	35.4	39.6	44.3	13.7	15.9	17.7	20.1	22.4	25.1
200	200	32.5	37.5	41.9	47.4	53.0	59.2	31.1	35.9	40.1	45.4	48.6	48.6
300	200	32.5	37.5	41.9	47.4	53.0	59.2	48.6	48.6	48.6	48.6	48.6	48.6
50	300	20.7	23.9	26.8	30.3	33.8	37.8	5.8	6.7	7.5	8.5	9.5	10.6
100	300	29.1	33.6	37.6	42.5	47.5	53.1	16.5	19.0	21.3	24.1	26.9	30.1
200	300	38.9	44.9	50.3	56.9	63.9	71.1	35.0	40.4	45.1	48.6	48.6	48.6
300	300	38.9	44.9	50.3	56.9	63.9	71.1	48.6	48.6	48.6	48.6	48.6	48.6
50	400	20.8	24.0	26.8	30.3	33.9	37.9	5.8	6.7	7.5	8.5	9.5	10.6
100	400	29.2	33.7	37.7	42.6	47.6	53.3	16.5	19.0	21.3	24.1	26.9	30.1
200	400	39.0	45.1	50.4	57.0	63.7	71.2	38.9	44.9	48.6	48.6	48.6	48.6
300	400	39.0	45.1	50.4	57.0	63.7	71.2	48.6	48.6	48.6	48.6	48.6	48.6

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Threaded Inserts and Accessories

QwikFix 96mm long - Single insert located near one edge

Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red

Single Edge Distance c_1	WLL in Tension kN WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f`c - MPa						WLL in Shear kN WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f`c - MPa					
	15	20	25	32	40	50	15	20	25	32	40	50
50	9.1	10.5	11.7	13.3	14.8	16.6	2.9	3.4	3.8	4.3	4.8	5.3
75	11.0	12.7	14.2	16.1	18.0	20.1	5.4	6.2	6.9	7.8	8.7	9.8
100	13.1	15.2	17.0	19.2	21.5	24.0	8.2	9.5	10.6	12.0	13.5	15.0
125	15.4	17.8	19.9	22.6	25.2	28.2	11.5	13.3	14.9	16.8	18.8	21.0
150	16.3	18.8	21.0	23.7	26.6	29.7	15.1	17.5	19.5	22.1	24.3	24.3
175	16.3	18.8	21.0	23.7	26.6	29.7	16.1	22.0	24.3	24.3	24.3	24.3
200	16.3	18.8	21.0	23.7	26.6	29.7	23.3	24.3	24.3	24.3	24.3	24.3
225	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3
250	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3
275	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3
300	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

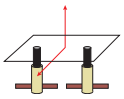
QwikFix 96mm long - Single insert located near two edges at right angles to each other

Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red

First Edge Distance c_1	Second Edge Distance c_2	WLL in Tension kN WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f`c - MPa						WLL in Shear kN WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f`c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	50	6.2	7.2	8.1	9.1	10.2	11.4	2.2	2.5	2.8	3.2	3.6	4.0
50	100	7.9	9.2	10.2	11.6	13.0	14.5	2.9	3.4	3.8	4.3	4.8	5.3
100	100	11.5	13.3	14.8	16.8	18.8	21.0	6.2	7.1	8.0	9.0	10.1	11.3
100	150	13.1	15.2	17.0	19.2	21.5	24.0	8.2	9.5	10.6	12.0	13.5	15.0
150	150	16.3	18.8	21.0	23.7	26.6	29.7	11.4	13.1	14.7	16.6	18.5	20.7
200	150	16.3	18.8	21.0	23.7	26.6	29.7	14.9	17.2	19.2	21.7	24.3	24.3
200	200	16.3	18.8	21.0	23.7	26.6	29.7	17.5	20.2	24.3	24.3	24.3	24.3
300	100	16.3	18.8	21.0	23.7	26.6	29.7	22.8	24.3	24.3	24.3	24.3	24.3
300	200	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3
300	300	16.3	18.8	21.0	23.7	26.6	29.7	24.3	24.3	24.3	24.3	24.3	24.3

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

A Group of TWO QwikFix 96mm long - Threaded Inserts located near one edge at various insert spacings



Working Load Limit of Unicoil Bolts Purple, G4.6 M20 Red

Single Edge Distance c_1	Spacing s_1	WLL in Tension for a PAIR of Threaded Inserts WLL limited by either N_{cb} / 2.5 or N_s / 2.5 Concrete Compressive Strength f`c - MPa						WLL in Shear for a PAIR of Threaded Inserts WLL limited by either V_{cb} / 2.5 or V_s / 2.5 Concrete Compressive Strength f`c - MPa					
		15	20	25	32	40	50	15	20	25	32	40	50
50	100	12.5	14.4	16.1	18.2	20.4	22.8	4.9	5.9	6.3	7.1	7.9	8.9
100	100	18.1	20.9	23.3	26.4	29.5	33.0	11.0	12.7	14.2	16.1	17.9	20.1
200	100	22.3	25.8	28.9	32.6	36.5	40.8	27.2	31.4	35.1	39.7	44.4	46.8
300	100	22.3	25.8	28.9	32.6	36.5	40.8	44.7	48.6	48.6	48.6	48.6	48.6
50	200	15.9	18.3	20.5	23.2	36.5	29.0	5.8	6.7	7.5	8.5	9.5	10.6
100	200	23.0	26.6	29.7	33.6	37.6	42.0	13.7	15.9	17.7	20.1	22.4	25.1
200	200	28.4	32.8	36.7	41.5	46.4	51.9	31.1	35.9	40.1	45.4	46.8	46.8
300	200	28.4	32.8	36.7	41.5	46.4	51.9	48.6	48.6	48.6	48.6	48.6	48.6
50	300	18.2	21.0	23.4	26.5	29.6	33.1	5.8	6.7	7.5	8.5	9.5	10.6
100	300	26.3	30.4	34.0	38.4	42.9	48.0	16.5	19.0	21.3	24.1	26.9	30.1
200	300	32.5	37.5	42.0	47.5	53.1	59.4	35.0	40.4	45.1	46.8	46.8	46.8
300	300	32.5	37.5	42.0	47.5	53.1	59.4	48.6	48.6	48.6	48.6	48.6	48.6
50	400	18.2	21.0	23.4	26.5	29.6	33.1	5.8	6.7	7.5	8.5	9.5	10.6
100	400	26.3	30.4	34.0	38.4	42.9	48.0	16.5	19.0	21.3	24.1	26.9	30.1
200	400	32.5	37.5	42.0	47.5	53.1	59.4	38.9	44.9	46.8	46.8	46.8	46.8
300	400	32.5	37.5	42.0	47.5	53.1	59.4	46.8	46.8	46.8	46.8	46.8	46.8

The full shear capacity can only be reached for slab thicknesses bigger than 1.5 · c_1

Additional Design Requirements for Earthquake Effects

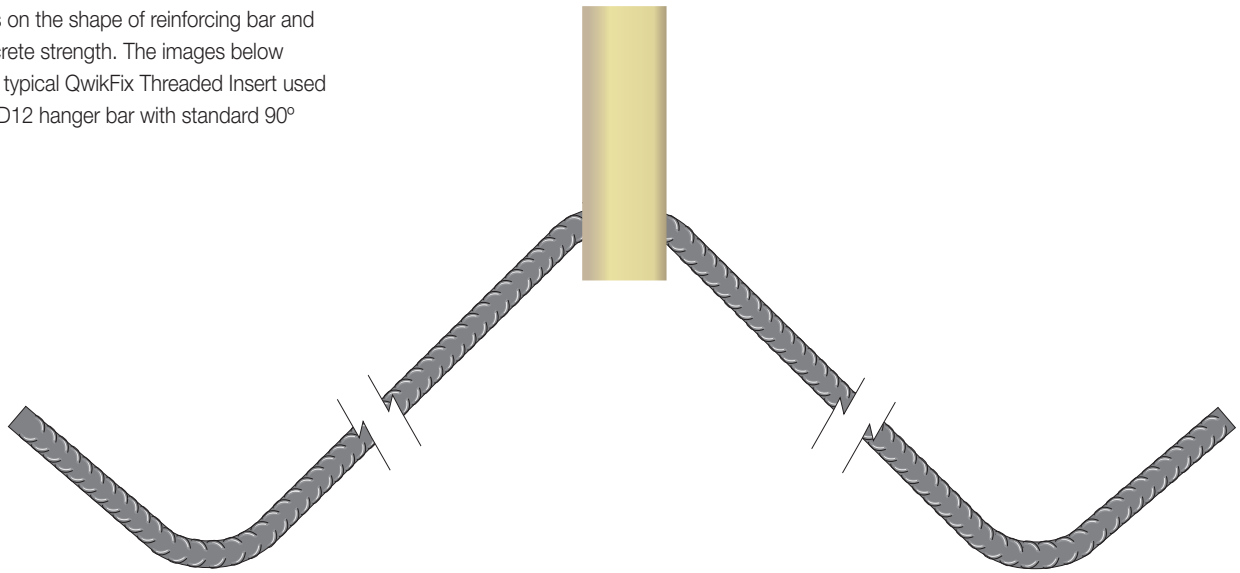
Clause 17.6 of NZS 3101:2006 - Amendment 3 specifies additional requirements for anchors designed for earthquake effects:

- Threaded inserts shall be designed to accommodate relative seismic movements by separation
- The strengths of the threaded insert are greater than the actions associated with ductile yielding of the attachment
- Threaded inserts shall be designed to remain elastic
- Threaded inserts shall be designed to accommodate the expected actions and deformations in a ductile manner.

Ancon Threaded Inserts can be used in conjunction with reinforcement bars to prevent brittle failure of the connection point. In case hanger bars are used, the tension capacity of insert is limited to minimum of:

- tension capacity of bolt
- tension capacity of threaded insert
- shear capacity of the hanger bar in the two cross sections where the loads are introduced
- capacity of the development of the reinforcement bar

The development length of the hanger bar depends on the shape of reinforcing bar and the concrete strength. The images below shows a typical QwikFix Threaded Insert used with a HD12 hanger bar with standard 90º hooks.



The tables on page 5 and 7 specify the diameter of the hanger bars that fit into QwikFoot and QwikFix Threaded Inserts.

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