

Swinburne University of Technology
Centre for Sustainable Infrastructure



ICCONS BlackTip Thunderbolt screw testing

January 2017

Report prepared for:
ICCONS Pty. Ltd.

Report by:
Kia Rasekhi and Dr. Jessey Lee

EXECUTIVE SUMMARY

Swinburne University of Technology was commissioned by ICCONS to carry out testing of M10×140mm BlackTip Thunderbolt screw anchors to assess the tension capacities of the specified anchor in concrete with characteristic compressive strength (f'_c) of 20MPa at 28 days in close to edge applications for an external wall hold-down panel. This report summarises the results for tests conducted.

Special concrete test blocks were cast and test setup was developed. The results for the tests conducted are summarised in Table 1.

Table 1: Summary of tension capacities of BlackTip Thunderbolt screw anchors

Type of test	Mean ultimate strength in 19.9 MPa concrete (kN)	Characteristic strength in 19.9 MPa concrete (kN)
Tension	29.3	22.9

Contents

Executive Summary..... i

1 Introduction 1

2 Concrete test block and anchors 1

3 Test Setup 1

4 Test Results 4

5 Conclusions 5

APPENDIX A – Load displacement curves for tension tests..... 6

DRAFT

1 INTRODUCTION

Swinburne University of Technology was commissioned by ICCONS to carry out testing of M10×140mm BlackTip Thunderbolt screw anchors (refer Figure 1) to assess the tension capacities of the anchors

The scope of work included: (i) casting of test block with concrete having characteristic compressive strength of 20MPa at 28 days; (ii) design and fabrication of test rigs which accommodates testing of the anchors in tension (iii) conduct anchor tests and concrete cylinder compression tests; (vi) provide a report on the work completed.

The work was undertaken at the Smart Structures Laboratory, Swinburne University of Technology (SUT) in Hawthorn, Victoria.



Figure 1: BlackTip Thunderbolt M10×140mm screw anchor

2 CONCRETE TEST BLOCK AND ANCHORS

Concrete was cast at Westkon Precast using the standard N20 mix from Boral Concrete, $f'_c = 20\text{MPa}$, 14mm aggregate with 80mm slump.

The concrete was placed in the moulds in layers directly from the mixing truck. The concrete was vibrated to ensure appropriate compactness. Standard cylinders were also cast to confirm the compressive strength by testing.

After 28 days of casting, the holes for the anchors were drilled to a depth of 100mm for the anchors with a hammer drill and a brand new 10mm carbide tipped drill bit. The drill bit was checked to ensure the diameter of the hard metal bit is within the tolerance specified in ETAG001. The drilled holes were cleaned as per instructions provided by ICCONS.

All anchors for testing were supplied by ICCONS.

3 TEST SETUP

Anchors were installed for tension tests as per installation instructions provided by ICCONS with embedment depth of 90mm at 59mm concrete edge distance; a minimal torque of 20Nm was applied to the anchors with a calibrated torque wrench. Fixture plate of 50mm thick with 12mm clearance hole was utilised. The test was conducted in displacement control. Figure 2 shows typical location of anchors for tension tests on a 2.0m × 1.4m × 0.4m block. Figure 3 shows schematic view of test setup.

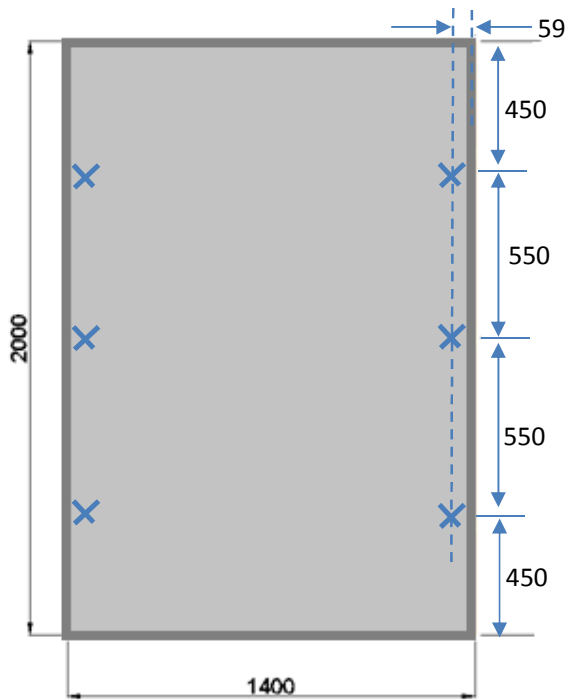


Figure 2: Schematic location of anchors for tension tests (all dimensions specified in mm), plan view

Calibrated displacement transducers were positioned on each sides of the anchor to measure the displacement of the anchor relative to the concrete surface during loading. Refer to Figure 4 and Figure 5 for tension test setup. The measurements from the displacement transducers and the load applied from the actuator were digitally recorded during the loading of each anchor. Tests were conducted by a qualified test engineer.

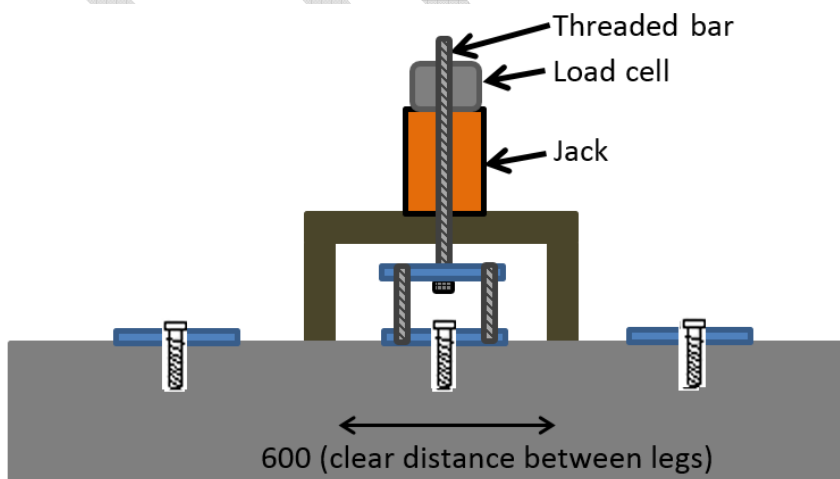


Figure 3: Schematic tension test setup



Figure 4: Test setup and instrumentations for tension test

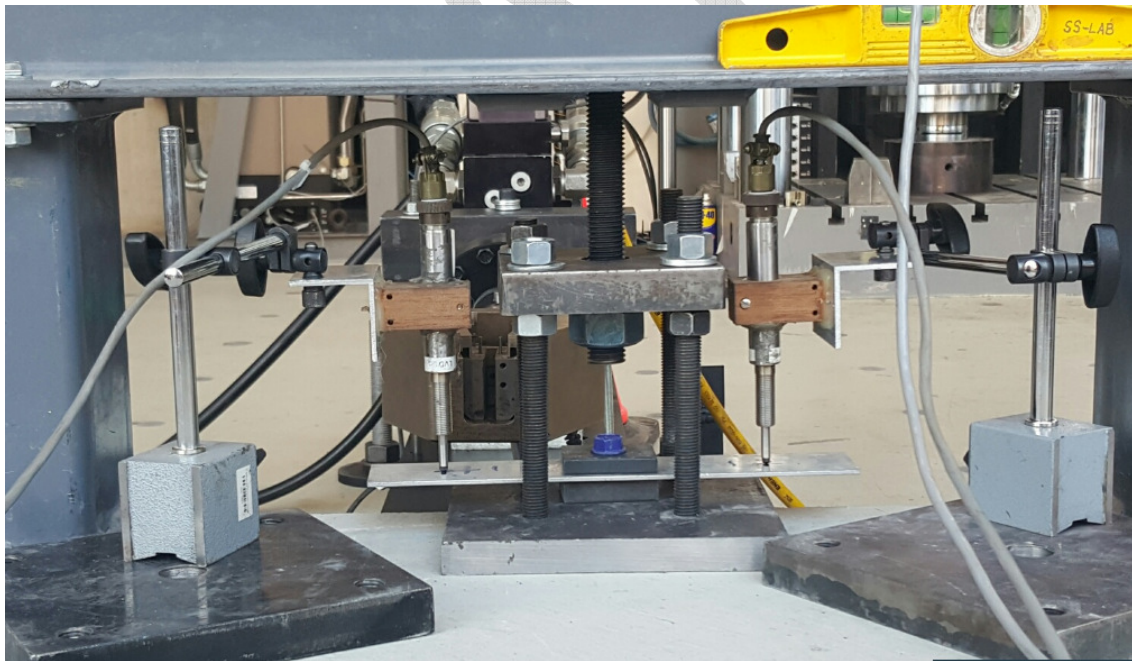


Figure 5: Close up view of test setup

4 TEST RESULTS

Results from basic tension tests are summarised in Table 2.

Table 2: Tension test results for BlackTip Thunderbolt screw anchors

Specimen No.	Ultimate test load in 19.9MPa concrete (kN)
1	32.3
2	26.2
3	29.3
4	28.1
5	30.6
6	29.5
Mean ultimate load (kN)	29.3

Average concrete cylinder strength (f_{cm}) = 19.9MPa

Number of specimens = 6

Standard deviation = 2.09 kN

Coefficient of variation = 7.1%

Sampling factor, k_s = 3.091

Characteristic strength = 22.9kN

Figure 6 shows a photo of typical concrete failure from the test. Load displacement curves from the tests can be found in Appendix A.





Figure 6: Concrete failure

5 CONCLUSIONS

An experimental test setup was developed to test BlackTip Thunderbolt screw anchors in basic tension. The anchors were installed in drilled holes of 10mm in diameter and hole depth of 100mm with embedment depth of 90mm and 59mm from edge of concrete. Fixture plate of 50mm total thickness with 12mm clearance hole was utilised. Screw anchors were tightened with a minimal torque of 20Nm for consistency. Installation of anchors was done in accordance to instructions provided by ICCONS. Table 3 summarises the results for the BlackTip Thunderbolt screw anchors.

Table 3: Summary of results for BlackTip Thunderbolt screw anchors

Type of test	# of samples	COV	Mean ultimate strength in 19.9MPa concrete (kN)	Characteristic strength in 19.9MPa concrete (kN)
Tension	6	7.1%	29.3	22.9

APPENDIX A – LOAD DISPLACEMENT CURVES FOR TENSION TESTS

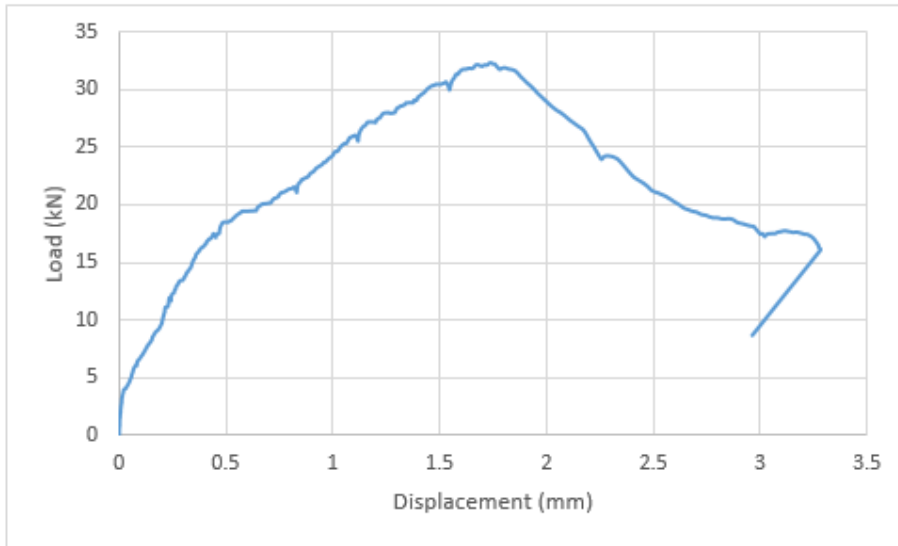


Figure 7: Load displacement curve for tension test #1 for BlackTip Thunderbolt screw anchor

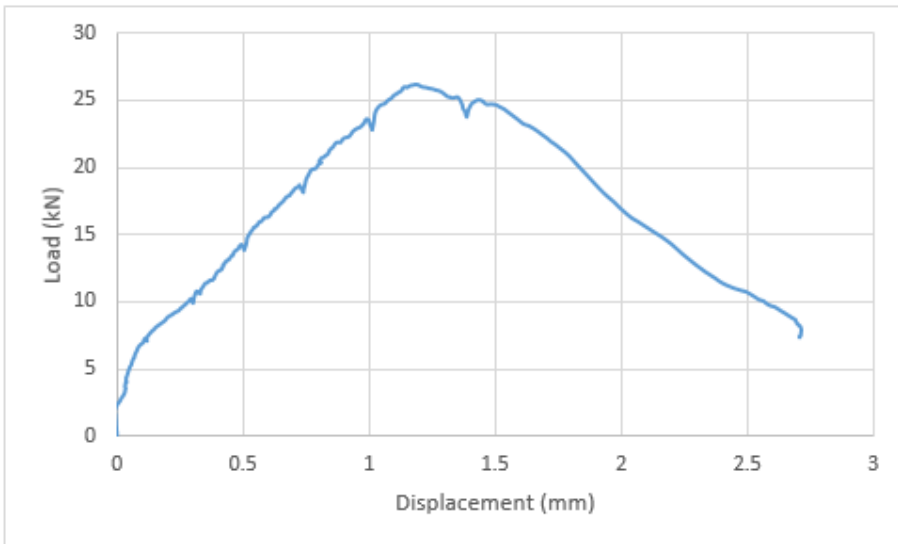


Figure 8: Load displacement curve for tension test #2

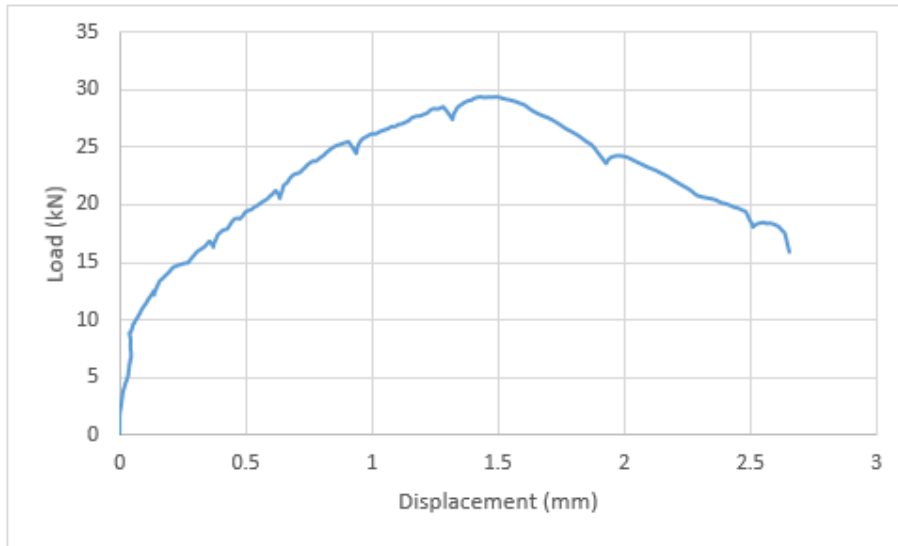


Figure 9: Load displacement curve for basic tension test #3

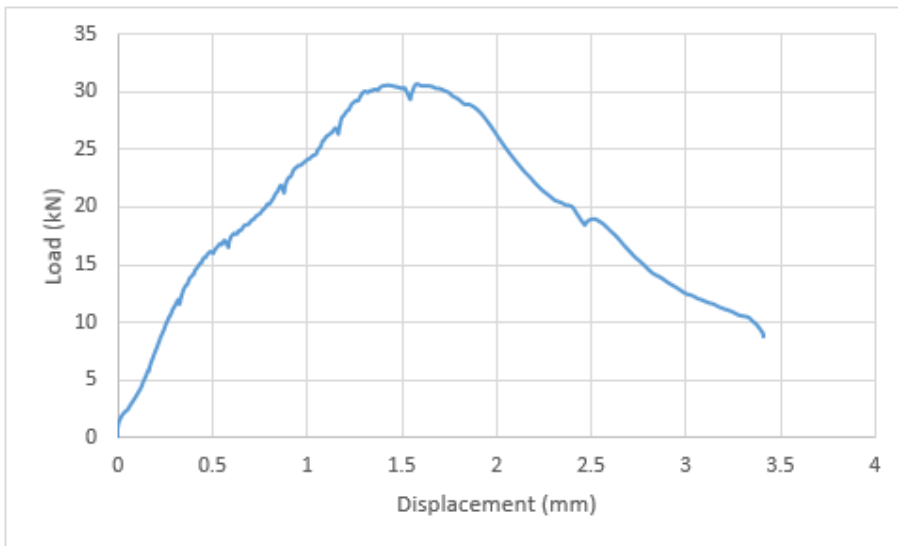


Figure 10: Load displacement curve for basic tension test #4

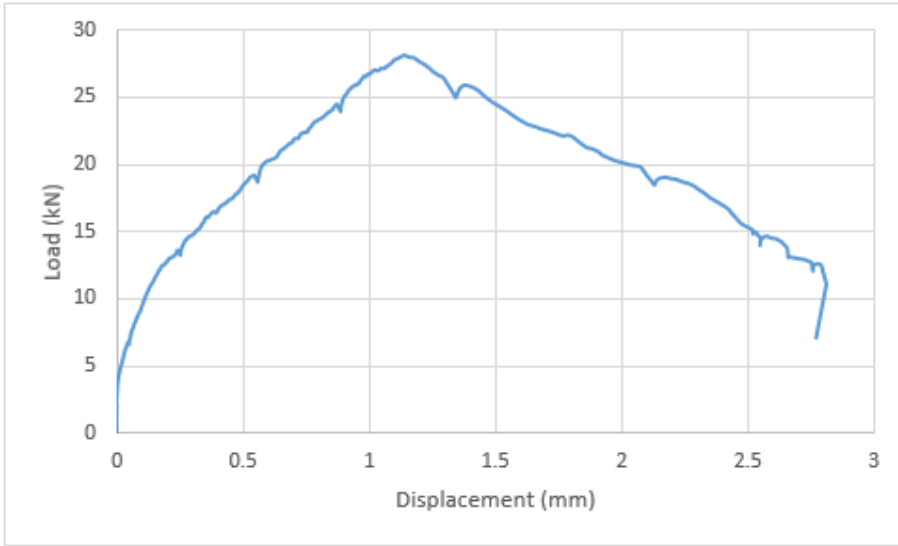


Figure 11: Load displacement curve for basic tension test #5

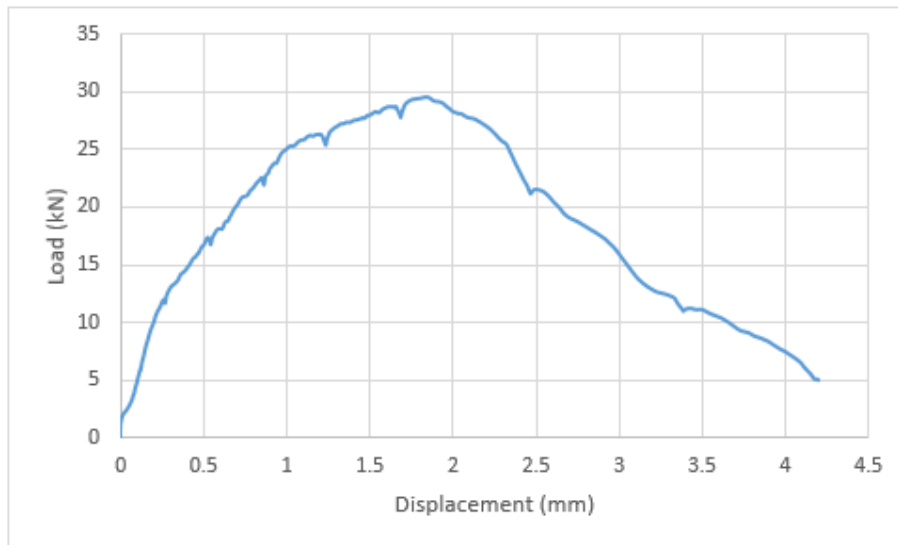


Figure 12: Load displacement curve for basic tension test #6