Construction Systems

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Product Engineering Laboratory

Reid™ Product Engineering Laboratory
All testing has been performed by independent IANZ and NATA accredited testing laboratories.
See below for details.

Reinforcement Technical Assessment

RTA-23/0015 of 20/10/2023

This Technical Assessment meets the testing requirements stipulated in clauses 8.7.5.2 (b), 8.9.1.3 (a), 8.6.11.1,2,3 & 4 of NZS 3101:2006 A3

Trade name of the construction product	ReidBar™ Steel Components: Threaded Inserts
Product family to which the construction product belongs	ReidBar™ Reinforcement System used in concrete structures sizes RB12, RBA16, RB20
Manufacturer	Reid Construction Systems 1 Ramset Drive Chirnside Park Victoria 3116 Australia
Manufacturing plant	Reid Construction Systems
This Technical Assessment contains:	14 pages & 10 Annexes which form an integral part of this assessment.
This Technical Assessment for NZS3101 is in accordance with the requirements stipulated in NZS 3101:2006 A3	Reference reports: WSP Opus Research • 5-24E97.00/B1-01 X-Ray Laboratories Ltd • 11966 Melbourne Testing Services • MTS-18-1019-A, B & C
This Assessment replaces:	RTA-19/0001 of 23/04/2020

1. Technical description of the product

ReidBar™ Steel Threaded Inserts are used as part of the ReidBar™ Mechanical Anchorage System.

All ReidBar™ components in this report are steel elements and the ReidBar reinforcing steel is Grade 500E (Seismic) produced in accordance with AS/NZS 4671:2019.

The illustration and the description of the product are given in Annex A1 and A2.

2. Specification of intended use

The performances given in Section 3 are only valid if the anchor Reinforcement System is used in compliance with the specifications and conditions given in Annex B.

3. Performance of the product and references to the methods used for its assessment

3.1 Performance Requirement of Mechanical Connections

Criteria	Performance
Elongation at $0.7f_y$ NZS 3101:2006 A3: Cl 8.7.5.2 (b)	See Annex C1
Alternating Large Strains NZS 3101:2006 A3: Cl 8.9.1.3 (a)	See Annex C2
Ultimate Tensile Strength NZS 3101:2006 A3: Cl 8.6.11.1 & 8.6.11.2	See Annex C3
Mode of Failure NZS 3101:2006 A3: Cl 8.6.11.1, 8.6.11.2, 8.6.11.3	See Annex C4
Resistance to Brittle Fracture NZS 3101:2006 A3: Cl 8.6.11.4	See Annex C5
Characteristic values of Anchorage Resistance NZS 3101:2006 A3: Cl 8.6.11.1 & 8.6.11.2 [NZTA Bridge Manual 3rd ed. A3: Cl 4.2.1 (f) (iii)]	See Annex C6

3.2 Testing Methodology of Mechanical Connections

3.2.1 Elongation at $0.7f_y$ – Cl 8.7.5.2 (b) NZS 3101:2006 A3

The bars and connectors were loaded into the test machine and loaded in tension up to 0.7 times the nominal yield load at a rate of 300 kN/min. Once at $0.7f_y$, the bars were held at $0.7f_y$, for 20 seconds before being returned to zero load. The displacement was measured using dual gauges over a fixed gauge length throughout the test with the displacement and load recorded at a rate of approximately 100 Hz.

The gauge length of the steel couplers was determined in accordance with ISO 15835-2:2009 *Steels for the reinforcement of concrete – Test methods*. ISO 15385-2 describes test methods applicable to couplers for mechanical splices of the two steel reinforcing bars, but Threaded Inserts are joined to only one bar. Therefore, it has been considered the gauge length (L_g) for the Threaded Inserts should be equal to the length of the fitting plus four times the bar diameter.

In order to determine the maximum elongation allowable, as per clause 8.7.5.2 (b) of NZS 3101, two samples of non-spliced ReidBar of the same size and from the same batches

have been tested for reference. A tensile load, corresponding to a stress level of 350MPa ($0.7f_y$), has been applied on the reference bars and the corresponding strain measured. The average value (ε_{350}), between the two measurements, times two and times the length of the fitting, is used to determine the maximum allowable elongation over the fitting's length.

ε_{350} is also used to determine the elongation over the fitting's length, from the measured elongation over the gauge length, by discounting the elastic elongation of the bars outside the coupler.

3.2.2 Alternating tension and compression test of large strains – Cl 8.9.1.3 (a) NZS 3101:2006 A3

For testing the performance of mechanical splices, ISO 15835-2:2009 §5.6.2 specifies the following loading programme:

- From zero strain up to twice the yield strain (strain at nominal yield strength) in tension followed by downloading to a strain corresponding to half of the stress of the nominal yield strength value of the reinforcing bar ($0.5R_{eH,spec}$) in compression, alternating 4 times.
- Thereafter, from zero strain up to five times the yield strain in tension, followed by downloading to a strain corresponding to the stress $0.5R_{eH,spec}$ in compression, alternating four times, followed by tensioning the test piece to failure.

Performance requirements are:

- Tensile strength: at least $R_{m,spec}$, or $R_{eH,spec} \times (R_m / R_{eH})_{spec}$
- Residual elongation: u4 ≤ 0.3 mm, u8 ≤ 0.6 mm

Where $R_{m,spec}$ is the nominal tensile strength value of the reinforcing bar, $R_{eH,spec}$ is the nominal yield strength value of the reinforcing bar, and $(R_m / R_{eH})_{spec}$ is the specified tensile/yield strength ratio of the reinforcing bar.

The strain/stress rates were set according to ISO 6892-1:2009 Metallic materials – Tensile testing – Part1: Method of test at ambient temperature.

For the Steel Couplers, in accordance with ISO 15835-2, the gauge length (L_c) should be equal to the coupler length plus eight times the diameter.

ISO 15835-2 describes test methods applicable to couplers for mechanical splices of two steel reinforcing bars. The Threaded Inserts are joined to only one bar. Therefore, we have considered the gauge length (L_c) should be equal to the Threaded Insert's length plus four times the diameter.

3.2.3 Ultimate Tensile Strength – Cl 8.6.11.1 & 8.6.11.2 NZS 3101:2006 A3

NZS 3101 A3, at Clause 8.6.11.2, defines the Upper Bound Breaking Strength of the reinforcing bar as 1.25 times the Upper Characteristic Yield Strength of the bar. For ReidBar, being 500E grade, this corresponds to 750MPa. Mechanical anchorages, at Clause 8.6.11.1 are required to be capable of developing the Upper Bound Breaking Strength.

Specifically heat treated ReidBars are connected to the fittings to be tested against this requirement. The thermal treatment allows the bar to develop a tensile strength above the minimum 750MPa required for the test.

3.2.4 Mode of Failure – Cl 8.6.11.1 & 8.6.11.3 NZS 3101:2006 A3

This particular test is often paired with other tests, like the 0.7fy or the ISO 15835 for large strains, to become the conclusive part of those tests. Once the main test is finished, the test sample is pulled to failure and the Mode of Failure is recorded.

3.2.5 Resistance to Brittle Fracture – Cl 8.6.11.4 NZS 3101:2006 A3 [Cl 4.2.1 (f) (iii) NZTA Bridge Manual 3rd Edition A3]

As per Clause 8.6.11.4 of NZS 3101 A3, mechanical anchorages shall be proven, by an appropriate test method, to possess resistance to brittle fracture at the service temperatures at which they are intended for use. However, there is no indication on what an appropriate test method would be.

The NZTA Bridge Manual, at Clause 4.2.1 (f) (iii), provides more guidance on how to demonstrate resistance to brittle fracture through testing.

In accordance with AS 1544.2, a Charpy V-notched impact resistance equal to or greater than 27 Joules shall be achieved when standard 10mmx10mm test pieces are tested at 0°C. Test pieces of smaller cross section, as listed in AS/NZS 3678 Table 9, may be used when standard 10mmx10mm is impractical. For these smaller test pieces, the acceptance criteria shall correspond to the L0 impact designation given in Table 9 of AS/NZS 3678. An equivalent energy value is also provided, utilizing the equivalent energy factors from Table 2.6.5.5 (A) of AS 1210.

3.2.6 Anchorage in Concrete: Cl 8.6.11.1 & Cl 8.6.11.2 - NZS 3101:2006 A3

NZS 3101 A3, at Clause 8.6.11.2, defines the Upper Bound Breaking Strength of the reinforcing bar as 1.25 times the Upper Characteristic Yield Strength of the bar. For ReidBar, being 500E grade, this corresponds to 750MPa. Mechanical anchorages, at Clause 8.6.11.1, are required to be capable of developing the Upper Bound Breaking Strength.

Specifically heat treated ReidBars are connected to the threaded inserts through a fabricated load applicator to be tested to this requirement. Calibrated linear deflection transducers can be affixed to the fabricated load applicator to measure the displacement of the test bars. The thermal treatment allows the bar to develop a tensile strength above the minimum 750MPa required for the test.

Testing was conducted for anchorage in a concrete test slab with the use of a test frame consisting of two (2) large concrete blocks and a structural beam crosshead spanning the blocks. A second structural steel beam was fixed across the width of the test slab at the specified cantilever distance.

The hydraulic jacking system and calibrated load measuring device was placed onto the steel crosshead and secured to the load applicator. The force was progressively applied to the pair of connections simultaneously until the target load was achieved. The test force was then to be held and the concrete slab inspected for signs of cracking or other obvious visible evidence of failure.

Upon achieving the nominated test force, the load was to be increased until failure occurred within the test bars or concrete panel. A total of up to six tests were to be conducted for each test case. Test force and resultant deflection were autographically recorded throughout the test and the test items were monitored for signs of cracking, spalling or other evidence of failure. The Characteristic capacities were derived using the tested values based on statistical method to provide a 5% fractile at a 90% confidence level using a normal distribution and average values.

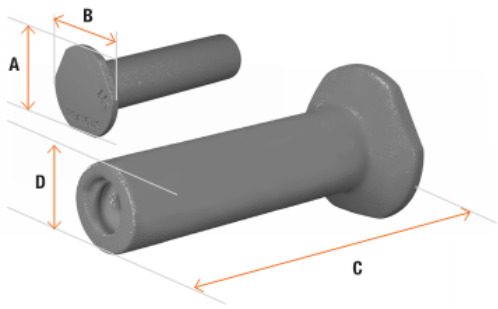
4 Material Safety Data Sheet

Refer to SDS ChemAlert SDS Date: 26 Apr 2022 Version No:1 (Ramset EPCON C8) for Safety Data Sheet according to New Zealand HSNO requirements.

ReidBar™ Steel Threaded Inserts
RB12TIS, RBA16TIS, RB20TIS

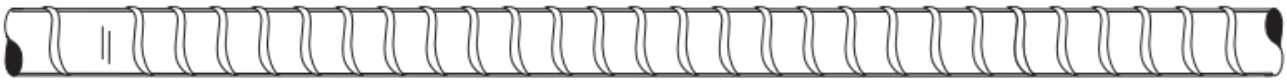
Part No.	Description	Foot Minor Diameter (A) (mm)	Foot Major Diameter (B) (mm)	Length (C) (mm)	Body Diameter (D) (mm)	Min Threaded Depth (mm)
RB12TIS	12mm ReidBar Steel Threaded Insert	37	39	101	22	53
RBA16TIS	12mm ReidBar Steel Threaded Insert	53	55	118	30	58
RB20TIS	12mm ReidBar Steel Threaded Insert	68	73	149	35	64

NOTE: Hot dip galvanised finish also applicable



ReidBar™ Reinforcing bar RB12, RBA16, RB20

Seismic® 500E Micro Alloyed Reidbar™



Commercial reinforcing (E Class - Seismic) bar to AS/NZS 4671:2019

Product Characteristics	Value
Lower Characteristic yield strength $R_{ek.L}$ (MPa)	≥ 500
Upper Characteristic yield strength $R_{ek.U}$ (MPa)	≤ 600
Characteristic Minimum Ultimate to Yield ratio – R_m/R_e	≥ 1.15
Characteristic Maximum Ultimate to Yield ratio - R_m/R_e	≤ 1.40

Specifications of intended use

Anchorages subject to:

- Seismic, Static and quasi-static load.

Base materials

- Non-cracked and cracked concrete for reinforcing bars RB12 to RB20.
- Reinforced or unreinforced normal weight concrete for use in construction in accordance with NZS 3101:2006 A3.

Design:

- The Mechanical anchorages are designed in accordance with the Standards New Zealand NZS 3101:2006 A3 – Concrete Structures Standard" under the responsibility of an engineer experienced in structural design and concrete work.
- Verifiable calculation notes and drawings are prepared taking into account the loads to be anchored. The position of the anchor or connection is indicated on the design drawings.
- The ReidBar Threaded Inserts are to be used with ReidBar Starter Bars of a development length designed in accordance with NZS 3101:2006 (A3) Clause 8.6.

Installation:

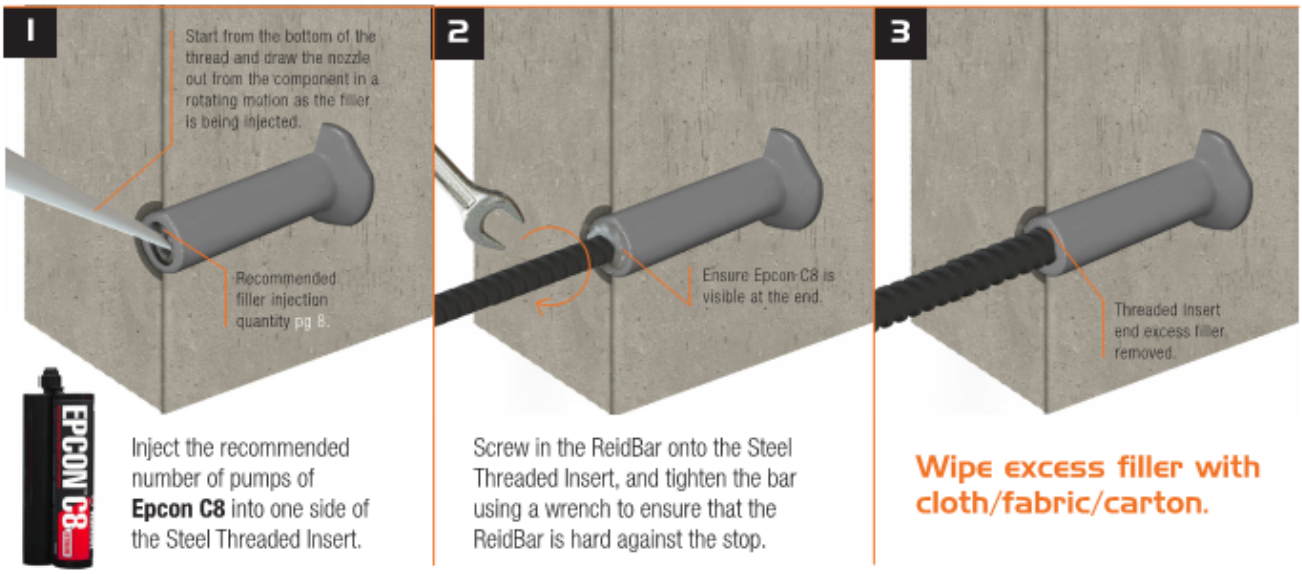
- Reinforcement installation carried out in accordance with ReidBar connection installation procedures (including the application of ECPON C8 thread filler in the starter bar fitment) by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

ReidBar™ Components	**Annex B 1**
Intended use Specifications	

Steps

ReidBar Steel Threaded Insert Installation Guidelines

Note: Detailed reinforcing not depicted in the below images.



Inject the recommended number of pumps of **Epcon C8** into one side of the Steel Threaded Insert.

Screw in the ReidBar onto the Steel Threaded Insert, and tighten the bar using a wrench to ensure that the ReidBar is hard against the stop.

Wipe excess filler with cloth/fabric/carton.

Ensure the appropriate PPE is worn when working with Ramset Epcon C8 XTREM.
Refer to www.ramset.co.nz for Epcon C8 XTREM MSDS Sheet.

ReidBar™ Steel Threaded Insert	Annex B 2
Intended use Installation procedure	

Table C1: Elongation at 0.7fy: Cl 8.7.5.2 (b) NZS 3101:2006 A3

Sample	Part No.	Lg Gauge length [mm]	Lc Insert length [mm]	No. (of Sampl. Tested)	ε_{350} Non-spliced ReidBar strain at $0.7f_y$	$0.7\ f_y$	Criteria assessed over Lc (Insert length)		Test report reference(s)
							Aver. displ. (over Insert Length)	Allw. max. displ. (over Insert length)	
					[mm/m]	[kN]	[mm]	[mm]	
ReidBar Steel Threaded Inserts									
12mm Steel Threaded Inserts	RB12TIS	148	100	5	2.12	39.55	0.21	0.42	WSP-Opus 5-24E97.00/B1-01
16mm Steel Threaded Inserts	RBA16TIS	182	118	5	2.07	70.35	0.11	0.48	WSP-Opus 5-24E97.00/B1-01
20mm Steel Threaded Inserts	RB20TIS	229	149	5	1.86	109.9	0.19	0.55	WSP-Opus 5-24E97.00/B1-01

Table C2: Large Strains: Cl 8.9.1.3 (a) - NZS 3101:2006 A3

Sample	Part No.	No. (of Samples Tested)	Criteria assessed						Test report reference(s)
			ISO $u_4 \leq 0.3$mm [mm]		ISO $u_8 \leq 0.6$mm [mm]		UTS ≥575MPa [MPa]		
			$u_{4(min)}$	$u_{4(max)}$	$u_{8(min)}$	$u_{8(max)}$	$UTS_{(min)}$	$UTS_{(max)}$	
ReidBar Steel Threaded Inserts									
12mm Steel Threaded Inserts	RB12TIS	3	-0.07	-0.05	-0.03	-0.01	625.1	627.5	WSP-Opus 5-24E97.00/B1-01
16mm Steel Threaded Inserts	RBA16TIS	3	-0.07	-0.04	-0.02	0.01	656.7	660.9	WSP-Opus 5-24E97.00/B1-01
20mm Steel Threaded Inserts	RB20TIS	3	-0.06	-0.02	-0.01	0.02	661.6	663.0	WSP-Opus 5-24E97.00/B1-01

Table C3: Ultimate Tensile Strength – Cl 8.6.11.1 & 8.6.11.2 NZS 3101:2006 A3

Sample	Part No.	No. (of Samples Tested)	Criteria assessed			Test report reference(s)
			UTS ≥750MPa [MPa]		Mode of Failure	
			$UTS_{(min)}$	$UTS_{(max)}$		
ReidBar Steel Threaded Inserts						
12mm Steel Threaded Inserts	RB12TIS	5	807.1	1254.0	5 hardened ReidBar break	WSP-Opus 5-24E97.00/B1-01
16mm Steel Threaded Inserts	RBA16TIS	5	926.4	1034.8	5 hardened ReidBar break	WSP-Opus 5-24E97.00/B1-01
20mm Steel Threaded Inserts	RB20TIS	5	930.3	1040.8	5 hardened ReidBar break	WSP-Opus 5-24E97.00/B1-01

		(of Samples Tested)	UTS [MPa]		Mode of Failure	reference(s)
			$UTS_{(min)}$	$UTS_{(max)}$		
ReidBar Steel Threaded Inserts						
12mm Steel Threaded Inserts	RB12TIS	3	625.1	627.5	3 ReidBar ductile failure clear of component	WSP-Opus 5-24E97.00/B1-01
16mm Steel Threaded Inserts	RBA16TIS	3	656.7	660.9	3 ReidBar ductile failure clear of component	WSP-Opus 5-24E97.00/B1-01
20mm Steel Threaded Inserts	RB20TIS	3	661.6	663.0	3 ReidBar ductile failure clear of component	WSP-Opus 5-24E97.00/B1-01

Table C4: Mode of Failure – Cl 8.6.11.1, 8.6.11.2, 8.6.11.3 NZS 3101:2006 A3

ReidBar Reinforcing Bar System	
Performances: Mode of Failure According to NZS3101:2006 A3 & AS/NZS 4671	**Annex C 4**

Table C5: Resistance to brittle fracture – Cl 8.6.11.4 NZS 3101:2006 A3 &
[Cl 4.2.1 (f) (iii) NZTA Bridge Manual 3rd Edition A3]

Sample	Part No.	No. (of Samples Tested)	Criteria assessed		Test report reference(s)
			Energy Absorbed at 0°C (Average) [J]	Comments	
ReidBar Steel Threaded Inserts					
12mm Steel Threaded Inserts	RB12TIS	3	42	10x10 samples	X-Ray Lab 11966
16mm Steel Threaded Inserts	RBA16TIS	3	13* (38J equiv.)	2.5x10 samples, equivalent energy on a standard 10x10 sample in brackets	X-Ray Lab 11966
20mm Steel Threaded Inserts	RB20TIS	3	17* (50J equiv.)	2.5x10 samples, equivalent energy on a standard 10x10 sample in brackets	X-Ray Lab 11966

* Sub-size sample, value in brackets reports the equivalent energy on a standard 10mmx10mm sample.

Table C6: Characteristic values of anchorage resistance: Cl 8.6.11.1 & Cl 8.6.11.2 - NZS 3101:2006 A3

Characteristic Ultimate Steel Tensile Capacity $N_{us} = f_{sy}$					
ReidBar Size			**RB12**	**RBA16**	**RB20**
ReidBar Grade 500E	N_{us}	**[kN]**	56.5	100.5	157.0
Capacity Reduction Factor	ϕ_s	**[-]**	0.75		

Concrete Cone Failure in Non-Cracked Concrete f'c = 40 MPa														
RBar Size	**Part Number**	**Installat'n details**	**Eff've depth h_{ef} (mm)**	**Min Edge Dist., e (mm)**	**Min.[3] Conc. thick b_w (mm)**	**Cap. Red'n Fctr, ϕ_c**	**Characteristic Ultimate Tensile Capacity**							
							Concrete Cone Failure							
							Tension, N_{uc} (kN) per anchor[2]							
							Anchor Spacing, a_1 [mm]							
							150	**200**	**250**	**300**	**350**	**400**	**450**	**500**
12	RB12TI	8mm thick Nailing Plate & EPCON C8	104	150	150	0.65	39.1	52.1	65.1	79.1[1]	83.7[1]	83.7[1]	83.7[1]	83.7[1]
16	RBA16TI		121	180	200		43.2	57.6	72.0	86.4	113.1[1]	113.1[1]	113.1[1]	113.1[1]
20	RB20TI		151	240	200		48.6	64.8	81.0	97.2	113.3	129.5	145.7	146.7

Concrete Cone Failure in Cracked Concrete f'c = 40 MPa														
Rbar Size	**Part Number**	**Installation accessories**	**Eff've depth h_{ef} (mm)**	**Min Edge Dist., e (mm)**	**Min.[3] Conc. thick b_w (mm)**	**Cap. Red'n Fctr, ϕ_c**	**Characteristic Ultimate Tensile Capacity**							
							Concrete Cone Failure							
							Tension, N_{uc} (kN) per anchor[2]							
							Anchor Spacing, a_1 [mm]							
							150	**200**	**250**	**300**	**350**	**400**	**450**	**500**
12	RB12TI	8mm thick Nailing Plate & EPCON C8	104	150	150	0.65	31.2	41.7	52.1	63.0[1]	66.1[1]	66.1[1]	66.1[1]	66.1[1]
16	RBA16TI		121	180	200		34.6	46.1	57.6	69.1	71.2[1]	71.2[1]	71.2[1]	71.2[1]
20	RB20TI		151	240	200		38.9	51.8	64.8	77.7	90.7	103.6	116.6	117.4

Threaded Inserts used alone as anchorage in Non-Cracked Concrete f'c = 40 MPa								
Rbar Size	**Part Number**	**Installation accessories**	**Eff've depth h_{ef} (mm)**	**Min Edge Dist., e (mm)**	**Min.[3] Conc. thick b_w (mm)**	**Cap. Red'n Fctr, ϕ_c**	**Gr500E ReidBar $1.5xf_{sy}$ (kN) as per NZS3101:2006 (A3) Cl 8.6.11.2**	**Characteristic Ultimate Tensile Capacity**
								Single Anchor Capacity without damage to concrete
								Tension, N_{ur} (kN) per anchor[2]
12	RB12TI	8mm thick Nailing Plate & EPCON C8	104	160	150	0.65	84.7	84.7[1]
16	RBA16TI	42mm deep rebate & EPCON C8	155	240	200		150.8	150.8[1]
20	RB20TI	67mm deep rebate & EPCON C8	210	315	250		235.5	235.5

[1] Capacity data has been validated through testing at ramsetreid facility, independently witnessed by Melbourne Testing Services, a NATA accredited laboratory. ***Test Report Reference MTS-18-1019-A, B & C.***

[2] Capacity data is derived by calculation in accordance with ***NZS3101:2006 (A3) Section 17***, unless noted otherwise

[3] All capacity data is based on minimum concrete thickness listed in table. For capacity data based on other concrete thicknesses, please calculate in accordance with ***NZS3101:2006 (A3) Section 17***

ReidBar Reinforcing Bar System

Performances: Anchorage
According to NZS3101:2006 A3 & AS/NZS 4671

Annex C6