Cast-In Anchoring
Solutions

Design Manual

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Reid™ has been supplying quality engineered products to the Australian mining and construction industries since the 1920's, and in the last 50 years has built a position of market leadership in the supply of cast-in components to 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, Grouters and Inserts that are used with ReidBar™ - continuously threaded Grade 500 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 certification, 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.

- ISO9001 accredited
- strict quality control systems
- products designed in Australia to Australian Standards
- products tested in Australian building materials
- full responsibility for our product range and performance data

Engineering and technical representation in all capital cities and regional centres.

Extensive technical data and support available.

Engineered Solutions

All structural products and systems require suitable engineering in their development and manufacture. In the case of construction projects and one-off solutions these are customised for the specific problem or requirement and usually involve extra time and cost to devise, certify and supply. In the case of standardised/ready-to-use products however, as offered to the industry by Reid™, these pre-engineered products also require customised *application*-engineering to devise and specify arrangements of standard product to deliver best-possible solutions to every unique, project-based problem and structural requirement. This approach nearly always allows the fastest and best-value solutions to the customer's needs and so is inherently *better engineering*.

This engineering resource from Reid™ is intended to supply what you need to know to get the solutions you need from the products we offer. You can either solve the problem for yourself or get any necessary assistance from Reid™.

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 Ferrules.

The performance data contained in this Design Guide relates only to the Reid™ range of Cast-In Ferrules. 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.

Once you have adequately defined the application/problem the essential steps to getting the right Reid™ solution are:

1. Options	IDENTIFY THE POTENTIAL SYSTEMS THAT WILL WORK
2. Choose	THE OPTION THAT BEST MEETS ALL THE REQUIREMENTS
3. Design	FOR THE EFFICIENT APPLICATION OF THE SPECIFIC PRODUCT CHOICE
4. Specify	THE SOLUTION CORRECTLY SO IT'S CLEAR WHAT NEEDS TO BE DONE

The goal of this process is to deliver the best possible combination of required safety, managed risk and best value performance for the designer and the downstream construction staff.

Some structural products supplied by Reid™ in conjunction with our own systems are sourced from our allied Business Unit – Ramset™. In such cases your Reid™ engineer can refer you to the appropriate engineering resources for these products. Whatever the information source Reid™ will only propose solutions which we know will work best for you and we take full responsibility for all products that we supply – be it the hardware or our engineering service. We hope you'll agree that we do this better than anybody else.

WE HAVE MORE ENGINEERING RESOURCES THAN CAN BE CONTAINED WITHIN THIS DESIGN GUIDE, SO, IF YOU WANT TO KNOW MORE OR JUST WANT TO KNOW THAT REID™ CAN SOLVE IT FOR YOU, CALL YOUR REID™ ENGINEER FOR ASSISTANCE:

NSW/ACT:	**0438 540 482**	**SA/TAS:**	**0409 672 943**
QLD/NT:	**0407 510 079**	**WA:**	**(08) 9455 3622**
VIC:	**0419 164 066**		

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1 Legend of Symbols

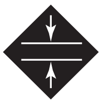
We have developed this set of easily recognisable icons to assist with product selection.

PERFORMANCE RELATED SYMBOLS

Indicates the suitability of product to specific types of performance related situations.

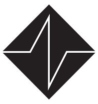
Has good resistance to cyclic and dynamic loading. Resists loosening under vibration.

Suitable for elevated temperate applications. Structural anchor components made from steel. Any plastic or non-ferrous parts make no contribution to holding power under elevated temperatures.



Anchor has an effective pull-down feature, or is a stud anchor. It has the ability to clamp the fixture to the base material and provide high resistance to cyclic loading.

May be used close to edges (or another anchor) without risk of splitting the concrete.



Suitable for use in seismic design.

MATERIAL SPECIFICATION SYMBOLS

Indicates the base material and surface finish to assist in selection with regard to corrosion or environmental issues.

Steel Zinc Plated to AS1789-2003. Recommended for internal applications only.

Steel Hot Dipped Galvanised to AS4680-2006. For external applications.

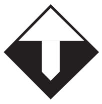
AISI Grade 316 Stainless Steel - Resistant to corrosive agents including chlorides and industrial pollutants. Recommended for internal or external applications in marine or corrosive environments.

Stainless Steel - Resistant to corrosive agents. Recommended for internal or external applications.

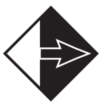
INSTALLATION RELATED SYMBOLS

Indicates the suitable positioning and other installation related requirements.

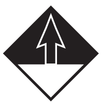
Suitable for floor applications.



Chemical anchors suitable for use in dry holes.



Suitable for wall applications.



Suitable for overhead applications.

2 Notation

GENERAL NOTATION

a = actual anchor spacing (mm)
a_c = critical anchor spacing (mm)
a_m = absolute minimum anchor spacing (mm)
A_b = reinforcing bar stress area (mm^2)
A_s = stress area (mm^2)
A_{st} = stress area of reinforcing bar (mm^2)
b_m = minimum substrate thickness (mm)
d_b = bolt diameter (mm)
d_f = fixture hole diameter (mm)
d_h = drilled hole diameter (mm)
e = actual edge distance (mm)
e_c = critical edge distance (mm)
e_m = absolute minimum edge distance (mm)
f'_c = concrete cylinder compressive strength (MPa)
f'_{cf} = concrete flexural tensile strength (MPa)
f_{sy} = reinforcing bar steel yield strength (N/mm^2)
f_u = characteristic ultimate steel tensile strength (MPa)
f_y = characteristic steel yield strength (MPa)
h = anchor effective depth (mm)
h_n = nominal effective depth (mm)
g = gap or non-structural thickness (mm)
k_1 = see AS3600 - 2001
k_2 = see AS3600 - 2001
L = anchor length (mm)
L_e = anchor effective length (mm)
L_{st} = length of reinforcing bar to develop tensile stress σ_{st} (mm)
$L_{sy.t}$ = reinforcing bar length to develop steel yield in tension (mm)
$L_{sy.t\,(nom)}$ = length of reinforcing bar to develop full steel yield in 32 MPa concrete (mm)
L_t = thread length (mm)
n = number of fixings in a group
N_{sy} = tensile steel yield load capacity
N_{ub} = characteristic ultimate tensile adhesive bond capacity (kN)
P_L = long term, retained preload (kN)
P_{Li} = initial preload (kN)
P_r = proof load (kN)
t = total thickness of fastened material(s) (mm)
T_r = assembly torque (Nm)
X_e = edge distance effect, tension
X_{na} = anchor spacing effect, tension
X_{nae} = anchor spacing effect, end of a row, tension
X_{nai} = anchor spacing effect, internal to a row, tension
X_{nc} = concrete compressive strength effect, tension
X_{ne} = edge distance effect, tension
X_{uc} = characteristic ultimate capacity
X_{va} = anchor spacing effect, concrete edge shear
X_{vc} = concrete compressive strength effect, shear
X_{vd} = load direction effect, concrete edge shear
X_{vn} = multiple anchors effect, concrete edge shear
X_{vs} = corner edge shear effect, shear
X_{vsc} = concrete compressive strength effect, combined concrete/steel shear
Z = section modulus (mm^3)
ß = concrete cube compressive strength (N/mm2)
μ_T = torque co-efficient of sliding friction
$\bar{x}$ = mean ultimate capacity
σ_{st} = steel tensile stress
$\sigma_{st\,(nom)}$ = steel tensile stress of reinforcing bar bonded into 32 MPa concrete

STRENGTH LIMIT STATE NOTATION

M^* = design bending action effect (Nmm)
M_u = characteristic ultimate moment capacity (Nm)
N^* = design tensile action effect (kN)
N_{tf} = nominal ultimate bolt tensile capacity (kN)
N_u = characteristic ultimate tensile capacity (kN)
N_{uc} = characteristic ultimate concrete tensile capacity (kN)
N_{ucr} = factored characteristic ultimate concrete tensile capacity (kN)
N_{ur} = design ultimate tensile capacity (kN)
N_{urc} = design ultimate concrete tensile capacity (kN)
N_{us} = characteristic ultimate steel tensile capacity (kN)
N_{usr} = factored characteristic ultimate steel tensile capacity (kN)
R_u = characteristic ultimate capacity
V^* = design shear action effect (kN)
V_{sf} = nominal ultimate bolt shear capacity (kN)
V_u = ultimate shear capacity (kN)
V_{uc} = characteristic ultimate concrete edge shear capacity (kN)
V_{ur} = design ultimate shear capacity (kN)
V_{urc} = design ultimate concrete edge shear capacity (kN)
V_{us} = characteristic ultimate steel shear capacity (kN)
V_{usc} = characteristic ultimate combined concrete/steel shear capacity (kN)
$\emptyset$ = capacity reduction factor
$\emptyset_c$ = capacity reduction factor, concrete tension recommended as 0.6
$\emptyset_m$ = capacity reduction factor, steel bending recommended as 0.8
$\emptyset_n$ = capacity reduction factor, steel tension recommended as 0.8
$\emptyset_q$ = capacity reduction factor, concrete edge shear recommended as 0.6
$\emptyset_v$ = capacity reduction factor, steel shear recommended as 0.8

PERMISSIBLE STRESS NOTATION

f_s = factor of safety
f_{sc} = factor of safety for substrate = 3.0
f_{ss} = factor of safety for steel in tension and bending = 2.2
f_{sv} = factor of safety for steel in shear = 2.5
M = applied moment (Nm)
M_a = working load limit moment capacity (Nm)
N = applied tensile load (kN)
N_a = working load limit tensile capacity (kN)
N_{ac} = working load limit concrete tensile capacity (kN)
N_{ar} = factored working load limit tensile capacity (kN)
N_{as} = working load limit steel tensile capacity (kN)
N_{asr} = factored working load limit steel tensile capacity (kN)
R_a = working load limit capacity
V = applied shear load (kN)
V_a = working load limit shear capacity (kN)
V_{ar} = factored working load limit shear capacity (kN)
V_{as} = working load limit steel shear capacity (kN)

3 Typical Bolt Performance Information

Tabulated below are nominal reduced ultimate characteristic capacities for bolts manufactured in accordance with ISO 898-1.

The expected capacity of bolts should be independently checked by the designer based on the bolt manufacturers published performance information.

It is recommended that Stainless Steel bolts be lubricated and that tightening torque be applied in a smooth, continuous manner. Impact wrenches (rattle guns) are not suitable for the tightening of Stainless Steel fasteners.

STRENGTH LIMIT STATE DESIGN INFORMATION

TENSION

Reduced nominal bolt tensile capacity, $ØN_{tf}$ (kN), $Ø_n = 0.8$

Bolt Type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	6.4	11.7	18.6	27.0	50.2	78.4	113.0
Grade 8.8 Carbon Steel	13.3	24.3	38.5	56.0	104.2	162.7	234.4
Stainless Steel A4-70 (AISI 316)	11.3	20.5	32.5	47.2	87.9	137.2	–

SHEAR

Reduced nominal bolt shear capacity, $ØV_{sf}$ (kN), $Ø_v = 0.8$

Bolt Type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	3.3	6.1	9.8	14.4	27.4	43.0	62.0
Grade 8.8 Carbon Steel	6.6	12.4	20.0	29.3	56.1	88.3	127.2
Stainless Steel A4-70 (AISI 316)	5.6	10.5	16.8	24.7	47.4	74.5	–

WORKING LOAD LIMIT DESIGN INFORMATION

TENSION

Allowable tensile load steel (kN), $F_{ss} = 2.2$

Bolt Type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	3.6	6.6	10.6	15.3	28.5	44.5	64.2
Grade 8.8 Carbon Steel	7.6	13.8	21.9	31.8	59.2	92.4	133.2
Stainless Steel A4-70 (AISI 316)	6.4	11.6	18.5	26.8	49.9	77.9	–

SHEAR

Allowable shear load steel (kN), $F_{sv} = 2.5$

Bolt Type	M6	M8	M10	M12	M16	M20	M24
Grade 4.6 Carbon Steel	1.7	3.1	4.9	7.2	13.7	21.5	31.0
Grade 8.8 Carbon Steel	3.3	6.2	10.0	14.7	28.1	44.2	63.6
Stainless Steel A4-70 (AISI 316)	2.8	5.3	8.4	12.4	23.7	37.3	–

4 Cast-In Anchoring - Overview

Panel Connections Design

Reid™ serves the industry not just with supply of hardware but, and perhaps more importantly, with technically superior engineering information, such as this design guide. This has proven to be a valued asset for professional engineers, allowing for informed, safe and efficient decisions, with the reassurance that the published capacities have been verified over years of extensive research, development and testing.

The following design information is provided for the guidance of 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. The Simplified Design Approach to achieve strength limit state design was developed by our business partner – Ramset™ and 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.

The Reid™ Cast-In ferrule range is available in Zinc, Hot Dip Galvanised and Stainless Steel finishes to cater for a wide range of atmospheric conditions and range in sizing from M10 through to M24.

5 Elephant Foot Ferrules

GENERAL INFORMATION

Product

The Elephant Foot Ferrule is a premium grade, medium to heavy duty, cast-in ferrule.

Benefits, Advantages and Features

Improved Security:

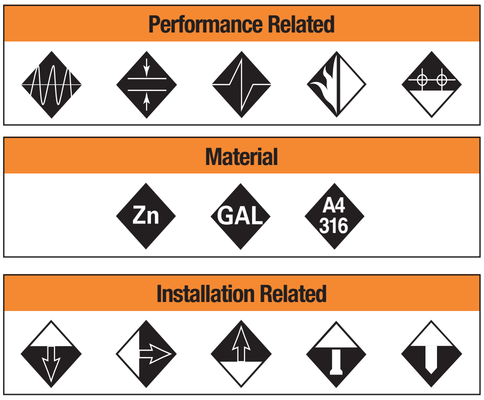
- No cross bar required to develop rated capacity.

High Quality Material Options:

- 5.8 grade.
- 42 micron hot dip galvanised.
- Premium 316 SS.

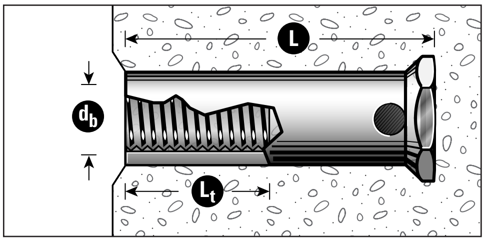
Versatile:

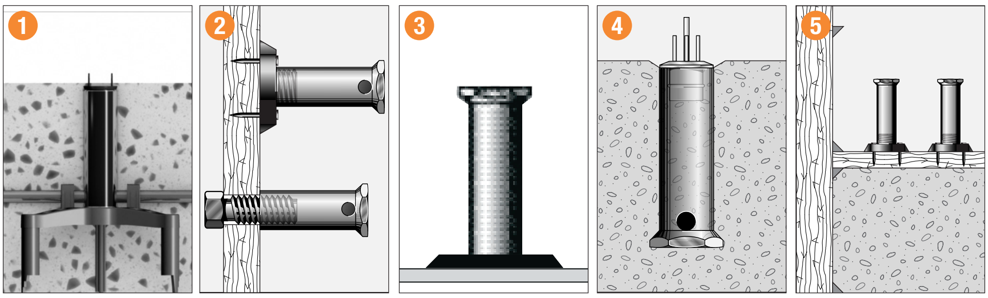
- Use in near or far face applications with our range of accessories.
- May be used with small rebar for fixing to mesh.



Principal Applications

- **Small and lightweight precast fixing point.**
- **Structural connections.**
- **Curtain wall and panel facade fixings.**
- **Temporary precast panel bracing points.**





1. Chair for tilt-cast.
2. Nailing plate or bolted to formwork.
3. Fixing to steel casting bed with magnetic or glue on nailing plate.
4. “Puddled” into wet concrete.
5. Templated onto face of panel.

Elephant Foot Ferrules

Installation and Working Load Limit Performance Details

Ferrule size, d_b x L (mm)	Installation details		Minimum dimensions*			Working Load Limit (kN)					
						Shear, V_a			Tension, N_a		
						Concrete Strength, f'_c			Concrete Strength, f'_c		
	Cross hole to suit	Tightening Torque, T_r (Nm)**	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	20 MPa	32 MPa	40 MPa	20 MPa	32 MPa	40 MPa
M10 x 45	R8	17	60	120	50	6.7	7.9	8.5	4.5	5.7	6.4
M12 x 55	R8	30	75	150	65	9.6	11.2	12.1	7.7	9.7	10.8
M12 x 95	R10		135	270	115	15.9	18.6	20.0	16.3	20.1	20.1
M16 x 70	R10	75	100	200	85	14.9	17.4	18.8	11.6	14.7	16.5
M16 x 95			135	270	115	20.6	24.0	25.9	18.8	23.8	26.6
M20 x 70	R10	144	100	200	85	17.6	20.6	22.2	13.0	16.5	18.4
M20 x 95			135	270	115	24.3	28.4	30.6	21.1	26.6	29.8
M24 x 95	N12	250	135	270	115	29.9	35.0	37.7	23.1	29.2	32.6

* For shear loads acting towards an edge or where these minimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
** Recommended tightening torques are based on the use of grade 4.6 bolts.
Note: Confirm bolt capacity independently of tabulated information.

DESCRIPTION AND PART NUMBERS

Ferrule size, d_b	Ferrule OD (mm)	Ferrule length, L (mm)	Effective depth, h (mm)	Thread length, L_t (mm)	Cross hole to suit	Part No.		
						Zn	Gal	316SS
M10	16	45	41	20	R8	FE10045		FE10045SS
M12	17	55	51	25	R8	FE12055	FE12055GH	FE12055SS
		95	91		R10	FE12095	FE12095GH	
M16	22	70	66	32	R10	FE16070	FE16070GH	FE16070SS
		95	91			FE16095	FE16095GH	
M20	26	70	66	35	R10	FE20070	FE20070GH	
		95	91	38		FE20095	FE20095GH	FE20095SS
M24	32	95	91	50	N12	FE24095	FE24095GH	

Effective depth, h (mm). Read value from "Description and Part Numbers" table.

ENGINEERING PROPERTIES

Ferrule size, d_b	Stress area threaded section, A_s (mm²)	Carbon Steel		Stainless Steel		Section modulus, Z (mm³)
		Yield strength, f_y (MPa)	UTS, f_u (MPa)	Yield strength, f_y (MPa)	UTS, f_u (MPa)	
M10	71.2	400	500	450	700	190.0
M12	88.3	400	500	450	700	334.5
M16	158.0	400	500	450	600	692.8
M20	242.0	400	500	450	600	1034.0
M24	365.0	400	500	n/a	n/a	2066.0

Strength Limit State Design / Elephant Foot Ferrules

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading – interaction diagram

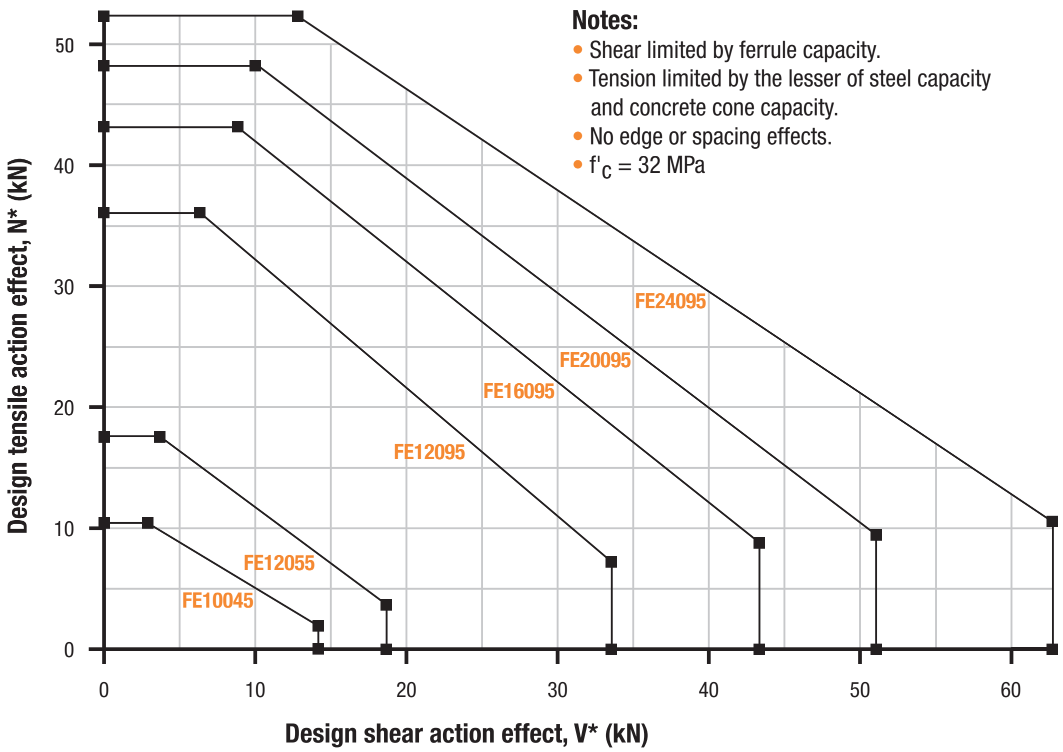


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Ferrule size, d_b	M10	M12	M16	M20	M24
e_m, a_m	30	36	48	60	72

Step 1c - Calculate anchor effective depth, h (mm)

Effective depth, h (mm) Read value from "Description and Part Numbers" table on previous page.

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

Strength Limit State Design / Elephant Foot Ferrules

STEP 2 Verify concrete tensile capacity - per anchor

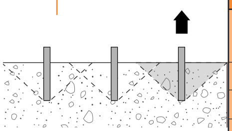
Table 2a - Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c$ = 0.6, f'_c = 32 MPa

Ferrule length, L (mm)	Effective depth, h (mm)	Ferrule size, d_b				
		M10	M12	M16	M20	M24
45	41	10.3				
55	51		17.5			
70	66			26.5	29.6	
95	91		36.2	42.9	48.0	52.5

Table 2b - Concrete compressive strength effect, tension, X_{nc}

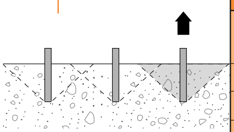
f'_c (MPa)	15	20	25	32	40	50
X_{nc}	0.68	0.79	0.88	1.00	1.12	1.25

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



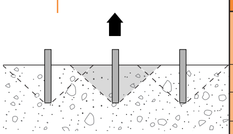
Edge distance, e (mm)		30	40	50	60	70	85	100	120	140	170
Ferrule length L (mm)	Effective depth h (mm)										
45	41	0.65	0.76	0.87	0.98	1					
55	51	0.58	0.67	0.76	0.85	0.94	1				
70	66	0.52	0.58	0.65	0.72	0.79	0.90	1	1		
95	91	0	0.51	0.56	0.61	0.66	0.74	0.81	0.92	1	

Table 2d - Anchor spacing effect, end of a row, tension, X_{nae}



Anchor spacing, a (mm)		30	40	50	60	70	85	100	125	150	200	250	300	350
Ferrule length L (mm)	Effective depth h (mm)													
45	41	0.63	0.66	0.70	0.74	0.78	0.85	0.91	1					
55	51	0.60	0.63	0.66	0.70	0.73	0.78	0.83	0.91	0.99	1			
70	66	0.58	0.60	0.63	0.65	0.68	0.71	0.75	0.82	0.88	1			
95	91	0	0.57	0.59	0.61	0.63	0.66	0.68	0.73	0.77	0.87	0.96	1	

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



Anchor spacing, a (mm)		30	40	50	60	70	85	100	125	150	200	250	300	350
Ferrule length L (mm)	Effective depth h (mm)													
45	41	0.25	0.33	0.41	0.49	0.57	0.69	0.81	1					
55	51	0.20	0.26	0.33	0.39	0.46	0.56	0.65	0.82	0.98	1			
70	66	0.16	0.20	0.25	0.30	0.35	0.43	0.51	0.63	0.76	1			
95	91	0	0.15	0.18	0.22	0.26	0.31	0.37	0.46	0.55	0.73	0.92	1	

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

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

Strength Limit State Design / Elephant Foot Ferrules

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a - Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n$ = 0.8

Ferrule size, d_b	M10	M12	M16	M20	M24
$ØN_{us}$ (Zinc)	28.5	35.3	63.2	96.8	146
$ØN_{us}$ (316 SS)	39.9	49.4	75.8	116.2	na

Step 3b - Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$, $ØN_{tf}$

Check $N^* / ØN_{ur} \leq 1$,

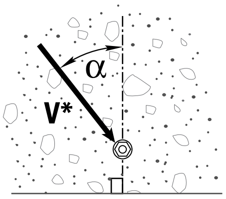
if not satisfied return to step 1

Strength Limit State Design / Elephant Foot Ferrules

STEP 4 Verify concrete shear capacity - per anchor

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

Ferrule size, d_b	M10	M12	M16	M20	M24
Edge distance, e (mm)					
30	3.4				
35	4.3	4.4			
40	5.3	5.4			
50	7.4	7.6	8.7		
60	9.7	10.0	11.3	12.3	
70	12.2	12.6	14.4	15.6	17.3
100	20.9	21.5	24.4	26.6	29.5
200	59.1	60.9	69.2	75.2	83.5
300		111.8	127.1	138.2	153.3
400			195.8	212.8	236.1
500				297.5	330.0
600					433.8



Load direction effect, conc. edge shear, X_{vd}

Table 4b - Concrete compressive strength effect, concrete edge shear, X_{vc}

f'_c (MPa)	15	20	25	32	40	50
X_{vc}	0.68	0.79	0.88	1.00	1.12	1.25

Table 4c - Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d - Anchor spacing effect, concrete edge shear, X_{va}

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

Edge distance, e (mm)	30	35	40	50	60	70	100	200	300	400	500	600
Anchor spacing, a (mm)												
30	0.70	0.67	0.65	0.62	0.60	0.59	0.56	0.53				
35	0.73	0.70	0.68	0.64	0.62	0.60	0.57	0.54	0.52			
40	0.77	0.73	0.70	0.66	0.63	0.61	0.58	0.54	0.53			
50	0.83	0.79	0.75	0.70	0.67	0.64	0.60	0.55	0.53	0.53		
60	0.90	0.84	0.80	0.74	0.70	0.67	0.62	0.56	0.54	0.53	0.52	
75	1.00	0.93	0.88	0.80	0.75	0.71	0.65	0.58	0.55	0.54	0.53	0.53
100		1.00	1.00	0.90	0.83	0.79	0.70	0.60	0.57	0.55	0.54	0.53
125				1.00	0.92	0.86	0.75	0.63	0.58	0.56	0.55	0.54
150					1.00	0.93	0.80	0.65	0.60	0.58	0.56	0.55
200						1.00	0.90	0.70	0.63	0.60	0.58	0.57
300							1.00	0.80	0.70	0.65	0.62	0.60
450								0.95	0.80	0.73	0.68	0.65
600								1.00	0.90	0.80	0.74	0.70
750									1.00	0.88	0.80	0.75
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

Strength Limit State Design / Elephant Foot Ferrules

STEP 4 continued

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

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

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

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

STEP 5 Verify anchor shear capacity - per anchor

Table 5a - Reduced characteristic ultimate steel shear capacity, $ØV_{us}$ (kN), $Ø_v$ = 0.6

(i) $ØV_{usc}$ Reduced characteristic ultimate combined concrete/steel shear capacity

Ferrule size, d_b		M10	M12	M16	M20	M24
Ferrule length, L (mm)	Effective depth, h (mm)					
45	41	14.2				
55	51		18.7			
70	66			31.4	37.1	
95	91		33.5	43.3	51.1	62.9

(ii) X_{vsc} Concrete compressive strength effect, combined concrete/steel shear

f'_c (MPa)	15	20	25	32	40	50
X_{vsc}	0.77	0.85	0.92	1.00	1.08	1.16

$$ØV_{us} = ØV_{usc} * X_{vsc}$$

Strength Limit State Design / Elephant Foot Ferrules

STEP 5 continued

Step 5b - Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Establish the reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

STEP 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2$,

if not satisfied return to step 1

HOW TO SPECIFY

Reid™ Elephant Foot Ferrule,
(Ferrule Size x Length) ((Part Number)) with a (Bolt Grade) bolt.

EXAMPLE

Reid™ Elephant Foot Ferrule,
M16 x 95 (FE16095GH) with a Grade 4.6 bolt.
To be installed in accordance with Reid™ Technical Data Sheet.

Please refer to Reid™ product guides for the range of accessories, (nailing plates, antennae caps, chairing solutions. etc.) that are available.

6 Round Bar Ferrules (Stiletto)

GENERAL INFORMATION

Product

The Stiletto Round Ferrule is a medium to heavy duty, cast-in ferrule.

Benefits, Advantages and Features

Economical:

- Simple cost effective design.

Outstanding Exterior Durability:

- 42 micron Hot Dip Galvanised coating.

Versatile:

- Use in near face, far face or side face applications with our range of accessories.

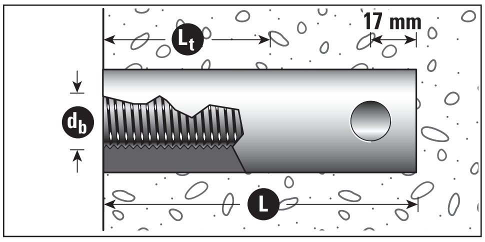
Performance Related

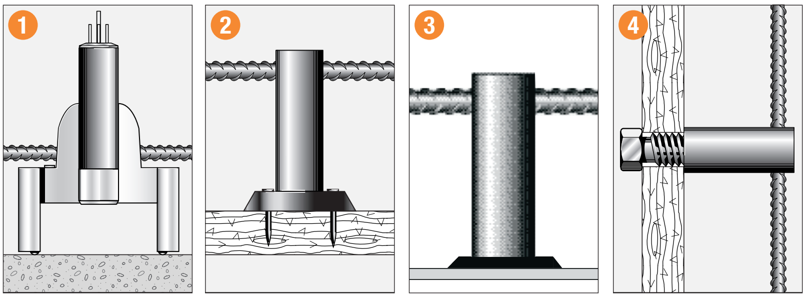
Material

Installation Related

Principal Applications

- **Structural connections.**
- **Panel to panel connection.**
- **High shear load applications.**
- **Temporary precast panel bracing points.**





1. Fitted in a chair, to suit panel thickness.
2. Fixed to casting bed with a nailing plate.
3. Fixing to steel casting bed with magnetic or glue on nailing plate.
4. Bolted through formwork.

Round Bar Ferrules

Installation and Working Load Limit Performance Details

Ferrule size, d_b x L (mm)	Installation Details		Minimum Dimensions*			Working Load Limit (kN)			
	Required Cross Bar	Tightening Torque, T_r (Nm)**	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Substrate thickness, b_m (mm)	Shear, V_{as} 4.6 Grade Bolt	Tension, N_a Concrete Strength, f'_c		
							20 MPa	32 MPa	40 MPa
M16 x 70	500Gr R10/N12	75	100	200	110	13.7	12.3	15.6	17.4
M16 x 95	x 300mm	75	130	250	130	13.7	21.8	27.5	30.8
M20 x 70	500Gr R10/N12	144	100	200	110	21.5	12.3	15.6	17.4
M20 x 95	x 300mm	144	130	250	130	21.5	21.8	27.5	30.8

* For shear loads acting towards an edge or where these minimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
** Recommended tightening torques are based on the use of grade 4.6 bolts.
Note: Confirm bolt capacity independently of tabulated values.

DESCRIPTION AND PART NUMBERS

Ferrule Size, d_b	Ferrule OD (mm)	Ferrule Length, L (mm)	Effective Depth, h (mm)	Thread Length, L_t (mm)	Cross Hole To Suit	Part No.	
						Zn	Gal
M16	26	70	54	32	500Gr	FS16070	FS16070GH
		95	79	39	R10/N12	FS16095	FS16095GH
M20	26	70	54	32	500Gr	FS20070	FS20070GH
		95	79	39	R10/N12	FS20095	FS20095GH

Effective depth, h (mm). Read value from “Description and Part Numbers” table.

ENGINEERING PROPERTIES

Ferrule size, d_b	Stress area at cross hole, A_s (mm^2)	Carbon Steel		Section modulus, Z (mm^3)
		Yield strength, f_y (MPa)	UTS, f_u (MPa)	
M16	163	330	430	1479
M20	163	330	430	1122

Strength Limit State Design / Round Bar Ferrules

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading – interaction diagram

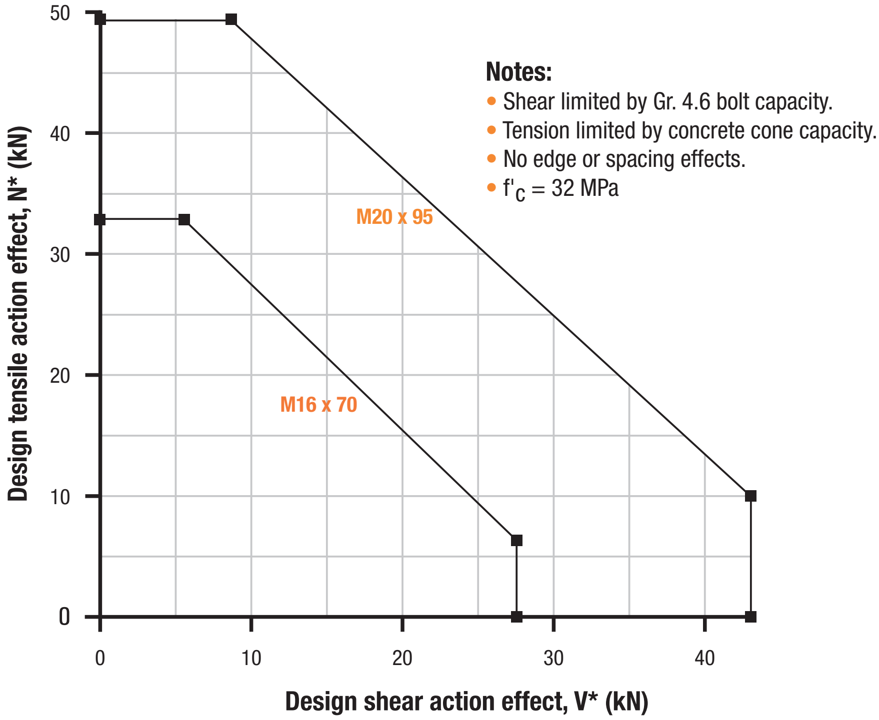


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Ferrule Length	70mm	95mm
a_m, e_m	50	60

Step 1c - Calculate anchor effective depth, h (mm)

Effective depth, h (mm) Read value from "Description and Part Numbers" table on previous page.

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

Strength Limit State Design / Round Bar Ferrules

STEP 2 Verify concrete tensile capacity - per anchor

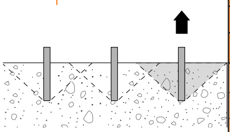
Table 2a - Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c$ = 0.6, f'_c = 32 MPa

Ferrule length, L (mm)	Effective depth, h (mm)	Ferrule size, d_b	
		M16	M20
70	54	28.1	28.1
95	79	49.5	49.5

Table 2b - Concrete compressive strength effect, tension, X_{nc}

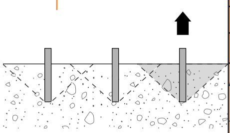
f'_c (MPa)	15	20	25	32	40	50
X_{nc}	0.68	0.79	0.88	1.00	1.12	1.25

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



Ferrule size, d_b	M16		M20	
Ferrule length, L (mm)	70	95	70	95
Effective depth, h (mm)	54	79	54	79
Edge distance, e (mm)				
40				
45	0.64	0.56		
50	0.68	0.59	0.68	0.59
55	0.72	0.62	0.72	0.62
60	0.76	0.65	0.76	0.65
70	0.84	0.70	0.84	0.70
80	0.91	0.76	0.91	0.76
90	0.99	0.82	0.99	0.82
100	1	0.88	1	0.88
125		1		1

Table 2d - Anchor spacing effect, end of a row, tension, X_{nae}



Ferrule size, d_b	M16		M20	
Ferrule length, L (mm)	70	95	70	95
Effective depth, h (mm)	54	79	54	79
Anchor spacing, a (mm)				
40				
50	0.64	0.60		
60	0.66	0.62	0.66	0.62
70	0.69	0.64	0.69	0.64
80	0.72	0.66	0.72	0.66
90	0.75	0.69	0.75	0.69
100	0.77	0.71	0.77	0.71
125	0.84	0.76	0.84	0.76
150	0.91	0.81	0.91	0.81
175	0.98	0.86	0.98	0.86
200	1	0.91	1	0.91
225		0.96		0.96
250		1		1

Strength Limit State Design / Round Bar Ferrules

STEP 2 continued

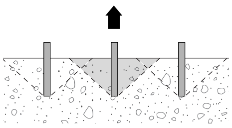


Table 2e - Anchor spacing effect, internal to a row, tension, X_{nai}

Ferrule size, d_b	M16		M20	
Ferrule length, L (mm)	70	95	70	95
Effective depth, h (mm)	54	79	54	79
Anchor spacing, a (mm)				
40				
50	0.27	0.21		
60	0.33	0.25	0.33	0.25
70	0.38	0.29	0.38	0.29
80	0.44	0.33	0.44	0.33
90	0.49	0.37	0.49	0.37
100	0.55	0.41	0.55	0.41
125	0.68	0.51	0.68	0.51
150	0.82	0.62	0.82	0.62
175	0.96	0.72	0.96	0.72
200	1	0.82	1	0.82
225		0.93		0.93
250		1		1

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

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

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a - Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Ferrule size, d_b	M16	M20
Round ferrule tension capacity	56.0	56.0

Step 3b - Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

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

Check $N^* / ØN_{ur} \leq 1$,

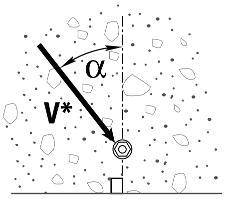
if not satisfied return to step 1

Strength Limit State Design / Round Bar Ferrules

STEP 4 Verify concrete shear capacity - per anchor

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

Ferrule size, d_b	M16	M20
Edge distance, e (mm)		
30		
40	6.8	
50	9.6	
60	12.6	12.6
80	19.3	19.3
100	27.0	27.0
125	37.8	37.8
150	49.6	49.6
200	76.4	76.4
300	140.4	140.4
400		216.1



Load direction effect, conc. edge shear, X_{vd}

Table 4b - Concrete compressive strength effect, concrete edge shear, X_{vc}

f'_c (MPa)	15	20	25	32	40	50
X_{vc}	0.68	0.79	0.88	1.00	1.12	1.25

Table 4c - Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d - Anchor spacing effect, concrete edge shear, X_{va}

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

Edge distance, e (mm)	35	40	50	60	80	100	125	150	200	300	400	500
Anchor spacing, a (mm)												
35	0.70	0.68	0.64	0.62	0.59	0.57	0.56	0.55	0.54			
40	0.73	0.70	0.66	0.63	0.60	0.58	0.56	0.55	0.54	0.53		
50	0.79	0.75	0.70	0.67	0.63	0.60	0.58	0.57	0.55	0.53		
60	0.84	0.80	0.74	0.70	0.65	0.62	0.60	0.58	0.56	0.54	0.53	
80	0.96	0.90	0.82	0.77	0.70	0.66	0.63	0.61	0.58	0.55	0.54	0.53
100	1.00	1.00	0.90	0.83	0.75	0.70	0.66	0.63	0.60	0.57	0.55	0.54
150			1.00	1.00	0.88	0.80	0.74	0.70	0.65	0.60	0.58	0.56
200					1.00	0.90	0.82	0.77	0.70	0.63	0.60	0.58
250						1.00	0.90	0.83	0.75	0.67	0.63	0.60
300							0.98	0.90	0.80	0.70	0.65	0.62
450							1.00	1.00	0.95	0.80	0.73	0.68
600									1.00	0.90	0.80	0.74
750										1.00	0.88	0.80
900											0.95	0.86
1050											1.00	0.92
1250												1.00

Strength Limit State Design / Round Bar Ferrules

STEP 4 continued

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

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

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

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

STEP 5 Verify anchor shear capacity - per anchor

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

Ferrule size, d_b	M16	M20
Round ferrule shear capacity	61.4	61.4

* This value requires minimum f'_c = 32MPa.

Step 5b - Reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ (kN)

Establish the reduced characteristic ultimate bolt steel shear capacity, $ØV_{sf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

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

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

Strength Limit State Design / Round Bar Ferrules

STEP 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2$,

if not satisfied return to step 1

HOW TO SPECIFY

Reid™ Round Ferrule,
(Ferrule Size x Length) (Part Number) with a (Bolt Grade) bolt.
N12 x 300mm cross bar required.

EXAMPLE

Reid™ Round Ferrule,
M16 x 75 (FS16070) with a Grade 8.8 bolt.
N12 x 300mm cross bar required.
To be installed in accordance with Reid™ Technical Data Sheet.

Please refer to Reid™ product guides for the range of accessories, (nailing plates, antennae caps, chairing solutions. etc.) that are available.

7 Double Ended Solid Ferrules

GENERAL INFORMATION

Product

The Double Ended Solid Ferrule is a heavy duty cast-in ferrule.

Benefits, Advantages and Features

Economical:

- Two fixing points in one cast-in ferrule.

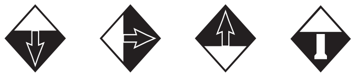
Superior Strength:

- 5.8 Grade, ideal for high shear loads.

Performance Related

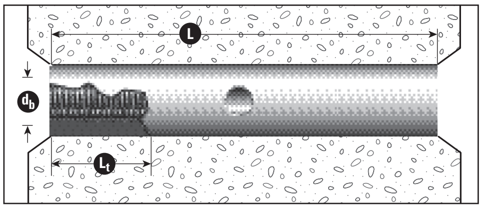
Material

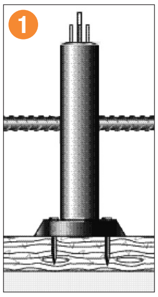
Installation Related

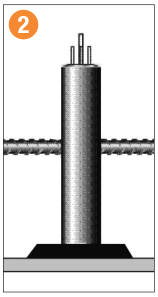


Principal Applications

- **Structural connections.**
- **Floor to panel.**
- **High shear load applications.**







1. Fixed to formwork with nailing plate.
2. Fixed to steel casting bed with magnetic or glue on nailing plate.

Double Ended Solid Ferrules

Installation and Working Load Limit Performance Details

Threaded Anchor Size	Installation Details		Minimum Critical Distances*			Working Load Limit (kN)				
	Cross Bar Details	Recommended Torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	To Suit Panel thickness, (t) (mm)	Shear, V_{as} Limited by Bolt Capacity		Tension, N_a Concrete Strength, f'_c		
						4.6 Grade	8.8 Grade	20 MPa	32 MPa	40 MPa
M16 x 115	N12 x 300	75	90	180	125	13.7	28.1	13.5	17.1	19.1
M16 x 140	N12 x 300	75	110	220	150	13.7	28.1	18.2	23.0	25.7
M16 x 165	N12 x 300	75	130	260	175	13.7	28.1	23.2	29.4	32.9
M20 x 115	N12 x 300	144	90	180	125	21.5	44.2	13.5	17.1	19.1
M20 x 140	N12 x 300	144	110	220	150	21.5	44.2	18.2	23.0	25.7
M20 x 165	N12 x 300	144	130	260	175	21.5	44.2	23.2	29.4	32.9
M20 x 190	N12 x 300	144	150	300	200	21.5	44.2	28.7	36.3	40.6

* If minimum critical distances cannot be achieved, please use the simplified limit state design process to verify capacity.
** Recommended tightening torques are based on the use of grade 4.6 bolts.
Note: Confirm bolt capacity independently of tabulated information.

DESCRIPTION AND PART NUMBERS

Ferrule size, d_b	Ferrule length, L (mm)	Effective depth, h (mm)	Min Thread length, L_t (mm)	Cross hole to suit	Part No. Zn
M16	115	62	32	N12	FD16115S
M16	140	75	32	N12	FD16140S
M16	165	87	32	N12	FD16165S
M20	115	62	38	N12	FD20115S
M20	140	75	38	N12	FD20140S
M20	165	87	38	N12	FD20165S
M20	190	100	38	N12	FD20190S

Effective depth, h (mm). Read value from “Description and Part Numbers” table.

ENGINEERING PROPERTIES

Ferrule size, d_b	Stress Area at cross hole, A_s (mm^2)	Carbon Steel	
		Yield strength, f_y (MPa)	UTS, f_u (MPa)
M16	234	400	500
M20	234	400	500

Strength Limit State Design / Double Ended Solid Ferrules

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading – interaction diagram

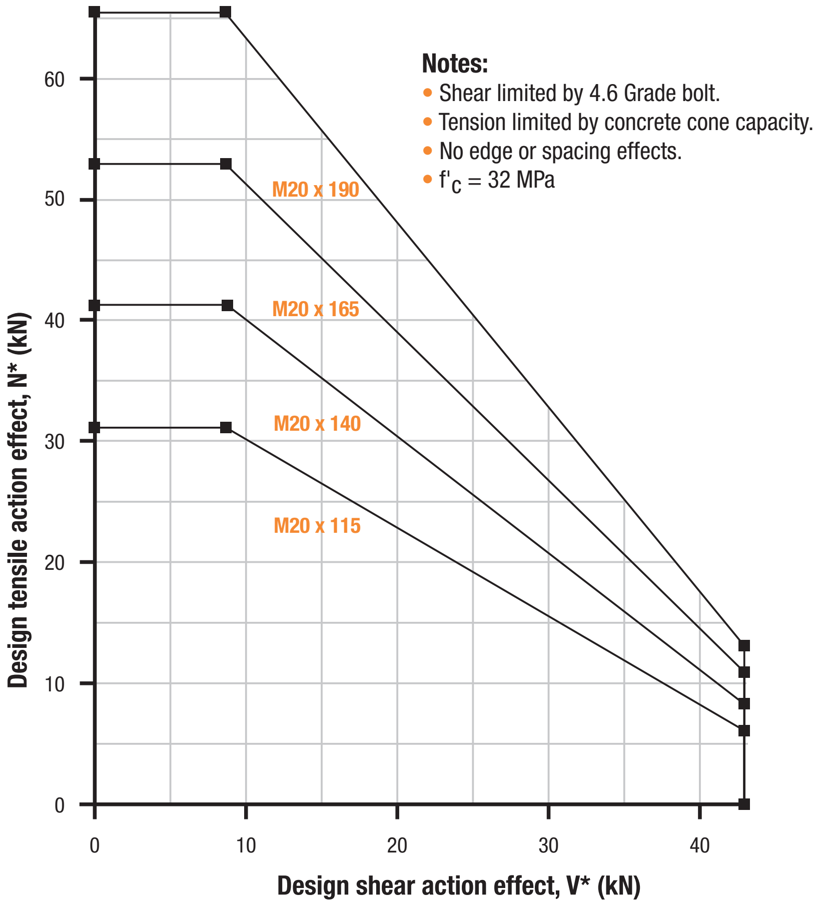


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Ferrule Length	115mm	140mm	165mm	190mm
e_m, a_m	40	50	60	70

Step 1c - Calculate anchor effective depth, h (mm)

Effective depth, h (mm) **Read value from "Description and Part Numbers" table on previous page.**

Checkpoint 1 **Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.**

Strength Limit State Design / Double Ended Solid Ferrules

STEP 2 Verify concrete tensile capacity - per anchor

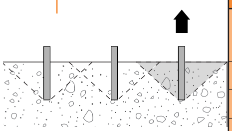
Table 2a - Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c$ = 0.6, f'_c = 32 MPa

Ferrule Length, L (mm)	Ferrule Size, d_b	Effective Depth, h (mm)	$ØN_{uc}$ (kN)
115	M16	62	27.2
140	M16	75	36.3
165	M16	87	41.4
115	M20	62	27.2
140	M20	75	36.3
165	M20	87	41.4
190	M20	100	55.8

Table 2b - Concrete compressive strength effect, tension, X_{nc}

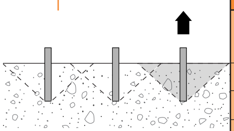
f'_c (MPa)	15	20	25	32	40	50
X_{nc}	0.68	0.79	0.88	1.00	1.12	1.25

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



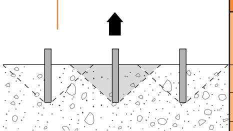
Edge distance, e (mm)		40	50	60	70	80	100	125	150
Ferrule length L (mm)	Effective depth h (mm)								
115	62	0.60	0.68	0.75	0.83	0.90	1.00		
140	75	0.55	0.61	0.67	0.74	0.80	0.92	1.00	
165	87		0.57	0.62	0.68	0.73	0.84	0.97	1.00
190	100			0.58	0.63	0.67	0.77	0.88	1.00

Table 2d - Anchor spacing effect, end of a row, tension, X_{nae}



Anchor spacing, a (mm)		40	50	60	70	80	100	125	150	175	200	225	250	300
Ferrule length L (mm)	Effective depth h (mm)													
115	62	0.61	0.63	0.66	0.69	0.72	0.77	0.84	0.90	0.97	1.00			
140	75	0.59	0.61	0.63	0.66	0.68	0.72	0.78	0.83	0.89	0.94	1.00		
165	87		0.60	0.61	0.63	0.65	0.69	0.74	0.79	0.84	0.88	0.93	0.98	1.00
190	100			0.60	0.62	0.63	0.67	0.71	0.75	0.79	0.83	0.88	0.92	1.00

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



Anchor spacing, a (mm)		40	50	60	70	80	100	125	150	175	200	225	250	300
Ferrule length L (mm)	Effective depth h (mm)													
115	62	0.22	0.27	0.32	0.38	0.43	0.54	0.67	0.81	0.94	1.00			
140	75	0.18	0.22	0.27	0.31	0.36	0.44	0.56	0.67	0.78	0.89	1.00		
165	87	0.15	0.19	0.23	0.27	0.31	0.38	0.48	0.57	0.67	0.77	0.86	0.96	1.00
190	100	0.13	0.17	0.20	0.23	0.27	0.33	0.42	0.50	0.58	0.67	0.75	0.83	1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

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

Strength Limit State Design / Double Ended Solid Ferrules

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a - Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n = 0.8$

Ferrule Size	M16	M20
$ØN_{us}$	93.6kN	93.6kN

Step 3b - Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$, $ØN_{tf}$

Check $N^* / ØN_{ur} \leq 1$,

if not satisfied return to step 1

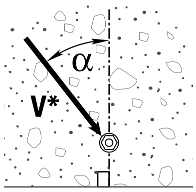
STEP 4 Verify concrete shear capacity - per anchor

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

Ferrule Length, L (mm)	115	140	165	190
Edge distance, e (mm)				
30	3.5	3.6	3.7	3.8
35	4.5	4.6	4.7	4.8
40	5.4	5.6	5.7	5.9
50	7.6	7.8	8.0	8.2
60	10.0	10.2	10.5	10.8
80	15.4	15.7	16.2	16.7
100	21.5	22.0	22.7	23.3
125	30.0	30.7	31.7	32.5
150	39.5	40.4	41.6	42.8
200	60.8	62.2	64.1	65.9
300		114.3	117.7	121.0
400			181.2	186.3
500				260.4

Strength Limit State Design / Double Ended Solid Ferrules

STEP 4 continued



Load direction effect, conc. edge shear, X_{vd}

Table 4b - Concrete compressive strength effect, concrete edge shear, X_{vc}

f'_c (MPa)	15	20	25	32	40	50
X_{vc}	0.68	0.79	0.88	1.00	1.12	1.25

Table 4c - Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d - Anchor spacing effect, concrete edge shear, X_{va}

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

Edge distance, e (mm)	30	35	40	50	60	70	100	200	300	400	500	600
Anchor spacing, a (mm)												
30	0.70	0.67	0.65	0.62	0.60	0.59	0.56	0.53				
35	0.73	0.70	0.68	0.64	0.62	0.60	0.57	0.54	0.52			
40	0.77	0.73	0.70	0.66	0.63	0.61	0.58	0.54	0.53			
50	0.83	0.79	0.75	0.70	0.67	0.64	0.60	0.55	0.53	0.53		
60	0.90	0.84	0.80	0.74	0.70	0.67	0.62	0.56	0.54	0.53	0.52	
75	1.00	0.93	0.88	0.80	0.75	0.71	0.65	0.58	0.55	0.54	0.53	0.53
100		1.00	1.00	0.90	0.83	0.79	0.70	0.60	0.57	0.55	0.54	0.53
125				1.00	0.92	0.86	0.75	0.63	0.58	0.56	0.55	0.54
150					1.00	0.93	0.80	0.65	0.60	0.58	0.56	0.55
200						1.00	0.90	0.70	0.63	0.60	0.58	0.57
300							1.00	0.80	0.70	0.65	0.62	0.60
450								0.95	0.80	0.73	0.68	0.65
600								1.00	0.90	0.80	0.74	0.70
750									1.00	0.88	0.80	0.75
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

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

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

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

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

Strength Limit State Design / Double Ended Solid Ferrules

STEP 5 Verify anchor shear capacity - per anchor

Table 5a - Reduced characteristic ultimate shear capacity, $ØV_{us}$ (kN)

Ferrule Size	M16	M20
$ØN_{us}$ (Zinc)	83.0*	83.0*

* This value requires minimum f'_c = 32MPa.

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

STEP 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2$,

if not satisfied return to step 1

HOW TO SPECIFY

Reid™ Double Ended Ferrule,
(Ferrule Size x Length) ((Part Number)) with a (Bolt Grade) bolt.

EXAMPLE

Reid™ Double Ended Ferrule,
M16 x 140 (FD16140S) with a Grade 4.6 bolt.

Please refer to Reid™ Product Guides for the range of accessories (nailing plates, antennae caps, chairing solutions, etc) that are available.

8 Tube Ferrules

GENERAL INFORMATION

Product

The Tube Ferrule is a light duty cast-in ferrule.

Benefits, Advantages and Features

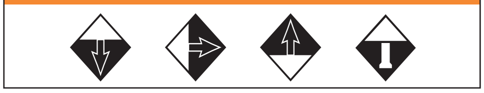
Economic Design:

- Simple and cost effective solution for light duty fixing points.
- Economical stainless steel solution

Performance Related

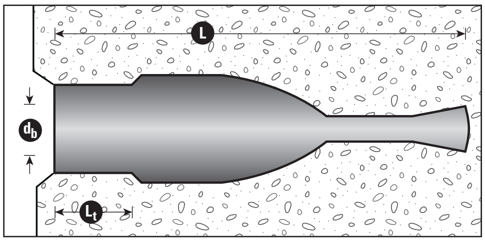
Material

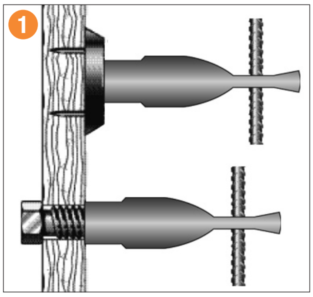
Installation Related

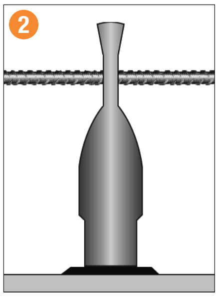


Principal Applications

- **Formwork support.**
- **Suspended services.**
- **Light to medium duty fixing points.**







1. Fixed with nailing plate or bolted through formwork.
2. Fixed to steel formwork with magnetic or glue on nailing plate.

Tube Ferrules

Installation and Working Load Limit Performance Details

Threaded Anchor Size	Installation details		Minimum Critical Distances*			Working Load Limit (kN)			
	Cross Bar Details	Recommended Torque, T_r (Nm)	Edge distance, e_c (mm)	Anchor spacing, a_c (mm)	Structure thickness, b_m (mm)	SS Shear Vas*	Tension, N_a Concrete Strength, f'_c 20 MPa	32 MPa	40 MPa
M10 x 50	R6 x 300	17	55	100	60	5.0	3.4	4.3	4.8
M12 x 60	R8 x 300	30	70	135	75	7.7	4.4	5.5	6.2
M16 x 80	R10 x 300	75	80	165	110	13.4	5.9	7.5	8.4
M20 x 100	N12 x 300	144	100	210	120	21.8	8.9	11.3	12.7
M24 x 120	N12 x 300	250	130	250	150	35.7	12.3	15.6	17.4

* For shear loads acting towards an edge or where these minimum dimensions are not achievable, please use the simplified strength limit state design process to verify capacity.
** Recommended tightening torques are based on the use of grade 4.6 bolts.
Note: Confirm bolt capacity independently of tabulated information.

DESCRIPTION AND PART NUMBERS

Ferrule size, d_b	Ferrule length, L (mm)	Effective depth, h (mm)	Thread length, L_t (mm)	Cross hole to suit	Part No.
					SS
M10	50	33	20	R6	FT10SS
M12	60	39	25	R8	FT12SS
M16	80	48	32	R10	FT16SS
M20	100	63	38	N12	FT20SS
M24	120	78	50	N12	FT24SS

ENGINEERING PROPERTIES

Ferrule size, d_b	Stress area threaded section, A_s (mm^2)	Stainless Steel		Section modulus, Z (mm^3)
		Yield strength, f_y (MPa)	UTS, f_u (MPa)	
M10	25	190	450	151
M12	30	190	450	250
M16	97	190	450	601
M20	101	190	450	1254
M24	141	190	450	2681

Strength Limit State Design / Tube Ferrules

STEP 1 Select anchor to be evaluated

Table 1a - Indicative combined loading – interaction diagram

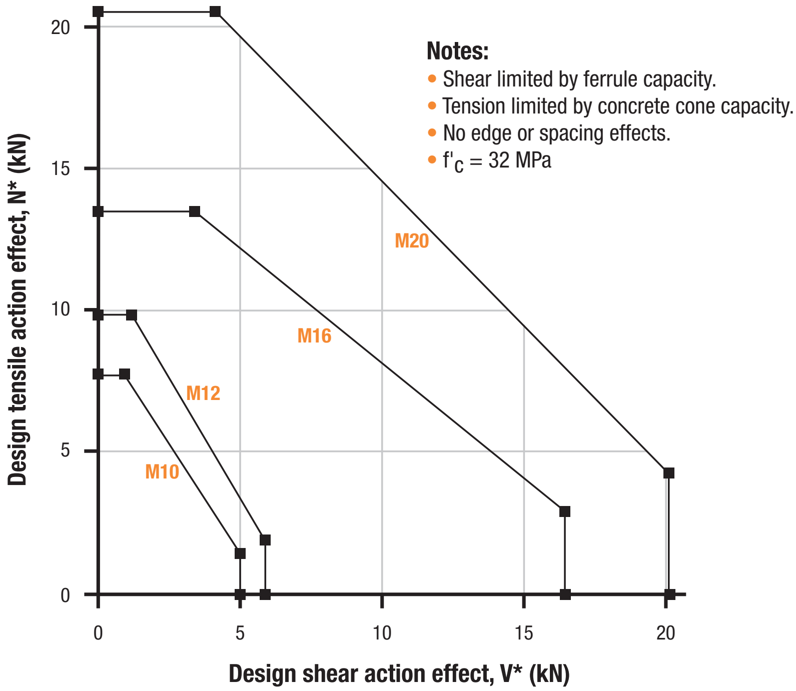


Table 1b - Absolute minimum edge distance and anchor spacing values, e_m and a_m (mm)

Ferrule Size	M10	M12	M16	M20	M24
e_m, a_m	30	35	40	50	65

Step 1c - Calculate anchor effective depth, h (mm)

Effective depth, h (mm)
Read value from "Description and Part Numbers" table on previous page.

Checkpoint 1 Anchor size determined, absolute minima compliance achieved, effective depth (h) calculated.

Strength Limit State Design / Tube Ferrules

STEP 2 Verify concrete tensile capacity - per anchor

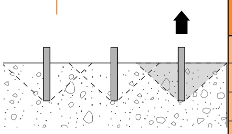
Table 2a - Reduced characteristic ultimate concrete tensile capacity, $ØN_{uc}$ (kN), $Ø_c$ = 0.6, f'_c = 32 MPa

Ferrule Length, L (mm)	Ferrule Size, d_b	Effective Depth, h (mm)	$ØN_{uc}$ (kN)
50	M10	33	7.7
60	M12	39	9.9
80	M16	48	13.5
100	M20	63	20.4
120	M24	78	28.1

Table 2b - Concrete compressive strength effect, tension, X_{nc}

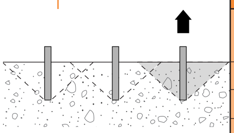
f'_c (MPa)	15	20	25	32	40	50
X_{nc}	0.68	0.79	0.88	1.00	1.12	1.25

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



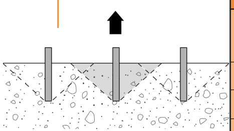
Edge distance effect, e (mm)	25	30	35	40	50	65	70	80	100	130
Ferrule size										
M10	0.62	0.68	0.75	0.82	0.96	1.00				
M12	0.56	0.60	0.65	0.70	0.80	0.97	1.00			
M16	0	0.55	0.59	0.63	0.71	0.84	0.88	1.00		
M20		0	0.53	0.56	0.62	0.72	0.75	0.82	1.00	
M24			0	0.52	0.57	0.64	0.67	0.72	0.83	1.00

Table 2d - Anchor spacing effect, end of a row, tension, X_{nae}



Anchor spacing, a (mm)		30	40	50	60	70	85	100	125	150	200	250
Ferrule Size	Effective depth h (mm)											
M10	35	0.64	0.69	0.74	0.79	0.83	0.90	1.00				
M12	45		0.65	0.69	0.72	0.76	0.81	0.87	1.00			
M16	55		0.62	0.65	0.68	0.71	0.76	0.80	0.88	1.00		
M20	70			0.62	0.64	0.67	0.70	0.74	0.80	0.86	1.00	
M24	85				0.62	0.64	0.67	0.70	0.75	0.79	0.89	1.00

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



Anchor spacing, a (mm)		30	40	50	60	70	85	100	125	150	200	250
Ferrule Size	Effective depth h (mm)											
M10	35	0.29	0.38	0.48	0.57	0.67	0.81	0.95	1.00			
M12	45		0.30	0.37	0.44	0.52	0.63	0.74	0.93	1.00		
M16	55		0.24	0.30	0.36	0.42	0.52	0.61	0.76	0.91	1.00	
M20	70			0.24	0.29	0.33	0.40	0.48	0.60	0.71	0.95	1.00
M24	85				0.24	0.27	0.33	0.39	0.49	0.59	0.78	1.00

Checkpoint 2

Design reduced ultimate concrete tensile capacity, $ØN_{urc}$

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

Strength Limit State Design / Tube Ferrules

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a - Reduced characteristic ultimate steel tensile capacity, $ØN_{us}$ (kN), $Ø_n$ = 0.8

Ferrule Size	M10	M12	M16	M20	M24
$ØN_{us}$ (SS)	9.1	10.8	29.7	36.5	51.0

Step 3b - Reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ (kN)

Establish the reduced characteristic ultimate bolt steel tensile capacity, $ØN_{tf}$ from literature supplied by the specified bolt manufacturer. For nominal expected capacities of bolts manufactured to ISO standards, refer to page 10.

Checkpoint 3

Design reduced ultimate tensile capacity, $ØN_{ur}$

$ØN_{ur}$ = minimum of $ØN_{urc}$, $ØN_{us}$, $ØN_{tf}$

Check $N^* / ØN_{ur} \leq 1$,

if not satisfied return to step 1

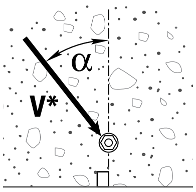
STEP 4 Verify concrete shear capacity - per anchor

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

Ferrule Size	M10	M12	M16	M20	M24
Edge distance, e (mm)					
30	1.90	2.4			
35	2.39	3.0	3.3		
40	2.93	3.7	4.0	4.5	5.2
50	4.09	5.2	5.6	6.4	7.2
60	5.38	6.8	7.3	8.3	9.5
80	8.28	10.5	11.3	12.9	14.6
100	11.57	14.5	15.8	18.0	20.4
125	16.16	20.4	22.1	25.1	28.6
150	21.25	26.8	29.1	33.0	37.5
200	32.71	41.2	44.7	50.8	57.8
300			82.2	93.3	106.2
400				143.7	162.5
500					228.1

Strength Limit State Design / Tube Ferrules

STEP 4 continued



Load direction effect, conc. edge shear, X_{vd}

Table 4b - Concrete compressive strength effect, concrete edge shear, X_{vc}

f'_c (MPa)	15	20	25	32	40	50
X_{vc}	0.68	0.79	0.88	1.00	1.12	1.25

Table 4c - Load direction effect, concrete edge shear, X_{vd}

Angle, α°	0	10	20	30	40	50	60	70	80	90 - 180
X_{vd}	1.00	1.04	1.16	1.32	1.50	1.66	1.80	1.91	1.98	2.00

Table 4d - Anchor spacing effect, concrete edge shear, X_{va}

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

Edge distance, e (mm)	30	35	40	50	60	70	100	200	300	400	500	600
Anchor spacing, a (mm)												
30	0.70	0.67	0.65	0.62	0.60	0.59	0.56	0.53				
35	0.73	0.70	0.68	0.64	0.62	0.60	0.57	0.54	0.52			
40	0.77	0.73	0.70	0.66	0.63	0.61	0.58	0.54	0.53			
50	0.83	0.79	0.75	0.70	0.67	0.64	0.60	0.55	0.53	0.53		
60	0.90	0.84	0.80	0.74	0.70	0.67	0.62	0.56	0.54	0.53	0.52	
75	1.00	0.93	0.88	0.80	0.75	0.71	0.65	0.58	0.55	0.54	0.53	0.53
100		1.00	1.00	0.90	0.83	0.79	0.70	0.60	0.57	0.55	0.54	0.53
125				1.00	0.92	0.86	0.75	0.63	0.58	0.56	0.55	0.54
150					1.00	0.93	0.80	0.65	0.60	0.58	0.56	0.55
200						1.00	0.90	0.70	0.63	0.60	0.58	0.57
300							1.00	0.80	0.70	0.65	0.62	0.60
450								0.95	0.80	0.73	0.68	0.65
600								1.00	0.90	0.80	0.74	0.70
750									1.00	0.88	0.80	0.75
1000										1.00	0.90	0.83
1250											1.00	0.92
1500												1.00

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

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

Anchor spacing / Edge distance, a / e	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.25	2.50
Number of anchors, n												
2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	0.72	0.76	0.80	0.83	0.86	0.88	0.91	0.93	0.95	0.96	0.98	1.00
4	0.57	0.64	0.69	0.74	0.79	0.82	0.86	0.89	0.92	0.94	0.97	1.00
5	0.49	0.57	0.63	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.97	1.00
6	0.43	0.52	0.59	0.66	0.71	0.77	0.81	0.85	0.89	0.93	0.96	1.00
7	0.39	0.48	0.56	0.63	0.69	0.75	0.80	0.84	0.88	0.92	0.96	1.00
8	0.36	0.46	0.54	0.61	0.68	0.74	0.79	0.84	0.88	0.92	0.96	1.00
9	0.34	0.44	0.52	0.60	0.67	0.73	0.78	0.83	0.87	0.91	0.96	1.00
10	0.32	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.87	0.91	0.96	1.00
15	0.26	0.37	0.47	0.55	0.63	0.70	0.76	0.81	0.86	0.90	0.95	1.00
20	0.23	0.35	0.45	0.54	0.61	0.68	0.75	0.80	0.85	0.90	0.95	1.00

Checkpoint 4

Design reduced ultimate concrete edge shear capacity, $ØV_{urc}$

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

Strength Limit State Design / Tube Ferrules

STEP 5 Verify anchor shear capacity - per anchor

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

Ferrule Size	M10	M12	M16	M20	M24
$ØN_{us}$ (Zinc)	5.0	5.9	16.4	20.1	
$ØN_{us}$ (SS)	5.6	6.7	18.4	22.6	31.6

Checkpoint 5

Design reduced ultimate shear capacity, $ØV_{ur}$

$ØV_{ur}$ = minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

Check $V^* / ØV_{ur} \leq 1$,

if not satisfied return to step 1

STEP 6 Combined loading and specification

Checkpoint 6

Check

$N^*/ØN_{ur} + V^*/ØV_{ur} \leq 1.2$,

if not satisfied return to step 1

HOW TO SPECIFY

Reid™ Tube Ferrule,
(Ferrule Size x Length) ((Part Number)) with a (Bolt Grade) bolt.
______ cross bar required

EXAMPLE

Reid™ Tube Ferrule,
M16 x 70 (FT16) with a Grade 4.6 bolt.
R10 x 300mm cross bar required

9 Anchoring Design Worksheet

Project

Design

Location

Project ID **Date**

Design by **Checked**

Sketch

Notes

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

Tensile design action effect	N*		kN
Shear design action effect	V*		kN
Fixture thickness	t		mm
Concrete compressive strength	f'_c		MPa
Anchor spacing	a		mm
Edge distance	e		mm
No. of anchors in row parallel to edge	n		
Direction of shear load			degs.

STEP 1 Select anchor to be evaluated

Table 1a Interaction Diagram — Anchor Type

Find intersection of N* and V* values.

Select anchor size.

Table 1b Absolute minima, a_m & e_m

Check for compliance with absolute minima — Tick

Step 1c Calculate effective depth, h

Checkpoint 1

Anchor size selected? Tick

Comply with absolute minima? Tick

Effective depth, h calculated? Tick

Notes for this application

STEP 2 Verify concrete tensile capacity - per anchor

Table 2a Concrete tensile capacity, $ØN_{uc}$

Table 2b Concrete compressive strength effect, X_{nc} x

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

Table 2d Anchor spacing effect, external to a row, X_{nae} x or

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

Checkpoint 2

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

STEP 3 Verify anchor tensile capacity - per anchor

Table 3a Calculate steel tensile capacity, $ØN_{us}$

Step 3b Confirm bolt tensile capacity, $ØN_{tf}$

Checkpoint 3

$ØN_{ur}$ = Minimum of $ØN_{urc}$, $ØN_{us}$, $ØN_{tf}$

$N^* / ØN_{ur} \leq 1.0$? / = Tick

If not satisfied return to step 1. **TENSILE DESIGN COMPLETED**

STEP 4 Verify concrete shear capacity - per anchor

Table 4a Concrete shear capacity, $ØV_{uc}$

Table 4b Concrete compressive strength effect, X_{vc} x

Table 4c Load direction effect, X_{vd} x

Table 4d Anchor spacing effect, X_{va} x

Table 4e Multiple anchors effect, X_{vn} x

Checkpoint 4

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

STEP 5 Verify anchor shear capacity - per anchor

Table 5a Calculate steel shear capacity, $ØV_{us}$

Step 5b Confirm bolt shear capacity, $ØV_{sf}$

Checkpoint 5

$ØV_{ur}$ = Minimum of $ØV_{urc}$, $ØV_{us}$, $ØV_{sf}$

$V^* / ØV_{ur} \leq 1.0$? / = Tick

If not satisfied return to step 1. **SHEAR DESIGN COMPLETED**

STEP 6 Combined loading and specification

Checkpoint 6

$N^* / ØN_{ur} + V^* / ØV_{ur} \leq 1.2$? / + / = Tick

If not satisfied return to step 1. **DESIGN CHECK COMPLETED**

Specify ____________________

____

____

Leading the Industry in Product Innovation

Reid™ has been providing solutions to the concrete construction sector for over 40 years and our knowledge of the industry has enabled us to evolve into a company that is a leader in product innovation and service. Many of our products are developed and produced in our Australian manufacturing plants, including our Round Bar Ferrules, proudly Australian made for over 15 years.

Leading the Industry in Safety

Reid are ISO 9001 accredited and have a complete quality control system in place, including in-house testing facilities, which has allowed us to maintain a long standing focus on quality and reliability, ensuring products carrying the *Reid* brand are the very best on the market.

Reid™ - partnering you and your business

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