PlyBrace™ Plywood Technical Note

Version 1 July 2022

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Contents

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bbi® PlyBrace™ Plywood Wall Bracing Specifications

Product	Min Wall Length	PlyBrace™ Thickness	Max Stud Spacing	Wind*	Earthquake**
	mm	mm	mm	BU/m	BU/m
bbi® AraucoPly®® DD F8	200	7	600	41	49
bbi® AraucoPly® DD F8	400	7	600	56	58
bbi® AraucoPly® DD F8	600	7	600	72	80
bbi® AraucoPly® DD F8	1200	7	600	93	100
bbi® Redline® Poplar Core	1200	9	600	109	111
bbi® Redline® Poplar Core	1200	12	600	101	108
bbi® Redline® Premium Hardwood Core	1200	12	600	134	157
bbi® Blondeline® Birch Poplar Core	1200	9	600	102	114
bbi® Blondeline® Birch Poplar Core	1200	12	600	106	106

As limited by the serviceability load capacity.* As limited by the ultimate load capacity.**
Maximum hold down rating for NZS 3604:2011 timber floors is 120BU's/m.
Maximum hold down rating for NZS 3604:2011 concrete floors is 150BU's/m.

bbi® PlyBrace™ Plywood Wall Bracing Systems

bbi® has a range of wall bracing systems in 7 mm, 9 mm, and 12 mm thicknesses used to resist earthquake and wind loads on timber framed buildings.

These products have been manufactured and tested in accordance with NZS3604:2011.

Wall Framing

Wall framing must comply with the New Zealand building code requirements. Nogs are not required to achieve the above bracing unit loadings.

Sheet Fastenings

50 x 2.8 flat head galvanised nails at 150mm centres around the perimeter of the sheet with fixings at 300 centres on internal stud.

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Frame Connections

GIB Handibrac® with M12 hold down bolts, except 7mm DD F8 200mm wall which uses 1 M12 hold down bolt with 50 x 50 x 3 square washer centered in the frame.

Installation Requirements

bbi® AraucoPly® DD F8 can be installed prior to the building being fully enclosed if H3.2 treated. The building must be fully enclosed within 60 days of installation.

bbi® Redline® and **Blondeline®** must only be installed once the building has been fully enclosed and the moisture content of the supporting timber framing does not exceed 18%.

Finishing System

All visible surfaces, including edges must be finished with three coats of polyurethane or a paint system comprising of a primer/sealer, and two topcoats*.

* Excludes bbi® AraucoPly® DD F8

Durability

bbi® PlyBrace™ Wall Bracing Systems have a serviceable life of at least 50 years providing they remain dry.

Design Considerations

bbi® PlyBrace™ Wall Bracing Systems are for use in dry, internal, protected locations of thermally insulated buildings which are heated, intermittently heated and predominantly unheated in accordance with NZS 3602 Section 110, Table 1E and Section 205. The internal environment must be such that the moisture content of the supporting timber framing does not exceed 18%.

bbi® PlyBrace™ Wall Bracing Systems must be located within the building thermal envelope and must either be exposed to view or be in locations easily accessible for inspection. **bbi® PlyBrace™** Wall Bracing Systems must not be located in any high moisture environment or in areas subject to water splash. They must not be used in areas such as bathrooms, toilets, laundries or kitchens.

bbi® PlyBrace™ sheets must not be used in saunas or steam rooms. **bbi® PlyBrace™** Wall Bracing Systems must not be exposed to temperatures of 50°C or greater for prolonged periods. Refer to appliance and fitting manufacturers for installation details.

Prevention of Fire Occurring

Separation or protection must be provided to **bbi® PlyBrace™** Wall Bracing Systems from heat sources such as stoves, heaters, flues and chimneys. Part 7 of NZBC Acceptable Solutions C/AS1 to C/AS6 and NZBC Verification Method C/VM1 provide methods for separation and protection of combustible materials from heat sources.

bbi® PlyBrace™ Wall Bracing Systems are designed to meet the requirements of the New Zealand Building Code and have been tested using the P21 method by Scion Research New Zealand as referenced in NZS3604:2011

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P21 Test Reports

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P21 Test Report

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bbi® AraucoPly®

DD F8 Structural Pine Plywood

7mm 200mm Wall, Brackets

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New Zealand
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Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi AraucoPly DD F8 Structural Pine Plywood 7mm 200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 200mm x 2.4m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side Walls with Brackets.

1. BU wind = 8 (41 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 10 (49 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side,
90x45 H1.2 SG8 framing, studs at 200mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates,
No brackets used
One M12 hold down bolt with 50x50x3mm washer to centre of bottom plate
P21 Supplementary restraints used.

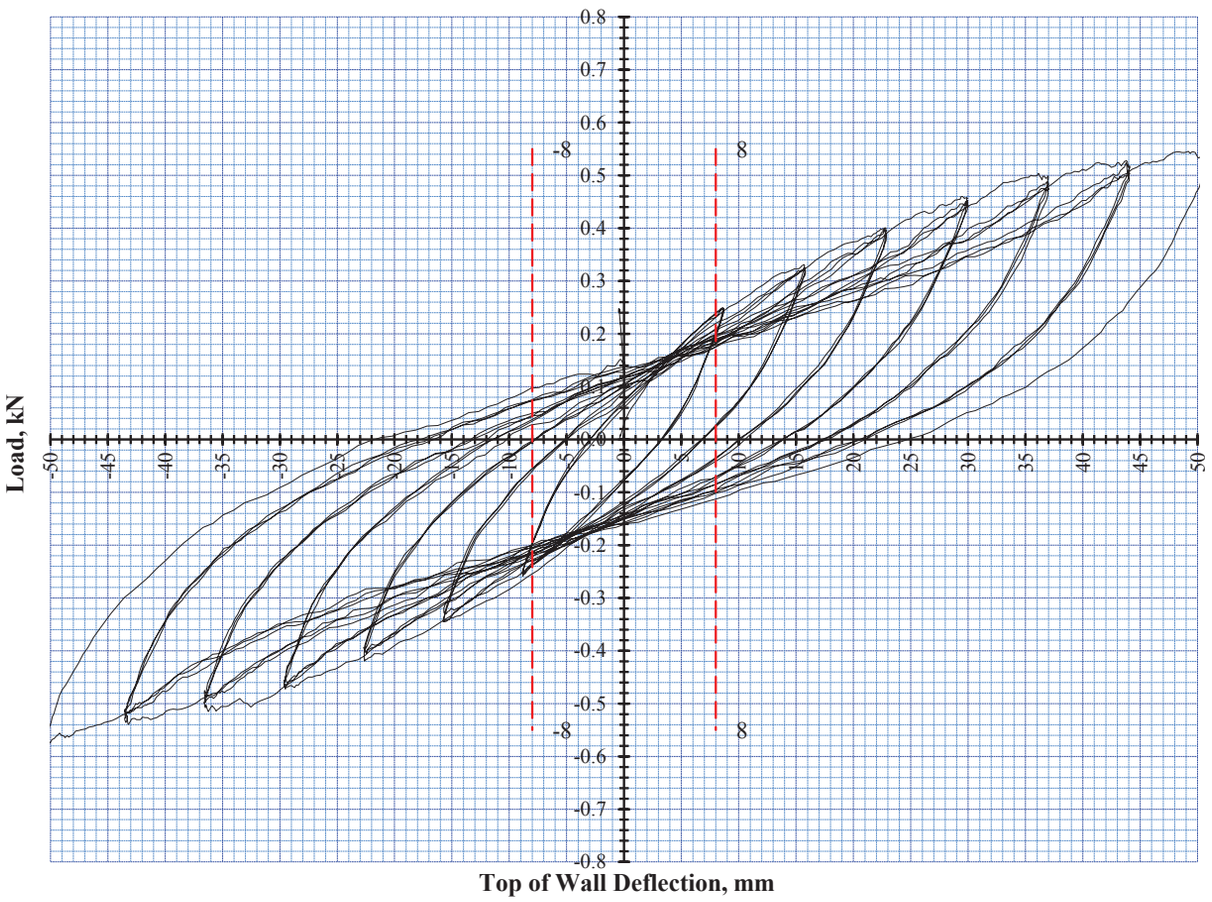

Figure 1: *Wall 289145*

Observations

No obvious signs of failure to framing or plywood

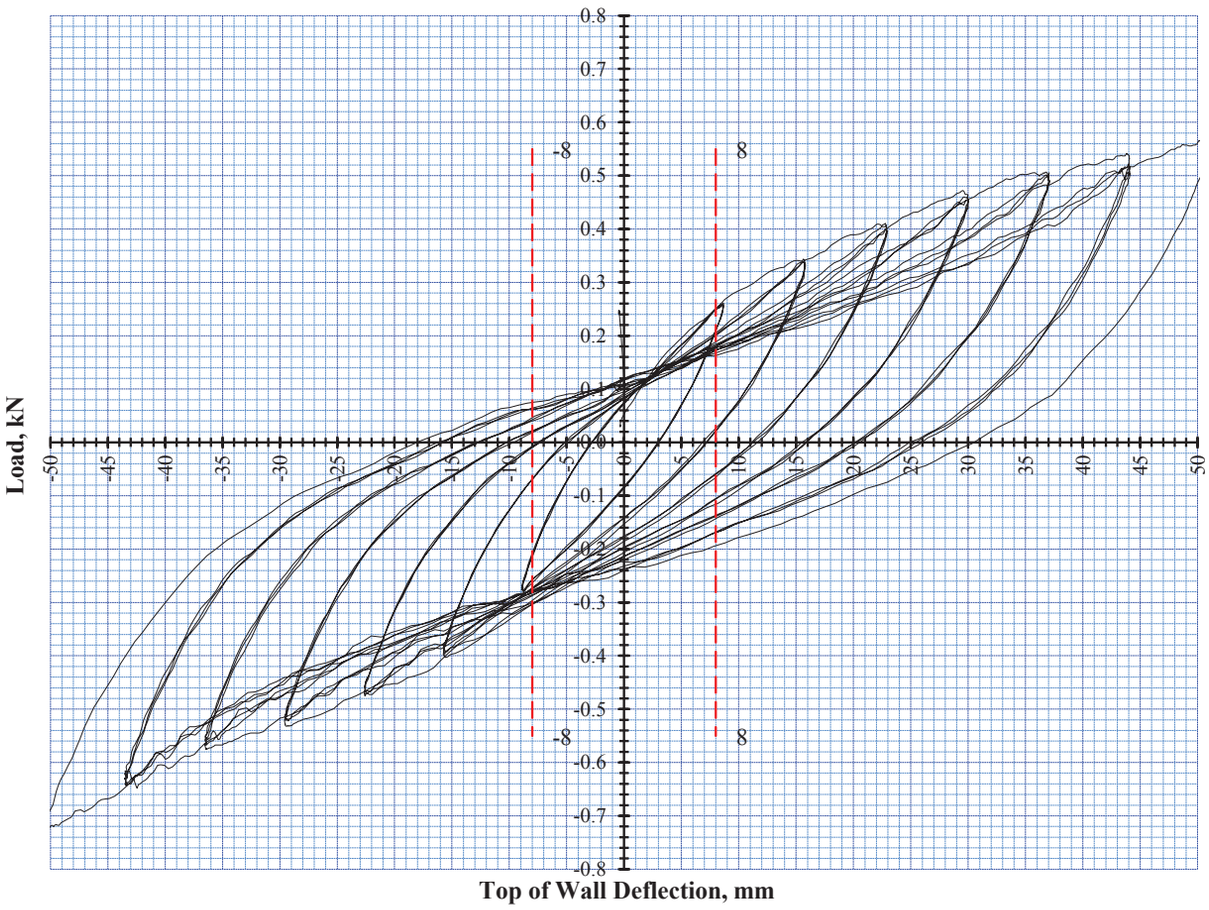

Figure 2: *Wall 289146*

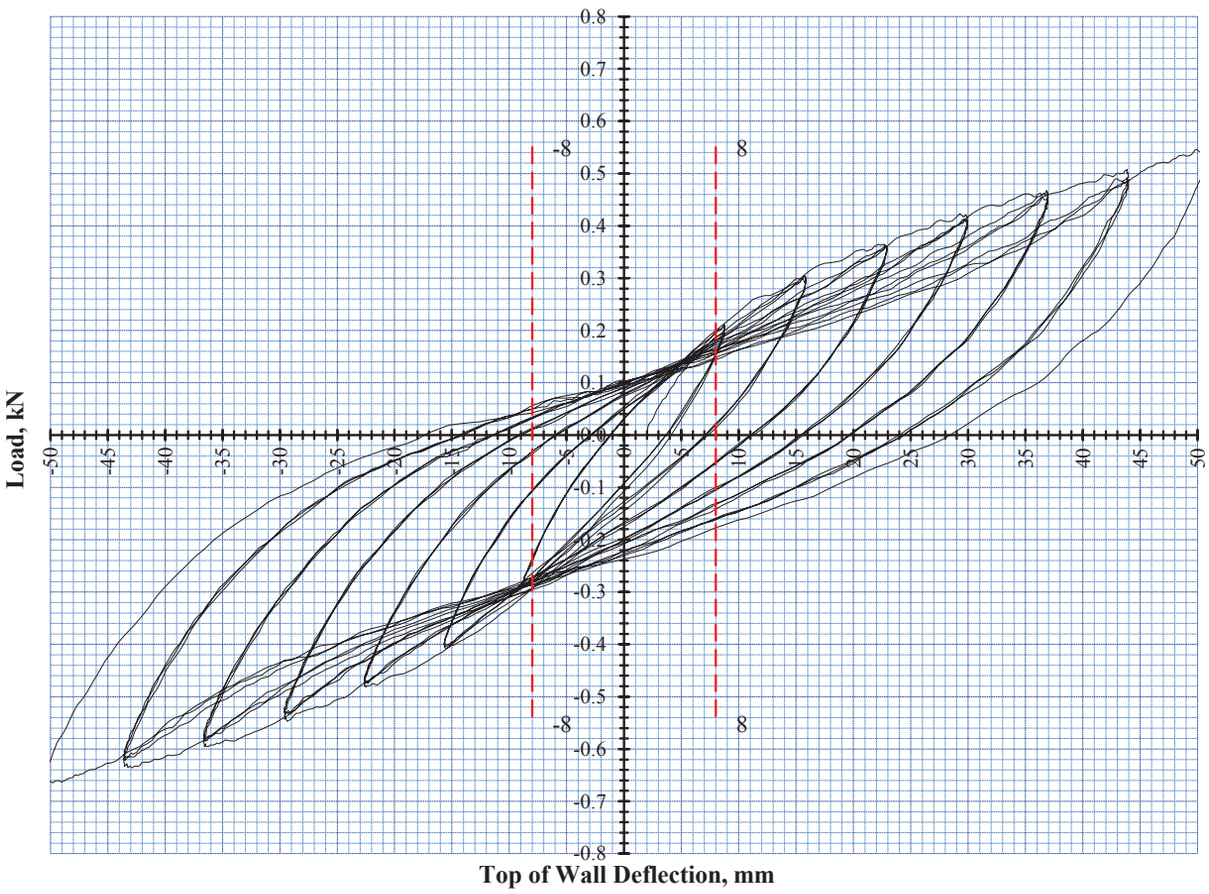

Figure 3: *Wall 289147*

P21:2010 BRACING RACKING TEST RESULT EVALUATION								
Wall Construction								
200mm, bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side								
90x45 H1.2 SG8 framing, studs at 200mm centres, no nogs								
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres						**Summary**		
to plates and external studs						**Earthquake**	**49 (U)**	**BU/m**
7mm min edge distances all around.						**Wind**	**41 (S)**	**BU/m**
One M12 hold down bolt with 50x50x3mm washer to centre of bottom plate								
P21 Supplementary restraints used								
Date of test:-		**25-May-22**	Ship No.	**3251**		Tested by	John Lee	
Date of calc's:-		**30-May-22**	Job No.	**TE21-068**		Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011					*Scion, Private Bag 3020 Rotorua.*			
		Serviceability Cycles		Ultimate Cycles				
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement			Wall dimensions	
		8.0	X mm	y=(mm)			L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum			200	2410
		(P_8)	Defln, C	Load	def @ P		d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)	d mm	kN
289145	**+**	**0.24**	**3.20**	**0.50**	**36.0**	0.25	**9.0**	**0.46**
	-	**0.24**	**2.50**	**0.51**	**36.0**			**0.48**
289146	**+**	**0.25**	**3.00**	**0.50**	**36.0**	0.25	**8.0**	**0.48**
	-	**0.26**	**2.80**	**0.57**	**36.0**			**0.52**
289147	**+**	**0.20**	**3.60**	**0.46**	**36.0**	0.23	**9.5**	**0.44**
	-	**0.28**	**1.10**	**0.59**	**36.0**			**0.57**
		(P_8)	(C)	(P)	(y)	P/2 (kN)	(d)	(Ry)
Averages		0.24	2.70	0.52	36.00	0.24	8.83	0.49
Coefficient of Variation %		9.97	29.32	8.50	0.00	3.97	7.06	8.56
y = average failure deflection or peak deflection of the three tests.								
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)								
R = Residual load, P = Peak Load, S = Serviceability load								
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =	1.2	
Average Structural Displacement Ductility factor						u = y/d	4.08	
Ductility Modification factor						K4 =	1.00	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces				

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289145	(BU)	1.00	9.5	10.4	10.1	8.1
	(BU/m)		47	52	51	40
289146	(BU)	1.00	10.0	11.1	10.7	8.6
	(BU/m)		50	56	54	43
289147	(BU)	1.00	10.1	10.5	10.5	8.1
	(BU/m)		51	52	53	41
		289145	*-6% Ok result*	*-4% Ok result*	*-5% Ok result*	*-4% Ok result*
<20% Result Check		*289146*	*2% Ok result*	*6% Ok result*	*4% Ok result*	*6% Ok result*
		289147	*4% Ok result*	*-3% Ok result*	*1% Ok result*	*-3% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**		**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**10**	(P8 x K1) x (K2/0.55) =	**11**
	49	**BU/m**	**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**		**Serviceability**
Wind (BU's)	20 * P =	**10**	(P8 x K1) x (K2/0.71) =	**8**
	41	**BU/m**	**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 200mm x 2.40m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

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P21 Test Report

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bbi® AraucoPly®

DD F8 Structural Pine Plywood

7mm 400mm Wall, Brackets

Endless possibilities.

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Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi AraucoPly DD F8 Structural Pine Plywood 7mm 400mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 400mm x 2.4m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side Walls with Brackets.

1. BU wind = 22 (56 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 23 (58 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side,
90x45 H1.2 SG8 framing, studs at 400mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates,
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

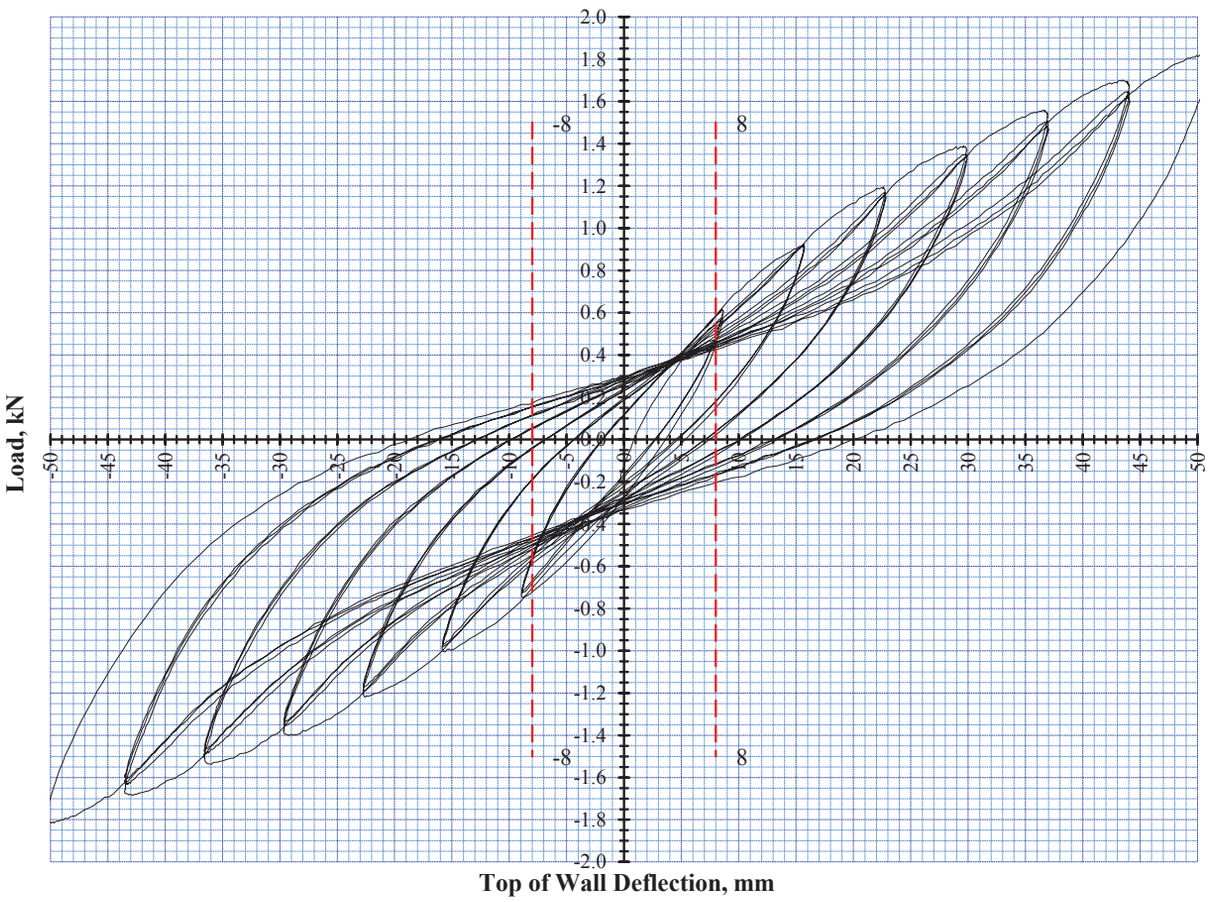

Figure 1: *Wall 289142*

Observations

No obvious signs of failure to framing or plywood

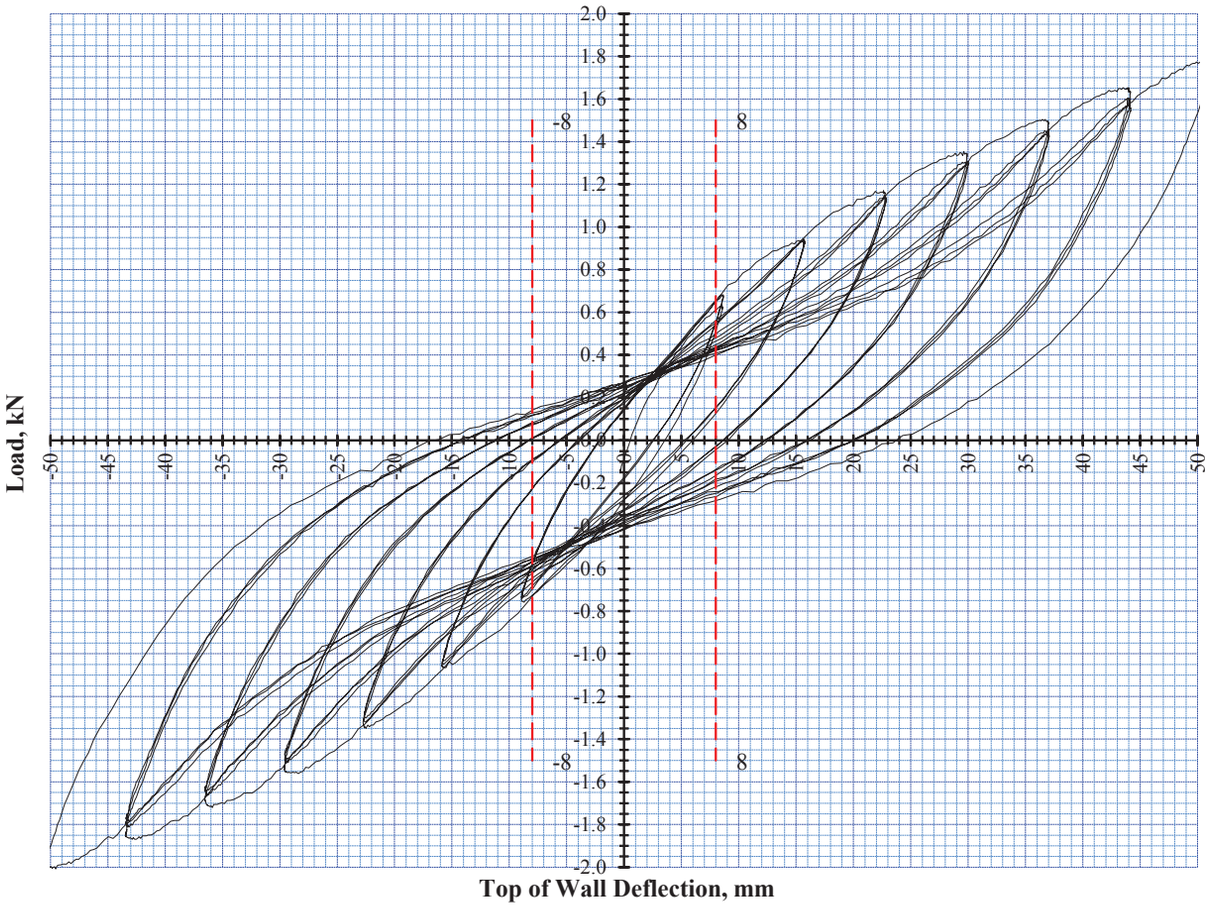

Figure 2: *Wall 289143*

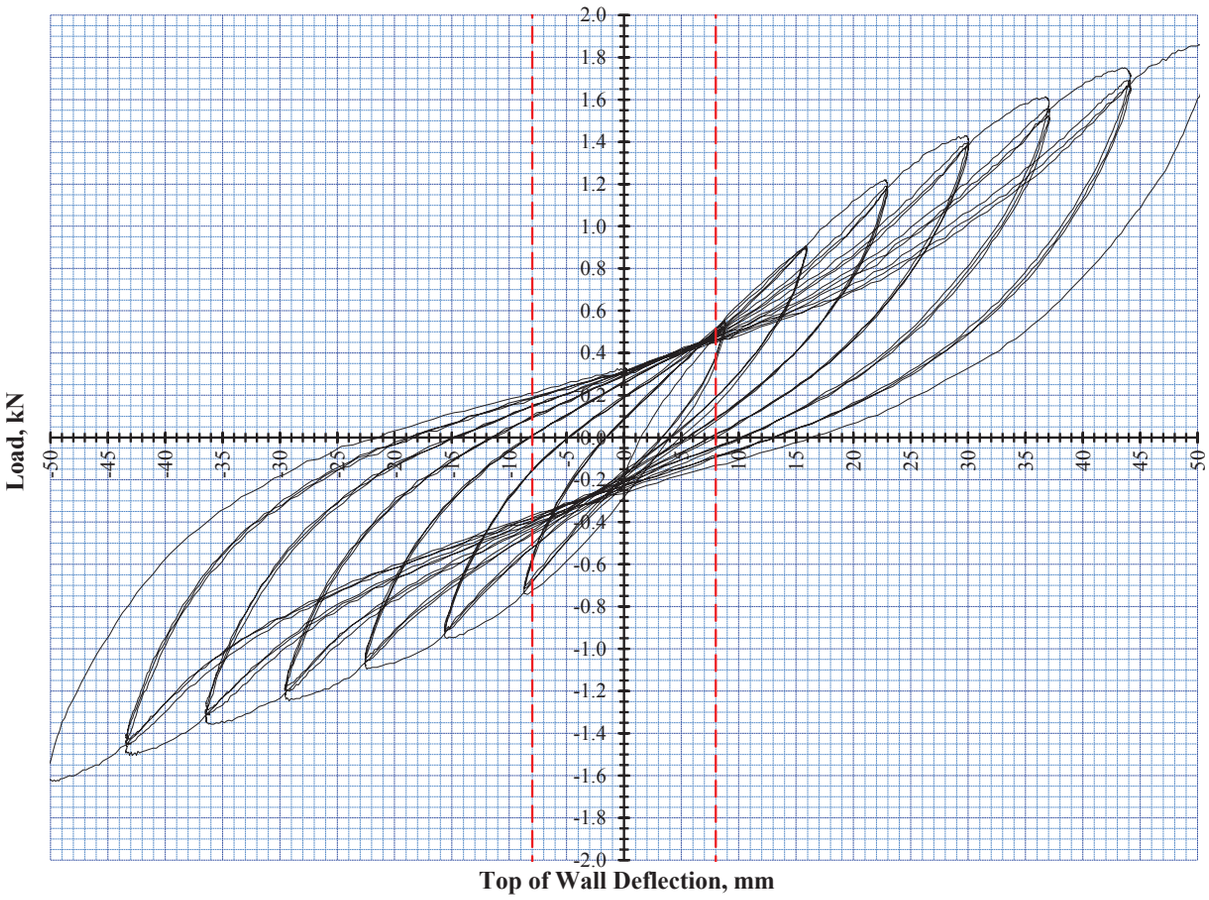

Figure 3: *Wall 289144*

P21:2010 BRACING RACKING TEST RESULT EVALUATION								
Wall Construction								
400mm, bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side								
90x45 H1.2 SG8 framing, studs at 400mm centres, no nogs								
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres						**Summary**		
to plates and external studs						**Earthquake**	**58 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end						**Wind**	**56 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets								
P21 Supplementary restraints used								
Date of test:-		**25-May-22**	Ship No.	**3251**		Tested by	John Lee	
Date of calc's:-		**30-May-22**	Job No.	**TE21-068**		Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011					*Scion, Private Bag 3020 Rotorua.*			
		Serviceability Cycles		Ultimate Cycles				
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement			Wall dimensions	
		8.0	X mm	y=(mm)			L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum			400	2410
		(P_8)	Defln, C	Load	def @ P		d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)	d mm	kN
289142	**+**	**0.58**	**2.70**	**1.55**	**36.0**	0.78	**11.6**	**1.44**
	-	**0.73**	**1.80**	**1.53**	**36.0**			**1.45**
289143	**+**	**0.67**	**2.40**	**1.50**	**36.0**	0.75	**9.7**	**1.40**
	-	**0.73**	**2.00**	**1.72**	**36.0**			**1.65**
289144	**+**	**0.52**	**3.20**	**1.60**	**36.0**	0.80	**13.3**	**1.47**
	-	**0.72**	**1.60**	**1.35**	**36.0**			**1.27**
		(P_8)	(C)	(P)	(y)	P/2 (kN)	(d)	(Ry)
Averages		0.66	2.28	1.54	36.00	0.78	11.53	1.45
Coefficient of Variation %		12.32	24.04	7.20	0.00	2.63	12.75	7.75
y = average failure deflection or peak deflection of the three tests.								
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)								
R = Residual load, P = Peak Load, S = Serviceability load								
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =	1.2	
Average Structural Displacement Ductility factor						u = y/d	3.12	
Ductility Modification factor						K4 =	0.80	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces				

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289142	(BU)	1.00	23.1	28.6	30.8	22.1
	(BU/m)		58	71	77	55
289143	(BU)	1.00	24.4	30.5	32.2	23.7
	(BU/m)		61	76	81	59
289144	(BU)	1.00	21.9	27.1	29.5	21.0
	(BU/m)		55	68	74	52
		289142	*0% Ok result*	*-1% Ok result*	*0% Ok result*	*-1% Ok result*
<20% Result Check		*289143*	*8% Ok result*	*9% Ok result*	*6% Ok result*	*9% Ok result*
		289144	*-8% Ok result*	*-9% Ok result*	*-7% Ok result*	*-9% Ok result*
Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.						

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**23**	(P8 x K1) x (K2/0.55) =		**29**
	58	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**31**	(P8 x K1) x (K2/0.71) =		**22**
	56	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 400mm x 2.40m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

bbi wood products

P21 Test Report

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bbi® AraucoPly®

DD F8 Structural Pine Plywood

7mm 600mm Wall, Brackets

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Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi AraucoPly DD F8 Structural Pine Plywood 7mm 600mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 600mm x 2.4m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side Walls with Brackets.

1. BU wind = 43 (72 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 48 (80 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates,
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

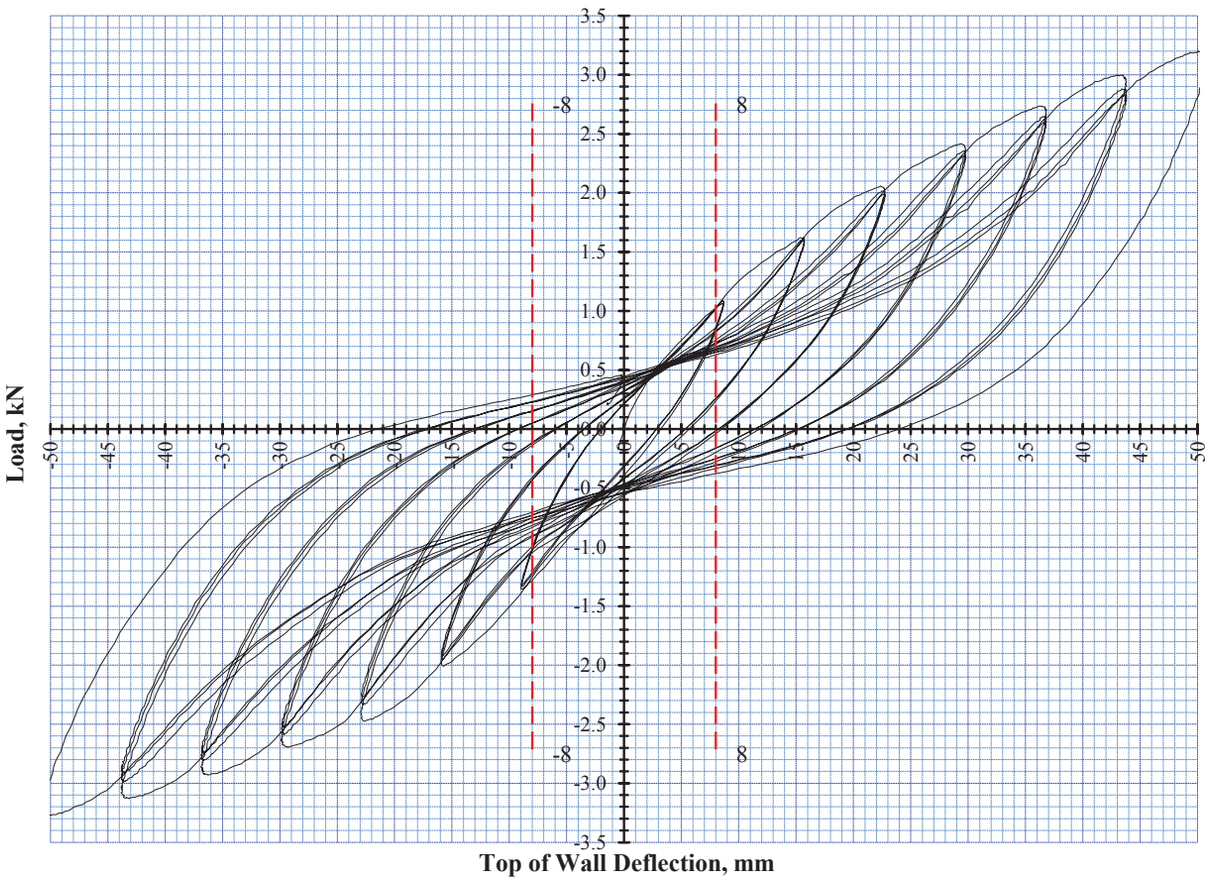

Figure 1: *Wall 289139*

Observations

No obvious signs of failure to framing or plywood

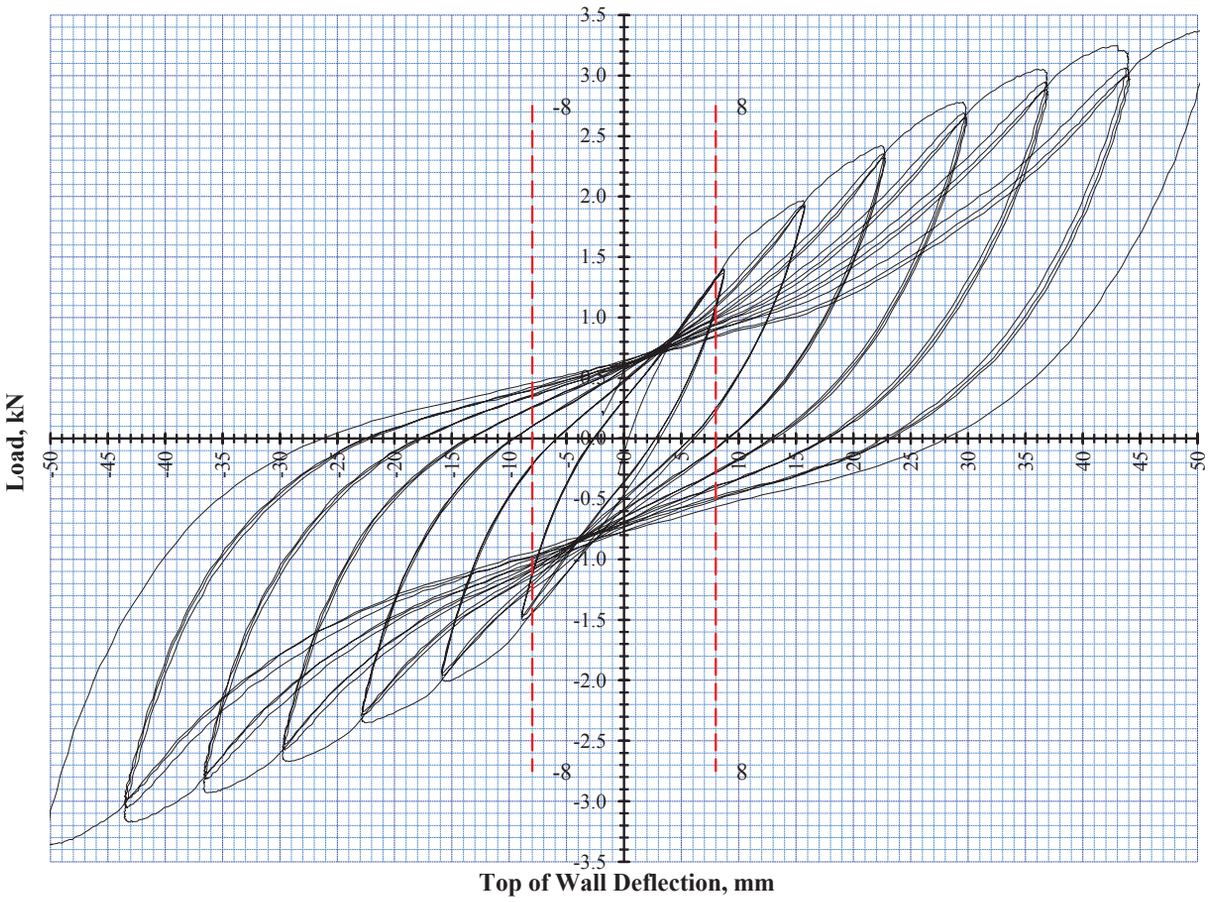

Figure 2: *Wall 289140*

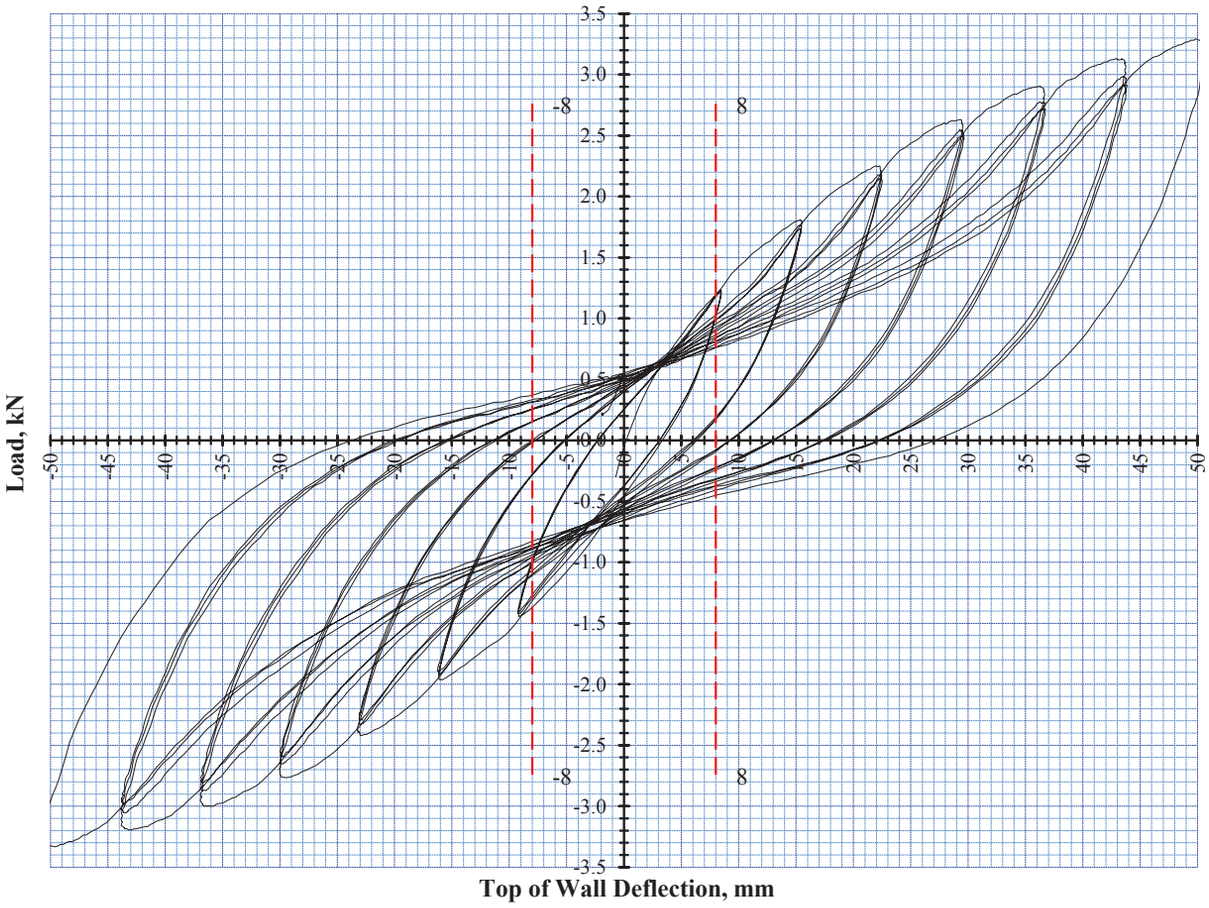

Figure 3: *Wall 289141*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
600mm, bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres						**Summary**			
to plates and external studs						**Earthquake**	**80 (U)**	**BU/m**	
7mm min edge distances all around. GIB Handibracs used each end						**Wind**	**72 (S)**	**BU/m**	
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**25-May-22**	Ship No.	**3251**		Tested by	John Lee		
Date of calc's:-		**30-May-22**	Job No.	**TE21-068**		Analysed by	Doug Gaunt		
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011				*Scion, Private Bag 3020 Rotorua.*					
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement			Wall dimensions		
		8.0	X mm	y=(mm)			L(mm)	H(mm)	
Lab Number	Direction	Loads	Residual	Maximum			600	2410	
		(P_8)	Defln, C	Load	def @ P		d at P/2	4th, R	
		kN	mm	P(kN)	y (mm)	P/2 (kN)	d mm	kN	
289139	**+**	**1.03**	**2.80**	**2.73**	**36.0**	1.37	**11.7**	**2.55**	
	-	**1.28**	**2.00**	**2.93**	**36.0**			**2.69**	
289140	**+**	**1.34**	**2.80**	**3.05**	**36.0**	1.53	**9.4**	**2.83**	
	-	**1.44**	**2.60**	**2.93**	**36.0**			**2.73**	
289141	**+**	**1.20**	**3.00**	**2.80**	**36.0**	1.40	**9.6**	**2.69**	
	-	**1.37**	**2.20**	**3.00**	**36.0**			**2.75**	
		(P_8)	(C)	(P)	(y)	P/2 (kN)	(d)	(Ry)	
Averages		1.28	2.57	2.91	36.00	1.43	10.23	2.71	
Coefficient of Variation %		10.42	13.81	3.79	0.00	4.80	10.17	3.12	
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =	1.2		
Average Structural Displacement Ductility factor						u = y/d	3.52		
Ductility Modification factor						K4 =	0.88		
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289139	(BU)	1.00	46.2	50.4	56.6	39.0
	(BU/m)		77	84	94	65
289140	(BU)	1.00	49.0	60.7	59.8	47.0
	(BU/m)		82	101	100	78
289141	(BU)	1.00	48.0	56.1	58.0	43.4
	(BU/m)		80	93	97	72
		289139	*-5% Ok result*	*-16% Ok result*	*-4% Ok result*	*-16% Ok result*
<20% Result Check		*289140*	*4% Ok result*	*12% Ok result*	*4% Ok result*	*12% Ok result*
		289141	*1% Ok result*	*1% Ok result*	*0% Ok result*	*1% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**48**	(P8 x K1) x (K2/0.55) =		**56**
	80	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**58**	(P8 x K1) x (K2/0.71) =		**43**
	72	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 600mm x 2.40m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

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P21 Test Report

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DD F8 Structural Pine Plywood

7mm 1200mm Wall, Brackets

Endless possibilities.

Te Papa Tipu Innovation Park
49 Sala Street
Private Bag 3020
Rotorua
New Zealand
Telephone: +64 7 343 5899
DDI: +64 7 343 5763
Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi AraucoPly DD F8 Structural Pine Plywood 7mm 1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side Walls with Brackets.

1. BU wind = 112 (93 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 120 (100 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

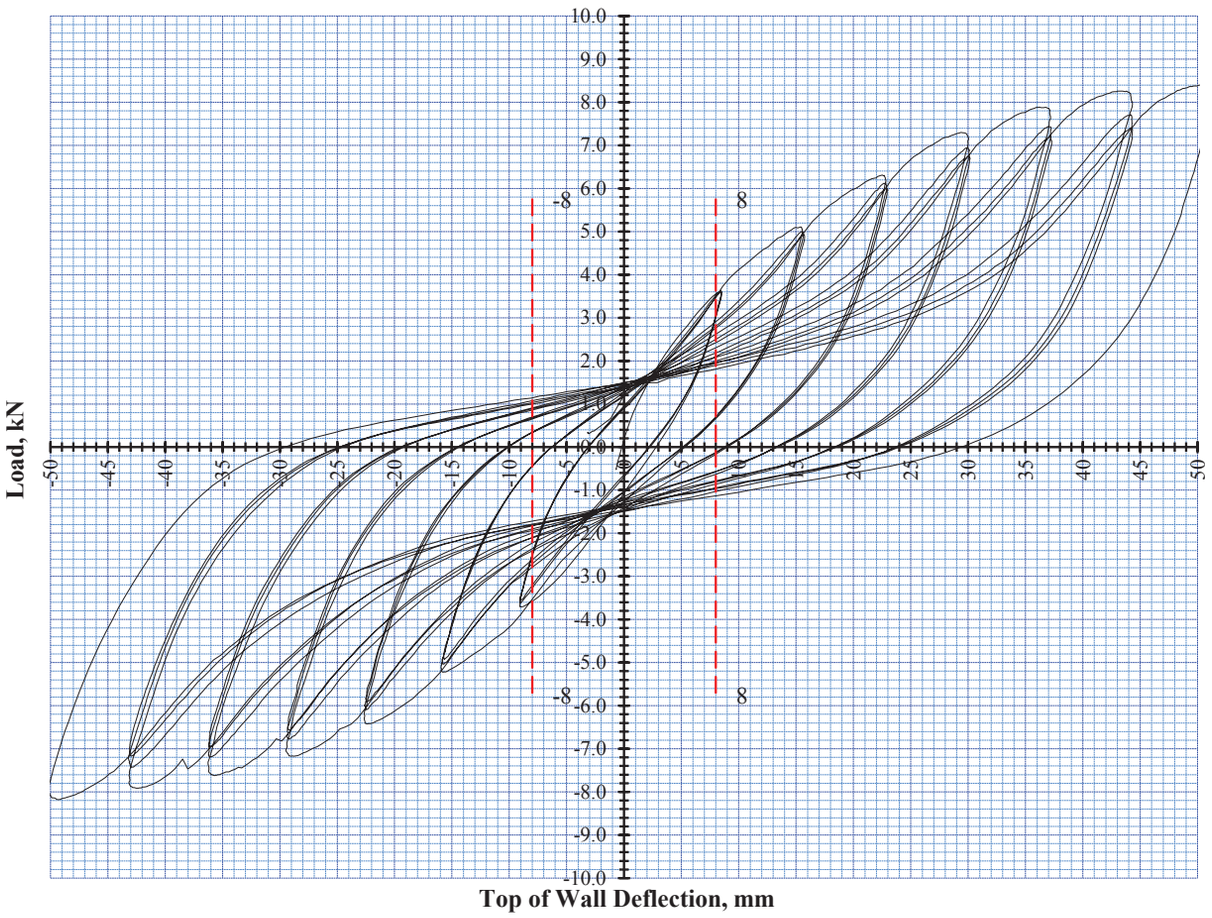

Figure 1: *Wall 289133*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

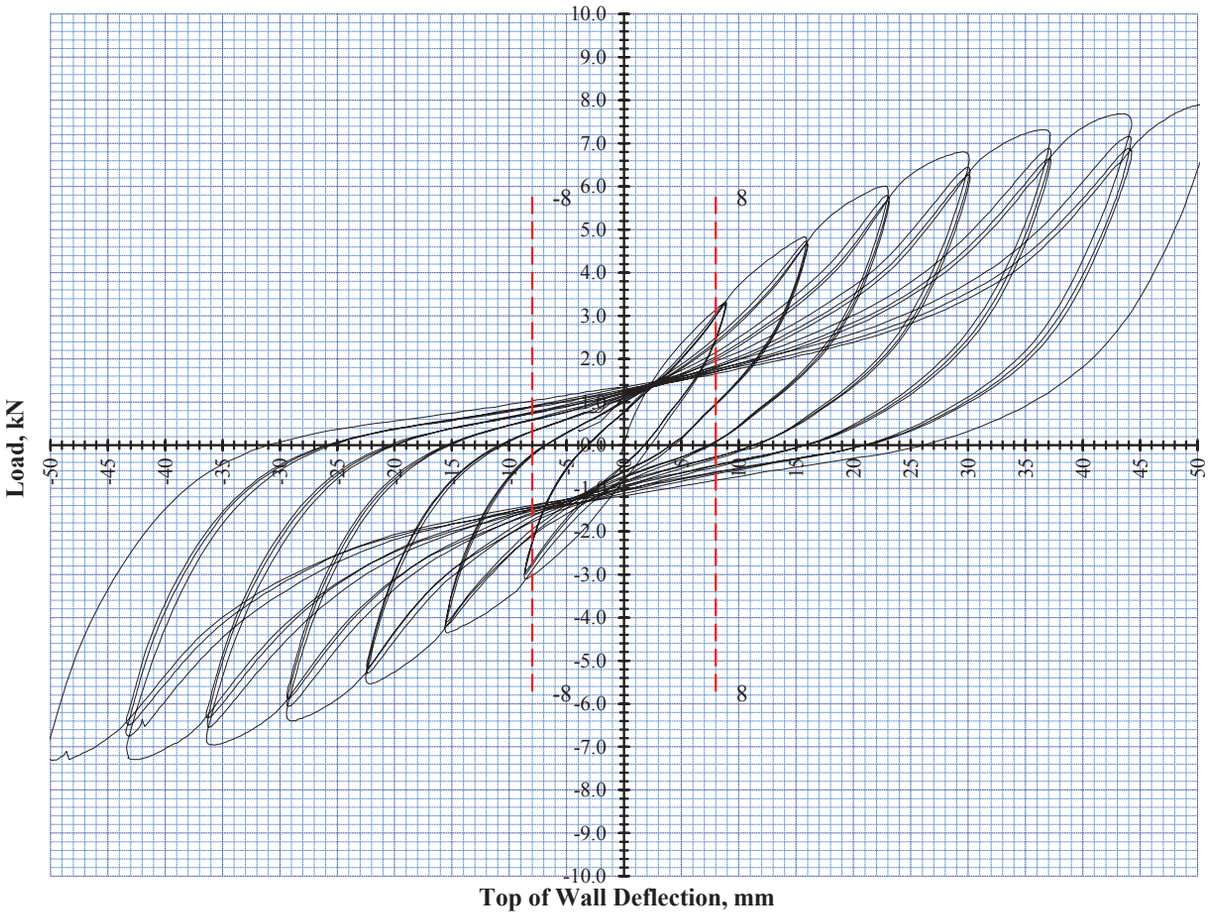

Figure 2: *Wall 289134*

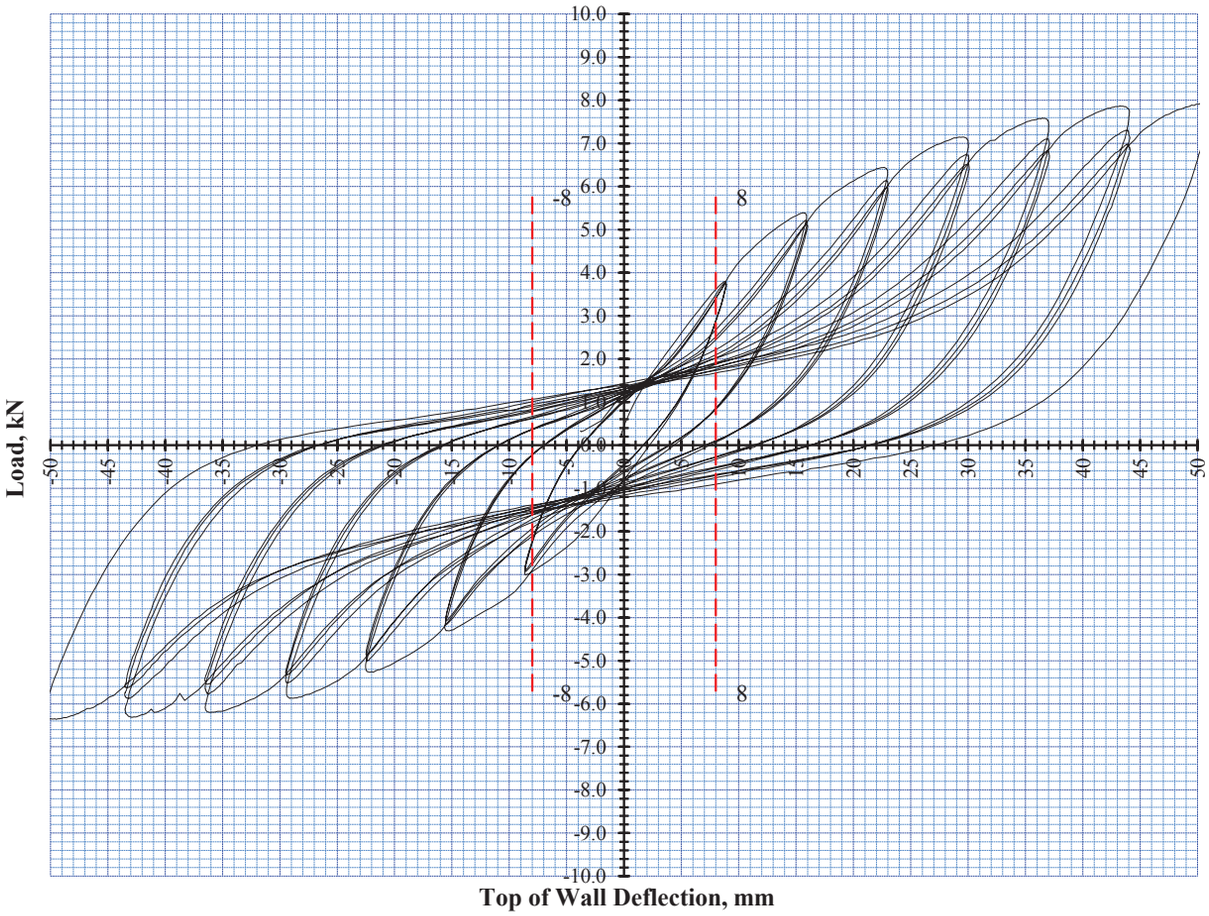

Figure 3: *Wall 289135*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
1200mm, bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres							**Summary**		
to plates and external studs, 300mm to internal studs,							**Earthquake**	**100 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end							**Wind**	**93 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**25-May-22**	Ship No.	**3251**			Tested by	John Lee	
Date of calc's:-		**25-May-22**	Job No.	**TE21-068**			Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011					*Scion, Private Bag 3020 Rotorua.*				
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement				Wall dimensions	
		8.0	X mm	y=(mm)				L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum				1200	2410
		(P_8)	Defln, C	Load	def @ P			d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)		d mm	kN
289133	**+**	**3.55**	**2.10**	**7.87**	**36.0**	3.94		**9.5**	**6.80**
	-	**3.58**	**3.10**	**7.80**	**36.0**				**6.95**
289134	**+**	**3.12**	**1.70**	**7.30**	**36.0**	3.65		**9.7**	**6.22**
	-	**3.04**	**3.10**	**6.96**	**36.0**				**6.18**
289135	**+**	**3.62**	**1.60**	**7.55**	**36.0**	3.78		**9.0**	**6.50**
	-	**2.93**	**3.60**	**6.19**	**36.0**				**5.35**
		(P_8)	(C)	(P)	(y)	P/2 (kN)		(d)	(Ry)
Averages		3.31	2.53	7.28	36.00	3.79		9.40	6.33
Coefficient of Variation %		8.55	30.29	7.90	0.00	3.08		3.13	8.23
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =		1.2	
Average Structural Displacement Ductility factor						u = y/d		3.83	
Ductility Modification factor						K4 =		0.95	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289133	(BU)	1.00	130.1	155.6	156.7	120.5
	(BU/m)		108	130	131	100
289134	(BU)	1.00	117.3	134.4	142.6	104.1
	(BU/m)		98	112	119	87
289135	(BU)	1.00	112.1	142.9	137.4	110.7
	(BU/m)		93	119	115	92
		289133	*12% Ok result*	*11% Ok result*	*11% Ok result*	*11% Ok result*
<20% Result Check		*289134*	*-3% Ok result*	*-11% Ok result*	*-3% Ok result*	*-11% Ok result*
		289135	*-10% Ok result*	*-1% Ok result*	*-9% Ok result*	*-1% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**120**	(P8 x K1) x (K2/0.55) =		**144**
	100	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**146**	(P8 x K1) x (K2/0.71) =		**112**
	93	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi AraucoPly DD F8 Structural Pine Plywood 7mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

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Poplar Core Plywood 9mm
1200mm Wall, Brackets

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Rotorua
New Zealand
Telephone: +64 7 343 5899
DDI: +64 7 343 5763
Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi RedLine Poplar Core Plywood 9mm 1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4mm bbi RedLine Poplar Core Plywood 9mm one side Walls with Brackets.

1. BU wind = 130 (109 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 133 (111 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi RedLine Poplar Core Plywood 9mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

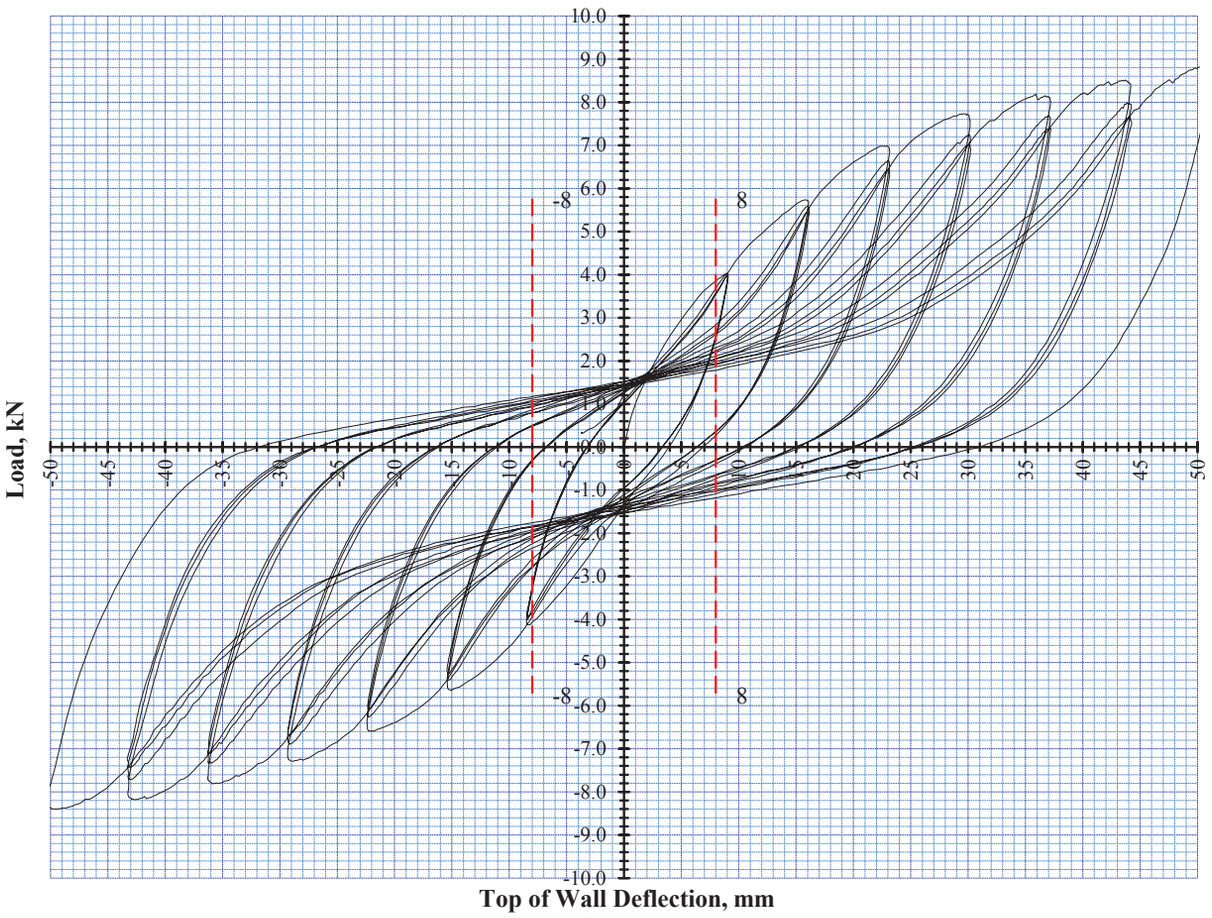

Figure 1: *Wall 289136*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

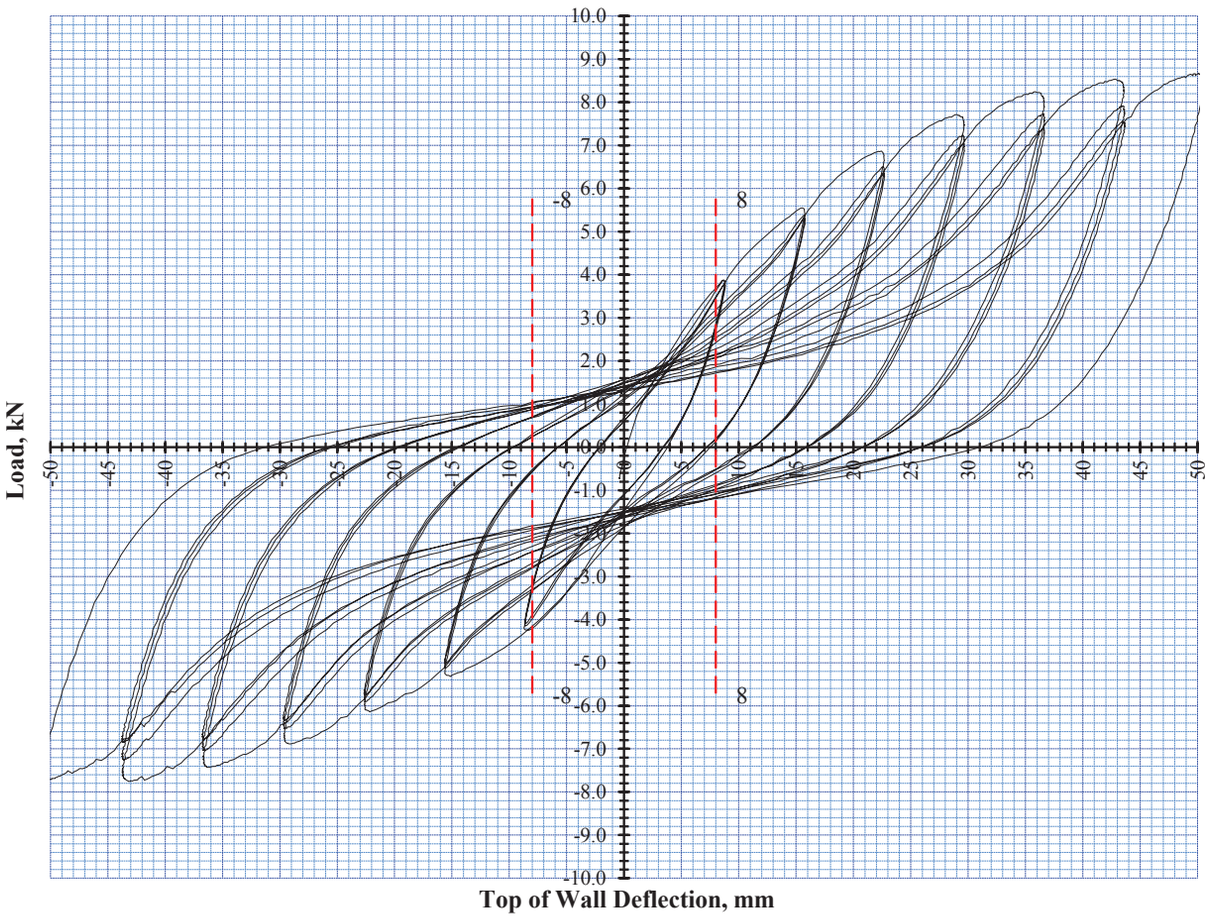

Figure 2: *Wall 289137*

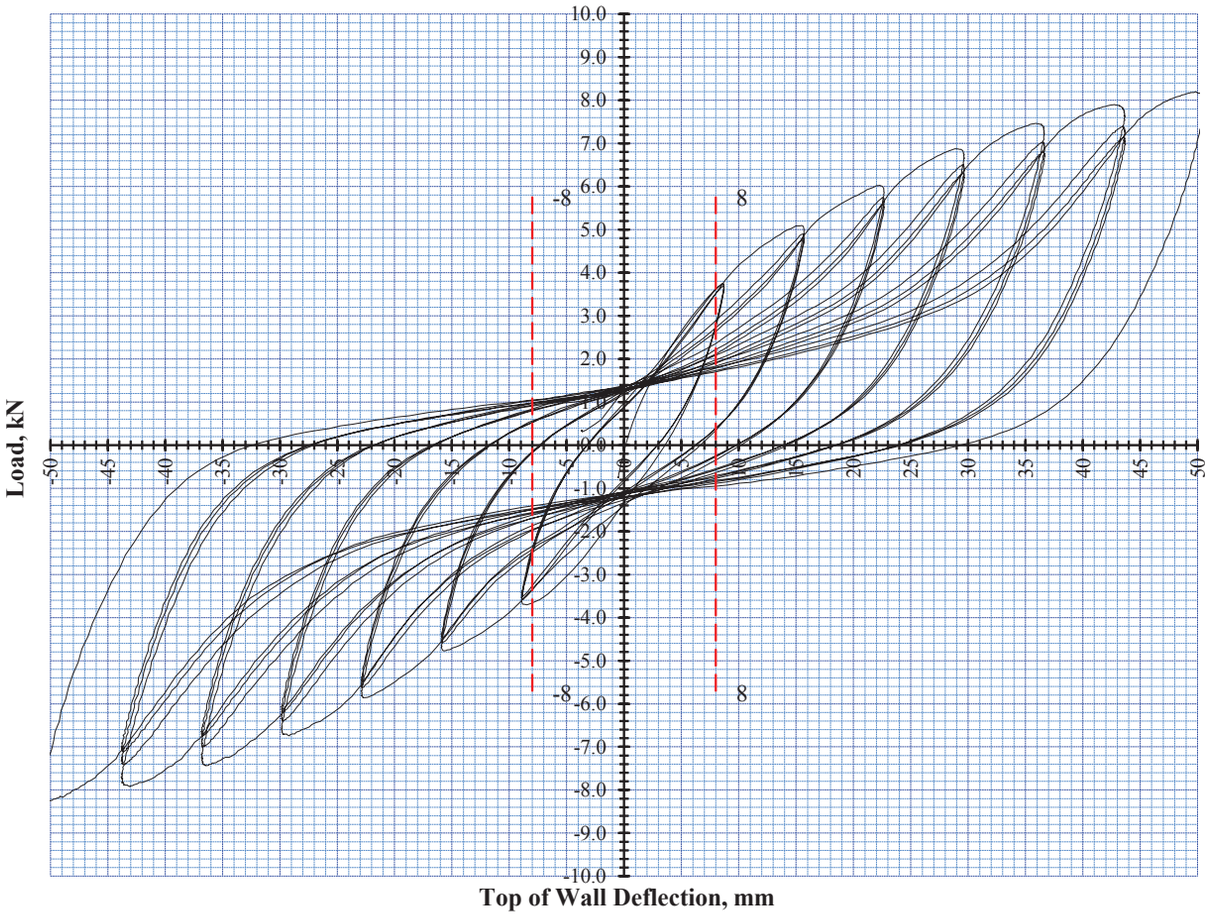

Figure 3: *Wall 289138*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
1200mm, bbi RedLine Poplar Core Plywood 9mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres							**Summary**		
to plates and external studs, 300mm to internal studs,							**Earthquake**	**111 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end							**Wind**	**109 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**25-May-22**	Ship No.	**3251**			Tested by	John Lee	
Date of calc's:-		**26-May-22**	Job No.	**TE21-068**			Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011					*Scion, Private Bag 3020 Rotorua.*				
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement				Wall dimensions	
		8.0	X mm	y=(mm)				L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum				1200	2410
		(P_8)	Defln, C	Load	def @ P			d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)		d mm	kN
289136	**+**	**3.83**	**3.30**	**8.10**	**36.0**	4.05		**9.1**	**6.97**
	-	**4.07**	**3.20**	**7.80**	**36.0**				**7.00**
289137	**+**	**3.85**	**2.90**	**8.22**	**36.0**	4.11		**9.5**	**7.20**
	-	**4.08**	**2.50**	**7.41**	**36.0**				**6.60**
289138	**+**	**3.65**	**2.80**	**7.45**	**36.0**	3.73		**8.5**	**6.62**
	-	**3.67**	**3.10**	**7.40**	**36.0**				**6.45**
		(P_8)	(C)	(P)	(y)	P/2 (kN)		(d)	(Ry)
Averages		3.86	2.97	7.73	36.00	3.96		9.03	6.81
Coefficient of Variation %		4.41	9.06	4.33	0.00	4.27		4.55	3.90
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =		1.2	
Average Structural Displacement Ductility factor						u = y/d		3.99	
Ductility Modification factor						K4 =		0.98	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289136	(BU)	1.00	136.7	171.6	159.0	132.9
	(BU/m)		114	143	133	111
289137	(BU)	1.00	135.0	173.0	156.3	134.0
	(BU/m)		113	144	130	112
289138	(BU)	1.00	127.9	159.7	148.5	123.7
	(BU/m)		107	133	124	103
		289136	*4% Ok result*	*3% Ok result*	*4% Ok result*	*3% Ok result*
<20% Result Check		*289137*	*2% Ok result*	*4% Ok result*	*2% Ok result*	*4% Ok result*
		289138	*-6% Ok result*	*-8% Ok result*	*-6% Ok result*	*-8% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**133**	(P8 x K1) x (K2/0.55) =		**168**
	111	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**155**	(P8 x K1) x (K2/0.71) =		**130**
	109	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi RedLine Poplar Core Plywood 9mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

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P21 Test Report

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Poplar Core Plywood 12mm
1200mm Wall, Brackets

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Private Bag 3020
Rotorua
New Zealand
Telephone: +64 7 343 5899
DDI: +64 7 343 5763
Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi RedLine Poplar Core Plywood 12mm 1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4m bbi RedLine Poplar Core Plywood 12mm one side Walls with Brackets.

1. BU wind = 121 (101 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 130 (108 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi RedLine Poplar Core Plywood 12mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

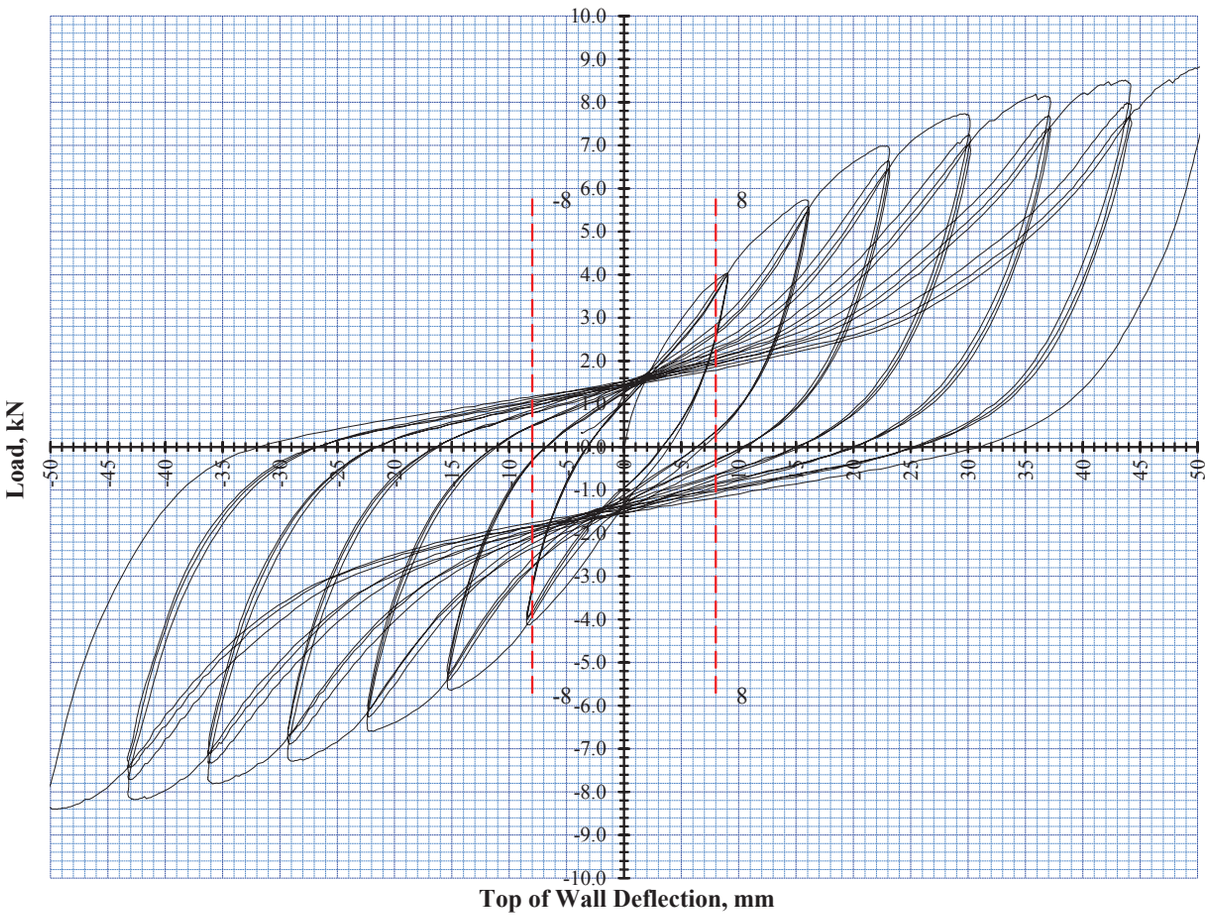

Figure 1: *Wall 289136*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

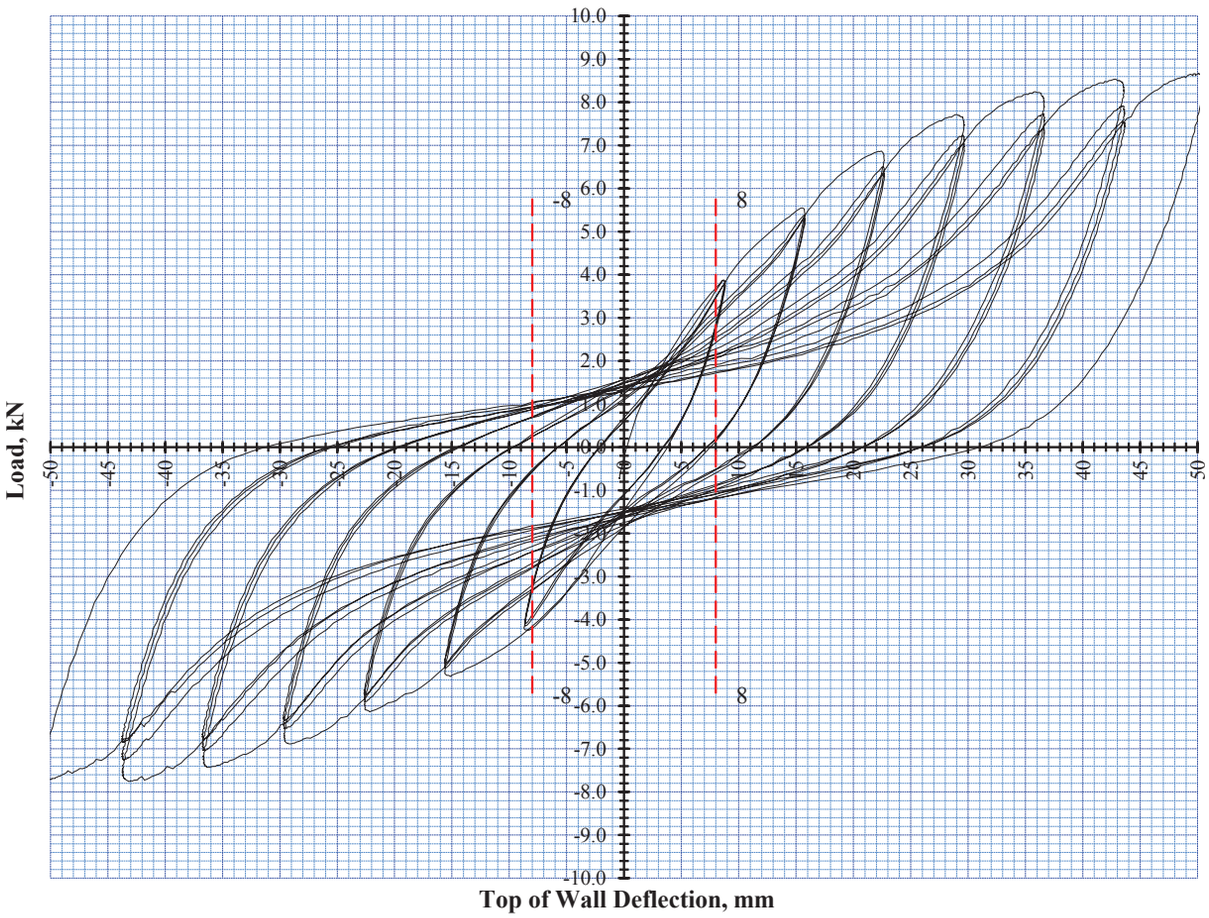

Figure 2: *Wall 289137*

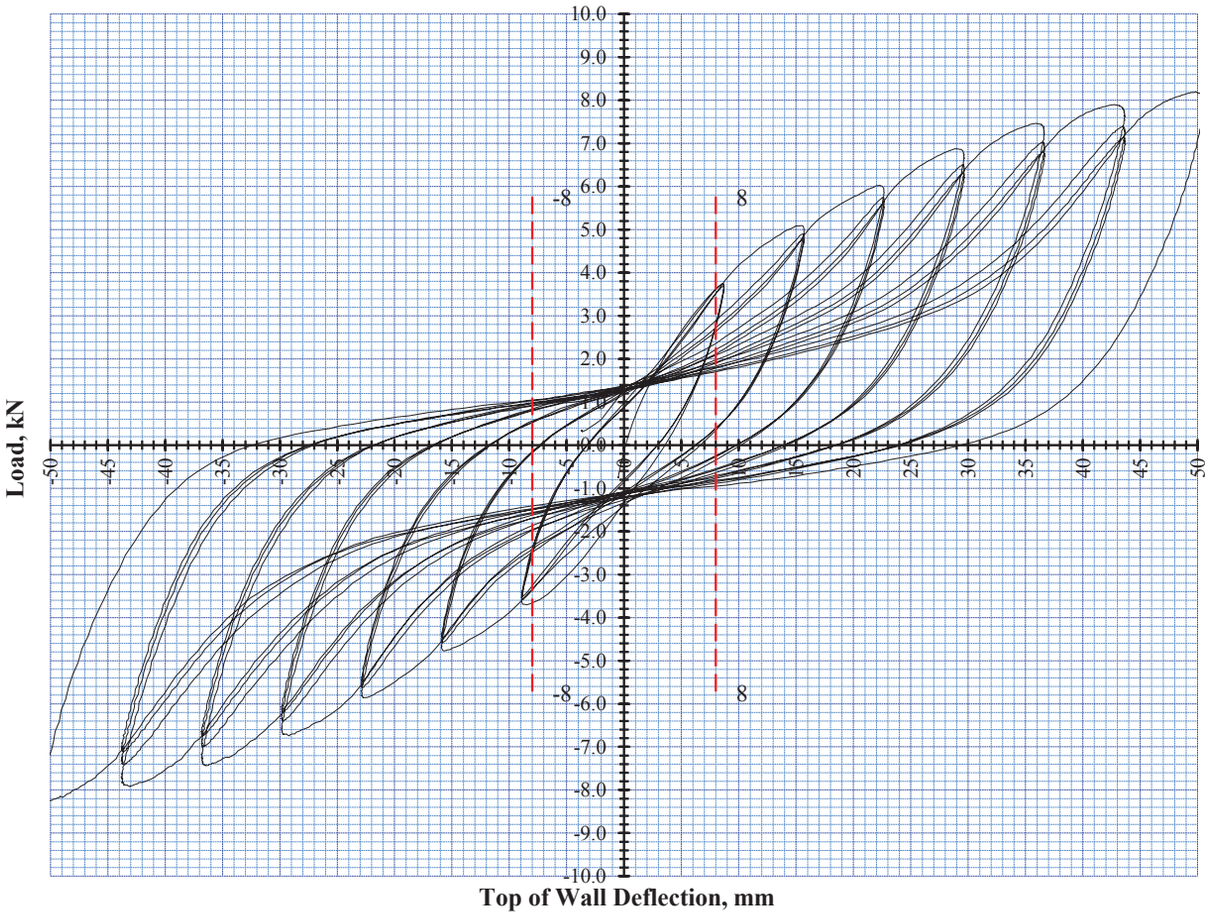

Figure 3: *Wall 289138*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
1200mm, bbi RedLine Poplar Core Plywood 9mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres							**Summary**		
to plates and external studs, 300mm to internal studs,							**Earthquake**	**111 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end							**Wind**	**109 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**25-May-22**	Ship No.	**3251**			Tested by	John Lee	
Date of calc's:-		**26-May-22**	Job No.	**TE21-068**			Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011				*Scion, Private Bag 3020 Rotorua.*					
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement				Wall dimensions	
		8.0	X mm	y=(mm)				L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum				1200	2410
		(P_8)	Defln, C	Load	def @ P			d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)		d mm	kN
289136	**+**	**3.83**	**3.30**	**8.10**	**36.0**	4.05		**9.1**	**6.97**
	-	**4.07**	**3.20**	**7.80**	**36.0**				**7.00**
289137	**+**	**3.85**	**2.90**	**8.22**	**36.0**	4.11		**9.5**	**7.20**
	-	**4.08**	**2.50**	**7.41**	**36.0**				**6.60**
289138	**+**	**3.65**	**2.80**	**7.45**	**36.0**	3.73		**8.5**	**6.62**
	-	**3.67**	**3.10**	**7.40**	**36.0**				**6.45**
		(P_8)	(C)	(P)	(y)	P/2 (kN)		(d)	(Ry)
Averages		3.86	2.97	7.73	36.00	3.96		9.03	6.81
Coefficient of Variation %		4.41	9.06	4.33	0.00	4.27		4.55	3.90
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =		1.2	
Average Structural Displacement Ductility factor						u = y/d		3.99	
Ductility Modification factor						K4 =		0.98	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289136	(BU)	1.00	136.7	171.6	159.0	132.9
	(BU/m)		114	143	133	111
289137	(BU)	1.00	135.0	173.0	156.3	134.0
	(BU/m)		113	144	130	112
289138	(BU)	1.00	127.9	159.7	148.5	123.7
	(BU/m)		107	133	124	103
		289136	*4% Ok result*	*3% Ok result*	*4% Ok result*	*3% Ok result*
<20% Result Check		*289137*	*2% Ok result*	*4% Ok result*	*2% Ok result*	*4% Ok result*
		289138	*-6% Ok result*	*-8% Ok result*	*-6% Ok result*	*-8% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**133**	(P8 x K1) x (K2/0.55) =		**168**
	111	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**155**	(P8 x K1) x (K2/0.71) =		**130**
	109	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi RedLine Poplar Core Plywood 9mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

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bbi® Redline®

Premium Hardwood Core
Plywood 12mm 1200mm
Wall, Brackets

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Rotorua
New Zealand
Telephone: +64 7 343 5899
DDI: +64 7 343 5763
Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi RedLine Premium Hardwood Core Plywood 12mm1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4m bbi RedLine Premium Hardwood Core Plywood 12mm one side Walls with Brackets.

1. BU wind = 134 (112 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 157 (131 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi RedLine Premium Hardwood Core Plywood 12mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

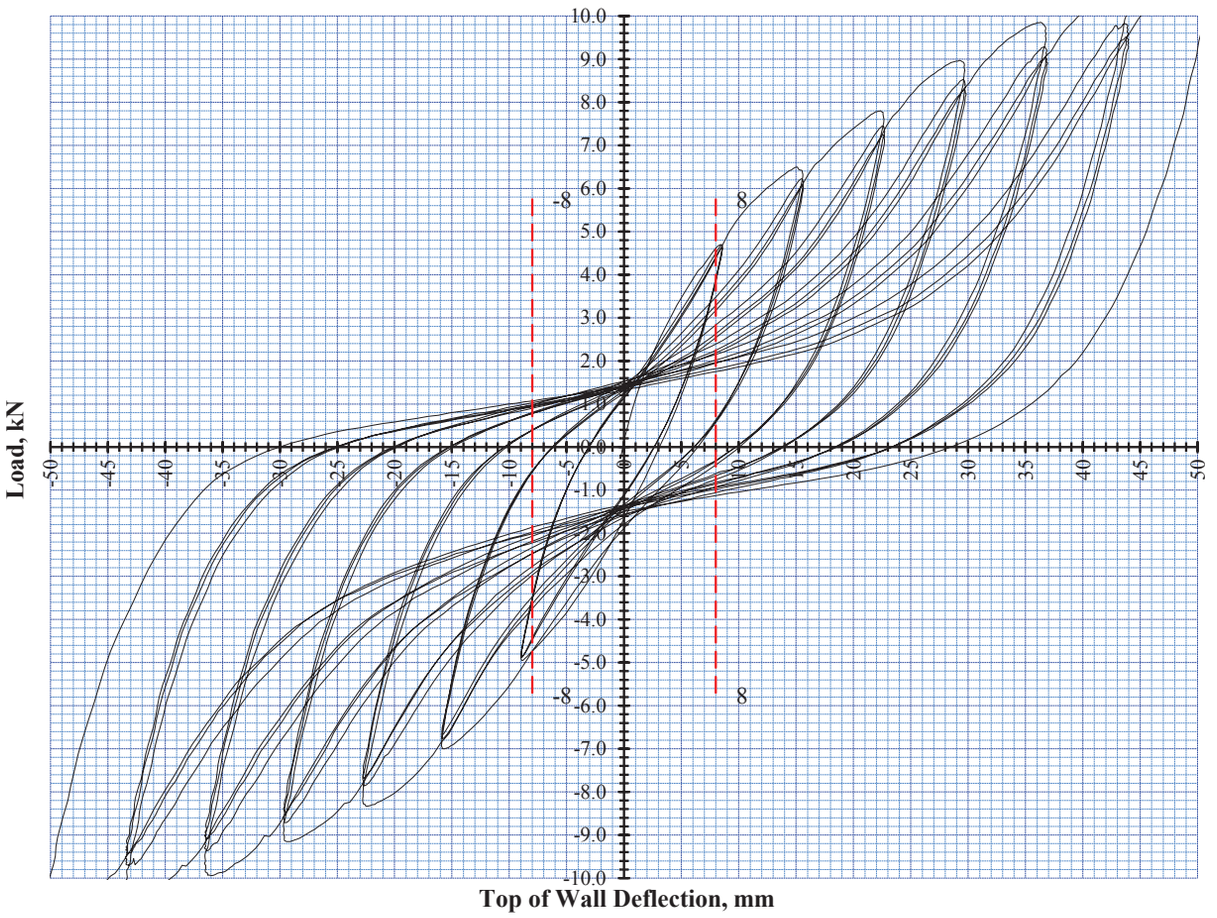

Figure 1: *Wall 289124*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

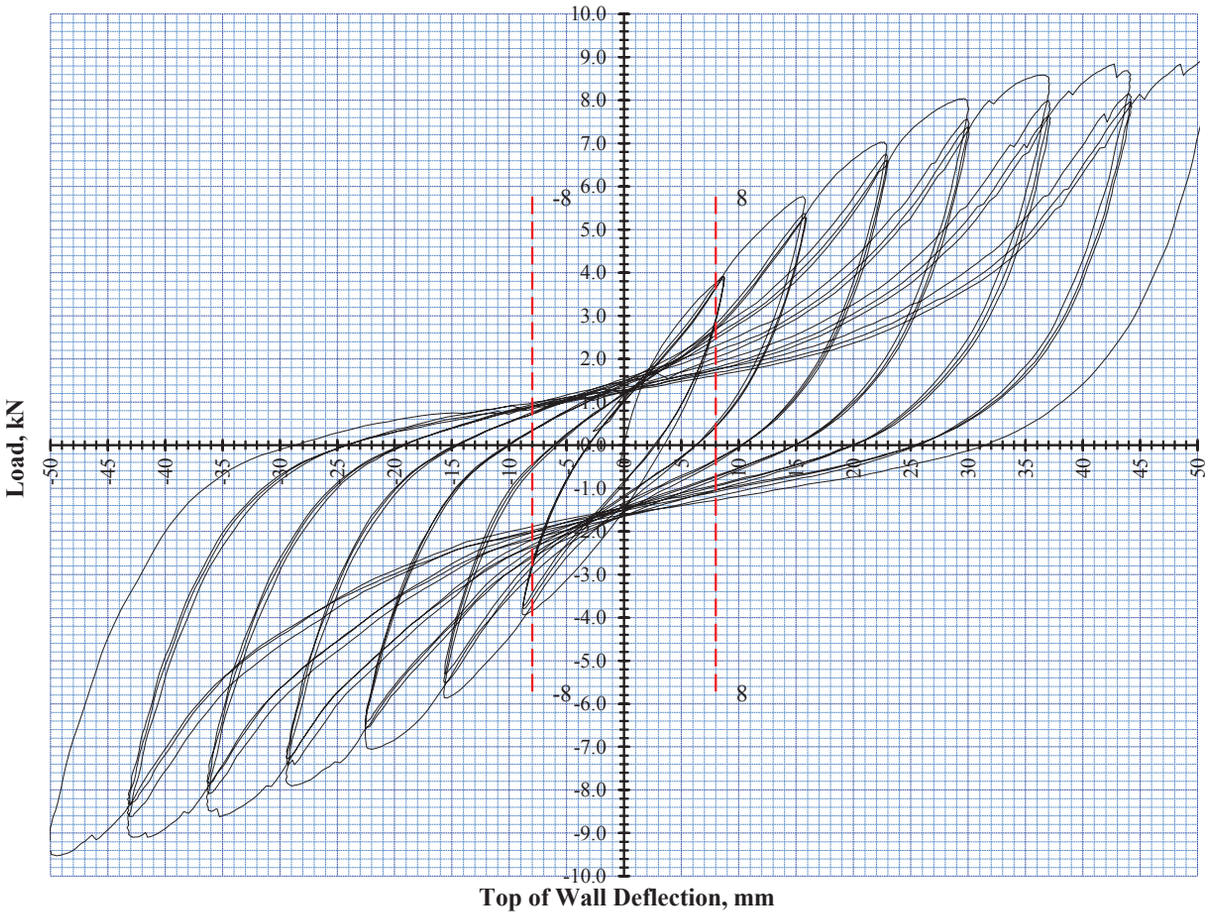

Figure 2: *Wall 289125*

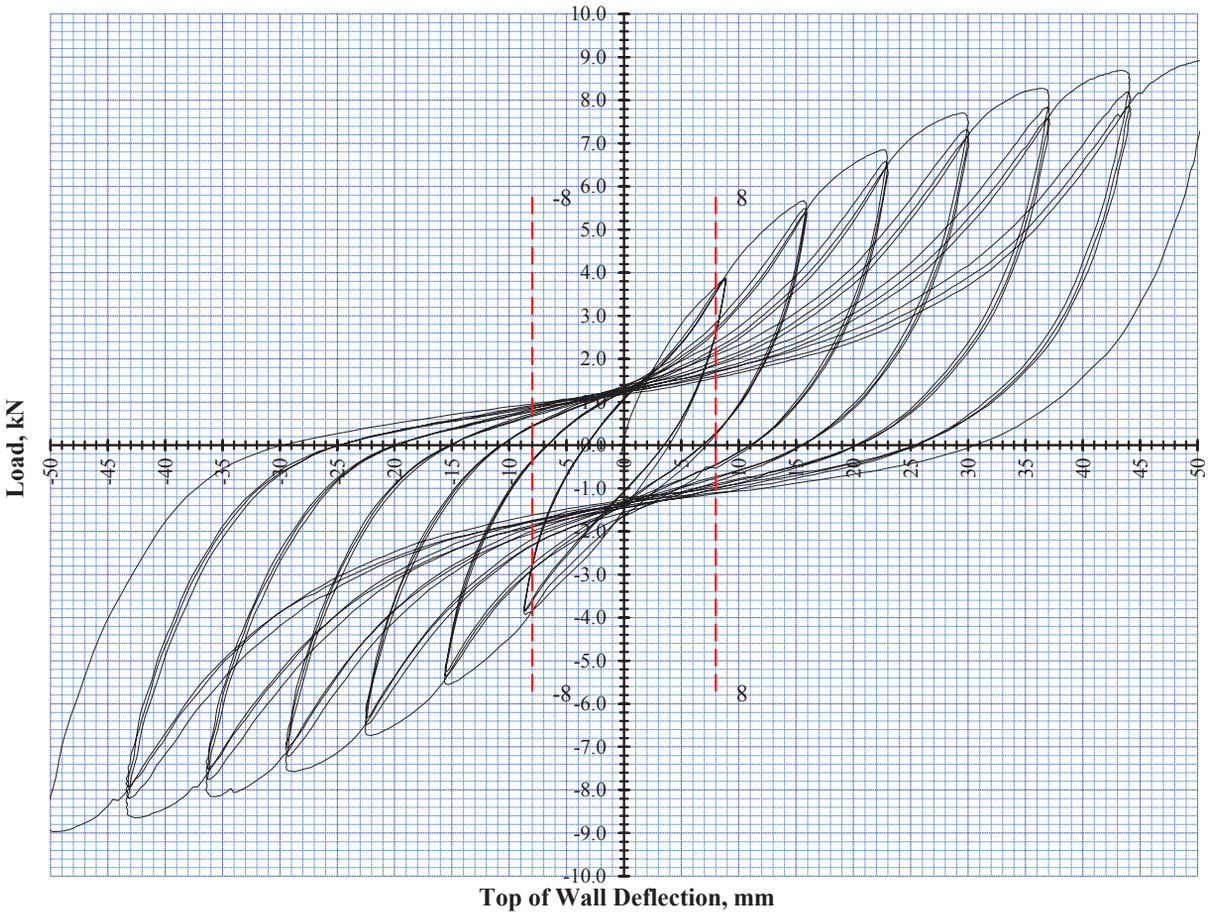

Figure 3: *Wall 289126*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
1200mm, bbi RedLine Premium Hardwood Core Plywood 12mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres						**Summary**			
to plates and external studs, 300mm to internal studs,						**Earthquake**	**131 (U)**	**BU/m**	
7mm min edge distances all around. GIB Handibracs used each end						**Wind**	**112 (S)**	**BU/m**	
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**24-May-22**	Ship No.	**3251**		Tested by	John Lee		
Date of calc's:-		**24-May-22**	Job No.	**TE21-068**		Analysed by	Doug Gaunt		
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011				*Scion, Private Bag 3020 Rotorua.*					
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement			Wall dimensions		
		8.0	X mm	y=(mm)			L(mm)	H(mm)	
Lab Number	Direction	Loads	Residual	Maximum			1200	2410	
		(P_8)	Defln, C	Load	def @ P		d at P/2	4th, R	
		kN	mm	P(kN)	y (mm)	P/2 (kN)	d mm	kN	
289124	**+**	**4.45**	**3.10**	**9.80**	**36.0**	4.90	**7.4**	**8.50**	
	-	**4.97**	**2.50**	**9.96**	**36.0**			**9.00**	
289125	**+**	**3.75**	**2.50**	**8.60**	**36.0**	4.30	**9.5**	**7.18**	
	-	**3.86**	**3.10**	**8.48**	**36.0**			**7.80**	
289126	**+**	**3.68**	**3.40**	**8.25**	**36.0**	4.13	**7.4**	**7.20**	
	-	**3.80**	**3.30**	**8.15**	**36.0**			**7.48**	
		(P_8)	(C)	(P)	(y)	P/2 (kN)	(d)	(Ry)	
Averages		4.09	2.98	8.87	36.00	4.44	8.10	7.86	
Coefficient of Variation %		11.50	11.99	8.21	0.00	7.47	12.22	8.62	
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =	1.2		
Average Structural Displacement Ductility factor						u = y/d	4.44		
Ductility Modification factor						K4 =	1.00		
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289124	(BU)	1.00	175.0	205.5	197.6	159.2
	(BU/m)		146	171	165	133
289125	(BU)	1.00	149.8	166.0	170.8	128.6
	(BU/m)		125	138	142	107
289126	(BU)	0.98	146.8	160.4	164.0	124.3
	(BU/m)		122	134	137	104
		289124	*15% Ok result*	*192.5*	*15% Ok result*	*149.1*
<20% Result Check		*289125*	*-7% Ok result*	*-10% Ok result*	*-6% Ok result*	*-10% Ok result*
		289126	*-11% Ok result*	*-16% Ok result*	*-12% Ok result*	*-16% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**157**	(P8 x K1) x (K2/0.55) =		**173**
	131	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**177**	(P8 x K1) x (K2/0.71) =		**134**
	112	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi RedLine Premium Hardwood Core Plywood 12mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

bbi wood products

P21 Test Report

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bbi® Blondeline®

Birch Poplar Core Plywood

9mm 1200mm Wall, Brackets

Endless possibilities.

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49 Sala Street
Private Bag 3020
Rotorua
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Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi BlondeLine Birch Poplar Core Plywood 9mm 1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4m bbi BlondeLine Birch Poplar Core Plywood 9mm one side Walls with Brackets.

1. BU wind = 123 (102 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 137 (114 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi BlondeLine Birch Poplar Core Plywood 9mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

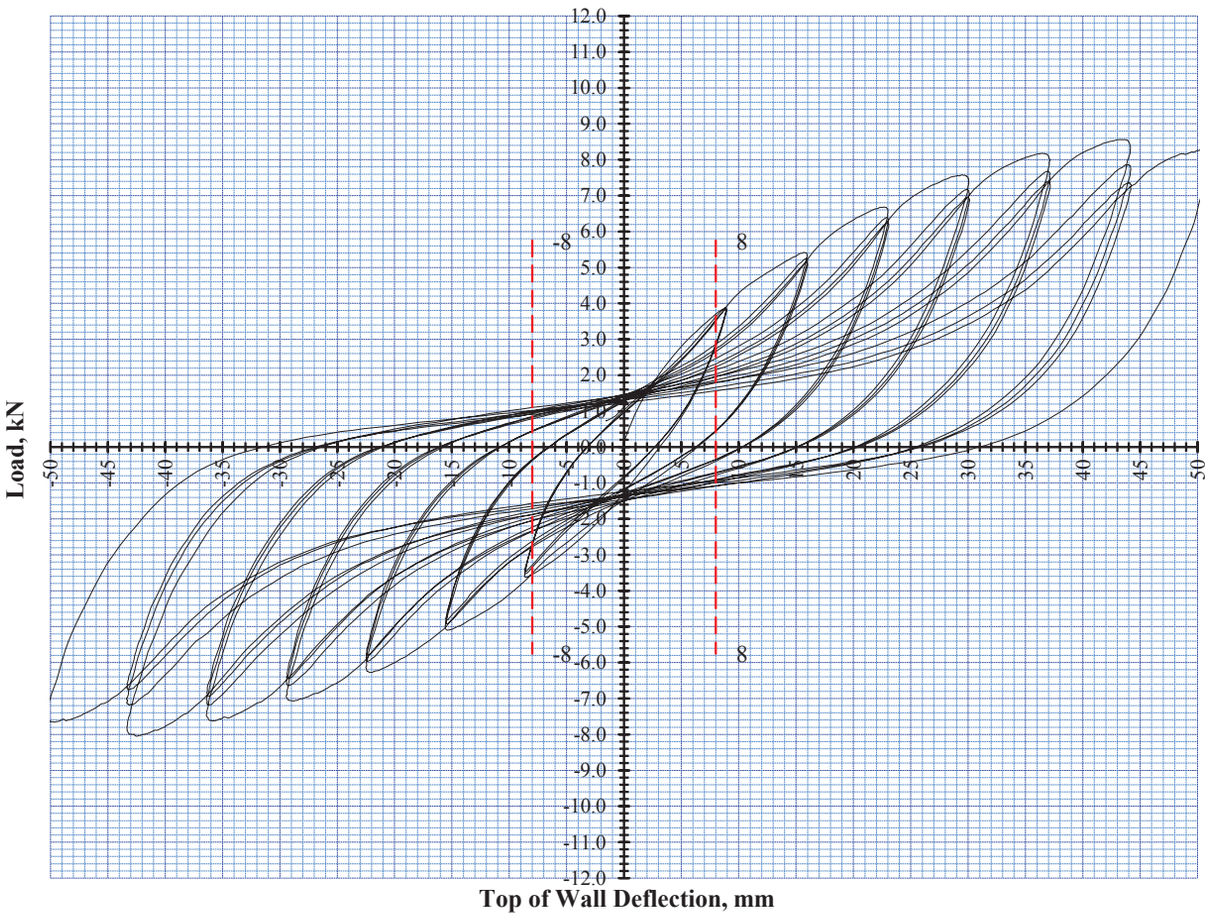

Figure 1: *Wall 289130*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

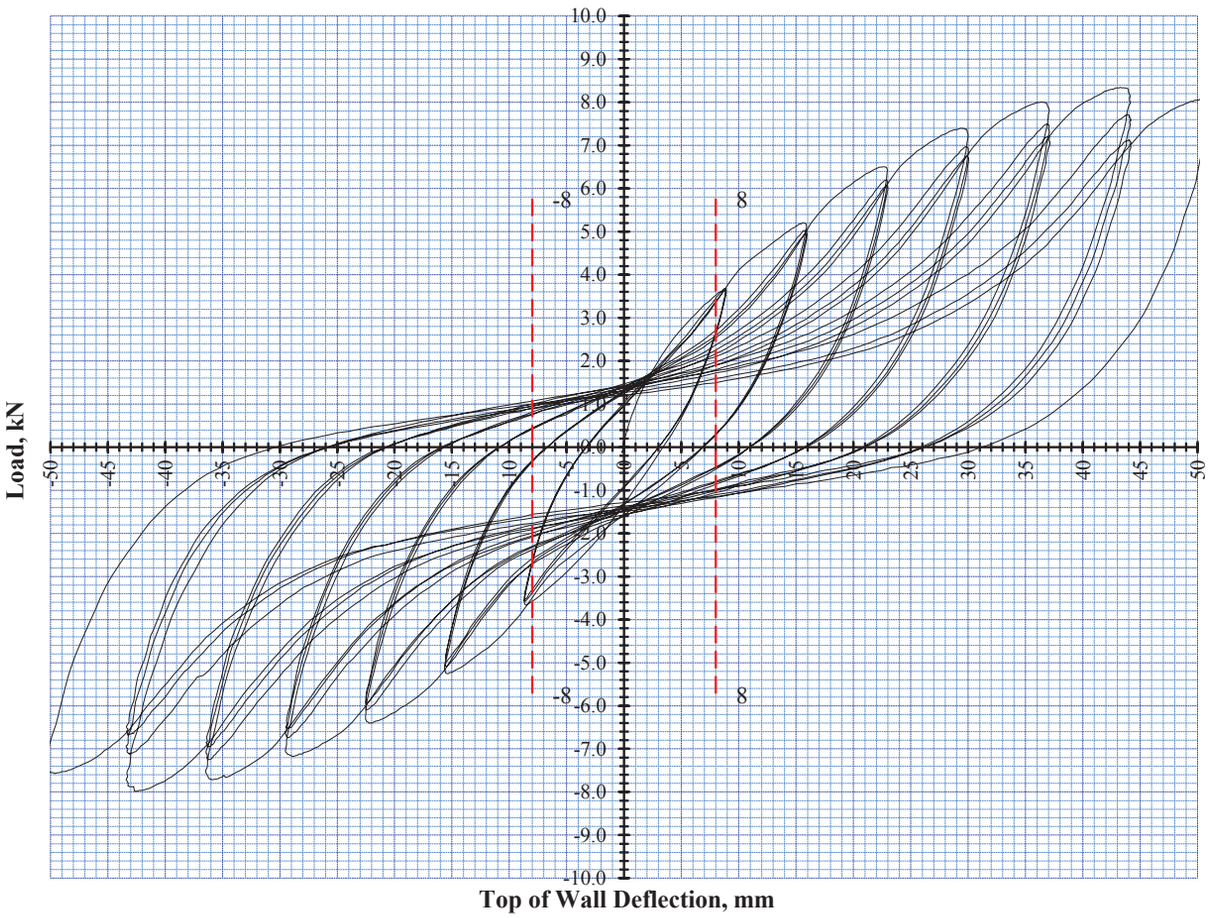

Figure 2: *Wall 289131*

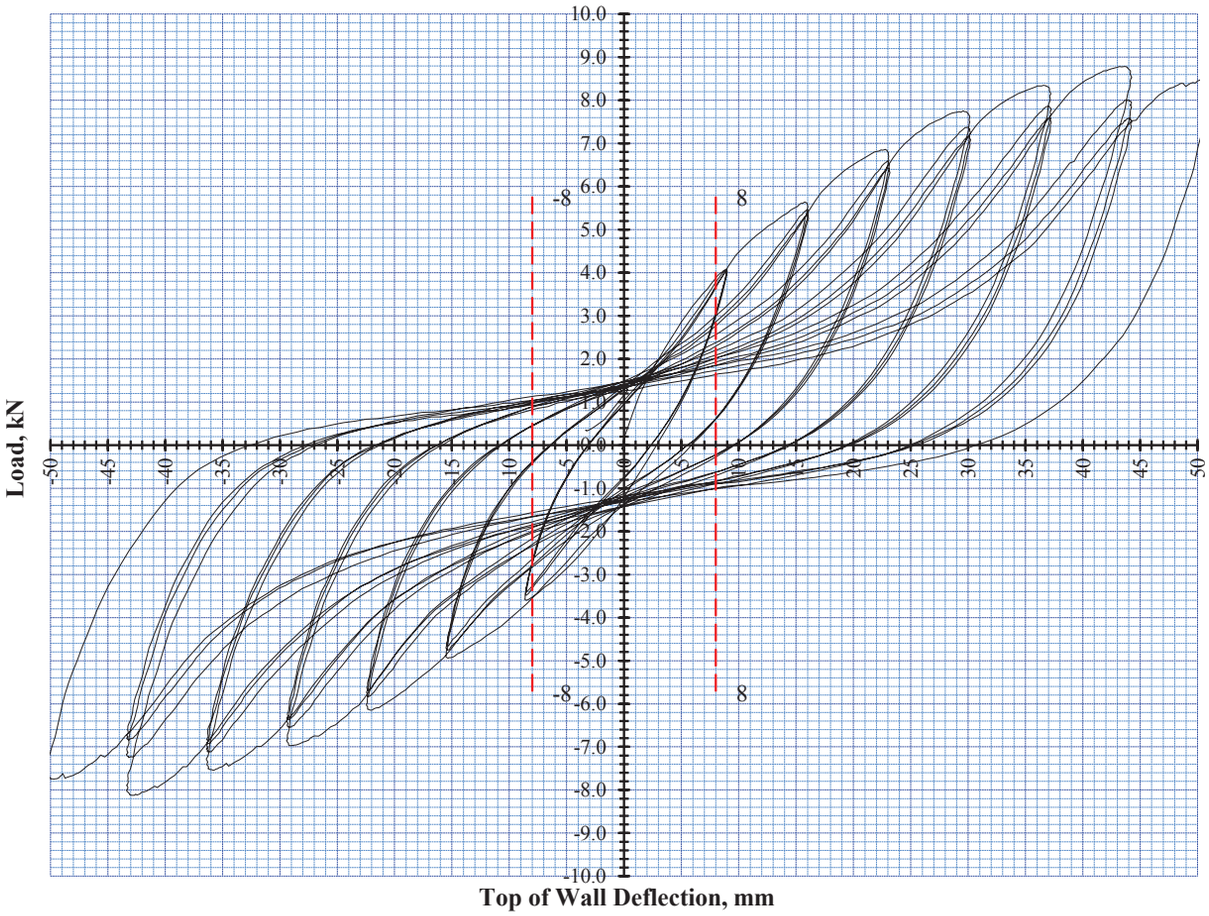

Figure 3: *Wall 289132*

1200mm, bbi BlondeLine Birch Poplar Core Plywood 9mm one side								
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs								
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres						**Summary**		
to plates and external studs, 300mm to internal studs,						**Earthquake**	**114 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end						**Wind**	**102 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets								
P21 Supplementary restraints used								
Date of test:-		**25-May-22**	Ship No.	**3251**		Tested by	John Lee	
Date of calc's:-		**25-May-22**	Job No.	**TE21-068**		Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011				*Scion, Private Bag 3020 Rotorua.*				
		Serviceability Cycles		Ultimate Cycles				
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement			Wall dimensions	
		8.0	X mm	y=(mm)			L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum			1200	2410
		(P_8)	Defln, C	Load	def @ P		d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)	d mm	kN
289130	**+**	**3.70**	**2.60**	**8.17**	**36.0**	4.09	**7.4**	**7.00**
	-	**3.70**	**3.20**	**7.61**	**36.0**			**6.75**
289131	**+**	**3.50**	**3.00**	**8.00**	**36.0**	4.00	**9.6**	**6.80**
	-	**3.55**	**2.30**	**7.72**	**36.0**			**6.80**
289132	**+**	**3.85**	**2.30**	**8.33**	**36.0**	4.17	**9.1**	**7.20**
	-	**3.52**	**3.20**	**7.53**	**36.0**			**6.58**
		(P_8)	(C)	(P)	(y)	P/2 (kN)	(d)	(Ry)
Averages		3.64	2.77	7.89	36.00	4.08	8.70	6.86
Coefficient of Variation %		3.43	13.95	3.73	0.00	1.65	10.82	2.87
y = average failure deflection or peak deflection of the three tests.								
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)								
R = Residual load, P = Peak Load, S = Serviceability load								
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =	1.2	
Average Structural Displacement Ductility factor						u = y/d	4.14	
Ductility Modification factor						K4 =	1.00	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces				

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289130	(BU)	1.00	137.5	161.5	157.8	125.1
	(BU/m)		115	135	132	104
289131	(BU)	1.00	136.0	153.8	157.2	119.2
	(BU/m)		113	128	131	99
289132	(BU)	1.00	137.8	160.8	158.6	124.6
	(BU/m)		115	134	132	104
		289130	*0% Ok result*	*3% Ok result*	*0% Ok result*	*3% Ok result*
<20% Result Check		*289131*	*-1% Ok result*	*-5% Ok result*	*-1% Ok result*	*-5% Ok result*
		289132	*1% Ok result*	*2% Ok result*	*1% Ok result*	*2% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**			**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**137**	(P8 x K1) x (K2/0.55) =		**159**
	114	**BU/m**		**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**			**Serviceability**
Wind (BU's)	20 * P =	**158**	(P8 x K1) x (K2/0.71) =		**123**
	102	**BU/m**		**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi BlondeLine Birch Poplar Core Plywood 9mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

bbi wood products

P21 Test Report

—

bbi® Blondeline®

Birch Poplar Core Plywood

12mm 1200mm Wall, Brackets

Endless possibilities.

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DDI: +64 7 343 5763
Facsimile: +64 7 348 0952
Email: douglas.gaunt@scionresearch.com

Results

To:	Martin Wallace	**From:**	Doug Gaunt
Organisation:	bbi Wood Products	**Subject:**	P21:2010 bbi BlondeLine Birch Poplar Core Plywood 12mm 1200mm Wall, Brackets
Location:	Hastings	**Date:**	30 May 2022
Fax No.:	021 745783	**No. of Pages:**	5
Tel No.:	06 8715539		

Martin

Please find below the P21 bracing results for your three 1200mm x 2.4m bbi BlondeLine Birch Poplar Core Plywood 12mm one side Walls with Brackets.

1. BU wind = 127 (106 BU/m) as limited by the serviceability load capacity.
2. BU Earthquake = 127 (106 BU/m) as limited by the ultimate load capacity.

Figures 1, 2 & 3 show the load deflection plots, Figure 4 shows the P21:2010 calculations.

Wall Construction

bbi BlondeLine Birch Poplar Core Plywood 12mm one side,
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs
Plywood fixed with 50x2.8mm Galv clouts at 150 centres to end studs and plates, 300mm centres on internal stud
GIB Handibracs brackets used
M12 hold down bolts to bottom plate and brackets
P21 Supplementary restraints used.

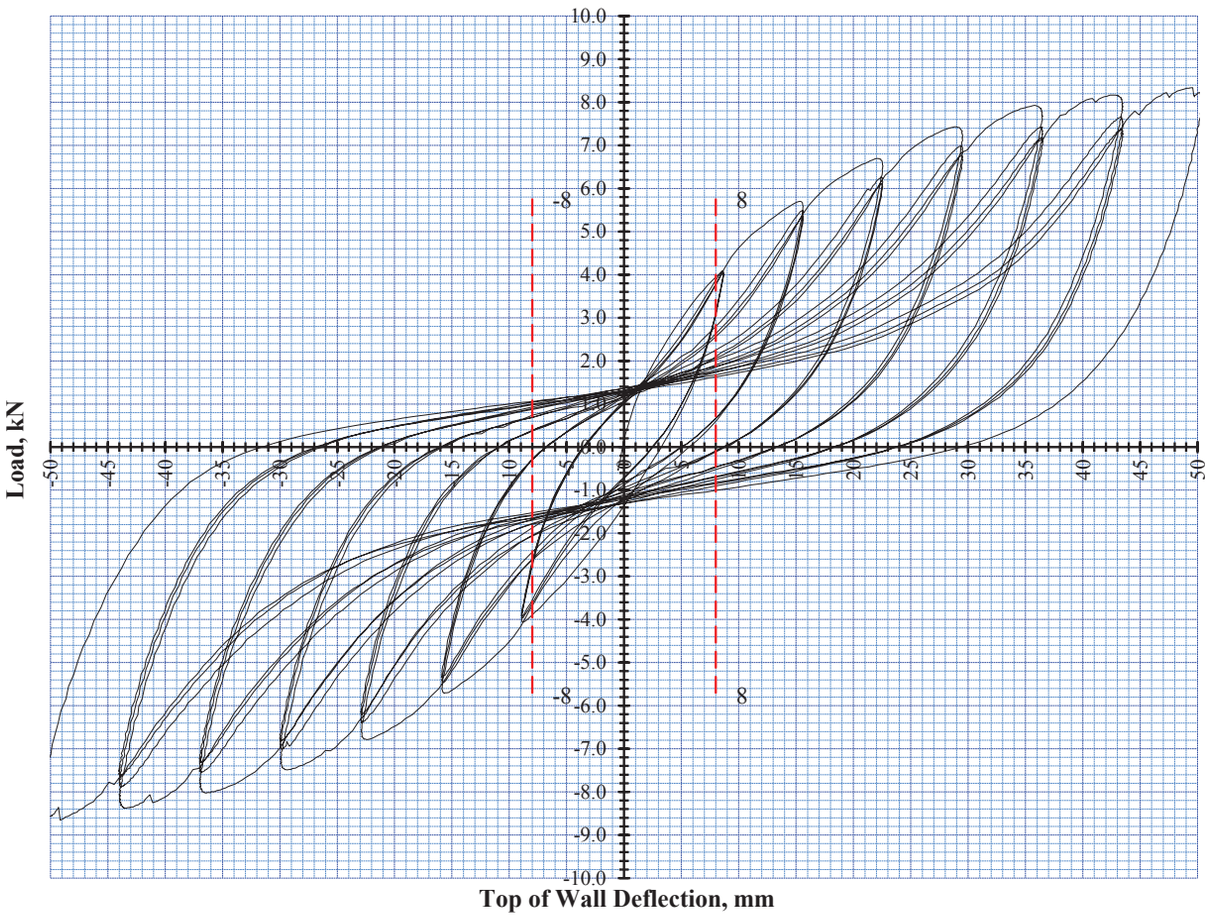

Figure 1: *Wall 289127*

Observations

No obvious signs of failure to framing or plywood
Plywood pulling on bottom plate nails.

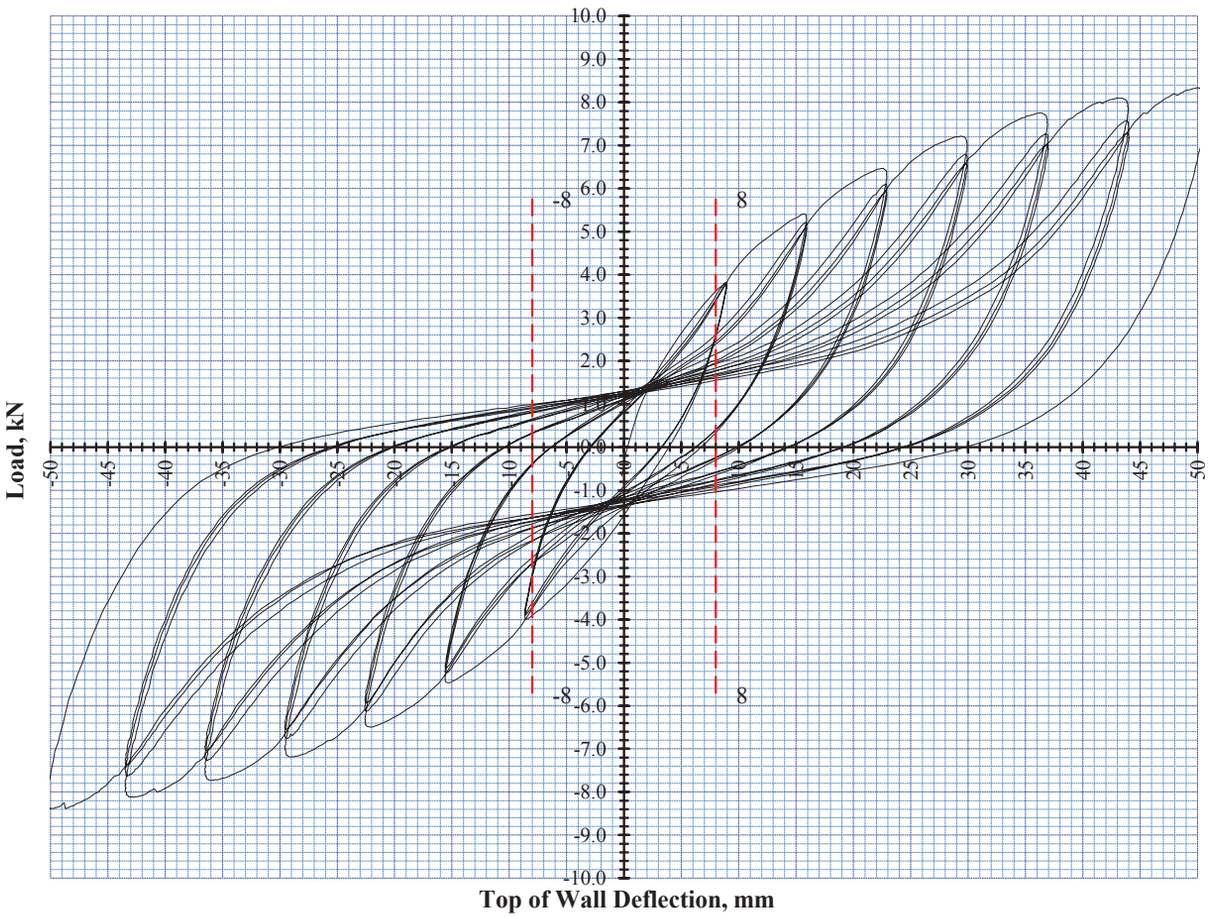

Figure 2: *Wall 289128*

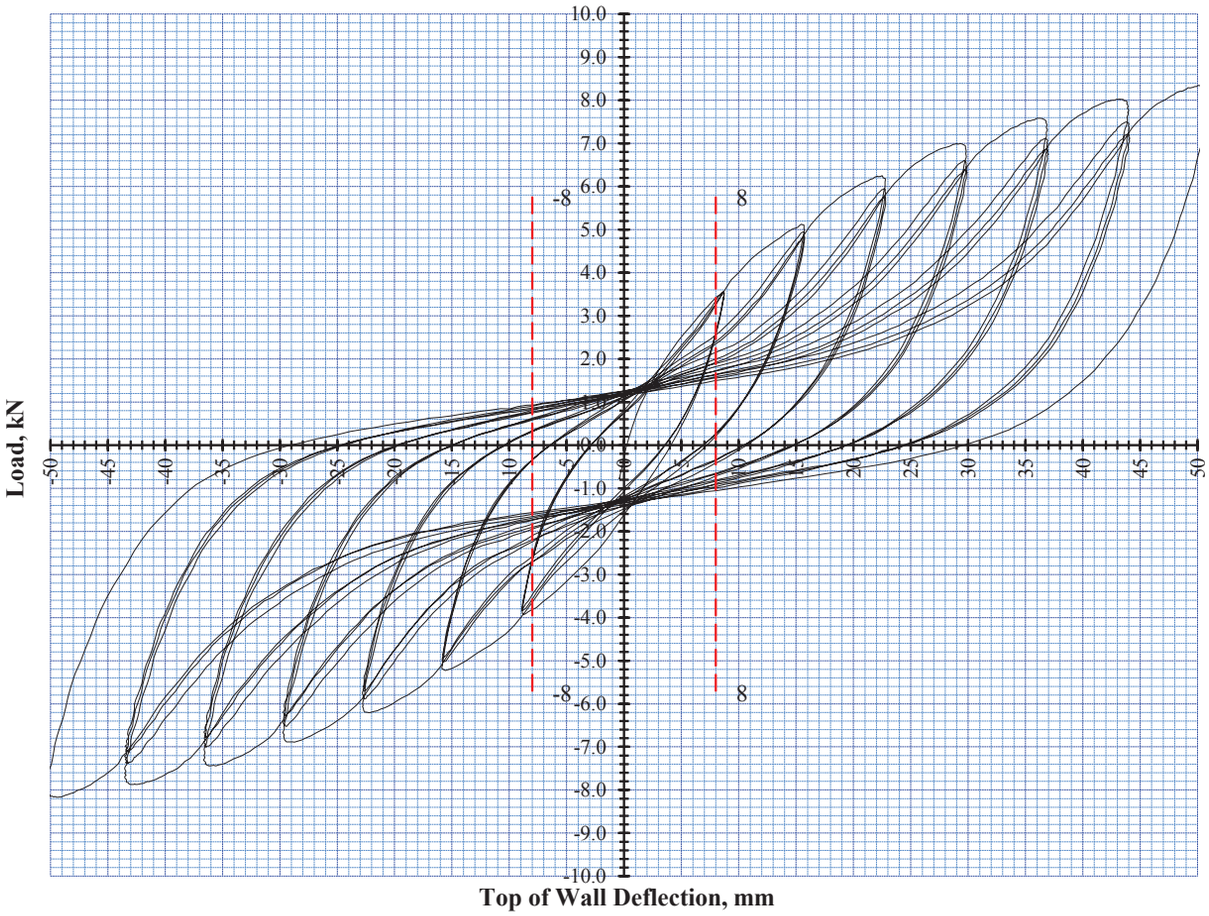

Figure 3: *Wall 289129*

P21:2010 BRACING RACKING TEST RESULT EVALUATION									
Wall Construction									
1200mm, bbi BlondeLine Birch Poplar Core Plywood 12mm one side									
90x45 H1.2 SG8 framing, studs at 600mm centres, no nogs									
Plywood fixed 50mmx2.8mm Galv Steel Nails at 150mm centres							**Summary**		
to plates and external studs, 300mm to internal studs,							**Earthquake**	**106 (U)**	**BU/m**
7mm min edge distances all around. GIB Handibracs used each end							**Wind**	**106 (S)**	**BU/m**
M12 hold down bolts to bottom plate & brackets									
P21 Supplementary restraints used									
Date of test:-		**25-May-22**	Ship No.	**3251**			Tested by	John Lee	
Date of calc's:-		**25-May-22**	Job No.	**TE21-068**			Analysed by	Doug Gaunt	
Calculated to BRANZ P21:2010, AS/NZS1170.2&5, NZS3604:2011					*Scion, Private Bag 3020 Rotorua.*				
		Serviceability Cycles		Ultimate Cycles					
		Cycle to H/300 or DLQ or DLW		Cycle to Displacement				Wall dimensions	
		8.0	X mm	y=(mm)				L(mm)	H(mm)
Lab Number	Direction	Loads	Residual	Maximum				1200	2410
		(P_8)	Defln, C	Load	def @ P			d at P/2	4th, R
		kN	mm	P(kN)	y (mm)	P/2 (kN)		d mm	kN
289127	**+**	**3.92**	**2.40**	**7.90**	**36.0**	3.95		**8.2**	**7.05**
	-	**3.90**	**3.50**	**8.00**	**36.0**				**7.05**
289128	**+**	**3.62**	**3.30**	**7.75**	**36.0**	3.88		**12.2**	**6.70**
	-	**3.88**	**3.00**	**7.72**	**36.0**				**6.96**
289129	**+**	**3.52**	**3.00**	**7.55**	**36.0**	3.78		**8.7**	**6.80**
	-	**3.75**	**3.30**	**7.45**	**36.0**				**6.80**
		(P_8)	(C)	(P)	(y)	P/2 (kN)		(d)	(Ry)
Averages		3.77	3.08	7.73	36.00	3.87		9.70	6.89
Coefficient of Variation %		4.01	11.45	2.44	0.00	1.85		18.35	1.95
y = average failure deflection or peak deflection of the three tests.									
d= average first cycle displacement at half peak, (the very first cycle wall reaches the load)									
R = Residual load, P = Peak Load, S = Serviceability load									
Displacement Recovery Factor (K1), (0.8 <= K1 <= 1.0)						Systems factor K2 =		1.2	
Average Structural Displacement Ductility factor						u = y/d		3.71	
Ductility Modification factor						K4 =		0.92	
DLW = Selected deflection limit for wind forces				DLQ = Selected deflection limit for earthquake forces					

P21:2010 BR Calc's		**K1**	**EQ ultimate**	**EQ service**	**Wind Ultimate**	**Wind Service**
Lab Number		**(= 1.4 - C/X)**	**BU's**	**BU's**	**BU's**	**BU's**
289127	(BU)	1.00	130.0	170.6	159.0	132.2
	(BU/m)		108	142	133	110
289128	(BU)	1.00	125.9	163.6	154.7	126.8
	(BU/m)		105	136	129	106
289129	(BU)	1.00	125.4	158.6	150.0	122.9
	(BU/m)		104	132	125	102
		289127	*3% Ok result*	*6% Ok result*	*4% Ok result*	*6% Ok result*
<20% Result Check		*289128*	*-1% Ok result*	*-1% Ok result*	*0% Ok result*	*-1% Ok result*
		289129	*-2% Ok result*	*-5% Ok result*	*-5% Ok result*	*-5% Ok result*

Note: Where the value of BR Wind or BR EQ for any specimen is more than 20% greater than either of the other two specimens, assign it a value of 1.2 times the lower value before averaging.

Average Earthquake BR		**Ultimate**		**Serviceability**
EQ (BU's)	20 x K4 x Ry =	**127**	(P8 x K1) x (K2/0.55) =	**164**
	106	**BU/m**	**Limited by**	**Ultimate limit state**
Average Wind BR		**Ultimate**		**Serviceability**
Wind (BU's)	20 * P =	**155**	(P8 x K1) x (K2/0.71) =	**127**
	106	**BU/m**	**Limited by**	**Serviceability limit state**

Figure 4: *P21:2010 calculations for 1200mm x 2.40m bbi BlondeLine Birch Poplar Core Plywood 12mm one side wall*

Please feel free to contact me to discuss this information.

Doug Gaunt

Notes

Notes

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0800 224 759 / sales@bbi.net.nz

Endless possibilities. **www.bbi.net.nz**

bbi wood products