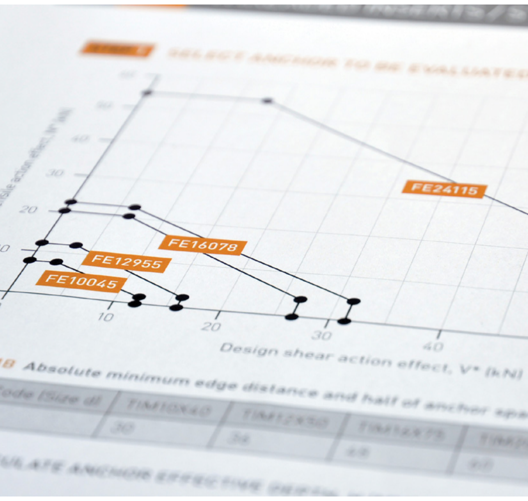
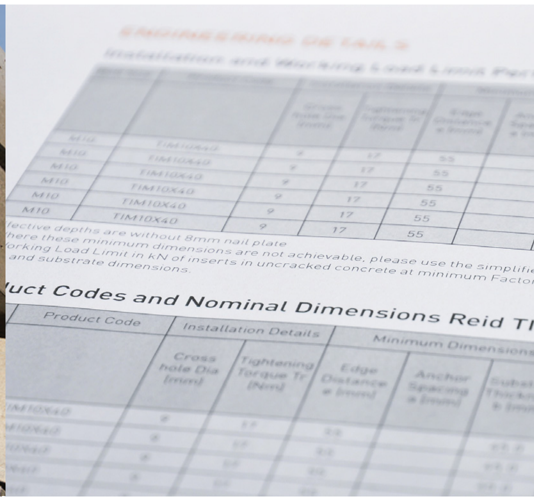




METRIC THREADED INSERTS

DESIGN GUIDE

Ph 0800 88 22 12 | www.reids.co.nz

WELCOME TO REID

Reid™ has been supplying quality engineered products to the New Zealand precast and construction industries for the last 25 years and we have built a position of market leadership in the supply of cast-in components to the concrete construction sector.

Reid introduced the revolutionary SwiftLift system, involving robust cast-in anchors and safe, quick release clutches. This unique system greatly increased safety and efficiency in the transportation and placement of large concrete components such as wall panels, stairs, beams and pipes.

Reid innovation continued with the development of the ReidBar system - ReidBar Couplers, Grout Sleeves and Inserts that are used with ReidBar - continuously threaded Grade 500E reinforcing steel produced in Australia and New Zealand. These products are now widely used to enable fast, easy and efficient reinforcement connections on major construction projects throughout all markets.

Reid's ongoing commitment to innovation and investment in better products, systems and services was further strengthened when the business became a part of the global ITW Group in 2004. This gives Reid people access to significant technology and business resources worldwide, the benefits of which flow to our customers.

In partnership with another ITW group member – Ramset, we can deliver lifting, connection, anchorage and fixing solutions for anything built from concrete.

At Reid we aim to be much more than just a supplier of components to the concrete construction industry. We work in partnership with our customers in all facets of planning, preparation, design, engineering, forming, production, rigging, lifting, anchoring and bracing... all critical stages in the safe and efficient manufacture and placement of concrete elements.

Our products help handle the physical load, whilst our professional support services help lift the risk load – each Reid design comes backed by the strength of ITW and our absolute commitment to delivering your project faster, safer, more efficiently.

This design guide is a practical demonstration of that commitment – we hope you find it useful.

- Technical representation in all cities and regional areas
- Extensive technical data and support available
- Strict quality control systems
- Products designed in New Zealand to meet New Zealand Standards
- Products tested in New Zealand building materials
- Stand behind our product range and performance data

CONTENTS

1.1 OVERVIEW

Threaded Inserts are designed for casting into concrete and providing fixing points for the attachment of structural members and ancillary fittings to be bolted directly to the concrete structure. Reid supply a range of threaded inserts from M10 to M24 in zinc, hot dipped galvanised and 316 Stainless Steel finishes.

Pre-engineered products such as threaded inserts, require customised application / engineering to devise and deliver the best results for each project. Ultimately this produces value-added solutions for our customer's needs and inherently better engineering.

The following design information is intended to provide guidance to qualified structural engineers or other suitably skilled persons in the design of cast-in anchors and allows the designer to determine load carrying capacities based on actual application and installation conditions. You can either solve the problem for yourself or get any necessary assistance from our team of engineers or technical sales people.

Extensive research, development and testing are invested in Reid™ products. This provides designers with the complete performance capabilities of the Reid range of Cast-In Metric Threaded Inserts.

The performance data contained in this Design Guide relates only to the Reid range of Cast-In Metric Threaded Inserts. Our superior steel grade and manufacturing tolerances are key factors in producing our excellent products. Generic products may appear similar physically, but their actual performance is heavily influenced by the steel grade and manufacturing tolerances used.

1.2 USING THIS DESIGN GUIDE

1.21 STRENGTH LIMIT STATE DESIGN

The Simplified Design Approach to achieve strength limit state design, originally first published by our sister company Ramset, has proven to be a simple and effective method to allow for rapid selection of a suitable anchor through systematic analysis, ensuring that it will meet the required design criteria under strength limit state principles.

1.22 DEVELOPING PULLOUT OF A CONCRETE CONE

The potential to develop a full pullout cone of concrete is assumed in determining the pullout capacity of an insert. Capacity is then modified for factors such as bolt steel strength, concrete strength, spacing to other inserts, or concrete edges that prevent full development of a concrete cone. Tables are provided in the Strength Limit State section of the design guide to calculate these reductions.

1.23 REINFORCEMENT

Reinforcement in the concrete around a threaded insert can affect the concrete pullout and shear capacity. But unless it is specifically designed to work with the insert and enhance its capacity in that situation, reinforcement should always be disregarded when assessing the capacity of the insert during design. For this reason, the design tables give loadings for inserts in <u>unreinforced concrete without the addition of a hanger bar.</u>

1.24 FORMULAE

Reid traditionally have applied pullout formulae for threaded inserts that have been well established and proven to reliably predict concrete pullout based on the strength of the concrete, location of the insert and the embedment depth.

For the new 2011 Design Guide however, we have modified our formula to be consistent in concept with the Concrete Capacity Design (CCD) approach of embedded anchor design that NZS3101 section 17 is modelled on. The CCD approach has its origins in pullout capacity being a function of the square root of the concrete strength whereas the previous Reid pullout formula used concrete strength to the power of two thirds. For the design of the concrete shear capacity we have used NZS3101 section 17 as the basis of design.

1.25 PREVIOUS DOCUMENTATION

The change in formula will supersede any previously published Threaded Insert information from Reid or Ramset. All prior information from Reid or Ramset should be discarded as it is out of date with the publication of this design guide.

1.26 FEEDBACK

We endeavour to provide an accurate and clear document. However, if the information is not clear, inaccurate or you feel that it is misleading, please do not hesitate to contact us to discuss your concerns. We welcome industry feedback.

REID METRIC THREADED INSERTS (TIMS)

Reid Threaded Metric Inserts (TIMS) are cast into concrete to provide fixing points for attachments and structural members. The TIM is the original Reid design with a large foot at the base of the insert (see nominal dimensions).

All TIMS with the exception of the TIM20x120 have a hole through the shaft to accept a hanger bar for situations where full pullout capacity of the TIM is required ie thin concrete sections or where the TIM is close to an edge.

FEATURES & BENEFITS

ADVANTAGES

- Easy and simple to use
- Improved security and reliability for slip free anchorage
- No cross bar required to develop rated capacity
- Resists dynamic loading
- Plastic nail plates simplify installation and minimise fouling during the concrete pour

REID Metric Threaded Insert

VERSATILE APPLICATIONS

- Medium to heavy duty applications
- Use in near or far face applications with our range of accessories
- May be used with small rebar for fixing to mesh
- Structural connections
- Curtain wall and panel facades
- Temporary precast panel bracing points

Metric Nail Plate

FINISHES AND MATERIAL

- High grade carbon steel
- Gold passivated zinc coating to AS1789:2003 recommended for internal applications
- Hot Dip Galvanised, recommended for external applications

TI Support Chair for ease of placement

TIMS - INSTALLATION & WORKING LOAD LIMITS

Working Load Limits in Shear (kN) for Steel Bolt Capacity, Factor of Safety = 3

Product Code	Thread Size	Area of Root of thread (mm^2)	Steel Grade of Bolt (kN)			
			4.6	5.8	8.8	10.9
TIM10X40	M10	52.3	4.14	6.8	10.5	13.6
TIM12X50	M12	76.2	6.0	9.9	15.2	19.8
TIM16X75	M16	144	11.4	18.7	28.8	37.4
TIM20X75 / TIM20X120	M20	225	17.8	29.2	45.0	58.5
TIM24X100	M24	324	25.6	42.1	64.8	84.2

Site Installation and Working Load Limit Performance Details Reid TIMS in Uncracked and Unreinforced Concrete

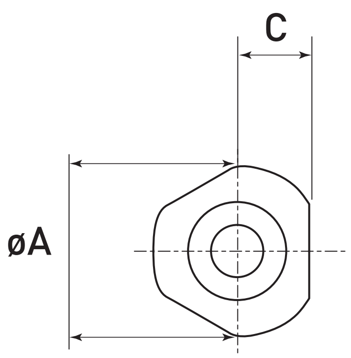
Bolt Size	Product Code	Installation Details			Minimum Dimensions*		Working Load Limit						
		Cross hole Dia, (mm)	Tightening Torque, T_r (Nm)	Insert Length (L)	Edge Distance or half distance to another anchor e_c (mm)	Substrate Thickness b_m (mm)	Limit for Shear no edge distance (Grade 8.8 Bolt) (kN)	Limit for Shear, V_a (kN)** towards edge e_c at minimum edge distance and thickness b_m			Limit for Tension, N_a (kN)**		
								Concrete Compressive Strength, f_c			Concrete Compressive Strength, f_c		
								20MPa	30MPa	40MPa	20MPa	30MPa	40MPa
M10	TIM10X40	9	17	40	60	50	10.5	1.6	1.9	2.2	4.3	5.3	6.1
	***with nail plate							1.6	2.0	2.3	5.7	7.0	8.1
M12	TIM12X50	9.5	30	50	75	65	15.2	2.4	2.9	3.4	6.6	8.1	9.4
	***with nail plate							2.5	3.0	3.5	8.3	10.2	10.9
M16	TIM16X75	11.6	75	75	115	95	28.8	5.1	6.2	7.2	14.1	17.0	17.0
	***with nail plate							5.2	6.4	7.4	16.4	17.0	17.0
M20	TIM20X75	15.5	144	75	115	95	45.0	5.6	6.9	7.9	15.8	19.3	22.3
	***with nail plate							5.7	7.0	8.1	18.3	22.5	26.0
M20	TIM20X120	0	144	120	180	150	45.0	12.1	14.9	17.2	31.9	35.1	35.1
	***with nail plate							12.3	15.1	17.4	35.1	35.1	35.1
M24	TIM24X100	20.5	250	100	150	125	64.8	9.6	11.7	13.5	26.6	32.6	37.6
	***with nail plate							9.7	11.9	13.7	29.8	36.5	42.2

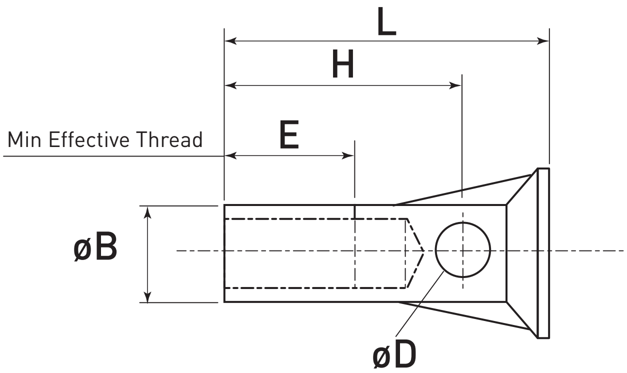
* Where these minimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity
** Working Load Limit in kN of inserts in uncracked concrete at minimum Factor of Safety = 3.0 for tension and shear capacity towards a edge at minimum edge and substrate dimensions (NZ3101).
*** Nail Plate set insert 8mm deeper into concrete

Product Codes and Nominal Dimensions Reid Threaded Insert (TIM)

REID METRIC THREADED INSERTS - NOMINAL DIMENSIONS (mm)									
REID Metric Threaded Inserts	Insert Length, L (mm)	ØA	ØB	C	ØD	E (min)	H	Thread / Pitch	Gusset
TIM10x40	40	25	16	10.6	9	14	25	M10x1.5P	NA
TIM12x50	50	28	17	11	9	20	37	M12x1.75P	NA
TIM16x75	75	39	22	16.6	11	35	55	M16x2P	NA
TIM20x75	75	53	30	23.5	15.5	32	55	M20x2.5P	NA
TIM20x120	120	50	30	NA	NA	35	NA	M20x2.5P	YES
TIM24X100	100	60	38	26	20	45	76	M24x3P	NA

TIM's come as a standard Zinc Passivated finish. To specify Galvanised TIM's, add a 'G' to the end of the product code. i.e. TIM16X75G.

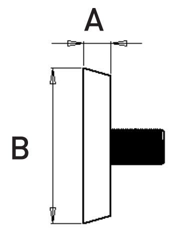


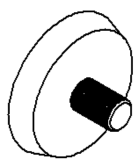


METRIC NAIL PLATES

Product Codes for Metric Nail Plates to suit Reid Threaded Inserts

Product Code	Description	Depth of Nail Plate (mm) (A)	Diameter of Nail Plate (mm) (B)
NP10	Metric Nail Plate M10	8mm	63mm
NP12	Metric Nail Plate M12	8mm	63mm
NP16	Metric Nail Plate M16	8mm	63mm
NP20	Metric Nail Plate M20	8mm	63mm
NP24	Metric Nail Plate M24	8mm	63mm



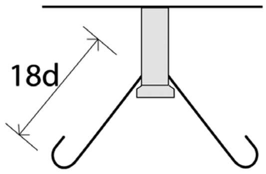


Engineering Properties Reid Threaded Insert (TIM)

Size	Product Code	Min.stress area of anchor, A_s (mm²)	Bearing area of head of insert, A_{brg}, (mm²)	Carbon Steel	
				Yield strength, f_y (MPa)	UTS, f_u (MPa)
M10	TIM10X40	65.0	237.4	240	400
M12	TIM12X50	81.4	247.5	240	400
M16	TIM16X75	127.8	696.4	240	400
M20	TIM20X75	263.4	1350.6	240	400
M20	TIM20X120	263.4	1350.6	240	400
M24	TIM24X100	410.8	1450.5	240	400

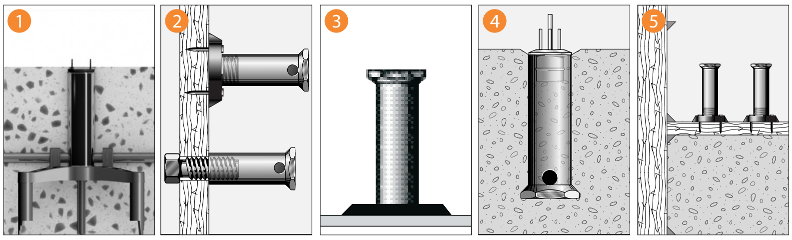
INSTALLATION INSTRUCTIONS

- Either insert a positioning bolt through the mould wall or boxing and thread the insert onto the bolt until flush with the wall, or thread the insert onto a nail on plate and fix this to the mould.
- Pass a rebar of the correct diameter and length through the cross-hole in the insert and tie to the reinforcement to prevent it moving during pouring and vibration of the concrete.
- When the concrete has cured remove the bolt and mould. If a nailing plate has been used leave it screwed into the insert until immediately before use to help protect the threads.



LIMITATIONS

- Not to be used for lifting. Use the Reid Swiftlift system for lifting points!
- Depends on the load capacity required or the diameter of the fixing bolt selected.
- Remember the practical aspect: small diameter inserts are much more prone to fouling and thread damage than larger inserts. For most applications it is preferable to use inserts of M10 or greater.



1 Insert Chair for tilt-up provides support
2 Nailing plate or bolted to formwork
3 Fixing to steel casting bed with glue-on nailing plate
4 "Puddled" into wet concrete
5 Templated onto face of panel

REID 316 STAINLESS STEEL METRIC THREADED INSERTS (TCM)

The Reid Stainless Steel Metric Threaded Inserts (TCM) are manufactured from premium grade 316 Stainless Steel and suit medium to heavy duty structural applications. Noticably different from the TIMS, this threaded insert has an Elephant Foot™ (original Ramset design).

All TCM have a hole through the shaft to accept a hanger bar for situations where full pullout capacity of the TCM is required ie thin concrete sections or where the TCM is close to an edge.

REID 316 SS Metric Threaded Insert

Metric Nail Plate

TI Support Chair for ease of placement

FEATURES & BENEFITS

ADVANTAGES

- Easy and simple to use
- Improved security and reliability for slip free anchorage
- No cross bar required to develop rated capacity
- Resists dynamic loading
- Plastic nail plates simplify installation and minimise fouling during the concrete pour

VERSATILE APPLICATIONS

- Suitable for use in corrosive areas where durability is required such as salt spray zones
- Use in near or far face applications with our range of accessories
- May be used with small rebar for fixing to mesh
- Structural connections
- Curtain wall and panel facades
- Temporary precast panel bracing points

FINISHES

- AISI Grade (A4-70) 316 Stainless Steel suitable for marine or corrosive environments

Working Load Limits in Shear (kN) for Stainless Steel Bolt Capacity, Factor of Safety = 3

Product Code	Thread Size	Area of Root of thread (mm^2)	Steel Grade
			A4-70 (AISI) 316 Stainless Steel*
FE10045SS	M10	52.3	7.0
FE12055SS	M12	76.2	10.3
FE16070SS	M16	144	19.7
FF20095SS	M20	225	31.1

* Stainless Steel properties of A4-70, 700MPa Ultimate strength, 450MPa Yield strength

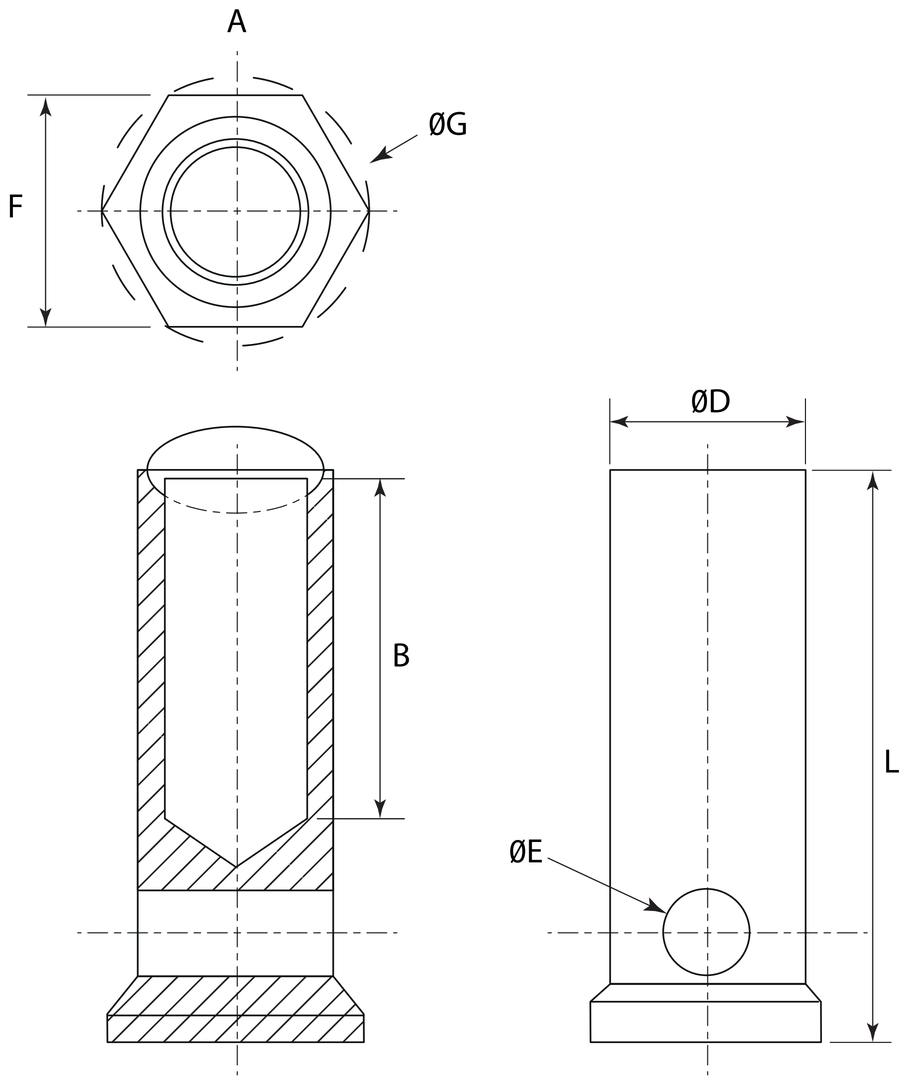
Site Installation and Working Load Limit Performance Details 316 Stainless Steel FE in Uncracked and Unreinforced Concrete

Bolt Size	Product Code	Installation Details			Minimum Dimensions*		Working Load Limit						
		Cross hole Dia, (mm)	Tightening Torque, T_r (Nm)	Insert Length L (mm)	Edge Distance, or half distance to another anchor e_c (mm)	Substrate Thickness, b_m (mm)	Limit for Shear no edge distance (A4-70 (AISI) 316 SS Bolt) kN	Limit for Shear, V_a (kN)** towards edge e_c at minimum edge distance and thickness b_m			Limit for Tension, N_a (kN)**		
								(kN)			Concrete Compressive Strength, f_c		
								20MPa	30MPa	40MPa	20MPa	30MPa	40MPa
M10	FE10045SS	8.4	17	45	60	50	7.0	1.6	1.9	2.2	4.5	5.5	6.4
	***with nail plate							1.6	2.0	2.3	5.9	7.2	8.3
M12	FE12055SS	8.4	30	55	75	65	10.3	2.4	3.0	3.4	6.8	8.4	9.7
	***with nail plate							2.5	3.0	3.5	8.5	10.4	12.0
M16	FE16070SS	11	75	70	100	85	19.7	4.1	5.1	5.9	11.6	14.3	16.5
	***with nail plate							4.2	5.2	6.0	13.8	16.9	19.5
M20	FF20095SS	14.1	144	95	135	115	31.1	7.3	8.9	10.3	21.1	25.8	29.8
	***with nail plate							7.5	9.2	10.6	25.4	31.1	35.9

* Where these minimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity
** Working Load Limit in kN of inserts in uncracked concrete at minimum Factor of Safety = 3.0 for tension and shear capacity towards a edge at minimum edge and substrate dimensions (NZ3101).
*** Nail Plate sets insert 8mm deeper into concrete.

Product Codes and Nominal Dimensions 316 Stainless Steel TCM

REID METRIC STAINLESS STEEL THREADED INSERTS - NOMINAL DIMENSIONS (mm)								
REID Metric Threaded Inserts	Insert Length, L (mm)	A	B	ØD	ØE	F	ØG	Thread / Pitch
FE10045SS	45	M10	20	16	8.4	19.0-19.3	20.9	M10X1.5P
FE12055SS	55	M12	25	17	8.4	22.0-22.3	24.4	M12X1.75P
FE16070SS	70	M16	32	22	11.0	28.5-29.0	31.9	M16X2P
FE20095SS	95	M20	38	26	11.0	31.5-32.0	35.4	M20X2.5P



TCM - STEEL PROPERTIES

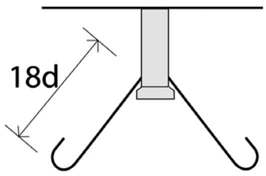
Engineering Properties 316 Stainless Steel TCM

Size	Product Code	Min.stress area of anchor, A_s (mm^2)	Bearing area of head of insert, A_{brg}, (mm^2)	Stainless Steel 316	
				Yield strength, f_y (MPa)	UTS, f_u (MPa)
M10	FE10045SS	73.1	111.6	450	700
M12	FE12055SS	90.2	192.2	450	700
M16	FE16070SS	148.6	323.3	450	700
M20	FE20095SS	216.8	446.3	450	700

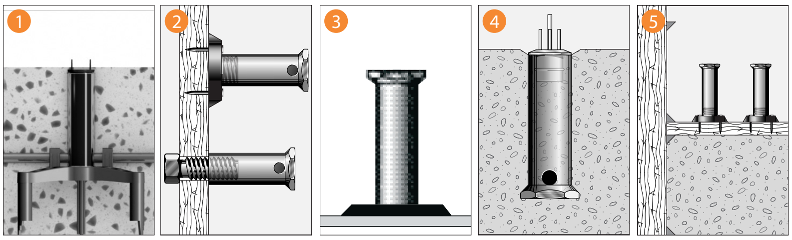
INSTALLATION INSTRUCTIONS

- Either insert a positioning bolt through the mould wall or boxing and thread the insert onto the bolt until flush with the wall, or thread the insert onto a nail on plate and fix this to the mould.
- Pass a rebar of the correct diameter and length through the cross-hole in the insert and tie to the reinforcement to prevent it moving during pouring and vibration of the concrete.
- When the concrete has cured remove the bolt and mould. If a nailing plate has been used leave it screwed into the insert until immediately before use to help protect the threads.

LIMITATIONS



- Not to be used for lifting. Use the Reid Swiftlift system for lifting points!
- Depends on the load capacity required or the diameter of the fixing bolt selected.
- Remember the practical aspect: small diameter inserts are much more prone to fouling and thread damage than larger inserts. For most applications it is preferable to use inserts of M10 or greater.

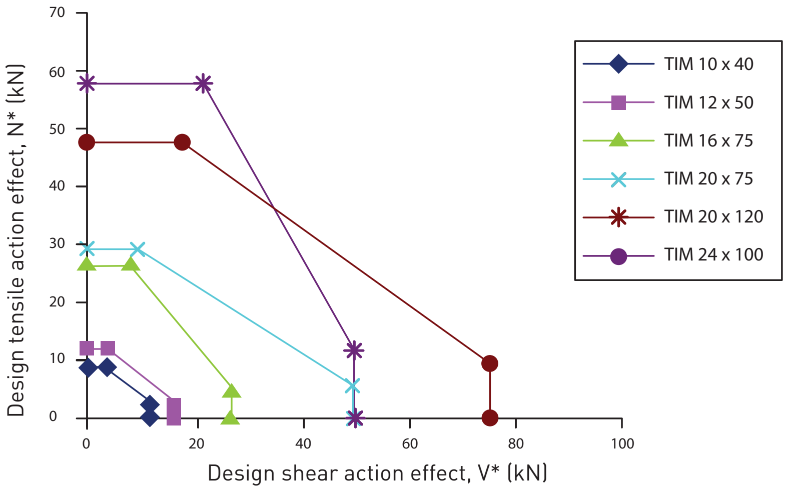


1 Insert Chair for tilt-up provides support
2 Nailing plate or bolted to formwork
3 Fixing to steel casting bed with glue-on nailing plate
4 "Puddled" into wet concrete
5 Templated onto face of panel

REID 316 SS METRIC THREADED INSERTS (TCMS)

STEP 1 SELECT ANCHOR TO BE EVALUATED

DIA 1A Indicative combined loading with no edge or spacing effects, e_m (mm) (TIM)



Notes:
1 Tension limited by the lesser of steel capacity and concrete cone capacity. No edge or spacing effects.
2 Shear limited by the TIM capacity
3 f'_c = 20 MPa
4 Without Nail Plate.

DIA 2A Indicative combined loading with no edge or spacing effects, e_m (mm) (TCM 316SS)

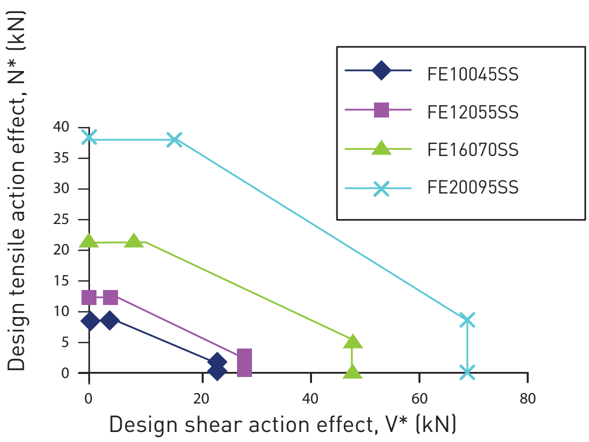


TABLE 1A Absolute minimum edge distance and half of anchor spacing values, e_m (mm)

Product Code	TIM10X40 FE10045SS	TIM12X50 FE12055SS	TIM16X75 FE16070SS	TIM20X75 FE20095SS	TIM20X120	TIM24X100
e_m, mm	30	36	48	60	85	72

ANCHOR TENSION CAPACITY

CHECKPOINT 1

ANCHOR SIZE, ABSOLUTE MINIMA COMPLIANCE ACHIEVED

STEP 2 VERIFY CONCRETE TENSILE CAPACITY ϕN_{URC} (Per anchor)

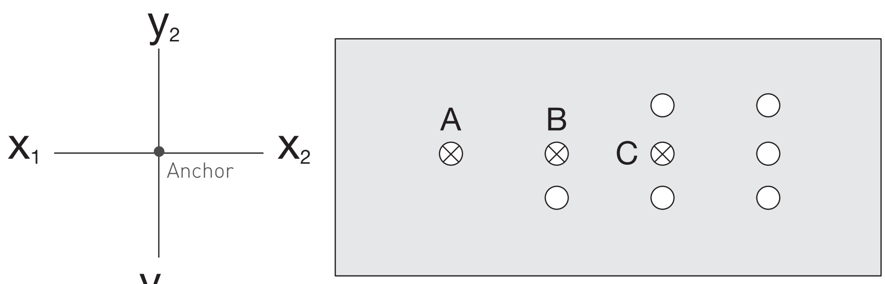
TABLE 2A Reduced characteristic ultimate concrete tensile capacity, ϕN_{uc} (kN), ϕ = 0.6, f_c = 20 MPa

Product Code	TIM10X40	TIM12X50	TIM16X75	TIM20X75	TIM20X120	TIM24X100
ϕN_{UC} (kN)	7.8	12.0	25.4	28.4	57.4	47.8
with nail plate	10.3	14.9	29.5	33.0	63.3	53.7
Product Code	FE10045SS	FE12055SS	FE16070SS	FE20095SS		
ϕN_{UC} (kN)	8.1	12.3	20.9	37.9		
with nail plate	10.6	15.3	24.9	45.7		

TABLE 2B Concrete compresive strength effect, tension, ψ_{nc}

f'_c (MPa)	15	20	25	≥32
ψ_{nc}	0.87	1.00	1.12	1.26

DIA 2 Edge and spacing effect, tension, $x = \phi x_1 * \phi x_2 * \phi y_1 * \phi y_2$



Apply edge and spacing reduction factors as appropriate to the anchor location.

EXAMPLES

Anchor →	A		B		C	
Factor	Type	Table	Type	Table	Type	Table
ϕx_1	Edge	2c	Spacing	2d	Spacing	2d
ϕx_2	Spacing	2d	Spacing	2d	Spacing	2d
ϕy_1	Edge	2c	Spacing	2d	Spacing	2d
ϕy_2	Edge	2c	Edge	2c	Spacing	2d

If edge distance to anchor greater than 1.5 times effective depth then reduction factor = 1.0.
If anchor spacing greater than 3 times effective depth then reduction factor = 1.0.

TABLE 2C Edge distance reduction factor ϕ_{ex} and ϕ_{ey}

Anchor Edge Distance, e (mm)	30	40	50	60	70	85	100	125	150	≥200
Product Code										
TIM10x40	0.65	0.77	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00
*with nail plate	0.59	0.69	0.79	0.88	0.98	1.00	1.00	1.00	1.00	1.00
TIM12x50		0.67	0.77	0.86	0.95	1.00	1.00	1.00	1.00	1.00
*with nail plate		0.62	0.70	0.78	0.86	0.98	1.00	1.00	1.00	1.00
TIM16x75			0.61	0.67	0.74	0.83	0.92	1.00	1.00	1.00
*with nail plate			0.58	0.64	0.69	0.78	0.86	1.00	100	1.00
TIM20x75			0.61	0.67	0.74	0.83	0.92	1.00	1.00	1.00
*with nail plate			0.58	0.64	0.69	0.78	0.86	1.00	100	1.00
TIM20x120						0.62	0.68	0.77	0.86	1.00
*with nail plate						0.60	0.65	0.74	0.83	1.00
TIM24x100					0.63	0.70	0.77	0.88	1.00	1.00
*with nail plate					0.60	0.67	0.73	0.84	0.95	1.00
316 Stainless Steel Threaded Inserts (TCM)										
FE100145SS	0.64	0.76	0.87	0.98	1.00	1.00	1.00	1.00	1.00	1.00
*with nail plate	0.59	0.68	0.78	0.87	0.97	1.00	1.00	1.00	1.00	1.00
FE12055SS		0.67	0.76	0.85	0.94	1.00	1.00	1.00	1.00	1.00
*with nail plate		0.62	0.70	0.77	0.85	0.97	1.00	1.00	1.00	1.00
FE16070SS			0.65	0.72	0.79	0.90	1.00	1.00	1.00	1.00
*with nail plate			0.62	0.68	0.74	0.84	0.93	1.00	1.00	1.00
FE20095SS			0.56	0.61	0.66	0.74	0.81	0.94	1.00	1.00
*with nail plate			0.53	0.57	0.62	0.69	0.75	0.87	0.98	1.00

TABLE 2D Anchor spacing distance reduction factor, ϕ_{sx} and ϕ_{sy}

Anchor Spacing a (mm)	30	40	50	60	70	85	100	125	150	200	250	300	350	≥400
Product Code														
TIM10x40	0.48	0.53	0.59	0.65	0.71	0.80	0.88	1.00	1.00	1.00	1.00	1.00	1.00	1.00
*with nail plate	0.45	0.49	0.54	0.59	0.64	0.71	0.79	0.91	1.00	1.00	1.00	1.00	1.00	1.00
TIM12x50		0.49	0.53	0.58	0.63	0.70	0.77	0.88	1.00	1.00	1.00	1.00	1.00	1.00
*with nail plate		0.46	0.50	0.54	0.58	0.64	0.70	0.80	0.90	1.00	1.00	1.00	1.00	1.00
TIM16x75			0.46	0.49	0.52	0.56	0.61	0.69	0.77	0.92	1.00	1.00	1.00	1.00
*with nail plate			0.44	0.47	0.50	0.54	0.58	0.65	0.72	0.86	1.00	1.00	1.00	1.00
TIM20x75			0.46	0.49	0.52	0.56	0.61	0.69	0.77	0.92	1.00	1.00	1.00	1.00
*with nail plate			0.44	0.47	0.50	0.54	0.58	0.65	0.72	0.86	1.00	1.00	1.00	1.00
TIM20x120						0.46	0.49	0.54	0.58	0.68	0.77	0.86	0.96	1.00
*with nail plate						0.45	0.48	0.52	0.57	0.65	0.74	0.83	0.92	1.00
TIM24x100					0.46	0.50	0.53	0.59	0.65	0.77	0.88	1.00	1.00	1.00
*with nail plate					0.45	0.48	0.52	0.57	0.62	0.73	0.84	0.95	1.00	1.00
316 Stainless Steel Threaded Inserts (TCM)														
FE100145SS	0.47	0.53	0.58	0.64	0.70	0.78	0.87	1.00	1.00	1.00	1.00	1.00	1.00	1.00
*with nail plate	0.44	0.49	0.54	0.59	0.63	0.70	0.78	0.90	1.00	1.00	1.00	1.00	1.00	1.00
FE12055SS		0.48	0.53	0.57	0.62	0.69	0.76	0.87	0.99	1.00	1.00	1.00	1.00	1.00
*with nail plate		0.46	0.50	0.54	0.58	0.64	0.70	0.79	0.89	1.00	1.00	1.00	1.00	1.00
FE16070SS			0.48	0.51	0.55	0.60	0.65	0.74	0.83	1.00	1.00	1.00	1.00	1.00
*with nail plate			0.46	0.49	0.52	0.57	0.62	0.69	0.77	0.93	1.00	1.00	1.00	1.00
FE20095SS			0.43	0.45	0.48	0.52	0.56	0.62	0.68	0.81	0.94	1.00	1.00	1.00
*with nail plate			0.41	0.44	0.46	0.49	0.53	0.58	0.64	0.75	0.87	0.98	1.00	1.00

VERIFY CONCRETE TENSION CAPACITY

STEP 2 COMPLETE THE TABLE AND DETERMINE, X AS THE PRODUCT OF THE FACTORS, ϕx_1 ϕx_2 ϕy_1 ϕy_2

Factor	Type	Table	Value
ϕx_1			
ϕx_2			
ϕy_1			
ϕy_2			
Factor X product of factors			

STEP 2a

DETERMINE IF THE CONCRETE SECTION WHERE THE ANCHOR IS LOCATED WILL BE CRACKED OR HAS THE POTENTIAL TO CRACK. EG TENSILE FACE OF BEAM.

If yes Cracked section Reduction Factor ψ_{CR} = 0.75
If no Cracked section Reduction Factor ψ_{CR} = 1.00

CHECKPOINT 2

DETERMINE THE REDUCED ULTIMATE CONCRETE TENSILE CAPACITY OF THE ANCHOR SITUATION, ϕN_{URC}

$\phi N_{URC} = \phi N_{UC} * \psi_{nc} * X * \psi_{CR}$

STEP 3 VERIFY STEEL TENSILE CAPACITY (Per Anchor), ϕN_{us} (kN)

TABLE 3A Reduced characteristic ultimate anchor steel capacity, ϕN_{us} (kN), $\phi = 0.65$

Product Code	TIM10X40	TIM12X50	TIM16X75	TIM20X75	TIM20X120	TIM24X100
ϕN_{us}, (kN)	16.9	21.2	33.2	68.5	68.5	106.8

Product Code	FE10045SS	FE12055SS	FE16070SS	FE20095SS
ϕN_{us}, (kN)	32.4	40.1	61.6	94.4

TABLE 3B Reduced characteristic ultimate bolt tensile capacity, ϕN_{TF} (kN), $\phi_n = 0.8$

Bolt Size	M10		M12		M16		M20		M24	
ϕN_{TF} (kN)	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8
	18.6	38.5	27	56	50.2	104.2	78.4	162.7	112.8	234.4

Bolt Size A4-70 316 SS Bolt	M10	M12	M16	M20
ϕN_{TF} (kN)	32.5	47.2	87.9	137.2

VERIFY STEEL TENSION CAPACITY

STEP 3 ESTABLISH THE REDUCED CHARACTERISTIC BOLT TENSILE CAPACITY, FROM THE LITERATURE OF THE SPECIFIED BOLT MANUFACTURER. TABLE 3B DETAILS THE NOMINAL EXPECTED CAPACITIES OF BOLTS MANUFACTURED TO ISO STANDARDS.

CHECKPOINT 3

DESIGN REDUCED ULTIMATE TENSILE CAPACITY, ϕN_{UR} (kN)

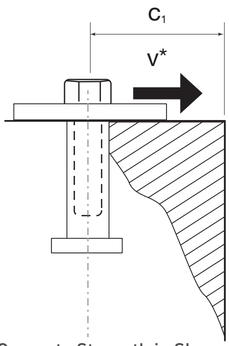
ϕN_{UR} = MINIMUM OF ϕN_{URC}, ϕN_{US}, ϕN_{TF}

CHECK $N^* / \phi N_{UR} \leq 1$,

IF NOT SATISFIED RETURN TO STEP 1

STEP 4 VERIFY CONCRETE SHEAR CAPACITY (Per Anchor Perpendicular to Edge, ϕV_{CB} (kN), $\phi = 0.75$

Anchor Shear Capacity (reference NZS3101 Section 17)



DIA 4A. Verify Concrete Strength in Shear

TABLE 4A Reduced basic concrete breakout strength in Shear, per anchor ϕV_B (kN), for single anchor $\phi = 0.75$ $f_c = 20$MPa

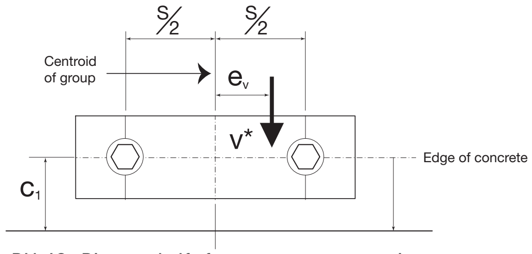
Product Code	c_1 - distance from the centre of resistance of an anchor to the edge of the concrete in the direction which the load is applied, mm											
	30	35	40	50	60	85	100	200	300	400	500	≥600
TIM10x40	1.6	2.0	2.4	3.4	4.5	7.6	9.7	27.3	50.2	77.4	108.1	142.1
*with nail plate	1.6	2.1	2.5	3.5	4.7	7.9	10.0	28.4	52.1	80.2	112.1	147.4
TIM12x50		2.1	2.6	3.6	4.8	8.1	10.3	29.1	53.5	82.4	115.1	151.3
*with nail plate		2.2	2.7	3.7	4.9	8.3	10.6	30.0	55.1	84.8	118.6	155.9
TIM16x75				4.3	5.6	9.5	12.1	34.1	62.7	96.5	134.9	177.3
*with nail plate				4.4	5.7	9.6	12.3	34.8	64.0	98.5	137.6	180.9
TIM20x75					6.2	10.4	13.2	37.4	68.8	105.9	148.0	194.6
*with nail plate					6.3	10.6	13.5	38.2	70.2	108.1	151.1	198.6
TIM20x120						11.4	14.5	41.1	75.6	116.4	162.6	213.8
*with nail plate						11.5	14.7	41.7	76.6	117.9	164.7	216.5
TIM24x100						11.8	15.1	42.6	78.2	120.4	168.3	221.3
*with nail plate						12.0	15.3	43.2	79.4	122.3	170.9	224.7
316 Stainless Steel Inserts (TCM)												
FE100145SS	1.6	2.0	2.5	3.4	4.5	7.6	9.7	27.5	50.5	77.7	108.6	142.8
*with nail plate	1.7	2.1	2.5	3.6	4.7	7.9	10.1	28.5	52.3	80.6	112.6	148.0
FE12055SS		2.1	2.6	3.7	4.8	8.1	10.3	29.2	53.7	82.7	115.6	151.9
*with nail plate		2.2	2.7	3.8	4.9	8.3	10.6	30.1	55.3	85.1	119.0	156.4
FE12055SS			3.0	4.2	5.5	9.2	11.8	33.3	61.1	94.1	131.5	172.8
*with nail plate			3.0	4.3	5.6	9.4	12.0	34.0	62.5	96.2	134.5	176.8
FE20095SS					6.1	10.3	13.2	37.3	68.5	105.5	147.4	193.8
*with nail plate					6.3	10.6	13.5	38.2	70.2	108.1	151.1	198.6

TABLE 4B Concrete compressive strength effect, shear, ψ_{vc}

f'_c (MPa)	15	20	25	≥32
ψ_{vc}	0.87	1.00	1.12	1.26

STRENGTH LIMIT STATE DESIGN

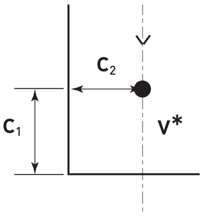
TABLE 4C Modification factor for anchor groups, Ψ_5 (if $e_V <$ half of centre-to-centre spacing, s)



DIA 4C. Distance half of centre-to-centre spacing

		c_1 - distance from the centre of resistance of an anchor to the edge of the concrete in the direction which the load is applied, mm											
e_V - distance between the point of shear force application and the centroid of the group of anchors resisting the shear in direction of the applied shear		30	35	40	50	60	85	100	200	300	400	500	≥600
	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	40	0.27	0.30	0.33	0.38	0.43	0.52	0.56	0.71	0.79	0.83	0.86	0.88
	80	0.16	0.18	0.20	0.24	0.27	0.35	0.38	0.56	0.65	0.71	0.76	0.79
	120	0.11	0.13	0.14	0.17	0.20	0.26	0.29	0.45	0.56	0.63	0.68	0.71
	160	0.09	0.10	0.11	0.14	0.16	0.21	0.24	0.38	0.48	0.56	0.61	0.65
	200	0.07	0.08	0.09	0.11	0.13	0.18	0.20	0.33	0.43	0.50	0.56	0.60
	240	0.06	0.07	0.08	0.09	0.11	0.15	0.17	0.29	0.38	0.45	0.51	0.56
	280	0.05	0.06	0.07	0.08	0.10	0.13	0.15	0.26	0.35	0.42	0.47	0.52
	320	0.04	0.05	0.06	0.07	0.09	0.12	0.14	0.24	0.32	0.38	0.44	0.48

TABLE 4D Modification factor for anchor groups, edge distance, Ψ_6



$c_2 < 1.5 \times c_1$

DIA 4D. Distance from the centre of resistance to the edge

c_2 - minimum edge distance or half of anchor spacing perpendicular to c_1, mm	c_1 - distance from the centre of resistance of an anchor to the edge of the concrete in the direction which the load is applied, mm											
	30	35	40	50	60	85	100	200	300	400	500	≥600
30	0.90	0.87	0.85	0.82	0.80	0.77	0.76	0.73	0.72	0.72	0.71	0.71
35	0.93	0.90	0.88	0.84	0.82	0.78	0.77	0.74	0.72	0.72	0.71	0.71
40	0.97	0.93	0.90	0.86	0.83	0.79	0.78	0.74	0.73	0.72	0.72	0.71
50	1.00	0.99	0.95	0.90	0.87	0.82	0.80	0.75	0.73	0.73	0.72	0.72
60		1.00	1.00	0.94	0.90	0.84	0.82	0.76	0.74	0.73	0.72	0.72
70			1.00	0.98	0.93	0.86	0.84	0.77	0.75	0.74	0.73	0.72
100				1.00	1.00	0.94	0.90	0.80	0.77	0.75	0.74	0.73
200						1.00	1.00	0.90	0.83	0.80	0.78	0.77
300								1.00	0.90	0.85	0.82	0.80
450									1.00	0.93	0.88	0.85
600										1.00	0.94	0.90
750											1.00	0.95
1000												1.00

TABLE 4E Modification factor for cracked concrete, Ψ_7

	Ψ_7
Cracked concrete with no supplementary minimum reinforcement	1
Cracked concrete with supplementary minimum of 12mm diameter reinforcing bar as supplementary reinforcment.	1.2
Concrete which is not cracked at service load levels	1.4

STRENGTH LIMIT STATE DESIGN

TABLE 4F Calculate the projected concrete failure area of anchor in shear when not limited by edge distance $A_{v0} = 4.5c_1^2$

c_1	30	35	40	50	60	70	100	200	300	400	500	600
A_{v0} ($\times10^4$)	0.4	0.6	0.7	1.1	1.6	2.2	4.5	18.0	40.5	72.0	112.5	162.0

STEP 4 CALCULATE THE PROJECTED CONCRETE FAILURE AREA OF ANCHOR IN SHEAR

$A_V = (c_{2a}+c_{2b})^*b_m$, $(c_{2a}, c_{2b}, b_m \leqslant 1.5c_1)$

c_{2a}, c_{2b} = EDGE DISTANCE OR HALF OF ANCHOR SPACING PERPENDICULAR TO THE LOADING DIRECTION (BUT LESS THAN $1.5c_1$).

b_m = SUBSTRATE THICKNESS (BUT LESS THAN $1.5c_1$)

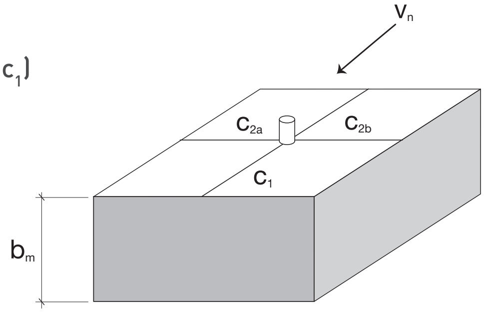


TABLE 4G Calculate $1.5c_1$

c_1	30	35	40	50	60	70	100	200	300	400	500	600
$1.5c_1$	45	52.5	60	75	90	105	150	300	450	600	750	900

CHECKPOINT 4

DESIGN CONCRETE BREAKOUT STRENGTH PERPENDICULAR TO EDGE IN SHEAR OF A SINGLE ANCHOR, ϕV_{CB}

$\phi V_{CB} = \phi V_B * \Psi_{VC} * \Psi_5 * \Psi_{6A} * \Psi_{6B} * \Psi_7 * A_V/A_{V0}$

STEP 5 VERIFY SHEAR STRENGTH OF STEEL ϕV_S (kN)

TABLE 5A Reduced characteristic ultimate anchor steel capacity, ϕV_{s1} (kN), $\phi = 0.75$

Product Code	TIM10x40	TIM12x50	TIM16x75	TIM20x75	TIM20x120	TIM24X100
ϕV_{s1} (kN)	11.7	14.7	23.0	47.4	47.4	73.9
Product Code	FE10045SS	FE12055SS	FE16070SS	FE20095SS		
ϕV_{s1} (kN)	22.4	27.8	42.6	65.4		

TABLE 5B Reduced characteristic ultimate bolt shear capacity, ϕV_{s2} (kN), ϕ = 0.8

Zinc Bolt Size	M10		M12		M16		M20		M24	
$\phi V_s 2$ (kN)	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8	G4.6	G8.8
	9.8	20.0	14.4	29.3	27.4	56.1	43.0	88.3	62.0	127.2

A4-70 316 SS Bolt Size	M10	M12	M16	M20		
ϕV_{s2} (kN)	16.8	24.7	47.4	74.5		

STEP 6 VERIFY CONCRETE PRY-OUT STRENGTH IN SHEAR, ϕV_{CP} (kN), ϕ = 0.75

TABLE 6A Co-efficient of pry out strength

h = length of insert (mm) plus 8mm for nail plate if used.

h	<65mm	≥65mm
k_{cp}	1.0	2.0

CHECKPOINT 5

CONCRETE PRY-OUT STRENGTH IN SHEAR

$\phi V_{CP} = 0.75/0.6 * k_{cp} * \phi N_{URC} * \psi_{vc}$

CHECKPOINT 6

DESIGN REDUCED ULTIMATE CONCRETE SHEAR CAPACITY PERPENDICULAR TO AN EDGE, ϕV_{URT}

ϕV_{URT} = MINIMUM OF ϕV_{CB}, ϕV_{S1}, ϕV_{S2}, ϕV_{CP}

CHECK $V^*/\phi V_{URT} \leq 1$,

IF NOT SATISFIED RETURN TO STEP 1

STEP 7 COMBINED LOADING AND SPECIFICATION

CHECKPOINT 7

CHECK

$N^*/\phi N_{UR} + V^*/\phi V_{UR} \leq 1.2$,

IF NOT SATISFIED RETURN TO STEP 1

4 SPECIFICATION

HOW TO SPECIFY

REID METRIC THREADED INSERTS (TIM),

(TIM SIZE X LENGTH) (PART NUMBER), (FINISH)

WITH A (BOLT GRADE) BOLT.

REID 316 STAINLESS STEEL ELEPHANT FOOT™ METRIC THREADED INSERTS

(FE SIZE X LENGTH) (PART NUMBER) WITH A (BOLT GRADE) BOLT.

EXAMPLE

REID METRIC THREADED INSERT

TIM16X75G GALVANISED FINISH WITH A GRADE 4.6 BOLT.

TO BE INSTALLED IN ACCORDANCE WITH REID TECHNICAL DATA SHEET.

ANCHORING DESIGN WORKSHEET

Project ______________________

Design ______________________

Location ______________________

Project ID ______________________

Design by ______________________

Date ______________________

Checked ______________________

Sketch

Inputs

N* & V* are the **per anchor** load demand.
Check both external and internal anchors for suitability.

Tensile design action effect	N*		kN
Shear design action effect	V*		kN
Substrate thickness	b_m		mm
Concrete compressive strength	f'_c		MPa

STEP 1 SELECT ANCHOR TO BE EVALUATED

Table 1a: Find the interaction of N* and V* values

Anchor Type ______________________

Table 1a: Absolute minima, edge distance and half of anchor spacing.

e_m ______________________

Check for compliance with absolute minima tick ☐

Checkpoint 1:

Anchor size selected? tick ☐

Comply with absolute minima? tick ☐

STEP 2 VERIFY CONCRETE TENSILE CAPACITY

Table 2a: Concrete tensile capacity ϕN_{UC} ____ kN

Table 2b: Concrete compressive strength effect ψ_{nc} ____

Table 2c and /or 2d: Edge distance and anchor spacing reduction factors

Factor	Type	Table	Value
ϕx_1			
ϕx_2			
ϕy_1			
ϕy_2			

Step 2a: Cracked concrete reduction factor ψ_{CR} ____

Checkpoint 2:
Calculate: $\phi N_{URC} = \phi N_{UC} * \psi_{nc} * \phi x_1 * \phi x_2 * \phi y_1 * \phi y_2 * \psi_{CR}$ ____ kN [1]

STEP 3 VERIFY STEEL TENSILE CAPACITY

Table 3a: Anchor steel capacity ϕN_{US} ____ kN [2]

Table 3b: Bolt steel capacity ϕN_{TF} ____ kN [3]

Checkpoint 3:
ϕN_{UR} = minimum of ϕN_{URC}[1], ϕN_{US}[2], ϕN_{TF}[3] = ____ kN

$N^* / \phi N_{UR} \leq 1.0$? ____ / ____ = ____ tick ☐

If not satisfied, return to step 1.

Tensile Design Completed

STEP 4 VERIFY CONCRETE SHEAR CAPACITY

Table 4a:	Concrete shear capacity	ϕV_B		kN
Table 4b:	Concrete compressive strength effect	ψ_{VC}		
Table 4c:	Anchor group factor	ψ_5		
Table 4d:	Edge distance factor	ψ_{6A}		
		ψ_{6B}		
Table 4e	Concrete crack failure	ψ_7		
Table 4f	Projected failure area when not limited by edge distance	A_{v0}		mm²

Step 4g Projected concrete failure area of anchor A_v

Edge distance / Half of anchor spacing, mm	Original value, A	Table 4g, $1.5c_1$ B	Calc value, min (A,B)
c_{2a}			
c_{2b}			
b_m			
$A_v = (c_{2a} + c_{2b}) * b_m$			

Checkpoint 4: Calculate

$\phi V_{CB} = \Phi V_B * \psi_{VC} * \psi_5 * \psi_{6A} * \psi_{6B} * \psi_7 * A_v / A_{v0}$ ____ kN [4]

STEP 5 VERIFY STEEL SHEAR STRENGTH ϕV_s

Table 5a: Steel shear capacity ϕV_{s1} ____ kN [5]

Table 5b: Bolt shear capacity ϕV_{s2} ____ kN [6]

STEP 6 VERIFY CONCRETE PRY-OUT STRENGTH IN SHEAR ϕV_{CP} (PER ANCHOR)

Table 6a: Pry-out co-efficient k_{cp} ____

Checkpoint 5:

Calculate $\phi V_{CP} = 0.75/0.6 * k_{cp} * \phi N_{URC} * \psi_{VC}$ ____ kN [7]

Checkpoint 6:

ϕV_{UR} = Minimum of ϕV_{CB}[4], ΦV_{S1}[5], ΦV_{S2}[6], ΦV_{CP}[7] = ____ kN

$V^* / \phi V_{ur} \leq 1.0$? ____ / ____ = ____

STEP 7 COMBINED LOADING & SPECIFICATION

Checkpoint 7:
$N_* / \phi N_{UR} + V^* / \phi V_{UR} \leq 1.2$?
____ / ____ + ____ / ____ = ____ tick ☐

If not satisfied, return to step 1.

reid™

SPECIFY: ______________________

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