STRUCTURES TEST REPORT

ST 18647

KOOLFOAM – CONCRETE EDGE INSULATION

CLIENT
Koolfoam

All tests and procedures reported herein, unless indicated, have been performed in accordance with the BRANZ ISO9001 Certification

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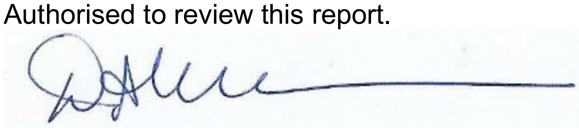

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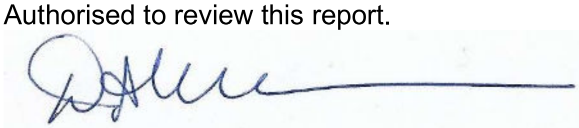

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FIGURES

TABLES

1. BACKGROUND

Koolfoam Insulation is an insulation product designed for the edge of concrete slabs. Koolfoam supplied BRANZ with enough edge insulation product to product 3 concrete slabs as described in section 4 Test setup. The profile of the edge insulation can be seen below Figure 1 Koolfoam edge insulation profile.

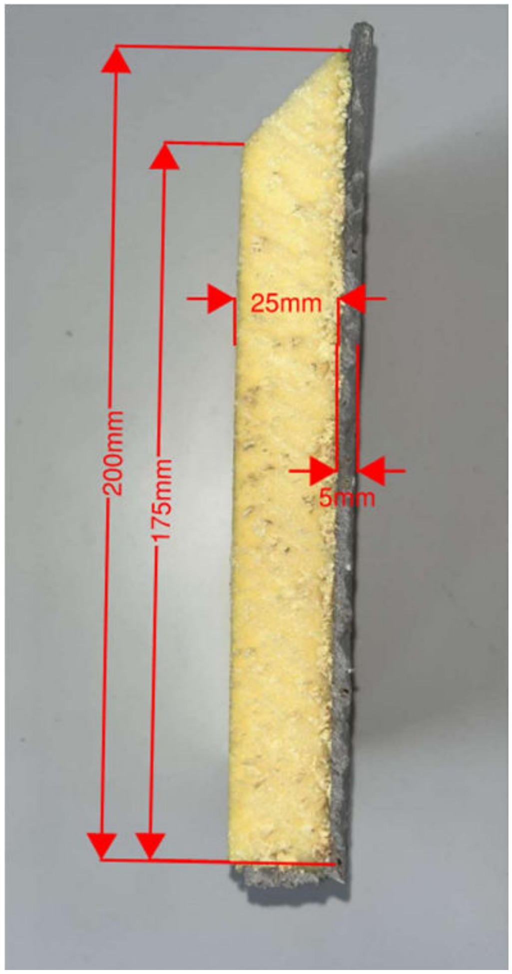

Figure 1 Koolfoam edge insulation profile.

The anchor system sent to BRANZ is a Bowmac M10 140mm Screw anchor shown below in Figure 2 to evaluate its capacity to be used as a hold down anchor system.

Testing has been carried out on the Bowmac M10 Screw anchor with the Koolfoam insulation product in concrete slabs. The purpose of the testing carried out in this report is to assess the combination of these components against NZS 3604's requirements for bottom plate capacities and to assess the anchor against the industry standard tension capacity of 15kN. Samples were sent to BRANZ in august 2024.

Figure 2 Bowmac M10 140mm Screw Anchors

2. OBJECTIVE

There were two objectives for this project:

- To determine the strength of Bowmac M10x140mm Screw Anchors used for securing the bottom plates of timber framed walls to concrete slabs incorporating a slab with Koolfoam edge insulation. Testing was carried out to requirements in NZS 3604 clause 7.5.12 [1].

- To determine the characteristic strength in axial tension of Bowmac M10x140mm Screw Anchors used for hold-down anchors for bracing elements installed in concrete slabs with Koolfoam edge insulation.

3. INTRODUCTION

Testing was carried out at the BRANZ structures testing laboratory located in Judgeford New Zealand in October 2024.

Cyclic testing for the bracket and timber connection were carried out in the Dartec testing frame, cycling from 0-1 kN for three cycles then increasing the applied load by 1 kN for three cycles, and continuing these load increases until failure was observed.

Cyclic testing for the concrete anchor was carried out on the laboratory strong floor using precast concrete slabs and a hydraulic actuator. Anchors were tested in tension cycling from 0-1 kN for three cycles then increasing the applied load by 1 kN for three cycles and continuing these load increases until failure was observed.

All data acquisition for testing of the timber to bracket connection was done through a computer-controlled system connected to the internal loadcells and displacement transformers of the test frame. An auxiliary loadcell was included throughout testing.

All data acquisition for testing of the concrete connection was done through a computer-controlled system connected to the internal loadcells and displacement transformers.

Loads cells were calibrated to international standard EN ISO 7500-1:2004, Grade 1 accuracy.

4. TEST SETUP

4.1 Concrete Anchor Connection

To test the concrete anchor specimens, a 2,400 mm x 450 mm x 250 mm thick concrete slab was cast. It was reinforced with 665 mesh centrally located and a 20 mm reinforcing bar running centrally and extending out the ends to provide lifting points. Reinforcing of the slab was to provide strength for handling and was not intended to replicate a standard floor slab edge.

The slab was poured using 20 MPa 19 mm aggregate concrete and Koolfoam insulation was cast into the slab at the slab edge.

Test cylinders were made and tested before testing began and tested at specified dates during testing.

Concrete was poured on 19/09/24.

Concrete anchors were installed as per manufacturer's instructions at 59 mm from the edge of the slab. Anchors were installed with 92 mm of embedment to allow for the use of a packer as shown in Figure 4.

Figure 3 Concrete Anchor Embedment

Samples were connected to a hydraulic actuator via a rigid metal plate shown in Figure 4 through a steel plate that allowed the pair of anchors to be loaded simultaneously.

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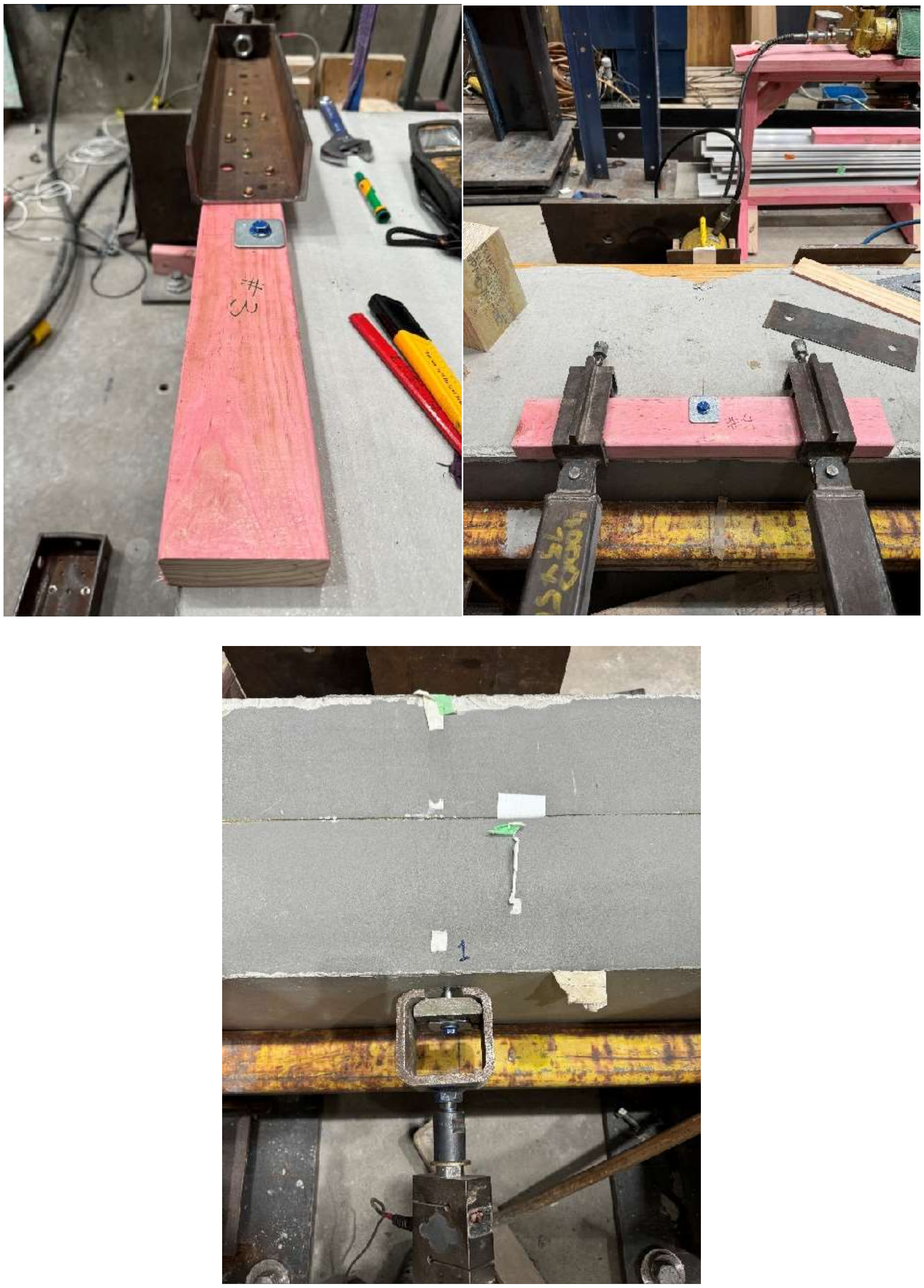

Figure 4 Test Setup for Anchors in Concrete

4.2 Test procedure

For all tests, the loading regime was cyclic in accordance with BRANZ Evaluation Method No 1(1999) [3], as required by NZS 3604:2011. This method included three cycles at each “level”, starting at a control load of 1kN +/- cycle with increment increases of 1kN.

5. OBSERVATIONS

5.1 Concrete Anchor Connection

Concrete anchor failure modes were consistently concrete cone breakout as shown in Figure 5 - Figure 7

Figure 5 Failure Mode Tension (Concrete anchor)

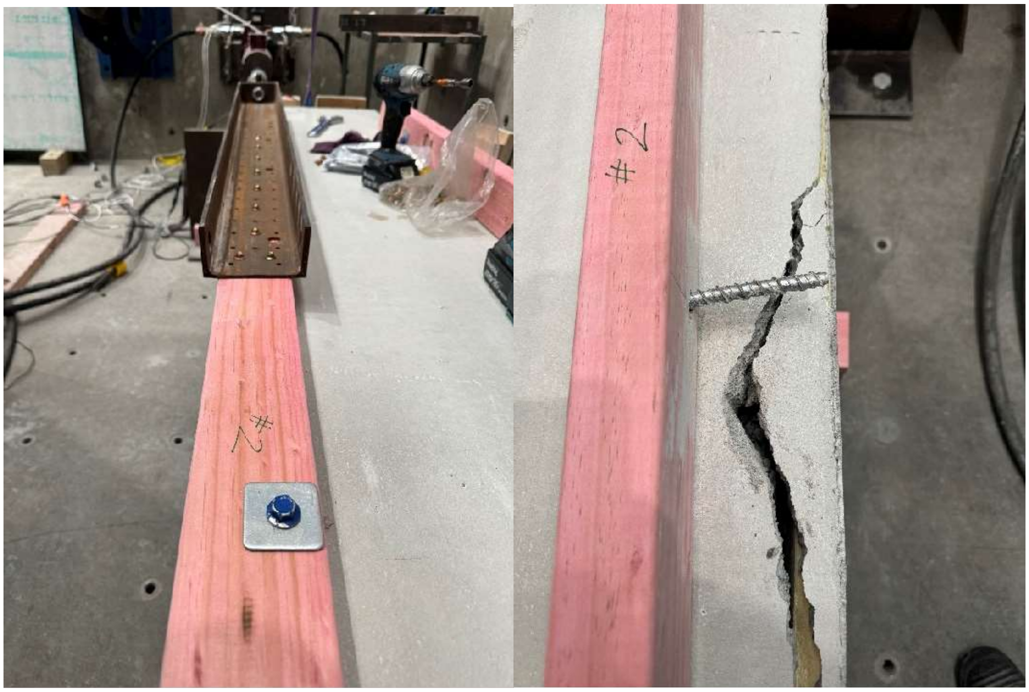

Figure 6 Failure Mode In plane (Concrete anchor)

Figure 7 Failure Mode out of plane (Concrete anchor)

6. RESULTS & ANALYSIS

6.1 Concrete Anchor Connection

6.1.1 Concrete strength

Concrete strength was interpolated between measured values in Table 1 below, with values highlighted in yellow being the measured values from cylinders cast at the time of the concrete pour.

The individual test results quoted in Table 2 include the characteristic strength according to BRANZ EM1 [4] and the design capacity according to NZS 1170.0.

The recorded loads have been adjusted by a factor to account for the actual concrete strength at the time of testing compared to the client specified design concrete strength of 20 MPa. The estimated concrete strength at the time of testing each individual anchor has been interpolated from concrete strengths tested before and during testing. The factor used is given by:

Factor = $\sqrt{\left({}^{20}/_{fc}\right)}$, where 20 MPa is the specified strength, and fc is the interpolated strength at the time of testing. This scaling is based on the equation for anchor performance from NZS3101.1:2006 [4] Section 17. Factors are included in Table 1

NZS 3604 normally requires the use of BRANZ EM1 to analyse connection test results, but because the failure mode in the tests was predominantly concrete edge breakout, rather than timber failure, analysis of these results was carried out using the methodology of AS/NZS 1170.0 Appendix B [4], using the equation:

Design capacity = ${}^{minimum\ result}/_{k_t}$, where k_t is a factor depending on number of test results and their variability. The values chosen were interpolated from Table B1 of AS/NZS 1170.0.

For use as hold-down anchors of bracing elements, the NZ industry standard is to quote characteristic strengths under uplift loading. After adjusting for concrete strengths as above, the characteristic strengths were determined using the standard statistical equation:

Characteristic strength is equal to $Mean\ Result - 1.65\ \times Std.Deviation$

Test results and analysis for concrete connection testing is provided in Table 3.

The Design capacities for proprietary bottom plate anchors as specified by clause 7.5.12 of NZS 3604:2011 [1] are as follows:

External walls:

Vertical loads in axial tension of the anchor 7 kN

For the anchor to be used to hold down bracing elements of up to 150 bracing units per metre, industry standard is for the characteristic load to be greater than or equal to 15 kN. This figure is based on the findings from the following Study Reports:

- J.T. Gerlich (1987) BRANZ SR2 The end restraint of timber framed panels in wall bracing tests.
- R.H. Shelton (2004) BRANZ SR125 Bottom plate anchors under NZS 3604:1999.

Date	Day	MPa Tested	Mpa interpolated	Factor
20/09/2024	1		15.00	
21/09/2024	2		15.42	
22/09/2024	3		15.83	
23/09/2024	4		16.25	
24/09/2024	5		16.67	
25/09/2024	6		17.08	
26/09/2024	7	17.5	17.50	
27/09/2024	8		17.92	
28/09/2024	9		18.33	1.04
29/09/2024	10		18.75	1.03
30/09/2024	11		19.17	1.02
1/10/2024	12		19.58	1.01
2/10/2024	13		20.00	1.00
3/10/2024	14		20.42	0.99
4/10/2024	15		20.83	0.98
5/10/2024	16		21.25	0.97
6/10/2024	17		21.67	0.96
7/10/2024	18		22.08	0.95
8/10/2024	19	22.5	22.50	0.94
9/10/2024	20		22.92	0.93

Table 1 Concrete Strength Table

In Plane			
Sample	result (kN)	Results With factors	Date
1	12.698	12.70	2/10/2024
2	13.11	13.11	2/10/2024
3	13.47	13.47	2/10/2024
4	12.515	12.52	2/10/2024
5	13.66	13.66	2/10/2024
6	12.73	12.73	2/10/2024
Std Dev	0.46		
Mean	13.03		
Characteristic Capacity	12.27	kN (Brace Element Hold Down Only)	
Co-eff Variation	0.04		
kt	1.13	Note Kt for 5% var	
Design capacity	11.08	kN (1170.0 approach)	

Out of Plane			
Sample	result (kN)	Results With factors	Date
1	5.98	5.69	7/10/2024
2	5.97	5.67	7/10/2024
3	6.97	6.62	7/10/2024
4	5.69	5.41	7/10/2024
5	6.61	6.28	7/10/2024
6	6.34	6.02	7/10/2024
Std Dev	0.45		
Mean	5.95		
Characteristic Capacity	5.21	kN (Brace Element Hold Down Only)	
Co-eff Variation	0.08		
kt	1.21		
Design capacity	4.48	kN (1170.0 approach)	

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Tension			
Sample	result (kN)	Results With factors	Date
1	17.99	16.91	8/10/2024
2	19.91	18.72	8/10/2024
3	16.86	15.85	8/10/2024
4	21.9	20.59	8/10/2024
5	20.17	18.96	8/10/2024
6	20.2	18.99	8/10/2024
Std Dev	1.69		
Mean	18.33		
Characteristic Capacity	15.55	kN (Brace Element Hold Down Only)	
Co-eff Variation	0.09		
kt	1.26		
Design capacity	12.62	kN (1170.0 approach)	

Table 2 Concrete Anchor Test Results and Analysis

7. CONCLUSIONS

It is concluded that in the opinion of Branz the design capacity of the tested Bowmac M10 140mm concrete screw anchor in association with the tapered Koolfoam Insulation exceeded the actions required by NZS3604 (clause 7.5.12.3) and hence testing has demonstrated compliance with NZS3604 clause 7.5.12 for proprietary anchors placed at 900mm centres.

Test results yielded a characteristic tension capacity exceeding the requirements for bottom plate anchors as per NZS 3604 [3] & the industry standard 15kN hold down requirement.

Both conclusions depend on the anchors being accurately installed with respect to the edge of the slab and minimum embedment and installed as per manufacturer guidelines.

8. REFERENCES

[1] Standards New Zealand (SNZ). 2011. NZS 3604:2011. Timber Framed Buildings. SNZ, Wellington, New Zealand.

[2] International Organisation for Standardisation (ISO). 2018. ISO 7500:2018 Metallic Materials – Verification of Static Uniaxial Testing Machines, Part 1: Tension/Compression Testing Machines – Verification and Calibration of the Force-Measuring System. ISO, Geneva, Switzerland.

[3] NZS 3603:1993. “Timber structures standard”. Standards New Zealand, Wellington, New Zealand.

[4] BRANZ EM1.

[5] AS/NZS 1170.0

[6] J.T. Gerlich (1987) BRANZ SR2 The end restraint of timber framed panels in wall bracing tests.

[7] R.H. Shelton (2004) BRANZ SR125 Bottom plate anchors under NZS 3604:1999.

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