STRUCTURES TEST REPORT

ST11512-001

P21 TESTING OF 600 MM AND 1200 MM LONG WALLS WITH DAIKEN CUSTOMWOOD SHEATHING

CLIENT
Daiken New Zealand Ltd
Upper Sefton Rd
Ashley
Rangiora 7477
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

Author

Graeme Beattie
Principal Structural Engineer
BRANZ

Reviewer

David Carradine
Senior Structural Engineer
BRANZ

DOCUMENT REVISION STATUS

ISSUE NO.	DATE ISSUED	DESCRIPTION
01	16/05/2019	Initial Issue

branz.nz | 1222 Moonshine Rd, RD1, Porirua 5381, Private Bag 50 908, Porirua 5240, New Zealand | Phone +64 4237 1170 | branz@branz.co.nz

1. OBJECTIVE

To determine the bracing ratings of a 0.6 m long wall and a 1.2 m long wall constructed using 9 mm thick medium density fibreboard (MDF) manufactured by Daiken New Zealand Limited as the sheathing material on one side and intended for use on a timber or concrete floor, where the bottom plate is respectively either bolted or coach screwed down to the floor.

2. DESCRIPTION OF SPECIMENS

2.1 Product description

Medium density fibreboard (MDF) manufactured by Daiken New Zealand Limited having a nominal 9 mm thickness was supplied by the client for testing. Sheets supplied were 2.4 m long by 1.2 m wide. The average measured density of the sheets was 6.05 kg/m^2.

2.2 Specimen construction

For each wall length, three replicate specimens were constructed according to typically accepted methods for building walls using MDF as the sheathing material. The timber frames were assembled from 90 x 45 mm SG8 kiln dried Radiata Pine. The plates were connected to the studs with two 90 x 3.15 mm power-driven nails. The overall frame dimensions were 2.42 m high by 0.60 m long as shown in Figure 1 for the shorter walls and 1.20 m long for the longer walls. No nogs were used.

The MDF sheets were fastened to one side of the timber framing using 2.8 mm x 40 mm hot-dipped galvanised flat-head nails. These were placed at the locations shown in Figures 1 and 2. The fasteners were placed 10 mm from vertical edges and 18 mm from the top and bottom edges. Fasteners around the perimeter of specimens were installed at 150 mm centres (Figure 3). The long edges of each MDF sheet were flush with the outside vertical edges of the framing. The bottom edge of each sheet was 10 mm short of the bottom of the bottom plates. The top edge of each sheet was 10 mm short of the top of the top plate.

Each end stud was secured to the bottom plate using a GIB® HandiBrac® hold-down which is shown in Figure 4. Of the five fasteners, four were installed in the stud and one was installed into the bottom plate.

A view of the bottom of a typical 600 mm long specimen is shown in Figure 5.

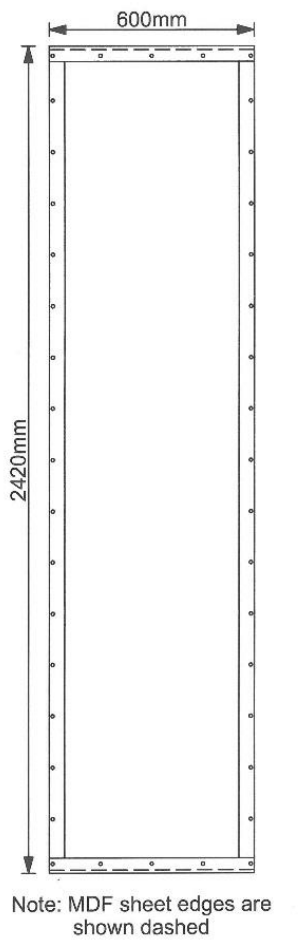


Figure 1. Daiken Customwood 600 mm Long Specimen Overall Dimensions (Note: P21 End Restraints and Handibrac Hold-Downs Not Shown)

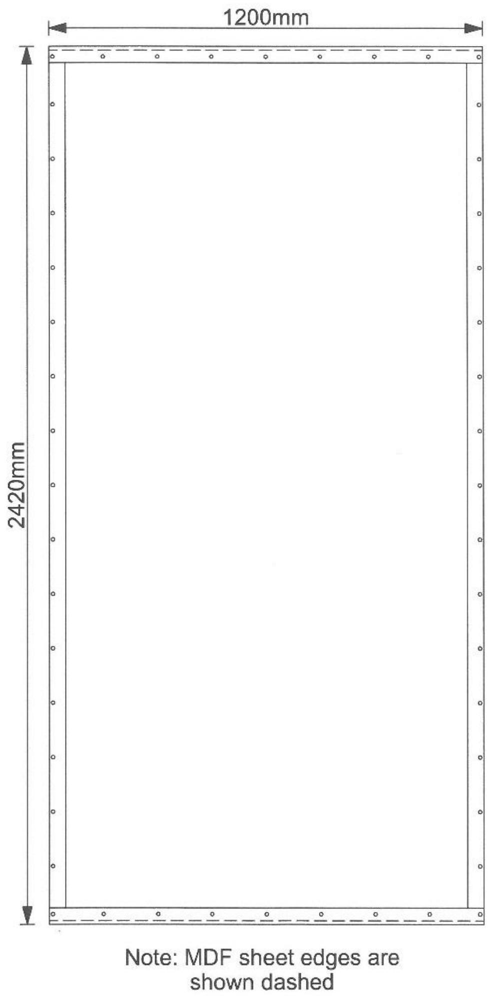


Figure 2. **Daiken Customwood 1200 mm Long Specimen Overall Dimensions (Note: P21 End Restraints and Handibrac Hold-Downs Not Shown)**

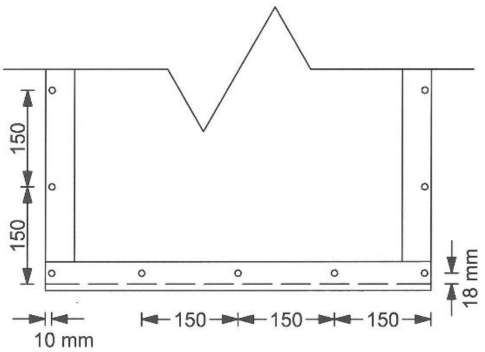


Figure 3. **Daiken Customwood 600 mm Long Specimen Fastener Spacing Pattern (Similar pattern for the 1200 mm long specimens)**

Figure 4. GIB® HandiBrac® hold-down

Figure 5. View of the bottom of a typical 600 mm specimen showing GIB® HandiBrac® hold-downs installed

3. DESCRIPTION OF TEST

3.1 Date and location of test

The tests were carried out in April 2019 at the Structural Engineering Laboratory of BRANZ Ltd, Judgeford, New Zealand.

3.2 Test set-up

The racking test specimens were installed in a rigid steel loading frame. P21 end restraints were installed in accordance with the recommendations of BRANZ P21:2010. "A Bracing Wall Test and Evaluation Procedure" [1], available on the BRANZ website.

The bottom plates of all specimens were secured to the test frame using 12 mm diameter threaded rods which were placed through holes drilled through the bottom plates and included and secured to the Gib® HandiBrac® hold-downs with doubled nuts on the threaded rods. All specimens were placed on top of a strip of 20 mm thick particle board floor and a timber foundation beam. The foundation beam was securely bolted to the steel beams of the P21 testing frame. Figure 5 shows the threaded rods and nuts used to secure specimen bottom plates to the testing frame.

Horizontal load was applied to the centre of the specimen top plates using a 30 kN closed loop electro-hydraulic ram and measured with a 25 kN load cell.

Out-of-plane movement of top plates was prevented by mechanical restraints located as close as possible to the ends of the specimens.

A linear potentiometer was used to measure the horizontal displacement of the top plate.

The test load and displacement measurements were recorded using a computer-controlled data acquisition system. The load cell was calibrated to International Standard EN ISO 7500-1 2018 [2] Grade 1 accuracy and the linear potentiometers were calibrated to an accuracy of 0.2 mm.

3.3 Test procedure

The tests were performed according to the recommendations of BRANZ P21:2010 test method [1]. The loading sequence consisted of 3 displacement controlled cycles of each specimen top plate to displacements of ±9, ±15, ±22, ±29, ±36 and ±43 mm. The cyclic regime used can also be seen in the hysteresis plots presented in Appendix A of this report.

4. OBSERVATIONS

During the tests very little damage to the fastenings or MDF was observed. Some movement of the nails was observed and could be seen at the end of the tests by slight rotation or protrusion of the nail heads from the surface of the MDF as seen in Figure 6. Generally, the extraction was small and the fixing in Figure 6 is the maximum observed extraction.

Figure 6. Extraction of the nail fixing at a bottom corner of a 1200 mm long specimen

5. RESULTS

Calculation sheets and typical test hysteresis loops are given in Appendix A. P21 results are summarised in Table 1 for the 600mm long specimens and Table 2 for the 1200 mm long specimens. The bracing ratings are only applicable to the construction as tested.

Table 1 Summary of test results for the 600 mm long specimens

BRANZ Identifier	Nominal Wall Length	Earthquake		Wind	
		Specimen rating (BU)	Rating per metre (BU)	Specimen rating (BU)	Rating per metre (BU)
MDF 600	0.6 m	62	103	61	102

Table 2 Summary of test results for the 1200 mm long specimens

BRANZ Identifier	Nominal Wall Length	Earthquake		Wind	
		Specimen rating (BU)	Rating per metre (BU)	Specimen rating (BU)	Rating per metre (BU)
MDF 1200	1.2 m	139	116	148	123

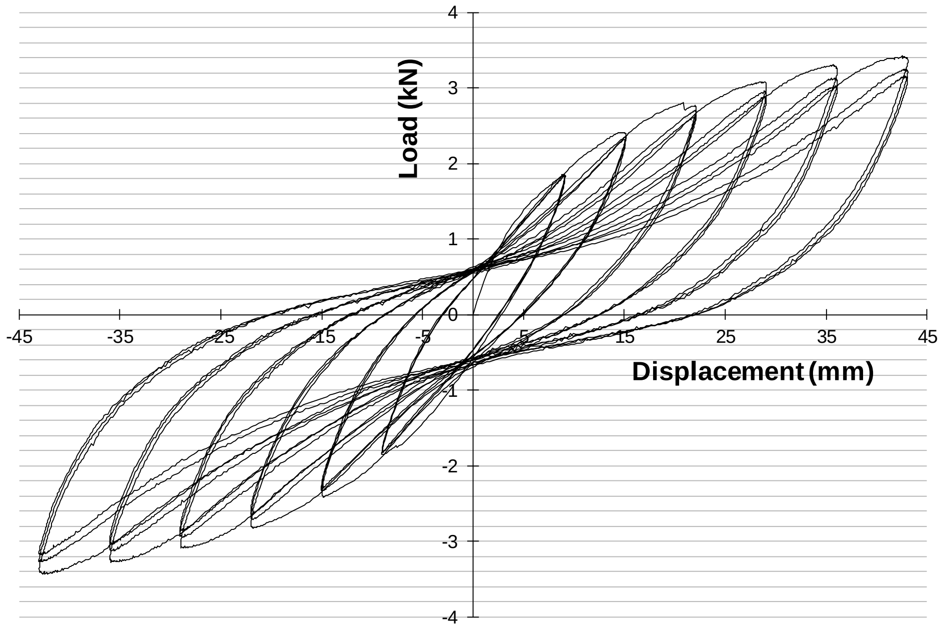
6. REFERENCES

(1) Shelton, R. 2010. Technical Paper P21 (2010) A Wall Bracing Test and Evaluation Procedure. BRANZ Ltd, Judgeford, 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.

APPENDIX A TYPICAL HYSTERESIS LOOPS AND CALCULATIONS

600 mm specimen



	Servicability Cycles Cycle To Displacement x = 8 (mm)		Ultimate Cycles Cycle To Displacement y = 36 (mm)			
Specimen No.	Load S (kN)	Residual Displacement C (mm)	Maximum Load P(kN)	Calculated P/2(kN)	Displacement @P/2=d (mm)	4th Cycle Load at y mm R (KN)
1	+ 1.76	+ 2.45	+ 3.31	+ 1.65	+ 7.00	+ 3.03
	- 1.77	- 2.90	- 3.28			- 3.05
2	+ 1.70	+ 3.10	+ 3.05	+ 1.53	+ 6.40	+ 2.80
	- 1.75	- 2.80	- 3.30			- 3.08
3	+ 1.93	+ 2.80	+ 3.38	+ 1.69	+ 6.10	+ 3.18
	- 1.95	- 3.17	- 3.62			- 3.38
Averages	S= 1.81	C= 2.87	P= 3.32		d= 6.50	R= 3.09

K1 = 1.4 - C/X = 1.00

F = K1 x S = 1.81

The "Asymmetry Of Performance" criterion in the last paragraph of Section 6.5 shall be followed.

u = y/d = 5.54

u	1.00	2.00	2.50	3.00	3.50	4.00
K4	0.35	0.60	0.67	0.74	0.87	1.00

For other values of u, linear interpolation is used to determine K4

Therefore K4 = 1.00

EVALUATION : EARTHQUAKE PERFORMANCE

BU(EQ) = 20 x the lesser of K4R or Fx1.2/0.55

K4 x R = 3.09 Fx1.2/0.55 = 3.95

Therefore BU(EQ) = 20 x 3.09 **BU(EQ) = 62 Bracing Units**

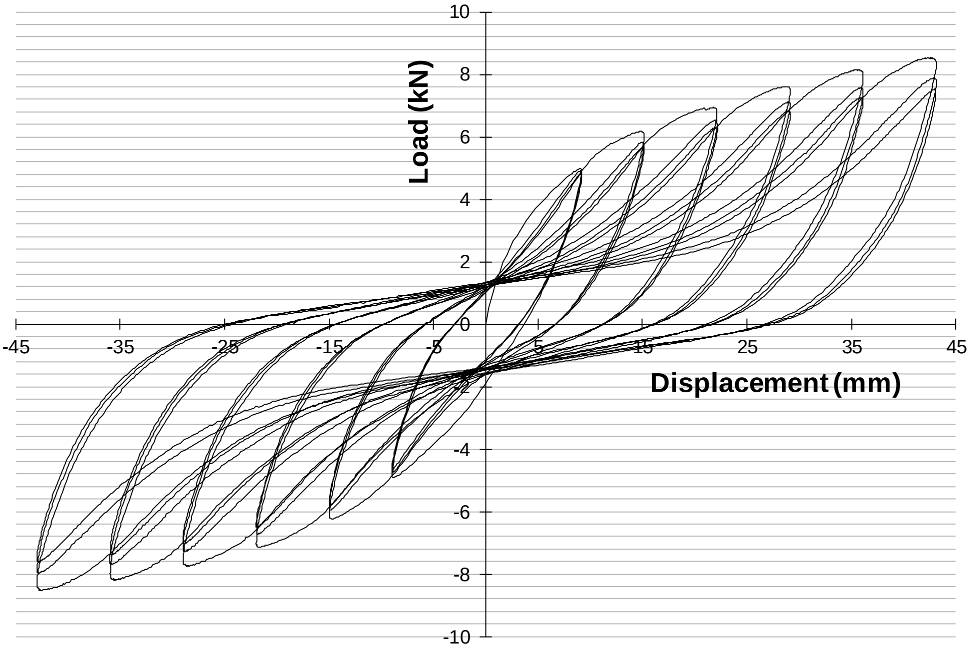
EVALUATION : WIND PERFORMANCE

BU(wind) = 20 x the lesser of P or Fx1.2/0.71

P = 3.32 Fx1.2/0.71 = 3.06

Therefore BU(WIND) = 20 x 3.06 **BU(WIND) = 61 Bracing Units**

1200 mm specimen



	Servicability Cycles Cycle To Displacement x = 8 (mm)		Ultimate Cycles Cycle To Displacement y = 36 (mm)			
Specimen No.	Load S (kN)	Residual Displacement C (mm)	Maximum Load P(kN)	Calculated P/2(kN)	Displacement @P/2=d (mm)	4th Cycle Load at y mm R (KN)
1	+ 4.78	+ 3.10	+ 8.15	+ 4.07	+ 5.75	+ 7.30
	- 4.75	- 3.08	- 8.19			- 7.33
2	+ 4.37	+ 3.50	+ 7.47	+ 3.73	+ 5.85	+ 6.63
	- 4.45	- 2.75	- 7.88			- 7.05
3	+ 4.19	+ 3.55	+ 7.66	+ 3.83	+ 6.40	+ 6.75
	- 4.15	- 4.00	- 7.52			- 6.72
Averages	S= 4.45	C= 3.33	P= 7.81		d= 6.00	R= 6.96

K1 = 1.4 - C/X = 0.98

F = K1 x S = 4.38

The "Asymmetry Of Performance" criterion in the last paragraph of Section 6.5 shall be followed.

u = y/d = 6.00

u	1.00	2.00	2.50	3.00	3.50	4.00
K4	0.35	0.60	0.67	0.74	0.87	1.00

For other values of u, linear interpolation is used to determine K4

Therefore K4 = 1.00

EVALUATION : EARTHQUAKE PERFORMANCE

BU(EQ) = 20 x the lesser of K4R or Fx1.2/0.55

K4 x R = 6.96 Fx1.2/0.55 = 9.55

Therefore BU(EQ) = 20 x 6.96 **BU(EQ) = 139** **Bracing Units**

EVALUATION : WIND PERFORMANCE

BU(wind) = 20 x the lesser of P or Fx1.2/0.71

P = 7.81 Fx1.2/0.71 = 7.4

Therefore BU(WIND) = 20 x 7.40 **BU(WIND) = 148** **Bracing Units**