STRUCTURES TEST REPORT

ST10088-001-02

LOAD TESTING OF ULTIBRAC TIMBER FRAMING CONNECTORS

CLIENT
Mattoni Holdings Ltd
1143 South Road
Oakura, 4314
New Zealand

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

LIMITATION

The results reported here relate only to the items tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

SIGNATORIES

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DOCUMENT REVISION STATUS

ISSUE NO.	DATE ISSUED	DESCRIPTION
01	8/08/2018	Initial Issue
02	8/08/2018	Clarification of specimen construction. Addition of characteristic values.

CONTENTS

FIGURES

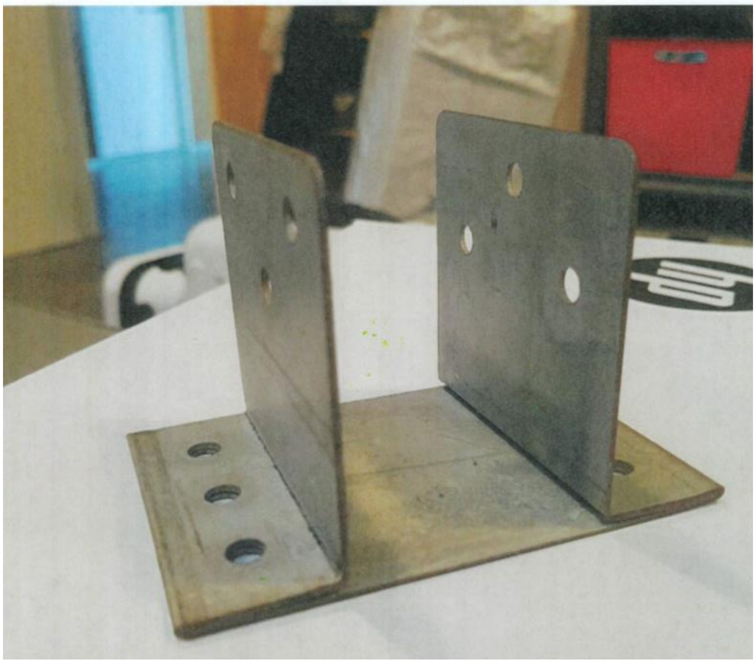
1. OBJECTIVE

To carry out structural load tests on Ultibrac Brackets. Ultibrac brackets supersede Joist Grippa brackets to provide structural connections between timber framing members. Tension load tests had already been carried out by others, and the tests described below were in shear, both the in-plane and out-of-plane directions.

2. DESCRIPTION OF SPECIMENS

1. Product description

Ultibrac brackets are one piece, folded stainless steel brackets (1.2 mm thick) intended to be used as general-purpose connections for timber framed building structures. They may be used (where appropriate) as alternative fixings within Table 2.2 of NZS 3604, "Timber framed buildings" [1], or as general structural connections. A bracket is shown in Photograph 1 and details in Figure 1.



Photograph 1. Ultibrac Bracket.

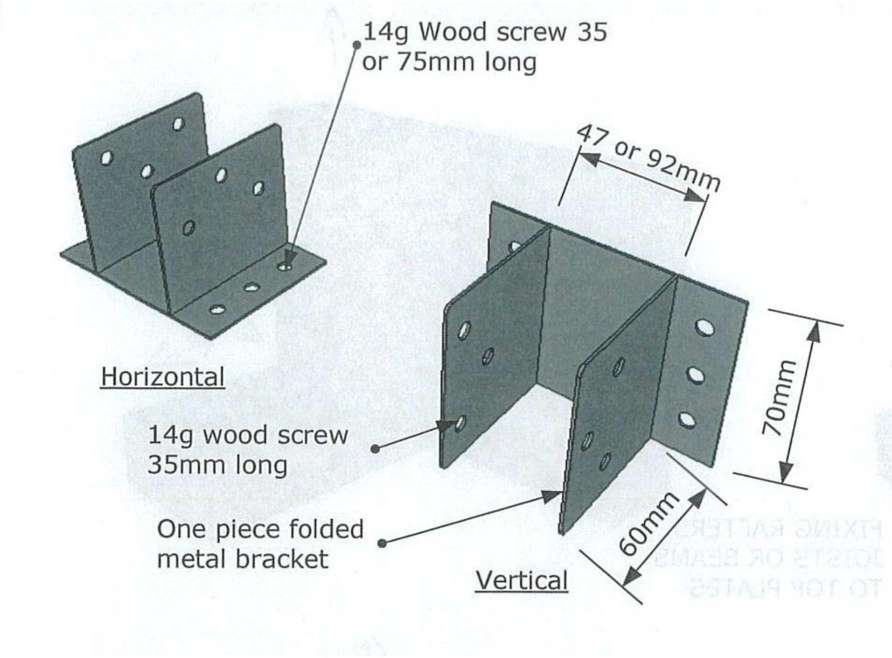


Figure 1. Dimensions and details of Ultibrac bracket (client supplied)

Together with the supplied screws, the brackets form a structural connection for three directions of loading as defined in Figure 2.

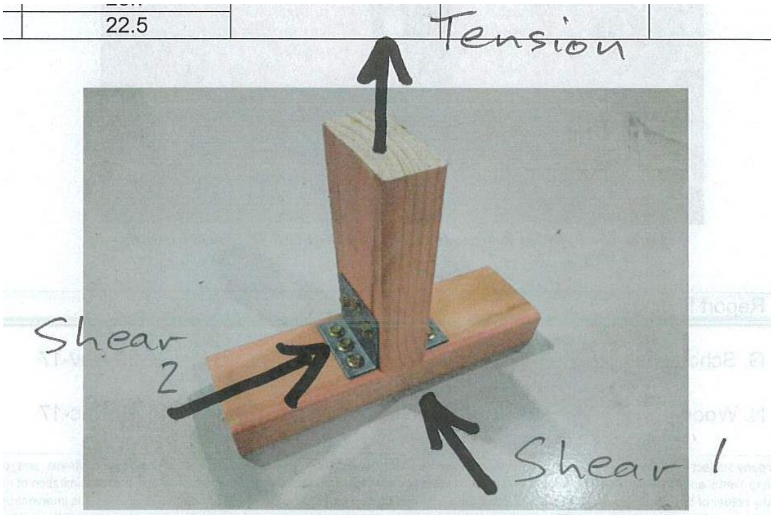


Figure 2. Loading directions (Shear 1 "out-of-plane", shear 2 "In-plane")

2. Specimen construction

The supplied brackets were installed in Radiata Pine SG8 framing timber members (H1.2 treated) in the Shear 1 and Shear 2 configurations (see Figure 2), six test specimens of each direction. All test specimens were "T" shaped, with the long leg representing a stud or joist, and the short leg a wall plate or boundary joist. Shear 2 tests used all 140 x 45 timber. Shear 2 specimens were initially constructed from 90 x 45 timber, but after timber breakages during trial tests (see Photograph 7) the long leg was changed to 140 x 45 timber, with 90 x 45 remaining for the short leg.

The long leg of the "T" measured 1,100 mm, and short leg 300 mm (both configurations). Brackets were screwed to the timber using the 14g self-drilling wood screws supplied by the client, three screws to each leg of the bracket (12 in total).

3. DESCRIPTION OF TEST

3. Date and location of test

The tests were conducted in June 2018 at BRANZ Structural Laboratory, Judgeford.

4. Test set-up

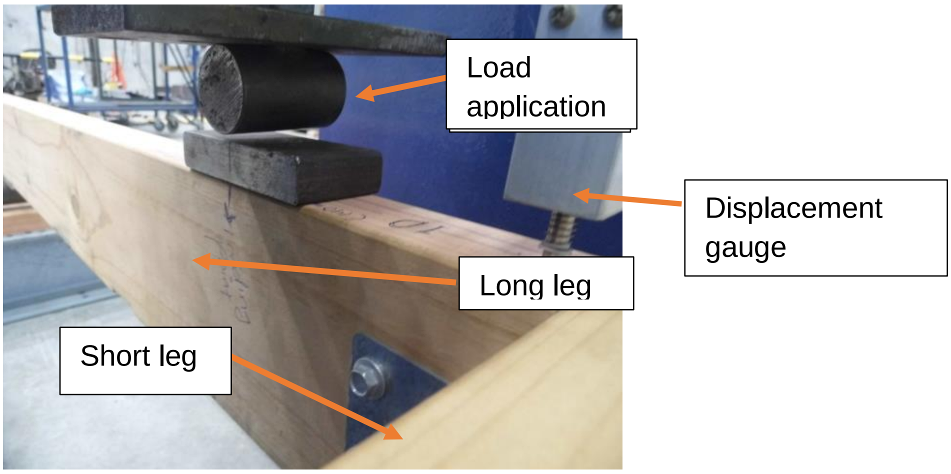
The specimens were set up for testing on the laboratory floor. See Photograph 2.

Shear 1 configuration (Out-of-plane direction): The short leg of the "T" was clamped to steel supports bolted to the floor. The far end of the long leg was supported on a pivot to prevent restraint due to the change of angle as the joint displaced (see Photograph 3).

Photograph 2. Test set up for Shear 1 configuration

Photograph 3. Support at end of long leg.

Load was applied as close as possible to the joint through a pivot to avoid spurious restraint. Displacement was measured adjacent to the joint. Load application and displacement gauges can be seen in Photograph 4.



Photograph 4. Load application and deflection gauge

Relevant dimensions of the test specimen are shown in Figure 3.

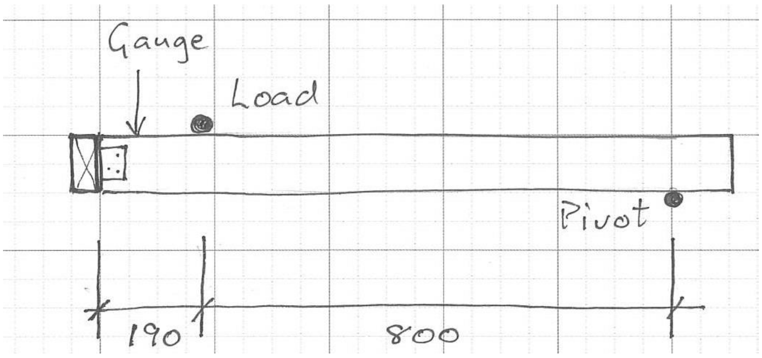
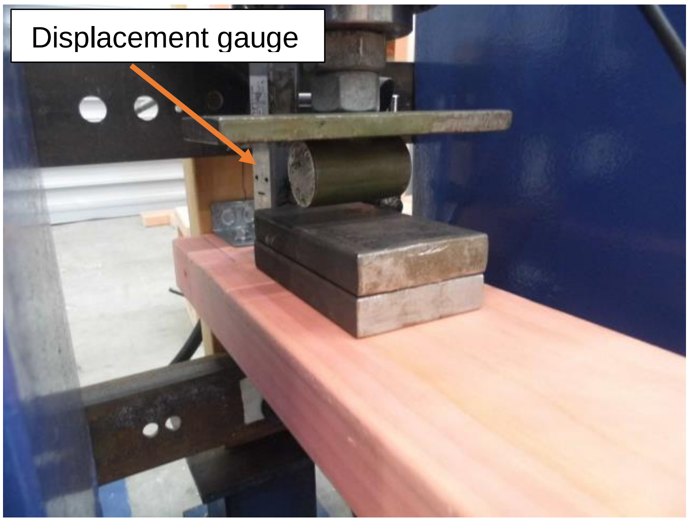


Figure 3. Test dimensions for Shear 1 configuration

Shear 2 configuration: (in-plane) The set up was very similar to Shear 1 configuration, with the only changes made to accommodate the different timber orientation. Load was applied as close as possible to the joint through a pivot to avoid spurious restraint, and displacement measured adjacent to the joint. Load application and displacement gauges can be seen in Photograph 5.



Photograph 5. Load application for Shear 2 configuration, displacement gauge behind.

Relevant dimensions are shown in Figure 4.

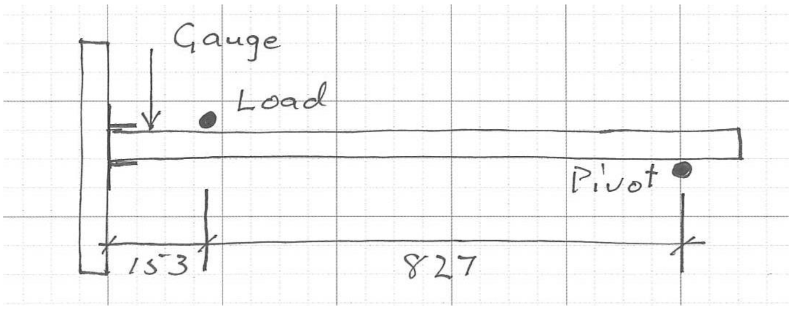


Figure 4. Test dimensions for Shear 2 configuration

For both configurations, a hand pumped hydraulic jack was used to apply load, applied through a loading applicator incorporating a pivot to follow avoid restraint as noted above. Load was measured with a 25 kN load cell. Displacement of the joint was measured with a linear potentiometer located as close as possible to the intersection of the timber members (approx. 50 mm).

The load cell was calibrated to International Standard EN ISO 7500-1 (2015) Grade 1 (2), and the potentiometer was calibrated to an accuracy of 0.2 mm.

5. Test procedure

Load was gradually increased until the joint failed or the displacement gauge ran out of travel. Load rate varied between 3 and 5 minutes to maximum displacement. Continuous readings of load and deflection were recorded for subsequent analysis using a computer-controlled data acquisition system.

4. OBSERVATIONS

Specimens failed either by timber fracture (either end splitting, or under the load application point), excessive distortion of the joint and bracket, or by screw withdrawal.

- Photograph 6 shows a typical failure by timber splitting from the end of the long leg. These failures occurred under Shear 1 loading
- Photograph 7 shows a typical failure by timber fracture. These were under Shear 2 loading.
- Photograph 8 shows a typical failure by distortion of the bracket coupled with screw withdrawal. These occurred under Shear 1 loading.
- Photograph 9 shows a typical failure by bracket distortion under Shear 2 loading.

Photograph 6. Failure by end splitting

Photograph 7. Failure by timber fracture under the load point (initial test)

Photograph 8. Failure by distortion of the bracket and screw withdrawal

Photograph 9. Failure by bracket distortion

5. RESULTS

Representative plots of load against deflection are presented in Figure 5. Peak load for each test was extracted and adjusted for joint load as described below.

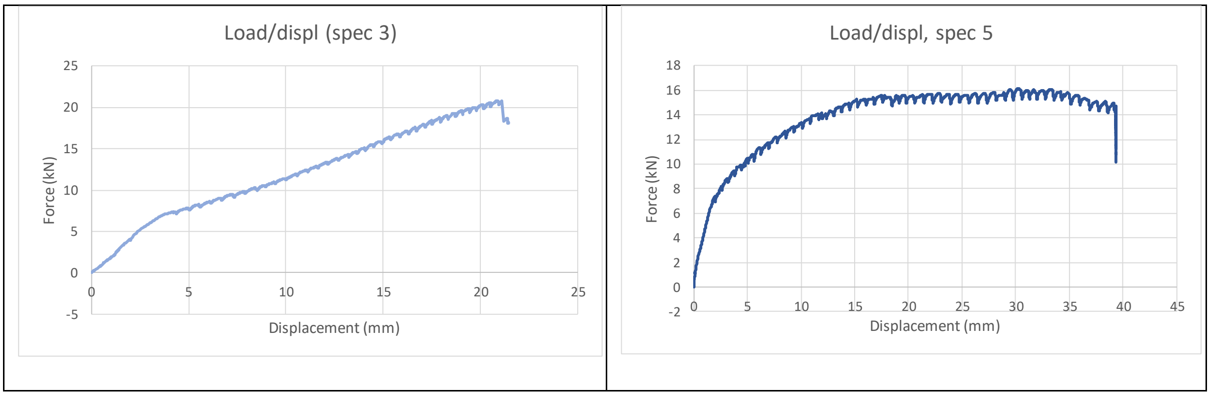
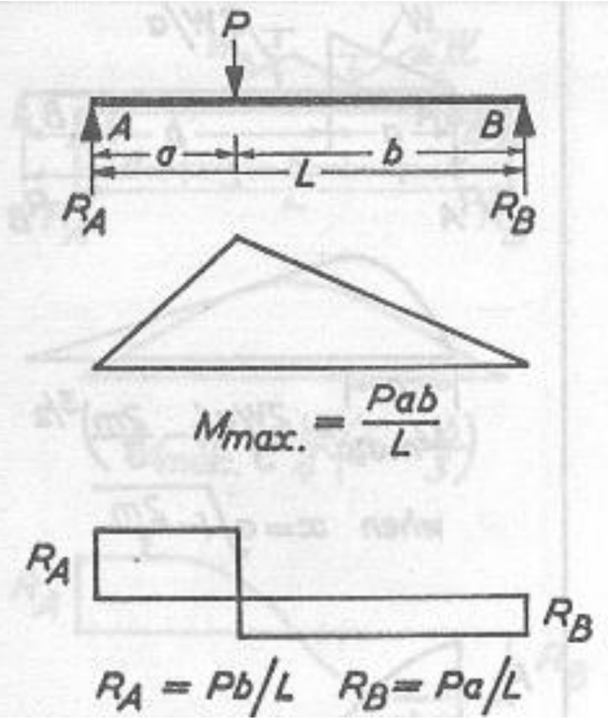


Figure 5. Typical load/displacement plots. Shear 1 on left, shear 2 on right

The load resisted by the joint (R_A) was derived from the peak load recorded for each test using the adjusting formula:



Design capacity for each configuration was derived using Appendix B of AS/NZS 1170.0 "Structural design actions. Part 0: General Principles" [3], using the following formula:

$$Design\ capcity = \frac{minimum\ result}{k_t}$$

Where k_t is a factor which allows for variability of test results.

Results are summarised in **Table 1**. Note that these are design capacities at ULS, independent of deflections. They may also be used as "alternative fixings" under NZS 3604.

Characteristic values calculated using the BRANZ EM1 test procedure are appended below the table. These may be used in conjunction with NZS 3603 to provide design capacities

Shear 1		
	Peak load (kN)	
Specimen	Recorded	Adjusted
1	14.3	11.6
2	14.0	11.3
3	16.9	13.7
4	16.6	13.4
5	16.1	13.0
6	22.6	18.3
Average		13.5
Std deviation		2.29
Coef of variation		16.9
k_t		1.52
Minimum		11.3
Des. capacity		7.4

Shear 2		
	Peak load (kN)	
Specimen	Recorded	Adjusted
1	18.4	15.5
2	13.9	11.7
3	20.8	17.6
4	15.4	13.0
5	20.7	17.5
6	24.4	20.6
Average		16.0
Std deviation		2.98
Coef of variation		18.6
k_t		1.57
Minimum		11.7
Des. capacity		7.5

Table 1. Results summary

Characteristic values:

Shear 1	Shear 2
8.8 kN	8.9 kN

6. REFERENCES

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

[2] International Organisation for Standardisation (ISO). 2018. ISO 7500-1:2018 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] Standards New Zealand. AS/NZS 1170.0:2011. Structural design actions. Part 0: General Principles. SNZ, Wellington, New Zealand.

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